GUIDE TO THE PLANT COMMUNITIES OF THE CENTRAL FINGER LAKES REGION

by

Charles L. Mohler, Peter L. Marks,
& Sana Gardescu

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All photographs in the book were taken by the authors.

Cover photos:

Upper left: the Red cedar-Oak type at Taughannock Gorge
Upper middle: northern woodsorrel in a Hemlock-Beech-Birch forest
Upper right: goldenrod in Herbaceous Old Field
Middle row, left: swamp milkweed in the Sedge-Grass type
Center: Cayuga Lake
Middle row, right: white trillium in a Sugar maple-Basswood-Ash forest
Lower left: a stand of the Hickory-Oak-Ash type
Lower middle: blue flag in a Cattail Marsh
Lower right: a Pine-Hemlock stand with red pines

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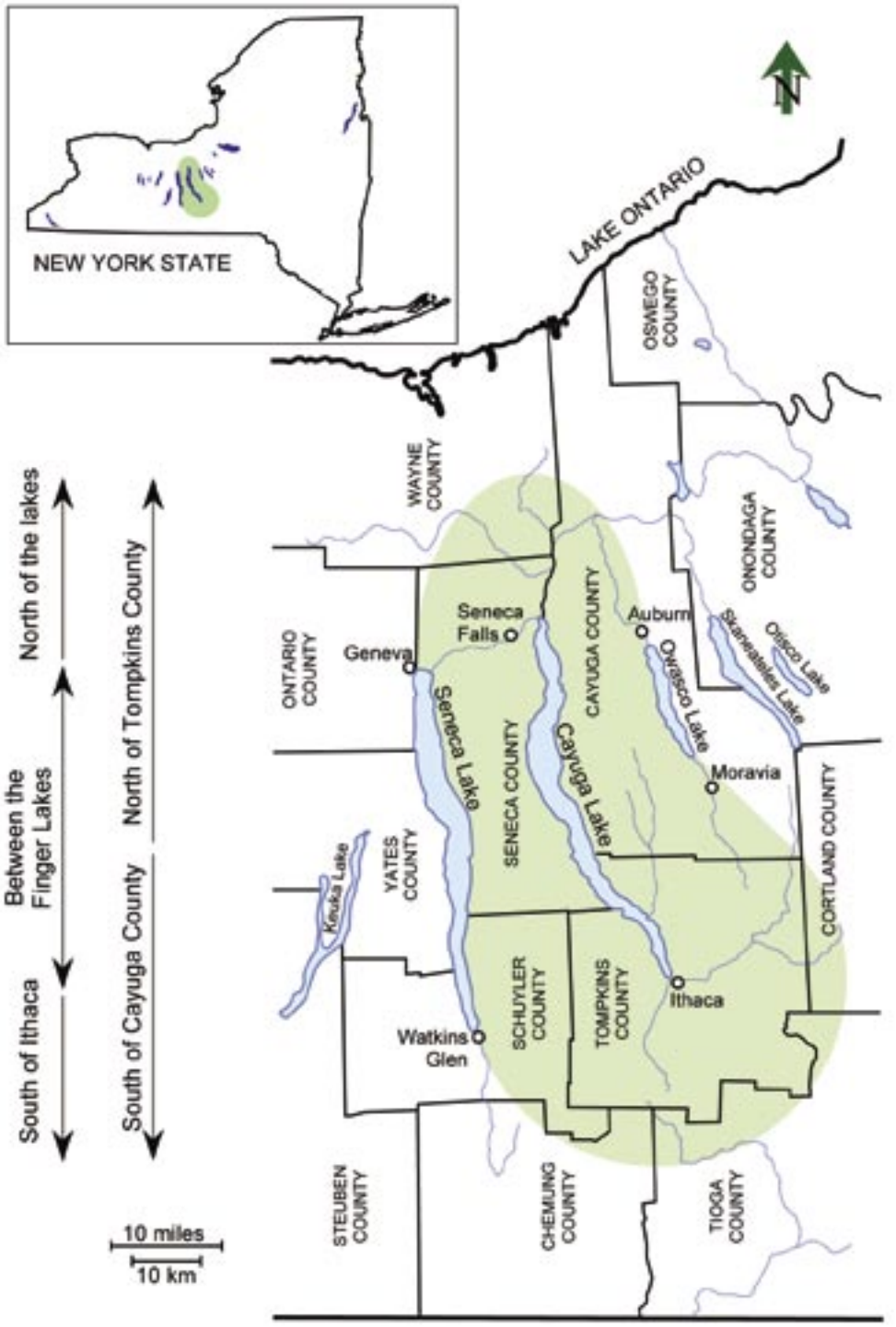


Figure 1. Map of the central Finger Lakes region.
The green shaded area shows the portion of central New York State covered by this book. On the left are north/south divisions referred to in the vegetation type descriptions.

INTRODUCTION

This book is for anyone with an interest in the outdoors, who would like to learn about the Finger Lakes region in general, and in particular about the kinds of plant communities found in central New York. Our main objective is to provide an introduction to the major types of plant communities in the region and where in the landscape they occur. It is intended to be read as a normal book, from beginning to end; it can also be used as a reference to be consulted about the nature of a particular community type. The book is written primarily for those without a background in botany or plant ecology, but should also be of interest to naturalists and biologists.

Most of the region was originally forested, before the land was cleared for farms and towns, and much of the book focuses on the various types of forests. Unforested wetlands are also described, as well as plant communities found on abandoned farmland. The book does not cover submerged aquatic vegetation, urban vegetation, plantations, orchards, or cultivated fields. The emphasis is on the most common plant species, so full species lists are not provided, nor is the book a field guide for species identification.

The area treated in this book covers about 1000 square miles of New York State, centered on Cayuga Lake (Figure 1). It includes all of Tompkins and Seneca Counties, the southwestern half of Cayuga County, eastern Schuyler County, and portions of Tioga and Wayne Counties. However, the plant community descriptions are probably valid for much of the central portion of the state.

In this book, seven major categories of plant community types are described. The central Finger Lakes region has a wide variety of habitats, including deep gorges, slopes above the large glacially carved lake valleys, rolling uplands between the lakes, higher hills to the south, and many wetlands. Different kinds of plant communities are found in each of those places. On hillsides that face south or west, **Dry Upland Forests** dominated by oak trees are common. On other slopes and in gorges, where more soil moisture is available, **Moist Upland Forests** with sugar maple or hemlock grow. Along the major creeks in lowland valleys, **Floodplain Forests** of sycamore and cottonwood can be found. **Swamp Forests** occur where water drainage is poor: next to lakes, in valley bottoms, and in upland depressions. Also found near lakes and streams are **Open Wetlands** that have few or no trees, such as cattail marshes. In the few small peat **Bogs** in the region, the plants grow on a deep layer of sphagnum moss.

The seventh and final major category of the plant communities covered in the book is **Successional Vegetation on Former Farmland**. This includes “old fields” of grasses and goldenrods, which change (undergo succession) over time, to become thickets of shrubs and young trees, and eventually, forest. These “post-agricultural” forests differ in key ways from the other forests of the region.

The seven major categories are subdivided into what we call *vegetation types*, each of which is covered in the main part of the book, **Descriptions of the Vegetation Types**. Examples include Maple-Beech forest and Hemlock Swamp. A few definitions will help to explain what we mean by "vegetation type." *Vegetation* is a general term for the plants of an area or region considered together. A *plant community* consists of the plants growing in one place, particularly a site with relatively uniform environmental characteristics – such along a stream, or on a south-facing hillside. The *species composition* of a plant community is not only which species grow there, but also the *abundances* of the species: which ones are most common in the site, and which occur only as a few plants. The most abundant or largest species at a site are called *dominant*.

Each of the *vegetation types* described in this book consists of a group of plant communities that have a similar species composition. Because no two sites are exactly alike in composition, a vegetation type cannot be precisely defined, but must include some range of variability in which species are present, which are dominant, and their relative abundance. Rather than deciding subjectively what species composition a type ought to have, we used an objective method to define each vegetation type. This was based on data on the plants and environments at the many sites we sampled across the central Finger Lakes region. To make the types more useful, we delineated vegetation types using a process that insured that each type matched with a set of environmental conditions. Thus, not only does each vegetation type have a characteristic species composition, but sites where that type occurs are similar in terms of environmental factors, such as soils and slope steepness.

Learning to recognize a basic set of vegetation types and where they grow expands one's appreciation of patterns in the natural environment. Forests are not all

A stand of Moist Upland Forest.

Open Wetland, in winter.

alike, and species are not scattered at random across the land. Rather, one set of trees grows on the hillsides that face north, compared to the south-facing hillsides across the valley. As you walk down a hillside you may notice a gradual change in the flowers growing along a trail. This book will help you interpret such changes. If you know how forests develop on abandoned farmland, a sudden change in the forest as you pass an old fence line will be comprehensible.

An understanding of the vegetation types allows prediction of what sort of plant community is likely to grow in a particular place. Conversely, based on the type of vegetation one can infer the site conditions, such as the kind of soils present. Understanding the vegetation types is also useful for locating species that occur only in certain habitats or kinds of vegetation – such as a rare plant, a bird that nests only in conifer forests, or an insect that feeds on milkweed. The issue of *why* each plant species is found in certain kinds of habitats and grows better in particular conditions is not answered in this book. That is the subject of extensive and continuing investigations by plant ecologists, physiologists, evolutionary biologists, and others.

The organization of the book is as follows. The first three sections provide a context for understanding the region's vegetation. In **Background**, we briefly summarize the landscape and environment of the central Finger Lakes region, define some terms used in the book, and describe how we developed the vegetation type classification. **Historical Context** is an overview of the impacts of humans, especially over the past few hundred years. The section on **The Relation of Vegetation Types to the Landscape** lays out the broad pattern of association between the vegetation types and the sites where they occur, based on soil characteristics and position in the landscape.

A Successional field, in September.

A Swamp Forest.

Following those sections is the main body of the book: **Descriptions of the Vegetation Types**. When reading about a type, understand that the vegetation types are human constructs, which simplify the complexity of variations in the vegetation in order to highlight recurrent patterns of species composition in the landscape. Plant communities that are intermediate between types are common.

If unfamiliar with the region's plant species, you may want to refer to field guides that cover the Northeastern trees and shrubs, flowers, or ferns. A map of the region that shows the towns, creeks, and smaller lakes will also be helpful.

Appendix I gives Latin names for species that are mentioned in the book. It is by no means a complete list of the region's plant species. Common names sometimes vary between field guides, and the Latin names provide an unambiguous identification for each species. Appendix II supplements the section on The Relation of Vegetation Types to the Landscape by providing a detailed summary of the positions in the landscape where the vegetation types occur. Appendix III gives details on plant abundance and species diversity for each type. It is described more fully in the introductory pages of the Descriptions of the Vegetation Types. Appendix IV lists some of the books and scientific papers we referred to in writing the book, and Appendix VI is a glossary of terms.

Finally, for anyone interested in seeing examples of the various vegetation types, Appendix V provides directions to selected places in the central Finger Lakes region.

The waterfall at Taughannock State Park.

BACKGROUND

This section includes an overview of the landscape, soils, and climate of the region, followed by a description of the sampling procedures and how the vegetation types were determined. A number of terms (in ***bold italic***) that are used in the Descriptions of the Vegetation Types are defined here.

1. The central Finger Lakes region

Location

The region covered by this book (see Figure 1, facing page 1) extends across several counties in central New York State. Most of the region is situated on what is called the Allegheny Plateau, except for the land just north of the Finger Lakes, which is on the Ontario Lowland, south of Lake Ontario. The entire area was covered by glaciers multiple times, the most recent of which began receding about fifteen thousand years ago. The glaciers scoured the landscape, moved and deposited rocks and finer material, and dug deep, broad, U-shaped valleys. Following the retreat of the glaciers, deep lakes formed, larger than the current Seneca and Cayuga Lakes. When lake levels dropped, the gorge ravines now characteristic of the region were created through stream erosion.

Today, much of the landscape is rolling hills and steep-sided valleys. Variations in elevation and steepness of the hillsides are greater south of the Finger Lakes, where the highest hills exceed 1,900 feet in elevation. The largest lakes, Cayuga and Seneca, are at about 400 feet above sea level. Between the Finger Lakes the slopes are more gentle and the hilltops are broader. The land north of the Finger Lakes is at about 400 feet in elevation, with many narrow, small, steep-sided "drumlins," up to 500 feet above sea level. Drumlins are north-south oriented hills made of glacial deposits.

Soils

There is an overall gradient in soil acidity (pH) across the region. In the northern third of the region, soils that are ***high-lime*** or ***calcareous*** are common. Such soils are high in calcium and thus alkaline, with a pH value greater than 7. Toward the south ends of the Finger Lakes, soils that are ***acidic*** (low pH, for example pH 5 to 6) are more frequent. South of Ithaca (see Figure 1), the soil pH on the hills is commonly less than 5. Calcareous limestone is common in the bedrock in the northern part of the region; to the south the bedrock is primarily acidic shale and sandstone. Most of the region's soils formed from glacial materials deposited on top of the bedrock. Since the glaciers ground up the bedrock surface and carried the material southward, calcareous deposits occur south of the area of calcareous bedrock.

At a smaller scale, soils vary greatly across the landscape. This is primarily due to variations in the distribution of materials deposited by glaciers or by streams and lakes. Departure from the north-south gradient in soil acidity also occurs along streams where erosion has exposed deeper bedrock layers, for example, limestone beneath acidic shale.

The soils of the region are primarily ***silt loams***. These are medium-textured soils, rather than coarse sands or fine clays. Silt loams retain more moisture and are therefore less "well drained" than sandy soils, but silt loams are better drained than clay soils.

Some areas of coarse-textured sandy or gravelly soils were deposited along streams or by glacial meltwaters. Also, places with sand or clay lake deposits formed shortly after the glaciers receded when the lakes were larger than today.

Many upland silt loam soils in central New York State are poorly drained due to a ***fragipan***, which is a dense layer in the soil. The fragipan, if it is present, usually begins one or two feet below the surface and can extend several feet deeper. A fragipan layer restricts the downward penetration of water and tree roots; as a result, plant roots may be flooded following snowmelt or rain. Such soils can also be droughty during dry periods, since the roots are restricted to the shallow soil above the fragipan.

Shallow soils where bedrock is near the surface also can have impeded drainage, shallow rooting, and droughtiness. Slopes, especially on steep sites or on the upper (higher) part of the slope, tend to be well drained. The water runs off such sites, whether or not the soil has a fragipan layer or is shallow over bedrock.

Wetland soils often have an organic surface layer of dead plant material, which accumulates because decay is slow in waterlogged conditions. This layer is called ***muck*** if it is well-decomposed, or ***peat*** if only partially disintegrated. Peat can form from sphagnum moss; sedge, grass, and cattail plants; or fallen logs and dead tree roots.

Climate

The central Finger Lakes region has a humid continental climate with warm summers and long, cold winters. Most of the region is in USDA Plant Hardiness Zone 5, but a few small areas along the lakes are in Hardiness Zone 6. The frost-free season is about 140 to 160 days long in the areas south of Cayuga County (see Figure 1). North of Tompkins County, the frost-free season lasts about 160 to 180 days, since Lake Ontario to the north makes spring and fall temperatures milder. The growing season is shorter in the hills farther from the Finger Lakes, and also in small, sheltered valleys. Sheltered valleys have late spring and early autumn frosts because cold air flows downhill and pools in the valleys. In lake valleys, however, heat stored in the water counters this effect, so the frost-free period is longer.

Precipitation at Ithaca, New York averages 35 inches per year, with slightly more coming in summer months than in winter. Brief periods of rainfall deficiency occur in most summers. Total snowfall in Ithaca averages 67 inches per year, with snow cover frequent from December to March.

2. Development of the vegetation type classification

This book is the culmination of a study designed to describe the region's plant communities and how they are associated with various environmental conditions. The vegetation classification was based on quantitative observations we made at hundreds of sites across the central Finger Lakes region, supplemented by several decades of research on the plant communities of Tompkins County, New York.

Plants

To describe the composition and structure of the vegetation, we sampled the trees, shrubs, vines, and herbaceous plants. ***Species composition*** (the plant species present, and

their abundances) was recorded in ***tenth-hectare*** plots: 50 x 20 meters in area, which is about 164 x 66 feet, or a quarter acre.

To summarize tree abundance, we calculated ***basal area***, a measure used by foresters to estimate the volume of timber in a stand, and by ecologists interested in species composition. Basal area is the summed cross-sectional areas of the tree trunks and smaller stems in a stand of forest. For each stem, we determined basal area by measuring stem diameter at "breast height" (about 4.5 feet above the ground) and calculating the stem's cross-sectional area. All ***woody plants*** were measured: trees, shrubs, and climbing woody-stemmed vines. The total basal area of woody plants is given in the Descriptions of the Vegetation Types in units of "m^2 per tenth hectare." One square meter (1 m^2) is about 11 square feet.

In describing tree species composition, we use ***relative basal area***, which is the basal area of a species as a percentage of the total basal area of all woody plants in the tenth hectare. This allows us to compare the relative abundance of a species across sites regardless of differences in total basal area. The species with high relative basal area have trees that are large in trunk diameter or numerous, and are called the ***dominant*** species in the stand.

As a measure of the density of the tree canopy, which shades the smaller plants, we estimated ***canopy cover***. This is the percentage of sky obscured by leaves and branches overhead, averaged from multiple readings through a sighting tube.

We also determined the density of all woody plants more than 3 feet tall, as numbers of stems per tenth hectare. These results are reported by "layer": the ***tree layer*** is defined as stems more than 2 inches in diameter; the ***sapling layer*** or ***shrub layer*** consists of stems taller than 3 feet, up to 2 inches in diameter. Each of those categories includes trees, large shrubs, and climbing woody vines. Two other subdivisions based on woody plant size are used in the vegetation type descriptions. We defined the ***overstory*** or ***large trees*** as ones with trunks greater than 6 inches in diameter, and ***understory*** woody plants as those with smaller diameter stems, over 3 feet tall. Not all trees in the "large" category have their crowns at the top of the forest overstory or canopy.

We recorded what species were in the ***ground layer***, which includes herbs, vines, short shrubs, and tree seedlings up to 3 feet tall. Included in the ***herb*** category are wildflowers, grasses, sedges, ferns, clubmosses, and low or creeping woody-stemmed plants, such as partridgeberry and wintergreen. Appendix I (page 100) gives the growth form categories we used for all species mentioned in the text.

To summarize the relative abundances of plants in the ground layer, we determined the ***cover*** of each species. This is the percentage of the area occupied by a species, when looking down at the ground. Ground layer cover in 1 x 1 meter samples was measured at 25 locations within a tenth hectare plot, and average cover was calculated for each species. Average total ground layer cover was calculated by summing the average cover values from all of the species. Species in the ground layer often overlap, so total cover sometimes exceeds 100%. Cover totals in the ground layer were also determined separately for all herb species, for shrubs and vines, and for tree seedlings. Moss cover was measured but not included in the calculations of total ground

layer cover.

The ***dominant*** or ***abundant*** species in the ground layer are those with high cover values. Species that are ***frequent*** are found in many sites, but do not necessarily have high cover within a site.

Diversity is summarized in the vegetation type descriptions as the number of species per tenth hectare. This is sometimes called "species richness" by other authors. Diversity is tallied separately for the herbs, for shrubs and vines, and for tree species (of all sizes, including saplings and seedlings). The species diversity of woody plants in the ***tree layer*** (>2 inches in diameter), and diversity of ***large trees*** (>6 inch diameter), are also provided.

Environment

Because different plant species grow in different kinds of sites, we recorded information about the environment at each site. We focused on environmental measures related to soil acidity and water availability. Soil acidity has direct effects on plants, but also is an indicator of plant nutrient availability, which tends to increase at pH values near neutral (pH 7), for soils in the Finger Lakes region.

We measured the acidity of fresh samples collected from the upper layers of the soil, using a Cornell pH test kit. The kit has chemical solutions that change color when mixed with soil, depending on the soil pH (acidity). Local USDA soil survey maps and soil type descriptions were consulted to determine the acidity of deeper soil layers, which are accessible to tree roots. Geographic location (north or south within the central Finger Lakes region) was also noted, as this relates to broad patterns in soil acidity.

To estimate water availability to the plants, we recorded information on each site's (i) soils, (ii) slope, and (iii) position in the landscape. We dug pits to observe the soil texture, and consulted published USDA soil surveys to determine soil depth and ***drainage*** (how rapidly water flows away). The six USDA categories from wet to dry are: very poorly drained, poorly drained, somewhat poorly drained, moderately well drained, well drained, and excessively well drained.

We measured ***slope***, because steep sites tend to have less water available. Rainwater runs off steep slopes rapidly, and the soil is often shallow due to erosion. Steepness is given as ***percent slope***, which is vertical distance divided by horizontal. A 10% slope has a 1 foot change in elevation across a 10 foot horizontal distance; a 100% slope has a 45° angle. We also measured ***slope aspect*** (the direction a slope faces), because south-facing slopes receive the most sun, and north-facing slopes receive the least. More sunshine increases the potential for drought stress. East-facing slopes are sunlit in the morning when the air is cooler, whereas west-facing slopes receive more sun in the afternoon. Thus slopes that face north or east are cooler and moister than the hotter, drier, south-facing and west-facing slopes.

We noted the elevation of each sampling plot, and its ***position*** in the landscape. Narrow hilltops and ridges are driest, and gorges (ravines) are shady and moist. Depressions on level hilltops and flat areas along lakes and streams tend to be poorly drained. ***Slope position*** ranges from lower, to mid, to upper slope. ***Shoulder slope*** positions are where an upper slope meets flatter land at the top.

To create a predictive model matching vegetation types with environment, habitats were grouped into categories, for example: "Broad flat uplands north of the Finger Lakes," and "Narrow creek valleys and ravines in lowlands." The environmental categories incorporated both geographic location (north or south within the region), and topography (including slope aspect, steepness, and position in the landscape), since these correspond to broad patterns in soil acidity and water availability, which affect plant species composition. A full list of environmental categories is given in Appendix II.

Derivation of the types

Distinctions among vegetation types in the book are based on plant species composition – primarily the tree species in forest samples, and shrubs and herbs in unforested communities. The sampled sites spanned the broad range of variation, in both community composition and environmental conditions, that exists in the central Finger Lakes region. A total of 140 sites were sampled using the tenth hectare procedure described above. These were supplemented with data from an additional 222 sites that were chosen to provide a balanced representation of the landscape positions and soil characteristics of the region. These additional sites were sampled using a more rapid method, in which the cover of each tree and shrub species was estimated visually. Dominant species in the ground layer, and environmental information (soil drainage, slope, etc.), were also noted.

We developed a systematic, objective process to divide the complex variation in species composition from site to site into a set of vegetation types that would be directly related to major patterns of variation in the environment. First, a computer program called TWINSPAN used the species composition data to group the 362 samples into a preliminary set of types. For each type, we then wrote a definition that described the samples that were included – summarizing which species were dominant, and which key species were absent. Next, we examined environmental information from the samples in each type. We then rewrote the type definitions based on species composition six times, until the samples within each type had a strong similarity to each other both in species composition and environmental characteristics. During this process, samples were moved between types, and types were merged or subdivided. The final analysis resulted in the 18 types summarized in Sections A to F of the Descriptions of the Vegetation Types. Some samples had species compositions that were intermediate between types, and these are also discussed.

Samples from successional sites on former farm fields were treated separately. These plant communities, described in Section G of the book, were divided into three age classes, ranging from recently-abandoned fields to post-agricultural forests. The type descriptions of Successional Vegetation on Former Farmland are based on samples from 86 sites, plus our other research on old fields and post-agricultural forests. To verify which forests had once been open farm fields, we consulted aerial photographs (from USGS and county mapping projects) that dated from the 1930s to the present. Forested areas, plowed land, open fields, and tree saplings and shrubs in abandoned fields, are all clearly visible in the aerial photographs.

HISTORICAL CONTEXT

The vegetation of the region has a long history of human influence. Prior to European contact, Native Americans cleared forest to plant crops, took wood for houses and fuel, and used fire to drive game and clear trails. Effects on the vegetation were concentrated near villages and trails, and primarily on the best agricultural land. There was likely little impact on the vegetation of hilltops, ravines, and poorly drained land. Agriculture in the central Finger Lakes region only became frequent within the last thousand years, in contrast to some other parts of North America where it began much earlier. Several plant species were likely spread in our region by Native American cultivation, such as black walnut. However, across much of the central Finger Lakes region Native American population levels were low, especially on the hills in the southern part of the region, and impacts on the vegetation would have been limited.

A more dramatic and pervasive influence occurred when settlers of European origin arrived and began to clear major areas of forest for agriculture. This started about 1790 in the central Finger Lakes region, when much the land was surveyed to give to Revolutionary War soldiers. Towns sprang up early in the 1800s, eventually linked by railroads, and forest clearing accelerated. Conversion of forest to farmland reached its maximum here in the late 1800s. Starting in the early 1900s, fields and entire farms were abandoned, particularly on steeper hillsides where plowing was difficult and crop returns were marginal. As fields underwent succession and reverted to forest, the area of forest increased during the 1900s from its earlier minimum. On the flatter, less acidic soils north of Tompkins County (see Figure 1, facing page 1) at least 90% of the original forest was cleared, and much remains in active agriculture today. In contrast, in the southern part of the region, where the land was less suited for farming, about 30% of the forest was never cleared, and much of what had been farmed in the 1800s was abandoned in the 1900s. In Tompkins County in the year 2000, about 50% of the land was in forest, and more than half of the forested area was once farmland.

Several new types of vegetation developed in the 1900s on the lands abandoned from farming. Such sites are called “post-agricultural,” “successional,” or “secondary.” A forest stand that developed on a former farm field differs in a number of ways from other forests. Therefore, knowing whether or not a piece of land was once cleared for farming is fundamental to fully understanding the current structure and species composition of a forest stand. To emphasize this distinction in land-use history, we use the term “secondary forest” to refer to stands on land that was once farmed, in contrast to “primary” forest, which is on land that was never cleared for agriculture. Primary forest includes “old-growth forest,” which is rare in the region today as most stands have had some logging, but primary forest also includes the many stands that have been logged, often more than once. The terms secondary and primary have been used in different ways and can be confusing, as some authors call stands of primary forest regrowing following logging “secondary forest” or “second-growth.”

In our region, Successional Vegetation on Former Farmland is a new kind of vegetation, which has become common only in the past hundred years. Some characteristic signs that vegetation is post-agricultural (secondary) are described in Section G of the book. Although post-agricultural stands are successional, note that succession also occurs in natural, non-post-agricultural, vegetation types, as when a marsh invaded by shrubs and trees becomes a forested swamp.

In the original natural vegetation prior to major settlement in the region, the dominant species characteristic of the types described in Sections A to F of the book would have been essentially the same as today. We know from notes of the early land surveyors in the 1790s that most of the region was originally in Moist Upland primary forests, with beech, sugar maple, hemlock, basswood, ash, and other trees. Dry Upland primary forests of oaks, hickories, and pines were common on the slopes above the larger lakes, while scattered swamps and other wetlands occurred in areas with poor water drainage. Wetlands were especially common on the lowlands north of the Finger Lakes.

While the broad patterns still hold, there have been several notable changes in the region's vegetation over the past few hundred years, even in the primary (not post-agricultural) forests. One change is that a few plant species no longer grow in this part of the central Finger Lakes region. F. R. Wesley, a botanist at Cornell University, has determined that of approximately 1,200 species of native plants found in the region in the 1800s, about 30 of them are no longer present. Most were herbaceous plants that only grew in a few sites or specialized habitats. None of them, when they grew in the region, were common enough to have been considered typical of any of our vegetation types, and none have gone extinct throughout their ranges. Many were near their northern or southern range limit in New York State.

Farmland and forest.

A patch of remnant old-growth forest.

Garlic mustard, a forest non-native.

Purple loosestrife, a wetland invader.

A more noticeable change in the vegetation composition is the many non-native species that established here over the past 200 years. F. R. Wesley has found that over 700 of the plant species in the central Finger Lakes region today were not originally native to the region – more than 35% of the current total number of species. Many of the non-native species are agricultural weeds. Many others spread from ornamental plantings. Non-native plants are now quite abundant and often dominant in disturbed habitats, such as agricultural fields, roadsides, successional vegetation, and secondary forests. Some species are invasive in more natural areas. For example, purple loosestrife has invaded unforested wetlands; and garlic mustard, Japanese barberry, and Norway maple are increasingly seen in upland primary forests. The majority of non-natives, however, are uncommon and not invasive in the region.

In our primary forests, the largest change in species composition is that a few of the tree species that were originally abundant have been greatly reduced in numbers and size. Several important tree species have been attacked by accidentally introduced diseases that originated in Asia or Europe. The most notable of these were the chestnut blight, which spread through the Finger Lakes region of New York in the 1920s, Dutch elm disease in the 1960s, and beech bark disease, in the 1980s. Chestnut trees were once abundant in some of the Dry Upland forest types, American elms were an important component of many wetland types, and recently the large beech trees in Moist Upland forests have been dying. However, none of these species have been completely eliminated: young elm trees and chestnut saplings are still frequent, occasional large chestnut and American elm trees persist, and American beech is still common.

Another important change in the primary forests of the region is that they have been logged, often repeatedly, and sometimes used for grazing cattle. Very few true old-growth or "virgin" forests remain. Tree cutting has altered the physical structure of many stands. The original primeval forest had more very large trees, more canopy gaps created by the fall of large old trees, and more large dead trees. Some of the dead trees were

standing; others were on the ground in various states of decay. Clear-cut logging is unusual in the region. Instead, only the larger trees were harvested, or sometimes small, poor-quality trees were removed to improve the growth of the stand. Usually, such cutting had little effect on the relative abundances of species, or at most merely shifted the ratio among several species that are equally representative of a particular forest type. Where the relative abundances of species have been greatly altered by logging, the subsequent stand composition may not fit the types described in this book.

Tree removal within the past decade is evident as cut stumps, and we avoided sampling recently cut stands. Logging less recently may be harder to discern, as stumps of species such as beech, birch, and maple rot quickly. In contrast, white pine stumps can persist a hundred years or more, with spiky remnants that have an odor of turpentine when broken. Chestnut stumps are also long lasting, often decaying in the center leaving an outer ring of solid wood. Oak stumps have noticeable white "ray cells," narrow bands radiating from the center. Red oak, red maple, and white ash often sprout from the base after cutting, producing clumps of several trunks. However, wind damage or deer browsing can also produce stem clusters, and some species, notably basswood, routinely form clumps of trunks, so this is not always diagnostic of logging.

In some sites, evidence of logging or other disturbance can be seen in the species composition of the current trees. For example, the presence of light-demanding trees such as bigtooth aspen or quaking aspen suggests that the site was heavily logged, if the stand otherwise appears to be a type of Moist Upland forest. The natural habitat of aspens includes some Dry Upland sites, so the presence of aspen does not always indicate a history of logging. Aspens also establish in large *blowdown* patches; fallen tree trunks and tree root tip-ups would be a sign that trees were blown down by strong winds. Many logged stands do not have aspen trees, however, and usually the forests regrew after a cutting with whatever trees and saplings were left standing. Thus, after several decades when the cut stumps have rotted away, determining the history of logging can be difficult.

A primary forest after logging.

This clump of sprouts grew from the stump of a logged tree.

THE RELATION OF VEGETATION TYPES TO THE LANDSCAPE

At a broad scale, vegetation reflects the environment. Many species grow primarily in certain habitats, species differ in the conditions to which they are adapted, and some become dominant only in places where others are absent or rare. Thus, certain types of vegetation occur in predictable situations, such as forests of oak on upper slopes that face south or west. We can also look across a landscape and, to some extent, understand the underlying environment based on the species composition of the vegetation. For example, sycamore or willow trees are good indicators that a stream is nearby; basswood, alternateleaf dogwood, or bitternut hickory are indicators of moist, fertile sites; whereas chestnut oak indicates dry, infertile soil. Sensitive fern and American hornbeam are indicators of moist ground.

The first six major categories of natural vegetation types (Sections A to F of the type descriptions) are Dry Upland Forest, Moist Upland Forest, Floodplain Forest, Swamp Forest, Open Wetland, and Bog. Clearly these differ in their association with dry, moist, or wet conditions. The broad categories are further divided into "vegetation types" with particular sets of species, which we define and describe in this book. These vegetation types also differ in the environmental conditions in which they occur.

Each of the vegetation types grows within a somewhat limited range of soil conditions. Figure 2 summarizes the general associations of the types to soil moisture availability and soil acidity. These relations are addressed in greater detail in the type descriptions. The approximate positions of the types are shown relative to a vertical axis from dry (above) to wet (below) – in other words from the most well drained, droughty soils on steep southwest-facing upper slopes, to waterlogged and flooded sites. The horizontal axis spans a range of soils from acidic (around pH 4), to neutral (pH 7), to high-lime (up to pH 8). Note that the positions of the types on the diagram represent average tendencies; many of the vegetation types span a fairly broad range of environmental conditions.

Sensitive fern.

American hornbeam, sometimes called "musclewood," has a trunk with a sinewy appearance.

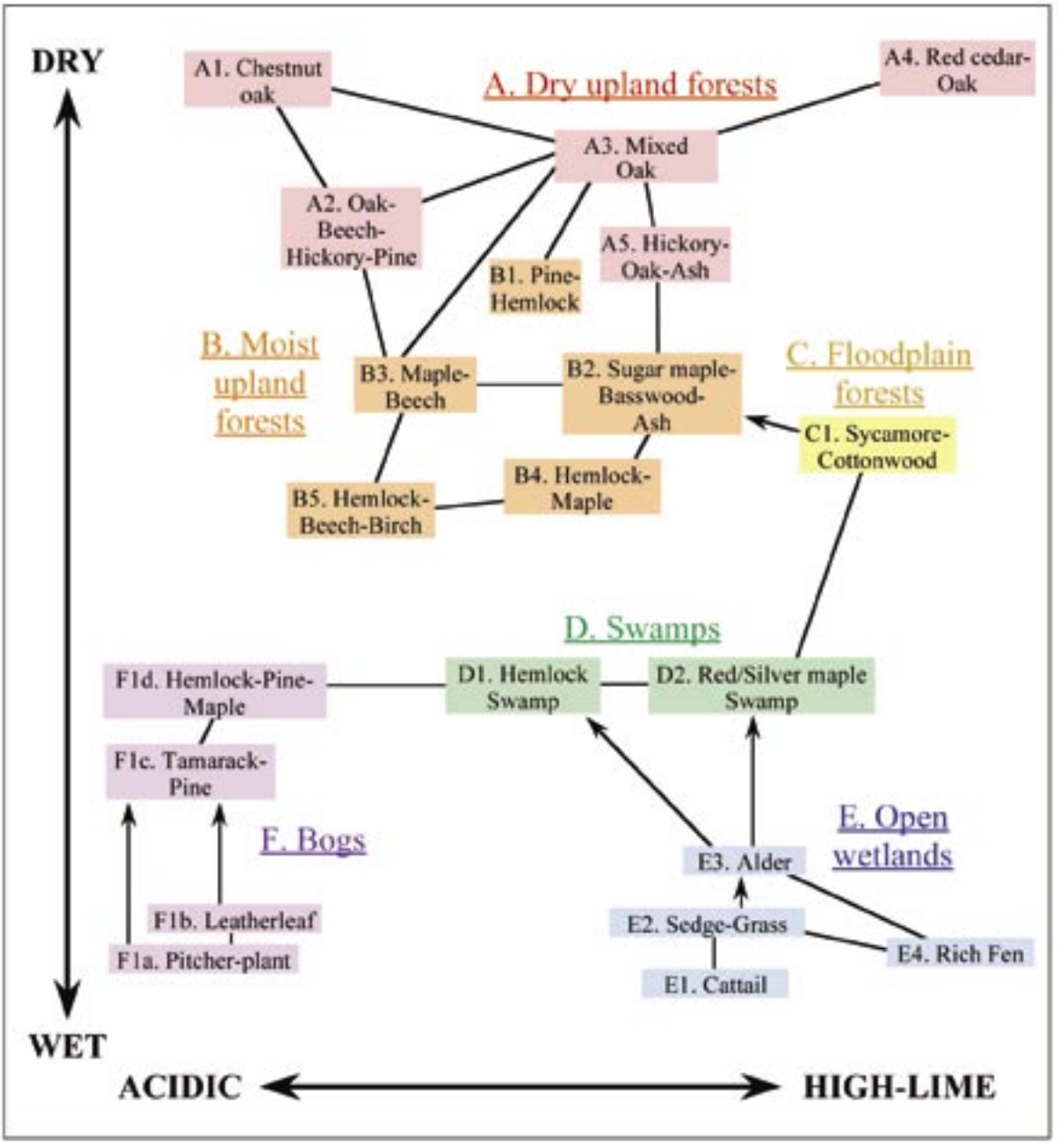


Figure 2. Diagram of the vegetation types in relation to soil moisture and acidity. Positions shown are approximate; many types can be found across a range of site conditions. Lines connecting two types indicate that stands with a species composition that is intermediate between the two types can be found. An arrow between types indicates the direction of change in species composition over time, for a type that develops into another type due to natural succession. Successional vegetation types on former farmland (Section G of the Descriptions) are not shown.

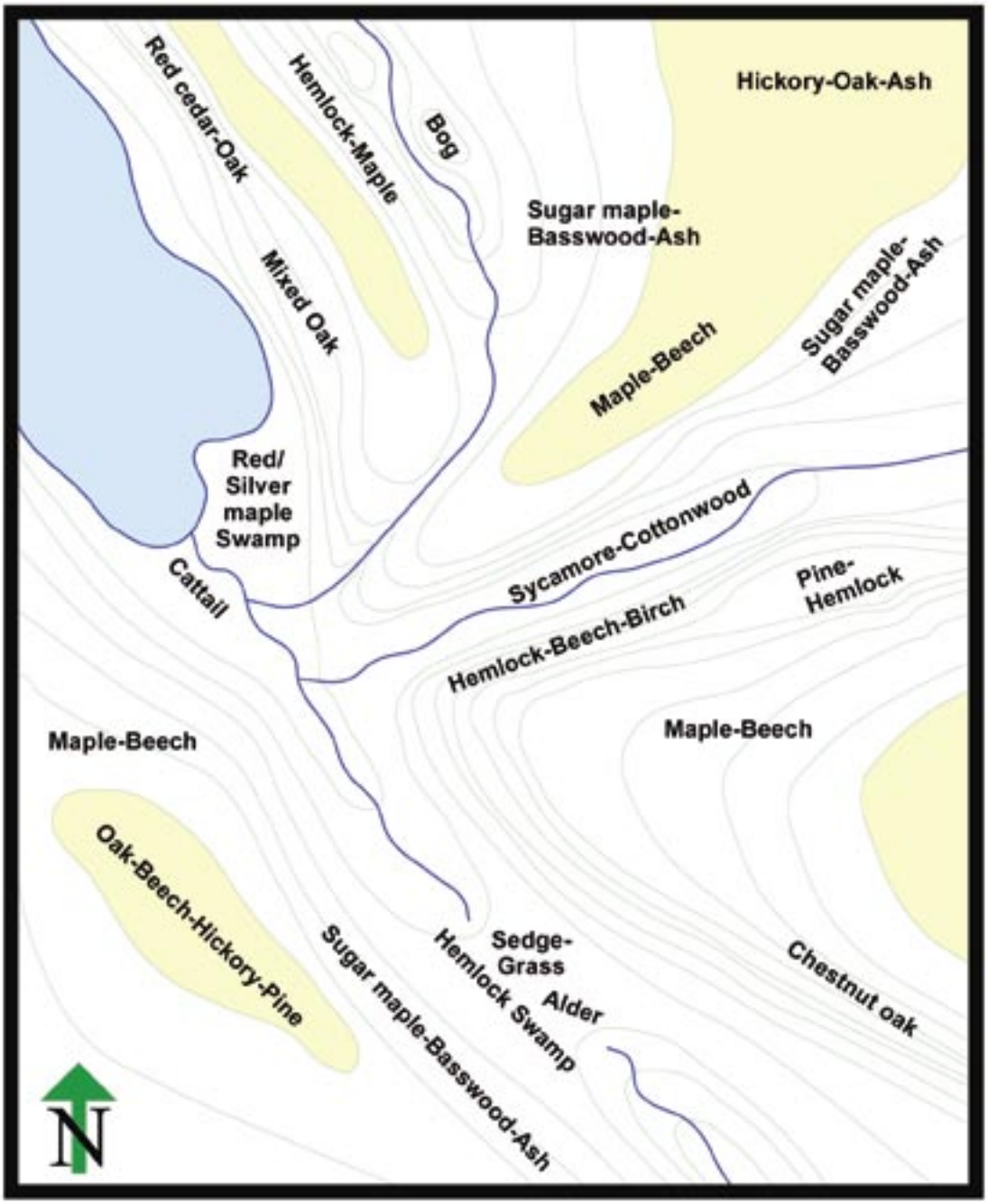


Figure 3. Typical landscape positions of the vegetation types.
A hypothetical, diagrammatic landscape, showing some of the site positions where the vegetation types typically occur. Variations in elevation and slope steepness are indicated by green contour lines representing elevation. Yellow areas are higher elevation flat uplands. Streams and a lake are in blue.

Soil moisture and acidity conditions are distributed across the landscape in predictable ways: the driest sites are steep, south-facing ridgecrests, the wettest are in low, flat areas, and the acidic soils are more common in the southern part of the region. The pattern of association of vegetation types with particular subsets of conditions is shown diagrammatically on a map of an imaginary landscape (Figure 3). For example, Mixed Oak stands occur on southwest-facing slopes, Maple-Beech forest can be found on flatter uplands or gentle slopes facing north, while Hemlock Swamps develop in low wet spots. The relations between vegetation types and positions in the landscape are given in more detail in Appendix II (page 106). This Appendix is in the form of a key, listing major categories of landscape position within the central Finger Lakes region, along with the vegetation types that are typically found in each kind of site.

These patterns are only approximate. Types occur in a greater range of potential conditions than Figures 2 and 3 imply. Also, within any given environmental category several types can usually be found (Appendix II, and Figure 3). The lack of unique correspondence with vegetation in some cases reflects environmental variation not specified by our categories. For example, within the flat upland category, subtle variations in slope or soils can have a large effect on soil drainage and thus vegetation. In some sites, logging may have changed the composition enough to shift the forest to a related type. However, in most cases the occurrence of multiple vegetation types in a given environment likely reflects biological reality. Most of the dominant tree species in the region have broad environmental tolerances.

Plant communities that are intermediate in species composition between two types are often found. Frequent occurrence of such intermediate stands is shown in Figure 2 as a line connecting two types. Compositionally intermediate communities are often found in environments that are intermediate between the landscape categories listed in Appendix II. The occurrence of such communities in those situations supports the relationship between vegetation and environment shown in Figures 2 and 3, and Appendix II.

Some sites do not fit well into any of the vegetation types. A large stand of forest is likely to contain patches of various types, which tend to intergrade rather than be distinct. There are also occasional sites where an unusual species is abundant. Stands can depart from the basic types due to historical factors, such as selective logging of certain species or severe windstorms blowing down overstory trees. Such disturbance, if accompanied by abundant seed production of one species, can result in a stand of unusual composition. For simplicity we have ignored the variants, focusing on the common, major community types.

DESCRIPTIONS OF THE VEGETATION TYPES

Each vegetation type description has three sections. **Composition** covers the species that are abundant or commonly occur in that type. **Where found** summarizes the landscape positions and soil conditions with which the vegetation type is associated. **Comments** includes other notes, such as how the type relates to those described in other vegetation studies in New York State and the surrounding regions. For definitions of terms used in the descriptions, see **Background** (pages 5-9) or **Appendix VI** (Glossary) at the end of the book.

Under **Composition**, we note the most common trees, any important shrubs and vines, and the herbaceous flowering plants and ferns that are most abundant or that are ***frequent*** (found in many sites). The general structure of the vegetation for most of the types is multi-layered, closed-canopy forest. Which tree species are ***dominant*** in a stand of forest is assessed based on ***relative basal area***. Forest types with particularly high total basal area are pointed out, as are types with low basal area (that is, those with smaller trees or a more open canopy). We also present typical values from the tenth-hectare sampling plots, for density (stems per tenth hectare), diversity (number of species per tenth hectare), and the amount of plant cover in the ***ground layer*** (herbs and woody plants up to 3 feet tall). ***Large trees*** are those with trunks more than 6 inches in diameter. The ***tree layer*** is defined as trees, shrubs, and vines more than 2 inches in diameter; the ***sapling layer*** or ***shrub layer*** is the smaller woody stems, up to 2 inches in diameter and over 3 feet tall.

Each vegetation type was named to indicate the plants that are the most common dominant species, or that are important in distinguishing the type from others. Not every species in the type name necessarily occurs in all stands of the type. Most of the types were named for tree species, not only because the large trees are often the first thing one notices in a forest, but also because the canopy trees have a strong influence on the community, through their shade, the nutrients and acidity of their fallen leaves, and the roots' effects on soil moisture availability. Several of the non-forested types were named for the abundant herb or shrub species.

Table 1 (on pages 20-21) summarizes the typical patterns in tree composition, for the forest vegetation types. The table shows the average relative basal area of the major tree species, illustrating key compositional differences among types – as highlighted in the type descriptions that follow – and also the many similarities between certain types. It is apparent from the table that some species grow in a range of types. For instance, red oak, which is common in Dry Upland Forests (types A1-A5), also is found in the Moist Upland Forest types (B1-B5). And red maple and white pine occur in nearly every type,

ranging from dry to flooded; white ash is nearly as ubiquitous. In contrast, some tree species are restricted to a few types. For example, the only type that sycamore is found in is Sycamore-Cottonwood (type C1).

Appendix III (page 109) summarizes a number of other characteristics of the vegetation that are mentioned in the text. Appendix III lists the average values from the tenth-hectare samples of each vegetation type for basal area, tree canopy cover, stem density, species diversity, and the cover of short plants (the ground layer). Values that are notably high or low are pointed out in the type descriptions, but some readers will want to consult Appendix III to see how the averages compare among the vegetation types. For example, tree basal area and canopy cover are highest in several of the Moist Upland Forest types (B1-B5), and the cover of herb species is greatest in Open Wetlands (E1-E3).

The average values given in Appendix III and Table 1 should be interpreted with the understanding that variation within each vegetation type is not shown. Consequently, in any actual site the abundances of the dominant species may deviate substantially from the average value for the type, and only a few of the less frequent species may be present.

After Table 1 (on the following pages) are six sections of vegetation type descriptions, from **A. Dry Upland Forests** to **F. Bogs**, followed by the final section, **G. Successional Vegetation on Former Farmland**.

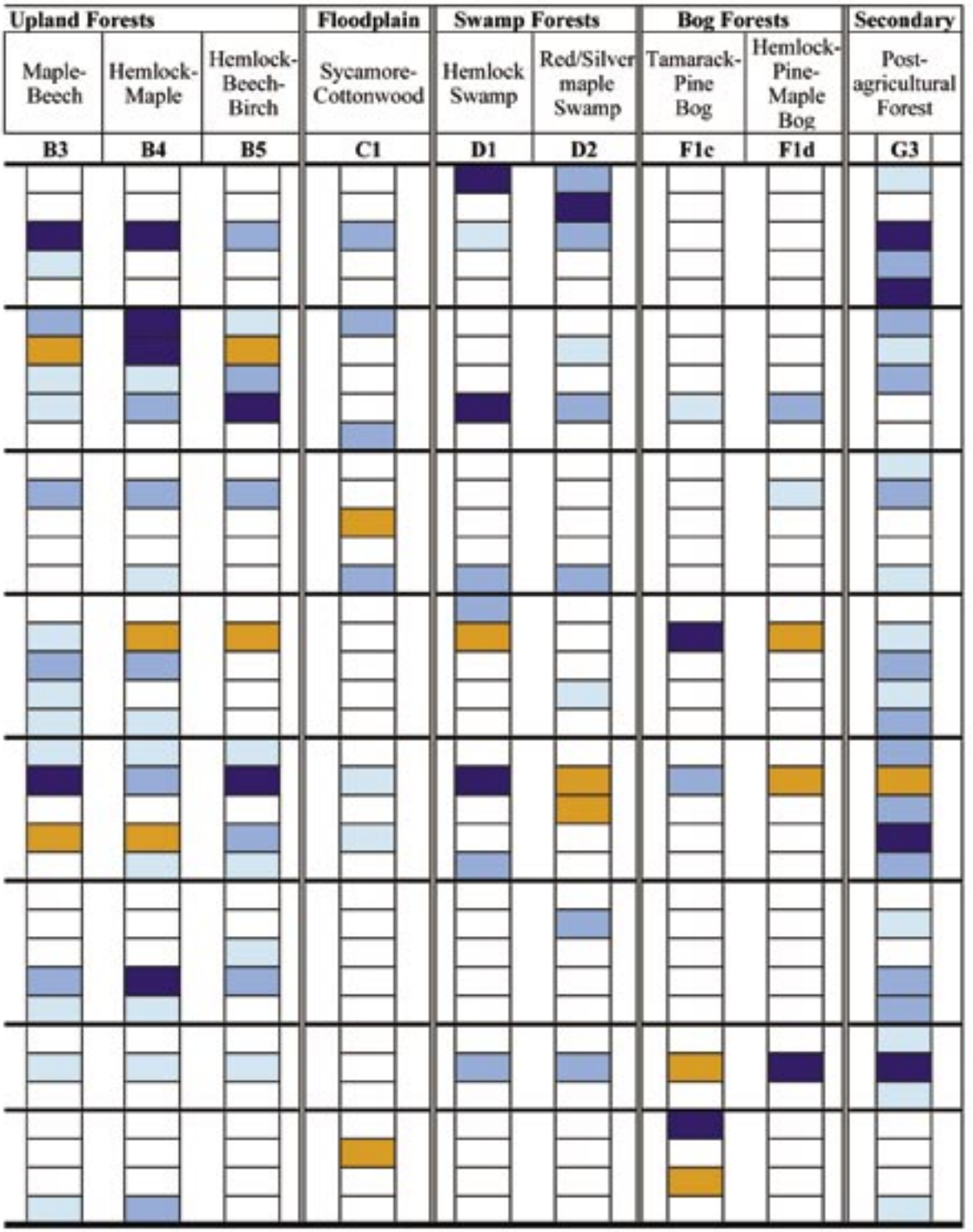
A hillside in autumn.

Table 1. Tree species composition of the forested types. For each column (a type), color categories show the average abundance of a species in the sampled stands of that type, as relative basal area (summed tree trunk sizes, as a percentage of the total from all species in a stand).

Relative abundance:	0.1 to 1%	>1 to 5%	>5 to 20%	>20%

Vegetation type	Dry Upland Forests					Moist	
	Chestnut oak	Oak-Beech-Hickory-Pine	Mixed Oak	Red cedar -Oak	Hickory-Oak-Ash	Pine-Hemlock	Sugar maple-Basswood -Ash
Tree species	**A1**	**A2**	**A3**	**A4**	**A5**	**B1**	**B2**
ASH, black							
ASH, green							
ASH, white							
ASPEN, bigtooth							
ASPEN, quaking							
BASSWOOD							
BEECH							
BIRCH, black							
BIRCH, yellow							
BOX ELDER							
CEDAR, red							
CHERRY, black							
COTTONWOOD							
DOGWOOD, flowering							
ELM, American							
FIR, balsam							
HEMLOCK							
HICKORY, bitternut							
HICKORY, pignut							
HICKORY, shagbark							
HOP-HORNBEAM							
MAPLE, red							
MAPLE, silver & hybrid							
MAPLE, sugar							
MUSCLEWOOD							
OAK, black							
OAK, bur							
OAK, chestnut							
OAK, red							
OAK, white							
PINE, red							
PINE, white							
SHADBUSH							
SPRUCE, black							
SYCAMORE							
TAMARACK							
TULIP TREE							

Uncommon trees are not included (species with an average relative basal area less than 1% in all types).
Not all species shown are in every stand of a type, or in these proportions.
Some species also occur in types where they are not indicated, in occasional stands or as small stems.
For Latin names of the species, see Appendix I (page 100).



A. Dry Upland Forests (five types)

Several species of oak are the most common trees in the Dry Upland types, and pines are important in some types (Table 1). Oaks and pines are among the most drought-tolerant of our tree species. Four of the five types that we describe occur most often on slopes, sometimes steep ones, and especially on sites that face to the south or west (Figure 3, and Appendix II). One type (Hickory-Oak-Ash) tends to occur on more level ground. The Dry Upland types span a wide range in soil acidity, from the Red cedar-Oak type on high-lime soils, to the Chestnut Oak type on the most acidic soils (Figure 2).

The tree canopy in several of the Dry Upland types is somewhat more open than in Moist Upland forest. This frequently allows the development of a more diverse understory, including shrubs, small trees, and in the ground layer, herbs. Some of the species are restricted to Dry Upland habitats, but others are found in Moist Upland Forest as well, or in Herbaceous Old Fields. A few Dry Upland Forest species are near the northern limit of their range, and their association with slopes that face south or that are adjacent to the large lakes may be due to the milder temperatures there.

Dry Upland Forests are less common than Moist Upland Forests in the region. This was also true prior to the widespread settlement and forest clearing of the 1800s. However, Dry Upland Forests still cover many thousands of acres, and sometimes occur in extensive stands. At the end of Section A, factors involved in the maintenance of oaks and other tree species of the Dry Upland Forests of the region are discussed.

A Chestnut oak stand on a steep slope.

Chestnut oak bark has chunky ridges.

A1. Chestnut oak type

Composition: The dominant trees in the Chestnut oak type are red oak and chestnut oak. Although red oak is abundant in all of the Dry Upland types, the Chestnut oak type is unique in having a high abundance of chestnut oak. Red maple, white oak, and white pine occur in most Chestnut oak stands, but are generally less abundant than red oak and chestnut oak. Pignut hickory, hemlock, sugar maple, red pine, black oak, and white ash occur in the overstory of occasional stands, but usually not in large numbers.

Pitch pine, a rare species in the region, is found in a few Chestnut oak stands. It grows on dry cliffs and the shoulders of ravines, and also occurs in some Red cedar-Oak stands. It was not abundant enough in our samples to be included in Table 1. Pitch pine is common in the Long Island and New Jersey Pine Barrens, and the Albany Pine Bush.

Prior to the chestnut blight, a disease that moved through this region in the 1920s, American chestnut was a major species in the Chestnut oak type. Its former abundance is still evident in many stands today as dead stumps and fallen logs, since the wood is extremely rot-resistant. Old stumps of chestnut trees that were logged have a characteristic narrow outer ring of persistent wood around a large hollow center. In some stands the roots were not killed, and new sprouts grow and survive in the understory for years, often reaching 2 to 6 inches in diameter before succumbing to the disease.

Total basal area of the woody plants in Chestnut oak forests today tends to be low, around 2 m^2 per tenth hectare, or about two-thirds the basal area of most other Dry Upland or Moist Upland forest types. Basal area is low because Chestnut oak stands are on dry slopes that support few large trees. Density in the tree layer is slightly less than in the other Dry Upland types, with an average of about 80 stems per tenth hectare. Diversity in the tree layer varies, but the average is about 10 species per tenth hectare. This is similar to other Dry Upland types and slightly greater than in Moist Upland forest. However, much of the diversity is in the understory; Chestnut oak stands often have 5 or fewer species of large trees (>6 inch diameter) per tenth hectare.

The tree canopy tends to be short, and moderately open. This allows development of a layer of tall shrubs and small trees, with an average density of over 400 stems per tenth hectare in the sapling layer. Saplings of the overstory species that are common include red maple and red oak. Chestnut oak saplings are less abundant. Saplings and small understory trees of beech are often present. Small hemlocks are often abundant in the understory, even though hemlocks of canopy size are infrequent.

Chestnut oak.

American chestnut.

Several species of small trees and tall shrubs grow in the understory. Shadbush was present in every Chestnut oak stand we sampled. Other common species in the sapling layer are witch-hazel, hop-hornbeam, striped maple, and sprout stems of chestnut. Flowering dogwood can be an important element of the understory layer of Chestnut oak stands, but is absent from many of them, and generally is not so abundant there as in the Mixed Oak type. Mountain laurel is an evergreen shrub that is essentially restricted to the Chestnut oak type, but is only occasionally present. Pink azalea, another species found on acidic soils, occurs in a few stands.

Generally the ground layer of Chestnut oak stands is dominated by short shrubs, especially mapleleaf viburnum, hillside blueberry, and other kinds of blueberry. Herbs are sparse, usually with less than 8% cover. The most commonly encountered herb species are wintergreen and trailing arbutus, which are both low, evergreen plants. Species found at some sites include partridgeberry, Canada mayflower, pussytoes, spreading dogbane, Pennsylvania sedge, bastard toadflax, and perfoliate bellwort. Many of the herbs are species associated with soils that are acidic and nutrient-poor, or sites where the ground is dry and free of leaf litter. At one site we found wavy hairgrass, which is a rare grass species indicative of dry, infertile soils. Among the common tree seedlings in the ground layer are red oak, chestnut oak, red maple, and shadbush.

Total species diversity tends to be somewhat lower than in the other Dry Upland types, with about 40 species per tenth hectare. A few Chestnut oak sites are richer, especially in herbs, but in most stands the woody species outnumber the herbs.

Mountain laurel.

Pink azalea.

Shadbush.

Trailing arbutus.

Where found: The Chestnut oak type is one of two types that can be found in the very driest habitat of the region: steep, upper slopes that face south, southwest, or west. Stands are often on mid to upper slopes above wide, glacially-carved valleys away from the larger lakes. The type also occurs on hilltops, and the slopes of narrower valleys, but not in sheltered gorges. The sites are steep, with 20% to 60% slope, and are usually at high elevation (1400-1700 feet).

The soils in Chestnut oak sites are well drained to excessively well drained, like those of the Red cedar-Oak type. The Chestnut oak type occurs on soils that are shallow to bedrock, very rocky, and strongly acidic (pH 4 to 5). Most stands are in the southern half of the region, where the soils are more acidic and slopes are steeper. A continuous stand of Chestnut oak forest stretches along the upper west-facing slope of the Cayuga Inlet Valley south of Cayuga lake, east of the village of West Danby. There are stands at Bald Mountain in the town of Caroline, above Cayuta Creek in the town of Catharine, and many other places. North of about the latitude of Ithaca the type is replaced on very steep, dry slopes by Red cedar-Oak, and on less steep slopes, by Mixed Oak. Scattered chestnut oak trees occur north of Ithaca in these other types, such as on upper slopes along the east side of Cayuga Lake.

Comments: The Chestnut oak type is the most commonly recognized of our oak types in the literature. Communities dominated by chestnut oak and red oak, with an understory of blueberry and related shrubs, have been described on rocky, acidic soils from Ohio, various parts of New York, eastern Pennsylvania, and western Connecticut. Similar forests are common in southern New England, and occur on ridges with acidic soils in the New Jersey highlands. To the east of the Finger Lakes region, the type is not restricted to south- and west-facing slopes. For example, in central New Jersey and southeastern Pennsylvania chestnut oak was dominant on north-facing slopes; mixed oak forests were on the south-facing slopes. Since the central Finger Lakes region has a cooler climate and finer textured soils than most of the area east of the Appalachian Mountains, possibly the soils in our region are generally not as dry. In that case chestnut oak may become dominant at a similar degree of droughtiness in both regions.

Intermediates between Chestnut oak and other Dry Upland types occur in our region. We sampled a south-facing slope on coarse, well drained soil that was acidic at the surface but with a high-lime layer deeper in the soil. The stand at that site was intermediate between Chestnut oak and Mixed Oak. Chestnut oak was a dominant species, but black oak and various shrubs and herbs of the Mixed Oak type were also abundant. Stands of intermediate composition also occur near the north/south transition between high-lime and acidic bedrocks, at about the latitude of Ithaca. Chestnut oak and Oak-Beech-Hickory-Pine intermediates are common south of Ithaca, as both can occur on steep south-facing slopes, although most Oak-Beech-Hickory-Pine stands are on flat hilltops. There are also some intermediates between Chestnut oak and the Moist Upland types, on sites that are less dry, such as south-facing lower slopes (which receive water from higher on the slope) and north-facing upper slopes.

A2. Oak-Beech-Hickory-Pine type

Composition: This type typically has several major tree species sharing dominance, with a combination of red oak, white oak, and red maple, along with some pignut hickory, beech, or white pine. Additional common species include sugar maple, hemlock, white ash, bigtooth aspen, shagbark hickory, and black cherry. Prior to the 1920s when chestnut blight reached the region, American chestnut was important. Some small sprout stems of chestnut still persist. Black gum, an uncommon species in the region, is found mostly in this type. Stands of Oak-Beech-Hickory-Pine in which red oak is strongly dominant often have a substantial component of bigtooth aspen, probably indicating a history of major logging, as aspen requires large openings to become established.

The overstory is slightly more diverse than most Chestnut oak or Mixed Oak stands, with an average of about 7 species of large trees (>6 inch diameter) per tenth hectare, compared to averages of 5 or 6 species in the other two types. Including smaller stems, diversity in the tree layer in Oak-Beech-Hickory-Pine is often more than 10 species per tenth hectare. Total basal area is moderate, about 3 m^2 per tenth hectare.

The sapling layer is moderately dense, with an average of less than 400 stems per tenth hectare. The most common tree saplings are beech, red maple, and hop-hornbeam. Witch-hazel is abundant in the understory at some sites. Other common shrubs include choke cherry, and in the ground layer, lowbush blueberry and mapleleaf viburnum. Cover in the ground layer is often low, with an average of 20% cover. Herbs are sparse, with <5% cover in most sites, but sometimes as much as 20%. Among the common tree seedlings in the ground layer are red maple, white ash, hop-hornbeam, and red oak.

The most common herb is Canada mayflower, found in every stand of Oak-Beech-Hickory-Pine sampled. Herbs present at some sites include partridgeberry and wintergreen (species indicative of infertile soils), along with species that also occur in more nutrient-rich forest sites, such as mayapple, wild sarsparilla, and spotted geranium.

With an average of more than 50 species per tenth hectare, total species diversity is greater than in the Chestnut oak type.

An Oak-Beech-Hickory-Pine stand.

Red oak acorns.

Beech nuts and the bristly pod that contains them.

Standing water in spring.

Canada mayflower.

Where found: The Oak-Beech-Hickory-Pine type occurs on flat hilltops, including broad uplands and narrow, nearly level hilltops. The type is also found on a range of slope positions that face south to west and are moderate to steep (10% to 40% slope). A few stands are found on steep sites with northerly aspect. Most of the forests are in the uplands south of Ithaca. Examples include stands at Connecticut Hill in the town of Newfield, and just west of Cayuta Lake in the town of Catharine. The type also occurs occasionally on slopes and level uplands between the lakes. Most sites are at elevations from 1400 to 1800 feet, but the type is sometimes found at lower elevations.

Oak-Beech-Hickory-Pine is most often found on acidic soil, with surface soil pH between 4 and 6. The soils tend to be moderately well drained to well drained, but nearly all stands are on soils with a dense subsurface fragipan layer, or with bedrock near the surface. In flat locations, this limits drainage so water stands at or near the soil surface during the spring after snowmelt. The shallow bedrock or fragipan layer restricts the vertical rooting depth of trees, leading to drought during summer dry periods. This may be a controlling environmental factor that promotes the dominance of drought-tolerant species such as oaks, white pine, and pignut hickory despite wet conditions in early spring.

Comments: The Oak-Beech-Hickory-Pine type seems to be uncommon outside the central Finger Lakes region. There is a Beech-White oak type with hickory and white ash that occurs on areas of flat land in Ohio, and similar forests are found in a seasonally wet bottomland in central Indiana. Forests that are similar to Oak-Beech-Hickory-Pine but without the beech are found on land too wet for agriculture in western Ohio, and on soils with a fragipan layer in northeastern Massachusetts. Forests of white oak, hickory, beech, and other trees occur on soils with restricted drainage in the Piedmont region of southeastern USA. However, in most of the Northeast, forests with a major component of white oak, red oak and hickory seem to lack the diversity of tree species commonly found in this type in the Finger Lakes region of New York.

Oak-Beech-Hickory-Pine and Mixed Oak have many species in common, and stands of intermediate composition occur in the central Finger Lakes region. Red maple and beech are more abundant in Oak-Beech-Hickory-Pine, while black oak and chestnut oak are more abundant in the Mixed Oak type. Oak-Beech-Hickory-Pine and Maple-Beech, a Moist Upland type, sometimes intergrade.

A3. Mixed Oak type

Composition: Major species of the Mixed Oak type include red oak, black oak, white oak, and white pine, typically with several of these sharing dominance. Pignut hickory and chestnut oak occur in lesser numbers in some stands. In the subcanopy and sapling layers, sugar maple is usually present, and to a lesser extent red maple or white ash. Basswood or hemlock occur in some stands. Flowering dogwood can be abundant in the understory.

Total basal area tends to be a little higher than the other Dry Upland types, sometimes more than 3 m^2 per tenth hectare, with an average of 85% canopy cover. This is similar to two of the Moist Upland types: Maple-Beech and Sugar maple-Basswood-Ash. The tree layer in Mixed Oak is moderate in stem density, with an average of 100 stems per tenth hectare, of which about one-third are large trees (>6 inches in diameter). Diversity in the tree layer is around 10 species per tenth hectare, similar to the other Dry Upland types, and slightly greater than in Moist Upland forest.

The sapling layer of Mixed Oak stands is usually less dense than in the other Dry Upland types. The most common tree saplings are sugar maple, which at some sites is abundant, and red maple. There are few oak and hickory saplings. Shrub species found in some stands include mapleleaf viburnum, nannyberry, witch-hazel, choke cherry, and in the ground layer, lowbush blueberry. Virginia creeper and summer grape are common vines. Common tree seedlings in the ground layer include sugar maple, red maple, white ash, and black cherry, and occasionally, seedlings of the canopy oak and hickory species.

Red oak (left) and white oak (right). Black oak leaves have pointed tips like red oak.

Red oak: vertical "ski trails."

Black oak: dark and chunky.

White oak: paler and flakier.

Herbs in the Mixed Oak type include some species that are common in Moist Upland forest, such as mayapple, blue-stemmed goldenrod, and enchanter's nightshade, as well as species more typical of Dry Upland forests, including perfoliate bellwort, Pennsylvania sedge, and tick-trefoil. Rue anemone and smooth Solomon's seal, which are near the northern limit of their ranges, grow in some stands of Mixed Oak and other Dry Upland types on dry slopes. The average cover of herbs in the Mixed Oak stands we sampled ranged between 1% and 30%. Stands with low herb cover often had high cover of shrubs in the ground layer.

Total species diversity is usually 40 to 50 species per tenth hectare, fairly evenly divided among trees, shrubs, and herbs. This is moderate relative to the other Dry Upland types, but higher than in Moist Upland forest.

Mayapple leaves and flower.

Tick-trefoil flowers and leaves.

Where found: The Mixed Oak type occurs primarily on west- and southwest-facing slopes overlooking the major lakes. Stands are more common on the slopes along the east side of Cayuga Lake than along Seneca Lake, where vineyards are more frequent today. Typical Mixed Oak sites are on mid-slopes or higher positions, with moderate to steep (10-20%) slope. The type also occurs occasionally on steeper east-facing slopes along the lakes, on steep south- to west-facing upper slopes of narrow valleys, and on slopes in some of the other broad valleys, such as above Six Mile Creek north of Rte. 79. The elevation of Mixed Oak stands is generally below 1000 feet.

Most stands in the region are north of Ithaca. Consequently, Mixed Oak forests tend to have a high-calcium bedrock and subsoil, although this is often not reflected in the surface soil, which is acidic in some sites. Surface soil pH in the sampled stands ranged from less than pH 5 to around 7. The soils are well drained or moderately well drained.

A Mixed Oak stand in summer.

Pennsylvania sedge.

Perfoliate bellwort.

Lowbush blueberry leaves.

Witch-hazel flowers, in October.

Comments: Forests similar to the Mixed Oak type have been described from many locations in the Mid-Atlantic states and southern New England. Indeed, in northeastern New Jersey and southeastern New York most of the trees recorded in the early land surveys ("witness trees") were oaks (white, black, and red), chestnut, or hickories. Thus, at the time of European settlement, forests closely related to the Mixed Oak type probably predominated in that region. Our Mixed Oak type corresponds to the Appalachian Oak-Hickory type of other ecologists, but, as in most of eastern USA, hickory is of secondary importance compared to oaks. Outside of the Finger Lakes region, one of the three characteristic oak species may be missing. Throughout its range, however, the type is distinguished from other oak-dominated communities by understory species that are more typical of Moist Upland forest types, and by an abundance of herbs. Both of these indicate that soil moisture and nutrient availability are probably higher in Mixed Oak than in our other Dry Upland types.

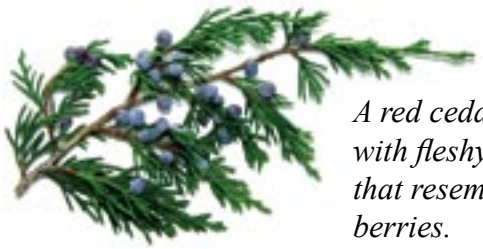
Stands that are intermediate between Mixed Oak and each of the other Dry Upland types can be found in our region. Intermediates also occur between Mixed Oak and Pine-Hemlock, a Moist Upland type.

A4. Red cedar-Oak type

Composition: The dominant trees in this type are red cedar and red oak. Some stands also have appreciable amounts of white ash, sugar maple, hop-hornbeam, or white oak. Pignut hickory or white pine may be present, shadbush is sometimes found in the understory, and hemlock occurs in some ravine stands. Pitch pine, a rare species in the region (not abundant enough to be included in Table 1), is found on dry upper slopes in a few stands of the Red cedar-Oak type and the Chestnut oak type.

The Red cedar-Oak type is found on dry, steep, eroding cliffs that support few large trees. Therefore basal area in Red cedar-Oak stands is low, around 2 m^2 per tenth hectare, or about two-thirds the typical basal area of the Mixed Oak type. The cover of canopy trees also tends to be low, with 70% or less of the sky covered by leaves and branches (vs. 80 to 90% in most other upland forest types). Red cedar trees do not have large crowns, and the density of stems in the tree layer tends to be higher than in the other types, except on extremely steep cliffs, where trees are sparse. Diversity in the tree layer is moderately high, with about 12 species per tenth hectare. Because of the short, open canopy, some tree species like sugar maple and white ash, which occupy only subcanopy positions in Mixed Oak forest, may form part of the canopy in the Red cedar-Oak type. Such moisture-demanding species tend to be more abundant on the lower slopes within the stands, presumably because seepage water from above comes to the soil surface from about mid-slope on down.

Red cedars on a south-facing gorge wall, in the sparsely vegetated form of the type that occurs on the steepest sites.



A red cedar twig, with fleshy cones that resemble berries.

Looking down the cliff to Taughannock Creek (Cayuga Lake visible in distance).

Rattlesnakeweed flowers and leaves.

Rue anemone.

A ledge on a less steep site.

Because the tree canopy in the Red cedar-Oak type is open, shrubs and vines can be abundant, and on extreme sites the larger shrub species may equal the stunted trees in height. The density of shrubs, vines, and tree saplings is higher than in other upland forest types, with over 500 stems per tenth hectare in the sapling layer in some sites. The diversity of smaller woody species in Red cedar-Oak is the highest of any of the types, with about 20 species of shrubs and vines per tenth hectare in the ground layer and sapling layer. Common shrub and small tree species are witch-hazel, mapleleaf viburnum, roundleaf dogwood, staghorn sumac, New Jersey tea, and buckthorn (a non-native species). Fragrant sumac and downy arrowwood are two native shrubs that are uncommon in the region, and which are primarily found on dry slopes in Red cedar-Oak stands. American bittersweet, poison ivy, and grape vines are frequent.

Tree saplings that may be present include red cedar, hop-hornbeam, and sugar maple. The most common species of tree seedlings are white ash, red maple, hop-hornbeam, and red oak. Tree seedlings contribute less than 5% cover to the ground layer.

On extremely steep cliffs where erosion uproots and buries the plants, and on rock faces with little soil, herb and shrub cover is low. On the less steep sites, cover of plants in the ground layer can be moderate, ranging from 30% to 70% cover, and the herb flora is diverse, with up to 40 or 50 species per tenth hectare. There are several factors contributing to this diversity. The open tree canopy allows light to reach plants on the ground. Erosion and dry soil on the steep slopes keep much of the ground bare, allowing some species to establish that cannot grow under lush herb cover. Small-scale variability – rock ledges, narrow cracks, piles of coarse talus (crumbling rock fragments), pockets of finer soil, and seeps – fosters a variety of species with differing habitat requirements. In addition, since Red cedar-Oak stands are on high-lime soils (Figure 2, page 15), some species occur that require calcareous conditions, such as bristleleaf sedge.

Herbs of Dry Upland habitat that grow in Red cedar-Oak stands include rue anemone, pussytoes, broadleaf sedge, stout goldenrod, yellow pimpernel, rattlesnakeweed, and bastard toadflax. Such species grow where the ground is generally bare of leaf litter or dense herb cover, and the trees cast less shade than in Moist Upland forests. In the moister pockets within Red cedar-Oak stands, there are species also found in Moist Upland forests, such as blue-stemmed goldenrod, false Solomon's seal, bearded shorthusk (a grass), spotted geranium, and asters. There are often some non-native weeds of open fields in Red cedar-Oak stands, such as dandelion, common St. Johnswort, oxeye daisy, and sweetclover. Several native species, notably spreading dogbane, early goldenrod, and common cinquefoil, have probably always occurred on these sites but are now more frequently encountered in abandoned farm fields and other human-disturbed habitats. Species composition of the herbs varies among sites, possibly because the stands are small patches surrounded by radically different communities, and thus chance factors have a large opportunity to affect the arrival and persistence of species.

The diversities of herb, shrub and vine, and tree species in the Red cedar-Oak type combine to give some of these stands the highest richness of all the types, with about 80 species per tenth hectare. Over half of the species are herbs. However, on cliff sites too steep to sample, the diversity of species is much lower.

Where found: The Red cedar-Oak type occurs in the driest environment of the region: calcareous talus (rock fragments) and bedrock on very steep south- to west-facing cliffs. With slopes often more than 45 degrees from horizontal, steepness can be >100% slope. Most sites are on upper or shoulder slope positions, but the type can also be found on rock outcrops at midslope and lower slope positions. Some Red cedar-Oak slopes face major lake valleys, such as cliff sites on the east side of Cayuga Lake. Other sites are on cliffs above narrower creek gorges, such as Taughannock, Buttermilk, and Great Gully. The stands are typically at moderate elevations (500 to 800 feet).

The soil is well drained to excessively well drained, although seepage along bedrock can produce local moist spots. The soils are high in lime (pH 7 to 8). Most of the stands are north of the latitude of Ithaca, where such soils are more frequent. On the more acidic cliffs and talus slopes to the south of Ithaca, scrubby forests of the Chestnut oak type occur instead.

Comments: The Red cedar-Oak type is approximately the same as the Calcareous Cliff and Shale Cliff & Talus communities described in a recent classification of New York State vegetation, but otherwise the type is not discussed in the literature. Vegetation of this sort likely occurs on calcareous cliffs elsewhere. Unlike our Red cedar-Oak type, glades and barrens dominated by red cedar in Tennessee and Kentucky have species associated with open prairies of the Midwest.

Red cedar also invades abandoned farmlands that are near the major lakes of the region, on soils that are not too acidic. Such sites can be differentiated from natural Red cedar-oak stands by their flatness, and by the abundance of successional Old Field species (Section G of the book).

A5. Hickory-Oak-Ash type

Composition: The tree composition of the Hickory-Oak-Ash type is variable, consisting of a mixture of oaks and hickories along with trees characteristic of moist, nutrient-rich soils in the Sugar maple-Basswood-Ash type (a Moist Upland forest type). Dominant species in Hickory-Oak-Ash are some combination of red oak, white oak, shagbark hickory, pignut hickory, sugar maple, basswood, white ash, or red maple. Bitternut hickory is occasionally important, and white pine occurs in some stands. Much of the tree diversity is included in the overstory, with about 8 species of large trees, out of an average of 11 species in the tree layer overall. Basal area is generally moderate, around 3 m^2 per tenth hectare. Tree canopy cover tends to be low, with an average of 75% cover. Density in the tree layer is about 90 stems per tenth hectare.

The sapling layer is also moderate in density relative to the other Dry Upland types, with an average of less than 400 stems per tenth hectare. The most common tree sapling is hop-hornbeam. There are sometimes a few saplings of oaks or hickories. In the ground layer, tree seedlings that are abundant at some sites include white ash, hop-hornbeam, red maple, and red oak.

Most of the shrub species in Hickory-Oak-Ash stands are indicative of disturbed conditions. For example, there are often non-native honeysuckles, which elsewhere occur primarily in successional farm fields and in floodplains. Several native shrub species common in the Hickory-Oak-Ash type – northern arrowwood, nannyberry, blackberry, and gray dogwood – often grow in open habitats such as Woody Old Fields.

Herb diversity is moderately high compared to the other upland forest types, with 20 to 40 species per tenth hectare. Common herbs include spinulose woodfern, spotted geranium, and partridgeberry. A few herbs characteristic of other Dry Upland types, notably rue anemone and tick trefoil, sometimes occur. In general the species are more typical of Moist Upland Forest, such as blue-stemmed goldenrod, mayapple, sensitive fern, jack-in-the-pulpit, sessile bellwort, and enchanter's nightshade. Species of Herbaceous Old Fields, such as wild strawberry and common cinquefoil, also occur.

The compound leaf of shagbark hickory.

Shagbark hickory nuts, with thick husks.

Hickory bark: shagbark (on left) and pignut (right).

Ground cover is notably high relative to the other upland forest types, with an average of over 60% cover. At some sites this is primarily lush herbs and shrubs; at others, tree seedlings are abundant. Total diversity in the Hickory-Oak-Ash type is usually more than 50 species per tenth hectare, which is moderate relative to other Dry Upland types, but higher than in Moist Upland forests.

Where found: Hickory-Oak-Ash forests are found primarily on broad, flat uplands from Ithaca northward, in areas with restricted drainage. Stands on the uplands between the Finger Lakes include sites east of Seneca Lake near Lodi, south of Seneca Falls, near the village of Cayuga at the north end of Cayuga Lake, and near Ithaca. The type is also common on moderately well drained to well drained soils in depressions between the drumlins (narrow glacial hills oriented north-south) north of the Finger Lakes. Stands occasionally occur on north- to east-facing slopes north of Ithaca, such as on the west side of Cayuga Lake, and near Moravia.

Hickory-Oak-Ash sites tend to be moister than in the other Dry Upland types. Where the soil is shallow over bedrock or a dense fragipan layer, groundwater pools near the surface in spring, restricting root growth to the upper unsaturated soil. During rain-free periods in summer, moisture availability is limited, due to the shallow rooting depth. This combination of wetness and droughtiness is likely an important factor favoring oaks and hickories, which can cope with seasonally varying moisture availability. A similar situation occurs in Oak-Beech-Hickory-Pine sites, although on slightly drier soils. Most of the sampled stands of Hickory-Oak-Ash were on level areas or slight slopes, on somewhat poorly drained but shallow soils, or on moderately well drained soils. One stand on a steeper slope had well drained soil. The surface soils of Hickory-Oak-Ash sites are usually mildly acidic (pH 5 to 6).

A stand at the Finger Lakes National Forest in summer, on level ground, with bare patches where shallow water pooled in spring.

Spinulose woodfern.

Spotted geranium.

Comments: Stands of the Hickory-Oak-Ash type occur over such a range of soil and site conditions, from shallow to deep soils, and somewhat poorly drained to well drained, that they appear to share few environmental conditions in common. In Tompkins County, a factor that the sites had in common was a history of severe human disturbance. Several of the Hickory-Oak-Ash stands showed evidence of heavy logging. Some appeared to have been grazed by cattle in the past. We were led to this conclusion from several lines of evidence: the stands were forested in the 1980s, but had barbed wire around the edges, and aerial photographs from the 1930s showed these sites had some trees but large areas of open meadow at that time. The land had never been plowed, however, since there were still "pits and mounds" on the ground, from trees that had fallen down and uprooted long ago. Letting livestock graze in farm woodlots was common in the region before the 1950s, in most of the upland forest types. Prolonged use by livestock opens up the ground layer due to browsing and trampling, and the soil compaction can also kill tree roots and thin the canopy. Opening up the canopy and ground layer may favor hickory over other trees. Prolonged grazing was probably more common on flat lands on the more nutrient-rich soils north of Ithaca. In the Hudson Highlands of eastern New York, forests dominated by white oak, black oak, and pignut hickory occur on abandoned pastures that were never plowed due to shallow, rocky soils.

However, the Hickory-Oak-Ash type may develop naturally, at least on some sites. In the notes made by the surveyors in the 1790s for places near the current Hickory-Oak-Ash sites we sampled, the original vegetation was generally Dry Upland forest. Oaks were the most frequent trees mentioned, followed by pines and hickory.

Stands intermediate in composition between Hickory-Oak-Ash and Mixed Oak are found in the region. Intermediates between Hickory-Oak-Ash and Sugar maple-Basswood-Ash, a Moist Upland type, occur occasionally on gentle slopes north of Ithaca.

Blue-stemmed goldenrod.

Compositional Stability in the Dry Upland Types

In the Dry Upland types of the region, a number of important tree species do not grow well as seedlings or saplings under a closed forest canopy. These include white oak, chestnut oak, the pines, and bigtooth aspen. Saplings of these species often appear to be too sparse to replace the overstory trees when those die. In contrast, saplings of sugar maple, beech, and hemlock are common in Moist Upland Forests, where they are dominant in the overstory. Seedlings of these shade-tolerant species can survive under a

closed canopy and grow even in small gaps formed when a single nearby tree dies. Sugar maple saplings often occur in Dry Upland stands, sometimes in high numbers. Will such sites shift toward a Moist Upland composition over time? It is clear from the records of the early land surveyors in the 1790s that oak and pine forests have long been an important component of the region's landscape. How have the light-demanding species maintained their dominance in the Dry Upland stands, given their requirement for large canopy openings in order to regenerate?

One possibility is that the current overstory trees established after large-scale natural disturbances that opened up the tree canopy. Large windfalls (blowdowns) occur every once in a while from strong thunderstorm winds and tornadoes. Several of the Dry Upland types occur on sites where blowdowns are likely. Tall trees on steep slopes, and on sites where rooting depth is shallow, are susceptible to windthrow. Canopy trees are also tipped over and broken by heavy snow or icestorms. On steep slopes, treefalls due to erosion and soil slumping can be frequent.

In the moist climate of the Finger Lakes region, fire is a less likely source of large forest openings than in other parts of North America. Forest fires have always been rare here, although a few fires have been recorded on hilltops and upper slopes. Land surveyors noted evidence of fires along Iroquois roads in the 1700s. We observed charcoal and charred stumps at a few sites in the 1970s. Oak seedlings resprout after fire, but several other species that are common in some Dry Upland types, notably beech, would not have survived a major burn.

During the past two hundred years, logging could be a factor helping to maintain the oaks, particularly in Chestnut oak stands. Some Mixed Oak stands, however, had large trees nearly 3 feet diameter in the 1970s, and these would have established before European settlement and widespread logging in the 1800s. Native American population levels were low across much of the region in the 1700s, and forest openings created by their tree cutting, fires, fields, and villages were limited. A history of both grazing and logging may have been involved in some Oak-Beech-Hickory-Pine and Hickory-Oak-Ash forests. There appear to be too few saplings of white oak, red oak, and white pine growing in these stands today to maintain their dominance. Livestock grazing in forests was a common practice in the region in the 1800s, which could have opened up the ground layer, allowing establishment of oak and pine after the stands were logged.

The low numbers of oak seedlings and saplings in many of the Dry Upland stands today may also reflect recent changes in animal abundance. Many acorns and oak seedlings are eaten by deer, rodents, and insects. Populations of white-tailed deer have greatly increased; perhaps oak regeneration was more common in the past.

However, oaks and pines can sometimes regenerate without major disturbance. In many Dry Upland stands, low soil moisture is likely the primary factor favoring these species over the Moist Upland tree species. Especially on the steeper sites of the Chestnut oak and Red cedar-Oak types, it is likely that extreme dryness and soil erosion are sufficient to keep the canopy open enough for occasional seedling regeneration.

Thus, both occasional severe windstorms and droughts have probably been important factors in maintaining oaks and other dominant species in Dry Upland Forests.

B. Moist Upland Forests (five types)

Moist Upland forests are frequent in the central Finger Lakes region. The Moist Upland types occur on sites with moderate levels of soil moisture (Figure 2, page 15) available for plant growth throughout most of the growing season. The prevalence of Moist Upland forest across the region, both now and in the 1700s before most of the land was cleared for farming, indicates that the climate and soils are conducive to the growth of species that are not drought-tolerant. The abundance of Moist Upland Forest in the Finger Lakes region contrasts with the dominance of oak forests to the south and east – closer to New York City, in southern New England, and across much of Pennsylvania.

Several of the Moist Upland types have a broad distribution across the landscape (Figure 3 on page 16, and Appendix II), ranging from flat upland areas to steeper sites, and on both southerly and northerly facing slopes. One type (Pine-Hemlock) is restricted to a particular situation near creek ravines. We have divided the Moist Upland forests into five types, but with the exception of Pine-Hemlock, these intergrade extensively. Consequently, large areas of the landscape are covered by forest which is less a mosaic of the several types, than a variable blend in which small changes in slope, soils, or history (such as logging) shift the composition toward one type or another. Intermediates are also common between a number of the Moist Upland and Dry Upland types (see Figure 2). Some intermediate stands occur in gorges, where the shelter of the ravine walls favors hemlock and birches (species of moist, cool sites), while the steepness makes water drain off rapidly, favoring the more drought-tolerant oaks typical of the Dry Upland types.

Sugar maple, hemlock, and beech are important tree species in the Moist Upland forest types. All three are long lived, and can survive as seedlings in the shade under the tree canopy. Saplings of other species typical of Moist Upland forest, such as red maple, white ash, red oak, and white pine, require more light. Such species are also common in Dry Upland forest (see Table 1, page 20). The canopy of Moist Upland forests is more dense than in many Dry Upland stands, and basal area is generally higher. Including understory species, the tree layer of Moist Upland stands generally has 9 or fewer woody species per tenth hectare, compared with 10 or more in Dry Upland forest. Stem density in the sapling layer is also lower in Moist Upland forest, often with 100 to 200 stems per tenth hectare, compared to averages of 300 to 500 in many Dry Upland stands.

The dense overstory in Moist Upland forests, along with competition from saplings in the understory, produces shady conditions unfavorable to many herb and shrub species. However, a number of northeastern forest wildflowers and ferns do well in such shaded, moist sites. Species diversity (including herbs, shrubs, vines, and trees) in Moist Upland forests is typically less than 40 species per tenth hectare. In comparison, diversity is often 50 to 70 species per tenth hectare in Dry Upland forests, Floodplain forests, and Swamp forests.

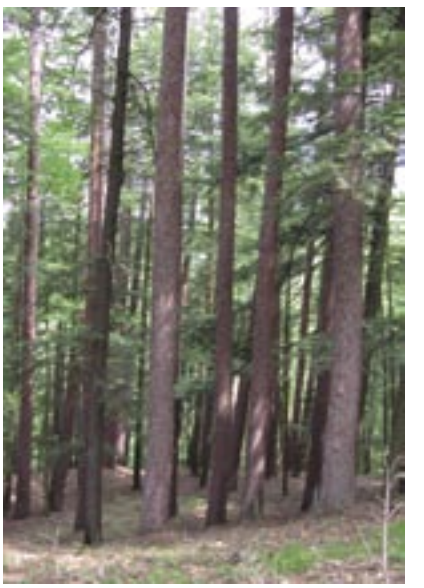
B1. Pine-Hemlock type

Composition: Forests of this type are among the most distinctive in the region, with a special character produced by a canopy dominated by large, tall, evergreen trees, which cast a cool, deep shade. This creates a very open understory, with a thick, springy layer of conifer needles carpeting the ground.

The dominant trees are primarily hemlock and white pine, or sometimes red pine. Those together contribute well over half the basal area. There are also a few hardwoods (non-conifers), especially red maple, red oak, white oak, or black oak. This results in a moderately diverse tree overstory, with 6 to 9 species of large trees (>6 inches in diameter) per tenth hectare in the sampled stands. The understory has few additional species, so the total average for the tree layer is 9 species per tenth hectare (as many as in some Chestnut oak and Mixed Oak stands). Other hardwoods such as white ash, sugar maple, basswood, or tulip tree are sometimes present. Hardwoods tend to be more abundant in the Pine-Hemlock stands that occur on soils that are more calcareous.

Pine-Hemlock stands are on deep soils in sheltered sites, where hemlock, pines, and hardwoods grow to large size. Basal area in the stands we sampled ranged from nearly 4 to over 7 m^2 per tenth hectare, or twice the average basal area of many Dry Upland stands. In the central Finger Lakes region, basal area is generally highest in upland forests that have a high proportion of hemlock. Also, the shade-tolerant,

Pine-Hemlock at Taughannock State Park.



Red pines and hemlocks at Robert H. Treman State Park.

Typical sparse ground layer.

From left to right, for cones, needles, and bark: white pine, red pine, and hemlock.

long-lived hemlocks fill in the subcanopy with medium to large diameter trees. White pine grows to large size on soils with good drainage, and where this species is dominant along with hemlock, basal area is extraordinarily high. The tree layer is less dense than in other upland forest types, with most stands having fewer than 80 stems per tenth hectare. The majority are large trees (>6 inch diameter), with about 5 trees per tenth hectare reaching >20 inches in diameter.

Tree canopy cover in Pine-Hemlock stands is dense, with an average of 90% of the sky obscured by foliage and branches. Beneath the well-spaced, massive trunks, the forest is relatively open, lacking the usual layer of saplings and shrubs, or the lush ground cover of herbaceous plants, that are typical of various other forest types. The density of shrubs and small trees is extremely low, averaging only 40 stems per tenth hectare in the sapling layer. Some stands have fewer than 10 stems per tenth hectare in the sapling layer. Saplings of the canopy tree species are very rare. Shrubs are almost absent from some stands, but on sites with more calcareous soils, scattered witch-hazel, flowering dogwood, and mapleleaf viburnum commonly occur.

The evergreen pines and hemlocks cast shade throughout the year, so Pine-Hemlock stands lack the spring ephemerals (wildflowers that die back by summer) found in several other Moist Upland types. The ground is usually nearly bare of herbs or small woody plants, with less than 3% cover in some stands, and about 20% cover in others. The barest stands have about 10 herb species, with the most common being Canada mayflower and partridgeberry. Additional herbs found in some stands include Christmas fern, white wood aster, broadleaf sedge, baneberry, and wild sarsparilla. On the more nutrient-rich sites there can be over 20 herb species per tenth hectare. The most common tree seedlings in the ground layer are red maple, white ash, black cherry, and red oak.

Despite a low diversity of herbs and shrubs, the total diversity is similar to other Moist Upland types, with an average of over 35 species per tenth hectare, due to the number of tree species.

Where found: Pine-Hemlock forests are uncommon in the region, being restricted to deep, well drained, coarse-textured soils. Often these occur along the upper edges of ravines, where stream deltas deposited sand and gravel long ago, when post-glacial lake levels were high. On topographic maps showing elevation contour lines, the areas appear as small, nearly flat terraces adjacent to the steep sides of the gorges, such as above Taughannock Creek. Above Enfield Creek at Treman State Park, Pine-Hemlock is on deep, coarse-textured glacial deposits that filled a former valley. Pine-Hemlock stands occur on level sites, or on steeper ground (30% to 70% slope) facing north to northeast. Typical positions are mid-slope, shoulder slope, or hilltop, from about 600 to 1000 feet in elevation. The type does not occur in the northern part of the region.

Most Pine-Hemlock stands are on gravelly loam soils; one we sampled was on sandy loam; in both cases the soils are deep and well drained. The surface soil can be infertile and very low in pH (around 4), since the litter of fallen pine and hemlock needles is acidic and causes the mineral nutrients to leach out of the upper soil layer. Some sites have surface soil that is less acidic (pH 5 to 6). Typically the layers deeper in the soil (2 to 5 feet below the surface), which the tree roots tap into, are much more calcareous (pH >6 and sometimes >7). On the diagram of the vegetation types (Figure 2), Pine-Hemlock has an intermediate position with respect to soil acidity, because of the influence on species composition and plant growth of both the deeper calcareous layers and the acidic surface soil.

Local historical accounts indicate that forests of pine and hemlock occurred extensively in the wide, glacially-carved valleys of the region during the 1800s. Coarse-textured soils from material deposited by glacial meltwater are common in those valleys. Such soils are excellent for agriculture, however, and were probably among the first areas cleared for farming. Thus, the type may have once been more common in the region, but the exact composition of those valley forests is unknown, since they are gone.

Christmas fern.

Partridgeberry flowers and fruits.

Comments: The environmental conditions conducive to the development of the type are restricted in area, but a number of well-developed stands have been preserved in the state parks of the region. The Pine-Hemlock type seems to be most closely related to certain subboreal forests of the Lake States, southern Canada, and higher mountains of the Northeast. The deep, gravelly soil on which the Pine-Hemlock type occurs in the Finger Lakes region is the only local soil that is as coarse-textured and well drained as the soils that predominate in regions where the type is more common. Although white pines can be abundant in many of our less well drained sites, such as on shallow soils over a fragipan layer, they grow taller and straighter, and attain larger diameters, on the deep, well drained soils of the Pine-Hemlock type.

In the Finger Lakes region, stands of the Pine-Hemlock type have few saplings, and not many seedlings, of any tree species. Browsing by deer may explain the lack of hemlock seedlings, since this species is shade-tolerant. White pine seedlings, however, rarely grow to sapling size in the shade of a closed forest canopy. In several stands of hemlock and pine in Pennsylvania and southern New England that were studied by forest ecologists, the co-dominance of white pine was attributed to large-scale disturbance in the past, such as fire, or storm winds blowing down trees. These openings in the canopy would have allowed pine seedlings to grow.

It thus seemed likely that most of the pines in our Pine-Hemlock stands had established following catastrophic disturbance. To investigate this, at two sites we collected small wood samples by boring into pine and hemlock tree trunks, and estimated tree ages by counting annual growth rings. At one site, a forest near the mouth of Taughannock Creek on Cayuga Lake, most of the pines and hemlocks dated from a short period between 1865 and 1877, indicating that something opened up the forest canopy in the 1860s. Storm winds blowing down many of the tall trees (*windthrow* or *blowdown*) is the likely explanation. In a nearby stand at Smith Woods in Trumansburg, blowdowns were observed in 1954 and 1989, and there was evidence of a similar event in the 1860s. Tree ages showed that after each blowdown, many tulip trees established at Smith Woods. Tulip tree seedlings, like white pine, do not grow in the shade. Annual growth rings in the hemlocks that survived the blowdowns showed a period of rapid growth after each canopy opening episode. Thus, there is evidence that a storm in the 1860s may have substantially opened the canopy of multiple forest stands west of Cayuga Lake, permitting regeneration of white pine and other tree species.

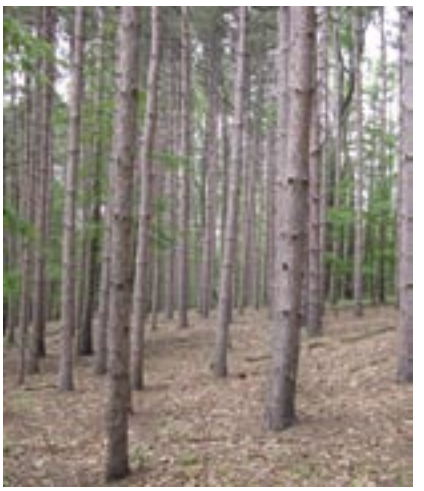
A large tree uprooted by strong wind, with a "tip-up" of roots and soil.

Other possible canopy-opening disturbances include ice storms or heavy snow, and fire. We did find a burned pine stump in one stand. If Pine-Hemlock forests had a fire origin, the fires must have been highly localized, since the stands are generally adjacent to the precipice of a gorge, and surrounded on the other side by moist forests that in this region do not burn. Possibly the current canopy trees in some stands grew after hemlock was logged for tanning bark during the 1800s, and in some cases the cut branches and logging residue left on the ground may have burned.

In contrast, at the second Pine-Hemlock site where we counted tree rings, the larger trees had established over a period of nearly a century, presumably in repeated episodes of canopy opening scattered through the stand.

The Pine-Hemlock type seems most closely related to the Mixed Oak type, because of the frequent occurrence of oaks in Pine-Hemlock stands, particularly white oak and black oak. Intermediates between the two types occasionally occur. Stands intermediate in composition between Pine-Hemlock and Chestnut oak also might be expected, because white pine, red pine, and hemlock are all found as secondary components in the Chestnut oak type. In fact, we sampled one such forest, dominated by those four species along with red oak and white oak, on a steep west-facing slope typical of the Chestnut oak type. Intermediates between Pine-Hemlock and Maple-Beech do not appear to occur, although the types are similar in soil moisture and acidity (Figure 2, page 15); in Pine-Hemlock stands beech and sugar maple are absent or sparse.

The red pine that is sometimes dominant in the Pine-Hemlock type is native to the region, but is much less frequent than white pine. Such stands can be distinguished from red pine plantations, which are more common today than natural Pine-Hemlock stands. Plantations occur in rectangular patches on poorer agricultural land on the hills in the State Forests, and on private land. Most were planted in the 1930s and never thinned or managed. In some plantations on poorly drained soils where the roots are shallow, by the 1990s many of the red pine trees were tipped over, by wind and ice storms. In contrast, red pines in natural stands of primary forest are typically larger, more widely-spaced, and well rooted in deep soil.



A plantation of red pines, about 70 years old.

B2. Sugar maple-Basswood-Ash type

Composition: The dominant species are sugar maple, basswood, and white ash, together making up 60 to 90% or more of the total stand basal area. Sugar maple is strongly dominant in some sites. Bitternut hickory is often abundant, and notably more frequent in Sugar maple-Basswood-Ash than in any of the other types. Less common are red oak, black cherry, beech, and shagbark hickory. Occasional stands have a few trees of hemlock, or butternut (which is not abundant enough in any of the types to be included in Table 1). Hop-hornbeam is found in most of the stands, but the trees are small and contribute little basal area.

Total basal area is moderate, generally around 3 m^2 per tenth hectare. The tree layer has low to moderate density and diversity, with about 90 woody plant stems and 7 species per tenth hectare. Density in the sapling layer is variable, ranging from less than 30 stems per tenth hectare to over 400 stems. The most common tree saplings are sugar maple, white ash, and sometimes black cherry. Sugar maple-Basswood-Ash forests generally have few shrubs. Choke cherry, buckthorn (a non-native species), alternateleaf dogwood, and red-berried elder are found in occasional stands. Virginia creeper vines are sometimes abundant.

Many spring forest wildflowers reach their peak abundance in the region in some of the stands. Lush patches of spring wildflowers can also be found in some Hemlock-Maple stands and occasionally in Maple-Beech forests, especially where the soil is high in nutrients and moist in spring. Wildflowers in the Sugar maple-Basswood-Ash type

A stand with numerous saplings.

From left to right: the winged, wind-dispersed fruits of basswood, sugar maple, and white ash.

that bloom in spring include the "ephemerals," whose leaves disappear by summer, such as squirrel-corn, spring beauty, Dutchman's-breeches, and toothwort. There are also spring-blooming herbs that stay green into the summer, such as white trillium, red trillium, jack-in-the-pulpit, blue cohosh, mayapple, sessile bellwort, and violets. Wild leek, which has ephemeral leaves but does not flower until summer, can be abundant in some sites. Other herbs found in some Sugar maple-Basswood-Ash stands include false Solomon's seal, enchanter's nightshade, herb-Robert, seersucker sedge, Pennsylvania sedge, garlic mustard (an invasive non-native), spinulose woodfern, and Christmas fern. Herbs that flower in late summer and early autumn include white wood aster, blue-stemmed goldenrod, and zigzag goldenrod.

Some sites are rich in ferns and other herbs, with at least 30 species per tenth hectare. Such stands have 30% cover of herbs in spring, but by late summer the herb cover is generally less than 10%. The herb layer at many sites, however, is not as lush. Overall, our Sugar maple-Basswood-Ash samples had an average of 21 herb species per tenth hectare, and 15% cover.

Tree seedlings are common in the ground layer of most sites. Sugar maple can form a layer of shade-tolerant seedlings and small saplings. White ash seedlings and seedlings or sprouts of basswood are also frequent. Other tree seedlings include bitternut hickory and hop-hornbeam. The sites we sampled had an average total cover in the ground layer (including tree seedlings, shrubs, and herbs) of 30% cover.

Dutchman's-breeches.

Spring beauty.

Blue cohosh berries.

White trilliums and red trilliums.

Zigzag goldenrod.

Where found: The Sugar maple-Basswood-Ash type is the most common of the primary forest types in the region. (Secondary, successional forests on abandoned farmland – Section G – are more abundant in the region today.) Sugar maple-Basswood-Ash is the principal type on all aspects and positions (level and sloped) of the gently rolling hills of Seneca, Cayuga, and northern Tompkins Counties. In the northern third of the central Finger Lakes region this type is everywhere, except in poorly drained areas, which have Hickory-Oak-Ash or wetland types.

The Sugar maple-Basswood-Ash type is less frequent on the slopes along the large lakes (Seneca, Cayuga, and Owasco), where oaks increase in importance, but the type can be found on gentle or moderate slopes facing south to west. South of Ithaca, stands occur on mid to lower concave slopes, and slopes with northerly exposure. The type is also common in gorges throughout the region, where it occurs mostly on lower slopes and southern to western aspects. It is also found in the bottoms of creek valleys on terraces, which are floodplain deposits that are no longer flooded.

The type is especially well developed on fertile, well drained soils. Surface soils are slightly acidic to neutral (pH 5 to 7). Because sugar maple leaves that drop to the ground in autumn tend to be high in nutrients, the surface soil can be enriched in calcium. The soils are generally well drained or moderately well drained. Although occasional stands occur on somewhat poorly drained soils, the type is not found in poorly drained valleys or depressions.

Sugar maple seedlings.

A Sugar maple-Basswood-Ash stand in early spring, at a site that is carpetted with wild leek ("ramps").

Violets.

Comments: The distribution of Sugar maple-Basswood-Ash can probably be explained by soil acidity, as the type is associated with less acidic (higher pH) sites. Both soil pH and the abundance of the characteristic species generally increase as one moves downslope in the southern part of the study area, or from south to north across the region. Similar correlations of soil pH with the importance of sugar maple, basswood, and white ash have been observed by others in southeastern New York and northern New Jersey. Near the climatic limit of white ash in the White Mountains of New Hampshire, that species is abundant only on the most nutrient-rich sites. Sugar maple, basswood, and white ash, along with tulip tree, are abundant on deep deposits of talus (rock fragments) at the base of the New Jersey Palisades, but in general, New Jersey forests on calcareous sites dominated by sugar maple have more canopy tree species than in our type.

In the 1790s, the type appears to have been frequent on the upland between Seneca and Cayuga Lakes. The surveyors noted forests that had "hard maple" (sugar), "linden" (basswood), and white ash, with lesser amounts of oak or hickory. The Sugar maple-Basswood-Ash type corresponds closely to a type described for New York State, called "Maple-Basswood Rich Mesic Forest." Sugar maple-Basswood-Ash also has a strong resemblance to the "Maple-Basswood" type of southern Wisconsin. For example, bitternut hickory is a common secondary species in both regions, and red oak and hop-hornbeam enter into the drier examples of the type in both places. Forests similar to our type have also been described in Connecticut.

Intermediates between Sugar maple-Basswood-Ash and Hemlock-Maple are common. There are also intermediates with Maple-Beech. Stands that are transitional between Sugar maple-Basswood-Ash and Hickory-Oak-Ash are frequent, especially to the north, which is not surprising since these two types occur on level sites that are moderately well drained and not too acidic. Such stands have too much sugar maple or basswood to be considered the Hickory-Oak-Ash type, and more red maple, red oak, or pignut hickory than the Sugar maple-Basswood-Ash type.

We sampled one stand intermediate between Sugar maple-Basswood-Ash and Red cedar-Oak. The stand was on high-lime talus and rock outcrops on the lower portion of a steep, south-facing, but very sheltered ravine wall. Red cedar, downy arrowwood, and fragrant sumac (species characteristic of the Red cedar-Oak type) were more abundant higher on the slope, whereas large basswood and white ash trees occurred near the bottom.

There are also transitional stands that are intermediate in composition between Sycamore-Cottonwood Floodplain Forest and Sugar maple-Basswood-Ash. Such forests develop over time along creeks in places that no longer flood, as discussed further in Section C, under Succession in Floodplains (page 61).

B3. Maple-Beech type

Composition: The dominant tree species are sugar maple and beech, together often making up more than half of the total basal area. Less frequently, white ash or red maple is an additional dominant. Sometimes beech is more abundant than maple; occasionally, sugar maple forms a nearly pure stand. Basswood may be moderately abundant. Red oak, black cherry, and bitternut hickory are minor components of some stands. Basal area is moderate, usually around 3 m^2 per tenth hectare. Diversity in the tree layer varied widely in our samples, between 2 and 10 species per tenth hectare, with an average of only 6 species. Diversity of large trees (>6 inches in diameter) was usually 4 to 6 species per tenth hectare.

In the sapling layer, sugar maple and beech are common and often abundant. Hop-hornbeam is sometimes abundant, striped maple is frequently present, and witch-hazel grows in some stands. Other species of small trees and shrubs are rare. In the ground layer, mapleleaf viburnum and choke cherry may be present. Seedlings of sugar maple and white ash, and seedlings or root sprouts of beech, are abundant. Black cherry, hop-hornbeam, or red oak seedlings occur in some sites. Cover of tree seedlings in the ground layer is frequently greater than the cover of low shrubs or herbs.

The herb flora is often species poor, with fewer than 15 herb species per tenth hectare in most stands. Jack-in-the-pulpit, spinulose woodfern, and beechdrops (a plant parasitic on beech roots) are the most common herbs. Canada mayflower is abundant in a few sites. Herb cover in most stands is typically less than 10%. In some sites this may be the result of competition from abundant tree seedlings and saplings, but in others few

A Maple-Beech stand at Fillmore Glen State Park.

Sugar maple.

American beech.

Sharp-lobed hepatica.

Striped maple, sometimes called moosewood.

The dark red flowers of wild ginger.

Jack-in-the-pulpit.

Beechdrops.

plants of any sort grow in the ground layer. However, a few sites we sampled had nearly 30 herb species. Many of the species mentioned under Sugar maple-Basswood-Ash also grow in some Maple-Beech stands. Spring-blooming wildflowers sometimes present include baneberry, hepatica, foamflower, wild ginger, trillium, and violets. Partridgeberry blooms in July. Late-summer wildflowers found in some stands include white wood aster, whorled aster, and blue-stemmed goldenrod. Seersucker sedge and Christmas fern occur in a few sites.

Total diversity in the Maple-Beech type averages about 26 species per tenth hectare, the lowest of all the forested types except Bog forests. The sites we sampled ranged from less than 15 species per tenth hectare to more than 50 species. Shrub species are notably few in the type.

Where found: The Maple-Beech type is widespread across the region, but is especially frequent in the southern half. It is characteristic of north- and east-facing slopes above 1000 feet in elevation. It is also found on gently sloping hilltops of any aspect, on low hills and coarse-textured glacial deposits in the major valleys, and elsewhere. Soils are acidic (usually pH 4.5 to pH 6), and well drained to moderately well drained. Occasional stands occur on somewhat poorly drained, broad level uplands.

Comments: Maple-Beech forests are found throughout New York State. Maple-Beech forests similar to those of the central Finger Lakes region predominate on well drained soils on the gently rolling land in southern Michigan, northern Indiana, and northern Ohio. The type is less common in the highlands of western Pennsylvania, where the climate is colder. In the Finger Lakes region in the land surveys of the 1790s, when forests covered almost all of the area, beech and maple were the two most frequently mentioned species.

In two classic studies of North American vegetation, Maple-Beech was mapped as the major forest type in the region south of Lake Ontario in western New York, and the area north of the Finger Lakes. We have found the Sugar maple-Basswood-Ash type to be much more common than Maple-Beech in the northern part of the central Finger Lakes region, but our Sugar maple-Basswood-Ash type would be included within the Maple-Beech category of the earlier studies. Although forests dominated by sugar maple, beech, and basswood also occur north and east of the Finger Lakes, for the most part these areas also have an abundance of species characteristic of cooler climates – such as yellow birch, paper birch *(Betula papyrifera)*, spruces (*Picea*), and mountain maple – so the type as we describe it is less common there. In particular, yellow birch is dominant along with sugar maple and beech in most hardwood forests in the Adirondack Mountains of New York, the Green Mountains of Vermont, and the White Mountains of New Hampshire. That type is often called "Northern Hardwoods."

Intermediate stands between Maple-Beech and other Moist Upland types are frequent in our region. Although the Maple-Beech and the Sugar maple-Basswood-Ash types represent consistent tendencies in the vegetation, at their most similar they are scarcely distinct. Similarly, in the Catskill Mountains of southeastern New York, beech, sugar maple, white ash, and basswood are correlated in their distributions, although beech and basswood tend not to occur together. Maple-Beech and Hemlock-Beech-Birch intergrade, as both are found on the slopes of narrow valleys south of Ithaca.

There is a noteworthy variant of the Maple-Beech type that is characterized by co-dominance of red oak. This variant is especially common on steep north- to east-facing slopes. There are also intermediates between the Maple-Beech type and two of the Dry Upland types (Figure 2): Chestnut oak and Oak-Beech-Hickory-Pine. Such stands occur south of Ithaca on steep sites: lower south- and west-facing slopes, and upper slopes facing north or east. Maple-Beech stands on moderately well drained soils are more likely to have red oak, white oak, pignut hickory, and other species of the Oak-Beech-Hickory-Pine type than are the more common stands on well drained soil.

In contrast, intermediates between Maple-Beech and Mixed Oak (which would

have black and white oak) appear to be rare, except on steep south- to west-facing slopes that do not face a major lake, north of Ithaca (category I.B.1.c in Appendix II). Since Maple-Beech and Mixed Oak differ in more than one major controlling environmental variable, namely aspect and acidity of the subsoil, intermediate conditions tend to favor other types, such as Hickory-Oak-Ash or Sugar maple-Basswood-Ash.

Beech bark disease will have major impacts on the Maple-Beech type. This disease is caused by fungi and an insect that damage the living bark, eventually killing the beech tree. Beech bark disease has been spreading across North America from the site of the insect's accidental introduction in Nova Scotia early in the 1900s. The disease reached the Finger Lakes region during the 1970s. Larger beech trees began dying in the 1980s, but few had died in our stands at the time we sampled. By the 1990s, many of the remaining large beech trees had lost their characteristic smooth, gray bark, which became lumpy and cracked. Beech trees in the region are continuing to succumb to the disease.

Beech will not be eliminated from the forests, since beech trees produce large numbers of root sprouts, especially when the main trunk is damaged. These small beech stems are less susceptible to the disease and can grow for decades. In Maine, where beech bark disease has been present since the mid-1900s, there are stands in their third wave of regrowth from deaths of the larger trees.

Over the next few decades, beech will continue to decline in dominance in Maple-Beech stands and other types where it is now common (Table 1, pages 20-21). Saplings and trees of the other species in the stands will grow to fill the gaps left by the deaths of the overstory trees, just as happened in Dry Upland forests when American chestnut was killed by the chestnut blight. Sugar maple, which is already abundant in the understory and canopy, is likely to increase its dominance in Maple-Beech stands. However, we expect the forests to remain essentially Maple-Beech type, still differing in composition of the canopy and ground layer, and in soil conditions, from Sugar maple-Basswood-Ash.

Beech normally has smooth gray bark.

A tree with beech bark disease.

A beech sapling that sprouted from a tree root.

B4. Hemlock-Maple type

Composition: This type is characterized by the co-dominance of hemlock with sugar maple and other tree species of the upland maple types. In some stands, tulip tree is one of the dominant tree species, and its presence along with hemlock is highly indicative of the Hemlock-Maple type. However, tulip tree is absent from many stands, being at the northern limit of its range in New York State.

Other common trees in the Hemlock-Maple type include beech, white ash, basswood, and sometimes red oak. Red maple, hop-hornbeam, black cherry, yellow birch, or bitternut hickory can be present as well. Cucumber magnolia grows in a few sites, but with just a few trees per stand; the species is also occasionally found in Sugar maple-Basswood-Ash and other types. The overstory in Hemlock-Maple stands sometimes has a high diversity, with 10 species of large trees (>6 inch diameter) per tenth hectare, but most stands have 5 to 7 large tree species. There are usually few additional species in the understory, so the total diversity in the tree layer averages only 9 species per tenth hectare. Basal area and canopy cover are high, as in the other upland hemlock types, with an average basal area of nearly 4 m^2 per tenth hectare, and 90% canopy cover.

Density in the sapling layer is moderately low, with an average of 190 stems per tenth hectare. The most common tree saplings are sugar maple, beech, and hemlock. There are very few small woody species. Most stands have less than 5 species of shrubs and vines per tenth hectare. Witch-hazel, striped maple, and mapleleaf viburnum occur occasionally. Alternateleaf dogwood, Canada yew, and red-berried elder are seen even less often. Mountain maple, a northern shrub indicative of cool climatic conditions, is present in some ravine stands of Hemlock-Maple (and some ravine stands of Hemlock-Beech-Birch). Common tree seedlings in the ground layer are sugar maple, beech, white ash, and black cherry.

The flower and leaves of tulip tree.

A Hemlock-Maple stand.

Herbs are often abundant and diverse, with an average of 21 species per tenth hectare. Some stands are quite rich, with 30 to 40 herb species per tenth hectare. Many of the same herbs can also be found in the Sugar maple-Basswood-Ash and Maple-Beech types. The most common herbs in Hemlock-Maple forests are partridgeberry, Canada mayflower, and spinulose woodfern. Jack-in-the-pulpit, hepatica, Christmas fern, false Solomon's seal, foamflower, trillium, and violets are often present. Species found at some sites include baneberry, wild ginger, blue cohosh, and other spring-blooming wildflowers, and spring ephemerals that disappear by summer, such as squirrel-corn, spring beauty, and toothwort. Other herbs that are sometimes present are seersucker sedge, shining clubmoss, and zigzag goldenrod. Some sites we sampled had a lush herb layer, with 30 to 60% cover; others had few herbs, and less than 10% cover.

Total plant diversity is moderate, with an average of 37 species per tenth hectare.

Foamflower.

Squirrel-corn.

Shining clubmoss.

Canada mayflower.

Where found: The Hemlock-Maple type is found mainly in locations with cool microclimates. The type is especially common in narrow creek valleys north of Ithaca, where it occurs on a range of aspects and positions, but it is also common on lower slopes of gorges from Ithaca southward. In addition, it sometimes occurs on north- to east-facing slopes of wider valleys, especially north of Ithaca. The type is best developed, and has the lushest herb layer, on ancient terraces above major creeks. The terraces are former stream deposits that have not been flooded for several thousand years, once the

creek cut deeper into the valley. Stands of the type occur near Fall Creek, Buttermilk Creek, Enfield Creek, and Taughannock Creek, as well as farther north near Moravia (south of Owasco Lake), and elsewhere.

Soils are usually well drained. The pH of the surface soil varies among sites, from strongly acidic (pH 4) to neutral (pH 7), with most stands between pH 5 and 6. Most sites have moderate to high lime below the surface. The surface soil may be enriched with calcium by the tree leaf litter, especially where tulip tree and sugar maple are abundant.

A lush mix of spring herbs, in a stand near Six Mile Creek.

Comments: The Hemlock-Maple type is the closest approximation in our region to what ecologists have described as "Mixed Mesophytic" (moist) forest. Although diversity of canopy species in the Hemlock-Maple type is high relative to some of our other types, our forests are less diverse than the Mixed Mesophytic forests of the unglaciated portions of western Pennsylvania. Our type lacks species that do not reach northward into central New York (such as yellow or sweet buckeye, *Aesculus flava*), and our Hemlock-Maple type is less diverse in oaks and hickories than most Mixed Mesophytic forests farther south. Forests similar to the Hemlock-Maple type occur in New Jersey, on steep, north-facing, slopes with calcareous soils.

Tulip tree, which is indicative of the Hemlock-Maple type but absent from most stands, is found from the Mississippi eastward, north as far as southern New England. Its range extends across New York along Lake Ontario, and down into the central Finger Lakes region, but not into the higher elevations of southern Tompkins County. Unlike sugar maple, beech, and hemlock, which have seedlings that can survive in the shade under a forest canopy for many years, tulip tree has seedlings that are not shade-tolerant, but which grow rapidly in large openings such as areas of tree blowdown.

Stands that are intermediate between Hemlock-Maple and either Hemlock-Beech-Birch or Sugar maple-Basswood-Ash can be found in the central Finger Lakes region. Hemlock Swamp stands, in contrast, lack the well drained soils and many of the characteristic species of the Hemlock-Maple type, and these two types do not intergrade.

B5. Hemlock-Beech-Birch type

Composition: The dominant trees are some mixture of hemlock and beech, along with red maple or sugar maple, and yellow birch or black birch (also called sweet birch). Usually hemlock and beech are the most abundant tree species, often contributing over three-quarters of the total basal area. Sugar maple is much less abundant than it is in the Hemlock-Maple type, and red maple is more common than in that type. Of the two birches, yellow birch is more frequent in the Hemlock-Beech-Birch stands that are cool and moist, such as in low areas prone to frosts due to cold air settling into a hollow, or on ravine slopes. Yellow birch often grows along wet areas within stands, while black birch is usually in better drained places. Many stands have both birch species.

Overstory diversity is low, with only 4 or 5 species of large trees (>6 inches in diameter) per tenth hectare in most stands. Including smaller stems, diversity in the tree layer averages only 7 species per tenth hectare. Some stands have black cherry, white ash, or red oak. Total basal area is high, about 4 m^2 per tenth hectare, but not as high as in some Pine-Hemlock stands. Density is generally moderate in the tree layer, averaging 100 stems per tenth hectare.

Density in the sapling layer is low, from less than 5 to about 250 stems per tenth hectare, with an average of 140. Beech saplings are the most abundant, followed by hemlock, and in some sites, sugar maple. Shrubs and small tree species are rare. Striped maple and mapleleaf viburnum occur in some sites.

Several of the herbs in the Hemlock-Beech-Birch type have a predominantly northern distribution, in keeping with the north- to east-facing slopes and shady ravines where the type occurs. Canada mayflower is the most common of these; bluebead and northern woodsorrel are found in a few sites. Partridgeberry, white wood aster, spinulose woodfern, and Christmas fern are frequent. Two species that lack green chlorophyll – beechdrops and Indian pipe – are often present. Herbs found in some sites include wintergreen, New York fern, blue-stemmed goldenrod, Indian cucumber root, and hepatica.

Yellow birch: thin, golden, peeling bark.

Black birch: darker,with thicker plates.

A stand of the Hemlock-Beech-Birch type.

In the dense shade of the hemlock trees, ground cover is nearly as low as in Pine-Hemlock stands. The Hemlock-Beech-Birch samples ranged from <5% to about 25% cover in the ground layer. Beech and hemlock are the most common tree seedlings in the ground layer. Shrub and vine diversity is extremely low, with only 1 to 5 species per tenth hectare. The cover of shrubs and herbs is particularly low, together totalling <5% cover at most sites. Herb diversity, however, is moderate, with an average of 20 species per tenth hectare.

Northern woodsorrel.

Indian pipe.

Bluebead, which has blue berries in summer.

Where found: The Hemlock-Beech-Birch type is found extensively in gorges and small sheltered creek valleys, but also occurs around the margins of swamps, on broad uplands south of Cayuga County, and occasionally elsewhere. Northern and eastern slope exposures, which are cooler and moister, are the most frequent, although Hemlock-Beech-Birch does occur on all aspects, as well as level sites. Among the places where the type is found are stands near Six Mile Creek, Taughannock Creek, Paine Creek south of Aurora, McCorn Creek in Chemung County, and on Eastman Hill in Danby State Forest.

Soils are usually well drained, but occasional stands occur on poorly drained soils. The type is more common on the acidic soils of the southern half of the region (pH 4 to about 5.5).

Comments: Two of the most indicative species of the type, hemlock and yellow birch, increase in importance north and east of our region; their ranges extend into the Adirondacks and mountains of northern New England, and into southern Canada. In the central Finger Lakes region these species are most common on north-facing slopes, and in low-lying locations where cold air accumulates. In a study in Wisconsin, upper slopes had higher air temperatures than the sheltered lower slopes where hemlock grew, and measurements of photosynthesis showed that hemlock seedlings did better in cooler temperatures. In New Jersey, forests dominated by hemlock are mainly on north-facing slopes of deep valleys.

Due to shallow rooting and thin bark on the young trees, hemlock is generally regarded as highly sensitive to fire, and ecologists in New England have attributed the distribution of hemlock in ravines and edges of swamps to protection from fire. However, in central New York wildfires have been uncommon and mostly restricted to ridgetops, yet hemlock follows the same distribution pattern in both regions. The small,

delicate seedlings of hemlock have difficulty emerging through forest leaf litter; as a result seedling establishment occurs primarily on mossy rotting logs, or on steep, north-facing ravine slopes where leaf litter does not accumulate and the germinating seeds stay moist. In the northern part of its range, hemlock is found on well drained soils kept reliably moist by climate, high water table, or seepage. The ravines, where hemlock is most commonly found in the central Finger Lakes region, are lined with seeps and stay moister due to the cooling effect of shade from the gorge walls. Such environments may similarly favor establishment of the small-seeded yellow birch. Yellow birch appears to be near its climatic limit in the central Finger Lakes region – even in the most favorable sites most individuals are small and poorly formed.

Prop-rooted yellow birch and hemlock. The seedlings originally established on a rotting stump.

Stands similar to our Hemlock-Beech-Birch type have been described from a valley southwest of Albany, New York, on an east-facing slope and ravine bottom in coastal Connecticut, in ravines and on north-facing slopes in northern New Jersey, and in some old-growth stands at mid elevations in central and western Massachusetts. Hemlock-Beech forests also occur elsewhere on the Allegheny Plateau of New York and Pennsylvania, though not necessarily with the same associated species. In the Catskill Mountains of New York, hemlock, yellow birch, black birch, red maple, and striped maple form a cluster of species with correlated distributions. In the the Allegheny National Forest of northwestern Pennsylvania, beech and hemlock together constituted over 60% of the trees prior to European settlement, and Hemlock-Beech forest similar to ours is the most common type in the old-growth stands there today. Hemlock-Beech was also the principal forest type originally present in much of northwestern Connecticut. Most of these New England and Northeastern stands of hemlock and beech have many of the same herbaceous species that are frequent in the Hemlock-Beech-Birch type of the central Finger Lakes region, such as Canada mayflower and partridgeberry.

In the Finger Lakes region, there is a variant of the Hemlock-Beech-Birch type that has notable amounts of red oak. Such stands can be found on some north- to east-facing cliffs along the larger lakes. Intermediates between Hemlock-Beech-Birch and Maple-Beech or Hemlock-Maple occur. However, Hemlock-Beech-Birch and Hemlock Swamp do not appear to intergrade, despite having hemlock, yellow birch, and red maple in common. Beech is not flood tolerant, and the black ash of Hemlock Swamp is a wetland species.

C. Floodplain Forests (one type)

The main kind of Floodplain Forest in the region is the Sycamore-Cottonwood type. These lowland forests occur in valleys along the major creeks. Floodplain Forest soils tend to be coarse sands and gravels that are well drained, but tree roots easily reach the ground water, so moisture is available throughout the year. Floods are primarily seasonal, in spring after snowmelt, but can occur after major rain storms at other times. The floods do not normally last long, nor do they occur every year. This contrasts with the more prolonged periods of saturated soil in the wetland types (Sections D, E, and F of the book).

C1. Sycamore-Cottonwood type

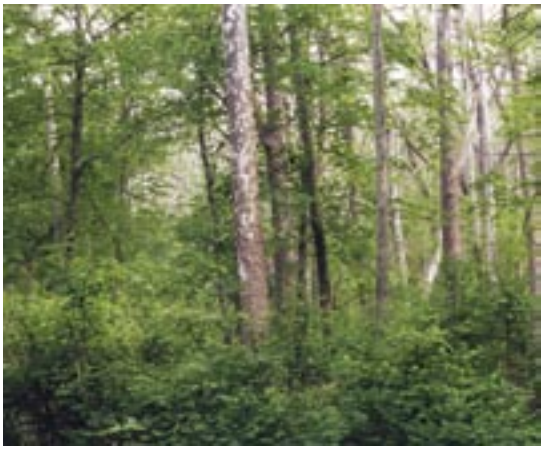
Composition: Sycamore and cottonwood are the dominant tree species of the type (Table 1, page 21). These are large, fast-growing trees that in our region are essentially restricted to streamsides and lake edges. Both species need an ample supply of water for tree growth, but their roots need to be well aerated in summer, and would be killed by prolonged flooding. Seedlings of cottonwood and sycamore require sunlight, and establish best in moist bare ground, such as silt or gravel deposits left by floods.

Composition of the canopy varies from almost pure sycamore to nearly pure cottonwood, with the two together usually making up 50% to 90% of the basal area. Overstory diversity is about 5 species of large trees (>6 inches in diameter) per tenth hectare; the tree layer as a whole has an average of 12 woody species. Other common trees include white ash and basswood. Willow trees (mostly white willow, a European species) are sometimes present. Large dead trees and fallen logs of American elm indicate that this species was important in the past, prior to disease epidemics. The trees in Sycamore-Cottonwood floodplain forests commonly grow to large diameter, but

Sycamore bark (left) and cottonwood.

Sycamore ball (above) and cottonwood catkin (below), and the fluffy seeds of each (right), which are dispersed by wind and water.

Honeysuckle in the shrub layer.



A patch of dame's rocket.

average density in the tree layer is only 70 stems per tenth hectare. Therefore, basal area is usually moderate, about 3 m^2 per tenth hectare, as is canopy cover (about 80% cover). The structure of Sycamore-Cottonwood forests is distinctive, with a discontinous canopy of large, tall trees above a layer of shrubs and small trees. At some sites, abundant vines grow up into the canopy – Virginia creeper, poison ivy, or riverbank grape form tangled knots and festoon the trees.

In the understory, boxelder is often abundant. This maple species has compound leaves with leaflets that resemble poison ivy, but which are usually in sets of five rather than threes. Boxelder in the region is virtually restricted to this type, and other disturbed areas near streams. The most common tree saplings are white ash and American elm. Sycamore and cottonwood are not present in the sapling layer. Common shrubs include non-native privet and honeysuckles, and the native choke cherry, alternateleaf dogwood, nannyberry, and common elderberry. Clumps of black raspberry are also frequent.

Flood periods are usually brief but can be destructive, leaving bare ground, nutrient-rich mud, and gravel deposits, which are colonized by weedy herbs that also grow in fields or other disturbed areas. Examples are yellow woodsorrel and white avens, and two non-native herbs, dame's rocket and ground ivy. In addition, Sycamore-Cottonwood stands have species also found in nutrient-rich Moist Upland Forest soils, such as zigzag goldenrod, jack-in-the-pulpit, enchanter's nightshade, and violets. Wetland herbs, such as pale touch-me-not, ostrich fern, and clearweed, grow in the wet depressions of former stream channels. Wood nettle, which has stinging hairs, occurs in some sites.

Herb cover varied from <10% to >60% cover in the sampled stands, which is lower than in Swamp or Open Wetland types. The Sycamore-Cottonwood sites with lower herb cover had higher cover of shrubs and tree seedlings in the ground layer. The most common tree seedlings are cottonwood, white ash, sycamore, and American elm. Total species diversity is 40 to 80 species per tenth hectare, similar to Dry Upland forest and the Swamp types. Some sites have more woody species than herbs; in other sites, herb species are more numerous.

Where found: The Sycamore-Cottonwood type develops on recent stream deposits, mainly gravelly, but sometimes also finer sandy or silty sediments. The type is found in active floodplains, such as in level areas along Salmon Creek, Six Mile Creek, and at Monkey Run on Fall Creek. Stands are below 1000 feet in elevation.

The type also occurs on some stream deltas along the lakes, but these sites have been highly disturbed by human activity. The compositional tendencies are still apparent in a few places, such as at Myers Point on Cayuga Lake.

Soils are usually very rocky and well drained, but ground water 1 to 3 feet below the surface makes moisture availability high. The surface soil of Sycamore-Cottonwood sites in the central Finger Lakes region is generally near neutral to high-lime (pH 7 to 8), because calcium and other bases are leached by rainwater from the uplands into the stream water, and many creeks in our region drain areas with lime-rich bedrock.

Herbs on gravel deposits.

Comments: Although occasional mixed stands of sycamore and cottonwood occur elsewhere, it is likely that in the Northeast this type is an important feature of floodplain forests only in central and western New York. Sycamore's natural range does not extend into the Adirondacks or the uplands of New England much past the northern border of Massachusetts. The range of cottonwood is primarily midwestern, extending into the Northeast only along Lake Ontario and the Finger Lakes, and along major river valleys such as the Hudson and Connecticut Rivers. Cottonwood is absent across much of Pennsylvania and New England. Thus, central New York is the primary region where the two species occur together, on gravelly stream deposits.

Floodplain vegetation outside the region has somewhat different dominant species. To the south and in Ohio, river birch (*Betula nigra*) becomes a major element in floodplain vegetation. In southern New England, the floodplain forests have sycamore and American elm, while cottonwood and willows are dominant on the sandbars and sandy banks. In floodplain forests in western New York, the major species are sycamore,

cottonwood, black willow, and silver maple, but not necessarily together in the same stands. In western New York floodplains, a Sycamore-Elm-Butternut type has been described, and a type with cottonwood and black willow. Shrubs, boxelder, and woody vines in such stands produce a dense mass of vegetation similar to that found in the creek bottom forests of the central Finger Lakes region.

As in our region, floodplain forests in Connecticut and elsewhere often have a notably high density of vines. Vines may grow well in floodplains because their roots can easily reach the ground water, allowing them to supply their large canopies of foliage through relatively small stems.

Fall Creek in flood.

Young sycamores on a gravel bar along Six Mile Creek.

Succession in Floodplains

Young sycamores and cottonwoods become established on recently deposited gravel bars along the larger creeks of the region. Sycamore establishes well on gravel, whereas cottonwood establishes in the pockets of wet sand and silt. Such colonization is the first stage in the development of forests of the Sycamore-Cottonwood type. By the time sycamores and cottonwoods have formed mature forest, in a hundred years or so, further stream deposition has built the bar into a higher terrace that floods less often. During this later period, young trees of Moist Upland Forest, particularly sugar maple, basswood, and white ash, as well as many shrubs, establish in the understory. As the forest ages, the relatively short-lived cottonwood trees die and are replaced by the Moist Upland species, provided the terrace is high enough that it does not flood too often.

At this point the forest is similar to the Sugar maple-Basswood-Ash type but with large sycamore trees, and many shrubs and vines. Young sycamores occur occasionally in these forests, but the trend over time seems to be toward a forest similar to the Sugar maple-Basswood-Ash type. Although we have located a few stands of the Sugar maple-Basswood-Ash type in creek floodplains, such stands are rare, probably because trees are periodically killed during catastrophic floods that allow the floodplain species to regenerate.

In creek terrace stands that are transitional between Sycamore-Cottonwood and Sugar maple-Basswood-Ash, a number of plants that are otherwise uncommon in the region can be found, particularly where temperatures are milder due to the proximity of a major lake. Such species include hackberry, red mulberry, Kentucky coffeetree, the shrubs bladdernut and ninebark, and moonseed (a vine). Also occasionally present are two species that have spread from planted trees: black locust (native to Pennsylvania and farther south), and white mulberry (originally from Asia). Two native trees in our area, butternut and black walnut, reach their maximum natural abundance on such former floodplain terraces, although black walnut is also common in abandoned farm fields in the northern third of the region. The herbaceous vegetation in such creek terrace forests has similarities to that of Sugar maple-Basswood-Ash forests on slopes, but generally is even richer in spring and summer wildflowers.

A transitional stand near Six Mile Creek, developing through natural succession from Sycamore-Cottonwood to Sugar maple-Basswood-Ash.

D. Swamp Forests (two types)

Swamp forests in the central Finger Lakes region develop on level to concave landforms with poor soil drainage. They occur in a variety of positions, ranging from lowlands around lakes to depressions on broad uplands (see Figure 3 and Appendix II). Swamps often occur at *drainage divides* – level areas that are between two creek or river drainage networks, which as a result are poorly drained. Unlike Upland Forest types, where slope steepness and aspect influence species composition, the distinction between the two Swamp types is associated with differences in water level fluctuations and microclimate. Some Swamps are flooded year-round; others are flooded only for a few months each year, but the ground remains saturated much of the time. The term "swamp" refers generally to any forested wetland, as opposed to marshes and other wetlands with few or no trees. Wetland forests on acidic peat are discussed in Section F: Bogs.

Important tree species of Swamp Forests (Table 1, page 21) in the region include silver maple, red maple, and hemlock. Hemlock also grows in Moist Upland stands and in Bogs. Silver maple is essentially restricted to Swamps here, although it is common in river floodplains farther south and west, and occurs in the Seneca River floodplain north of the Finger Lakes. In contrast, red maple is frequent in a wide range of our types, from wetlands to Dry Uplands (Table 1).

Basal area and tree density is low in some stands. Since some of the best developed Swamp Forests have basal areas of 3 to 4 m^2 per tenth hectare, the low basal area of many others may be due to slow recovery following cutting, or recent tree deaths (such as American elm). Some Swamps, however, seem to be naturally more open. Herb cover, especially in sites with less tree cover, is higher in Swamps than in Upland Forests, but not as great as in marshes. Water level fluctuations presumably affect tree abundance. In addition to natural annual cycles in water depth, human activities affect water levels on longer time scales, through dam building or alterations in drainage regime. Beavers also make dams, which flood low-lying areas for several years or more. Once their preferred tree species have been depleted, the beavers usually leave, the abandoned dam breaks, and water levels recede.

American elm was formerly an important species in Swamp Forests. By the late 1900s, most of the large elm trees in the region had been killed, by Dutch elm disease and by elm yellows. Black ash, another wetland tree, has also declined in abundance. Many of the swamps noted in the original land surveys of the region in the 1790s were called "black ash swamp," and over 3% of the witness trees marking the corners of the surveyed lots were black ash. That value is remarkable in that swamps covered only a small portion of the area, and today a black ash larger than 6 inches in trunk diameter is unusual. Black ash was also once important in the swamps of western New York, but by the 1890s, a botanist noted that black ash, which had outnumbered the other swamp species, had been replaced by American elm and maples. Similar losses of black ash occurred in Wisconsin and Ohio, possibly due to changes in water levels, tree harvesting for basket weaving, disease, or other factors.

D1. Hemlock Swamp type

Composition: In the Hemlock Swamp type, dominance is shared among hemlock, red maple, and yellow birch. Stands vary in the extent to which one or another of these three is dominant. Occasionally a few white pine trees are also present. American elm was formerly a major species as well, and a few trees still occur in some sites. Balsam fir, a more northern species that is quite rare in the region, occurs in a few Hemlock Swamps. Total tree basal area is low to moderate (2 to 3 m^2 per tenth hectare), in contrast to the Moist Upland hemlock types, which often have basal areas greater than 4 m^2 per tenth hectare. Density in the tree layer of Hemlock Swamps is high, with an average of 120 stems per tenth hectare, second only to Red cedar-Oak (a Dry Upland type). Diversity is somewhat low, with an average of 8 woody species per tenth hectare in the tree layer, which is similar to Moist Upland forest.

The sapling layer in the Hemlock Swamp samples ranged from <10 to >500 stems per tenth hectare. Black ash is usually abundant as an understory tree or sapling, and American hornbeam occurs in most stands. Yellow birch and hemlock are also common in the sapling layer. Common tree seedlings in the ground layer include black ash, white ash, red maple, yellow birch, and hemlock.

Shrubs are abundant and often quite diverse. The most frequent are witch-hazel, common elderberry, speckled alder, Canada yew, northern arrowwood, spicebush, and winterberry. Additional shrubs found at some sites include red osier, highbush blueberry, poison sumac, and gray dogwood. Poison ivy vines are frequent.

Vegetation in the ground layer is lush, often with more than 80% cover. Herb diversity in the Hemlock Swamp samples ranged from 30 to 80 species per tenth hectare. The herb layer is differentiated into two distinct phases. Moss-covered hemlock roots and fallen logs create mounds, which provide a moist place where herbs that are not

A Hemlock Swamp.

Skunk cabbage.

tolerant of prolonged flooding can grow, perched above the water-saturated muck. Many of the flood-intolerant herbs in Hemlock Swamps are common in northern and montane habitats, including spinulose woodfern, goldthread, Canada mayflower, northern woodsorrel, foamflower, and violets. The presence of these species on mounds that are only 4 to 12 inches above the muck indicates that episodes of deep flooding are infrequent and brief. Between the root mounds, the wet muck supports a thick growth of flood-tolerant herbs, often exceeding 5 feet in height. Examples are spotted touch-me-not, various sedges (*Carex* species), ferns (sensitive fern, cinnamon fern, crested woodfern, and marsh fern), northern bugleweed, skunk cabbage, willowherb, fowl mannagrass, dwarf raspberry, mad-dog skullcap, beggarticks, and fragrant bedstraw.

Total species diversity is high, ranging from 40 to over 100 species per tenth hectare in the sites we sampled. Species of herbs far outnumbered tree and shrub species in every stand, with an average of 48 herb species per tenth hectare.

Goldthread and Canada mayflower on a moss-covered tree root mound.

Cinnamon fern, a flood-tolerant species.

Where found: Hemlock Swamp is the principal kind of swamp forest in the southern half of the study area, but is rare in the northern half. It commonly occurs in valleys on level ground at drainage divides between two stream networks. Examples of these are Michigan Hollow between Michigan Creek and Buttermilk Creek in Danby, and the wetland north of Freeville between Fall Creek and the stream leading to the Owasco Inlet. The type also occurs in depressions on broad uplands. Both valley drainage divides, and upland depressions, receive cold air drainage from adjacent slopes. The type is absent from low-elevation wetlands near the larger lakes (Seneca, Cayuga, and Owasco) where Red/Silver maple Swamps and Cattail marshes occur. It also is absent from the margins of smaller lakes (such as Cayuta), but can occur nearby.

Hemlock Swamps occur in a restricted elevational range, with all known stands between 1000 and 1500 feet in elevation. Because these swamps are relatively high in the landscape and have some outlet for flood waters, it seems likely that water level fluctuations are minimal. Soils are slightly acidic to neutral (pH <6 to nearly 7), and usually very poorly drained. Most have a surface layer of muck, formed from incompletely decomposed dead plant parts, that is an inch to several yards thick.

Comments: The tree canopy in the Hemlock Swamp type is dominated by hardwoods, primarily red maple and yellow birch, along with hemlock, a conifer. This is similar to a type that has previously been described in New York State as "Mixed Conifer and Hardwood Swamp Forest." The author who described that type considered it to be transitional between the northern conifer swamps of the Adirondacks and the predominantly hardwood swamps of the mid-Atlantic coastal plain. In addition to the mixed tree composition in our Hemlock Swamp type, there is also a combination of northern herbs (such as goldthread and Canada mayflower) with species that are abundant in swamps of the Southeast, such as smallspike false nettle. The intermediate nature of the Hemlock Swamp type between northern conifer swamps and coastal hardwood swamps is also supported by the geographic distribution of the type, which is largely confined to central New York. It is possible that this distinctive wetland type is more widespread but in studies of other regions it may have been merged with upland forests. For example, one ecologist described a swamp forest similar to our Hemlock Swamp type but included it in his Hemlock-Northern Hardwoods type.

Beggarticks.

Spicebush berries.

Mad-dog skullcap.

Intermediates between Hemlock Swamps and Moist Upland forests in our region are infrequent but can be found. On poorly drained, high-lime (pH 7.6), fine-textured soil in the bottom of a small glacially carved valley, we sampled a stand almost exactly intermediate between Hemlock Swamp and the Sugar maple-Basswood-Ash upland type. Had the site been slightly wetter it would probably have been a typical drainage-divide Hemlock swamp. Curiously, although the Hemlock-Beech-Birch upland type is similar to the Hemlock Swamp type in dominant species, we have not found stands intermediate between those two. They sometimes occur side by side at the margin of wetlands, but the transition is quite abrupt with, for example, beech absent from the organic wetland soils, and black ash absent from the better drained upland.

D2. Red/Silver maple Swamp type

Composition: These swamps are characterized by a nearly pure overstory of red maple, silver maple or, quite commonly, an apparent hybrid of the two species. Hybrids, sometimes called Freeman maple, have leaves with moderately deep lobing and seeds of intermediate size. Which of these maples is dominant does not seem to correlate with composition of the understory or ground layer, or with easily measured attributes of the environment. Usually the canopy is quite open, but there is much variation. Basal area in the Red/Silver maple Swamp samples ranged from 1 to 5 m^2 per tenth hectare. Some sites had a number of large standing dead trees of various species. Density in the tree layer is often less than 60 stems per tenth hectare.

Tree deaths in swamps can occur due to changes in water depth, but in addition, many of the region's Red/Silver maple Swamps formerly had substantial American elm populations, which died in the 1960s and 1970s due to disease. The trunks of dead American elm trees can be identified by breaking off a piece of bark, if any is left, to look for the diagnostic dark and light layers. Smaller young elms are still present in most of the swamps. In a number of sites the maples also seem to have suffered a decline in vigor and are dead or dying, perhaps due to recent changes in water levels. Deaths of multiple elm or maple trees have led to an increase in abundance of shrubs in many sites. We also found three sites that were once Red/Silver maple Swamp forests, but extreme dieback of the overstory trees had left them as open shrub thickets, dominated by buttonbush, a wetland shrub species.

A lush ground layer of ferns and skunk cabbage.

From top to bottom, the leaves, and the seeds, of: red maple, hybrid, and silver maple.

Bark of a live American elm.

A piece of American elm bark cut in cross-section, showing the diagnostic "layer cake" of light and dark bands.

Diversity in the tree layer is low, with an average of only 5 woody species per tenth hectare. Often there are only 2 or 3 species of large trees (>6 inches in diameter). Deep inundation during flood periods may exclude all but the most flood-tolerant tree species. White pine occurs in some sites. Oaks in our region are primarily trees of upland forests, but two wet-site species can be found in some Red/Silver maple Swamps: bur oak and swamp white oak.

Red/Silver maple Swamps vary in composition, from those characterized by the presence of yellow birch and black ash, to others that lack yellow birch and usually have green ash instead of black ash. Along with that pattern of variation in tree composition among sites, there is also some variation in the ground layer species.

In contrast to the sparse tree layer, the layer of saplings and shrubs in maple swamps can be dense, often with 500 stems per tenth hectare. At some sites there is a nearly continuous thicket in the understory, with 1000 or more stems per tenth hectare. The most common shrub species are winterberry and northern arrowwood. Spicebush, speckled alder, highbush blueberry, and red osier are also frequent. Vines of poison ivy and Virginia creeper are common; riverbank grape is less abundant. The most common saplings are red maple, silver maple, and the hybrid, but these are absent from many sites.

A Red/Silver maple Swamp with a sparse tree canopy and standing dead trees.

Total cover of herbs is the highest of any of the forested types, often with 80 to 100% cover or more (summed from each species). Many of the herb species of the Alder type (page 76) are common in Red/Silver maple Swamps. The herbs are also similar to those in the Hemlock Swamp type, but with lower abundance of flood-intolerant species, because the large, exposed, tree root mounds found in Hemlock Swamps are uncommon in Red/Silver maple Swamps. The mounds that are present tend to be low and just around the bases of large trees, since the maple roots are down in the muck.

The most abundant herbs in Red/Silver maple Swamps include spotted touch-me-not, northern bugleweed, smallspike false nettle, spinulose woodfern, and sedges, primarily species of *Carex* and *Dulichium*. Several common herbs are typical of locations with fluctuating water levels, such as sensitive fern, beggarticks, and rice cutgrass. Other frequent species are turtlehead, royal fern, tall meadow-rue, marsh fern, swamp jack-in-the-pulpit, blue flag, and skunk cabbage. In the Red/Silver maple Swamps that have yellow birch and black ash trees, additional common herbs are Canada mayflower, cinnamon fern, and dwarf raspberry. In the swamps that lack yellow birch, lizard's tail commonly occurs.

The ground layer is dominated by herbs, but a few sites have substantial cover of short shrubs and sprawling vines. Tree seedlings, primarily of the maples, ash species, and American elm, are frequent but contribute less than 5% cover.

Total diversity in the Red/Silver maple Swamp Type is moderately high, with an average of more than 50 species per tenth hectare.

Spotted touch-me-not.

Water parsnip.

Turtlehead.

Purple fringed orchid.

Where found: Swamp forests dominated by red maple, silver maple, or hybrids occur on level, poorly drained soils throughout the region, but they are more common in the northern half.

The kind of Red/Silver maple Swamp that has green ash or white ash, but not yellow birch, is the main form of swamp forest in the northern third of the region. These swamps occur in the many poorly drained swales and depressions around the north ends of Cayuga, Seneca, and Owasco Lakes, and also north of the Finger Lakes in low areas between the narrow drumlins (glacial hills oriented north-south). Sluggish streams flow through or near many of these sites, all of which are at low elevations (400-800 feet).

In contrast, Red/Silver maple Swamps that have yellow birch and black ash generally occur at moderate elevations (1000-1400 feet). This kind is found in upland depressions on the plateaus between Seneca, Cayuga, and Owasco Lakes; in swamps around smaller lakes like Cayuta Lake and Dryden Lake; and occasionally in the bottoms of broad, glacially carved valleys in the southern half of the region.

The soils of Red/Silver maple Swamps are usually very poorly drained, but occasionally poorly to somewhat poorly drained. The degree of flooding varies over the year and among sites; some are dry at the surface at times during the summer. Most of the swamps, especially those with yellow birch, have a surface layer of muck. The pH of the surface soil is slightly acidic to neutral (pH 6 to 7), but occasional sites are more acidic (pH <5).

Royal fern.

Pink azalea occurs in some swamps, but also grows on slopes in Dry Upland Forest.

Comments: Swamps dominated by red maple are the principal type of wetland forest in southern New England, although in some cases the present dominance by red maple may be due to removal of hemlock and white pine by logging. Since hemlock is usually absent from the maple-dominated swamps in the central Finger Lakes region, and since the stumps of white pine, which decay slowly, are generally not observed here, the dominance of maples in swamps of our region does not appear to be due to removal of conifers. Swamps dominated by red maple that are similar to the Red/Silver maple Swamp type are also found northeast of the Finger Lakes in the Saint Lawrence River valley, and in southeastern New York State on central Long Island. The Long Island swamps have some shrub species that are not found in the Finger Lakes region.

Nearly pure silver maple forests are the predominant vegetation on the lower parts of the Connecticut River floodplain near Hartford, Connecticut. Many of the same herb species are abundant both in Connecticut and in the Red/Silver maple Swamps of the central Finger Lakes, most notably sensitive fern, smallspike false nettle, and spotted touch-me-not. Our Red/Silver maple Swamps that lack birch are compositionally similar to the Silver maple-American elm forests of broad floodplains of major rivers in the Midwest and southern Ontario. Swamp forests dominated by American elm, ash species, red maple, and silver maple cover large areas in northeastern Ohio. The abundance of green ash in Red/Silver maple Swamps relates the type to the river-bottom forests of the prairie states.

Water levels fluctuate substantially in Red/Silver maple Swamps. These swamps lie in the lowest spots in the landscape, where water accumulates during snowmelt and heavy rains, then is drained away gradually by slow-moving streams. At several sites the ground water was several inches below the soil surface in mid-summer, but dried mud on the tree trunks indicated that the stands had been flooded in spring. This contrasts with less fluctuation in water level in Hemlock Swamps, which lie in upland depressions where creeks carry excess water away into the lowlands, and in drainage divides – the highest points in valley bottoms. Unlike Hemlock Swamps, where flood-intolerant herbs grow on exposed tree-root mounds, in Red/Silver maple Swamps such species are uncommon, indicating that maximum water levels are higher.

One might expect vegetation intermediate between Red/Silver maple Swamp and Sycamore-Cottonwood on poorly drained soils deposited by streams where they enter the major lakes. Such habitats are now rare because of heavy disturbance of lake shores, but one such intermediate stand occurs at the south end of Cayuga Lake, at Stewart Park in Ithaca. Silver maple and cottonwood are the dominants, with a mixture of smaller woody plants, including green ash (a tree of maple swamps), boxelder (a floodplain species), and others found in both types, such as spicebush and poison ivy.

E. Open Wetlands (four types)

Wetlands that have few trees (in contrast to swamps, which are forested) are treated here, including such communities as marsh, wet meadow, and wetland shrub thicket. Marshes are generally wetter than meadows, but they intergrade and the degree of saturation and flooding varies over the season, so we use the terms loosely. Open Wetlands form on level, poorly drained ground: along slow-moving streams, at the ends of lakes, in drainage divides between stream headwaters, and in other depressions in the landscape. Because decomposition is slow in waterlogged conditions, an organic surface layer of muck and peat often accumulates, from dead leaves of sedges, cattails, and other plants.

Some botanists differentiate more than 20 kinds of unforested wetlands in New York State. In this section we focus on four basic types, which are found on sites that are slightly acidic to neutral, or calcareous (see Figure 2, page 15). Acidic sphagnum Bogs, which often include open wet areas and forested patches, are treated in Section F.

By definition, few trees grow in Open Wetlands, so these types are not included in Table 1. The occasional tree species that do occur are mentioned in the descriptions. At the end of Section E, we discuss the patterns of natural successional change in species composition over time that occur as Open Wetlands develop into Swamp Forests.

A large Cattail Marsh, south of Seneca Lake.

Common cattail: the female flowers are below the male flowers, which soon fall off of the stalk.

Few other species can grow under dense cattails.

E1. Cattail type

Composition: The lakeshore Cattail marshes are very simple communities, composed almost entirely of dense cattail plants. Three kinds of cattail occur in the region: common cattail, narrow-leaved cattail, and a robust hybrid (*Typha x glauca*) that grows 6 to 9 feet tall. The hybrid cattail dominates the lakeshore marshes, while common cattail is the usual dominant in smaller Cattail marshes in other locations.

Scattered among the cattails are often a few small plants of spotted touch-me-not, northern bog bedstraw, threepetal bedstraw, or bulblet-bearing water hemlock. Additional species found at some sites include swamp milkweed, beggarticks, clearweed, water purslane, marsh fern, and purple loosestrife. True sedges (species of *Carex*) are rarely present, but species of *Cyperus* sedge occur occasionally. Common duckweed is usually abundant, floating on the standing water between cattail plants.

Diversity is low, often with fewer than 15 herb species per tenth hectare. Trees and shrubs are extremely rare. The low species richness of cattail marshes probably results from competitive dominance by cattail plants, which exploit much of the available resources.

Common duckweed floating on the water next to a clump of cattails.

Where found: Cattail-dominated marshes occur on flooded land. Water levels vary, but much of the year standing water is at least a few inches deep. Extensive areas of Cattail marsh in the region are found primarily around the ends of the large lakes, for example near Watkins Glen south of Seneca Lake, and at Montezuma National Wildlife Refuge north of Cayuga Lake. The type is less frequent in drainage divide wetlands in upland stream valleys. Cattail plants also grow in the water along the edges of man-made ponds, in roadside ditches, and scattered in wetter spots in the Sedge-Grass type.

Generally the soil in the Cattail type is a deep, mucky layer of cattail peat that is near-neutral (pH 6 to 7). In one marsh, the peat layer was nearly 10 inches thick, underlain by a neutral (pH 6.8), gray clay. Presumably most Cattail marshes are on similar clay deposits of lake sediment.

Comments: Other extensive cattail marshes in New York are found along Lake Ontario, the Saint Lawrence River valley, the lower Hudson River, and the Long Island shore. Cattail marshes also occur from Wisconsin to Connecticut.

It is possible that narrow-leaved cattail and the hybrid moved west from Atlantic coastal salt marshes with the building of canals into central New York. However, both kinds were already present in the central Finger Lakes region in the 1800s, and may be native here, like common cattail.

E2. Sedge-Grass type

Composition: Typically these marshes and wet meadows are strongly dominated by one or two robust species of sedge or grass. The vegetation is short, several feet in height or less. Hummocks formed by the clumps of sedge or grass, with soft mud between, can make walking difficult. Potential dominants include sedges, such as fringed sedge, and grasses, for example rice cutgrass and bluejoint.

Sedge-Grass marshes generally have a moderate diversity, with 20 to 40 species per tenth hectare, almost all herbaceous. Additional species present at some sites include hairy sedge, soft rush, cattail, and *Scirpus* species such as wool grass and bulrush. Herbs that grow between the sedge clumps at some sites include swamp milkweed, spotted touch-me-not, water dock, arrow-leaved tearthumb, vervain, water purslane, marsh fern, and various species of bedstraw and smartweed. Small patches of speckled alder or a few stunted red maple trees occur occasionally, particularly toward the edge of the marsh.

Among the many variations of the Sedge-Grass type are meadows where rice cutgrass is strongly dominant, accompanied by beggarticks and willowherb. Rice cutgrass often grows where beaver pond muds have been exposed following the breakup of a beaver dam.

Another version of the type can be seen in a part of the extensive Montezuma Marsh at the north end of Cayuga Lake, where a species-rich Sedge-Grass marsh is dominated by bluejoint (grass) and marsh fern, with occasional dense shrubby thickets of meadowsweet.

Sedge-Grass along a stream.

Fringed sedge.

Wool grass.

Swamp milkweed.

Blue flag.

Where found: The Sedge-Grass type occurs on ground that is continuously saturated but only seasonally flooded. Usually the sites are not as wet as in Cattail marsh. Some Sedge-Grass marshes occur adjacent to open water. Natural Sedge-Grass communities are found in drainage divide areas, often adjacent to alder thickets or swamp forests, at former beaver ponds, and in other wet depressions. Similar-looking marshes have been produced by clearing of swamp forest for pasture and hay meadow.

The surface soil is typically a thick, slightly acidic (pH around 6) organic deposit of muck or sedge peat. At one site the muck was over 40 inches deep, over clay.

Comments: Marshes or wet meadows of sedges and grasses are widespread in northeastern USA. One botanist suggested that they occur in climatic zones that are too cool for the Cattail type. This is generally in accord with the distribution of these types in the central Finger Lakes region. Though patches of cattail can occur in wetter areas in Sedge-Grass marshes, the Cattail type is found primarily in the temperate climate adjacent to large lakes. In contrast, the Sedge-Grass type occurs mainly in valley bottoms and depressions that receive cold air drainage.

Comparison of the sedge-grass marshes between regions is difficult due to the large compositional variation within each region. Bluejoint, a grass that is dominant at Montezuma marsh north of Cayuga Lake, is frequently a dominant species in sedge-grass marshes throughout the northern Midwest and the Northeast. Tussock sedge (*Carex stricta*), the dominant sedge species in the marsh meadows of Connecticut and Wisconsin, is not common in the central Finger Lakes region.

Vegetation intermediate between Sedge-Grass and the Alder type develops naturally over time (see Wetland Succession, page 79).

Rice cutgrass.

Vervain.

Arrowhead.

Marsh fern.

E3. Alder type

Composition: The Alder type is a thicket of shrubs, which grow about 6 to 12 feet tall. Density of shrub stems (<2 inches in diameter) in the Alder type is very high, with an average of over 2500 stems per tenth hectare. Alder thickets can be difficult to clamber through, since stems are so dense and the ground is muddy or flooded.

Speckled alder is overwhelmingly the dominant species, often accounting for over 90% of the stems greater than a half-inch in diameter. Smooth alder, a more southern species that is uncommon here, is found in thickets near Cayuta Lake and a few other places. Red maple trees are usually scattered through the thicket, with fewer than 30 per tenth hectare. A few may be more than 8 inches in diameter, but the trees are short. An occasional sugar maple, yellow birch, white pine, black cherry, or American elm may occur. Other species capable of growing to large size are usually absent. Typically there are only 4 woody species per tenth hectare in the tree layer, including speckled alder. Of the vegetation types dominated by woody plants, Alder thickets have the lowest total basal area, less than 1 m^2 per tenth hectare.

Red osier and meadowsweet shrubs are sometimes abundant, but are shorter than the alder. Northern arrowwood frequently occurs. An abundance of shrubby willow species generally indicates that a site was once a pasture or wet hay meadow. Other shrubs include highbush blueberry, red raspberry, and winterberry. Bittersweet nightshade, a vine of Eurasian origin, forms tangles among the shrubs.

Herb cover is mostly continuous, except in the shadiest spots under dense shrubs. The herbs are a mixture of the species of Sedge-Grass marsh and Hemlock Swamp. Herbs that are frequent include beaked sedge and other sedges, spotted touch-me-not, skunk cabbage, crested woodfern, tufted loosestrife, and common cattail. Some sites have creeping bentgrass (of European origin), marsh fern, smartweed, swamp jack-in-the-pulpit, fringed loosestrife, tall meadow-rue, or northern bugleweed. Herb diversity is moderate, but with an average of 13 shrub and vine species, total diversity is moderately high: 40 or more species per tenth hectare.

A shrub thicket of the Alder type.

Looking into the thicket of stems.

Speckled alder. From left to right: leaf, female flower catkins, and male flower catkins.

Red osier stems in winter.

Where found: Thickets of the Alder type occur in similar places to the Sedge-Grass type: in saturated, sometimes flooded, level areas and depressions; at drainage divides between streams; and at the margins of small lakes. Often the Alder type is adjacent to Sedge-Grass marsh, Hemlock Swamp, or both. The soil is typically an organic muck that is near neutral (pH 6.5 to around 7).

Comments: The Alder type is often a transitional successional stage between marsh and swamp forest (see Wetland Succession, page 79). As such, intermediates occur between the Alder type and Sedge-Grass, Red/Silver Maple Swamp, and Hemlock Swamp.

As in the central Finger Lakes region, in most other areas alder is strongly dominant in wetland thickets. However, alder thickets in Connecticut have a greater diversity of shrub species, including several that are absent or rare in central New York.

Dense stands of speckled alder occasionally occur on abandoned agricultural land in the central Finger Lakes, on better drained soils than in natural Alder type wetlands. The herb species composition of such post-agricultural sites resembles other successional fields (Section G of the book).

A bittersweet nightshade vine, in fruit.

Fringed loosestrife.

The flowers of the meadowsweet shrub.

E4. Rich Fen type

Composition: The Rich Fens of high-lime sites are similar in appearance to other Open Wetland types, but have a notably different suite of species. Some Rich Fens are dominated by sedges; others, by shrubs. North of the Finger Lakes in Seneca County, we sampled a site dominated by beaked spikerush (a sedge) and shrubby cinquefoil. Other abundant species included northern bayberry, smooth sawgrass, roundleaf sundew, pitcher-plant, and Ohio goldenrod. Mosses covered about 30% of the ground. At a shrub-dominated Rich Fen in northeastern Tompkins County, the primary species were red osier and shrubby cinquefoil, with some alderleaf buckthorn and buttonbush.

Rich Fens often have extremely high plant diversity, especially of rare species adapted to high-lime, saturated conditions. Among the rare herbs that can occur are grass-of-Parnassus, bog goldenrod, and various orchids. The type is not included in the table of type averages in Appendix III, because we only sampled a few sites. The Seneca County sedge-dominated site was not very diverse, with 33 species per tenth hectare (mosses were not counted). Various species of "brown moss" are more common in Rich Fens than sphagnum moss species.

Where found: The Rich Fen type is infrequent in the region, restricted to near-neutral to high-lime sites (pH 7 to 8) kept moist by ground water seeping through calcareous deposits, or on calcareous bedrock. Most sites are in depressions on undulating glacial deposits that block a stream valley, such as within the Fall Creek valley in northeastern Tompkins County, and sites north of the Finger Lakes. Other wetland types often occur nearby, in other low areas on the glacial deposits.

The ground is usually saturated, being wet at the surface but not flooded. The soil is generally a deep muck. Water movement in Fens is slow, and levels of two important plant nutrients, nitrogen and phosphorus, are usually very low. Rich Fens do not develop where non-calcareous stream water flows more rapidly through a site.

Comments: Rich Fens occur in high-lime wetlands where ground water is the primary source. *Fen* can also be used more generally for any calcareous wetland, regardless of the water source. Others call any ground water fed site a *fen*, calling the more acidic sites medium or poor fens, in contrast to high-lime, rich fens. Forested fens also exist.

Showy lady's-slipper.

Yellow lady's-slipper.

Grass-of-Parnassus.

Wetland Succession

Three of the Open Wetland types – Cattail, Sedge-Grass, and Alder – occur in environments that do not differ in any obvious way from those of adjacent swamp forests, so it is reasonable to expect that they are eventually replaced by Swamp Forest. The rate at which this succession takes place varies. When a beaver dam is abandoned and breaks, succession on the exposed pond sediments can be rapid. Rice cutgrass and beggarticks establish in the bare mud from buried dormant seeds. Within a few years, these species are largely replaced by sedges and other herbs of the Sedge-Grass type. Alder may establish within ten years. In contrast, successional change can be very slow in Open Wetlands along lake margins and other areas not associated with beaver dams. Such sites are gradually invaded by shrub and tree seedlings, which eventually grow and become more abundant.

In the wetlands of drainage-divide valleys, Sedge-Grass marshes are likely to be invaded by Alder, and eventually replaced by Hemlock Swamp. To investigate wetland succession, we sampled along linear transects from marsh into swamp forest at Michigan Hollow, a wetland south of Ithaca. Here, an open pond at a beaver dam was surrounded by a Sedge-Grass marsh, with scattered red maples and patches of stunted buttonbush towards the outer edges. Next to the marsh was an extensive belt of Alder thicket with a few red maples and other trees, and beyond that, adjacent to the upland, there was

A cottonwood tree recently felled by a beaver.

This wetland alternates between pond, Sedge-Grass, and Alder (note dead stems), depending on beaver flooding.

At this site, when Swamp Forest canopy trees were killed by flooding, the area in the foreground reverted to Sedge-Grass.

Hemlock Swamp with red maple. Portions of this sequence are repeated in many other wetlands, with Sedge-Grass next to Alder thickets, or Alder near Hemlock Swamps. Except in situations where flooding increases over time, the clumps of alder and young red maple found in Sedge-Grass, and the red maples in Alder thickets, gradually become more dominant, leading to the next successional stage. If beavers return, the process is reversed, as dam building and flooding change swamp, thicket, or marsh back to open water.

Possibly Red/Silver maple Swamps sometimes form an intermediate successional stage between the Alder thicket and Hemlock Swamp types. Red maple is found in all three, and both Red/Silver maple Swamps and Hemlock Swamps commonly have some alder, red osier, or other shrubs of the Alder type. On the other hand, Red/Silver maple Swamps sometimes occur next to large lakes in the region, but Hemlock Swamps do not. Perhaps dominance by red maple is a terminal stage of succession wherever water level fluctuations are great, but the red maple is partially replaced by the hemlock and yellow birch of the Hemlock Swamp type where the water levels are relatively shallow and stable. The presence of rotting wood from dead red maple trees probably facilitates colonization by hemlock and yellow birch, by providing a moist but unflooded spot for seedling establishment.

To investigate successional patterns in the Cattail type, we sampled across a transition from marsh to swamp in the Montezuma National Wildlife Refuge, at the north end of Cayuga Lake. The Swamp Forest was mostly red maple with scattered green ash and American elm. The forest and adjacent Cattail marsh were both on poorly drained deep muck, but the border between them was abrupt. If forest had been invading open marsh, there would have been younger trees and saplings scattered into the marsh margin, but there were not.

If the primary way Swamp Forest invades Cattail marsh is when large old trees on the edge die and fall into the marsh, providing decaying logs for tree seedlings to establish on, encroachment into the marsh would be limited to a few dozen feet per hundred years. However, before the level of Cayuga Lake was regulated by dams, establishment of swamp trees may have occurred within the marsh during drier climatic periods when lake levels were low. In any case, the rate of succession in lake marshes must be slow. Montezuma and the other large Cattail marshes near the Finger Lakes presumably have existed for thousands of years, since the layer of cattail peat is many feet deep in places.

Over the past two hundred years, some wetlands in the region have been colonized by purple loosestrife. This invasive European species can spread vigorously, crowding out native wetland plants. In the 1860-1880s botanists noted two areas of purple loosestrife on the shores of Cayuga Lake and Cayuga Inlet. In the 1900s, the species established populations in various wetlands, along lake shores (including Beebe Lake at Cornell University), and in roadside ditches. In the 1980s, we found patches of purple loosestrife at several sampled sites, in Cattail, Sedge-Grass, and Red/Silver Maple Swamp types. Today purple loosestrife occurs throughout the region, and is the target of an extensive biocontrol program, using introduced insects that feed on it.

F. Bogs (four subtypes)

"Bog" is a term with a variety of usages, from generally any wet or swampy area, to a more specific meaning, differentiated from swamps, marshes, and other wetlands. To many people, bogs are places that have a peat layer of dead sphagnum moss. Some specialists differentiate bogs from other kinds of wetlands based on species composition, on pH, or on water and nutrient inputs. Here, we will consider the Bog type to include wetland communities in basins that are characterized by (a) a lack of flowing water, (b) a surface layer of sphagnum moss over acidic peat, and (c) a group of plants that can grow in low-nutrient, waterlogged conditions. Bogs contrast with swamps and marshes, which form along streams and lakes where surface water carries nutrients to the plant roots. Our Bog type is restricted to vegetation found on acidic peat, and does not include high-lime wet sites that may have "bog" in the name of the place.

Composition: Bogs can be forested or open, and most of ours include both kinds of vegetation. Species of *Sphagnum* moss carpet the bog surface on top of an accumulating layer of peat. Unforested open areas in the Bog are dominated by mosses and sedges, or by low creeping shrubs in the Blueberry Family along with the moss. In the forested bogs of the central Finger Lakes region, conifers are common – primarily hemlock and white pine.

Most bogs in the region consist of several distinct communities, either in concentric rings, or as mosaics of small patches of each type. Given the intimacy with which the several kinds of vegetation occur, we consider the bogs to form a single complex type, with four subtypes (Figure 2, page 15). Two are open areas of herbs and low shrubs; two are forested. Descriptions of the subtypes follow the general discussion of the Bog type.

Sphagnum moss.

Open bog, with shrubs and forested bog at the margins.

Where found: Bogs are extremely rare in the central Finger Lakes region. They are essentially restricted to a few small, poorly drained depressions, in areas of undulating glacial deposits that block stream drainage within valleys. Such bogs occur in northeastern Tompkins County and nearby in Cortland County, and north of the Finger Lakes on the lowlands south of Lake Ontario. Non-acidic wetlands – Swamp Forest, Sedge-Grass marsh, and Rich Fen – often occur nearby on the glacial deposits in other depressions in the landscape.

Water input to the bogs is primarily from precipitation (rain and snow), rather than ground water seepage or streamflow; the depression in the landscape within which water can flow into the bog is small. Precipitation is low in nutrients relative to water that has moved through soil. If ground water enters through seeps, the vegetation is sometimes referred to as "poor fen," but since the water source is often not evident, we include poor fens in the Bog type.

Bogs in the region occur almost exclusively in kettle basins. Kettles formed when huge blocks of ice left by a retreating glacier became buried by glacial meltwater deposits of sand and gravel. When the ice blocks eventually melted, bowl-shaped depressions were left in the deposits. If drainage was restricted by a layer of clay at the bottom of the basin, a kettle pond formed. Sphagnum mosses, which grow in waterlogged, cool, low-nutrient conditions, would have colonized the pond edges during the period of cool climate that followed the retreat of the glaciers. As the mosses grew, the lower dead parts created peat, since decomposition in cool, waterlogged, acidic conditions is extremely slow. Over thousands of years, an increasingly deep layer of peat developed.

Bogs are the most acidic of our types (Figure 2, page 15). Rather than deriving from acidic bedrock or mineral soils, the acidity is due to sphagnum moss releasing hydrogen ions, and to acidic organic byproducts from incomplete decay in the peat. Nutrient availability to plant roots is severely restricted in the acidic peat, especially for nitrogen, calcium, and magnesium. Given the very low nutrient inputs from precipitation, the result is a community of species able to grow in a nutrient-limited, wet environment. Typically the soil in the Bog type in the region today is composed of a deposit many feet deep, of acidic (pH 4 or less) sphagnum moss peat, with a few bits of wood and other buried plant remains.

Air circulation is probably also a factor in bog formation in this region. Cold air draining into the Bog cannot exit the basin, and hence frost occurs early in the fall and late in the spring. Most of the Bogs in the region occur above 1000 feet in elevation.

Comments: Various kinds of bogs cover large areas of the far north in Canada, Europe, and Asia. Perhaps because the central Finger Lakes region lies near the southern limits for the formation of sphagnum kettle bogs, some species are absent or infrequent here. However, the dominant species in the Bogs of the region also occur elsewhere in New York, the Northeast, and the northern Midwest. A number of the species have ranges that extend into northern Canada, such as leatherleaf and small cranberry.

The vegetation structure of the small bogs of the central Finger Lakes region also is similar to many of the bogs elsewhere. Open water may occur in the center of the bog,

surrounded by a zone of low vegetation dominated by herbs and creeping shrubs, and finally tall shrubs and trees, which increase in abundance toward the bog margin. This pattern is largely due to a greater availability of nutrients for the growth of trees and shrubs near the outer edge of the bog. Nutrient availability is quite low in the middle of the bog, where rainwater is the primary source of nutrients and plant roots cannot reach through the deep peat to mineral soil. In contrast, closer to the bog margin some nutrients arrive in ground water and in leaves blown in from the adjacent upland. Bogs in the region are often surrounded by a moat one or two feet wide, of soft muck or open water. Such moats are generated by water level fluctuations that allow drying and more rapid decomposition of dead plant material at the edge of the basin.

Many bogs appear to undergo a gradual succession over time, as woody plants colonize the peat in the open parts of the bog and displace the herbs and low shrubs characteristic of that zone. To a large extent this succession is driven by the accumulation of peat raising and drying the bog surface. It also is probably hastened when trees die and fall toward the center of the bog, as the decaying fallen logs provide a drier and slightly more nutrient rich spot where seedlings of woody plants can grow.

A local study indicates that successional changes in our bogs can sometimes happen relatively rapidly. At McLean Bog, Cornell University researchers and students compared vegetation records from the early 1900s with observations made about 75 years later. Over that time the distance across the open bog decreased from 170 feet to 140 feet, as the taller shrubs encroached from the edges. This suggests that within a few hundred years the open bog may be completely covered by taller woody plants. The peat layer at the site is over 30 feet deep, so it has been a bog for thousands of years.

The effects air pollution and climate change may have on the bogs of the region are unclear. The increase in nitrogen content of precipitation in recent decades could provide nutrients that would hasten the encroachment of shrubs and trees. A warmer climate might eliminate those bog species that are near the southern edge of their range in this region – but presumably not pitcher-plant, which ranges south to Florida.

This bog is covered in short leatherleaf shrubs in the open area, with scattered pine trees, and taller shrubs at the edges.

F1a. Pitcher-plant Bog subtype

The Pitcher-plant subtype, if it is present, generally occurs near the center of the bog. The ground surface consists of a continuous mat (essentially 100% cover) of live sphagnum moss of various species. The mat may extend out over open water, forming a floating mat or "quaking bog." Other than mosses, the most abundant plants are sedges, especially cottongrass and threeway sedge. Pitcher-plants are also common, and low shrubs or creeping woody plants, including leatherleaf, bog rosemary, and small cranberry. Large cranberry and spoonleaf sundew are abundant in some locations. Less frequently seen are roundleaf sundew, and orchids such as grass pink and rose pogonia.

Pitcher-plants and the sundew species are insectivorous. The low nutrient availability in bogs favors plants that can get nitrogen from insects. The tiny sundew plants have sticky leaves that capture insects and absorb the nutrients. Insects drown in the rainwater-filled vase-shaped leaves of pitcher-plants, and the nutrients are absorbed into the leaves.

Scattered, tiny seedlings of red maple may be present. The leaves of the red maples are yellowish from lack of nutrients, and the seedlings apparently die before growing to sapling size. Diversity of herbs and woody plants is low, typically little more than 10 species per tenth hectare (not counting mosses). Cover of plants other than mosses can be sparse in some parts of the bog. If leatherleaf or bog rosemary shrubs are present, these tend to be short (less than 20 inches), and do not cover much of the surface, in contrast to the Leatherleaf subtype.

Pitcher-plant leaves.

Seed heads of cottongrass, a sedge, in autumn.

Bog rosemary leaves are pale underneath.

Looking down onto the surface of a Pitcher-plant Bog.

F1b. Leatherleaf Bog subtype

In the extreme, this is a simple community of monotonous appearance. Leatherleaf shrubs form a nearly continuous low thicket about 2 feet high. They cover 80% or more of the ground, which consists of a mat of living sphagnum moss. Among and below the woody plants in the Leatherleaf Bog there may be small cranberry or large cranberry. These and the leatherleaf have green leaves year round. There are few other herbs, except for sedges such as cottongrass, and occasional pitcher-plants. Tree seedlings are rare. Typically there are fewer than 8 species of herbs and woody plants per tenth hectare. The low species diversity of the Leatherleaf and Pitcher-plant subtypes probably results from exclusion of most other species due to wetness, acidity, and lack of nutrients.

The Leatherleaf and Pitcher-plant subtypes tend to occur toward the center of the bog basin, where they float on a mat of mosses. Both subtypes are rare in the central Finger Lakes region, but similar open bog communities occur widely throughout the Northeast and the northern Midwest.

Leatherleaf.

A Leatherleaf Bog ringed by water.

F1c. Tamarack-Pine Bog subtype

The dominant trees of this kind of forested bog are white pine and tamarack. In addition, a few red maple trees may occur, and sometimes black spruce or hemlock. Both black spruce and tamarack – a conifer that loses its needles in autumn – are near the southern edge of their range, in the Finger Lakes region. A form of Tamarack-Pine Bog without tamarack also occurs, having only white pine trees, or pine and red maple.

The typical tree canopy is sparse, with many large openings. Tree density averages about 40 per tenth hectare, the lowest of any of the forested types. Basal area is very low: 1 m^2 or less per tenth hectare. The trees appear to grow slowly, presumably because of nutrient deficiency and wetness, and few seem to attain even moderate size before succumbing to wind damage or disease. Diversity in the tree layer is low, with only about 4 species per tenth hectare.

In contrast to the sparse and open tree canopy, the shrub layer can be very dense,

with 1000 to 3000 stems per tenth hectare. Tall shrubs are abundant, especially highbush blueberry, as well as mountain-holly, black chokeberry, and wild raisin. Sometimes the shrubs form such impenetrable, dense thickets that we were forced to crawl through the bog on hands and knees under the shrubs to make our measurements during sampling. Tree saplings are less abundant; the most common is red maple.

In patches where trees and tall shrubs are sparse, the ground layer resembles that of the open bog subtypes, with low plants such as leatherleaf, small cranberry, cotton-grass, and pitcher-plant. Under a closed tree canopy, the more common herbs are wintergreen and sedge species, and at some sites, cinnamon fern, Virginia chain fern, starflower, and an occasional orchid.

The overall average cover in the ground layer of Tamarack-Pine can be 50% to more than 100%. Tree seedlings such as red maple are present, but contribute little cover. Herb diversity is low, with fewer than 10 species per tenth hectare. With shrubs and trees included, total diversity is not much more than 20 species per tenth hectare. Living sphagnum moss is abundant, but generally covers only about 60% of the ground, rather than close to 100% as in the areas of open bog.

Comments: Compositionally, the Tamarack-Pine Bog subtype resembles some of the "forested fens" (found where ground water is the primary input) and "peat swamps" that have been described by others, elsewhere in New York. White pine does not appear to be a common dominant on peat deposits outside central New York State.

White pine and tall shrubs in an open-canopied Tamarack-Pine Bog.

Highbush blueberry.

Hemlock-Pine-Maple Bog, with a carpet of sphagnum moss.

Grass pink, an orchid.

F1d. Hemlock-Pine-Maple Bog subtype

Adjacent to open bog, there is often some closed-canopy wetland forest dominated by conifers. Hemlock is the primary species, followed by red maple and white pine, with lesser amounts of yellow birch. Hemlock usually contributes over 50% of the basal area. Total basal area is similar to that of Moist Upland forest, over 3 m^2 per tenth hectare. Density in the tree layer is also moderately high, usually with more than 100 stems per tenth hectare. Diversity in the tree layer is low, however – about 5 species per tenth hectare. Total diversity is low and similar to that of Tamarack-Pine, with 20 to 30 species of herbs and woody plants per tenth hectare.

Shrubs found in some Hemlock-Pine-Maple Bogs include species typical of Tamarack-Pine: highbush blueberry, wild raisin, mountain-holly and black chokeberry. Winterberry may be present. Hemlock is the most frequent tree sapling. However, because of the dense coniferous overstory, the shrubs and saplings are not abundant, with an average density of less than 100 stems per tenth hectare. Red maple, yellow birch, and hemlock seedlings are sometimes numerous in the ground layer, but contribute only 1% of the ground layer cover.

Cover in the ground layer is low to moderate, and is primarily herbs. However, only a few herb species are present, about 10 per tenth hectare. The most common herbs are goldthread, Canada mayflower, skunk cabbage, and cinnamon fern. Less frequent are partridgeberry, Indian cucumber root, spinulose woodfern, bluebead, and northern woodsorrel. Many of the species have ranges that extend north into Canada. A number of the herbs also grow in Hemlock Swamps.

The soil is a very acidic (pH 4) peat composed mainly of dead woody material rather than just sphagnum. Sphagnum mosses are common, but the average coverage is <15% of the ground surface. The ground is slightly springy, and much drier than the sphagnum peat of the adjacent open bog areas, or the mucky soils of Hemlock Swamps.

Comments: Hemlock-Pine-Maple Bogs differ from Hemlock Swamps only in having more white pine and less yellow birch, and more of the acid-loving species in the understory and ground layer. Stands intermediate in composition between Hemlock-Pine-Maple Bog and Hemlock Swamp sometimes occur. We encountered one such stand in a level drainage divide between the upper ends of two streams. The tree root mounds typical of Hemlock Swamps were larger and more closely spaced than normal. This supported an unusual abundance of the relatively flood-intolerant white pine, and reduced the area of saturated muck available for lush growth of the Swamp Forest herb species normally found between the mounds, thus making the stand similar to a Hemlock-Pine-Maple Bog. Other drainage divides in the region usually have Swamp Forest or Open Wetland vegetation, whereas the Bogs develop in small basins with little water flow.

G. Successional Vegetation on Former Farmland
(three types)

An additional group of plant communities is found on land abandoned from agriculture, principally former plowed fields, hay meadows, and pastures. For economic reasons, much of the farmland in central New York is no longer in active agriculture, and through natural succession the fields are gradually reverting to forest. Most *old fields*, as they are called, spend one to two decades dominated by perennial herbs with gradually increasing dominance by shrubs and tree saplings. The forests that eventually develop on such sites are called *secondary* or *post-agricultural* forests, to distinguish them from the *primary* Upland Forests (Sections A and B) found on land that was not farmed.

Secondary forests differ substantially from primary forests in structure and composition. The species that colonize old fields and post-agricultural forests are typically those that have rapid seed dispersal into the sites, and vigorous growth in the open field environment. Because many forest species, both trees and herbs, do not grow well in full sun or in competition with dense grasses and herbs, abandoned farm fields and secondary forests lack many of the characteristic species of primary forests. Thus, both the prevalence of certain species that are less common in the primary forest types, and the absence of others, distinguish post-agricultural stands from primary forests. Among the trees that frequently occur in successional fields and secondary forests are red maple, white ash, and white pine (Table 1, page 21). In contrast, hemlock, a dominant tree in many primary Moist Upland stands, is rarely seen on former farmland.

Where found: Secondary forests are more common than any of the natural vegetation types in the region today. In Tompkins County, over 60% of all forested land is in stands that developed on former farm fields. The post-agricultural vegetation types are not shown in the summaries of soil conditions and landscape position (Figures 2 and 3, and

A field of goldenrods and asters.

Shrubs in an old pasture.

Red maples and white pines in autumn, in a young secondary forest.

Appendix II), but the original farm fields were primarily on gentle slopes, in moderately moist, non-acidic conditions where Moist Upland forests once grew. Some fields were abandoned because they were too wet in spring to plow, often due to a fragipan layer impeding soil drainage; these sites may once have been Dry Upland forest of the Oak-Beech-Hickory-Pine or Hickory-Oak-Ash types. Even a few wetlands were partially drained and plowed. Not all farm fields required plowing, however, and some steeper, rockier, or wetter areas, which would once have supported forests of Dry Upland types or Swamp Forest, were cleared for pastures.

Post-agricultural fields and forests occur across the region. The abundance of secondary forest is higher on the hills south of Ithaca, where more farmland was abandoned early in the 1900s, compared to farther north on the flatter land and better soils, where more of the fields remain actively farmed. Primary forest is also more common today on the hills south of Ithaca than northward, but in addition it occurs throughout the region on sites that were too steep or too wet to farm. Small stands of primary forest on gentle, better-drained slopes are also scattered across the agricultural areas, since most farms retained some forested land to provide timber and fuelwood.

Comments: Although certain groups of species tend to dominate old fields and post-agricultural forests, species composition varies widely from site to site. Since seed colonization comes primarily from whichever plants were growing in and around the field, local effects on composition can be substantial. However, much of the variation in species composition follows recognizable patterns, depending on the time since abandonment, soil conditions in the field, and farming history (described further in the type descriptions below). Many of the species in post-agricultural vegetation are not native. Many more alien herbaceous species occur in Successional Vegetation on Former Farmland than in primary forests or natural wetlands. Non-native shrubs and small trees are also numerous in successional vegetation. Even some earthworms are non-native, and these are much more common in old fields and secondary forests than in primary forests.

We have divided the gradual successional changes in the vegetation over time into three basic types: Herbaceous Old Fields, Woody Old Fields, and Post-agricultural Forests. Each of these encompasses a greater range in species composition than in most of the natural vegetation types. The most common variations within the post-agricultural types are highlighted in the following descriptions.

A pasture in a valley.

G1. Herbaceous Old Fields

Recently abandoned farm fields are dominated by the weeds of cultivated fields. Key factors determining the initial species composition are the crop that was last planted, and what weeds were abundant. Whether the land was plowed the year before abandonment, or was covered in hay meadow or pasture grasses, is particularly important. Many weeds of plowed fields are annuals that grow rapidly in bare ground, with seeds that can persist for decades in the soil and still germinate. In contrast, grassy fields are covered in a dense sod that is harder for new seedlings to grow in.

Abandoned plowed fields are dominated for the first few years by a variable mixture of agricultural weeds. Most came from Europe, such as dandelion, oxeye daisy, Queen Anne's lace, quackgrass, white clover, and species of foxtail grass. Many of the weeds were brought along inadvertently with hay or crop seeds, and spread along roadsides and from field to field across the Northeast. Some were spread in cattle manure, others on hooves, wheels, and farm implements. Common ragweed, an annual, and yellow woodsorrel, a perennial, are two native weeds that are common in plowed fields and recently abandoned fields. Some native species in Old Fields probably grew as weeds in the crop fields of Native Americans. Seedlings of woody plants are usually sparse, except near trees or shrubs that are producing many fruits and seeds.

Young field weeds.

The 1st year after corn (note stubble).

Grass and goldenrod.

Within a few years, annuals are replaced by perennials, especially goldenrods and grasses. From around 3 to 15 years after the last plowing, Herbaceous Old Fields are dominated by native, perennial species, in the Aster Family. These have plumed seeds that blow in from field edges and nearby fields. The most common are tall goldenrod, rough-stemmed goldenrod, early goldenrod, grass-leaved goldenrod, New England aster, and calico aster. These are all herbs of open areas (rough-stemmed goldenrod also grows in Post-agricultural Forest). Thus, the goldenrods and asters that now color Old Fields across the Northeast with yellow, purple, and white each September, would once have been restricted to the widely scattered small openings in an otherwise heavily forested landscape, such as stream-edges and cliffs. They likely also grew in abandoned crop fields of Native Americans.

Other common species from 3 to 15 years after the last plowing include various non-native species such as sheep sorrel, oxeye daisy, dandelion, sulfur cinquefoil, tall buttercup, and various hawkweed species, along with native herbs like wild strawberry,

common cinquefoil, and common milkweed. Typical diversity in fields more than a few years old is 40 to 60 species of herbs per tenth hectare. Seedlings of various trees and shrubs also colonize during this period. Their numbers and species depend on seed availability from nearby woody plants, soil conditions, and time since abandonment.

Abandoned pastures and hay meadows have a somewhat different set of herbs. Such sites are initially dominated by non-native forage species grown to feed cattle or horses, usually some combination of grasses – timothy, orchardgrass, or smooth brome – and legumes (in the Bean Family) such as birdsfoot-trefoil, alfalfa, or clover species. Weeds such as quackgrass, bluegrass, Queen Anne's lace, and dandelion often also occur. Many of the species are not native to New York. Abandoned hayfields are eventually invaded by native goldenrods, asters, and other species typical of 3 to 15 year old fields, mentioned in the previous paragraphs.

On wetter fields, various sedge and rush species are usually important, and the suite of goldenrods and asters changes; late goldenrod and flat-topped white aster are common. In contrast, gray goldenrod and heath aster are found in dry, infertile fields, mixed with grasses and other herbs. Poverty-grass, if it is present in the field, is a good indicator that the soil is dry and infertile. Poverty-grass can be recognized by the curly, short, pale-brown tufts of last year's dry leaves, carpeting the ground. Fields that are dry and nutrient-poor can remain open for many years, because seedlings of many of the trees and shrubs grow slowly in such conditions.

In fields that are mowed, succession in the community is arrested at the Herbaceous Old Field stage, since seedlings of trees and shrubs are prevented from gaining dominance over the grasses, goldenrods, and other herbs.

Cinquefoil.

Tall goldenrod.

New England aster.

Birdsfoot-trefoil, red clover, and oxeye daisy.

Gray goldenrod.

Calico aster.

G2. Woody Old Fields

Within one to three decades after abandonment, the shrubs and tree saplings emerge above the herbaceous layer, if there is no intervention such as mowing. Emergence of the first woody plants above the herbs accelerates conversion of the field to dominance by trees and shrubs. The taller plants provide perches for birds, which drop seeds of fruit-bearing shrubs, such as gray dogwood and honeysuckle. In addition, the shrubs and young trees soon begin producing seeds within the field. They also cast shade, which suppresses the grasses and goldenrods, whose dense cover in Herbaceous Old Fields inhibits the growth of woody seedlings.

During the decades when trees and shrubs are taking over, patches dominated by woody plants are interspersed with areas of field herbs, which persist until the encroaching thicket becomes too dense and shady. The vegetation structure typically changes from a mosaic of meadow and woody patches at 15-25 years after abandonment to a dense thicket of young forest within 30-40 years. The common herbs that persist for some decades in Woody Old Fields include various goldenrods (such as grass-leaved, tall, and rough-stemmed), wild strawberry, and a long list of species also found in younger fields, such as oxeye daisy. Herb diversity does not change greatly over time, with about 40-60 species per tenth hectare on average in Woody Old Fields, eventually declining as the site becomes Post-agricultural Forest.

Old fields vary widely in the density of woody stems, species composition, and the duration of each stage (from herb dominance, to woody thicket, and finally forest). A dense thicket of shrubs can delay tree dominance for many years, while early invasion of a field by fast-growing pines can rapidly change an old field into forest. If huge quantities of tree seeds of a vigorous species disperse into a bare field the year it is abandoned, as sometimes happens, the herbaceous stage may last only a few years.

Woody Old Fields, and active farm fields, with forest on the hilltop.

Honeysuckle berries.

Red cedars invading an abandoned field.

White pine and white ash saplings.

A pasture in winter, with cone-shaped apple and shrub mounds browsed by cattle.

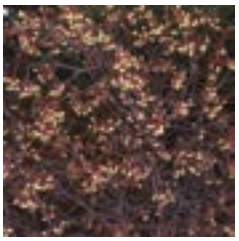
Close-up (glove for scale).

A thicket of hawthorn.

In the Woody Old Fields of the region, several basic patterns of species composition can be seen: (a) a mixture of several of the tree species that are common in our upland forests; (b) a mixture primarily of fruit trees and thorny shrubs; (c) thickets of shrubs; and (d) a few other variations that develop in particular situations. The species found in each of these kinds of Woody Old Fields overlap, and all intergradations occur.

(a) Many plowed fields, abandoned from crops or hay, become dominated by some mixture of local forest trees. The most common are white pine, white ash, and red maple, all of which have winged seeds that blow into the fields. White pine, white ash, and red maple trees grow in most of the primary forest types (Table 1). Their seedlings grow more vigorously in full sun in Old Fields than the shade-tolerant seedlings of some other forest species, such as hemlock. Other tree saplings frequently seen in Woody Old Fields include bigtooth aspen and quaking aspen, American elm, black cherry, and somewhat less often, sugar maple. Northern arrowwood and gray dogwood shrubs are also common in tree-dominated fields, and sometimes nannyberry and choke cherry. In addition, there are various non-native ornamentals with berries whose seeds are spread by animals, such as birds and deer. Among these are honeysuckle, multiflora rose, and autumn olive.

(b) When pastures are abandoned, often it is because they have been invaded by woody plants. This contrasts with hay meadows and plowed fields, which are colonized by woody plants after abandonment. Because seedlings of white pine, white ash, and red maple do not cope with being eaten and trampled by livestock, species that are more tolerant of browsing predominate in many pastures. Many of the woody plants common in active pastures are thorny, and sprout back with multiple branches when eaten. Apple trees, whose seeds are spread by cows eating fencerow apples, often invade active pastures. Native hawthorns are also common. In the shelter of the browsed mounds of apple and hawthorn, seedlings of other species establish, often from bird-dispersed berries. Additional species frequently found in pastures are blackberry and other brambles, nannyberry, and buckthorn. Red cedar also grows in pastures, especially on calcareous soils north of Ithaca. When grazing ends, other species invade, including the shrubs and wind-dispersed tree species typical of other old fields.



The fruits of gray dogwood, also called red-panicled dogwood.

A shrub thicket.

Northern arrowwood leaves damaged by a non-native beetle.

Northern arrowwood in bloom.

(c) Some sites, whether abandoned plowed fields or former pastures, become dominated by shrubs rather than trees. This happens commonly on fields with poor soil drainage, sites with few seed-source trees along the edges, and places that were mown after woody plants invaded (since the shrubs are better at resprouting). Stem density in such thickets can be extremely high. Dominant shrubs in such fields are typically a mixture of gray dogwood and northern arrowwood, along with brambles and nannyberry. Northern arrowwood may soon lose its dominance, due to a non-native leaf-eating viburnum beetle that has recently invaded the region. Speckled alder is abundant in some fields near wetlands. Buckthorn is common on sites with less acidic soils. Tree saplings of various old-field and pasture species mentioned above are also present in shrub-dominated sites, but where the shrubs are dense, they limit the growth of tree seedlings. Consequently the field can persist as a shrub thicket for decades.

(d) There are a few other notable varieties of Woody Old Fields. Willows and other wetland shrubs are dominant on poorly drained soils following intense disturbance such as forest clearing followed by grazing. Willows also dominate along streams in wet pastures. The canopy may be short if shrubs like silky willow or pussy-willow are dominant, or may exceed 50 feet if white willow or black willow are present.

On well drained, fertile, lime-rich soils, Woody Old Fields are often dominated by some mixture of red cedar, white ash, black walnut, or hickories, usually with some buckthorn. This occurs most often on slopes along the major lakes, and occasionally on well drained soils in the major valleys of the southern part of the region.

Finally, there are some Woody Old Fields of unique mixtures of species created by chance events. For example, a plowed field abandoned the year that the sugar maples in the adjacent forest had a huge seed crop, developed in five years into a dense thicket of sugar maple saplings. Some fields have been invaded by seeds from adjacent suburban yard trees of unusual species, such as hybrid ornamental crabapples or non-native pines. Small fields surrounded by woods are sometimes colonized rapidly by seedlings of forest species like black birch. If black locust or quaking aspen trees grow near the field, these species can invade by fast-growing sprout stems from the tree roots that extend into the field. In contrast, other sites, especially large fields on dry and infertile soils, may remain open much longer.

G3. Post-agricultural Forests

Eventually successional fields return to forest, dominated by the trees typical of Woody Old Fields. The major period of field abandonment in the region began early in the 1900s, so the Post-agricultural Forests we sampled were less than 100 years old, but most were already stands of large trees.

The dominant trees typical of Post-agricultural Forests in the region, just as in Woody Old Fields, often include varying mixtures of red maple, white ash, and white pine, along with other species (Table 1). Red maple is the most common, and because more than half of the forests in the region are now of post-agricultural origin, red maple is much more abundant today than in the original forests. Sugar maple is also frequently among the dominant trees in older post-agricultural stands.

Quaking aspen is another species that can be important in some of the post-agricultural forests, in contrast to the other forest types (Table 1). Quaking aspen is a fast-growing, light-demanding species that colonizes bare ground. The species likely was once restricted to forest openings in our region, such as around beaver ponds or in windfall areas where trees were blown down. Quaking aspen is now much more common, both in post-agricultural forests, and in some upland stands of primary forest that were logged.

A thicket of tree saplings in a young Post-agricultural stand.

Secondary forest in autumn.

This older Post-agricultural stand resembles many primary Upland Forests in appearance, but differs in species composition.

Quaking aspen.

Black cherry bark is dark and flaky, like "burnt potato chips."

Aspens, red maple, and beech, in autumn.

Apple blossoms.

A number of other species are occasionally dominant in Post-agricultural Forests, including red oak, black cherry, and bigtooth aspen. Both bigtooth and quaking aspen are more common at higher elevations. Other trees that are common but usually less abundant include black birch, basswood, and bitternut hickory. Tree composition can change with time. Oaks and beech, which have nuts that are dispersed by blue jays, often do not colonize the stand until other tree species have grown, providing habitat for the jays. Also, light-demanding, short-lived trees like aspen usually die without replacing themselves. On soils where seasonal wetness restricts rooting depth, white pine is often overtopped by other species and dies before reaching large size.

The most frequent shrubs and small trees in Post-agricultural Forests include choke cherry and shadbush, which establish in Old Fields and persist after the forest tree canopy develops. Hawthorn, buckthorn, and apple trees (species not listed in Table 1) are sometimes abundant in the understory, particularly in forests that grew on abandoned pastures. Pear trees may also be present, in the canopy or understory of such sites. On lime-rich soils on slopes above the lakes, red cedar, black walnut, and hickory species are often abundant. Other, more unusual, species turn up near tree plantations. These include red pine, Scotch pine, Norway spruce, and black locust. Stands on wetter farmlands, likely abandoned because they were difficult to plow, may have some Swamp trees, such as American elm, black ash, or silver maple.

These examples of variations in Post-agricultural forests reflect three factors: (a) their mixed histories, (b) effects of soils and landscape position on the ability of certain species to grow well, and (c) the proximity of seed source trees in the surrounding landscape. Our summary of the common trees in Post-agricultural forest in Table 1 (page 21) represents averages for the stands we sampled. Individual stands do not have all of those species, and there is much variation in which species are dominant.

Herb diversity in Post-agricultural Forest is lower than in the old fields that preceded them, with an average of fewer than 30 herbaceous species per tenth hectare. Many post-agricultural stands retain open patches with old-field herbs for some years, but as the canopy closes and the dominant grasses and goldenrods die off, species of forest herbs gradually colonize. However, even after 100 years such post-agricultural stands still have a reduced diversity of forest herbs. Some old field herb species persist under the forest canopy, including rough-stemmed goldenrod and common speedwell. Herbs of primary forest often found in Post-agricultural stands include Canada mayflower, false Solomon's seal, starflower, spinulose woodfern, jack-in-the-pulpit, and mayapple. Partridgeberry or blue-stemmed goldenrod sometimes occur. Running pine, a clubmoss, is notably more abundant in Post-agricultural Forest than primary stands.

Some post-agricultural stands have retained more forest herbs. A small number of Post-agricultural Forests in the region developed on land that was cleared for pasture but never plowed. In these unplowed sites, or around large rock piles or remnant trees, occasional patches of herbs from the original forest likely persisted through the period of open pasture, especially in fields that were pastured for only a few decades before being abandoned. Although soil compaction from the grazing animals and other impacts slows the return to full diversity of forest herbs, stands on such former unplowed pastures tend to have more forest herbs than stands that developed on former plowed fields.

The diversity and abundance of forest herbs in Post-agricultural Forests depend not only on the history of land-use and time since abandonment, but also on the soil type and tree canopy. Moist and less acidic soils tend to have more herbs; shady pine stands have fewer. The surrounding landscape is also quite important: a site adjacent to a primary stand that has a lush ground layer will be colonized by forest herb species much more rapidly than a Post-agricultural site surrounded by open fields.

Ripe fruits of Jack-in-the-pulpit.

Starflower.

Running pine.

False Solomon's seal, with unripe fruits.

A sign of Post-agricultural forest: this white pine retained its dead lower branches, which grew when it was a sapling in Old Field.

The large trunk and low, spreading branches of a "wolf tree," which once stood alone in a farm field, and now is surrounded by secondary forest.

Comments: Post-agricultural Forest can be recognized by many features. In addition to tree species composition, signs that indicate a forest is post-agricultural include tree growth form, remnants of the former field edge, and characteristics of the ground. Pines that established in open fields can be recognized, since they retain the lower dead branches, in contrast to pines that grew in shadier conditions. Where white pine established early, maples and other hardwoods often outgrow them, leaving dead and dying pine trunks – with their characteristic whorls of lower branches – in the understory. Large "wolf trees" with big, low, spreading branches, especially oaks, are frequent remnant trees in stands that developed on old pastures or fields.

Where a post-agricultural stand developed adjacent to older woods, there are several diagnostic signs to look for along the boundary between them. The boundary is usually straight, since most plowed fields are rectangular. The trees on the edge of the older stand are often asymmetric, leaning or with large limbs growing out towards what was once an open field. However, the side of the line of trees without low spreading limbs is not always primary forest; there are occasional sites where the edge separates older secondary forest from younger. In other forests, a line of old trees with large, low, spreading branches on both sides indicates a former fence line or "hedgerow," between two fields that have since grown up to post-agricultural forest. If there are rock piles or remnants of a stone wall along the old field edge, it is clear the land was once plowed. Stones were difficult to move and would have been left if the field was unplowed pasture. Old barbed wire fencing is a sign that cows or horses were on one side or the other, in which case characteristic species of former pastures, like hawthorn and apple, can

indicate which side. However, barbed wire is often found running through stands of primary forest, since many of the farm woodlots in the region were used for grazing cattle, at least until the 1950s when the practice was discouraged as being detrimental to the forest. A change in tree size and species composition across a straight border also suggests that one side is post-agricultural, although logging in primary stands also follows property boundaries.

A sign that a forest stand is on a site that had been plowed, is a relatively smooth, even ground surface. Plowing obliterates the pits and mounds that are a natural feature of primary forest stands. These scattered undulations and variations in the ground surface – sometimes most noticeable when walking across them – are from trees uprooted by wind. A pit is left where the roots had been; a mound develops as the tipped-up rootball gradually slumps and the roots decay. The pits and mounds of primary forests have accumulated over the centuries. However, the presence of pits and mounds does not always indicate that a stand is primary forest, as they also occur in some secondary forests where the land had once been cleared for pasture but was never plowed. In those stands, a tree species composition characteristic of Post-agricultural Forest is the best clue that the site is not primary forest. Recent treefalls also create pits and mounds in secondary stands, but the fallen log would still be evident.

Two windthrown tree trunks (to the left), a mound (center) developing as dirt slumps from the tipped up rootball, and the pit (right) created when the trees uprooted.

In this primary forest, tree shadows highlight ancient treefall "pits and mounds" – a sign that the ground was never plowed.

At this secondary forest, the relatively smooth ground surface indicates that the stand developed on a former plowed field.

Appendix I. LATIN AND COMMON NAMES OF THE SPECIES

Plants of the region that are mentioned in the text, in alphabetical order by common name. Latin names are from Gleason & Cronquist's 1991 *Manual of Vascular Plants of Northeastern United States and Adjacent Canada*. Multiple species within a genus are indicated as "spp." Some frequently used alternate names are in parentheses. Growth form (tree, shrub, woody vine, or herb) indicates how we counted the species. For example, small trees that also grow as large shrubs were treated as only one or the other. Origin ("N" = native; vs. "non-native"; vs. "Both") is for the central Finger Lakes region. For multiple species ("spp."), "Origin" applies to the species at our sampled sites, not necessarily to the whole genus.

Common name	Latin name	Growth form	Origin
alder	*Alnus* spp.	shrub	N
alderleaf buckthorn	*Rhamnus alnifolia*	shrub	N
alfalfa	*Medicago sativa*	herb	non-native
alternateleaf dogwood	*Cornus alternifolia*	shrub	N
American beech	*Fagus grandifolia*	tree	N
American bittersweet	*Celastrus scandens*	vine	N
American chestnut	*Castanea dentata*	tree	N
American elm	*Ulmus americana*	tree	N
American hornbeam	*Carpinus caroliniana*	tree	N
apple	*Pyrus malus (Malus* sp.)	tree	non-native
arrowhead	*Sagittaria* spp.	herb	N
arrow-leaved tearthumb	*Polygonum sagittatum*	herb	N
aster	*Aster* spp.	herb	N
autumn olive	*Elaeagnus umbellata*	shrub	non-native
balsam fir	*Abies balsamea*	tree	N
baneberry	*Actaea alba* & *A. rubra*	herb	N
basswood, American	*Tilia americana*	tree	N
bastard toadflax	*Comandra umbellata*	herb	N
beaked sedge	*Carex rostrata*	herb	N
beaked spikerush	*Eleocharis rostellata*	herb	N
bearded shorthusk [a grass]	*Brachyelytrum erectum*	herb	N
bedstraw	*Galium* spp.	herb	N
beech	*Fagus grandifolia*	tree	N
beechdrops	*Epifagus virginiana*	herb	N
beggarticks	*Bidens* spp.	herb	N
bigtooth aspen	*Populus grandidentata*	tree	N
birdsfoot-trefoil	*Lotus corniculatus*	herb	non-native
bitternut hickory	*Carya cordiformis*	tree	N
bittersweet nightshade	*Solanum dulcamara*	vine	non-native
black ash	*Fraxinus nigra*	tree	N
black birch (sweet birch)	*Betula lenta*	tree	N
black cherry	*Prunus serotina*	tree	N
black chokeberry	*Aronia melanocarpa*	shrub	N
black gum	*Nyssa sylvatica*	tree	N
black locust	*Robinia pseudoacacia*	tree	non-native
black oak	*Quercus velutina*	tree	N
black raspberry	*Rubus occidentalis*	shrub	N
black spruce	*Picea mariana*	tree	N
black walnut	*Juglans nigra*	tree	N
black willow	*Salix nigra*	tree	N
blackberry	*Rubus allegheniensis*	shrub	N
bladdernut	*Staphylea trifolia*	shrub	N
bluebead	*Clintonia borealis*	herb	N
blueberry	*Vaccinium* spp.	shrub	N

Common name	Latin name	Growth form	Origin
blue flag	*Iris versicolor*	herb	N
bluegrass	*Poa* spp.	herb	Both
bluejoint [a grass]	*Calamagrostis canadensis*	herb	N
blue-stemmed goldenrod	*Solidago caesia*	herb	N
bog rosemary	*Andromeda glaucophylla*	shrub	N
boxelder	*Acer negundo*	tree	N
brambles	*Rubus* spp.	shrub	Both
bristleleaf sedge	*Carex eburnea*	herb	N
broadleaf sedge	*Carex platyphylla*	herb	N
brown moss	*Campylium, Aulacomnium,* & others	moss	N
buckthorn, European	*Rhamnus cathartica*	shrub	non-native
bulblet-bearing water hemlock	*Cicuta bulbifera*	herb	N
bulrush	*Scirpus (Schoenoplectus) validus*	herb	N
bur oak	*Quercus macrocarpa*	tree	N
butternut	*Juglans cinerea*	tree	N
buttonbush	*Cephalanthus occidentalis*	shrub	N
calico aster	*Aster (Symphyotrichum) lateriflorus*	herb	N
Canada mayflower	*Maianthemum canadense*	herb	N
Canada yew	*Taxus canadensis*	shrub	N
cattail [an unnamed hybrid]	*Typha x glauca*	herb	N
chestnut	*Castanea dentata*	tree	N
chestnut oak	*Quercus prinus (Q. montana)*	tree	N
choke cherry	*Prunus virginiana*	shrub	N
Christmas fern	*Polystichum acrostichoides*	herb	N
cinnamon fern	*Osmunda cinnamomea*	herb	N
cinquefoil	*Potentilla* spp.	herb	Both
clearweed	*Pilea pumila*	herb	N
clover	*Trifolium* spp.	herb	non-native
common cattail	*Typha latifolia*	herb	N
common cinquefoil	*Potentilla simplex*	herb	N
common duckweed	*Lemna minor*	herb	N
common elderberry	*Sambucus canadensis*	shrub	N
common milkweed	*Asclepias syriaca*	herb	N
common ragweed	*Ambrosia artemisiifolia*	herb	N
common speedwell	*Veronica officinalis*	herb	non-native
common St. Johnswort	*Hypericum perforatum*	herb	non-native
cottongrass	*Eriophorum* spp.	herb	N
cottonwood, eastern	*Populus deltoides*	tree	N
crabapple	*Pyrus* (*Malus*) spp.	tree	non-native
creeping bentgrass	*Agrostis stolonifera*	herb	non-native
crested woodfern	*Dryopteris cristata*	herb	N
cucumber magnolia	*Magnolia acuminata*	tree	N
dame's rocket	*Hesperis matronalis*	herb	non-native
dandelion	*Taraxacum officinale*	herb	non-native
downy arrowwood	*Viburnum rafinesquianum*	shrub	N
Dutchman's-breeches	*Dicentra cucullaria*	herb	N
dwarf raspberry	*Rubus pubescens*	herb	N
early goldenrod	*Solidago juncea*	herb	N
enchanter's nightshade	*Circaea lutetiana (C. quadrisulcata)*	herb	N
false Solomon's seal	*Smilacina racemosa*	herb	N
flat-topped white aster	*Aster (Doellingeria) umbellatus*	herb	N
flowering dogwood	*Cornus florida*	tree	N

APPENDIX I. (continued)

Common name	Latin name	Growth form	Origin
foamflower	*Tiarella cordifolia*	herb	N
foxtail [a grass]	*Setaria* spp.	herb	non-native
fowl mannagrass	*Glyceria striata*	herb	N
fragrant bedstraw	*Galium triflorum*	herb	N
fragrant sumac	*Rhus aromatica*	shrub	N
fringed loosestrife	*Lysimachia ciliata*	herb	N
fringed sedge	*Carex crinita*	herb	N
garlic mustard	*Alliaria petiolata*	herb	non-native
goldthread	*Coptis trifolia (C. groendlandica)*	herb	N
grape	*Vitis* spp.	vine	N
grass-leaved (flat-top) goldenrod	*Euthamia (Solidago) graminifolia*	herb	N
grass-of-Parnassus	*Parnassia glauca*	herb	N
grass pink	*Calopogon tuberosus (C. pulchellus)*	herb	N
gray dogwood	*Cornus racemosa (C. foemina)*	shrub	N
gray goldenrod	*Solidago nemoralis*	herb	N
green ash	*Fraxinus pennsylvanica*	tree	N
ground ivy	*Glechoma hederacea*	herb	non-native
hackberry	*Celtis occidentalis*	tree	N
hairy sedge	*Carex lacustris*	herb	N
hairy Solomon's seal	*Polygonatum pubescens*	herb	N
hawkweed	*Hieracium* spp.	herb	Both
hawthorn	*Crataegus* spp.	tree	N
heath aster	*Aster (Symphyotrichum) pilosus*	herb	N
hemlock, eastern	*Tsuga canadensis*	tree	N
hepatica	*Hepatica acutiloba* (*H. nobilis*)	herb	N
herb-Robert	*Geranium robertianum*	herb	non-native
highbush blueberry	*Vaccinium corymbosum*	shrub	N
hillside blueberry	*Vaccinium pallidum*	shrub	N
honeysuckle	*Lonicera* spp.	shrub	non-native
hop-hornbeam, eastern	*Ostrya virginiana*	tree	N
Indian pipe	*Monotropa uniflora*	herb	N
Indian cucumber root	*Medeola virginiana*	herb	N
jack-in-the-pulpit	*Arisaema triphyllum*	herb	N
Japanese barberry	*Berberis thunbergii*	shrub	non-native
Kentucky coffeetree	*Gymnocladus dioica*	tree	N
large cranberry	*Vaccinium macrocarpon*	herb	N
late goldenrod	*Solidago gigantea*	herb	N
leatherleaf	*Chamaedaphne calyculata*	shrub	N
lizard's tail	*Saururus cernuus*	herb	N
lowbush blueberry	*Vaccinium angustifolium*	shrub	N
mad-dog skullcap	*Scutellaria lateriflora*	herb	N
mapleleaf viburnum	*Viburnum acerifolium*	shrub	N
marsh fern	*Thelypteris palustris*	herb	N
mayapple	*Podophyllum peltatum*	herb	N
meadowsweet	*Spiraea alba*	shrub	N
moonseed	*Menispermum canadense*	vine	N
mountain-holly	*Nemopanthus mucronatus*	shrub	N
mountain laurel	*Kalmia latifolia*	shrub	N
mountain maple	*Acer spicatum*	shrub	N
multiflora rose	*Rosa multiflora*	shrub	non-native
nannyberry	*Viburnum lentago*	shrub	N

Common name	Latin name	Growth form	Origin
narrow-leaved cattail	*Typha angustifolia*	herb	N
New England aster	*Aster (Symphyotrichum) novae-angliae*	herb	N
New Jersey tea	*Ceanothus americanus*	shrub	N
New York fern	*Thelypteris noveboracensis*	herb	N
ninebark	*Physocarpus opulifolius*	shrub	N
northern arrowwood	*Viburnum dentatum (V. recognitum)*	shrub	N
northern bayberry	*Myrica pensylvanica*	shrub	N
northern bog bedstraw	*Galium labradoricum*	herb	N
northern bugleweed	*Lycopus uniflorus*	herb	N
northern woodsorrel	*Oxalis acetosella*	herb	N
Norway maple	*Acer platanoides*	tree	non-native
oak	*Quercus* spp.	tree	N
Ohio goldenrod	*Solidago (Oligoneuron) ohioensis*	herb	N
orchardgrass	*Dactylis glomerata*	herb	non-native
ostrich fern	*Matteuccia struthiopteris*	herb	N
oxeye daisy	*Chrysanthemum leucanthemum (L. vulgare)*	herb	non-native
pale touch-me-not	*Impatiens pallida*	herb	N
partridgeberry	*Mitchella repens*	herb	N
Pennsylvania sedge	*Carex pensylvanica*	herb	N
perfoliate bellwort	*Uvularia perfoliata*	herb	N
periwinkle	*Vinca minor*	herb	non-native
pignut hickory	*Carya glabra*	tree	N
pin cherry	*Prunus pennsylvanica*	tree	N
pink azalea	*Rhododendron prinophyllum*	shrub	N
pitch pine	*Pinus rigida*	tree	N
pitcher-plant	*Sarracenia purpurea*	herb	N
poison ivy	*Toxicodendron (Rhus) radicans*	vine	N
poison sumac	*Toxicodendron (Rhus) vernix*	shrub	N
poverty-grass	*Sporobolus vaginiflorus*	herb	N
privet	*Ligustrum vulgare*	shrub	non-native
purple fringed orchid	*Habenaria psycodes*	herb	N
purple loosestrife	*Lythrum salicaria*	herb	non-native
pussytoes	*Antennaria* spp.	herb	N
pussy-willow	*Salix discolor*	shrub	N
quackgrass	*Elytrigia (Agropyron) repens*	herb	non-native
quaking aspen	*Populus tremuloides*	tree	N
Queen Anne's lace	*Daucus carota*	herb	non-native
rattlesnakeweed	*Hieracium venosum*	herb	N
red-berried elder	*Sambucus racemosa (S. pubens)*	shrub	N
red cedar, eastern	*Juniperus virginiana*	tree	N
red maple	*Acer rubrum*	tree	N
red mulberry	*Morus rubra*	tree	N
red oak	*Quercus rubra (Q. borealis)*	tree	N
red osier	*Cornus sericea (C. stolonifera)*	shrub	N
red pine	*Pinus resinosa*	tree	N
red raspberry	*Rubus idaeus*	shrub	Both
red trillium	*Trillium erectum*	herb	N
rice cutgrass	*Leersia oryzoides*	herb	N
riverbank grape	*Vitis riparia*	vine	N
rose	*Rosa* spp.	shrub	Both
rose pogonia	*Pogonia ophioglossoides*	herb	N
rough-stemmed goldenrod	*Solidago rugosa*	herb	N

APPENDIX I. (continued)

Common name	Latin name	Growth form	Origin
roundleaf dogwood	*Cornus rugosa*	shrub	N
roundleaf sundew	*Drosera rotundifolia*	herb	N
royal fern	*Osmunda regalis*	herb	N
rue anemone	*Anemonella thalictroides*	herb	N
running pine [a clubmoss]	*Lycopodium digitatum (L. complanatum)*	herb	N
rush	*Juncus* spp.	herb	N
Scotch pine	*Pinus sylvestris*	tree	non-native
sedge	*Carex, Cyperus, Dulichium, Eriophorum* etc.	herb	N
seersucker sedge	*Carex plantaginea*	herb	N
sensitive fern	*Onoclea sensibilis*	herb	N
sessile bellwort	*Uvularia sessilifolia*	herb	N
shadbush	*Amelanchier* spp. [mostly *A. arborea*]	tree	N
shagbark hickory	*Carya ovata*	tree	N
sheep sorrel	*Rumex acetosella*	herb	non-native
shining clubmoss	*Lycopodium lucidulum*	herb	N
showy lady's-slipper	*Cypripedium reginae*	herb	N
shrubby cinquefoil	*Potentilla fruticosa (Dasiphora floribunda)*	shrub	N
silky willow	*Salix sericea*	shrub	N
silver maple	*Acer saccharinum*	tree	N
skunk cabbage	*Symplocarpus foetidus*	herb	N
small cranberry	*Vaccinium oxycoccos*	herb	N
smallspike false nettle	*Boehmeria cylindrica*	herb	N
smartweed	*Polygonum* spp.	herb	N
smooth alder	*Alnus serrulata*	shrub	N
smooth brome [a grass]	*Bromus inermis*	herb	non-native
smooth sawgrass	*Cladium mariscoides*	herb	N
smooth Solomon's seal	*Polygonatum biflorum*	herb	N
soft rush	*Juncus effusus*	herb	N
speckled alder	*Alnus incana (A. rugosa)*	shrub	N
sphagnum moss	*Sphagnum* spp.	moss	N
spicebush	*Lindera benzoin*	shrub	N
spinulose woodfern	*Dryopteris (spinulosa): carthusiana* & *intermedia*	herb	N
spoonleaf sundew	*Drosera intermedia*	herb	N
spotted geranium	*Geranium maculatum*	herb	N
spotted touch-me-not	*Impatiens capensis*	herb	N
spreading dogbane	*Apocynum androsaemifolium*	herb	N
spring beauty	*Claytonia caroliniana & C. virginica*	herb	N
squirrel-corn	*Dicentra canadensis*	herb	N
staghorn sumac	*Rhus typhina*	shrub	N
starflower	*Trientalis borealis*	herb	N
stout goldenrod	*Solidago squarrosa*	herb	N
striped maple	*Acer pensylvanicum*	tree	N
sugar maple	*Acer saccharum*	tree	N
sulfur cinquefoil	*Potentilla recta*	herb	non-native
summer grape	*Vitis aestivalis*	vine	N
swamp jack-in-the-pulpit	*Arisaema triphyllum* var. *stewardsonii*	herb	N
swamp milkweed	*Asclepias incarnata*	herb	N
swamp white oak	*Quercus bicolor*	tree	N
sweetclover	*Melilotus* spp.	herb	non-native
sweet flag	*Acorus calamus*	herb	N
sycamore	*Platanus occidentalis*	tree	N

Common name	Latin name	Growth form	Origin
tall buttercup	*Ranunculus acris*	herb	non-native
tall goldenrod	*Solidago canadensis var. scabra (S. altissima)*	herb	N
tall meadow-rue	*Thalictrum pubescens*	herb	N
tamarack (eastern larch)	*Larix laricina*	tree	N
threepetal bedstraw	*Galium trifidum*	herb	N
threeway sedge	*Dulichium arundinaceum*	herb	N
tick-trefoil	*Desmodium* spp.	herb	N
timothy	*Phleum pratense*	herb	non-native
toothwort	*Cardamine (Dentaria) diphylla & C. laciniata*	herb	N
trailing arbutus	*Epigaea repens*	herb	N
trillium	*Trillium* spp.	herb	N
tufted loosestrife	*Lysimachia thyrsiflora*	herb	N
tulip tree	*Liriodendron tulipifera*	tree	N
turtlehead	*Chelone glabra*	herb	N
vervain	*Verbena hastata*	herb	N
violet	*Viola* spp.	herb	N
Virginia chain fern	*Woodwardia virginica*	herb	N
Virginia creeper	*Parthenocissus quinquefolia*	vine	N
water dock	*Rumex orbiculatus*	herb	N
water parsnip	*Sium suave*	herb	N
water purslane	*Ludwigia palustris*	herb	N
wavy hairgrass	*Deschampsia flexuosa*	herb	N
white ash	*Fraxinus americana*	tree	N
white avens	*Geum canadense*	herb	N
white clover	*Trifolium repens*	herb	non-native
white mulberry	*Morus alba*	tree	non-native
white oak	*Quercus alba*	tree	N
white pine	*Pinus strobus*	tree	N
white trillium	*Trillium grandiflorum*	herb	N
white willow	*Salix alba*	tree	non-native
white wood aster	*Aster (Eurybia) divaricatus*	herb	N
whorled aster	*Aster (Oclemena) acuminatus*	herb	N
wild ginger	*Asarum canadense*	herb	N
wild leek	*Allium tricoccum*	herb	N
wild raisin	*Viburnum nudum (V. cassinoides)*	shrub	N
wild sarsparilla	*Aralia nudicaulis*	herb	N
wild strawberry	*Fragaria virginiana*	herb	N
willow	*Salix* spp.	shrub & tree	Both
willowherb	*Epilobium* spp.	herb	N
winterberry	*Ilex verticillata*	herb	N
wintergreen	*Gaultheria procumbens*	herb	N
witch-hazel	*Hamamelis virginiana*	shrub	N
wood nettle	*Laportea canadensis*	herb	N
wool grass	*Scirpus cyperinus*	herb	N
yellow birch	*Betula alleghaniensis (B. lutea)*	tree	N
yellow lady's-slipper	*Cypripedium calceolus*	herb	N
yellow pimpernel	*Taenidia integerrima*	herb	N
yellow woodsorrel	*Oxalis stricta*	herb	N
zigzag goldenrod	*Solidago flexicaulis*	herb	N

Appendix II. KEY TO THE VEGETATION TYPES BY POSITION IN THE LANDSCAPE

Types in square brackets [ ] occur less often in that position. Successional types on former farmland are not included. For the locations of north/south geographic divisions mentioned, see Figure 1 at the beginning of the book.

I. UPLANDS (hilltops and slopes, sides of valleys and ravines)

A. Uplands - north of the Finger Lakes

1. Hilltops and slopes.....Sugar maple-Basswood-Ash ; Maple-Beech
2. Broad flat uplands.....Sugar maple-Basswood-Ash ; Hickory-Oak-Ash
3. Upland depressions or poorly drained areas.....Red/Silver maple Swamp

B. Uplands - between the Finger Lakes, and south of the lakes

1. Hill slopes and sides of broad valleys
   a. Slopes facing a major lake valley, aspect SE to W
      Cliff faces (rock outcrop and crumbling rock talus).....Red cedar-Oak
      Other slopes.....Mixed Oak ; Sugar maple-Basswood-Ash
   b. Slopes facing a major lake valley, aspect NW to E
      Cliff faces (rock outcrop and crumbling rock talus).....Hemlock-Beech-Birch with red oak
      Steep slopes.....Mixed Oak ; Maple-Beech with red oak ; [Hickory-Oak-Ash] ; [Hemlock-Maple] ; [Sugar maple-Basswood-Ash]
      Gentle slopes.....Hickory-Oak-Ash ; Hemlock-Maple ; [Maple-Beech] ; [Sugar maple-Basswood-Ash]
   c. Slopes not facing a major lake valley - North of Ithaca
      Steep slopes, aspect SE to W.....Sugar maple-Basswood-Ash ; [Maple-Beech/Mixed Oak intermediates]
      Steep slopes, aspect NW to E.....Maple-Beech ; Hemlock-Maple ; [Hickory-Oak-Ash]
      Gentle slopes.....Sugar maple-Basswood-Ash ; Maple-Beech ; [Sugar maple-Basswood-Ash/Hickory-Oak-Ash intermediates]
   d. Slopes not facing a major lake valley - South of Ithaca
      Aspect SE to W
         Steep slopes - Upper and mid-slopes.....Chestnut oak ; [Maple-Beech]
         Steep slopes - Lower slopes.....Oak-Beech-Hickory-Pine ; [Chestnut oak/Maple-Beech intermediates] ; [Hemlock-Maple]
         Gentle slopes.....Oak-Beech-Hickory-Pine ; Sugar maple-Basswood-Ash ; Maple-Beech

Aspect NW to E

Upper and mid-slopes.....Maple-Beech ; [Sugar maple-Basswood-Ash] ; [Hemlock-Beech-Birch] ; [Chestnut oak/Moist Upland intermediates]

Lower slopes.....Sugar maple-Basswood-Ash ; Maple-Beech ; [Hemlock-Maple]

2. Narrow, nearly level hilltops

a. North of Ithaca.....Maple-Beech

b. South of Ithaca.....Oak-Beech-Hickory-Pine ; [Maple-Beech]

3. Broad, nearly level uplands

a. North of Tompkins County

Drainage good to somewhat poor.....Hickory-Oak-Ash ; [Maple-Beech] ; [Sugar maple-Basswood-Ash]

Drainage poor to very poor.....Red/Silver maple Swamp ; [Hemlock Swamp] ; [Maple-Beech]

b. South of Cayuga County

Drainage good to somewhat poor.....Hickory-Oak-Ash ; Oak-Beech-Hickory-Pine ; [Maple-Beech] ; [Sugar maple-Basswood-Ash]

Drainage poor to very poor.....Red/Silver maple Swamp ; Hemlock Swamp ; Hemlock-Beech-Birch

4. Level areas of deep, coarse-textured soils in or adjacent to ravines.....Pine-Hemlock ; [Hemlock-Maple]

5. Slopes of ravines and narrow V-shaped valleys

a. Ithaca and northward

Upper slopes - Aspect SE to W

Steep to moderate slopes, on soil.....Mixed Oak ; Hemlock-Maple ; [Oak-Beech-Hickory-Pine]

Cliff faces, on rock outcrop and talus.....Red cedar-Oak

Upper slopes - Aspect NW to E.....Hemlock-Maple ; [Mixed Oak] ; [Maple-Beech]

Lower slopes

Steep ravine walls.....Hemlock-Maple ; Sugar maple-Basswood-Ash ; Hemlock-Beech-Birch

Gentle slopes.....Sugar maple-Basswood-Ash ; Hemlock-Maple

b. South of Ithaca

Upper slopes.....See B.1.d. above (Hill slopes, not facing a major lake valley - South of Ithaca)

(continued on next page)

APPENDIX II. (continued)

5. b. Slopes of ravines and narrow V-shaped valleys; South of Ithaca ***(continued)***

Mid-slopes

Aspect SE to W.....Chestnut oak ; [Hemlock-Beech-Birch]

Aspect NW to E.....Hemlock-Beech-Birch ; [Hemlock-Maple] ; [Maple-Beech]

Lower slopes

Aspect SE to W.....Sugar maple-Basswood-Ash ; Hemlock-Maple ; [Maple-Beech] ; [Hemlock-Beech-Birch]

Aspect NW to E.....Hemlock-Beech-Birch ; [Hemlock-Maple] ; [Sugar maple-Basswood-Ash]

II. LOWLANDS (valley and ravine bottoms, poorly-drained basins, and larger depressions)

A. Well-drained lowlands

1. Low hills and other well-drained areas in U-shaped glacial valleys.....Maple-Beech ; [Hemlock-Maple]
2. Moderately well- to well-drained depressions north of Finger Lakes.....Sugar maple-Basswood-Ash ; Hickory-Oak-Ash
3. Well-drained stream deposits in creek valleys and ravines
   a. Old, elevated stream terraces (moderately acidic soil).....Hemlock-Maple
   b. Recent, lower stream deposits .....Sycamore-Cottonwood ; [Sugar maple-Basswood-Ash]
4. Well-drained to somewhat poorly-drained stream deposits adjacent to lakes
   a. Stream deposits at ends of lakes.....intermediates between Sycamore-Cottonwood & Red/Silver maple Swamp
   b. Small stream deltas along sides of lakes.....Sycamore-Cottonwood

B. Lowland wetlands (usually with wetland symbol, on USGS topographic maps)

1. Narrow creek valleys and ravines.....Hemlock Swamp
2. Flat ground at about the elevation of the nearest large lake or river.....Red/Silver maple Swamp ; Cattail
3. Small basins, such as on glacial deposits in shallow valleys
   a. Acidic (low pH).....Bog (Pitcherplant, Leatherleaf, Tamarack-Pine, Hemlock-Pine-Maple)
   b. Less acidic.....Sedge-Grass ; Alder ; Red/Silver maple Swamp ; Hemlock Swamp
   c. Calcareous (high pH).....Rich Fen
4. Other poorly drained flats and depressions (including drainage divides and margins of small lakes)
   a. North of Tompkins County.....Sedge-Grass ; Alder ; Red/Silver maple Swamp ; [Hemlock Swamp] ; [Maple-Beech]
      On high-lime bedrock.....Rich Fen
   b. South of Cayuga County.....Sedge-Grass ; Alder ; Red/Silver maple Swamp ; Hemlock Swamp

Appendix III. AVERAGE PLANT DENSITY AND SPECIES DIVERSITY IN EACH TYPE

Values are from the tenth-hectare (0.1 ha) samples of each type, rounded to simplify comparisons.

Type	Basal area [1] (m^2 per 0.1 ha)	Canopy cover [2] (%)	Woody plant density (stems per 0.1 ha)		Ground layer cover [5] (%)		Diversity (species per 0.1 ha)				
							Tree layer [4]	All sizes			
			Sapling & shrub layer [3]	Tree layer [4]	Herbs	Total		Trees	Shrubs & vines	Herbs	Total
A1. Chestnut oak	2.2	80	430	80	8	40	10	17	8	17	41
A2. Oak-Beech-Hickory-Pine	2.9	80	370	110	8	20	11	16	12	25	53
A3. Mixed Oak	3.2	85	240	100	15	40	10	14	12	19	45
A4. Red cedar-Oak	2.1	70	550	140	25	45	12	16	20	46	82
A5. Hickory-Oak-Ash	3.0	75	390	90	25	65	11	16	10	31	56
B1. Pine-Hemlock	5.0	90	40	70	5	10	9	14	6	16	36
B2. Sugar maple-Basswood-Ash	3.1	85	240	90	15	30	7	11	6	21	37
B3. Maple-Beech	3.0	80	210	80	5	20	6	9	3	14	26
B4. Hemlock-Maple	3.8	90	190	90	20	25	9	11	4	21	37
B5. Hemlock-Beech-Birch	3.9	85	140	100	5	10	7	9	3	20	32
C1. Sycamore-Cottonwood	3.3	80	130	70	30	50	12	14	11	32	56
D1. Hemlock Swamp	2.4	75	210	120	75	90	8	11	11	48	70
D2. Red/Silver maple Swamp	2.6	60	470	60	85	100	5	8	11	33	52
E1. Cattail	0.0	0	0	0	115	115	0	0	0	13	13
E2. Sedge-Grass	0.0	0	0	0	125	125	0	0	1	29	30
E3. Alder	0.5	25	2500	30	105	125	4	5	13	24	43
F1a. Pitcher-plant Bog	0.0	0	1	0	100	125	0	2	2	8	12
F1b. Leatherleaf Bog	0.0	0	3	0	12	100	0	1	2	3	6
F1c. Tamarack-Pine Bog	0.7	25	2000	40	80	140	4	9	6	8	23
F1d. Hemlock-Pine-Maple Bog	3.3	85	90	110	45	50	5	8	5	10	23
G1. Herbaceous Old Field	0.0	0	2	0	100	105	0	3	4	48	55
G2. Woody Old Field	0.2	4	1000	10	80	100	2	6	7	48	61
G3. Post-agricultural Forest	2.5	80	150	120	15	25	9	14	6	26	47

1 ***Basal area*** – *the summed cross-sectional areas of all woody stems. Includes woody plants more than 4.5 feet tall: trees, shrubs, and climbing vines.*

2 ***Canopy cover*** – *percentage of sky obscured by tree leaves and branches overhead.*

3 ***Sapling & shrub layer*** – *stems more than 3 feet tall, up to 2 inches in stem diameter. Includes tree species, shrubs, and climbing vines.*

4 ***Tree layer*** – *stems more than 2 inches in diameter. Includes tree species, shrubs, and climbing vines.*

5 ***Ground layer cover*** – *the sum of the % of area occupied by each species, for herbs and woody plants up to 3 feet tall. Sums can be >100%.*

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Appendix V. PLACES TO VISIT

This appendix briefly describes a number of public places where examples of the vegetation types can be seen. Under Site Descriptions, we point out some of the types that occur along the trails. To find sites that have a particular type, use the list below.

Places in the Finger Lakes region to see examples of the vegetation types.

Type	*Sites*
A1. Chestnut oak	Buttermilk; Finger Lakes Trail - Caroline
A2. Oak-Beech-Hickory-Pine	Finger Lakes Natl. Forest (south); Finger Lakes Trail - Conn. Hill
A3. Mixed Oak	Treman; Willard
A4. Red cedar-Oak	Taughannock
A5. Hickory-Oak-Ash	Eldridge Wilderness; Ellis Hollow; Finger Lakes Natl. Forest (north)
B1. Pine-Hemlock	Taughannock; Treman
B2. Sugar maple-Basswood-Ash	Cayuta Lake; Fall Creek; Lime Hollow
B3. Maple-Beech	Fillmore Glen; Hammond Hill
B4. Hemlock-Maple	Buttermilk; Six Mile Creek
B5. Hemlock-Beech-Birch	Lime Hollow; McIlroy
C1. Sycamore-Cottonwood	Six Mile Creek
D1. Hemlock Swamp	Cayuta Lake; Lime Hollow; Von Engeln
D2. Red/Silver maple Swamp	Cayuta Lake; Sapsucker Woods
E1. Cattail	Catharine Creek; Montezuma
E2. Sedge-Grass	Dryden Lake; Goetchius; McIlroy; Montezuma
E3. Alder	Dryden Lake; Goetchius
F1. Bog	Lime Hollow; Von Engeln
G1-G2. Old Field/shrub thicket	Cayuta Lake; Fall Creek; Lime Hollow; McIlroy
G3. Post-agricultural Forest	Cayuta Lake; Finger Lakes Trail - Caroline

SITE DESCRIPTIONS (in alphabetical order)

Two-letter acronyms refer to the map on page 115.
The notes are not complete guides to the trails. Some sites have trail maps available at the entrance, or on the internet. The maps usually do not show slope and aspect, so a USGS topographic map can be useful (or see http://www.terraserver.com). Some paths can be muddy. State Parks have restrooms, and parking fees in summer. Deer hunting season is in November and December. Most gorge trails are closed in winter. Brief directions to the sites are provided, but you will also need a road map of the county or Finger Lakes Region to get to the sites.

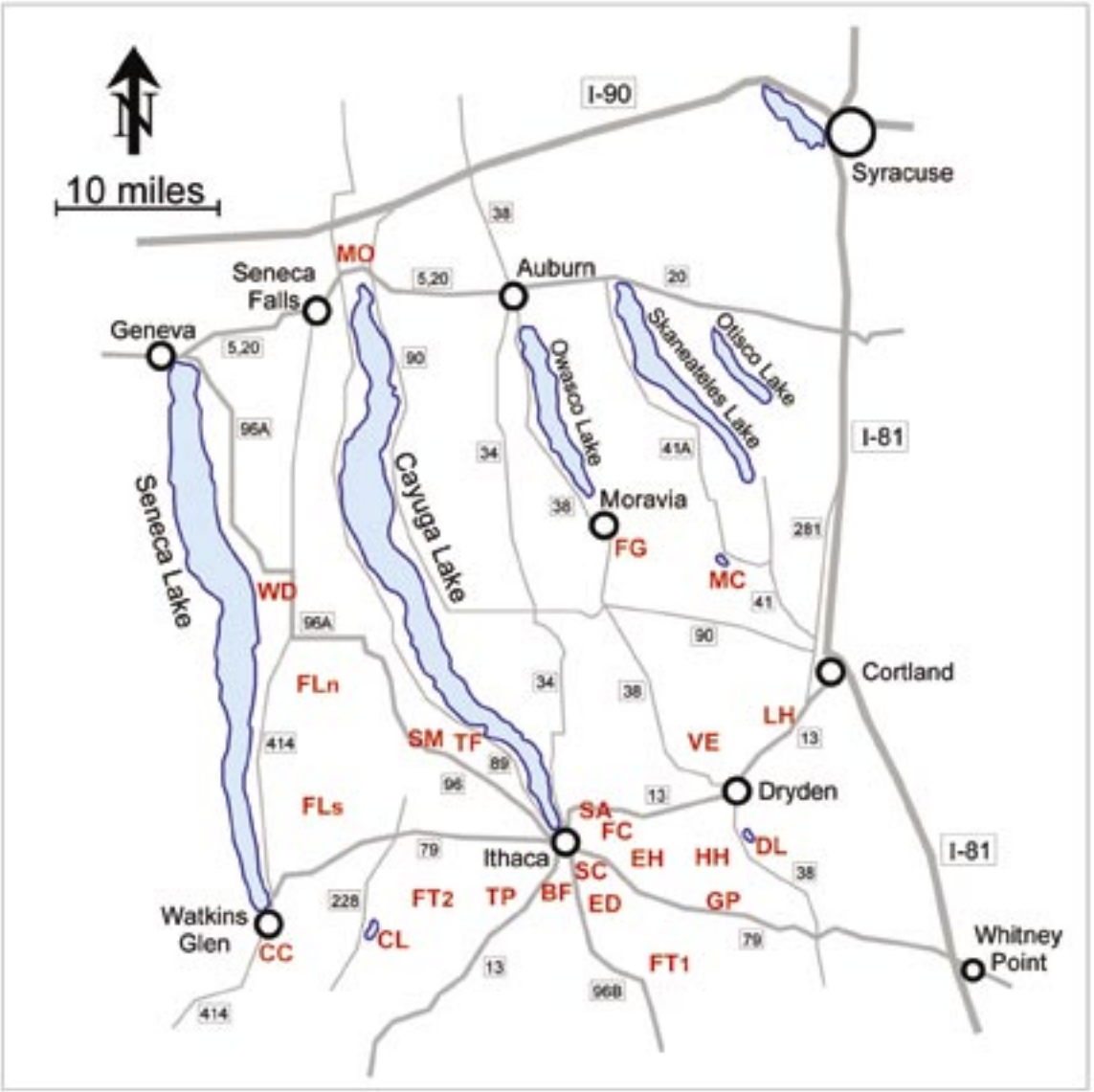
BF: Buttermilk Falls State Park

Upper Entrance, West King Rd. (Town of Ithaca, Tompkins County) USGS map: Ithaca West
For general information: http://nysparks.state.ny.us/parks (see "Buttermilk Park")

From Rte. 96B heading south from Ithaca, a mile past Ithaca College at a stoplight, turn right (west) onto West King Rd. Go about a half-mile, to the Upper Buttermilk Park entrance on the left. Trail maps are available at the booth by the parking area.

The Bear Trail starts on the left (south) side of West King Rd. just beyond the Park Entrance. Several hundred feet along the trail is a patch of **Mixed Oak**, on a south-facing slope as the trail rises and bends right. The trail then follows the west side of Buttermilk

continued on page 116



Map of the site locations in relation to the major roads (Rte. numbers shown).

KEY:

BF Buttermilk Falls State Park
CC Catharine Creek State Wildlife Mgmt. Area
CL Cayuta Lake
DL Dryden Lake
ED Eldridge Wilderness
EH Ellis Hollow Preserve
FC Fall Creek (Cornell Plantations Natural Area)
FG Fillmore Glen State Park
FLn Finger Lakes Natl. Forest - Interloken Trail (North)
FLs Finger Lakes Natl. Forest - Interloken Trail (South)
FT1 Finger Lakes Trail - Caroline Section
FT2 Finger Lakes Trail - Connecticut Hill
GP Goetchius Preserve
HH Hammond Hill State Forest
LH Lime Hollow Center
MC McIlroy Bird Sanctuary
MO Montezuma Natl. Wildlife Refuge
SA Sapsucker Woods Sanctuary
SC Six Mile Creek Preserve
SM Smith Woods
TF Taughannock Falls State Park
TP Treman State Park
VE Von Engeln Preserve
WD Willard State Wildlife Mgmt. Area

BF: Buttermilk Falls State Park ***(continued)***

Creek through forest that is mainly **Hemlock-Maple**. The forest is quite rich in wildflowers, especially in May. There are a few tulip trees. Farther along, to the left of the trail is lower, old floodplain terrace, with vegetation transitional between **Sycamore-Cottonwood** and **Sugar maple-Basswood-Ash**, and abundant spring flowers. Bear Trail is 3/4 mile one-way. Return the same way, or by Park Rd. on the other side of the creek.

The Rim Trail begins directly across King Road from the Upper Park Entrance. A few hundred feet along the trail, opposite a metal fence on the left, there is a stand of **Chestnut oak** on a slope to the right of the trail. Blueberries and mosses dominate the ground layer. If you continue on the trail down the steep slope, after 3/4 mile the trail reaches the Lower Park Entrance.

CC: Catharine Creek State Wildlife Management Area

Fairgrounds Lane (Watkins Glen, Schuyler County) USGS map: Montour Falls
For information and map: http://www.dec.state.ny.us/website/reg8/wma

From Watkins Glen, take Rte. 14 south, past the junction with Rte. 414. Turn left (east) at a stoplight, onto Fairgrounds Lane. Stop before you enter Marina Road, and park in a pulloff on the right. Look on the right (south side of Fairgrounds Lane) for a shrubby area with a footpath, and a gate set back from the road.

A 2-mile trail from Watkins Glen to Montour Falls follows the former railroad bed just west of the canal, across Queen Catharine Marsh. In 2005, the path was unmarked but level and dry. The trail goes south across the extensive **Cattail Marsh** that is south of Seneca Lake. In the past, much of the area was drained and farmed, or used for reed harvesting. Now growing on the railroad bed are native and non-native shrubs typical of Woody Old Fields, and a few wetland shrub and tree species. To the left (east) is open canal. Beavers were active here in 2005. Turn around at any point to return, unless you have a map for the Queen Catharine Marsh Spur of the Finger Lakes Trail and want to return northward via Rock Cabin Rd., east of the marsh.

CL: Cayuta Lake

(Town of Catharine, Schuyler County) USGS maps: Alpine, Mecklenburg

To get to the lake, take Rte. 228. If heading south from Rte. 79 at Mecklenburg, go about 5 miles on Rte. 228, then turn right (east) onto Cayutaville Rd. for the first 3 sites (a–c), or for the Finger Lakes Trail (d) go about 7 miles south on Rte. 228 and bear left onto North Settlement Rd. Alternatively, if coming from Watkins Glen and going north on Rte. 228 from Odessa, go about 3 miles and turn right onto North Settlement Rd. for site (d), or go about 5 miles north from Odessa and turn right onto Cayutaville Rd. for the other sites (a–c).

a. Cornell Plantations Natural Area
(Cayuta Lake Inlet, northeast of the lake)
For information and trail map: http://www.plantations.cornell.edu (see "Natural Areas")

From Rte. 228, head east on Cayutaville Road. Go 0.7 mile to a small mown pulloff on the right, with a sign (set back from the road): Allen Wetland Preserve. The trail heads south across **Old Field** to **Post-agricultural Forest**. Orange-blazed trees mark a half-mile trail, and a side loop to the west. About 20 yards along a red pine plantation, the trail forks. Go right (straight) for the side loop, or left into the plantation. The left path goes through **Post-agricultural Forest**, with old stone cellarholes and a small orchard. The trail ends (double blaze) at **Red/Silver maple Swamp**, north of the Cayuta Inlet

creek. The side loop (which rejoins the main trail just north of the homestead) goes through **Hemlock Swamp**, across mossy tree root mounds, small boardwalks, and mud; follow the orange-blazed trees to stay on the trail.

b. Cayutaville Road

About a mile east of Rte. 228 on Cayutaville Rd., where the road crosses a creek (Cayuta Inlet), there is a broad area of wetland shrubs, fringed by **Alder Thicket**, visible from the roadside.

c. Cayuta Lake NYS DEC Fishing Access

A quarter-mile east of Rte. 228 on Cayutaville Rd., turn right onto the fishing access road. It heads south for a half mile, through **Red/Silver maple Swamp**, to Cayuta Lake.

d. Finger Lakes Trail: Connecticut Hill Section

(Cayuta Lake Outlet, south of the lake)

To hike more than a short way, get Finger Lakes Trail maps from a bookstore or sporting goods store.

From Rte. 228 (about 7 miles south of Rte. 79, or 5 miles north of Odessa), head south on North Settlement Rd. (County Rd. 10), then turn left (east) onto County Rd. 6.

To see **Red/Silver maple Swamp**, go less than a mile on County Rd. 6, and after it bends sharply left (north), look for a Finger Lakes Trail yellow sign at a gate on the left, just before a small bridge. Pull off to park. The white-blazed, dry, level trail heads west along the southwest edge of the Cayuta Lake Outlet swamp. Many trees in the swamp are clusters of stump sprouts, from logging some years ago. Royal ferns are large and lush. The trail goes west for 0.7 miles to County Rd. 10 (no loop).

To see **Sugar maple-Basswood-Ash** in a quiet, shady, creek valley, continue on County Rd. 6 past the sharp left and bridge (mentioned above), and turn right onto Gulf Rd. Park at a pulloff to the right a few hundred feet in, by a footpath with a small yellow Finger Lakes Trail sign. The white-blazed trail runs along "The Gulf," the outlet creek from Cayuta Lake. Sugar maple-Basswood-Ash is on the slope above the trail. Across The Gulf, hemlock dominates the north-facing slope, with yellow birch near the water. The trail follows the creek east and then south, for over a mile. Turn around at any point, or return by a 5.5 mile loop via Van Lone Hill (Finger Lakes Trail).

DL: Dryden Lake State Wildlife Management Area

East Lake Road (Town of Dryden, Tompkins County) USGS map: Dryden
For trail map: http://www.dryden.ny.us/scene.html

To get to The Jim Schug Trail access on East Lake Rd., take Rte. 38 south from the Village of Dryden about 3 miles, and turn left (east) onto Purvis Rd. Along Purvis Rd., looking left, a **Leatherleaf Bog** can be seen (privately owned; no access). Go less than a mile, and turn left (north) onto East Lake Rd. Go about half a mile to a small parking area on the left, with a small sign for The Jim Schug Trail. This runs northwest on an old railroad bed, south of Dryden Lake. You can also park at the other end of the lake at a trail access on Chaffee Rd. and walk southeast, or go to Dryden Lake Park on West Lake Rd. and take the path that heads east along the lake.

From the East Lake Rd. access, heading northwest, The Jim Schug Trail passes **Alder Thicket** on the right, old beaver meadow with willow clumps and flood-killed trees on the left, and small wetter areas of **Sedge-Grass** marsh. At the southeast end of

DL: Dryden Lake State Wildlife Management Area *(continued)*

Dryden Lake (less than half a mile along the trail), look out to the right to see the Alder Thicket, and a patch of **Cattail** marsh by the inlet creek. The trail continues northwest, past the lake, to the Village of Dryden. Turn around at any point; there is no loop.

ED: Eldridge Wilderness (preserve owned by The Nature Conservancy)

Troy Road (Town of Ithaca, Tompkins County) USGS map: Ithaca East

From Rte. 96B heading south from Ithaca, a mile south of Ithaca College turn left (east) from 96B onto East King Rd. Go about a mile, then turn right (south) onto Troy Rd. Go a quarter mile, and look for a small parking pulloff on the left, opposite the house at #232 Troy Rd.

A sign shows the basic trail loop, which is about a half mile. Some parts may be muddy. In 2005 the trail was little used; watch carefully for the white blazed trees to stay on the trail. Double blazes with ">" indicate turns in the trail. Go left at the fork (clockwise around the loop), to see **Hickory-Oak-Ash** as the trail descends a northeast-facing slope. This part was logged years ago; stumps are no longer visible, but some clustered trunks appear to be stump sprouts. If you go farther, the trail passes a patch of black gum trees, turns upslope through younger forest, and eventually goes through **Pine-Hemlock**, on the shoulder of a small ravine near the east edge of the preserve. Farther upslope, closer to Troy Rd., is **Woody Old Field**; the trail may be difficult to follow through the thicket.

EH: Ellis Hollow Preserve (Finger Lakes Land Trust)

Ellis Hollow Creek Road (Town of Dryden, Tompkins County) USGS map: Ithaca East
For information and trail map: http://www.fllt.org/preserves.html

From Rte. 79 about 7 miles east of Ithaca (1 mile west of Slaterville Springs), turn north onto Ellis Hollow Rd., go 2 miles north, and turn right at the only stop sign, onto Ellis Hollow Creek Rd. Go 2 miles (northwest), to just past a power-company building, and look to the right (north) for a pulloff with a Nature Trail sign, just east of a small creek (and before Genung Rd.).

The path from the pulloff goes north through a powerline right-of-way, into **Post-agricultural Forest**, then to an information sign with trail maps. The left-hand Yellow Trail goes into primary forest, up a moderately steep slope, passing a small stand of **Pine-Hemlock**, and through formerly logged woods intermediate between Dry Upland and Moist Upland types. If you turn right onto the Red Trail and head back along the southwest-facing slope, beech drops out and hickories appear, and the type becomes **Hickory-Oak-Ash**, just before the Red Trail turns right and heads downhill. That route is a loop of about 1 mile; other trails are available.

FC: Fall Creek (Cornell Plantations Natural Area)

Forest Home Drive (Varna and Ithaca, Tompkins County) USGS map: Ithaca East
For information and trail map: http://www.plantations.cornell.edu (see "Natural Areas")

One trail access is from Park Park. Take Rte. 366 northeast 1 mile from the stoplight at the Cornell Veterinary College (or from Rte. 13 west of Dryden, turn onto Rte. 366 and go 2 miles), and turn west onto Forest Home Drive. Go about 0.1 mile to a parking area on the left (south) after the road bends left. A sign with a map of the trails is just west of the parking area.

Park Park has two trail loops, about 2/3 mile total. The eastern loop goes up through

a patch of **Post-agricultural Forest** with red maples and white pines, then descends through older forest, crosses the road, and continues to Fall Creek. The western loop crosses a small **Herbaceous Old Field**. Along the edges of the field is sapling thicket, which is changing over time from **Woody Old Field** into young **Post-agricultural Forest**. Some wildflowers at Park Park were planted, and several of the woody species are ornamentals that spread from nearby gardens. There is a boardwalk over a small patch of **Rich Fen**.

At the west end of the field, the trail heads into forest to join a loop of the Morgan Smith Trail. Stairs ascend a north-facing slope that is lush with blue cohosh and ferns. The type intergrades between **Maple-Beech** on the steeper, lower slope along the stairs, and **Sugar maple-Basswood-Ash** higher up. Farther west on the Morgan Smith Trail are intermediate **Moist Upland** types, with some hemlock.

FG: Fillmore Glen State Park

Rte. 38 (Moravia, Cayuga County) USGS map: Moravia
For general information: http://nysparks.state.ny.us/parks (see "Fillmore Glen")

Take Rte. 38 (north from Dryden or south from Auburn) to the park entrance at the south end of Moravia. Trail maps are available at the entrance booth.

If you park at the main pavilion, walk past the swimming area to the Gorge Trail sign and take the steps up the steep slope, leading to a large shelter and a small restroom building. The South Rim Trail starts behind the restroom. **Hemlock-Beech-Birch**, with yellow birch, is on the slope along the beginning of the trail. Or, continue on the Gorge Trail to see Dry Creek and its waterfalls, with hemlocks along the gorge walls.

To see **Maple-Beech**, drive or walk a mile east on the South Rim Road to a small parking turnaround on the left, near the Pinnacle Overlook. Walk west on the South Rim Trail, past the creek overlook, and a red pine plantation, to Maple-Beech forest on the level ground left (south) of the trail. The ground layer is typical for the type, with partridgeberry, Canada mayflower, etc. Hemlock dominates the north-facing gorge slope to the right.

If you walk the South Rim Road, just west of the Pinnacle Overlook parking there is a **Sugar maple-Basswood-Ash** stand on the south side of the road (northeast of a field). The ground layer is richer in wildflowers than in the Maple-Beech forest that is on the north side of the road.

FL: Finger Lakes National Forest

For trail map: http://www.fs.fed.us/r9/gmfl/fingerlakes/recreation_management/hikingtrails.htm

The Finger Lakes National Forest extends more than 10 miles along the upland between Seneca and Cayuga Lakes, with primary and Post-agricultural forests, Woody Old Fields, and active pastures. Trail maps are available at trailhead information signs. Interloken Trail is also a Finger Lakes Trail.

FLn: Finger Lakes National Forest – Interloken Trail (north)

Butcher Hill Road (Town of Lodi, Seneca County) USGS map: Lodi

From Rte. 96A between Interlaken and Lodi, turn south onto County Rd. 146, go 3 miles, and turn right (west) onto Butcher Hill Rd. Go 2/3 mile and park at a pulloff on the left, with an information sign and map. The first mile of the righthand path (Interloken Trail) goes south through **Hickory-Oak-Ash** on Butcher Hill, which is flat and muddy in places. Return the same way, loop back onto No-tan-takto Trail, or continue south on the Interloken Trail, through Post-agricultural Forest and other types.

FLs: Finger Lakes National Forest – Interloken Trail (south)

Picnic Area Road (Town of Hector, Schuyler County) USGS map: Burdett

From Rte. 79 east of Watkins Glen, less than a mile east of Burdett, turn north onto Logan Rd. (County Rd. 4). Go 4 miles, then turn right (east) onto Picnic Area Rd. Go less than 2 miles, past a campground entrance, to a small parking area on the right. Cross the road and head north on the Interloken Trail. On the left after entering the woods is a wet patch with swamp white oak, royal ferns, and highbush blueberry. The forest along the first quarter mile of trail is **Oak-Beech-Hickory-Pine** with few pine trees, and is similar in some respects to the Hickory-Oak-Ash at the north end of the Interloken Trail (FLn). If you continue north, the trail enters Post-agricultural Forest and other types.

FT: Finger Lakes Trails

For information: http://www.lightlink.com/ctc, and also: http://www.fingerlakestrail.org

Maps are sold at some sporting goods stores, or get the most recent edition of "Guide to Trails of the Finger Lakes Region," by the Cayuga Trails Club, from a local bookstore.

FT1: Finger Lakes Trail – Caroline Section

Brearly Hill Road (Town of Caroline, Tompkins County) USGS map: Speedsville

To see a **Chestnut oak** stand and **Post-agricultural Forest**, take the part of the trail between Brearly Hill Rd. ("Braley" or "Brailey" on some maps) and White Church Rd. From Rte. 79 east of Ithaca (about 7 miles), less than a mile west of Slaterville Springs, turn south onto Boiceville Rd. At the T, turn left onto Central Chapel Rd., go about 2 miles, and turn right onto Brearly Hill Rd. (a gravel road). Go less than 2 miles, and park where the road widens on the left. Walk a short distance farther (south) to a marked trail on the right (west) side of the road. The trail is well blazed, but parts are muddy or steep.

The trail enters **Post-agricultural Forest**, then red pine plantation. Just beyond, note the former hedgerow of large trees across the trail. Farther along, the vegetation on the flat ridgetop (in the Shindagin Hollow State Forest) appears to be **Maple-Beech** (recently logged). The trail descends a northwest-facing slope with **Hemlock-Beech-Birch**, also logged, and then a west slope with **Post-agricultural Forest**. Watch for a line of large hedgerow trees and stones that once separated two fields. The trail crosses this line twice. At the shoulder of a ridge, the trail enters primary forest. Along the upper part of the steep slope south of the trail, is **Chestnut oak** forest. Mountain laurel in the understory is lovely in flower in late June. There is no trail loop; return the same way (over a mile back to Brearly Rd.), or continue a half mile, down the steep trail, across a creek, to White Church Road.

FT2: Finger Lakes Trail – Connecticut Hill Section

Cayutaville Road (Town of Enfield, Tompkins County) USGS map: Mecklenburg

To see **Oak-Beech-Hickory-Pine**, go to a part of the trail northeast of Connecticut Hill. Take Rte. 79 west about 8 miles from Ithaca (2 miles east of Mecklenburg), turn south onto Black Oak Rd., go 4 miles, and turn left (east) onto Cayutaville Rd. Go 0.2 mile, and park on the shoulder. Look for a small Finger Lakes Trail sign on a tree north (left) of the road. This part of the trail goes north through disturbed woods with aspen and pine, then onto a level saddle with **Oak-Beech-Hickory-Pine**. There are chestnut saplings along the trail, and lowbush blueberry. The white-blazed trail continues through a small stand of Post-agricultural Forest to a powerline right-of-way (a half mile from the road), then downhill to Griffin Rd. Turn around at any point; there is no loop.

GP: Goetchius Preserve (Finger Lakes Land Trust)

Flatiron Road (Town of Caroline, Tompkins County) USGS map: Dryden
For information and trail map: http://www.fllt.org

From Rte. 79 two and a half miles east of Slaterville Springs, turn north onto Flatiron Rd. and go 0.2 mile. There is no sign or parking area; pull onto the shoulder or the mown right-of-way on the left (west), just past the houses, where the creek goes under the road. There is a large **Sedge-Grass** marsh, bordered by **Alder Thicket**, along Mud Creek. Walk north on the road, past willows, to see the alder up close.

To reach the preserve trail, walk west on the mown right-of-way south of the marsh, then cross an unmown area to a trail sign at the edge of the woods. There is a double trail loop. The yellow-blazed loop goes near the marsh edge. The northern part of the woods is **Maple-Beech**. The blue-blazed loop goes south through **Post-agricultural Forest**, with abundant honeysuckle. The full trail loop is less than half a mile, level, and muddy in spots. (In 2005, the path was lightly used and somewhat overgrown.)

HH: Hammond Hill State Forest

Star Stanton Hill Road (Town of Dryden, Tompkins County) USGS map: Dryden
For trail map: http://www.spidergraphics.com/cnsc/cnscmaps.html

From Rte. 13 west of the Village of Dryden, take Irish Settlement Rd. south 3.5 miles, and turn left (east) onto Hammond Hill Rd. If you need a trail map, at the fork with Star Stanton Rd. bear right to stay on Hammond Hill Rd. and go a short way to a large parking area on the right. Across the road, a path through the bushes leads to a kiosk with maps. The State Forest has plantations, Post-agricultural Forest, and primary forest. Some trails also cross private land.

To see **Maple-Beech**, from Hammond Hill Rd. turn onto Star Stanton ("Star Station" on some maps), go a short way and park at the snowplow turnaround (except in winter). Continue east, walking up the unpaved road, past a few unmarked, gated trails. As the road nears the top and curves slightly left, look for small yellow tree markers where the Y1 Trail crosses the road, and go right (south) onto Y1. Stay right when an unmarked path forks left. The trail then goes through **Maple-Beech** forest (with more red maple than sugar maple). The stand is lush with ferns, clubmosses, and northern wildflowers, such as bluebead, Indian cucumber root, and Canada mayflower. If you continue about a mile farther on Y1, the trail enters conifer plantation, turns west, and ends at Hammond Hill Rd. by the map kiosk and parking area.

LH: Lime Hollow Center for Environment & Culture

Gracie Road (Town of Cortlandville, Cortland County) USGS maps: Cortland, Groton
For information and trail map: http://www.limehollow.org

From Rte. 13 between Dryden and Cortland, a mile east of the Tompkins/Cortland County line, turn northwest at the Lime Hollow sign onto Gracie Rd. If you park in the main lot for Lime Hollow on the left (south) side of Gracie Rd., walk through the woods to a Visitor Center with trail maps. Just a few places along the trails are noted here; much of the area is conifer plantation, Post-agricultural forest, and patches of primary forest that are intermediate between types.

If you take the Fen Connector trail and turn right (north) onto Fen Way, to the left (west) of Fen Way is **Hemlock Swamp** with lush skunk cabbage, and to the right is a patch of **Rich Fen**. If you turn left at the Fen Connector and head the other direction on

LH: Lime Hollow Center for Environment & Culture ***(continued)***

Fen Way (towards Hermits Way), to the right of Fen Way is **Hemlock Swamp**, and **Hemlock-Beech-Birch** is on the slope above (to the left of) Fen Way.

Sugar maple-Basswood-Ash grows on the north-facing slope at Fossil Dome.

The High Vista Loop has **Woody Old Field** on the southwest part of the loop. The Hawthorn Connector goes through an old thicket of hawthorn, with apple and pear, that was likely once pasture.

The Phillips Memorial Trail leads to an overlook at a **Leatherleaf Bog**. Continue north on Gracie Rd. past the Visitor Center and park on the right (east) side, at the Chicago Bog sign with a trail map. A 0.7-mile trail loop goes through Moist Upland forest, a stand of **Sugar maple-Basswood-Ash** with spring wildflowers, and **Post-agricultural Forest**. A spur trail up an esker ridge has **Maple-Beech** on the slope to the left. At the southeast end of the main trail is a view out over the open Leatherleaf Bog.

MC: McIlroy Bird Sanctuary (Finger Lakes Land Trust)

Lake Como Road (Town of Summerhill, Cayuga County) USGS map: Sempronius
For information and trail map: http://www.fllt.org/preserves.html

From Rte. 90 at Homer (north of Cortland), go west about 5 miles, and turn right (north) onto Lake Como Rd. Go 2.7 miles and turn right onto Lane "A," and drive in a short way (across a patch of **Alder Thicket**), to a parking area on the right.

A path crosses **Old Field**, leading to an information sign with maps, at the far end. Total trail distance is about 1.5 mile. Much of the main Yellow trail loop is in **Hemlock-Beech-Birch**, with yellow birch, northern woodsorrel, and Canada yew. A short side spur marked "Rich fen" leads to the edge of a **Red/Silver maple Swamp** that is quite open, with trees killed by beaver-dam flooding. The Yellow trail crosses a small part of an extensive area of **Hemlock Swamp**, which has skunk cabbage and other wetland herbs, differentiating it from the Hemlock-Beech-Birch type. The Blue trail spur leads to an overlook at a large **Sedge-Grass** wetland, with a bench and viewing platform.

MO: Montezuma National Wildlife Refuge

Rte. 5/20 (Town of Tyre, Seneca County) USGS maps: Cayuga, Seneca Falls
For information and map: http://www.fws.gov/r5mnwr/ (see "Enjoying the Refuge")

The main entrance is on the north side of Rte. 5/20, at the north end of Cayuga Lake. The Visitor Center has trail maps and a viewing platform. The marsh is circled by a road several miles long, for driving slowly to see birds and plants, with a few Observation Areas where you can stop and get out. Short hiking trails are just west of Rte. 89.

From the Visitor Center or road loop, large areas dominated by **Cattail** and by **Sedge-Grass** are visible, with swamp milkweed and other wetland plants. Migrating geese and ducks stop here to rest and feed. Goldenrods and other meadow vegetation grow along the edges, where the ground is above the water table.

SA: Sapsucker Woods Sanctuary (Cornell University, Lab. of Ornithology)

Sapsucker Woods Road (Towns of Ithaca & Dryden, Tompkins County) USGS map: Ithaca East
For information and trail map: http://www.birds.cornell.edu (see "Sanctuary")

From Rte. 13 northeast of Ithaca, a mile east of the traffic lights at Warren Road and the airport, turn right (south) onto Sapsucker Woods Road. Park at the Laboratory of Ornithology (Johnson Center for Birds), which has trail maps and a visitor center.

The Woodleton Boardwalk crosses a **Red/Silver maple Swamp** that is lush with

cinnamon ferns, winterberry, highbush blueberry, and pink azalea in the understory. The southern leg of the Van Severinghaus Trail loop, and part of the Wilson Trail southwest of the pond, go through **Maple-Beech** forest. Many of the trees have beech bark disease. The site is flat and poorly drained, so the ground layer has wetland tendencies and is not typical for upland Maple-Beech.

SC: Six Mile Creek Preserve

Giles Street (City of Ithaca, Tompkins County) USGS map: Ithaca East

From Rte. 79 (State St.), at a stoplight less than 1 mile east of downtown Ithaca, turn south onto Giles St. Go a quarter mile to a parking area on the left, with a "Mulholland Wildflower Preserve" sign, just before Giles Street crosses the creek. A trail map is posted at the far end of the parking area.

The main trail follows the creek, leading past **Sycamore-Cottonwood** floodplain forest. Non-native plants are abundant, including honeysuckle, garlic mustard, and dame's-rocket. Young sycamores have colonized gravel bars in the creek. The trail then skirts a **Maple-Beech** slope on the left, crosses large old water pipes by the creek, and reaches an older floodplain terrace, with forest that is intermediate between **Sycamore-Cottonwood** and **Sugar maple-Basswood-Ash**. When the trail forks, take the left-hand path through a rich, level area of spring wildflowers, which is mainly **Hemlock-Maple** or intermediate to Sugar maple-Basswood-Ash. Make a small loop and return by the right-hand path along the creek, or continue up to the reservoir. The short loop is about a mile.

SM: Smith Woods

Falls Road & Cemetery Street (Trumansburg, Tompkins County) USGS map: Trumansburg

Take Rte. 96 to the southeast end of the Village of Trumansburg. Turn north (right, if coming from Ithaca) onto Cemetery St., go 1 block, and turn right at the cemetery onto Falls Rd. Pull off near the corner to park. A trail begins at the Smith Woods sign, at the northwest corner of the woods.

The stand has some impressive, large trees, especially hemlocks, beech, and tulip trees. Some of the hemlocks are more than 300 years old. The forest near the entrance is intermediate between **Maple-Beech** and **Hemlock-Maple**. Periwinkle, a non-native evergreen plant that spread from the cemetery, carpets the ground near the road. Farther into the woods, many of the trees were blown down in a windstorm in 1989. Some logs were salvaged, but numerous trunks, stumps, and root tipups are still evident. The sandy soil, which is exposed by the tipups, was deposited when the post-glacial lake was larger than Cayuga Lake is now. Vigorous young tulip trees established in the gaps created by the blowdown. The blowdown obliterated the remainder of the trail loop, but you can wander in the west half of the woods, with the sounds of Rte. 96 to the south to keep you oriented. The east half is wet and harder to navigate.

TF: Taughannock Falls State Park

Rte. 89 (Town of Ulysses, Tompkins County) USGS map: Ludlowville
For general information: http://nysparks.state.ny.us/parks (see "Taughannock Park")

Take Rte. 89, along the west side of Cayuga Lake, to the State Park parking area west of the road. A sign with a trail map is next to the parking area.

The South Rim Trail leads up steep steps to a level area with a stand of **Pine-Hemlock**, with large white pines and hemlocks. If you continue on the trail up to the height of land, to the left (south) note the **Post-agricultural Forest** with red maple and

TF: Taughannock Falls State Park ***(continued)***

white pine. Farther along the trail are two overlooks where the metal fencing angles out. Look across to the south-facing gorge cliffs to see **Red cedar-Oak** on the steep rock face, and look west to see the waterfall. Red cedar trees also grow just outside the overlook fencing.

The Gorge Trail is an easy, flat walk to the waterfall; about a mile and a half, round-trip. The north-facing gorge slopes along the trail are intermediate between **Hemlock-Maple** and **Hemlock-Beech-Birch**, with both yellow birch and black birch. Halfway to the falls, there are places to reach the creek and look across up the south-facing gorge wall. (A "Cliff-Dwellers" information sign was at one such spot, in 2005.) The **Red cedar-Oak** type is on the cliffs, with red cedar growing out of the cracks in the rock face. This steep example of the type has few herbs or oaks. Other conifers (hemlock and white pine) are nearby on the south-facing slopes, while hardwoods are on the slope talus below, and above the gorge.

TP: Robert H. Treman State Park

Rte. 327 (Towns of Enfield and Ithaca, Tompkins County) USGS map: Ithaca West
For general information: http://nysparks.state.ny.us/parks (see "Robert H. Treman Park")

Take Rte. 13 south from Ithaca several miles, and turn right (west) onto Rte. 327, then left into the Lower Park Entrance. Alternatively, for the Upper Park, continue about 2 miles west on Rte. 327, then turn left onto the Upper Park Entrance road.

To see **Mixed Oak**, use the Lower Park Entrance and go to the main parking lot near the Park Office. The first part of the Gorge Trail goes up a steep south-facing slope that has Mixed Oak, with flowering dogwood and some scattered sugar maples and hemlocks. The trail continues 2 miles west along Enfield Glen, through upland forest with hemlock, oaks, maples, and other species.

To see **Pine-Hemlock**, park at the Upper Park Entrance. Cross a bridge and walk past the picnic area, to the Red Pine Trail. This goes up a steep slope above the gorge. As the trail levels off, to the left is a stand of Pine-Hemlock with large, naturally-established red pines (not a plantation), hemlocks, and a few hardwoods, white pines, and pitch pine.

Turn around to return, or make a 2/3 mile loop and come back on the Upper Gorge Trail to see Enfield Creek and the waterfall. A stand of **Hemlock-Maple** occurs near the junction of the Red Pine and Upper Gorge Trails.

VE: Von Engeln Preserve (The Nature Conservancy)

West Malloryville Road (Town of Dryden, Tompkins County) USGS map: Groton
For information: http://nature.org/wherewework/northamerica/states/newyork/preserves/art11831.html

From Rte. 13 between Dryden and Cortland, just west of the Tompkins/Cortland County line turn west onto Gulf Hill Rd. When Gulf Hill turns right, go straight, onto East Malloryville Rd. Cross North Rd. and Fall Creek Rd., and continue on West Malloryville Rd. another half mile west past Fall Creek Rd. The preserve parking area is on the right (north) on West Malloryville Rd., with a sign and trail map.

The Bog Trail is a 1 mile loop. If you turn right to go counter-clockwise, **Hemlock Swamp** is on the left, before the bog boardwalk.

The boardwalk viewing platform extends into the open bog area, which is **Pitcher-plant Bog** with abundant sedges, sphagnum moss, and some short leatherleaf shrubs.

Grass pink blooms in July. Scattered around the area of open bog is **Tamarack-Pine Bog**, with sparse pines and highbush blueberry, but no tamarack. Nearby along the Bog Trail, there is also **Hemlock-Pine-Maple Bog**, which can be distinguished from Hemlock Swamp by the carpet of sphagnum moss.

Along the 3/4 mile Esker Trail that returns towards the main entrance, the forest up on the esker ridge is **Hemlock-Beech-Birch**.

WD: Willard State Wildlife Management Area

Rte. 131 (Town of Ovid, Seneca County) USGS map: Ovid
For information and trail map: http://www.dec.state.ny.us/website/reg8/wma/

Take Rte. 414, 96, or 96A, to Rte. 414/96A between Ovid and Lodi. Turn west onto County Rd. 132 (Gilbert Rd.). Go just over a mile, then turn south onto County Rd. 131. Go about half a mile to the entrance on the west side of the road, which has an information sign and parking.

Walk or drive west on the dirt road for a mile, past **Old Field**, to a parking area at the far end. Look for a small, unmarked footpath heading west into the woods from this parking area. The quarter-mile, fairly level, trail goes through **Mixed Oak** forest on the west-facing slope above Seneca Lake. The trail ends at a bluff with a view of the lake. **Red cedar-Oak**, with fragrant sumac shrubs, grows along the edge. A side trail leads south a hundred feet to a small ravine with hemlocks. Return by the same path you came in on; there is no trail loop.

A view across the wetland at Goetchius Preserve in winter.

Appendix VI. GLOSSARY

Definitions of technical terms as used in the book
(see Background, pages 5-9, for more information).

Acidic - pH less than 7; soils of pH 4 are strongly acidic; pH 5 to 6 is somewhat acidic.

Aspect - the direction a slope faces, such as south or northeast.

Basal area - the summed cross-sectional areas of all woody plant stems, based on "diameter at breast height" of each stem, measured at 1.4 meters (about 4.5 feet) above the ground.

Calcareous - high in calcium; high-lime or alkaline, rather than acidic.

Canopy cover - percentage of sky obscured by leaves and branches overhead in a forest.

Composition - which plant species are present at a site, and the abundances of each species.

Cover - percentage of area occupied by a species (including leaves and stems). Total cover is summed from each species, and can exceed 100%.

Diversity - number of species in a sample; species richness.

Dominant - tree species with high relative basal area (large in stem diameter or numerous); or for herbaceous vegetation, the abundant species in terms of cover (area occupied).

Drainage - how rapidly water flows away. Categories from wet to dry are: very poorly drained, poorly drained, somewhat poorly drained, moderately well drained, well drained, and excessively well drained.

Drainage divide - level land between two creek drainages, often forming a wetland.

Fragipan - a dense soil layer that restricts downward penetration of water and roots.

Frequent - found at a number of sites (not necessarily abundant in the sites).

Ground layer - herbs, vines on the ground, and shrubs or tree seedlings up to 3 feet tall.

Herbs - herbaceous plants (such as wildflowers, grasses, sedges, ferns, clubmosses) and creeping woody-stemmed plants (such as partridgeberry – but not vines). Mosses were not included. Appendix I lists which species mentioned in the text were treated as herbs.

High-lime - calcareous, alkaline; pH greater than 7; not acidic.

Landscape position - for example hilltop, upper slope, or bottom of a narrow ravine.

Large trees - those with trunks greater than 6 inches in diameter, measured at breast height (4.5 feet from the ground).

Muck - well-decomposed dead plant material, which accumulates in wetlands.

Overstory - in general, the tree canopy. When referring to diversity: the large trees.

Peat - dead plant material that is partially decomposed, from sphagnum moss in bogs, from sedges or other plants in open wetlands, or from woody plants.

Relative basal area - the basal area of a species as a percentage of the total basal area, which is summed from all the woody plant species in the vegetation sample.

Sapling layer or **Shrub layer** - woody stems greater than 3 feet tall, up to 2 inches in stem diameter, including trees, large shrubs, and woody vines.

Shoulder slope - where an upper slope meets flatter land at the top.

Shrub (vs. **Tree**) - short multi-stemmed woody plant. Appendix I lists which species mentioned in the text were treated as shrubs.

Silt loam - a medium-textured soil, rather than coarse sand or fine clay.

Slope (**percent slope**) - vertical distance divided by horizontal. A 10% slope has a 1 foot change in elevation across a 10 foot horizontal distance; a 100% slope has a 45° angle.

Slope position - such as upper slope, mid slope, and lower slope.

Tenth-hectare - 1000 square meters; 50 m x 20 m; approximately 164 x 66 feet or a quarter acre.

Tree layer - stems greater than 2 inches in diameter at breast height (4.5 feet). Includes trees, large shrubs, and large climbing woody vines.

Understory - in general, woody plants below the overstory canopy in a forest. When referring to diversity: woody plants more than 3 feet tall, with stems up to 6 inches in diameter (as opposed to overstory or large trees).

Woody plants - trees, shrubs, and woody-stemmed vines. Excludes some low, creeping woody-stemmed plants that were treated as herbs (see Appendix I).



From left to right: Mohler, Marks, and Gardescu

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