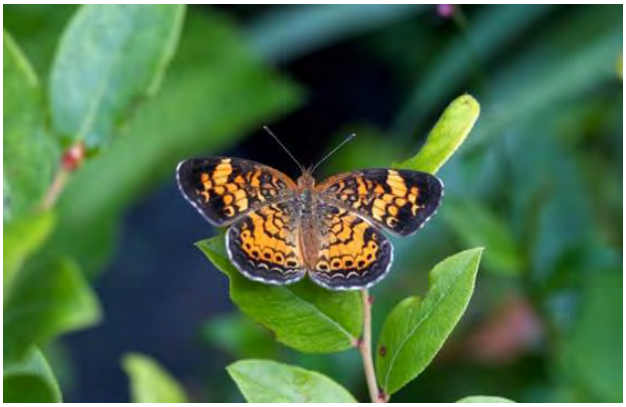

Photo credit: Tom Finkle

Chapter 6:
Biological Resources and Biodiversity of Dutchess County, NY

Mary Ann Cunningham, Neil Curri, and Robert Wills[1]
October 2010

BIODIVERSITY IN OUR AREA

Chapter Contents

Situated in the mid-Hudson River Valley, at a biological crossroads between species and habitats of the surrounding regions, Dutchess County contains a rich diversity of habitats (Strong, 2008, Map 6.1[2]). These habitats support species that are rare in more densely settled regions, from river otters and black bear to pileated woodpeckers, woodland warblers, and specialized wetland orchids and sedges. The county supports federally listed threatened species, such as the Blanding's turtle and the Indiana bat. Many residents might be surprised to learn about the level of diversity that persists in what we often consider a suburban county. In this chapter we review the

[1] This chapter was written in 2010 by Dr. Mary Ann Cunningham (Vassar College), Neil Curri (Cornell Cooperative Extension Dutchess County), and Robert Wills (Dutchess County Department of Planning & Development), with assistance from the NRI Committee. It is an updated and expanded version of the vegetation and wildlife chapters of the 1985 document *Natural Resources, Dutchess County, NY* (NRI).
[2] Maps are located at the end of this chapter.

county's key habitat types, distribution of ecological regions, and factors that influence the biological diversity of our area.

The Dutchess County Legislature identified the importance of the county's biological diversity when it established an Environmental Management Council in 1972. The EMC was established to help protect "the biologic integrity of the natural environment, on which man is dependent for survival, and the natural and functional beauty of our surroundings which condition the quality of our life," (Dutchess County Legislature, 1972). The concept of **biodiversity** can be defined as the entire diversity of genetic variety, species, and ecosystems in a given region (U.N. Convention on Biological Diversity, 1992). Biodiversity includes plants, animals, fungi, and microorganisms, although we give most attention to the larger plants and animals. Conserving these organisms and the systems they occupy requires some familiarity with the current state of the resources, both rare and common.

Biodiversity conservation in Dutchess County requires collaboration of private land-owners and local decision makers. Over 90 percent of the county is privately owned, and many important habitat areas in the county occur on private lands. For example, most known locations of the Northern cricket frog (a state listed endangered species) in the county are on privately owned land (NY Natural Heritage Program). Populations such as these have often been viewed as obstacles to development, but protecting them can also help protect the landscapes and habitats that make our area distinctive.

Conservation is most effective when communities can identify important biological resources and develop conservation priorities before target species become threatened. Planning ahead can help communities save time and money in land use disputes, in debates between land developers and planning and zoning boards, or even in legal action over conservation of legally protected species and their habitats.

The goals of this chapter are: 1) to guide municipal officials and residents toward identifying biodiversity resources in their communities, and 2) to provide resources to aid local governments, land owners, and communities in identifying priorities for biodiversity conservation.

2 Natural Resource Inventory of Dutchess County, NY

Benefits of Habitat Conservation

Habitat conservation can entail protecting key spots of special value, or it can mean maintaining open space with minimal development or clustered development. "Green space" is another term often used for vegetated open space. Both green space and open space may be actively used, for example, in farming, pasture, or forestry, and often these actively managed areas can provide useful habitat for a variety of flora and fauna. Thus the ideas of "open space" and "habitat" can overlap considerably. Certainly habitat conservation is generally impossible *without* open space conservation.

Why Should I Care about Natural Areas and Wildlife?

Diverse natural ecological systems provide a number of beneficial services to human health and our communities.

- Forests, wetlands, and stream corridors work together to keep our water supply clean and abundant.
- Natural areas and open spaces can provide economic benefit through increased tourism and reduced cost of town services.
- Nature keeps your family healthy—by cleaning the air and water, lowering stress, and lessening the risk of disease.
- Plants and animals and the intact natural areas that support them are important parts of community character and local quality of life.
- Protected natural areas and associated wildlife provide vital recreational opportunities.

Source: Strong, 2008
http://www.dec.ny.gov/lands/5096.html

Conserving open space can provide a variety of economic benefits. Protecting open space, as outlined in Dutchess County's "centers and green spaces" plans, can support the local farm economy while conserving woodlands and open fields. Wetland and floodplain conservation can help reduce the impact of flooding and also protect groundwater resources. The aesthetic amenity of open space enhances property values, and biodiversity contributes to regional income from recreation and tourism. These and other benefits have been outlined by the Hudson River Valley Greenway Compact.

Conserving open space and biodiversity also helps communities safeguard essential ecological services on which we depend, such as water purification (performed as soil microbes consume nutrients from septic effluent), soil development, and climate regulation. (For more information on ecosystem services, see NRI Chapter 1: Introduction.) Healthy ecosystems can minimize erosion and sediment accumulation in streams, maintain groundwater resources by protecting aquifer recharge zones, and reduce flooding and low stream flow associated with denuded or impervious landscapes (see Natural Capital project.org; NRI Chapter 5: Water Resources.)

Open space and biodiversity conservation don't mean stopping all development. Land development and conservation can work together if development is done thoughtfully. Strategic site design can allow smart development that preserves water quality; conserves soil, vegetation, and biodiversity; and maintains aesthetic values (http://www.sustainablesites.org/report/). Smart development strategies also have economic benefits, as they can reduce a community's liability for things such as road building and maintenance, sewer and water, fire and police (http://smartgrowth.org; Dutchess County Planning).

Conservation priorities for the Hudson Valley region

This document reviews main points for communities to consider for understanding and conserving biodiversity. Further details are available from a wealth of publications and organizations that provide data on biodiversity in our region, particularly the New York Department of Environmental Conservation (DEC), the New York Natural Heritage Program (NYNHP) and Hudsonia Ltd. These organizations document species and their habitats, and provide conservation guides and fact sheets about individual species' needs. Karen Strong (2008), in cooperation with the DEC and Cornell Cooperative Extension, has provided many of the arguments and justifications for understanding how to plan for biodiversity conservation in the Hudson River Valley.

A first step toward identifying areas of importance for conserving biodiversity is to identify target habitats, or habitats likely to be of value in the Hudson Valley region (Table 6.1). In addition to these general environments, specific habitats, such as acid bogs, talus slopes, or tidal marshes can shelter rare species. Examples of these habitats (and threatened or vulnerable species that may occur) include fens and calcareous wet meadows (Bog Turtle, *Glyptemys muhlenbergii*), kettle shrub pools (Blanding's turtles, *Emydoidea blandingii*), and cliff habitats (Ram's head ladyslipper, *Cypripedium arietinum*). Characteristics of these habitat types have been documented by the NY Natural Heritage Program and by Kiviat and Stevens (2001).

Familiarity with regional species and habitats of concern will aid in identifying priority areas in your community. Maps (including those in this Natural Resource Inventory) can aid in identifying local resources. A key resource is the DEC's New York Natural Heritage Program (NYNHP), which has mapped biologically important areas for the region. Biologists at NYNHP can aid communities in prioritizing species and areas for conservation. Communities can also consult with other

municipalities in the area that have completed biodiversity conservation plans. To identify these municipalities, local groups should consult with Dutchess County Planning and NYNHP. Findings and decision criteria should then be documented for later reference.

Table 6.1: Target habitats with special value for conservation (Strong et al., 2008)

Habitat	Examples of species needing this habitat
Shoreline corridors*	river otter, wood turtle, cerulean warbler, wading birds, trout, stream salamanders and Hudson River water nymph
Unbroken forests	scarlet tanager, warblers, wide-ranging mammals, hawks, owls, box turtles, and plants like fringed polygala flower
Grasslands and shrublands	northern harrier, bobolink, eastern meadowlark, golden-winged warbler, short-eared owl and uncommon butterflies
Wetlands	American bittern, marsh wren, Blanding's turtle, northern leopard frog and a rich diversity of flora like pitcher plant
Seasonal woodland pools	Northeast including Jefferson, marbled, and spotted salamanders, wood frog, spotted turtle, fairy shrimp and others declining throughout the Northeast
Caves and cliff habitats	bats, peregrine falcon, overwintering snakes, migrating hawks, and rare cliff plants like purple cliffbrake and prickly pear
Unique natural areas	at-risk plants and animals

* Includes Hudson River shoreline, streams, intermittent streams

KEY CONCEPTS

Keeping in mind some general principles will aid in identifying priority areas and understanding why some areas are especially valuable for maintaining biodiversity. In this section we define some of these key concepts.

Biodiversity (or "biological diversity") refers to the variety of different kinds of living organisms in an area. Maintaining high diversity of species implies that populations of rare species, as well as common species, are protected. Ecologists often describe biodiversity in terms of **species richness** (the total number of species in an area) and **species evenness**, or the relatively high abundance of many different species, rather than the dominance of just a few. For example, a pine plantation is dominated by one tree species; in contrast, a well-established Hudson Valley deciduous forest might contain smaller numbers of a dozen or more maple, oak, hickory, and other species. There is greater

species evenness in the latter community. In general, a more diverse forest is likely to support a greater variety of other animal and plant species than a low-diversity community.

Endangered and threatened species that are legally designated, or listed, have stronger legal protections than other species. **Endangered species**, as defined by the US Endangered Species Act (ESA), are species in danger of extinction throughout all or a significant portion of its range (excepting insect pests). **Threatened species** are those likely to become endangered in the foreseeable future. New York State also lists endangered species that are (1) native species in imminent danger of extirpation or extinction in New York and (2) listed by the ESA for all or part of its range. In addition, **species of special concern** are those that warrant attention and consideration, but for which there is insufficient information yet for listing as endangered or threatened. A list of New York designated endangered, threatened, and special concern species can be found here.

Habitat is the area and the resources that support species. In the Hudson Valley, the dominant natural habitat is eastern deciduous forest, but many additional habitats are critical, including wetlands, seasonal woodland pools, tidal environments, and others. Some organisms occupy only one specific type of habitat; some can make use of many different types. Urban environments also provide habitat; for example, cities provide habitat for a variety of birds as well as urbanized mammals (such as skunks, deer, and coyotes). Stream corridors within cities can also be high in biodiversity. Most often we pay attention to habitat types that are uncommon and thus need special protection. Maintaining overall abundance of common habitat is also important, however, for "keeping common species common."

Ecosystems are interacting communities of living things and the non-living resources on which they depend. For example, a lake can be described as an ecosystem that contains aquatic plants, insects, fish, fish-eating birds, and so on. Living organisms depend on nutrients and other resources from the lake, and they contribute to the organic matter accumulated on the lake bed, the chemical characteristics of the water, and so on. (For more information on ecosystems, see NRI Chapter 1: Introduction.)

Fragmentation is the division of once-expansive habitats or ecosystems into smaller or more isolated parts. For example, before European settlement, the Hudson Valley contained expansive areas of deciduous forest, which have been reduced to smaller and more isolated areas of forest since the introduction of agriculture. In recent decades, deciduous forests have expanded again, and the principal cause of habitat fragmentation at present is expansion of residential land uses (see *Historic Changes and Current Threats to Biodiversity* section below).

Interior habitat (or core habitat) and **edge habitat** are often considered ecologically distinct because some species avoid edges—such as the edge of a wooded area or the edge of a grassland area—while other species prefer to occupy edges. In general, our current land use patterns include roads, residential neighborhoods, and commercial developments, which tend to increase abundance of edges and decrease availability of interior habitat. Consequently, preserving expansive undeveloped areas that contain abundant interior habitat is often a concern in biodiversity planning.

Connectivity is a general term for connectedness among habitat areas. Species may be less vulnerable to population declines when they are able to move safely among different habitat areas. Connectivity can give access to more resources, increase the amount of core habitat, and also minimize inbreeding that can happen in isolated populations. **Corridors** are areas that connect larger units of habitat. For example, bobcats and black bears can travel safely along wooded corridors to move from one wooded area to another. Maintaining connectedness among habitat areas is usually a priority in conservation planning. Wetland complexes can also be considered connected, for example salamanders can travel safely among a cluster of wetlands when the complex is not fragmented by roads or other development.

Disturbance is any process that interrupts an ecosystem, such as fire, development, drought, floods, or other disruptive processes. Systems may show resilience to disturbance or an ability to recover to pre-disturbance conditions.

An **ecological region** is an area roughly defined by general similarity of habitat types, topography, underlying geology, or other factors that help shape the biological community. Identifying ecological regions can help communities place their plans in a context of more generally defined biological areas. Ecological region boundaries have been mapped, but it should be remembered that in reality

boundaries are rarely clear or sharp, and there are usually gradual transition zones between ecological regions.

Ecosystem services are resources or functions provided by natural systems, such as water filtration by soils, air purification by plants, or temperature regulation by water and forests. Usually the benefits of these services is diffuse and the value hard to calculate, but they contribute to environmental health and quality of life (see the Natural Capital Project and The Economic Evaluation of Biodiversity (TEEB) project). (For more information on ecosystem services, see NRI Chapter 1: Introduction.)

Terms for general classes of organisms help us describe the general groups of species that may share particular habitat types or general ecological roles. **Herpetofauna** include amphibians (frogs, toads, salamanders, newts) and reptiles (snakes, turtles, and lizards), many of which require wetlands or undisturbed rocky environments. **Invertebrate** is a general term for organisms that lack a backbone, including insects, spiders, crayfish, worms, and other groups.

CURRENT STATE OF BIOLOGICAL RESOURCES

The Hudson Valley has some of the greatest biodiversity in New York, owing to the combination of woodlands, wetlands, river, and mountain environments. Mature deciduous forests support an abundance of bird species as well as mammals, including black bear and bobcat. Streams and wetlands support fauna as diverse as river otter, native clams, and threatened and endangered turtles. Localized and uncommon habitats such as sedge meadows or rocky summits support rare species adapted to extreme conditions.

In this section, we review the major habitat types in Dutchess County and identify several notable species of concern or of interest for each. The maps and discussion here may be used as starting points for identifying key habitat areas and species in areas that interest individual communities in the county. For a detailed inventory of habitat types and their associated flora and fauna, see the 1985 Natural Resources Inventory (http://dutchessemc.org/projects/dutchess-county-nri/1985-nri/) and the Hudsonia Biodiversity Manual (Kiviat & Stevens, 2001).

Areas of greatest biodiversity are frequently those least disturbed by development. Often these remnant undisturbed environments are too steep, wet, or remote for easy access or building. Environments with minimal human activity tend to occur in large blocks of habitat unfragmented by roads or built structures. A "biodiversity block" approach thus can be used to map unbuilt habitats—including forest, open fields, wetlands, and so on—which are especially likely to have high conservation values (Wills, 2010; Map 6.2). Another way to identify areas of biodiversity value is to locate *concentrations* of a *target* habitat type. In Dutchess County, where forest is the dominant habitat type and most species occupy forest cover, it is also useful to identify areas of concentrated forest, which are most likely to contain abundant core habitat and minimal amounts of anthropogenically modified edge (Map 6.3). Wetlands also are frequently areas of high biodiversity: having abundant moisture and sunshine, they can have high biological productivity and can support specialized or rare species. Conservation of these areas of key biodiversity value is one of the important strategies for maintaining overall diversity in our area.

Wildlife Communities

In reflection of the wide range of habitats in Dutchess County, our area supports a diversity of plant and animal communities. We have a rich diversity of birds, dragonflies, butterflies, amphibians, and other groups. Larger mammals include white-tailed deer, black bear and coyote, as well as rarer species such as red fox and river otter. The widespread and relatively common animal species have value for wildlife viewing and for maintaining ecosystem structure in general. Most legal protections, however, focus on less common species. The New York Natural Heritage Program (http://www.acris.nynhp.org/), a collaboration of scientists from the DEC and the Nature Conservancy, provides online guides to aid land managers, planners, and others in understanding rare, threatened, and endangered species in New York. NYNHP provides online guides to the rare or threatened animals, plants, and habitats known to occur in each county in New York (Appendix 1).

DUTCHESS COUNTY HABITATS

Identifying habitat types in an area is a first step toward understanding the species that are present. New York's habitat types have been defined by the DEC's Ecological Communities of New York State (Edinger et al., 2002). Habitat types within Dutchess County specifically have been defined by Kiviat and Stevens (2001) and by the 1985 Dutchess County NRI.

Aquatic Habitats

Tidal shorelines and wetlands

Tidal shorelines and wetlands are distinctive because of daily cycles of flooding and drying, and plants must tolerate these daily changes. Tidal environments in Dutchess County generally are freshwater systems because the dense, deep salt water moving north from the ocean normally reaches no farther than New Hamburg, although brackish water can reach Poughkeepsie during droughts (USGS, 2008). Tidal environments are distinguished by variations in depth: **subtidal** areas remain below the waterline at low tide; the **intertidal** zone is the range between high and low tide lines, so that it is flooded at high tide and exposed at low tide. **Supratidal** areas are above the high tide line and are not generally flooded. Tidal zones are also distinguished by the composition of the substrate—generally muddy, sandy, or rocky.

Tidal shorelines occur along the Hudson River and at the mouths of tributary streams, such as at Tivoli Bay, Norrie Point, and New Hamburg. Mud flats may be exposed at low water. Below the low tide line, submerged aquatic vegetation roots in the river bottom, with leaves floating on the surface. In the intertidal zone (which experience both flooded and exposed conditions) vegetation includes cattail, pickerelweed, and other herbaceous plants. Tidal environments support plants and invertebrates that tolerate varying degrees of salinity (where water is brackish), as well as animals and birds that forage in exposed mudflats. A wide range of plants; waterfowl, wading birds, and songbirds feed in the shallow water and low vegetation. Species of conservation concern include the American Bittern, Wood turtle, and Northern leopard frog (Kiviat & Stevens, 2001).

Non-tidal Wetlands

Non-tidal wetlands are widely distributed across Dutchess County, including lowland and level areas, floodplains, and rocky ridge tops. Isolated wetlands are also important, however, as they support specialized groups of amphibians, turtles, dragonflies, and other fauna. Wetlands are often hot spots of biodiversity. They provide high-productivity environments that support specialized plants and a high diversity of fish, amphibians, turtles, birds, mammals, and invertebrates.

Wetlands are differentiated according to length of saturated seasons, vegetation types (wooded, emergent herbaceous, floating vegetation), substrate type (muddy, sandy, or organic beds) and other factors (Cowardin et al. 1979).

Many of the region's wetlands were drained for agriculture or development decades ago. Most that remain are protected by laws put in place since the 1970s, which protect wetlands larger than 12.4 acres, as well as a 100-foot buffer surrounding protected wetlands. Many extant wetlands are also too expansive or too wet for cost-effective drainage. Because of their biological importance, and because of their function in mitigating flooding and maintaining water supplies, there are federal, state, and local ordinances that protect them from draining, filling, or other destruction (see Implications for Decision-making, below). Upland areas that drain into wetlands, however, are not necessarily addressed by most wetland protection laws, and development of these areas can alter the depth, water quality, and vegetative community of wetlands.

Unlike forests, wetlands have great biological importance when they are small and isolated. Where isolated wetlands lack stream outlets, they are generally inaccessible to fish that would prey on the eggs and young of frogs and salamanders. Thus isolated and seasonal wetlands provide safe reproductive habitat for amphibians. This type of wetland is often referred to as seasonal wooded wetlands because they typically occur in wooded areas in our region. They may also be called *vernal pools*, because they are most evident in spring. These wetlands can be easy to overlook: they are usually too small to appear on maps, they may be dry in late summer or fall, and their extent varies from year to year. In addition, wetland complexes can consist of scattered water bodies that appear isolated from above but are hydrologically connected below ground. Modification of part of such a complex can lead to unforeseen effects on other parts of the complex.

Riparian Habitat

In-stream and river environments provide critical biological resources including fish, eels, invertebrates, and plants that contribute to on-shore ecosystems and even to human food supplies. Riparian habitats are distinguished by substrate conditions, size of stream, and abiotic conditions such as oxygen levels and temperature, which influence the biotic community in the stream.

Terrestrial Habitats

Major plant communities of Dutchess County are documented by the 1985 NRI and by the Hudsonia Biodiversity Manual. We follow these in the discussion below. The relative abundance of different land cover gives an indication of the availability of general habitat types in the county (Table 6.2).

Table 6.2: Distribution of habitat types in Dutchess County

Land Use	Area (1,000 acres)	Percentage of county
Forests	2941	56%
Agriculture, grasslands	1233	23%
Developed	472	9%
Wetland	237	4%
Shrublands	225	4%
Open water	149	3%
Unclassified	18	0%

Source: NOAA Coastal Change Analysis Program (C-CAP) Land Cover Data, NOAA Ocean Service, Coastal Services Center (CSC), 2006.

Forests

Forests are wooded areas in which trees are the dominant vegetation type. In this chapter, wooded areas are considered forested if their trees at least five meters tall occupy more than 20 percent of the land area (NOAACSC, 2007). Dutchess County forests are mostly deciduous, but there are also some significant areas of coniferous and mixed forest.

Deciduous Forest

Deciduous forests (dominated by maples, hickory, oak, ash, birch) occur throughout the county and are the dominant forest type. The 1985 NRI differentiated lower slope, mid-slope, and upper slope deciduous forest. All have forest canopies dominated by the tree families noted above, although

proportions vary. Understory vegetation also varies: at low elevations, common species include spice bush, honeysuckle, dogwood, grape, and Virginia creeper; at higher elevations common species include mountain laurel and blueberry.

Deciduous forests grow over much of the county, but notable areas of expansive, unfragmented forest include the Hudson Highlands, the Taconic Highlands, and the Wappinger Creek headwaters area of north-central Dutchess County. Among these forests, wooded wetlands can have particular value for birds, mammals, invertebrates, and specialized plants, as noted above. Much of this forest is second-growth, and 75 years after agriculture it may still retain an understory, soil, and herbaceous characteristics that are still developing toward mature old-growth conditions. Mature deciduous forest may contain a greater richness of spring ephemeral flowers as well as a richer soil microbial community, mushrooms, and other characteristic woodland flora and fauna.

Species of interest for conservation include a variety of spring ephemeral flowers (Figure 6.1), eastern box turtle, wood frogs, salamanders, woodland warblers, woodpeckers, American turkey, and Indiana bat http://www.sustainablesites.org/report/). Sugar maple, a traditional dominant, is a species of concern because it is widely being displaced by the similar-looking Norway maple. Less common but notable species include the Cooper's hawk, barred owl, pileated woodpecker, black bear, bobcat, and southern flying squirrel.

Photo credit: Tom Finkle

Figure 6.1. Spring ephemeral flowers such as this Dutchman's Britches (*Dicentra cucullaria*) grow mainly in undisturbed deciduous forest with a healthy understory.

Coniferous and Mixed Forest

Dutchess County contains some conifer plantations as well as scattered naturally occurring coniferous stands. Plantations consist of more uniform stands of Scotch pine, red pine, European larch, and Norway spruce, while natural stands include eastern hemlock, white pine, and eastern red cedar. Coniferous forests provide important habitat for a variety of mammals, including winter

shelter for white-tailed deer. Some species of owls and hawks utilize coniferous forests for roosting and nesting, because the dense foliage provides secure cover year round. Many songbirds also nest in coniferous forests.

Mixed forests comprise a combination of deciduous and coniferous tree species, where neither type is dominant (NOAACSC, 2007). White pine, red cedar, and hemlock are common conifers in mixed forest stands, as well as maple, oak, hickory, and other deciduous trees.

Grasslands and Shrublands[3]

Open habitats in Dutchess County are dominated by grasses and by herbaceous plants (goldenrod, asters), shrubs (blackberry, multiflora rose, juniper, sumac), and scattered early successional trees (red cedar, gray birch, white pine, quaking aspen). These open areas are less abundant than in previous decades, owing to the regrowth of tree cover noted above. These habitats generally include plant types that readily occupy disturbed environments, since many remain open beause of haying or grazing. Although grasslands and shrublands are often considered temporary or transitional in our region, they can be of great ecological interest as they support birds, butterflies, fireflies, distinctive grassland plants, and other flora and fauna of interest.

Grasslands

This category includes areas dominated by grassland and other herbaceous species, including hayfields, pasture, and croplands. Habitat values in these areas vary by the type of vegetation present and the type of disturbance to which they are subjected. Infrequently mowed hayfields, for example, may support grassland breeding birds while cultivated croplands may have little habitat value. However, when left undisturbed, pastures, hayfields, and croplands tend to develop similar characteristics as diverse species of grasses, forbs, and shrubs colonize and create habitat for a variety of wildlife species, including invertebrates, reptiles, mammals, and birds.

Shrublands

Shrublands are upland areas dominated by woody vegetation less than 5 meters in height (NOAACSC, 2007). Shrublands represent an intermediate stage of ecological succession, or transition from abandoned fields, pasture, or cropland to forest. Forest is considered the climax

[3] The primary source of this information can be found in Hudsonia's "Biodiversity Assessment Manual for the Hudson River Estuary Corridor" by Kiviat and Stenvens (2010).

ecological community in this region of the country, since open areas left undisturbed will eventually develop into mature forests. Typical shrubland plant species include goldenrod, aster, orchard grass, gray dogwood, multiflora rose, black raspberry and many other shrubby species. Some bird species, such as northern mockingbird and American robin, nest in shrublands. Several state and federal-listed birds can be found utilizing shrublands, including northern harrier, golden-winged warbler, and grasshopper sparrow. Many butterflies may be present as well.

ECOLOGICAL REGIONS[4]

Ecological regions denote areas of general similarity in ecosystems and in the type, quality, and quantity of environmental resources (Bryce et al., 2010). Dutchess County is comprised of six ecological regions: Hudson Valley, Taconic Foothills, New England Marble Valleys, Hudson Highlands, and Berkshire Transition (Map 6.3). Each ecological region has unique characteristics that structure the ecosystems they contain. Local officials can use ecological regions to help determine which of the habitats described in the previous section may be found in their community, identify priority habitats for conservation, become aware of their important or unique characteristics (such as the presence of rare or threatened species), and develop appropriate conservation and management strategies.

The remainder of this section includes a brief description of each ecological region in Dutchess County, with suggested priority habitats for conservation.

Hudson Valley

The Hudson Valley ecological region in Dutchess County extends along the entire western boundary of the county, encompassing all or most of the area of each municipality along the Hudson River, including the county's two urban centers, the Cities of Poughkeepsie and Beacon (Map 6.1). One of the county's main transportation corridors and its most developed urban corridor, U.S. Route 9, runs north and south through this ecological region.

[4] The primary source of this information can be found in the references section of this chapter, "Ecoregions of New York" by Bryce et al. (2010).

The Hudson Valley consists of plains broken by hills and terraces, with a narrow floodplain along the Hudson River. Low elevations and the moderate climate of the Hudson Valley allow Appalachian oak-hickory forest, with black and white oak and pignut, mockernut, and shagbark hickories, to penetrate northward. Some of the Appalachian species are at the northern extent of their distribution, but as the climate warms they are expected to expand their range into areas now dominated by northern hardwoods. Common land uses include pasture and cropland, deciduous forest, mixed deciduous and evergreen forest, major urban, suburban, and rural residential land.

Freshwater tidal marshes and mudflats occur along the river, with Tivoli Bays just south of the Village of Tivoli being the largest and most ecologically significant in Dutchess County (Map 6.1). Estuarine species include shortnose sturgeon, American eel, and American shad.

Priority habitats: tidal aquatic communities, streams, wetlands, contiguous forest, open grasslands.

Taconic Foothills

The Taconic Foothills form a transition zone between the Hudson Valley and the Hudson Highlands to the south, and the Western New England Marble Valleys, the Berkshire Transition, and Taconic Mountains to the east and northeast. It extends northward into Columbia County and along the eastern boundary of the Hudson Valley ecological region. The foothills therefore have a more rounded and rolling profile than the upended Taconic Mountains, but also contain narrow valleys with steep slopes, which are drained by moderate gradient bedrock, boulder, and cobble-bottomed trout streams. Some natural lakes and ponds occur throughout the region, but many have been created by small dams.

Appalachian oak-hickory forest dominates this ecological region in Dutchess County, with some northern hardwoods (maple-beech-birch). Hemlock forests can be found on northern slopes and in narrow valleys with steep slopes. Stands of red maple, eastern white pine, and sugar maple are often found colonizing abandoned farm fields. The land use mosaic in the Taconic Foothills consists of woodland, pasture, minor areas of cropland, and rural residential development. In Dutchess County, the southern portion of this ecological region is significantly more developed than the northern area, which contains more forested and agricultural lands (Map 6.1: CCAP habitat data map).

Priority habitats: Contiguous Forest, Seasonal Woodland Pools, Grasslands (including pasture), Streams and Intermittent Streams

Hudson Highlands

This ecological region extends from the southwest corner of Dutchess County, through the southern portions of Fishkill, East Fishkill, and extending north along the boundaries of Beekman and Pawling, Union Vale, and Dover.

The Hudson Highlands ecological region is a low portion of the Appalachian Mountains between the mid-Appalachians and the Berkshires and Green Mountains in New England. It is comprised of hills and low mountains, with steep narrow valleys and lakes, some containing fish or functioning as drinking water reservoirs. Streams have moderate gradients with boulder and cobble-bottom substrates, containing trout or cool enough to support trout. Naturally acidic runoff plus acid deposition from upwind industrial sources put the Hudson Highlands' lakes at risk for future harm to aquatic life from acidification.

Bedrock outcrops are common. Soils are shallow, rocky and highly acidic. As a result, the Hudson Highlands region is mostly forested with Appalachian oak-hickory on drier sites and northern hardwoods and hemlock on north slopes and moist sites. Transition hardwood forests of sugar maple, American beech, black birch, tulip tree, oaks (red, white, and chestnut oak) and hickories (shagbark and pignut hickory) are dominant.

The forested highlands provide an important natural buffer zone and an outer boundary for the New York City megalopolis. These lands have long been recognized by conservation groups as important for wildlife habitat, tourism, and recreation. While there is some rural residential development in the Hudson Highlands, most of the region in and outside of Dutchess County is forested; much of it is protected in state parks or privately-owned conservation land. A 16-mile stretch of the Appalachian Trail passes through the Hudson Highlands region.

Priority habitats: Contiguous Forest, Cliff Habitats, Streams and Intermittent Streams

Western New England Marble Valleys

Portions of the Western New England Marble Valleys exist in two separate areas of Dutchess County. From the north, this ecological region covers much of Pine Plains and part of Stanford in northern Dutchess County. The other part of this region lies in the Harlem Valley, which extends through the towns on the county's eastern boarder with Connecticut and Massachusetts (Map 6.4).

Steep-sided valleys with floodplains, terraces, and rolling to hilly terrain characterize this region. Streams have low to moderate gradients with bedrock, boulder, cobble, and sandy substrates. Springs, seeps, and wetlands are common, with few lakes and reservoirs.

Wetland habitats in the Western New England Marble Valleys are common, and include diverse swamps, floodplains, and calcareous fens. One of the largest wetlands in the Hudson Valley, the Great Swamp, covers an area of almost 2,000 acres in the Town and Village of Pawling as well as southern Dover (NYS Dept. of Environmental Conservation, 2007). Another critical wetland habitat in this ecological region is Thompson Pond in Pine Plains, a rare example of a circumneutral bog lake. These spring-fed water bodies support vegetation typical of both acidic bogs and calcareous marshes, and contain habitat for a variety of rare and uncommon species (Kiviat and Stevens 2001).

Woodland habitats in the Western New England Marble Valley consist of northern hardwoods (maple-beech-birch) and species-rich transition hardwoods (maple-beech-birch, Appalachian oak-hickory forest). Hardwood species include sugar maple, white ash, basswood, bitternut hickory, hophornbeam, and alternate-leaved dogwood. Calcareous rock outcrops contain eastern red cedar, purple clematis, and roundleaf shadbush.

Land use in the Western New England Marble Valley is a mosaic of pasture and cropland, mixed and deciduous forest, urban, suburban, and rural residential development and rock quarries.

Priority habitats: Contiguous Forest, Grassland, Swamps, Calcareous Fens, Calcareous Rock Outcrops, Floodplains, Streams and Intermittent Streams

Berkshire Transition

A small portion of this ecological region lies within New York near the border with Connecticut. The Berkshire transition is comprised of low mountains and narrow valleys, with some steep slopes. Its streams have moderate gradients, with bedrock, boulder, or cobble substrate. There are some natural lakes and ponds, and a few larger reservoirs.

Forest types resemble those in the Hudson Highlands. Northern hardwoods (maple-beech-birch), hemlock, and white pine are mixed with a species-rich Appalachian oak-hickory forest in warmer microclimates. Northern hardwoods and hemlock-white pine forest occur on dry to mesic – mostly north-facing – slopes and ravines. Red oak-sugar maple transition forests are found on mesic mid-slopes with northern red oak, sugar maple, beech, black birch, and some white pine and hemlock. Oak-hemlock-white pine forests include white oak, chestnut oak, northern red oak, and black birch. Some ridgetop habitats with pitch pine-scrub oak woodland can be found. On steep slopes and terraces, red maple, silver maple, American elm, basswood, sugar maple, shagbark hickory, and black cherry occur.

Land uses include a mix of forestry, hay/pasture, rural residential, tourism, recreation, and some urban land as well as some public state forest and state park lands.

Priority habitats: Contiguous Forest, Streams and Intermittent Streams, Seasonal Woodland Pools

Taconic Mountains

On the eastern border of New York, the highest ridges of the Taconics gradually descend to the more gently rolling Taconic Foothills (58x) and Hudson Valley (59i) ecological regions (Map 6.4). The Taconics consist of low mountains and high hills, gently rounded to steep slopes, and narrow valleys. Streams have moderate to high gradients, with bedrock, boulder, and cobble-bottomed substrates. Wild rainbow trout inhabit many streams. There are some springs and caves, and few to no lakes.

Forest vegetation consists of northern hardwoods (maple-beech-birch), with small areas of spruce-fir at higher elevations. Oak and hickory predominate throughout in the south and on south-facing

slopes and at lower elevations in the north. Population centers are limited by the prevalence of steep slopes and incised valleys that are typically too narrow for profitable agriculture.

Land uses include deciduous forest, mixed deciduous and evergreen forest – for forestry, recreation, and hunting – as well as some minor pasture and cropland in narrow valleys.

Priority habitats: Contiguous Forest, Streams and Intermittent Streams, Seasonal Woodland Pools

HISTORIC CHANGES AND CURRENT THREATS TO BIODIVERSITY

The dominant trends in biological resources in the past century have to do with economic shifts, primarily the growth and decline of farming, followed by regrowth of forests on old fields, then expansion of suburban land uses into former farm fields, orchards, and woodlands. In this section we highlight some details and results of these changes.

Historic Changes in Population and Land Use

Dutchess County's population has grown steadily since European settlement, with notable increases in the 1950s and 1960s (Figure 6.2). This change has resulted in clearing for farmland, followed by substantial field abandonment in the 1940s. These changes can be observed in historic photographs, some of which have been made available by Dutchess County Office of Computer Information Systems. These photos capture the county during the decline of agriculture in the 1920s and before the post-war housing boom of the 1950s (Figure 6.3). Preliminary analysis of these photos has shown that tree cover in the county as a whole has increased by approximately 140 percent from 1936 to now**.** (Table 6.

An important recent trend in land use have been dominated by expanding developed land, in particular housing, commercial, and transportation activities. These land uses increasingly occur in away from urban centers, as residents increasingly want, and can afford, large lot sizes, larger houses, and longer commutes to work. In the past 10-15 years, roughly one-third of new houses have been built on lots 2 acres or larger—a dramatic transition from the 1960s and 1970s (Figure 6.4). The implications of this change for biodiversity in the county include (but are not limited to) greater

fragmentation of habitat, road hazards to wildlife, increasing opportunities to invasive species to colonize new areas.

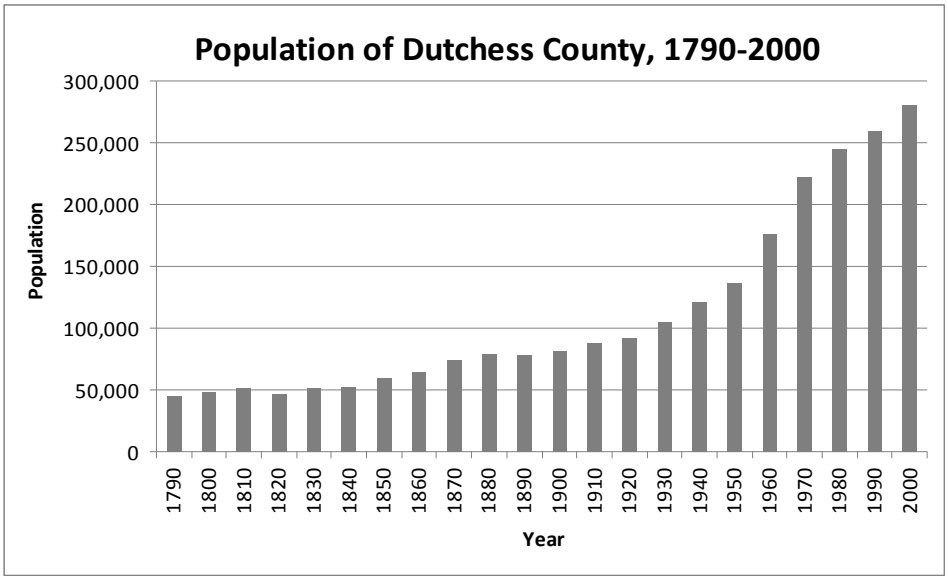

Figure 6.2: Population Growth in Dutchess County from 1790-2008. (from U.S. Census)

Figure 6.3. Land use changes in Dutchess County, 1936 and 2009. Table 6.3 provides as summary of key changes.

Table 6.3: Changes in forest cover and orchards, and roads from 1936 to 2000.

Land use class	1936	2000	Percentage change
Forest	75,410 ha	116,300 ha[1]	+54%
Orchards	5120 ha	1202 ha[2]	-77%
Roads	2,867 km	4,609 km[3]	+61%

Sources: Unpub. data, M.A. Cunningham; GIS data from Dutchess County Planning, Dutchess County Office of Computing and Information Services
[1] (2000 aerials)
[2] (EMC LUNR 1998)
[3] (DC Road Centerline – 2004)

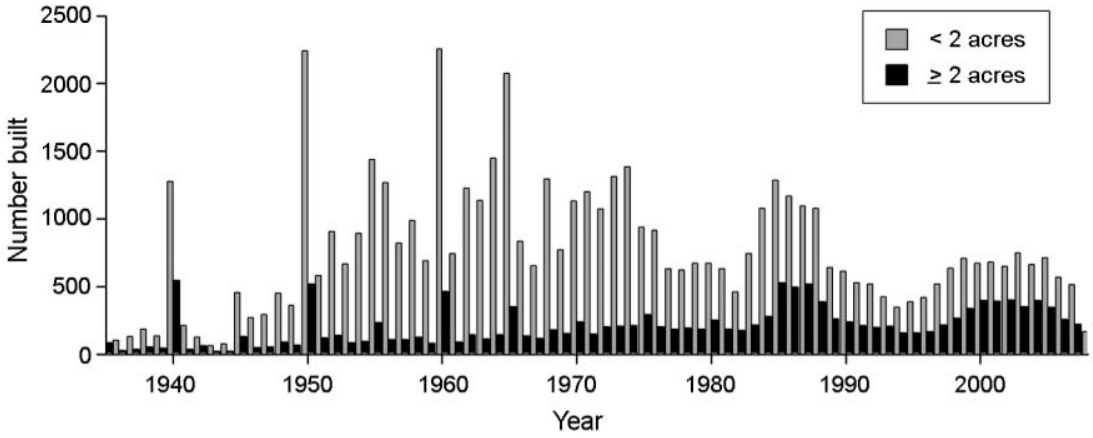

Figure 6.4: Number of houses built in a year, on small lots and large rural lots, from RPS4 data, 2008. Peaks at decades (e.g. 1940, 1950) include records for which build dates were rounded or estimated. (RPS4 2008 data; Cunningham et al. 2009.)

Changes in Biodiversity

Historic shifts in biodiversity have occurred in response to a variety of factors, chief among them: changing land use, human settlement, and climate change. Systematic long-term records are available for few taxonomic groups. One exception is bird populations, which have long been monitored by skilled volunteer birders. For Dutchess County, these records have been kept by the Waterman Bird Club (http://www.watermanbirdclub.org/). Plots of the group's May census data produce several distinctive trends. Many woodland and yard birds have increased as woodland habitat and suburban environments have expanded (for example the tufted titmouse, Figure 6.5). Another evident trend seems to be an increase in populations of southern species, such as northern cardinal, Carolina wren, and red-bellied woodpecker. Populations of many open country birds, such as grasshopper sparrow

and eastern meadowlark, have declined in recent decades, reflecting a decline in grassland habitat availability. However, some open country birds have remained relatively stable, possibly those that can tolerate relatively small fragments of open country (bobolink, savannah sparrow).

Mammal population shifts parallel those in the Hudson Valley as a whole. These shifts have included declines in habitat specialists, including amphibian species and turtles, and declines in many invertebrates, including some migratory species such as monarch butterflies. Trends have also included increasing populations of white-tailed deer, which thrive on wooded edges and in suburbs, as well as raccoons and opossums and coyotes, which adapt readily to suburban and urban conditions.

Amphibian populations are of concern because they are known to be declining globally and nationally. Causes of declines generally include habitat loss, chemical contamination (for example, from agricultural pesticides), introduced pathogens, road mortality, predation, and possibly other factors. The North American Amphibian Monitoring Initiative, founded in 2000, has been collaborating with the DEC to assess and monitor Hudson Valley amphibians since 2008. Thus little local information is available, but reasons for concern for amphibians are well established.

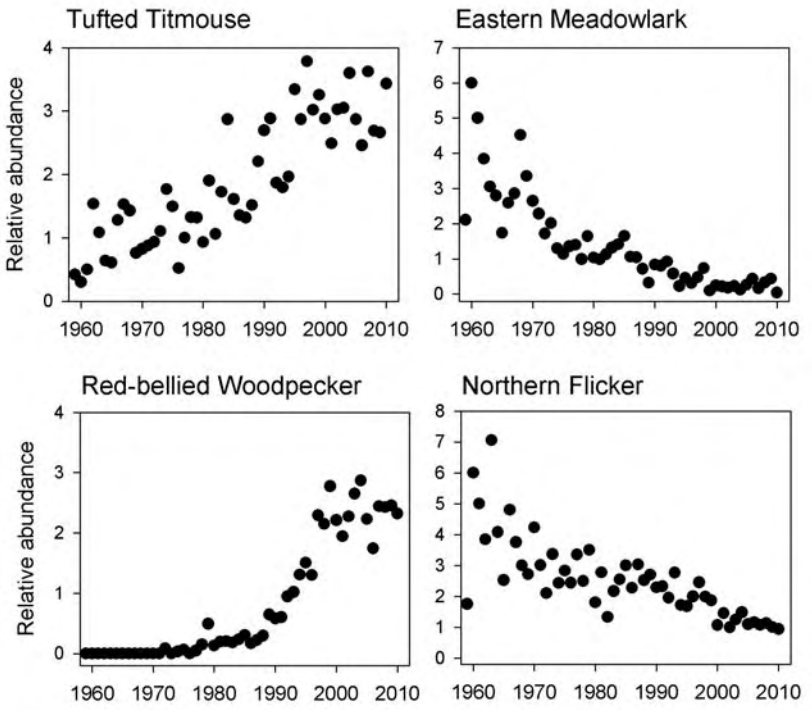

Figure 6.5: Relative species abundance, 1959-2010. Trends in woodland bird populations are consistent expansion of tree cover in Dutchess County, as well as increases in suburban yard birds (e.g., Tufted Titmouse, Red-bellied Woodpecker). Open grassland, farmlands, and hayfields have declined, as have open-country birds (e.g., Western Meadowlark, Northern Flicker).[5]

Current Threats to Biodiversity

Habitat Loss

Habitat loss is perhaps the most important cause of lost biodiversity globally. In Dutchess County, the nature of habitat loss is primarily the loss of unfragmented forest, resulting from expansion of suburbs, and decline of open hay fields and pastures. Fragmentation of expansive habitat areas is a special case of habitat loss: some species are understood to survive most readily within core areas of large woodlands or grasslands. For these species, expansive woodland provides suitable habitat; for those that don't require habitat, unfragmented habitat also supports larger populations and promotes genetic diversity, compared to isolated and fragmented populations.

Invasive and Exotic Species

The spread of invasive plant species, especially vine types, is also a dramatic trend in recent years. In particular there is mile-a-minute, porcelain berry, Asiatic bittersweet, Japanese knotweed, and

[5] Graphs from May census data, http://watermanbirdclub.org. To estimate relative abundance over time, it was necessary to adjust for increasing detection rates (more birds counted per observer) over time. Thus Y axes show species counts divided by the third quartile of all species counts in a year, not actual counts. The third quartile was used to normalize counts because the mean is weighted by large outliers, while the median varies little over time, owing to large numbers of 0 counts each year. Graphs created from R.T.Waterman Bird Club data by M.A. Cunningham, 2010.

Japanese stiltgrass. Many previous invaders, such as ailanthus (tree of heaven), purple loosestrife, and leafy spurge, have become established as part of the local community. Invasive species include animals and pathogens, as well. European starlings, house sparrows, rock pigeons, and house finches are common, introduced urban birds. Pathogens are important invaders, as well. Lyme disease is a pathogen that has spread through the region in the recent decades, and tree pathogens such as Dutch elm disease and beech blight have dramatically altered the composition of Dutchess County forests. New invertebrate invaders, including the Asian long-horned beetle and the emerald ash borer, may cause the next round of ecological transitions in our region. At the time of writing, the emerald ash borer is present in western NY and Ulster County but has not yet been recorded in Dutchess County. How this and others will modify forest conditions remains to be seen.

Biotic Impacts

Impacts of predation, herbivory, and competition among resident species can alter habitats and biological communities. Predation by "subsidized predators," or predators aided by human settlement, including house cats, raccoons, skunks, or coyotes, can impact survival of birds, turtles, amphibians, and other animals. White-tail deer might be called subsidized browsers, as they thrive on forest edges, lawns, and gardens of suburban areas. Impacts of deer browsing on the forest community include dramatic reduction of understory habitat and groundcover, which provides essential nesting cover for many birds. Deer also alter forest tree composition, as they selectively browse the most palatable seedlings, such as sugar maple and yellow birch, and leave behind less palatable species, such as Norway maple and American beech. Many subsidized predators and herbivores are aided not only by their ready adaptation to human settlement but also by removal of natural predators, such as wolves.

Wetland loss

Destruction of wetlands is legally restricted for those greater than 12.4 acres (5 hectares), and a 100 foot buffer around these wetlands, but smaller wetlands remain vulnerable to development and drainage. These are a particular concern for seasonal woodland pools, which may be invisible to the eye for much of the year. Often these wetlands occur as wetland complexes with extensive underground interconnections. Development of nearby upland areas can interfere with subterranean flow, increase the rate of runoff, or introduce contaminants to these wetland complexes.

Damage to riparian zones

Loss of stream-side (riparian) zones can alter in-stream habitats by increasing sediment, chemical, and salt inputs into streams. Riparian zones are critical environments for upland species, such as birds that nest and forage in stream-side shrubs, as well as for in-stream organisms such as turtles, frogs and invertebrates. Riparian habitat is especially important in urban areas, where water and undisturbed shrub environments are otherwise uncommon. Normally the riparian zone is protected from new development in local master plans or comprehensive plans. But the width of the riparian zone is defined differently by different localities (see NRI Chapter 5: Water Resources). Minimum standards are frequently 25 feet, but a buffer of 100 feet or more is of value for stream health and for habitat provision in the riparian corridor. Runoff of nutrients, sediment, and other contaminants is affected by amounts of development within 300 feet or more (Cunningham et al., 2010). Loss and degradation of these habitats remains an important consideration in biodiversity conservation beyond the stream corridor itself.

Water contamination

Water quality affects the health, biodiversity, and composition of in-stream biotic community, even in relatively undeveloped areas. Principal contaminants in surface waters in Dutchess County include road salt, excess nutrients (which increase algae populations), and sediment, and high temperatures. Road salt has widespread impacts because roads are widely distributed across the county. In general, salt levels in streams increase proportionally as the area of roads and other impervious surfaces increase (Cunningham et al., 2009), so that urbanized areas have high salt levels and rural areas have low to moderate salt levels. Salinity affects the survival of invertebrates and other instream organisms that require clear, fresh water. Nutrients from waste treatment plants, fertilizers, septic systems, and leaking sewer systems, can reduce in-stream biodiversity by causing excessive growth of algae in streams and ponds. Sediment, such as sand or silt, derives from exposed soil or from pavement, and constant sediment influx can smother rocky habitat in the substrate and maintains an unstable stream bed. In-stream biotic diversity is also degraded by warm temperatures, which result from extensive pavement and from turbidity in water that absorbs solar heat. Reduced riparian vegetation also exposes streams to solar heating and raises temperatures. (For further discussion on water quality, see NRI Chapter 5: Water Resources.)

Climate Change

Warming winters, longer summers, and possibly deeper droughts in summer are already having important impacts on biological communties in our area, although at present many of the observations are anecdotal. Impacts on biodiversity are likely to involve northward shifts in populations of vegetation, animals, and diseases or parasites that affect wildlife or plants, as well as increased prevalence of invasive species. In many areas of New York, including Dutchess County, cold winters previously prevented the survival of many invasive species, which can cause dramatic shifts in habitat and biotic communities. Examples include deer ticks and tick-borne diseases, or the wooly adelgid, a minute aphid-like insect that has depleted hemlock stands in warm climates. Forest composition is expected to change considerably as a consequence of climate change. For further details, see NRI Chapter 2: Climate and Air Quality.

IMPLICATIONS FOR DECISION-MAKING

Communities can use the ideas outlined above to identify priority habitats or species, contiguous habitat areas, or other important areas that are biologically important. Communities should then prepare to work with landowners in developing plans for clustered development, for low-impact design, or other strategies that can support biological diversity on private lands.

Communities can also work within the various policy frameworks that protect biodiversity. Biological resources are protected by laws at the federal and state level, as well as by policies outlined in local comprehensive plans. In this section we identify some of the legal frameworks and policies that can be useful for decision making when planning for biodiversity conservation.

Developing policy for biodiversity conservation

While laws to protect biodiversity have been enacted at the federal and state level, New York is a home-rule state, which means that local municipalities hold considerable power to set land use policies, to outline plans for biodiversity protection, and to regulate land use. Thus local areas are legally empowered to make decisions, but they also have responsibility for policy making through zoning and local planning processes. Citizens can wield considerable influence by attending local planning meetings, municipal council meetings, and zoning board meetings.

Municipal and county comprehensive plans outline the general intent regarding development and land use. Development plans can then be evaluated on whether or not they are consistent with an accepted plan. Examples of master plans, with statements of intent for open space and biodiversity conservation, can be found on line, such as those from the Town of Clinton, the Town of Beekman, or the Town of Poughkeepsie. In principle, plans are to be revised approximately every decade, and these revision processes are points at which local residents can weigh in on priorities they would like to see established in the town plan.

While a master plan, or comprehensive plan, lays out the intent of a community, the zoning code identifies legally enforceable rules for land use. Zoning codes are usually available online for each town in Dutchess County. Exceptions and appeals to zoning rules are frequently discussed by town Zoning Boards, and these board meetings can provide important opportunities for citizens to learn about or influence local land use decisions.

In addition to these policy settings, there are many additional opportunities for municipalities to influence biodiversity protection or to seek aid in projects that can support local biodiversity. These include policies and organizations such as the Hudson River Greenway Compact, the Hudson River Watershed Alliance, the Open Space and Farmland Protection Plan, and many others.

In addition to these policies and legal structures, habitat conservation strategies include conservation easements and transfer of development rights. Conservation easements are clauses attached to deeds that restrict future development. Transfer (or purchase) of development rights involves payment to landowners today to control development rights in the future. Alternatively, development rights can be exchanged from one property to another. As with conservation easements, a non-profit organization normally purchase or holds development rights. A review of these options has been provided by Hudsonia, Inc.

Legal protections

The principal legal mechanism for environmental review in New York is the State Environmental Quality Review (SEQR). Like the federal government's Environmental Impact Statement, a SEQR study identifies probable environmental impacts and outlines how a project will address those impacts. State, county, and local governments can act to enforce the SEQR process. In addition,

since 2005, all environmental impact statements must be posted online for public access. Thus citizens have access to examine the contents of review findings.

The importance of biodiversity for its own sake has been acknowledged in the formation of legal codes that protect species and their habitat. There are legal protections for rare, threatened, and endangered, and migratory species, in efforts to minimize threats to biodiversity. Agencies that administer these regulations usually also provide assistance to landowners. Because landowner participation is so important in conservation in the New York, the US Fish and Wildlife Service and other agencies are charged with helping landowners design conservation plans, devise plans for development that maximize habitat conservation, and provide grants for assistance in habitat conservation.

Biodiversity is protected most specifically at the federal level by the Endangered Species Act of 1973, which defines and lists rare, threatened, vulnerable, and endangered species both nationally and regionally. The ESA also provides assistance in planning for habitat conservation, and it provides a framework for enforcing species protection laws if necessary. The Migratory Bird Treaty Act of 1918 is one of our earlier landmark species protection laws that allows for protection of wild birds. These and other federal policies can provide the most general policy protection for biodiversity in our area, if local polices prove insufficient.

RESOURCES FOR ADDITONAL INFORMATION

A wealth of resources are available for understanding biodiversity in our region, including (but not limited to) documents from the New York DEC (http://www.dec.ny.gov/lands/5094.html), the New York Natural Heritage Program (http://www.dec.ny.gov/animals/29338.html), and education programs from Hudsonia Ltd. (http://hudsonia.org/education). The New York Natural Heritage Program in particular documents species and their habitats, as well as providing conservation guides and fact sheets about individual species' needs. Strong (2008), in cooperation with the DEC and Cornell Cooperative Extension, has provided many of the arguments and justifications for understanding how to plan for biodiversity conservation in the Hudson River Valley.

Educational institutions and community organizations are also resources for understanding local biodiversity. The Cary Institute of Ecosystem Studies, Cornell Cooperative Extension Dutchess County, the New York DEC (field station at Norrie Point, Stony Kill Farm), and local colleges are among the many institutions in our area that offer public talks, ecology walks, and training sessions. Citizen groups such as the Ralph T. Waterman Bird Club (http://watermanbirdclub.org) and local watershed groups (http://dutchesswatersheds.org) hold educational events and nature walks that attract people from within the county and beyond it.

- **NYS DEC Species Conservation overview**: http://www.dec.ny.gov/animals/279.html
- **Dutchess County Greenway Guides:** http://www.co.dutchess.ny.us/CountyGov/Departments/Planning/17329.htm
- **Dutchess County Planning and Development:** http://www.co.dutchess.ny.us/CountyGov/Departments/Planning/PLIndex.htm
- **New York Natural Heritage Conservation Guides:** http://www.acris.nynhp.org/

Conservation guides are comprehensive fact sheets about individual rare species and natural community types that are designed to help land managers, decision-makers, planners, scientists, consultants, students, and the interested public better understand the biodiversity that characterizes New York. Conservation Guides include information on biology, identification, habitat, distribution, conservation, and management. Guides are completed for many of New York's rare species and natural community types, and more are continually being added to the Guides website.

- **NYS DEC Ecological Community Information:** http://www.dec.ny.gov/animals/29338.html

Ecology staff assess and delineate New York's natural communities which are variable assemblages of interacting plant and animal populations that share a common environment.

- **Northern Wallkill Biodiversity Plan:** http://www.ecostudies.org/mca/13_Northern_Wallkill_Biodiversity_Plan.pdf

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- **Hudsonia Ltd.:** (http://hudsonia.org/education).

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Appendix 1. Animal, plant, and habitat guides listed for Dutchess County by the NY Natural Heritage Program. Species are not distinguished here by status designations (such as rare, threatened, or vulnerable). See guides linked below or the NYNHP website for further details. Source: NYNHP http://www.acris.nynhp.org/search.php.

Animal Guides
Sort by: -Common Name- -Scientific Name-

 **A Noctuid Moth** *Fagitana littera*	 **Alewife Floater** *Anodonta implicata*	**Atlantic Needlefish** *Strongylura marina*
Atlantic Sturgeon *Acipenser oxyrinchus*	 **Bald Eagle** *Haliaeetus leucocephalus*	 **Barn Owl** *Tyto alba*
 **Blanding's Turtle** *Emydoidea blandingii*	 **Bog Turtle** *Glyptemys muhlenbergii*	 **Common Loon** *Gavia immer*
 **Dwarf Wedgemussel** *Alasmidonta heterodon*	 **Eastern Pondmussel** *Ligumia nasuta*	 **Eastern Spadefoot** *Scaphiopus holbrookii*
 **Fence Lizard** *Sceloporus undulatus*	 **Golden Eagle** *Aquila chrysaetos*	 **Great Blue Heron** *Ardea herodias*
 **Indiana Bat** *Myotis sodalis*	 **Kentucky Warbler** *Oporornis formosus*	 **King Rail** *Rallus elegans*
 **Least Bittern** *Ixobrychus exilis*	 **Mocha Emerald** *Somatochlora linearis*	 **New England Cottontail** *Sylvilagus transitionalis*
 **Northern Cricket Frog** *Acris crepitans*	 **Northern Harrier** *Circus cyaneus*	 **Northern Metalmark** *Calephelis borealis*
 **Peregrine Falcon** *Falco peregrinus*	 **Pied-billed Grebe** *Podilymbus podiceps*	 **Russet-tipped Clubtail** *Stylurus plagiatus*
 **Sedge Wren** *Cistothorus platensis*	**Shortnose Sturgeon** *Acipenser brevirostrum*	 **Southern Leopard Frog** *Rana sphenocephala*
 **Spatterdock Darner** *Rhionaeschna mutata*	 **Tawny Emperor** *Asterocampa clyton*	 **Timber Rattlesnake** *Crotalus horridus*
 **Upland Sandpiper** *Bartramia longicauda*	 **Worm Snake** *Carphophis amoenus*	 **Yellow Lampmussel** *Lampsilis cariosa*

Plant Guides

Sort by: -Common Name- -Scientific Name-


American Waterwort
Elatine americana


Back's Sedge
Carex backii


Basil Mountain-mint
Pycnanthemum clinopodioides


Black Sedge
Carex nigra


Brown Bog Sedge
Carex buxbaumii


Button-bush Dodder
Cuscuta cephalanthi


Carey's Smartweed
Persicaria careyi


Carolina Whitlow-grass
Draba reptans


Cat-tail Sedge
Carex typhina


Clustered Sedge
Carex cumulata


Davis' Sedge
Carex davisii


Delmarva Beggar-ticks
Bidens bidentoides


Dragon's Mouth Orchid
Arethusa bulbosa


Drummond's Rock-cress
Boechera stricta


Dwarf Bulrush
Lipocarpha micrantha


Estuary Beggar-ticks
Bidens hyperborea var. *hyperborea*


Fairy Wand
Chamaelirium luteum


Fernald's Sedge
Carex merritt-fernaldii


Glaucous Sedge
Carex glaucodea


Golden Club
Orontium aquaticum


Golden Corydalis
Corydalis aurea


Golden-seal
Hydrastis canadensis


Green Milkweed
Asclepias viridiflora


Gypsy-wort
Lycopus rubellus


Handsome Sedge
Carex formosa


Heartleaf Plantain
Plantago cordata


Hill's Pondweed
Potamogeton hillii


Hooker's Orchid
Platanthera hookeri


Hudson River Water-nymph
Najas guadalupensis ssp. *muenscheri*


Knotted Spikerush
Eleocharis equisetoides


Large Twayblade
Liparis liliifolia


Marsh Horsetail
Equisetum palustre


Marsh Valerian
Valeriana uliginosa


Meadow Horsetail
Equisetum pratense


Mock-pennyroyal
Hedeoma hispida


Mountain Spleenwort
Asplenium montanum


Narrow-leaved Sedge
Carex amphibola


Northern Blazing-star
Liatris scariosa var. *novae-angliae*


Northern Bog Aster
Symphyotrichum boreale


Northern Reedgrass
Calamagrostis stricta


Ogden's Pondweed
Potamogeton ogdenii


Ovate Spikerush
Eleocharis ovata


Pod Grass
Scheuchzeria palustris


Purple Milkweed
Asclepias purpurascens


Rattlebox
Crotalaria sagittalis


Reflexed Sedge
Carex retroflexa


Riverbank Quillwort
Isoetes riparia


Rough Avens
Geum virginianum


Scarlet Indian-paintbrush
Castilleja coccinea


Schweinitz's Sedge
Carex schweinitzii


Shining Bedstraw
Galium concinnum


Side-oats Grama
Bouteloua curtipendula var. *curtipendula*


Smooth Bur-marigold
Bidens laevis


Smooth Cliff Brake
Pellaea glabella ssp. *glabella*


Southern Yellow Flax
Linum medium var. *texanum*


Spongy Arrowhead
Sagittaria montevidensis var. *spongiosa*


Spotted Pondweed
Potamogeton pulcher


Stiff-leaf Goldenrod
Oligoneuron rigidum var. *rigidum*


Straw Sedge
Carex straminea


Swamp Birch
Betula pumila


Swamp Cottonwood
Populus heterophylla


Swamp Lousewort
Pedicularis lanceolata

Tinged Sedge
Carex tincta


Torrey's Mountain-mint
Pycnanthemum torrei


Two-ranked moss
Pseudotaxiphyllum distichaceum


Violet Wood-sorrel
Oxalis violacea


Virginia False Gromwell
Onosmodium virginianum


Woodland Agrimony
Agrimonia rostellata


Woolly Lip-fern
Cheilanthes lanosa


Yellow Giant-hyssop
Agastache nepetoides

Community Guides


Acidic Talus Slope Woodland


Appalachian Oak-Hickory Forest


Brackish Intertidal Mudflats


Brackish Tidal Marsh


Calcareous Cliff Community


Calcareous Red Cedar Barrens

 Chestnut Oak Forest

 Deep Emergent Marsh

 Dwarf Shrub Bog

 Floodplain Forest

 Freshwater Intertidal Mudflats

 Freshwater Intertidal Shore

 Freshwater Tidal Marsh

 Freshwater Tidal Swamp

 Hemlock-Northern Hardwood Forest

 Limestone Woodland

 Maple-Basswood Rich Mesic Forest

 Medium Fen

 Oak-Tulip Tree Forest

 Pitch Pine-Oak-Heath Rocky Summit

 Post Oak-Blackjack Oak Barrens

 Red Cedar Rocky Summit

 Red Maple-Hardwood Swamp

 Rich Graminoid Fen

 Rich Shrub Fen

 Rich Sloping Fen

 Rocky Summit Grassland

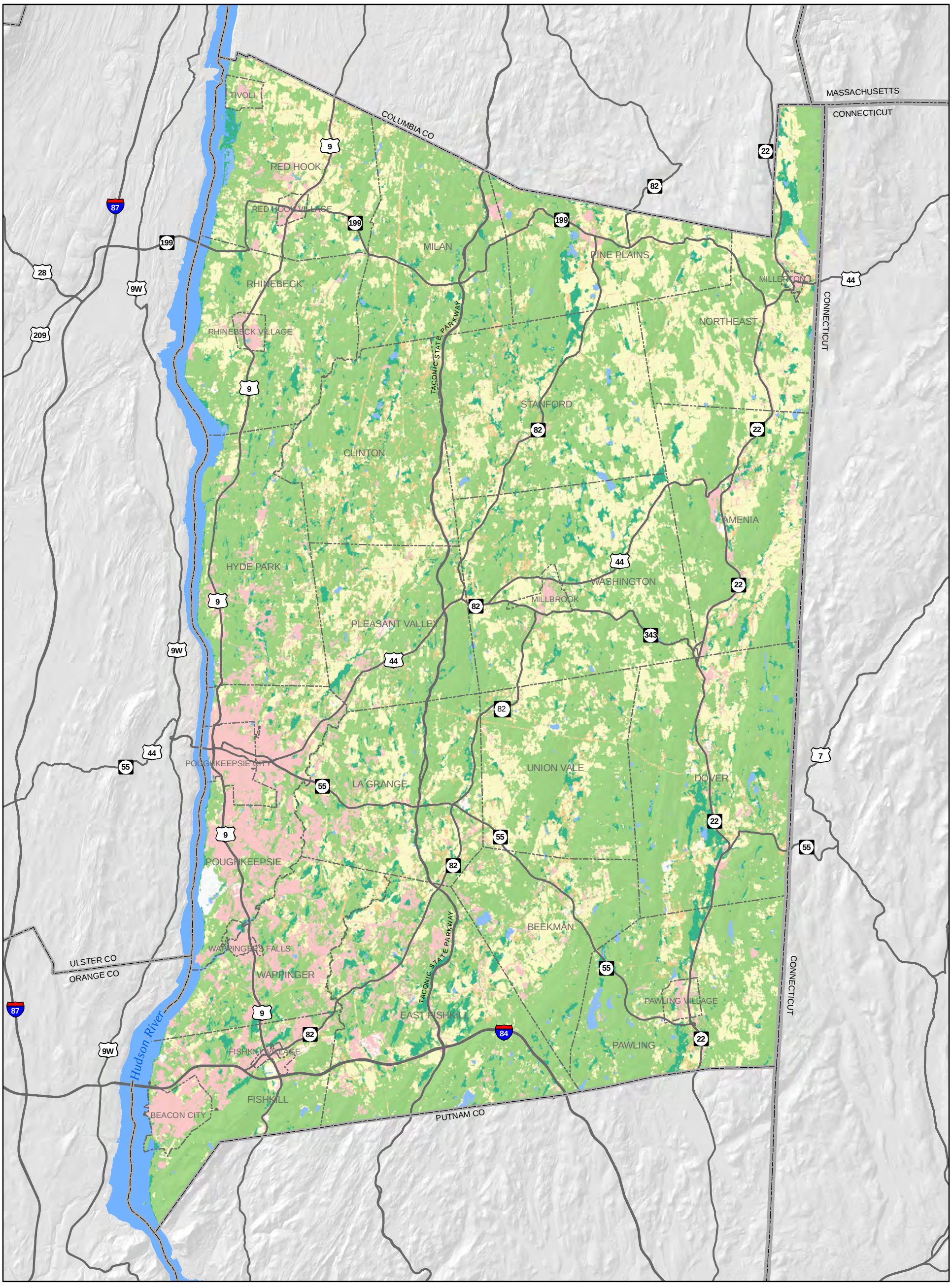
 Sedge Meadow

 Tidal River

Map 6.1: Habitat Types

Dutchess County, New York

Prepared by:
CCEDC GIS Lab, 2010



Habitat Types

- Unclassified
- Developed
- Grasslands and Agriculture
- Forests
- Shrublands
- Wetlands
- Open water

Miles
2 1 0 2
4 2 0 4
Kilometers

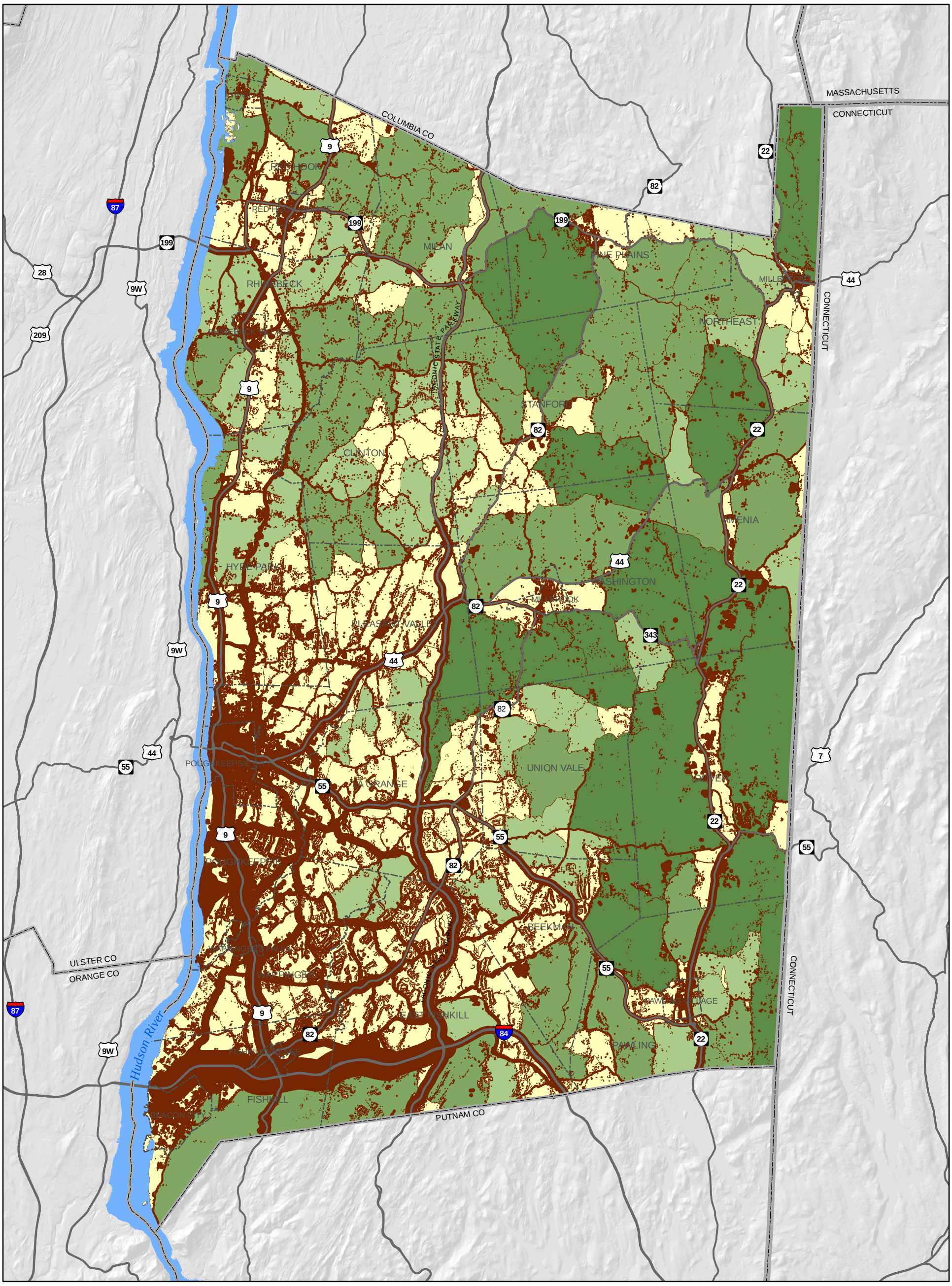
N

1:225,000

Map 6.2: Biodiversity Blocks

Dutchess County, New York

Prepared by:
CCEDC GIS Lab, 2010



Biodiversity Blocks (acres)

- > 0 - 1000
- > 1000 - 2000
- > 2000 - 6000
- > 6000

Human Activity Buffers

Miles
2 1 0 2
4 2 0 4
Kilometers

N

1:225,000

Map 6.3: Habitat Index

Dutchess County, New York

Prepared by:
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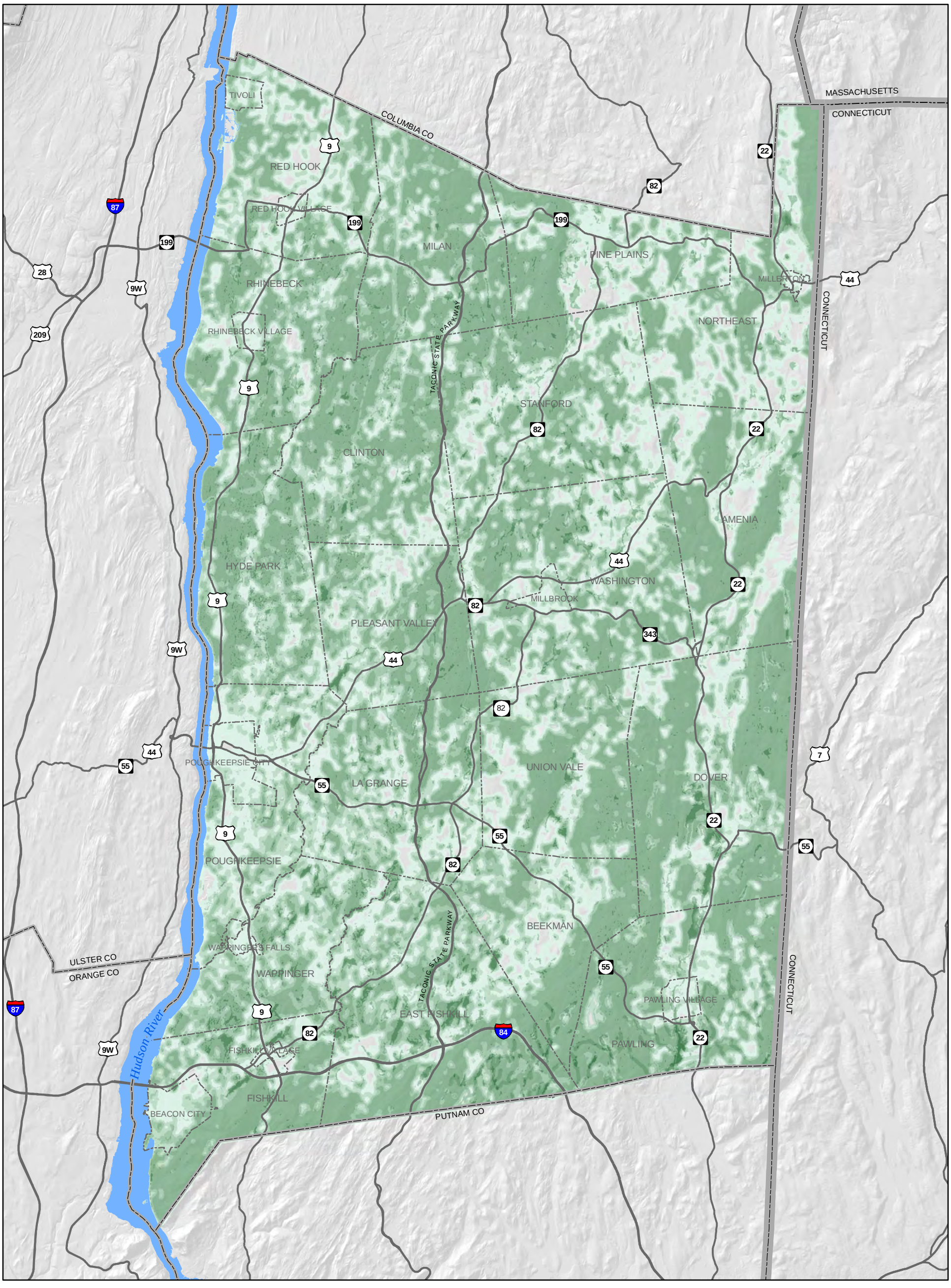

Habitat Index*

- 1
- 2
- 3
- 4
- 5
- 6
- 7

* Habitat index values represent the sum of key habitat attributes identified by Strong et al., 2008 (Table 6.1): amount of forest cover, wetlands, stream corridors, and seasonal wetlands. Dark areas represent areas of core and high value habitats, while lighter areas show edge and lower value habitats.

Miles
2 1 0 2
4 2 0 4
Kilometers

N

1:225,000

Map 6.4: Ecological Regions

Dutchess County, New York

Prepared by:
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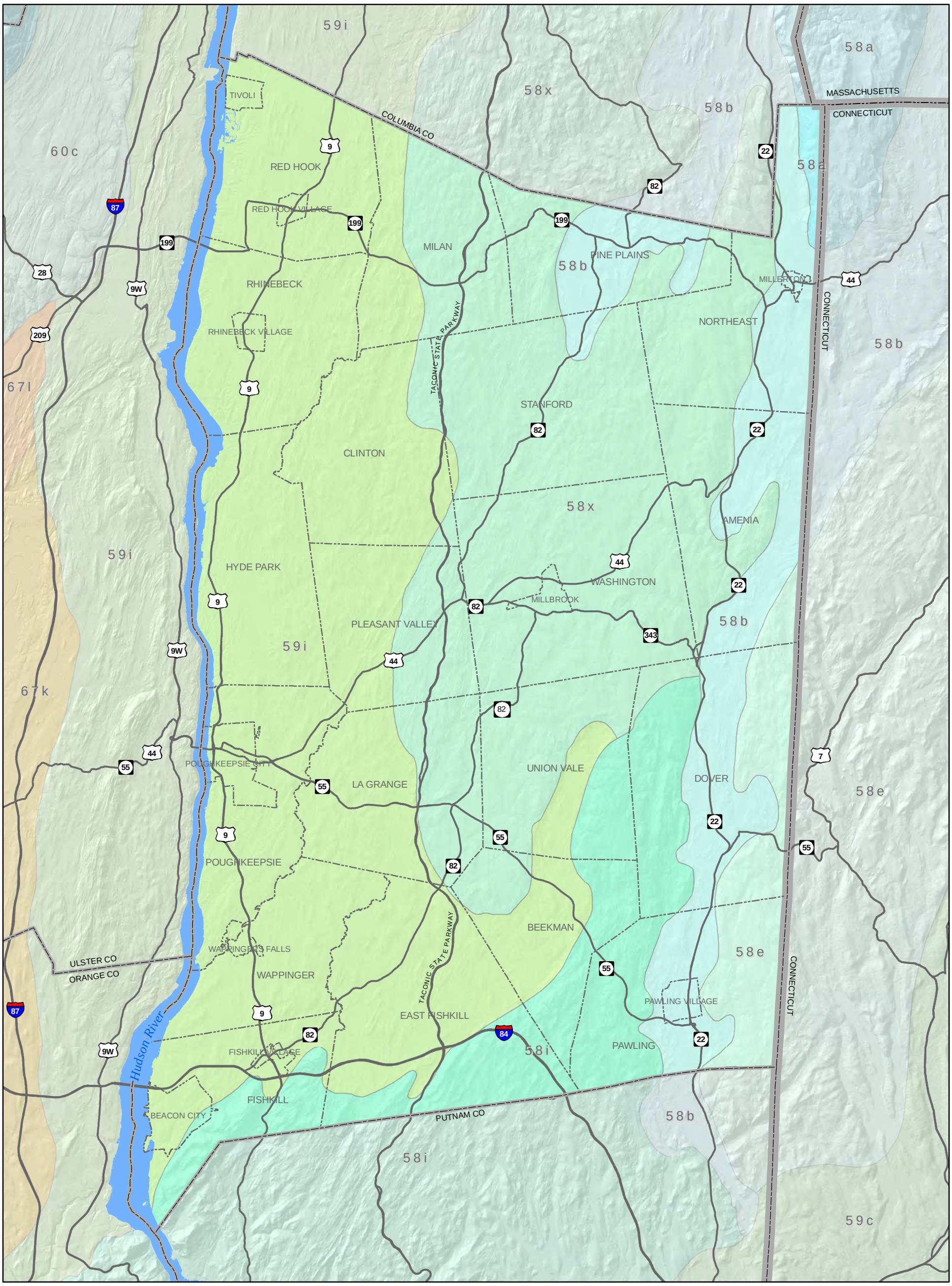

Ecological Regions of Dutchess County

- 58a Taconic Mountains
- 58b Western New England Marble Valleys
- 58e Berkshire Transition
- 58i Glaciated Reading Prong/Hudson Highlands
- 58x Taconic Foothills
- 59i Hudson Valley

Miles
2 1 0 2
4 2 0 4
Kilometers

N

1:225,000