

Biological Diversity



Ram's Head Ladyslipper, orchid



Marbled Salamander

Orange County is a biologically diverse place. It is home to an exceptional variety of plant and animal species as well as an incredible diversity of habitats in which these creatures live. This richness and variety remain despite losses historically and in recent times. The richness of species and the wide variety of geologic, soil, and climate conditions that support our varied habitats are due to an uncommon convergence of factors:

1. The County's diverse **geology** (from limestone outcroppings to glacial deposits) has given rise to many distinctive habitat types, which in turn support many unique and rare species.
2. Orange County is situated at an **ecological crossroads**. The geographic position of the County has enabled many species from numerous regions to thrive here. The assemblage of species in Orange County is unique because it is the northernmost range of many southern species and the southernmost range of many northern (boreal) species.
3. **Low-density development, the historical pattern in Orange County**, has preserved many of the ecological treasures. Although the *status quo* is changing rapidly in some places, large tracts of relatively pristine, interconnected habitats remain in many areas.
4. **Active agriculture** has maintained many of the important grassland and open habitats within the County. The importance of farmland to biodiversity has only recently been recognized.

These characteristics have afforded Orange County and the surrounding region some impressive treasure houses of species and their habitats. For example:

- **Orange County has the second-highest number of dragonfly and damselfly species in the United States.¹** At 128 species, Orange County is

second in only to Sussex County, N.J., neighboring Orange, where just over 130 of these insects were inventoried.

- **Orange County has the highest diversity of reptiles and amphibians (herps) in New York.**ⁱⁱ The County houses 48 species of these cold-blooded animals. Sterling Forest has 37 of these species, many of them rare, making it one of the most critical sites for herp conservation statewide.
- **Orange County has the second-highest number of plant species in New York.**ⁱⁱⁱ There are 1,698 different species of plants found in the County. Many of these are found in Orange County's portion of the Highlands, especially in and around Sterling Forest.
- **Orange County has the highest concentration of northern cricket frogs in New York.**^{iv} This species is listed by New York State as Endangered, meaning that it is in imminent danger of extirpation or extinction in the State. Despite this precarious status, several hundred are clustered at one location in Orange County, and less dense populations reside throughout other parts of the County as well.
- **The Hudson Valley has the third-highest number of turtles in the world,** after the Irrawaddy-Mekong region and the Suwannee River basin.^v There are 13 species in the region, one of which, the Bog Turtle, is Federally listed as Threatened.
- **Orange County has two regionally significant wildlife corridors: the Highlands and the Shawangunk Ridge/Allegheny Plateau.** These upland areas are portions of much larger geologic formations that are important because they contain unique collections of species and are major wildlife corridors, allowing for the movement of plants and animals on a regional scale.

Human communities directly benefit in many ways from biological resources and these benefits can often be measured in economic terms. For example, wetlands provide a variety of important functions, including flood control, water quality improvement, aquifer recharge, stream base flow maintenance, recreational opportunities, and more. One published study found that an acre of wetland provides about \$150,000 in benefits to the public.^{vi}

Productive agricultural lands managed for their biological resources contribute to the County's economy and help maintain the rural character that defines Orange County's

Box 1. Values of Biological Diversity

Natural lands include these many important benefits:

- providing citizens with an attractive, safe, and desirable place to live
- regulating climate
- cleansing and detoxifying air, water, and soil
- pollinating crops
- dispersing seeds
- mitigating drought and floods
- cycling and moving nutrients
- decomposing waste
- preventing soil erosion and maintaining soil fertility
- controlling pests
- moderating weather extremes

landscapes. As discussed later in this section, maintaining open habitats such as fallow fields contributes greatly to local biological diversity.

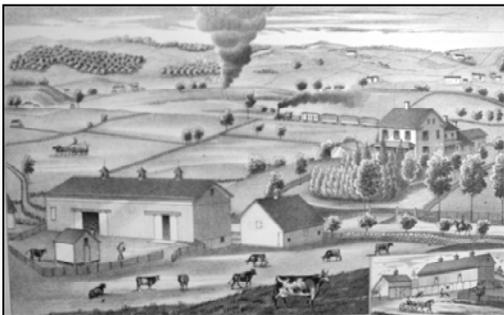
When the services provided by living systems are lost, replacing them with human-made engineered substitutes is enormously costly. No matter how much time and money is spent on them, engineered systems are rarely as efficient as natural systems.

Many species found in Orange County, such as the bog turtle and cerulean warbler, are currently experiencing long-term declines. In many cases, these declines are tied closely to urban, suburban, and rural sprawl. If the habitat and conservation needs of these species are not addressed, these creatures will likely become candidates for listing as State or Federal Endangered or Threatened species.

With the intensifying threats to ecosystems in Orange County, cooperative initiatives and local planning are needed to protect irreplaceable plant and animal life and maintain and enhance the diverse natural landscape of the County. Measures must be taken to keep these species' populations healthy in order to ensure that they remain part of Orange County's environment and are not lost forever. Such measures should include improved land use planning to better balance economic growth with environmental integrity.

Landscape History and the Impacts of Human Activity

While geological forces have shaped Orange County into an area of unusually high biological richness and variety, humans—particularly the European settlers who arrived within the last three centuries—have dramatically altered the resident plant and animal populations via large-scale modifications of the landscape.



Above: Rendering of Minisink & Wawayanda landscape in 1875, showing extensive clearing for farmland.

It was in the 19th Century that humans became the dominant force in shaping the landscape. Settlers believed it was their right—indeed, their duty—to tame the wilderness; natural resources were commonly viewed as inexhaustible. The blossoming of the dairy and horse industries provoked clear-cutting of much of the

County's landscape as it was converted to pasture and cropland for livestock. The tanning industry, which harvested hemlock tree bark for its tannic acid, also had a hand in deforesting the County. Although wildlife

that requires mature forest declined, species that require more open habitats, such as bog turtles, bobolinks, leopard frogs, and meadowlarks, benefited.

These trends crested during the 1880s and 1890s, which naturalist Kathleen Redmond termed the “really lean years in wildlife populations.”^{vii} Three-fourths of virgin forest had been cut and converted to farms—leaving us today with no old growth forest in the Orange County landscape. Over-hunting, bounties on wildlife, and habitat destruction eliminated turkeys and wolves from some areas of the County. It was during this time that the passenger pigeon was sighted in Orange County for the last time.

Major impacts that humans have had on Orange County's natural landscape and biological diversity since the late 1600s can be outlined as:

Construction of dams along waterways

Beginning in the late 1600s, dams were installed along many of Orange County's rivers and streams to produce hydropower for mills. Though most were used only for short periods, many were never demolished. Presently, there are at least 280^{viii} dams in the County.¹ Dams impede migration of fish and other aquatic species and act as barriers to species dispersal, they increase water temperature, lower the amount of oxygen dissolved in the water, create a water body that is more stagnant, and in other ways change the aquatic environment. Three dams on the Quassaick Creek were built for a historic mill in Newburgh and, though the mill is no longer in use, the dam remains and blocks migration of river herring, which need this Hudson River tributary to spawn upstream. The first Cuddebackville dam was built in 1828 to divert water for the Delaware & Hudson Canal; in the period 1911–1915 a second section of the dam was built to provide hydropower to communities in the Town of Deerpark. Now abandoned, this structure presents a dispersal barrier to many native species.

Drainage of the Atlantic white cedar swamp

The vast swamp that covered sections of the towns of Minisink, Warwick, Goshen, and Wawayanda was drained over many decades by creating channels leading to the Wallkill River. To clear the swampland, the trees were logged, and this extensive cleared area with its highly fertile soil is now the farming district known as the Black Dirt Region. Today, the only known remnant of the forested swamp ecosystem is a small fragment in the town of Warwick. There are only a handful of other Atlantic white cedar swamps in the County and this natural community is extremely rare elsewhere in New York State.



Above: Aerial photo of the Wallkill River, displaying the dramatic alteration of the River's course. The historic riverbed forms the border between the three towns labeled in this image.

¹Though some estimates are much higher.

Channelizing and degrading the Wallkill River (above)

The Wallkill River has a wide floodplain, especially in the southern part of the County, and as the river overflowed its banks during heavy rains or snowmelts it frequently flooded adjacent land. In the 1940s, the Army Corps of Engineers created an alternate route for the Wallkill's channel, digging a straighter, deeper course that would move water downstream faster and alleviate much of the flooding. Unfortunately, this channelization, among other factors, has reduced species diversity and impaired water quality in the river, aside from *increasing* flooding downstream of the channel. Fish species are few and a high percentage of those present are not native to the river. A recent article by New York State's ichthyologist (fish scientist) Bob Daniels noted the change in fish diversity since the early 1900s. In 1936, there were 48 species of fish in the river, with no one species dominating the system. When he sampled the same areas of the river in the early 1990s, he found only 16 species of fish and only a quarter of the total fish population that was present in 1936. Species lost include catfish, pickerel, minnows, and suckers. Impacts of channelizing are not limited solely to the river body itself; water levels of wetlands flanking the river are low because they have been separated from the water flow, and the biological diversity of these habitats has consequently changed.

Drainage of wetlands

Historically, wetlands have been viewed as inhospitable, useless, and often

Box 2. Benefits of wetlands

Wetlands benefit Orange County in many ways. They cleanse water of nutrients, toxins, sediment, and other pollutants (and are commonly used to treat both stormwater runoff and sewage). They hold water during storms, thus reducing the frequency and severity of floods; they also recharge groundwater aquifers and help to maintain water levels in streams and rivers during droughts. They provide habitat and sanctuary for many species of plants and animal species. And they reduce atmospheric levels of carbon dioxide (a greenhouse gas) by storing carbon in plant matter and muck soils.

dangerous pieces of land needing "improvement" by draining and clearing. Still often considered an impediment, wetlands continue to be altered or destroyed. But these ecosystems are exceptionally important not only because of the myriad services they provide to humans but also for their role as transitional zones between land environments and water bodies.

Degradation of habitat

Few, if any, habitats in Orange County are unaffected by the presence of humans. Our roads and parking lots prevent rain and snow from seeping into the ground but instead send the water, often

highly polluted, into our rivers and streams. We drain, fill, pollute or otherwise damage wetlands. We degrade soils by applying pesticides and synthetic nutrients to our lawns and crops. Or we eliminate natural cover such as trees or bushes to make way for a building, pavement, or non-native plant life. Erosion runoff into rivers caused by land clearing for development on the surrounding landscape has altered and destroyed mussel beds that are used during trout spawning, leading to lower numbers of trout in many Orange County streams.

Orange County Open Space Plan June, 2004

Even areas that are out of direct human reach are still vulnerable to acid precipitation, groundwater pollution, and the effects of human-induced global warming (increases in severe weather, elevated levels of carbon dioxide, changes in species composition, irregular pest outbreaks, etc).

Creation of a fragmented landscape

Construction of roads, canals, railroads, airports, drainage ditches, dams, power lines and fences; growth of three cities and 17 villages with suburbia swelling on their peripheries; a dramatic increase in the rate of housing construction and tree removal, notably in the last few decades; increases in the average residential lot size (which spreads the impacts across more area, often into high-quality habitats); and increases in traffic—all have resulted in fragmentation of much of the County's landscape into more or less isolated patches. (The notable exception is the substantial state park system in the Highlands.)

Habitat disturbance is a natural process, but many species are unable to survive in areas that have been disturbed too often or too extensively. Fragmentation reduces both the amount of range area available to a species and the ability of individual animals to move from one place to another.

When barriers totally, or nearly totally, eliminate species' ability to move between areas, habitats may become totally isolated. Wildlife populations in isolated fragments are stressed more readily than populations with more land area, food, water, and habitat. Even with protection of a few thousand acres in, for example, Highland Lakes State Park, the park is limited in the animal species it can support because it is isolated from any network of open space that would support species that must range widely, like the black bear. Except where underpasses allow for movement, the three interstates that slice through the County effectively stall passage of many animals from one side to the other.

Fragmentation and isolation seriously threaten biological diversity and the functioning of natural systems.^{ix}

Alteration of species composition²

That composition of species in Orange County has changed is evidenced by the recent loss of species that once were found here. Generally speaking, populations of so-called "specialist" species, which require specialized habitats, have declined. Such specialist species are usually relatively rare to begin with, are less resistant to disturbances, and face a lack of alternative habitat in which to reside. Among our specialists experiencing decline are many salamander species, leopard frogs, bog turtles, ribbon snakes, northern copperheads, many forest warblers, grassland birds, bobcats, and freshwater mussels.

In contrast, population numbers of "generalist" species—those that can live in many types of habitats and may actually thrive under disturbed conditions—

² Species composition refers to both the number of species present and the population size of each species.

have attained unhealthy levels in Orange County. These species, which prefer the patchwork pattern created by disturbances across the landscape, are usually abundant, common, and resilient to disturbance. Examples include the white-tailed deer, non-migratory Canada goose, white-footed mouse, raccoon, grey squirrel, carp, coyote, bullfrog, American crow, and deer tick. See Box 3 for a discussion on generalist species.

Species composition has also changed because of increasing numbers of species that continue to invade from other areas, often from other countries and continents. These so-called exotic species tend to outcompete native species and decrease overall species diversity. For example, the invasive exotic plant

Box 3. Generalist Species: Causes and Effects

The Biodiversity section of this Plan primarily focuses on those species and habitats that are rare in Orange County (primarily due to a lack of habitat). Certain other species, however, become more *abundant* as the County is developed – the sizes of these populations serve as indicators of landscape fragmentation.

The **white-tailed deer** is considered an “edge species” because it is often found browsing the edges of forests, fields, lawns, and disturbed areas with ample vegetation. As Orange County becomes increasingly fragmented by development, larger tracts of woodlands are broken into smaller woodlots, creating more opportunities for edge species and fewer opportunities for predators who prefer larger tracts of intact forest, such as wolves and coyotes. Unchecked deer populations can alter forest ecosystems by eating saplings and other understory vegetation, which in turn can lead to destruction of certain bird habitats and a decline in plant diversity. Additionally, elevated deer populations are both a nuisance and a hazard to citizens as they eat through gardens and interfere with traffic.

Another indicator of a fragmented landscape is the **Canada goose**. Historically, the entire population of these geese migrated through the County. But with the creation of lawns, golf courses, and other open areas, many geese have chosen to remain in the County throughout the year. As they graze, these geese – often in large flocks -- deposit much waste that pollutes nearby water bodies with nutrients, degrades habitat conditions, and poses a human health concern. They also repel native bird species and can be sources of noise pollution. Measures have been taken in some jurisdictions to manage populations in order to balance the local biological diversity; the only long-term solution is to maintain or restore habitats to conditions that are less desirable to geese. For example, restoring shrubs and other native vegetation to the banks of lakes and ponds, rather than maintaining lawn up to the water's edge, makes an area less attractive to geese.

In terms of human health, recent research done in Dutchess County, N.Y., reveals a connection between forest fragmentation and **Lyme disease**.¹ As the size of forest patches decrease (from 19 down to 2 acres), biological diversity decreases and populations of the **white-footed mouse** increase. The author quotes: “(white-footed mouse) population densities often are considerably higher in small, isolated woodlots embedded in agricultural or urbanized landscapes than they are in continuous forest.” Since this mouse is the most effective carrier of the spirochete bacterium that causes Lyme disease, incidence of the bacterium is much higher among ticks in a fragmented setting than those in a more intact landscape.

¹Allan, Brian; Felicia Keesing, Richard Ostfeld. 2003. Effect of Forest Fragmentation on Lyme Disease Risk. *Conservation Biology* 17:1, 267-272.

purple loosestrife has come to dominate many wetlands but does not offer food or any other benefit to many types of birds, reptiles and insects. As a result, many loosestrife-infested wetlands have lost their varied plant and animal life.

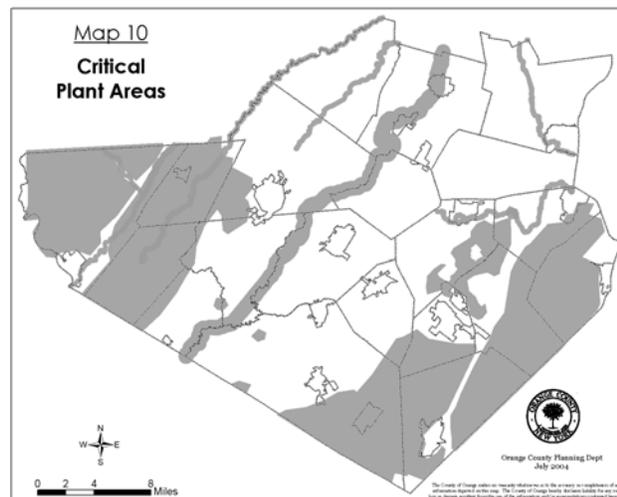
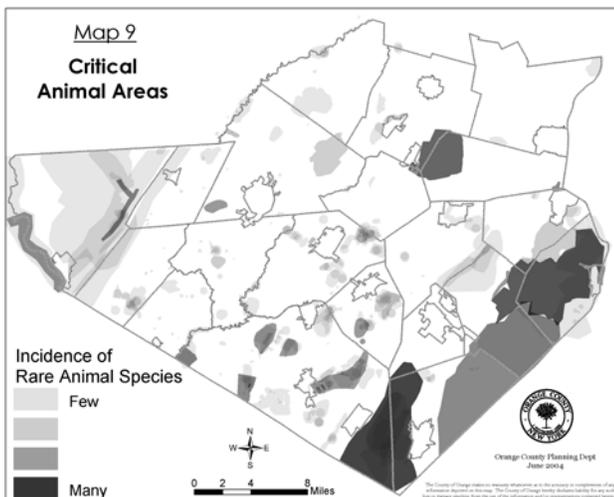
The list of exotic animals that have taken up residence in the County or its waters include the zebra mussel, longhorn beetle, rusty crayfish, gypsy moth, and house sparrow. Non-native plants include: Purple loosestrife, Dutch elm, Japanese knotweed, garlic mustard, water chestnut, Japanese barberry, and common reed (specifically, the Eurasian strain of *Phragmites*).

Critical Plants, Animals, and Habitats

While some biologically diverse portions of the County have been permanently protected, many areas with remarkable richness remain unprotected and thus vulnerable to development. The current high and increasing growth rate threatens the remaining biologically diverse region, unless measures to prevent habitat fragmentation and degradation are put into place. Preservation of the County's intact natural communities will assure protection of many species facing decline.

Species

For this Open Space Plan, information on the locations of rare or otherwise critical species sitings was gathered in order to create a geographic database of vital habitats within the County³. Since critical species are listed as Endangered, Threatened, or of Special Concern because their low population numbers leave them ultimately vulnerable to extinction, it is especially important that these species have sufficient quality habitat to guarantee their continued survival. And because species population numbers are often low due to insufficient habitat, it is a high priority to locate, map, and ultimately protect the habitats upon which rare species depend. Aside from those on the State and Federal Listings, species that depend on vernal pools (small, seasonal wetlands)



³ See Appendix 1 for a list of the rare species that can be found in Orange County.

but are unlisted were also included because these wetlands and the surrounding forest receive little or no regulatory protection and are rapidly disappearing. Bobcats, forest-interior birds, and other specialist species were also considered because their presence indicates high quality habitat.

Map 9 (Critical Animal Areas) was generated from known sites of existing critical animal species while Map 10 (Critical Plant Areas) used existing critical plant sites in conjunction with extrapolation of where critical plants are likely to grow. The darker areas on both maps contain more critical species than the lighter areas. White areas on this map should not be interpreted as being void of significant species; critical species may indeed be present in white areas due to the fact that the research that *has* been done in the County is limited and may not have covered these areas. These maps are therefore *not* substitutes for biological inventories; only a thorough study by a qualified professional can reveal the presence or absence of critical species at specific sites. More research and inventories are needed in areas of the County where there are data gaps. Maps 9 and 10 are meant to display areas that are already known to have critical species, making them useful in planning.

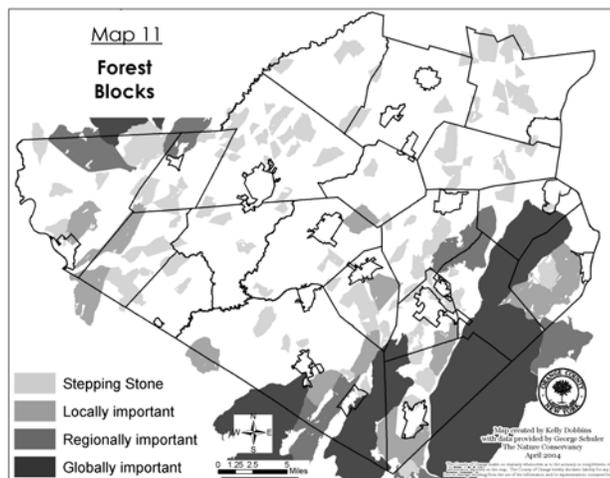
Systems

This plan focuses on all aspects of biological diversity, including species, ecological communities, and ecosystems. Understanding these relationships is key to effective conservation.^x As opposed to the species-specific analysis above, all species are taken into account when examining ecological communities and ecosystems, including known locations of both common and rare species in addition to other areas likely to support biodiversity. Effective conservation will result only from the protection of intact, interconnected communities and ecosystems; the preservation of individual species will naturally follow.^{xi} Focusing on biological diversity at this broad scale is a proactive approach to biological conservation because it protects whole assemblages of species before any single species declines into imperilment.

Forest Systems

Map 11 represents areas of the County that are dominated by forested land. These forested areas are expected to contain many habitat types, including swamps, ridgelines, old and new forest, and even meadows. Map 11 divides forests into four size classes, each important for different reasons:

1. Globally important (greater than 15,000 acres). These large and intact forest ecosystems support characteristic, wide-ranging and area-sensitive species, especially those



that depend on interior forest. In Orange County, these species include many birds (broad-winged hawk, barred owl, neotropical warblers), mammals, reptiles and insects. Globally important forests are large enough so over time they will express a range of forest successional stages including areas that have been subjected to recent large-scale disturbance such as *blowdowns* and fire, areas under recovery, and mature areas. These forests also provide sufficient area to support enough individuals of most species to maintain genetic diversity over several generations.

2. Regionally important: (14,999 down to 6,000 acres) Patches greater than 6,000 acres provide habitat to more area-sensitive species and they can accommodate the large-scale disturbances that maintain forest health over time. Smaller patches are often less able to maintain the entire range of needed habitats and successional stages after large-scale disturbances.
3. Locally important: (5,999 down to 2,000 acres) These smaller but locally important forest ecosystems, often represent the lower limit of intact, viable forest size for forest-dependent birds. Such bird species often require 2,500 to 7,500 acres of intact interior habitat. These forests, like the larger regionally important forests, also provide important corridors and connectivity among forest ecosystems within Orange County.
4. Stepping stone forests: (1,999 down to 200 acres) These examples of smaller forest ecosystems provide valuable relatively broad (not just a narrow strip) corridors and links to larger patches of habitat such as the local, regional, and global forests found in Orange County. These smaller forests, therefore, enable a large array of species, including the County's wide-ranging and area-sensitive species, to move from one habitat to another across an otherwise hostile and fragmented landscape. They also provide important habitat at key times during many animals' life cycles. These forests should be considered the absolute minimum size for intact forest ecosystems. Forests as small as 200 acres will support some forest interior bird species, but several may be missing, and species that prefer "edge" habitats will dominate.

Smaller blocks of habitats are less likely to support many of the significant species discussed throughout this chapter. Priorities for protection therefore range from high to low as forest blocks range from globally important (high priority) to stepping stone (lowest priority). Protection can be accomplished through measures of general land protection such as purchase of forestland, conservation easements, and conservation subdivision design.

Aquatic Systems

The biological health of Orange County's waterways is as important as that of its terrestrial systems. Fortunately, maintaining healthy ecosystems on land helps to keep aquatic systems healthy, too. In fact, how land is used and maintained within a watershed, or drainage basin, is the primary factor that determines water quality and biological diversity of the water body: Impervious surfaces,

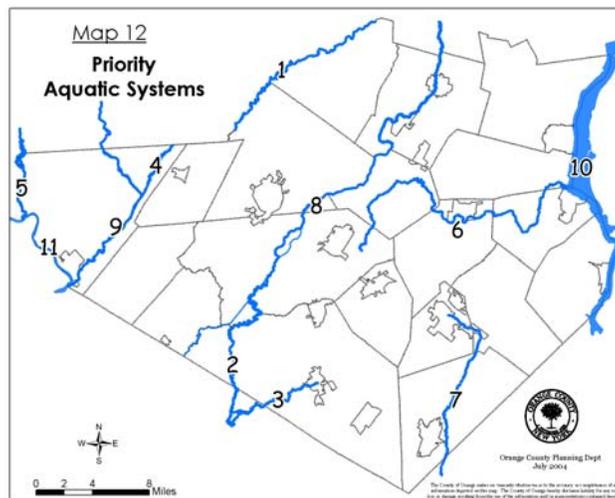
polluting land uses, and sparse vegetation within a watershed will have a negative effect on water quality, while a watershed that is managed for point and non-point source pollution and has ample vegetative buffers will result in healthy waterways.

Orange County contains portions of two ecologically distinct large watersheds: the upper Delaware River and the lower Hudson River. Each of these large watersheds contains smaller watersheds. Because these smaller watersheds are similar in such physical features as elevation, geology, landforms, gradients and drainage patterns, they are expected to contain similar biodiversity patterns.

The County's streams and watersheds of the upper Delaware and lower Hudson were classified by both their living and non-living attributes, in order to make sure we had a representation of the full variety of freshwater biodiversity in Orange County. Each of the following streams thus represents a separate kind of aquatic system and the healthiest stream ecosystem of its class. Map 12 displays these rivers and streams.

They are:

1. Shawangunk Kill
2. Pochuck Creek
3. Wawayanda Creek
4. Basher Kill
5. Mongaup River
6. Otter Kill/Moodna Creek
7. Ramapo River
8. Walkkill River
9. Neversink River
10. Hudson River
11. Delaware River



Protection of these priority water bodies can be accomplished through land use regulations throughout the watershed as well as creating or maintaining vegetative buffers along the water body itself. It is of utmost importance to ensure a maximum of natural land cover within these watersheds and minimize the amounts of runoff and other pollutants that are discharged into the ground or onto the ground surface.

The **Town of Montgomery** has made noteworthy progress towards boosting the health of the Walkkill River. As it flows through Montgomery, the River passes by more than 280 acres of protected land along its banks, 185 of which are owned or safeguarded by the Town. These protective buffers help to stabilize the banks, improve water quality, provide access for recreation, and ensure that the corridor is not developed in an incompatible manner.

Farmland

A third ecosystem type uniquely important to the biological diversity of Orange County is farmland. Both working farms and post-agricultural lands—if managed properly—can support a diverse array of species. Many declining and “listed” species of reptiles, amphibians, and birds depend almost entirely on Orange County’s farms because they are one of the few land uses that maintain open grasslands, fields, and shrublands. Because of its agricultural heritage, Orange County is regionally significant for these open habitat types and the species they support.

Farm-related habitats are rapidly disappearing throughout the northeastern United States, along with the species that require them. Major causes of these declines include re-growth of forests as fields are abandoned, and urbanization, which fragments and eliminates open habitat. As with forest wildlife, many farm-dependent species must be able to disperse among open habitats; therefore, fragmentation by roads and developments should be

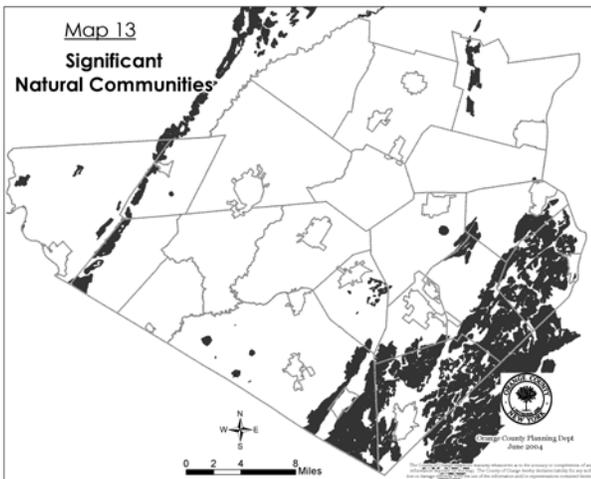


minimized in agricultural areas having high biological diversity. Policies and practices that promote the continuation of small-to-medium-scale, ecologically-sensitive farms that are interconnected throughout the County would help to maintain biological diversity and should be actively encouraged.

The KeziahLain farm in Minisink is a 150-acre organic cow and hay farm that provides valuable habitat to many species. Because most of the farm is pasture, hayfields, or wooded and thus not intensively tilled or cultivated, the farm serves as a haven and corridor for both migratory and resident wildlife. Grassland birds, songbirds, waterfowl, amphibians, reptiles, invertebrates, and many species of mammals flourish here.

Other Significant Habitat Types

Map 13 displays natural communities that the New York Natural Heritage Program has



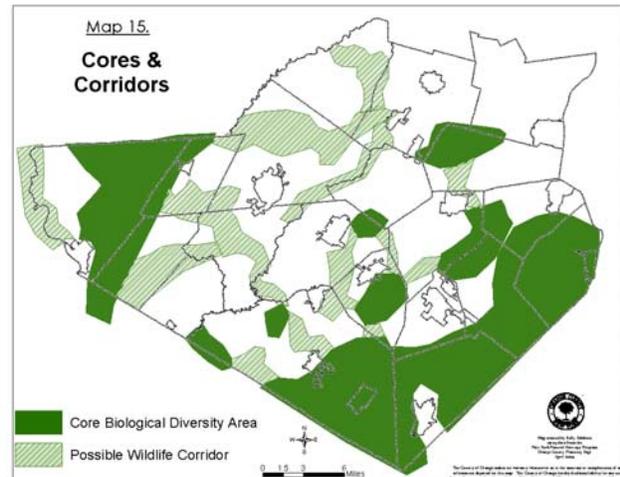
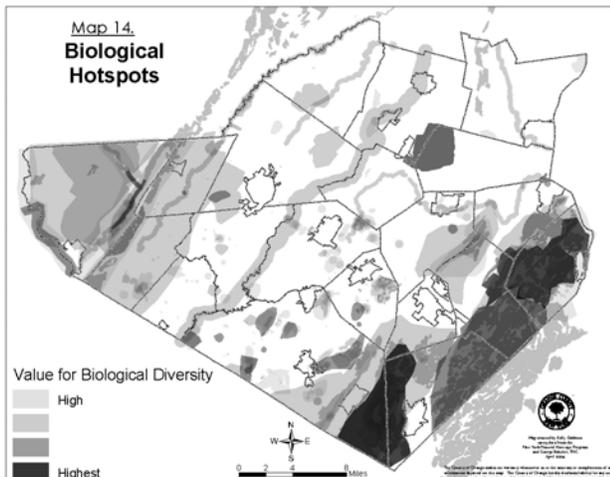
identified as being of statewide significance.⁴ Other unique Orange County communities, such as limestone outcrops and beds of submerged aquatic vegetation, have also been added to this map because their distinctive character indicates a unique assemblage of species and a unique role in the landscape.

Protection of these important natural communities should occur through measures of general land protection such as purchase of forestland, conservation easements, and conservation subdivision design.

⁴ See Appendix 2 for a list of significant natural communities present in Orange County.
Orange County Open Space Plan June, 2004

Biological Diversity Hotspots

One of the most important actions that both the County and local governments can take to maintain and enhance the County's unique biological diversity is to preserve biological "hotspots." Shown in [Map 14](#), these areas have high concentrations of rare or otherwise critical species, both plant and animal, or contain significant natural communities.



These hotspots were analyzed in conjunction with the map of forest blocks and the Priority Aquatic Systems map to generate a map of Core Biological Diversity Areas (shown in [Map 15](#)). Core Biological Diversity Areas are significant because of their species composition and percent of natural land cover. The following Core Biological Diversity Areas were identified:

1. Highlands (including Sterling Forest, Harriman, and Bear Mountain State Parks)
2. Neversink Valley (including the southern Shawangunk Ridge and the Basher Kill)
3. Goosepond Mountain (including Goosepond Mountain State Park)
4. Stewart State Forest
5. Mt. Adam and Mt. Eve
6. Schunnemunk Mountain
7. Purgatory Swamp
8. Upper Walkkill River/Wawayanda Creek

Intense development should be avoided in these areas. If development is proposed in such areas, particular attention should be given, using existing parameters within the SEQRA environmental review process, to ensure that the project has a minimal impact on the biological resources.

Wildlife Corridors

Through the creation of wildlife corridors, Core Biological Diversity Areas can be connected to one another and fragmented habitat conditions can be partially overcome. A wildlife corridor is a broad swath of land that becomes a link from one tract of land to another. Conservation biologists generally agree that species viability and diversity are enhanced by well-connected habitats.^{xii} Because small, isolated habitats are unlikely to maintain viable populations over the long-term, and because climate change and disturbances require that

organisms be able to move over large distances, corridors are recommended as an important conservation measure to counter the negative effects of habitat fragmentation and isolation.^{xiii} By analyzing where forest blocks and protected open space are located, Potential Wildlife Corridors were devised (shown in Map 15). These Potential Wildlife Corridors are (*denotes a linear river corridor which includes the river and its adjacent land):

1. *Delaware/Mongaup River Corridor
2. Neversink Valley to Mt. Adam and Mt. Eve
3. Mt. Adam and Mt. Eve to the Highlands
4. Upper Walkkill River/Wawayanda Creek to the Highlands
5. Goosepond Mountain to the Highlands
6. Goosepond Mountain to Schunnemunk Mountain
7. Black Meadow Reservoir (not a core) to Purgatory Swamp
8. *Walkkill River Corridor
9. Schunnemunk Ridge to Stewart State Forest
10. Walkkill River/Highland Lakes to the Shawangunk Kill
11. *Otter Kill/Moodna Creek Corridor (linear along river)
12. *Shawangunk Kill river Corridor (linear along river)
13. Greenville/Wawayanda Corridor

ⁱ Nick Donnelly, Pers. comm.,

ⁱⁱ New York State Dept of Environmental Conservation, Amphibian and Reptile Atlas Project

ⁱⁱⁱ New York Flora Association

^{iv} NYS DEC, Endangered Species Unit

^v Michael Klemens, Pers. comm.,

^{vi} Stephen Miller, "The Economic Benefits of Open Space," Islesboro Islands Trust, Islesboro Islands, ME: Islesboro Islands Trust, May 1992.

^{vii} Redmond, Kathleen. 1969. Nature and Man: Natural History in Orange County. Booklet No. 4 of the Orange County Community of Museums and Galleries, Goshen.

^{viii} NYS DEC Dam Safety database

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