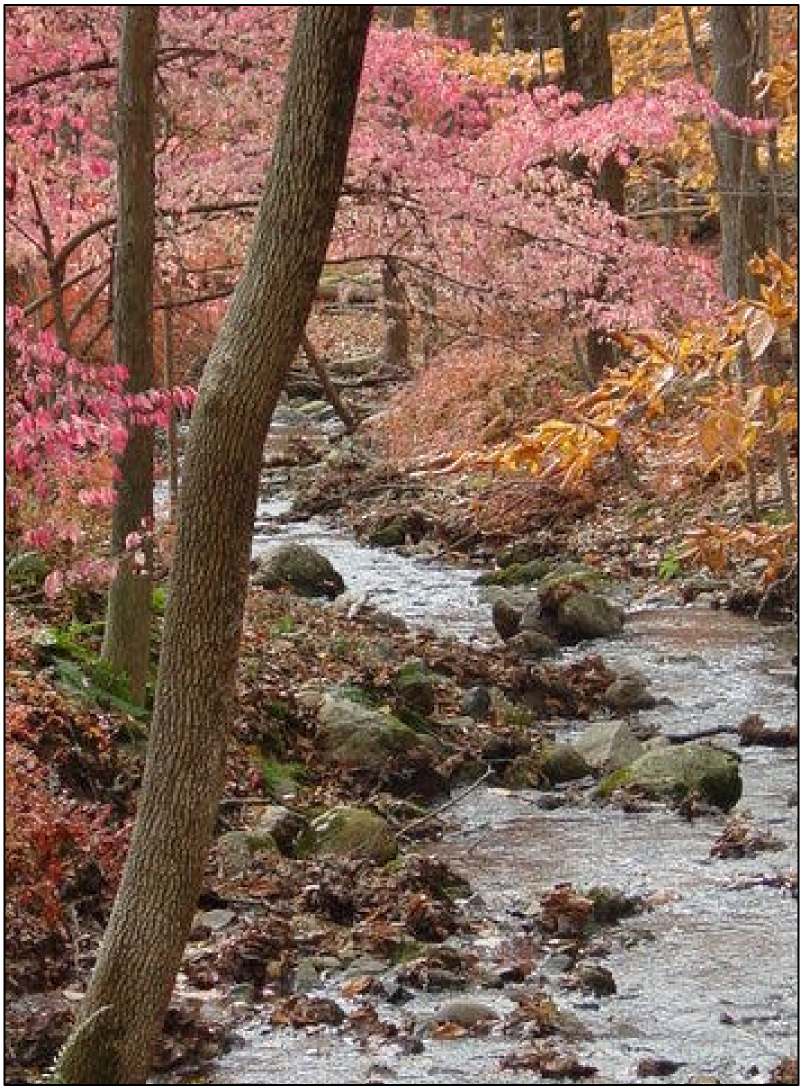
Croton-to-Highland Biodiversity Plan: Somers Addendum



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Croton-to-Highland Biodiversity Plan: Somers Addendum

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Introduction

Project Background

The Somers Biodiversity Study is a joint project between the Wildlife Conservation Society's Metropolitan Conservation Alliance (MCA) and the Town of Somers, New York that began in 2006. The primary purpose of this project is to identify the portions within the Somers study area that are of high biodiversity value in order to provide the Town with the information it needs to improve planning to protect these resources. A secondary purpose of this project is to determine if biodiversity areas in Somers link up to those in Yorktown which would make Somers an ecological extension of the Croton-to-Highlands Biodiversity Plan.

Regional Overview

Like many parts of the United States, Westchester, once a rural county of farms and villages, has become suburbanized by a pattern of development known as "sprawl." Sprawl is low-density, automobile-dependent development that is characterized by strip malls, cookie-cutter "big box" stores, industrial parks, oversized houses (i.e., "McMansions"), and anonymous housing developments. As sprawl takes over, we lose what is special about the place we live, in terms of both natural resources and community character. Sprawl began in the post-World War II era when people left declining cities in favor of greener surroundings. Ironically, many decades later, sprawl has reached a point where few of the green, open spaces for which people originally left cities remain. Many Westchester residents recall woods, open fields, and farms from childhood that have since been built up or paved over. Most of us assume that this is "inevitable" or "the cost of progress," but is it really? At MCA, we believe that human societies can choose to grow in ways that serve the need for economic growth while maintaining the health of the ecology. In this report, we offer tools to help Somers move toward this ecologically-friendly model of development.

Somers is the eighth town in Westchester to form a partnership with MCA in order to identify biodiversity resources, map them, and improve land use planning practices to maintain them. The towns of Cortlandt, New Castle, and Yorktown (along with Putnam Valley in Putnam County) are partner to the Croton-to-Highlands Biodiversity Plan in northwestern Westchester, while the towns of Lewisboro, North Salem, Pound Ridge, and Bedford are partner to the Eastern Westchester Biotic Corridor. MCA recently completed a biodiversity study with Town of North Castle as well. Somers joins a growing movement among municipalities that are proactively protecting their resources by using innovative land use planning tools. This project is an important first step in the fight to contain sprawl and maintain the special "sense of place" unique to Somers.

Concepts and Issues

Biodiversity in the Lower Hudson Valley

The rich tapestry of genes, species, ecosystems, and their interactions are collectively referred to as "biological diversity," often shortened to "biodiversity." The lower Hudson Valley, including Somers, is home to significant habitats and rich assemblages of wildlife due to a unique convergence of factors:

1. The geographic position of the lower Hudson Valley is at an ecological crossroads, which contributes to the diversity of plants and animals found here. At the close of the Wisconsin glaciation (ca. 15,000 years ago) plants and animals moved into and repopulated southern New York from a variety of routes, including the Wallkill Valley, the Atlantic Coastal Plain, and from the Midwest via the Mohawk Valley. These routes converged in southeastern New York's lower Hudson Valley.

2. The historic development pattern of small rural villages with intervening open space has fostered both the scenic and biodiversity values of the area. This type of development – intensive but limited in scope – has preserved many of the ecological treasures of the region. Although sprawl is changing this rapidly in some areas, a few tracts of relatively undeveloped land remain in the region.

3. Biodiversity within the region is represented by both widespread species and species that are declining in the lower Hudson Valley and throughout the Northeast, including many that are on state and federal lists of endangered, threatened, and special concern wildlife. Species such as the box turtle are near the northern limit of their natural range in the lower Hudson Valley. The stewardship of such species becomes increasingly important as the world's climate changes, potentially causing their ranges to expand northward. Stewardship of all of the region's biodiversity has conservation value that extends far beyond the towns, adding value to broader conservation efforts in New York State and throughout the Northeast.

Importance of Biodiversity to Somers

It is often argued that biological diversity has its own inherent value, that it is our obligation to preserve biodiversity for its own sake. However, when development and sprawl collide with biodiversity concerns, land use practitioners need more than ethical arguments based on inherent value to make a decision in favor of biodiversity. Therefore, it is important to note that communities directly benefit in many ways from their biological resources and that these services can often be measured in tangible terms, including those of economics and human welfare. The following paragraphs provide a rationale for including biodiversity as one of the fundamental foundations of sound land use decisions.

- **Human Health**

  A major benefit of biodiversity is its direct impact on human health, including the prevalence of Lyme disease. Research conducted in southeastern New York has revealed that the diversity of small mammals (e.g., mice, moles, voles, shrews) is reduced by forest fragmentation. The small mammal that ends up dominating these isolated fragments—the white-footed mouse—is the primary carrier of the Lyme bacterium. The risk of Lyme disease is much lower in intact forest ecosystems where the infection rate is suppressed by a diversity of small mammals. By maintaining larger tracts of interconnected forest habitat, we can maintain high biodiversity levels and simultaneously reduce human health risks (Allan et al. 2003).

✍ **Recreation**
Biodiversity provides important recreational opportunities, including hunting, fishing, hiking, bird watching, and photography, contributing to the high quality of life that Somers residents enjoy. In addition, recreational opportunities often directly translate into economic gain for communities, sustaining businesses that cater to outdoor enthusiasts such as outdoor equipment suppliers and canoe/kayak rental and touring outlets.

✍ **Natural Beauty**
Biodiversity provides a scenic backdrop to the daily activities of residents. Rocky ridgelines cloaked in green forests, maple swamps glowing red as their leaves turn in autumn, grassy fields shining with dew on spring mornings—these are the stages on which we act out our daily routines. These settings can reduce stress and bring peace of mind back into our busy lives.

✍ **Education**
Forests, wetlands, fields, and associated wildlife and plant communities serve as important outdoor laboratories used by schools and nature centers to educate our young people and the park visitors.

✍ **Ecosystem Services: Pollination**
Bees, butterflies, and other pollinators have a direct influence on agricultural crop yields and the vitality of gardens. These factors benefit the economy and human welfare. Bee pollination alone is required for an estimated $14 billion of agricultural production in the United States (Morse & Calderone 2000). Bees are also essential for pollinating some of our favorite local garden produce such as apples, plums, cherries, blueberries, raspberries, squashes, melons, and pumpkins (Cane 2005).

✍ **Ecosystem Services: Wetlands**
Research goals of the scientific community have begun to shift. Rather than focusing on the negative impacts that humans have on the environment, researchers are beginning to ask more pertinent and useful questions such as “do people benefit when they protect and maintain the environments in which they live?” Wetlands provide an excellent case study of how, by maintaining biodiversity, humans can reap substantial benefits. Many wetlands are extremely biologically diverse, which is sometimes a rationale provided for their protection. But wetlands protected for their biodiversity also provide a variety of ecological services to people (Smith et al. 1995). Because of their ability to temporarily store floodwaters during storms, they help to reduce and eliminate damaging floods. Wetlands uptake and store pollutants, resulting in cleaner, safer water. Their dense vegetation and unique soils store carbon, reducing global warming. Some wetlands recharge groundwater aquifers and maintain water flow in streams and rivers during drought. Wetlands and waterways also provide corridors for flora and fauna to disperse and alter distributions in response to global warming.

✍ **Ecosystem Services: Forests**
Forest ecosystems provide a multitude of services to people. For example, they: stabilize stream banks, prevent erosion, reduce stormwater runoff, allow rain to infiltrate groundwater aquifers, retain and transform lawn and agricultural fertilizers, filter pollutants from our air, provide oxygen, cool air temperatures during the summer, and reduce greenhouse gases by absorbing atmospheric carbon, among other benefits.

✍ **Ecosystem Services: Water Quality**
Actions to protect and plan for biodiversity in Somers will aid in broader, ongoing efforts to improve water quality in the watershed of the Hudson River. For example, maintaining the ecological integrity of wetlands allows them to continue filtering water of pollutants, water that eventually flows to the Hudson.

The diversity of wildlife populations, or biodiversity, within a town or region is a direct measure of ecosystem health; therefore, biodiversity is also a measure of the ability of these ecosystems to provide important and cost-effective services to our communities. The benefits of maintaining Somers's biodiversity are far-reaching. Issues of water quality, water quantity, rural aesthetics, community character, and human health are all closely intertwined with biodiversity. A biologically diverse landscape is resilient to change and provides an "insurance policy" that the ecological services in our communities will continue, now and into the future.

Biodiversity and Local Land Use Planning
Biodiversity receives some protection through state and federal regulations. These laws, however, are not designed to protect ecological function. Federal and state species protection encompasses a small subset of biodiversity—only those species that are at greatest risk of disappearing. These threatened and endangered species are akin to critically ill patients in a hospital who require an extraordinary allocation of resources in order to recover. Work by MCA has demonstrated that as much as 75% of the region's reptiles and amphibians (far more than are on state or federal lists) are in long-term, non-cyclical declines (Klemens 2000). Reliance on regulations is insufficient to protect these species and increased regulatory strictures are often politically unpalatable. In addition, it is not feasible to preserve (through land acquisition or easement) the entire network of extensive, interconnected habitats that would be necessary to maintain the region's biodiversity.

We discard the premise that municipalities have merely one tool—land preservation—to conserve biodiversity. The idea that properties must either be completely preserved or completely destroyed through development is overly simplistic. This premise must be replaced by one which recognizes that thoughtful development adds value to and interconnects protected areas. Even Westchester County's largest protected area, the 4,300 acre Ward Pound Ridge Reservation, cannot survive without appropriate planning in the surrounding privately held, developable lands (Miller and Klemens 2002).

Therefore, protection of Somers's biodiversity will require proactive action at the local land use decision-making level. Apart from sustaining biodiversity at the local level, a scientifically informed, landscape-scale approach to biodiversity management will prevent site-by-site conflicts over the ecological value of lands. This approach will help focus development into areas where it will have less impact on the ecological fabric and function of the region. By planning with nature in mind, Somers can create quality communities for future generations where human progress is in greater harmony with the natural world.

Project Premises and Goals

All too often, land use decisions are made at the municipal level without the benefit of baseline biological information or without any mechanisms to integrate such information into the planning process. This occurs despite significant efforts of concerned citizens and municipal officials. The gap between information providers (scientists) and information users (local decision-makers) creates a major obstacle. MCA has identified three fundamental challenges that lead to this situation:

1. *Baseline data are generally not available.* Without such data, it is impossible to plan for economic growth while simultaneously ensuring environmental integrity. Baseline ecological data can be used to identify areas of biological significance worthy of protection and to identify areas of lesser significance. Development could be channeled toward the latter areas, thus reducing the level of impact on more ecologically-sensitive areas. For these reasons, one of the project goals was to collect new biological data. These data have been used to generate a map, indicating areas of greatest importance for biodiversity within the Somers study area.

2. *Even where data are already available, mechanisms rarely exist to translate the information into policy.* To address this problem, MCA has been developing a set of tools—a "conservation toolbox"—that will aid planners and other decision-makers in the application of biological data. These tools, which include this report, are published as the MCA Technical Paper Series, and are targeted at a broad constituency to address land use issues within the tri-state region. See Appendix E for the list of reports in the Technical Paper Series.

3. *Biological data and conservation tools are ineffective unless they are accepted as part of a community's goals and integrated consistently into land use planning practices.* Those concerned with the protection of biodiversity need to more fully embrace the legitimacy of competing goals and uses on the land. Environmental advocates are often very good at saying "no," but much less adept at asking "how?" How can we work together to create patterns of development that are more biologically sensitive and sustainable? MCA strives to raise awareness and understanding of biodiversity concerns among land use decision-makers, including municipal staff and volunteers, land trust personnel, landowners, and others who influence the patterns of development upon our landscapes. We accomplish this by serving in an advisory capacity to planning boards, conservation boards and other entities, providing workshops that focus on the relationship between biodiversity and land use planning, and promoting inter-municipal, cooperative efforts to plan for biodiversity.

To summarize the above statements, the primary goal of this project is to address the impacts of sprawl on natural ecosystems by: (1) providing baseline scientific information, (2) developing tools that translate information into policy, and (3) integrating those elements into the land use decision-making process. These steps will create a platform for more thorough municipal and intermunicipal discussions of opportunities and challenges.

Land Use Changes and Biodiversity

Changing Patterns of Land Use

The tri-state region surrounding New York City has undergone substantial and widespread land use changes over the past several hundred years. Before settlement by European immigrants, the landscape was primarily composed of extensive, unfragmented forests, interspersed with open habitats such as coastal plains, beaver-created wet meadows, and forest gaps created by fire. By the 18th and 19th centuries, most of the forested habitat had been converted to agricultural lands, and the beaver, a landscape architect, was nearly extinct. During this agricultural period, areas unsuitable for farming (e.g., wetlands and very steep slopes) served as "refugia" for much of the region's wildlife communities. Although current development pressures impinge on such areas, they remain some of our most biologically rich and unique habitats. More recently, farms have been abandoned as agricultural land uses shifted to states further west. Through natural successional processes, most former farm fields have reverted back to forests; some are still in a transitional state, consisting of meadow or shrubland habitat.

The key element that allowed wildlife to survive these changing land use patterns was habitat connectivity. As land uses changed over time, many wildlife species were able to adapt and even thrive. For instance, with the onset of agriculture, bog turtles began to make use of wet meadows maintained as open habitat through the light grazing of domestic cattle, rather than their traditional wildfire-created or beaver-maintained habitats. Certain grassland dependent birds, such as the bobolink and the eastern meadowlark, made use of hayfields as a surrogate for their native grassland breeding habitats.

However, today's land use patterns are entirely different from those of historic times. In the current wave of sprawl, permanent structures are erected. Highways, parking lots, and subdivisions fence in remaining tracts of habitat, fragment them into smaller pieces, and isolate them from other tracts. These permanent land use changes that sever habitat connections make it difficult, if not impossible, for wildlife to adapt in the face of changing land use, increasing the likelihood of local extinctions of species in the near-term. Compounding the problem for wildlife is that at the same time that habitat connectivity is diminishing, it will become increasingly important in the long-term, as global warming proceeds. Species will need to migrate northward or upslope to higher elevations to adapt to new temperature regimes and resulting changes in habitat structure and composition; where sprawl blocks this migration, species are likely to face extinction. The transitions that are occurring within our landscape today are more permanent than past changes and they do not accommodate our native biodiversity. The few wildlife species that have adapted to such changes are opportunistic and invasive species that thrive at the expense of a more diverse and balanced biological community (e.g., white-tailed deer, Canada geese, snapping turtles).

Landscape Configuration: Planning at the Landscape Level

As sprawl proceeds, large tracts of habitat within our landscape are fragmented into ever- smaller components. *To maintain biodiversity, we must ensure that remaining habitats are of sufficient acreage to support viable wildlife populations and that they are arranged in such a way to allow* *dispersal of animals across the landscape*. Although careful planning can mitigate some of the adverse impacts of sprawl, most planning occurs on a site-specific scale, and does not consider much larger landscape-scale ramifications. Ironically, the land review process, as required by the New York State Environmental Quality Review Act (SEQR), may actually foster fragmentation by considering too small an area in the review process.

To ensure that development is compatible with biodiversity, core wildlife habitat areas and the corridors that connect them must be accommodated. In general, larger core areas are better able to support healthy, viable wildlife populations than smaller areas. The connections between core areas are of paramount importance as they enable dispersal of animals among the core areas, maintaining gene pools and preventing extirpations. Such connections have traditionally been referred to as "corridors." Corridor is an appropriate name because it implies movement from one area to another. However, that name can also be misleading. A wildlife corridor is not a narrow, linear green strip between habitats. It is highly unlikely that such strips, which are often associated with walking paths or bike trails, would be used by most wildlife. Instead, MCA's definition of a corridor is a broad swath of habitat that connects core habitat areas. Although these swaths may not be as pristine as the parks or the hubs that they connect, they do provide secondary habitat in addition to their role as dispersal corridors. The movement of wildlife across the landscape can be likened to the sheet flow of water across land during a flood. Development should be located so that there are sufficient spaces for wildlife to move through and around development nodes, rather than attempting to force wildlife movements into human-created linear configurations.

Because we are making permanent changes to our landscape, it is imperative to carefully identify where the matrix of wildlife habitats and corridors occurs. It is not sufficient to randomly protect small parcels of habitat across the region in the hope that they will be beneficial to wildlife. Instead, we must discover where species already occur (i.e., which habitats are most valuable) and use this information as a template for making future land use decisions. If we apply this template to guide development patterns, it may be possible to maintain biodiversity and ecological health. Without this template to guide us, loss of biodiversity is a certainty.

This approach may sound simple, but it constitutes a 180-degree shift from the way development has been planned for to-date. Instead of erroneously assuming that natural resources will rearrange themselves around a development, we must understand the resources by gathering data and then fit the development in appropriate places. This approach is not only logical but is also cost-effective in the short- and long-term. In the short-term, it provides transparent, easily accessible information upon which to base land use decisions. By having an agreed-upon set of data, the planning conversation shifts from lengthy, contentious discussions about the quality of the data to a much more useful discussion about the implications of the data. This results in better, more ecologically sound projects and avoids protracted and costly arguments between opposing viewpoints concerning the impacts of development. In the long-term, ecosystems are protected in their entirety because decisions are made with a regional ecological context in mind, which prevents fragmentation of the ecosystem into smaller, dysfunctional units, avoiding mitigation that is both costly and, often, ineffective.

Methods

Study Area Delineation & Site Access

The study area of the Somers Biodiversity Study is approximately 4,500 acres (see map, Appendix A). MCA and representatives of the Town of Somers delineated the study area based on a combination of factors including a) land within the town that is relatively undeveloped/unfragmented and therefore likely to contain significant wildlife resources, b) land that is at risk of development, and c) land area that could be covered given limited time and staff resources.

Once the study area was delineated, MCA coordinated with the Town of Somers to request access to private land for biodiversity surveys. Letters were mailed to the 459 landowners of all 526 parcels in the study area requesting permission to access the land, as well as providing informational materials describing the study. In order to publicize the study to the public, MCA provided a PowerPoint presentation and question-and-answer session on April 18, 2007, at 7:00pm at the Somers Town House in a public forum directed at landowners that was subsequently televised.

While most of the estimated 4,500 acre study area was surveyed by field biologists, portions of the study area were not surveyed due to lack of site access permission by landowners for certain parcels. Nonetheless, we were able to survey a sufficient amount of acreage to make a determination on the biodiversity levels within the study area. Of the 526 parcels in the study area, we received permission to survey 42 privately owned parcels and 46 publicly owned parcels (including county-owned Lasdon Park and Muscoot Farm and New York City-owned watershed protection lands) for a total of 88 parcels, or a 17% positive response rate. This "response rate" refers to the number of *parcels* that we received permission to access, not the number of *landowners* who gave permission which would be 40 private landowners and 2 public landowners (Westchester County and New York City) of 459 landowners or 9%. While the response rate may appear low, it actually represents about half the land in the study area.

Field Data Collection

All sites were surveyed for all three classes of animals (amphibians, birds, and reptiles), and most sites were surveyed on multiple occasions in order to maximize the likelihood of encountering wildlife species inhabiting the site. The study area contains a mixture of privately and publicly owned land, including watershed protection lands owned by the New York City Department of Environmental Protection, Westchester County's 777-acre Muscoot Farm and 234-acre Lasdon Park, and the 654-acre former Eagle River property[1].

The MCA field ornithologist conducted breeding bird surveys during the breeding season (mid-May through early July) at peak song period, starting approximately thirty minutes before sunrise when weather conditions were calm (winds less than 10 mph, no rain), until approximately 12:00 noon, assuming weather conditions remained favorable. Species detection rates are maximized at

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[1] A portion (385 acres) of the former Eagle River property is now jointly owned by Westchester County and the Town of Somers and will become Angle Fly Preserve, while the remaining 269 acres is now New York City-owned watershed protection land. This report refers to these areas jointly as "the former Eagle River property" for sake of simplicity.

these times and under these conditions. The territory covered in a survey was based on habitat quality, the likelihood of encountering uncommon breeding birds, and accessibility. Most data was collected through auditory cues (i.e., listening to bird songs and calls). Playbacks (recordings of bird songs and calls) were used to help confirm or document uncommon birds, or common birds that had not yet been detected in an area. Less often, birds were visually observed by the field ornithologist.

MCA field herpetologists conducted surveys between late March and late June, concentrating on adult amphibians in March-April and reptiles in April-June. Survey techniques consisted primarily of visual searches and the turning over of cover objects (logs, rocks, and other debris).

All field data was collected in 2007 with the exception of a small number of data points from a previous study in 2006. These data points represent marbled salamanders (a Development-Sensitive species) observed at the former Eagle River Property and were added to this study due to the fact that the 2007 surveys revealed no marbled salamanders yet MCA herpetologists were aware this species had been found at that location.

The Focal Species Approach

MCA concentrates survey efforts on wildlife species which respond specifically to development impacts including habitat loss and habitat fragmentation. Such species are termed "focal taxa," and can be further divided into two broad categories. Many focal species experience population declines as a result of urbanization. These species, referred to as "Development-Sensitive" focal species, are usually habitat specialists with relatively narrow ecological requirements and/or complex life-history requirements that involve use of multiple, interconnected habitat types. These specialized habitats and interconnections are often compromised by development. Examples include Neotropical migrant bird species, vernal pool-breeding amphibians, and long-lived species such as box turtles. Because of poor dispersal abilities, herpetofauna (amphibians and reptiles) are initially more affected by fragmentation than birds (see LaBruna, et al. 2006). Such animals tend to disappear from the landscape as their habitats are altered or fragmented. Populations of other focal species increase in response to urbanization. These species, referred to as "Development-Associated" focal species, are usually habitat generalists. That is, they can use a variety of habitat types because they do not have highly specific habitat requirements. Human alterations to landscapes favor, or "subsidize" (see Mitchell and Klemens 2000), these generalists which tend to be found in areas that have already been degraded or along habitat edges, such as highway right-of-ways. Examples of such species include Corvids (crows and jays), Canada geese, bullfrogs, snapping turtles, raccoons, and white-tailed deer. As urbanization proceeds, Development-Sensitive species are out-competed by Development-Associated species which tend to increase and, over time, replace Development-Sensitive species, resulting in an overall reduction of biodiversity.

MCA refers to the process of evaluating the mix of focal species, and its implications for ecosystem health and land use, as the "Focal Species Approach," or "FoSA." The results of FoSA analysis can enhance planning efforts by assessing the importance of individual sites for conservation. For example, development should be discouraged within areas that support healthy populations of Development-Sensitive focal species, and redirected toward sites that are already degraded (i.e., those that are dominated by Development-Associated species). Note that some species do not respond to development with either a clear increase or decrease in number. As a result, they are not useful indicators of habitat quality and are not used in FoSA. We call these "Development-Neutral" species.

FoSA represents an innovative departure from traditional conservation efforts. By expanding the scope of investigation beyond federal or state listed threatened and endangered species, we are able to more proactively conserve natural resources. There are many species, currently unlisted and unprotected, whose populations are declining in response to sprawl. At the current pace of urbanization, these species are highly likely to be candidates for official listing in the near future. Rather than waiting until they are on the brink of extinction (when recovery efforts are not only dangerously uncertain, but also very expensive), it is wiser to attempt to address their habitat requirements and to stabilize their populations now. In addition, ecosystems contain complex interactions among many species. FoSA evaluates systems more reliably by considering a much broader suite of species and their relative abundances, as opposed to basing land use recommendations on a single threatened or endangered species. The FoSA method is not intended to replace the existing and necessary efforts to conserve threatened and endangered species; instead, it complements ongoing conservation efforts.

Lists of Development-Sensitive focal species vary from region to region because species ranges, habitat requirements, and responses to development also vary. The creation of the Somers focal species list was based on a review of literature that addressed development-sensitivity within the New York/New England region (e.g., Andrle and Carroll 1988, Klemens 1990, Klemens 1993, Bull 1998, Klemens 2000) and on observations of species distribution trends in the field. MCA focused, in particular, on amphibians, birds, and reptiles. Besides being particularly "reactive" to development pressures (and therefore good indicators of ecosystem condition), the presence and status of these three groups of animals can be rapidly assessed in a relatively cost-efficient manner using established field techniques. Birds also show differing responses to fragmentation than do amphibians and reptiles. When used in tandem, these three groups provide a robust evaluation of ecosystem integrity.

In order to determine the relative quality of an area's habitat, we normally compare the proportion of Development-Sensitive to Development-Associated species. But because Somers is located in a highly fragmented suburban matrix, Development-Associated species were observed regularly at nearly every survey site. Therefore, we focused on presence of Development-Sensitive species to delineate the areas that are most important for sustaining biodiversity. That is, presence of abundant Development-Associated species was not used heavily as a rationale to exclude an area from the Biodiversity Area map, nor was lack of Development-Associated species used heavily as a rationale to include an area in the Biodiversity Area map.

Considering the close proximity and potential for ecological connections between the current study and the Croton-to-Highlands study, an effort was made to be as consistent as possible and use the same criteria, that is, the same Development-Sensitive species, to delineate biodiversity areas. In light of this, fifteen bird species observed in the current study that are identified as "Development-Sensitive" were not used to delineate biodiversity areas because they were not observed in the Croton-to-Highlands study and could therefore not be used for delineation in that study. One situation arose that required us to make an exception to our effort to be consistent.

Seven species (6 birds, 1 amphibian) observed in the Croton-to-Highlands study, but not identified as "Development-Sensitive," have since been shown to be sensitive to development and were therefore identified as Development-Sensitive species in the current study and used for Biodiversity Area delineation. See notations in Appendix C for these special cases.

Data Management & Analysis

Field survey data were stored in a Microsoft Access relational database, while spatial data, both species location and survey site location, were stored in shapefiles created in ArcGIS 9.0.

The data were analyzed and the Biodiversity Areas Map was created using ArcGIS 9.0.

Step 1 – FoSA Designation

For each observation of a bird, amphibian, or reptile, we attributed the appropriate FoSA category for that species, either: Development-Associated, Development-Neutral, or Development-Sensitive.

Step 2 – Habitat Area Mapping

Mapping herpetofauna habitat required a somewhat different approach than mapping bird habitat due to behavioral differences between these two groups of animals.

Herpetofauna

An animal's "home range" is the habitat area it needs in order to fulfill its life requirements such as obtaining food, water, and shelter. For most herpetofauna, home range size tends to be restricted and therefore a useful tool for mapping herpetofauna biodiversity areas. To approximate the home range habitat area used by observed individuals, using the ArcGIS 9.0 "buffer" function, we mapped a circular area around each Development-Sensitive herpetofauna point equal to that species' home range (with a buffer radius equal to home range radius). This technique assumes that the individual was observed at the center of its home range. Due to the relatively small size of most herpetofaunal home ranges, we considered this a reasonable assumption.

Birds

Birds tend to have large home ranges, so a) delineating home ranges would produce a large mapped area instead of pinpointing the most important bird habitat and b) the likelihood that the location where a bird is observed is at/near the center of its home range is smaller than that for herpetofauna, which would make mapping by this method less accurate. Therefore, we chose a different approach for mapping bird habitat. We mapped bird habitat not by estimating home range but rather according to how bird observations were spatially clustered. Rather than mapping individual circles around each point, we mapped the habitat area immediately surrounding the cluster of bird points, and contiguous habitat of similar type.

Step 3 – Map Riparian Corridors

In recognition of the important role that rivers and their riparian corridors play as habitat and dispersal routes for wildlife, we mapped a 1000-foot-wide riparian corridor (500 feet from each side) along the Muscoot River, Hallocks Mill Brook, and Angle Fly Brook.

Step 4 – Editing & Extrapolation

To further refine the map and avoid unnecessarily including low quality habitat areas, we made changes informed by the following additional GIS layers: hydrography, wetlands, road networks, tax parcels, topography, and orthoimagery. We excluded those sections that were already heavily fragmented (i.e., housing subdivisions), and included areas that either connected existing mapped areas or were both adjacent to existing mapped areas and of high habitat quality (i.e., not fragmented by development).

Step 5 – Synthesis

All mapped layers were merged to form the final Somers Biodiversity Areas Map (see Appendix B).

Results & Discussion

Development-Sensitive Species of Somers

Of all species observed in the study area, thirty are designated by MCA as Development-Sensitive and used for delineation of biodiversity areas. See tables below for lists of these species (five amphibians, three reptiles, and twenty-two birds). For a comprehensive list of all amphibian, reptile, and breeding bird species observed in the Somers study area, see Appendix C.

Table 1-3. Common and Latin names of 30 Development-Sensitive species observed in Somers study area. "Status" column indicates any special status afforded by federal, state, or county governments, or Audubon Society WatchList status (birds only).

Table 1. Development-Sensitive Amphibians

Common Name	Latin Name	Status
Spotted salamander	*Ambystoma maculatum*	
Marbled salamander	*Ambystoma opacum*	Special Concern (New York State)
Four-toed salamander	*Hemidactylium scutatum*	
Red-spotted newt	*Notophthalmus viridescens*	
Wood frog	*Rana sylvatica*	

Table 2. Development-Sensitive Reptiles

Common Name	Latin Name	Status
Spotted turtle	*Clemmys guttata*	Special Concern (New York State); Threatened (Westchester Co.)
Wood turtle	*Clemmys insculpta*	Special Concern (New York State); Endangered (Westchester Co.)
Eastern box turtle	*Terrapene carolina*	Special Concern (New York State); Threatened (Westchester Co.)

Table 3. Development-Sensitive Birds

Common Name	Latin Name	Status
American black duck	*Anas rubripes*	Special Concern (Westchester Co.); Declining (Audubon)
Barred owl	*Strix varia*	
Yellow-billed cuckoo	*Coccyzus americanus*	
Pileated woodpecker	*Dryocopus pileatus*	
Eastern kingbird	*Tyrannus tyrannus*	
Eastern wood-pewee	*Contopus virens*	
Field sparrow	*Spizella pusilla*	
Eastern towhee	*Pipilo erythrophthalmus*	
Indigo bunting	*Passerina cyanea*	
Scarlet tanager	*Piranga olivacea*	
Warbling vireo	*Vireo gilvus*	
Yellow-throated vireo	*Vireo flavifrons*	

Table 3. Development-Sensitive Birds		
Common Name	**Latin Name**	**Status**
Black-and-white warbler	*Mniotilta varia*	
Worm-eating warbler	*Helmitheros vermivorum*	Special Concern (Westchester Co.); Declining (Audubon)
Blue-winged warbler	*Vermivora pinus*	
Chestnut-sided warbler	*Dendroica pensylvanica*	
Ovenbird	*Seiurus aurocapilla*	
Louisiana waterthrush	*Seiurus motacilla*	
Hooded warbler	*Wilsonia citrina*	
Wood thrush	*Hylocichla mustelina*	Special Concern (Westchester Co.); Declining (Audubon)
Veery	*Catharus fuscescens*	
Eastern bluebird	*Sialia sialis*	

The Eastern Biodiversity Area

We discovered two separate Biodiversity Areas in Somers, one on the Eastern side of the study area and one on the Western side. The much larger of the two is the Eastern Biodiversity Area which encompasses Lasdon Park, Muscoot Farm, the former Eagle River property, New York City-owned watershed protection lands, and private lands between and surrounding these protected areas.

Birds

The following Development-Sensitive bird species were observed breeding in the Eastern Biodiversity Area, the: American black duck, barred owl, black-and-white warbler, chestnut-sided warbler, Eastern bluebird, Eastern kingbird, Eastern towhee, Eastern wood-pewee, field sparrow, hooded warbler, ovenbird, pileated woodpecker, scarlet tanager, veery, warbling vireo, wood thrush, worm-eating warbler, yellow-billed cuckoo, Louisiana waterthrush, indigo bunting, blue-winged warbler, and yellow-throated vireo.

In suburban landscapes, large blocks of unfragmented forest are rare. However, some of the Development-Sensitive species we observed indicate that Somers still retains large tracts of quality forest habitat. For example, forest-interior specialists like the ovenbird, wood thrush, and veery indicate presence of quality forest habitat that has not been degraded by the “edge effects” of fragmentation, while presence of pileated woodpecker and worm-eating warbler indicate that there are large tracts of intact, unfragmented forest to sustain these area-sensitive species. Because of its rather specific nesting requirements (nest trees must be old and large), it is likely that, when the habitat needs of the pileated woodpecker are met, other woodpeckers also benefit (Bull and Meslow 1977). Because woodpeckers create holes for many other species of cavity-dwellers, including other birds and mammals, the presence of pileated woodpeckers indicates that multiple types of cavity-dwelling wildlife may be present. Worm-eating warblers are ground nesting birds and are therefore more prone to predation by Development-Associated predators like the raccoon, skunk, opossum, and domestic cat. Although we do not know if they or their chicks fell prey to such predators, their presence is a positive sign.

The contiguous forest tract in the Eastern Biodiversity Area is the largest in the entire town. This is important to successful breeding because the effects of nest predators and parasites decrease as distance from a forest edge increases (Brittingham & Temple 1983). That is, the number of nests parasitized by brown-headed cowbirds is significantly less in interior forest than at the forest edge. Many bird species, including worm eating warblers, are more likely to breed successfully in unfragmented forest such as this where parasitism from brown-headed cowbirds, which frequent forest edges, is minimized. Brown-headed cowbirds parasitize nests up to about 300 meters from the forest edge. There are portions of forest in the Eastern Biodiversity Area that are further from the forest edge than this, providing sanctuary from such parasites.

The Eastern Biodiversity Area provides more than simply forest habitat. The blue-winged warbler and yellow-throated vireo inhabit places where there is a transition from one habitat type to the next, such as the intersection between farmland and forest edge. However, unlike the white-tailed deer which also use forest edges, these birds do not tolerate urbanization. Their presence indicates a mix of habitat types that support such Development-Sensitive, transitional habitat specialists. In addition, the presence of Louisiana waterthrush suggests healthy riparian habitat, while the field sparrow indicates habitat for grassland specialists, a type of habitat that is on the decline in the Northeast region as farmland reverts to forest or is converted to housing developments.

Amphibians & Reptiles

All five Development-Sensitive amphibian species (wood frog, spotted salamander, marbled salamander, four-toed salamander, and red-spotted newt) and all three Development-Sensitive reptile species (box turtle, spotted turtle, and wood turtle) were observed in the Eastern Biodiversity Area. Many of these were found within protected areas, including the only spotted turtle (found at Muscoot), the only wood turtle (found on NYC DEP land), and four of seven box turtles (two at Muscoot and two at the former Eagle River property) observed. These findings suggest that these large protected areas are vital to the survival of many herpetofauna species. It is likely that protected areas harbor source populations from which herpetofauna disperse into surrounding lands. For example, the remaining three box turtles observed were found on unprotected land, but without nearby protected areas hosting source populations of herpetofauna, these individuals may not exist.

All three turtle species observed are state and county-listed because of their declining numbers. Spotted turtles and wood turtles are now unusual finds in Westchester County because they are so highly sensitive to development, and both were found in this study, which is an encouraging sign. For example, a recent (though smaller) MCA study in North Castle revealed no wood turtles nor spotted turtles and only a single box turtle, while a 2002-2005 MCA study at Rockefeller State Park Preserve and surrounding private lands found no wood nor spotted turtles and very few box turtles. However, the spotted and wood turtle observations in Somers should be treated with caution. The fact that only a single individual of each these two species was found is most likely an indication that their numbers in Somers are low (although, we should note that at least four wood turtles were found along the Angle Fly Brook as part of the Eagle River project review (M. Klemens, personal communication, Dec 16, 2007)). Additionally, turtles are long-lived species, so presence of adults does not necessarily indicate a healthy, reproducing population. Older individuals may remain long after the population has ceased to reproduce. Or, if reproduction is still occurring, the predation rate on hatchlings may be so high that none survive to reproductive age (the Development-Associated raccoon, skunk, and opossum all prey on turtle hatchlings). Only observation of a variety of age classes is evidence that the population is reproducing. Since only a single individual of each species was found, we do not know the reproductive status of these populations. A study of spotted turtles begun in 1990 at Muscoot Farm conducted by the late John Behler, long-time herpetology curator at the Wildlife Conservation Society's Bronx Zoo, suggests that spotted turtles are not reproducing successfully. He found that the spotted turtle population there declined over the thirteen years the study was conducted (Soltesz & Garber 2004). Soltesz and Garber (2004) report a box turtle population at Muscoot that is more widespread than the spotted turtle population, an observation that matches with our survey results for the broader study area (we found a ratio of 1 spotted turtle to 7 box turtles). They also describe reports of copperheads *(Agkistrodon contortrix)* although they do not appear to have found any in their study. Copperheads are a highly Development-Sensitive reptile and would be a positive sign if they are indeed present.

MCA observed a similar phenomenon of depressed turtle numbers in southern Westchester in the Pocantico Hills Biodiversity Study which was conducted at Rockefeller State Park Preserve and adjacent Rockefeller family lands (see LaBruna et al. 2006). Surveys there revealed a remnant, non-sustainable box turtle population, and MCA recommended that a mark-recapture study be conducted with the potential of a box turtle reintroduction program. However, we do not recommend turtle reintroduction programs in Somers because, unlike Pocantico Hills, the habitat in Somers retains ecological connections to adjacent turtle habitat and therefore reintroduction efforts could introduce diseases and maladaptive genes into the wild turtle population, harming the population more than helping it. Instead, we advocate that land owners and managers protect, manage, and restore turtle habitat with the expectation that, in time, the turtles will respond with a growth in population.

It is worth noting that the habitat of one of the box turtles observed on private land could not be incorporated into a Biodiversity Area even though this species is an important indicator of quality habitat. In a "textbook" case of habitat fragmentation, the patch of forest this particular box turtle is using has become ecologically severed from the Western Biodiversity Area due to recent housing development along Fieldstone Drive. This turtle is now trapped in a small fragment of forest that may or may not meet all of its life requirement needs for food, water, shelter, and reproduction. Once this box turtle dies, box turtles will be extirpated from this forest fragment. Even if there are other box turtles in this forest fragment that went undetected in our surveys, this does no improve the long-term outlook for box turtles at this location. Small populations are statistically likely to be wiped out more quickly than large populations, and with no outside ecological connections, there is no chance of box turtles re-colonizing this forest fragment. See Figure 1 for illustration.

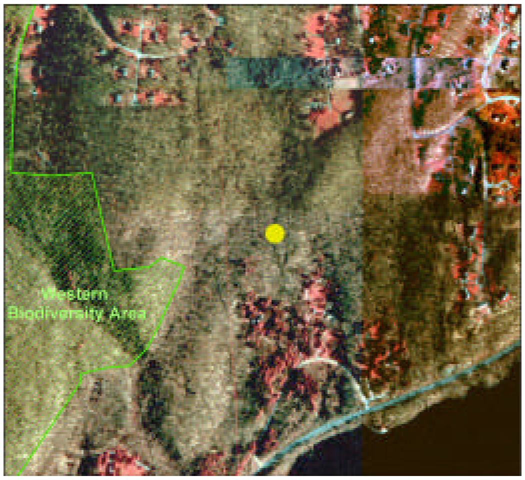

Figure 1A. An Eastern box turtle, represented by the yellow dot, is enclosed on three sides by roads and housing developments but can still access habitat in the Western Biodiversity Area.

Figure 1B. Road and house building along Fieldstone Drive divides the box turtle's habitat into two. The turtle can no longer access the habitat in the Western Biodiversity Area, and is restricted to a small fragment of habitat enclosed on all four sides. The box turtle population in this fragment will soon die out.

Amphibians are delicate animals with skin that is water permeable and therefore very sensitive to pollution and desiccation (drying out). These are often some of the first species to be extirpated in areas experiencing sprawl development. MCA field biologists made multiple observations of the vernal pool-dependent wood frog and spotted salamander (both adults and egg masses), which indicate functioning vernal pool wetlands with associated upland habitat at multiple sites throughout the Eastern Biodiversity Area. Previous biological surveys conducted at Muscoot Farm for the Westchester County Department of Parks found these two Development-Sensitive amphibians plus the even more sensitive marbled salamander (Soltesz & Garber 2004).

Although the robustness of the Eastern Biodiversity Area lies partly in its protected lands, that value is multiplied by its "connectedness," that is, the relative lack of fragmentation between protected areas. For this Biodiversity Area to remain ecologically vibrant, it is important that the ecological linkages *between* protected areas (i.e., private lands) be maintained and not severed by ecologically-inappropriate development.

The Western Biodiversity Area

The Western Biodiversity Area is much smaller than its Eastern sister; so small that normally it would not meet the criteria of a "Biodiversity Area." Fortunately, from the Croton-to-Highlands Biodiversity Plan study (completed by MCA in 2004, see MCA Technical Paper No. 7), we know that Development-Sensitive wildlife use habitat across the town line in Yorktown. This means that the Western Biodiversity Area is actually an extension of a much larger Biodiversity Area in the Croton-to-Highlands Biodiversity Plan, which raises its relevance to that of a true "Biodiversity Area."

One would expect that the Western Biodiversity Area, being smaller in size, would contain fewer species overall. While field biologists found this to be the case, they did observe important species such as the Development-Sensitive box turtle, wood frog, and spotted salamander, as well as the Eastern wood-pewee, ovenbird, pileated woodpecker, scarlet tanager, wood thrush, worm-eating warbler, yellow-billed cuckoo, and Louisiana waterthrush. During the Croton-to-Highlands surveys in Yorktown, the Development-Sensitive Indigo bunting, veery, Eastern bluebird, yellow-throated vireo, Eastern towhee, blue-winged warbler, hooded warbler, black-and-white warbler, and Northern slimy salamander were observed in the section of forest to the west of, and contiguous with, Somers' Western Biodiversity Area. As wildlife do not observe political boundaries, it is likely that species observed during the Croton-to-Highlands study use Somers' Western Biodiversity Area as habitat as well. Also observed during that study were species found during the Somers study: Louisiana waterthrush, wood thrush, ovenbird, worm-eating warbler, box turtle, and wood frog. To reiterate, the importance of the Western Biodiversity Area lies mainly in its ecologically strategic location as an extension of the Croton-to-Highlands Biodiversity Area.

The Eastern Biodiversity Area is vitally important to the ecological health of the Town of Somers. The Western Biodiversity Area is smaller but important in that it connects Somers' ecology to a network of Biodiversity Areas in the Croton-to-Highlands Biodiversity Plan. There are other lands in Somers that deserve attention as well. A parcel of land which straddles the Somers-Yorktown border which we were unable to survey due to lack of landowner permission could, if found to be biologically significant, extend the Eastern Biodiversity Area further west into Yorktown (see orange hatched area on map in Appendix B). Also, due to a relative lack of sprawl development in parts of Somers northwest and northeast of the Amawalk Reservoir, it is likely that these sections of town also harbor biodiversity resources. We encourage the town to pursue future studies to examine these areas.

Improving Habitat Quality

The purpose of this project is to identify the extent of biodiverse habitat remaining in the study area. However, we would be remiss if we did not also address the importance of habitat *quality* to wildlife survival. When we speak of habitat quality, we are referring to: (1) abundance of vegetation, (2) plant species diversity, (3) structural complexity (for forests this means layers of vegetation including mature trees and an understory composed of smaller trees/saplings, shrubs, and a layer of herbaceous undergrowth), and (4) control of any invasive plants or predators (e.g., Japanese barberry, domestic cat). Salamanders, hatchling turtles, and ground-nesting birds use the forest understory as cover from predators, while the latter also use the understory for nesting. Habitat quality also affects the ability of Neo-tropical migrant birds to survive their fall migration. After the breeding season, the adult bird population density increases dramatically due to dispersal of fledgling birds. Therefore, bird populations require greater food and habitat resources between the time birds fledge the nest and the time migration begins. During this critical time of post-breeding dispersal (approximately July to September, depending on the species), birds extend their range beyond the breeding territory (this is when you are more likely to see uncommon bird sightings, such as hummingbirds, in your backyard) and Neo-tropical migrants begin to store fats in preparation for migration, provided they can access a sufficient diversity and abundance of food resources (insects, fruits, and/or nuts, depending on bird species). Thus, the ability of the habitat to provide those food resources (i.e., habitat quality) is vital to the birds' survival.

Utilize Deer Exclosures
A major threat to forest habitat quality in Westchester is deer overbrowse (excessive foraging), which strips forests of understory vegetation, reduces tree diversity, diminishes forest structural complexity, and encourages establishment of invasive plants. White-tailed deer proliferate in suburbanized landscapes as they benefit from the large amount of "edge" habitat (where forest meets field) made available by fragmentation. However, this also means that the remaining tracts of forest in the landscape experience more deer browse than they can sustain, resulting in a forest with minimal, degraded understory. A practical method property owners and managers can utilize to improve habitat quality is to install deer exclosures (fencing that excludes deer from a given area). Exclosures do not necessarily need to encircle the entire property; indeed, for large properties the cost of doing so may be prohibitive. But even an exclosure of limited size will see the vegetation within it rebound and thrive in the absence of deer. If you have several different habitat types on your property, such as wetlands, moist woods, and dry woods, consider installing a deer exclosure that encompasses portions of all of these habitat types. A major problem with traditional deer fencing is that it excludes other wildlife as well. We recommend fencing that has large enough holes to allow smaller wildlife, such as small mammals and turtles, to pass through so that only deer are excluded.

It is important to note that the value of deer exclosures is limited to small-scale protection. This is helpful in providing localized habitat restoration for birds and other wildlife; however, it will not solve the regional problem of deer overpopulation, as exclosures may increase the density of deer in non-exclosed areas. Since roadways and right-of-ways fall into this category, and because deer readily used these corridors, increased numbers of traffic collisions could be a real concern. Long-term reduction and stabilization of the deer herd in Westchester will require multiple management techniques at multiple scales and the involvement of the New York State Department of Environmental Conservation (DEC). Representatives of the DEC, Westchester County, and conservation, education, hunting and humane organizations banded together in 2006 to deal with the deer overpopulation issue, forming the Westchester County Forest Regeneration Citizens' Task Force. The group plans to release a report in early 2008 that provides guidelines to towns, villages, and the county on options for controlling the deer population. You can also contact the DEC Region 3 Wildlife Department at (845) 256-3098 to inquire about what they are doing to control the deer herd in Westchester.

"Naturalize" Your Land
Landowners and land managers can improve habitat quality by "naturalizing" manicured lawns and gardens. The following are ways to make your land more hospitable to wildlife:

- since lawns are ecological "deserts," reduce lawn size in favor of forest, grassland or wetland,
- decrease use of biocides (pesticides, insecticides, and herbicides), particularly near waterways,
- allow a "buffer" zone of shrubs to grow where there is currently an abrupt transition between lawn and forest to benefit bird species like brown thrasher, chestnut-sided warbler, and blue-winged warbler,
- mow fields every three-to-five years instead of annually to create "old field" habitat to benefit bird species such as pheasant, yellow warbler, blue-winged warbler, and ruffed grouse, and

- ✍ allow a complex, multi-layered vegetation structure to grow in your forest instead of pruning, raking, and otherwise simplifying it.

Keep Cats Indoors

Reducing the number of invasive predators will help protect Somers' native biodiversity. The domestic cat, a Development-Associated invasive species, is a skilled hunter that hunts a wide variety of prey, ranging from birds and amphibians to reptiles and small mammals. The cat has made the World Conservation Union's infamous list of "100 of the World's Worst Invasive Alien Species" (Lowe et al. 2000) due to the damage cats inflict on native biodiversity throughout the world. One conservative estimate states that the combined outdoor pet cat and feral cat population of 71 million kills 568 million birds per year in the United States alone (Pimentel et al. 2000). MCA supports the American Bird Conservancy's call on cat owners to keep their cats indoors to protect wildlife. For more information on the "Cats Indoors!" campaign, go to www.abcbirds.org/cats/.

Recommendations for Implementation

The following sections outline tools and techniques that can be employed to achieve the goal of this biodiversity plan—a sustainable balance between development and conservation within Somers and the larger lower Hudson Valley region.

Important Considerations and Caveats
a. Mapped areas are not being recommended solely for land preservation.

Preservation of all the land within the mapped Biodiversity Areas through purchase or easement is not a prerequisite to conservation. Some of the mapped areas contain privately owned land with homes and contribute, through taxes, to the economic health and sustainability of the towns. Instead, within Biodiversity Areas, we propose a balanced approach to conservation and development that incorporates the diverse suite of land use planning and conservation tools presented below.

b. Development outside of the delineated Biodiversity Areas on the maps needs to remain mindful of environmental and land use issues.

Exclusion from the mapped Biodiversity Area does *not* provide "carte blanche" for development activities. The map is intended for broad-scale planning efforts, not for development planning and review at a site-specific scale. Regardless of location, individual development proposals—both inside and outside of the mapped area—should undergo careful review and consideration of potential biological impacts.

c. Conservation opportunities may occur outside of Biodiversity Areas.

Small or isolated habitats outside of the mapped areas may contain significant species or natural communities that have high conservation value (e.g., a fen, bog, or remnant patch of old-growth forest). They may have been excluded from our maps because (1) they were not detected during surveys and analyses, or (2) no connectivity could be established with a larger ecological corridor or system. While careful planning within the mapped area will contribute significantly to the long-term maintenance of biodiversity at a regional scale, additional conservation opportunities should be considered.

Recommendations for Future Development and Economic Growth
To balance development with the conservation goals of this project, we propose that it continue to be concentrated in areas outside of those identified as the Biodiversity Area. In particular, we recommend encouraging new development in and around existing development nodes (i.e., the hamlet of Somers and other hamlets). By doing this, it may be possible to alleviate development pressures in areas that are critical for biodiversity. Previously developed areas contain the infrastructure (roads, water lines, sewage lines, etc.) and services (schools, hospitals, stores, etc.) to support further development in a cost-effective manner. Conversely, development that sprawls into Biodiversity Areas would have both ecological and economic costs for the town. We must reiterate that development does not necessarily need to be excluded from Biodiversity Areas; instead, the town should attempt to focus development in areas that have already experienced

such growth and simultaneously reduce the "ecological footprint" of development in Biodiversity Areas. Recommendations to achieve these goals are made in the following two sections.

Recommendations for Land Preservation

Although this project focuses on conservation through an expanded scale and scope of local land use planning, under certain circumstances land preservation remains the best route to maintaining biodiversity on select parcels.

a. Attempt to add area (through acquisition or easement) to existing protected areas.

Protected areas contribute greatly to the ecological robustness of the Eastern Biodiversity Area. Adding additional protected area to their periphery will buffer the existing protected habitat from externally caused degradations (e.g., runoff of polluted water from roads and parking lots, noise pollution). It will also help to reduce "edge effects," (e.g., changes in vegetation structure, temperature, predation levels, parasitism levels, and other factors near habitat edges), which can negatively impact many Development-Sensitive species, including those that are area-sensitive such as the pileated woodpecker and worm-eating warbler.

b. Attempt to preserve (through acquisition or easement) areas that are currently unprotected and have significant levels of biodiversity, or that contain populations of imperiled species.

c. Partner with local and regional land trusts and others to protect areas identified in this report.

d. Develop an open space preservation plan for your town that incorporates biodiversity issues or integrate biodiversity criteria, through amendments, into your existing open space plan.

Somers should develop an Open Space Plan – either as a new stand-alone document or as a revision of the 1994 Master Plan's "Open Space and Recreation" section -- that takes biodiversity into consideration when prioritizing open spaces for protection. To encourage the preservation of land within Biodiversity Areas, the Open Space Plan should include the Somers Biodiversity Areas Map (see Appendix A). It is important to note that not all open space uses are in harmony with conservation. For instance, Biodiversity Areas may be considered for passive recreation such as hiking, bird watching, and snow-shoeing, but should not be converted to active recreation sites such as ballfields, playgrounds or golf courses, for example. While Biodiversity Areas are not to be considered for preservation alone, the map will help to prioritize areas for preservation.

e. When considering proposals to subdivide and develop parcels, always opt for conservation easements and open space reservations instead of fee-in-lieu payments or other buyouts.

Choose conservation easements before open space reservations and have those easements held by a land trust or municipality instead of a homeowner's association. Attempts should be made to consolidate the portions under easement, because one large protected area is more valuable from a conservation standpoint than numerous small, fragmented protected areas. If possible, the portion of a property to be protected in this manner should be selected based on its biodiversity value in relation to other portions. It is important to note that an applicant cannot usually receive a charitable donation for an easement that is a *requirement* of a development application. Individuals are advised to obtain professional advice on how to create conservation easements as part of the site development process *prior to* entering the formal land use permitting process.

Recommendations for Local Land Use Planning

The following recommendations (including procedures, steps, and tools) can help to maintain biodiversity in areas where land preservation is not feasible or desirable. These recommendations are not listed in order of priority.

a. Avoid large-lot zoning, including "upzoning."

Increasing the size of buildable residential lots, or "upzoning," is often perceived as a "quick fix" to sprawl. These zoning changes result in development patterns that appear to be "green," with fewer houses and more trees visible. In reality, however, upzoning encourages sprawl by spreading the impacts of development across a much larger area, destabilizing and often eliminating local populations of Development-Sensitive wildlife species while also creating large amounts of "edge" habitat. Statistics show that while the human population in the New York metropolitan region increased by only 8% between 1970 and 1990, land consumption during the same period increased by 65% (Diamond and Noonan, 1996). It is no surprise that wildlife, habitats, and ecosystem integrity are disappearing. A shift from large-lot zoning to a more centralized, compact pattern of development is critical to maintain the biodiversity and ecological health of our region. From an ecological standpoint, upzoning is only acceptable when accompanied by a *mandatory* cluster requirement (see next section and Klemens et al., 2006, section 3).

b. Consider novel types of development, including Conservation Subdivisions and Traditional Neighborhood Design.

Conservation subdivisions cluster housing, making it is possible to reduce the amount and impact of associated infrastructure, such as roads, reducing the "ecological footprint" of development to more closely match the "built footprint." This has ecological as well as economic benefits. To maximize the ecological benefits, siting of clusters should be based on knowledge of relative biodiversity levels and proximity to other developments. It is imperative that housing clusters take up no more than 25-50% of the parcel being considered for development. This allows 50-75% of the parcel to remain free of development, providing ecological connection to adjacent parcels.

Traditional Neighborhood Design (TND) recreates traditional, village-style development by setting densely developed nodes in a matrix of large open space that enable wildlife to circumvent developed areas. TNDs are popular because they create a sense of character and community that is often lacking in conventional, "cookie-cutter" style subdivisions. Creating TNDs with real conservation value may require modification of existing municipal regulations, zoning codes, and procedures in order to harmonize the goals of tight clusters with existing municipal standards.

Making incentives available to developers who build these types of eco-appropriate developments is an important consideration. Density bonuses (permitting a developer to build additional units of clustered housing), fast-tracking of the permitting process, and easing of other building standards are examples of incentives that the town may opt to utilize.

c. Pass a Conservation Overlay District Ordinance (e.g., MCA Technical Paper No. 3).

The purpose of a conservation overlay district ordinance is to maintain habitat connectivity. It does so by minimizing the impacts of development within the designated conservation overlay district. A conservation overlay district ordinance need not completely prohibit development; development can be allowed within the conservation overlay district, but additional development regulations would apply, as would incentives for eco-appropriate development.

Most municipal laws and regulations created to protect natural resources address one type of resource (wetlands ordinances, tree preservation ordinances, steep slope ordinances, etc.). They tend not to address the ecological connections between habitat types, the connections that must be maintained to conserve the many wildlife species that use multiple habitat types. A conservation overlay can "pick up" where a wetlands ordinance "drops off." For instance, Somers' wetlands ordinance stipulates a 100-foot buffer around wetlands of 5,000 square feet or larger (Town of Somers 1997). This is an adequate buffer width for water quality protection purposes; however, it is inadequate for purposes of wildlife habitat protection. For instance, vernal pool-dependent amphibians require at least a 750-foot buffer of forested upland habitat. Also, the 5,000 square foot minimum wetland size does not address all of the very small, but important, wetlands, such as vernal pools. Rather than revising the wetlands ordinance to increase buffer width and to address smaller wetlands, it is often more practical to create a conservation overlay district in which development would be strictly controlled in the 750-foot buffer around vernal pools.

A conservation overlay district ordinance should also address connections between different types of wetland habitat (e.g., between vernal pools, semi-permanent pools, and ponds) and connections within a single habitat type. For instance, to maintain the integrity of forest habitat, a conservation overlay district ordinance can require that housing developments be conservation (cluster) developments rather than conventional subdivisions. As discussed above in "*b*", the town can provide incentives for eco-appropriate development in the conservation overlay district.

Rather than a strict regulatory approach where a map is adopted and development within that mapped area is restricted and requires a permit, the conservation overlay district ordinance allows for an information-based dialogue to take place between the applicant and the Town (most likely the Planning Board). This dialogue allows the Planning Board to weigh alternatives against complex ecological variables in order to arrive at the best possible solution for that particular situation, something that the rigidity of regulations does not allow for.

A conservation overlay district is a useful tool that allows a town, through home rule authority, to influence patterns of development within its borders in a way that minimizes impacts to wildlife and habitats. We recommend that Somers consider such an ordinance, adopting the entire Biodiversity Areas Map as the conservation overlay district, with the potential for expansion pending future biodiversity studies in other portions of the town.

d. Integrate the recommendations and maps in this report into your town's Comprehensive Plan.

It is important to note that Comprehensive Plans can be amended at any point, even after an update has occurred, so it is possible to incorporate the findings and recommendations of this report into the current plan.

Comprehensive Plans need to be more than a "shopping list" of community desires; for each goal, a clear pathway to attaining that goal must be laid out. For example, if a community desires to encourage TNDs, it must amend many of its regulations and procedures. The specifics of these changes should be detailed in the Comprehensive Plan.

e. Formalize the intermunicipal relationship between the Town of Somers and other municipalities.

Due to the ecological connection between Somers' Western Biodiversity Area and a biodiversity area in the Croton-to-Highlands Biodiversity Plan (CHBP), we recommend that Somers join the CHBP intermunicipal agreement which aims to implement the conservation and preservation recommendations in a consistent, joint fashion. Somers should also have representation on the intermunicipal council established to oversee implementation.

The intermunicipal council should focus on a broad array of land use issues (affordable housing, transportation, economic development, recreation opportunities, tourism, and others). Biodiversity conservation will not be successful unless it is carefully woven into a broader tapestry of land use issues.

f. Encourage the extension and application of biodiversity and planning concepts, tools and mapped areas into towns adjacent to Somers communities.

Conservation efforts in neighboring towns can add value to those in the Somers. This is particularly important for adjacent towns that share ecological linkages, for example, the towns of Yorktown, Bedford, and Carmel.

g. Encourage better SEQRA reviews by:

- Considering impacts beyond individual project sites (that is, consider cumulative impacts of site-specific development proposals on wildlife, habitat connections, and biodiversity at town- and region-wide scales).

- Encouraging use of the Generic Environmental Impact Statement (GEIS) process. This is a planning process wherein the town creates an environmental impact statement for a large block of land. Then, as individual development projects are proposed, they are evaluated against the findings of the GEIS. The town recovers the costs of the GEIS through a pro-rated fee assigned to each development project.

- Requiring standards for wildlife surveys to ensure that adequate effort is being expended—at appropriate times of year and using established techniques—to assess wildlife resources for preparation of development proposals at specific sites. MCA has prepared standards to this effect that have already been adopted by towns in New York. The "Scoping" stage of the SEQR process is important because it is then that the type of studies and study methods are determined. The "Completeness Review" is also important because it is the point at which it is determined whether or not studies have been conducted in accordance with the Scoping. If not, then it is required that the studies be completed before the Draft Environmental Impact Statement is designated as "sufficiently complete for public review."

h. Seek out biodiversity training workshops and other educational forums for your town's land use decision-makers.

An informed group of decision-makers is empowered and motivated to ensure that their town's natural resources are maintained. Training and educational programs available in this region are offered by MCA and by our partner organizations, such as Hudsonia, Ltd., Glynwood Center, and Pace University's Land Use Law Center. NYS DEC's Hudson River Estuary Program coordinates a variety of training and educational opportunities. A new resource is MCA Technical Paper No. 10, "From Planning to Action: Biodiversity Conservation in Connecticut Towns" (Klemens et al., 2006) which contains guidance for land use planners and has direct applicability to New York towns. Consider instating a training requirement to encourage land use decision makers to utilize these resources.

i. Develop and support programs to educate citizens in your town about the importance of biodiversity.

An informed citizenry is a constituency that can empower elected officials to make decisions that benefit both people and the environment. Somers has already made progress to this end with the public lecture series on issues related to biodiversity conservation planned by the Bedford-Somers Biodiversity Training Group.

j. Amend your wetlands ordinance to better protect wetland biodiversity.

Somers already has a relatively strong wetlands ordinance that protects multiple wetland types and sizes (at least 5,000 square feet), as well as a surrounding buffer of 100 feet, from many destructive activities such as draining, filling, clearing of vegetation, etc. (Town of Somers 1997). However, some vernal pool wetlands are smaller than this minimum size and are therefore left unprotected. Because of the importance of vernal pool wetlands to the reproductive cycles of many sensitive wildlife species, we recommend that Somers amend its wetlands ordinance to protect even the smallest of vernal pools.

k. Map vernal pools and other small wetlands within your town.

To successfully protect small wetlands, which often support a unique assemblage of biodiversity that cannot be found in larger wetlands, one first needs to know where they are located. Broad-scale wetlands maps often fail to identify smaller wetlands and as a result, they tend to "slip" through regulatory "cracks." Proactively mapping small wetlands is preferable to identifying wetlands reactively (as development proposals are submitted) because it provides town staff with a regional context which will assist them in making informed planning choices. Although a labor-intensive task, mapping vernal pools would be a prudent next step for Somers to undertake. A volunteer, citizen-scientist mapping program may help to make this a practical task. Procedures and considerations for mapping vernal pools on a town-wide basis are provided in MCA Technical Paper No. 5 (Calhoun and Klemens 2002).

l. Formally adopt and apply "Best Management Practices" and "Best Development Practices" that can help to reduce impacts to biodiversity during both town-wide planning and individual site review processes.

An example of such a manual is MCA Technical Paper No. 5**, "**Best Development Practices: Conserving Pool-Breeding Amphibians in Residential and Commercial Developments in the Northeastern United States" (Calhoun and Klemens 2002), which provides guidelines for protecting vernal pool species in areas being developed. Additional BMPs from other organizations and agencies may also prove to be useful.

m. Develop and adopt a Rare, Threatened, and Endangered species list that is specific to your town.

Federal and state lists do not take into account the decline or extinction of species at the scale of individual towns, groups of towns, watersheds, or counties. Some counties in New York have developed lists, but they have no jurisdiction outside of county parks. We recommend that Somers develop and adopt its own list (in consultation with conservation organizations and local naturalists), and that the town require listed species to be considered during review of development proposals. Such a list would not be regulatory in nature but would instead help to guide discussions and generate options in development proposals (e.g., where to locate open space areas created as part of the site approval process).

n. Ensure that all environmental regulations within your town are adequately enforced.

Enforcement should be a major focus of communities attempting to preserve their biodiversity resources because any lack of enforcement, or uneven enforcement, undermines the effectiveness of environmental regulations. However, enforcement can be expensive and time-consuming; therefore, communities with limited funds and time should consider hiring enforcement officers on cost-share and time-share bases with neighboring communities.

Placing multiple conditions on projects in order to approve them creates a series of follow-up tasks for local officials to monitor, overextending town resources. Although town officials often use "conditioning" out of an effort to be helpful, it is not the responsibility of the town to repair an inadequate proposal in this manner. It is better to deny an application and provide clear guidance to the applicant on how to remedy deficiencies in the next application rather than permit the application with numerous conditions (see Klemens, et al., 2006, section 11). This is because "conditioning" (1) rarely creates a successful project out of an inferior proposal and (2) disenfranchises the public as conditions are to be met after the public review period has concluded.

o. Revise the formula used by your town to calculate housing density yields.

Like many other towns, in Somers, residential housing density yields for subdivisions are calculated by dividing total property acreage by lot size, as established in zoning codes. While this formula in and of itself does not account for areas within properties that are not buildable due to environmental constraints, fortunately, Somers' wetlands, steep slope, and tree ordinances remove these environmentally constrained areas from building consideration. This results in a "theoretical" number of house lots. The next step for a conventional housing subdivision, as required by the Westchester County Department of Health, would be to perc-test every site that requires a septic system to see if the soils can support such a system. This determines the final number of buildable house lots. However, when building a conservation (cluster) subdivision, what often happens is that the number of clustered house lots is based on the "theoretical" figure without perc-testing an adequate number of lots. According to Arendt (1999), a subset of at least 10% of the "theoretical" lots should be perc-tested to determine if the site can truly support that number of clustered lots. Subdivision regulations should stipulate these procedures. See Arendt (1999) for further details.

p. Strive to make the land use planning and review processes as inclusive and transparent as possible.

Land use planning and review procedures are often fraught with mistrust and tension, resulting in decisions that satisfy few or none. All interested parties should be included as early as possible in this process, preferably at a "pre-application" meeting, to incorporate the needs and goals of developers, landowners, local governments, agencies, environmental advocates, affordable housing advocates, and private citizens. Through inclusiveness and transparency, intractable differences may be avoided and acceptable solutions achieved before positions become entrenched.

q. Include the maintenance of biodiversity as a major goal in the management plans of parks, preserves, and other protected areas within the Biodiversity Area.

Most parks and preserves are protected for a variety of reasons, including recreation, aesthetics, protection of water supplies, and biodiversity, among others. Park development and management activities that target one of these goals may come at the expense of the others. For instance, clearing shrubs and ground layer vegetation to improve views within a park will negatively impact water quality and biodiversity. Such clearing may be appropriate for a small park within an urbanized area, where primary goals include picnicking and walking. However, parks and preserves within Biodiversity Area should be carefully managed to ensure that biodiversity can persist. With careful planning, biodiversity conservation can be accomplished in harmony with other goals.

r. Consider opportunities for restoration of ecological connectivity when upgrading and maintaining roads and highways.

Roads and highways sever ecological connections. Where they cross a Biodiversity Area, these ecological connections should be improved during the upgrading and maintenance of the roads. For example, to enhance amphibian passage across roads, it is possible to build an underpass. To ensure that the passage is used by wildlife, it should meet certain specifications. Stream corridors can form natural connectivity across roads; culverts should be designed and installed to maximize this connectivity potential. For a complete discussion of road impacts on wildlife, along with potential solutions, see Forman et al. (2003).

s. Conserve farms that contribute to biodiversity, using innovative approaches.

Farms often provide quality habitats for wildlife and are also attractive alternatives to other land uses, such as sprawl development. To maintain farm-related biodiversity, preservation alone is an insufficient conservation tool. Purchase of Development Rights (PDR) programs should be initiated, funded, and applied. Such programs should, in particular, target farms that demonstrate a high level of biodiversity; such farms may occur inside or outside of the mapped Biodiversity Areas.

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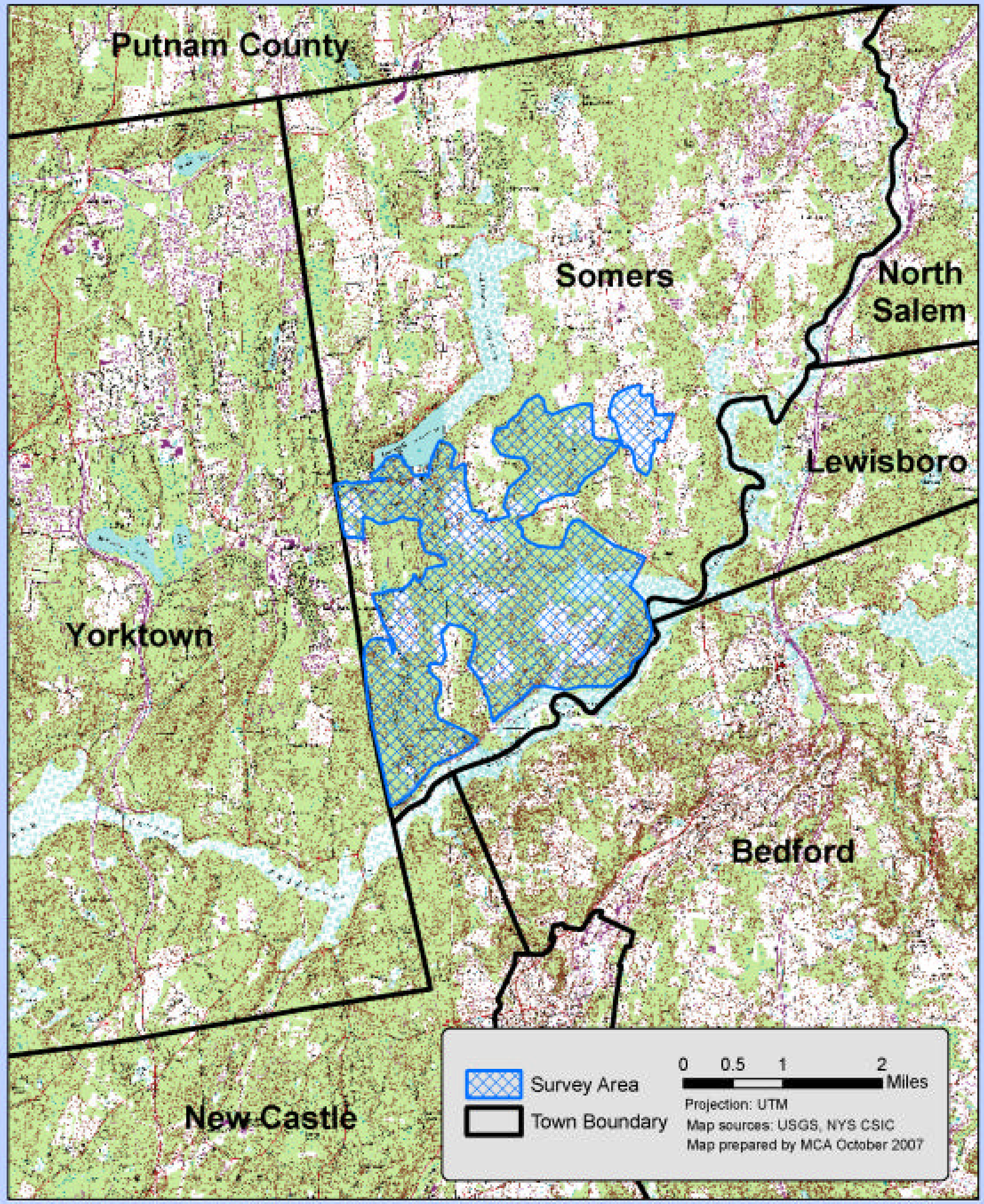
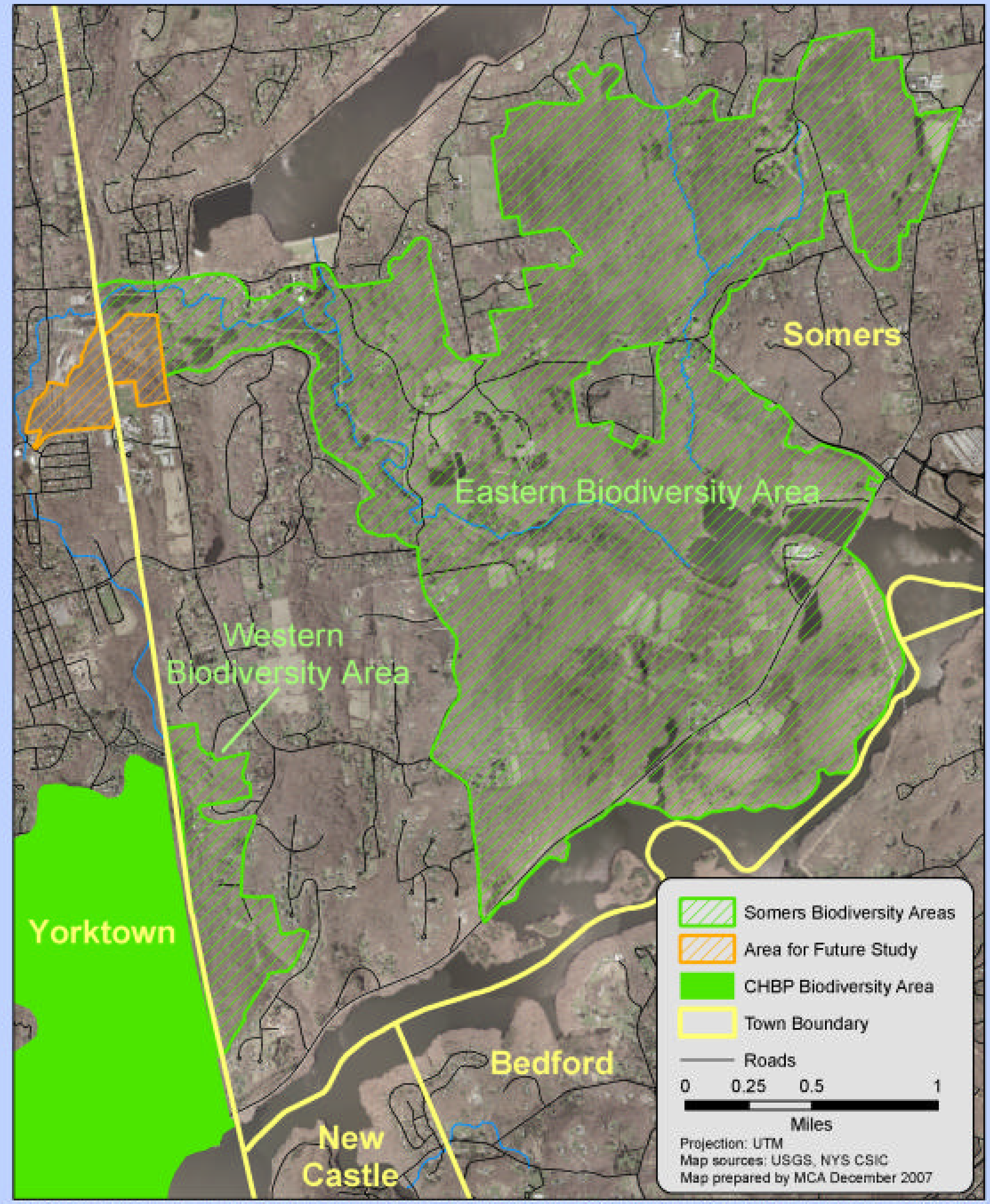
Appendix A:
Somers Study Area Map



Appendix B:
Somers Biodiversity Areas Map



Appendix C: Species Observed in Somers

FoSA Designation: DA=Development-Associated, DN=Development-Neutral, DS=Development-Sensitive
Federal, State and County Status: SC=Special Concern, T=Threatened, E=Endangered

Amphibians

Common Name	Latin Name	FosA Designation	Federal Status	NY State Status	Westchester Co. Status
Spotted salamander	*Ambystoma maculatum*	DS			
Marbled salamander	*Ambystoma opacum*	DS***		SC	
Northern two-lined salamander	*Eurycea bislineata*	DA			
Four-toed salamander	*Hemidactylium scutatum*	DS**			
Redback salamander	*Plethodon cinereus*	DA			
Red-spotted newt	*Notophthalmus viridescens*	DS			
American toad	*Bufo americanus*	DN			
Northern spring peeper	*Pseudacris crucifer*	DN			
Gray treefrog	*Hyla versicolor*	DN			
Bullfrog	*Rana catesbeiana*	DA			
Green frog	*Rana clamitans*	DA			
Pickerel frog	*Rana palustris*	DN			
Wood frog	*Rana sylvatica*	DS			

Reptiles

Common Name	Latin Name	FoSA Designation	Federal Status	NY State Status	Westchester Co. Status
Common snapping turtle	*Chelydra serpentina*	DA			
Painted turtle	*Chrysemys picta*	DA			
Spotted turtle	*Clemmys guttata*	DS		SC	T
Wood turtle	*Clemmys insculpta*	DS		SC	E
Eastern box turtle	*Terrapene carolina*	DS		SC	T
Red-eared slider	*Trachemys scripta elegans*	DA			
Northern water snake	*Nerodia sipedon*	DA			
Eastern garter snake	*Thamnophis s. sirtalis*	DA			

Breeding Birds

All birds listed below are breeding birds. Any birds observed that are believed to be migrants are not included on this list.

Common Name	Latin Name	FoSA Designation	Federal Status	NY State Status	Westchester Co. Status	Audubon WatchList Status
Mallard	*Anas platyrhynchos*	DN				
American black duck	*Anas rubripes*	DS			SC	Declining
Wood duck	*Aix sponsa*	DS*				
Canada goose	*Branta canadensis*	DA				
Mute swan	*Cygnus olor*	DA				
Great blue heron	*Ardea herodias*	DN				
Great egret	*Ardea alba*	DS*				
Spotted sandpiper	*Actitis macularia*	DS*				
Killdeer	*Charadrius vociferus*	DA				
Wild turkey	*Meleagris gallopavo*	DN				
Rock dove	*Columba livia*	DA				
Mourning dove	*Zenaida macroura*	DN				
Turkey vulture	*Cathartes aura*	DN				
Red-tailed hawk	*Buteo jamaicensis*	DN				
Broad-winged hawk	*Buteo platypterus*	DS*				
Barred owl	*Strix varia*	DS				
Yellow-billed cuckoo	*Coccyzus americanus*	DS**				
Belted kingfisher	*Ceryle alcyon*	DN				
Hairy woodpecker	*Picoides villosus*	DN				
Downy woodpecker	*Picoides pubescens*	DN				
Pileated woodpecker	*Dryocopus pileatus*	DS				
Red-bellied woodpecker	*Melanerpes carolinus*	DN				
Northern flicker	*Colaptes auratus*	DS*				
Chimney swift	*Chaetura pelagica*	DN				
Ruby-throated hummingbird	*Archilochus colubris*	DN				
Eastern kingbird	*Tyrannus tyrannus*	DS**				
Great crested flycatcher	*Myiarchus crinitus*	DS*				
Eastern phoebe	*Sayornis phoebe*	DN				
Eastern wood-pewee	*Contopus virens*	DS**				
Willow flycatcher	*Empidonax traillii*	DS*				Declining

Blue jay	*Cyanocitta cristata*	DA				
American crow	*Corvus brachyrhynchos*	DA				
European starling	*Sturnus vulgaris*	DA				
Brown-headed cowbird	*Molothrus ater*	DA				
Red-winged blackbird	*Agelaius phoeniceus*	DN				
Orchard oriole	*Icterus spurius*	DS*				
Baltimore oriole	*Icterus galbula*	DS*				
Common grackle	*Quiscalus quiscula*	DA				
House finch	*Carpodacus mexicanus*	DA				
American goldfinch	*Carduelis tristis*	DN				
Chipping sparrow	*Spizella passerina*	DN				
Field sparrow	*Spizella pusilla*	DS**				
Song sparrow	*Melospiza melodia*	DN				
Eastern towhee	*Pipilo erythrophthalmus*	DS				
Northern cardinal	*Cardinalis cardinalis*	DN				
Rose-breasted grosbeak	*Pheucticus ludovicianus*	DS*				
Indigo bunting	*Passerina cyanea*	DS				
Scarlet tanager	*Piranga olivacea*	DS**				
Cliff swallow	*Petrochelidon pyrrhonota*	DS*				
Barn swallow	*Hirundo rustica*	DN				
Tree swallow	*Tachycineta bicolor*	DS*				
Cedar waxwing	*Bombycilla cedrorum*	DN				
Red-eyed vireo	*Vireo olivaceus*	DS*				
Warbling vireo	*Vireo gilvus*	DS**				
Yellow-throated vireo	*Vireo flavifrons*	DS				
Black-and-white warbler	*Mniotilta varia*	DS				
Worm-eating warbler	*Helmitheros vermivorum*	DS			SC	Declining
Blue-winged warbler	*Vermivora pinus*	DS				Declining
Yellow warbler	*Dendroica petechia*	DN				
Chestnut-sided warbler	*Dendroica pensylvanica*	DS				
Pine warbler	*Dendroica pinus*	DN				
Ovenbird	*Seiurus aurocapilla*	DS				
Louisiana waterthrush	*Seiurus motacilla*	DS				
Common yellowthroat	*Geothlypis trichas*	DN				
Hooded warbler	*Wilsonia citrina*	DS				

American redstart	*Setophaga ruticilla*	DS*				
House sparrow	*Passer domesticus*	DA				
Northern mockingbird	*Mimus polyglottos*	DA				
Gray catbird	*Dumetella carolinensis*	DN				
Carolina wren	*Thryothorus ludovicianus*	DN				
House wren	*Troglodytes aedon*	DA				
White-breasted nuthatch	*Sitta carolinensis*	DN				
Tufted titmouse	*Baeolophus bicolor*	DN				
Black-capped chickadee	*Poecile atricapillus*	DN				
Blue-gray gnatcatcher	*Polioptila caerulea*	DS*				
Wood thrush	*Hylocichla mustelina*	DS			SC	Declining
Veery	*Catharus fuscescens*	DS				
American robin	*Turdus migratorius*	DN				
Eastern bluebird	*Sialia sialis*	DS				

*These 15 DS bird species were not observed in the original Croton-to-Highlands study and, for sake of consistent methods between it and the present study, were therefore not used to delineate biodiversity areas in the present study.

**These 7 species (6 birds, 1 amphibian) were observed in the original Croton-to-Highlands study but not identified as "DS" in that study. They have since been shown to be sensitive to development and were therefore identified as DS species in the current study and used for Biodiversity Area delineation.

***The marbled salamander observations are from a 2006 study.

Appendix D: Glossary of Terms

Biodiversity	Short for "biological diversity," this term refers to the diverse forms of life on Earth at all scales of organization, from genes to species to ecosystems.
Built footprint	The area of land covered by built structures, including houses, garages, driveways, pools, roads, and other structures. Smaller than the "ecological footprint."
Conservation	Protection of wildlife and nature that emphasizes human use of nature in a manner that allows other species to continue to exist and allows ecological processes to be maintained (in contrast to "Preservation").
Development-Associated	A term coined by the MCA that refers to wildlife species that respond to development with an *increase* in number. Examples include "weedy" species such as the white-tailed deer, Canada goose, snapping turtle, and bullfrog. A high proportion of these species indicates degraded habitat. Abbreviation is "DA."
Development-Neutral	A term coined by MCA that refers to wildlife species that do not respond to development with either a clear increase or decrease in numbers, and are therefore not used as indicators of habitat quality. Contrast with Development-Associated and Development-Sensitive species.
Development-Sensitive	A term coined by the MCA that refers to wildlife species that respond to development with a *decrease* in number. Examples include many warbler species, the box turtle, and the spotted salamander. These species are used as indicators of quality wildlife habitat. Abbreviation is "DS."
Ecological footprint	The impact on the ecological function of the area surrounding built structures. This is a larger area than the "built footprint" and results from the effects of lighting, sound, fragmentation and other human activities on wildlife habitat.
Ecosystem	Short for "ecological system," this term refers to organisms (plants, animals, fungi, etc.) interacting with their non-living environment (water, soil, light, etc.). Ecosystems can be of any size, from a single log to a stand of trees to an entire forest, but this term is often used to refer to large-scale systems such as a "forest ecosystem" or "grassland ecosystem."
Edge effects	The difference in ecological processes at the edge of a forest as opposed to its interior. Edge effects include increased light, wind, and noise; lower air and soil moisture; and increased vulnerability to predatory, parasitic, and invasive species. These changes reduce

	habitat quality for many species, lowering their chances of survival, and effectively reducing available habitat. Forest fragmentation increases the amount of forest edge.
Fauna	Animal life.
Federally listed	A species that is listed by the U.S. Fish & Wildlife Service as either Endangered or Threatened under the provisions of the U.S. Endangered Species Act.
Flora	Plant life.
Habitat fragmentation	Occurs when wildlife habitat is cut into smaller, separate fragments by the building of roads, driveways, powerline right-of-ways, housing developments, and the like. Risk of local extinction is greater in fragments than the original, larger, intact habitat. Fragmentation of forest habitat contributes to edge effects (see above), lowering habitat quality.
Herpetofauna	A term used to refer to reptiles and amphibians collectively.
Preservation	Protection of wildlife and nature that emphasizes limiting or eliminating human use of nature (in contrast to “Conservation”).
Riparian	A term that refers to the banks of streams and rivers. Riparian habitats are important in that they tend to be biodiverse, biologically productive, and serve as dispersal corridors for wildlife.
Sprawl	Low-density, automobile-dependent development characterized by a dispersed pattern of single- and low-density uses. Sprawl typically consists of large-lot, single-family homes, office campuses, and strip malls. Sometimes described as "suburban sprawl," "urban sprawl" or "exurban sprawl," sprawl need not be defined by proximity to an urban center but by type of development, regardless of where it occurs.
State listed	A species that is listed by New York State Department of Environmental Conservation as Endangered, Threatened, or Special Concern.
Succession	The process by which a disturbed area (such as an old agricultural field or burned forest) progresses through the following ecological stages in sequence: grassland, shrubland, young forest, mature forest.

Appendix E: MCA Technical Paper Series

To download PDFs or to order hard-copy publications, go to www.metropolitanconservationalliance.org or www.wcs.org/mca.

North Castle Biodiversity Plan, MCA Technical Paper No. 14. MCA conducted this study in the Byram Lake Reservoir section of North Castle in 2007 and discovered a core area of biological diversity. Contains map of Biodiversity Area, land use recommendations to conserve biodiversity, and recommendations for future studies. By Danielle T. LaBruna and Michael W. Klemens, MCA 2007. *PDF available online.*

Northern Wallkill Biodiversity Plan: Balancing Development and Environmental Stewardship in the Hudson River Estuary Watershed, MCA Technical Paper No. 13. The Northern Wallkill Biodiversity Plan is the result of a multi-year partnership between MCA and the Town of Lloyd, the Town of New Paltz, and the Village of New Paltz, New York. This publication provides a map outlining the areas of highest biodiversity in the three municipalities as well as land preservation and land use recommendations to maintain this biodiversity. By Danielle T. LaBruna and Michael W. Klemens, MCA 2007. *PDF available online.*

Pocantico Hills Biodiversity Plan, Rockefeller State Park Preserve and Associated Private Lands: A Public-Private Land Stewardship Initiative, MCA Technical Paper No. 12 The Pocantico Hills Biodiversity Plan is the result of a public-private partnership between MCA, the New York State Office of Parks, Recreation and Historic Preservation, Rockefeller family members, Friends of the Rockefeller State Park Preserve, and the Rockefeller Brothers Fund. This report provides conservation, management, restoration, and public education recommendations to maintain and increase the wildlife biodiversity on Rockefeller State Park Preserve and surrounding Rockefeller family lands. Includes map highlighting areas of significant biodiversity. Ideas presented apply to any North American suburban park containing temperate ecosystems. By Danielle T. LaBruna, Michael W. Klemens, Julian D. Avery and Kevin J. Ryan, MCA 2006. *$10.00*

The Farmington Valley Biodiversity Project: A Model for Intermunicipal Biodiversity Planning in Connecticut. MCA Technical Paper No. 11 The Farmington Valley Biodiversity project presents a model for Connecticut towns to establish intermunicipal collaborations to prioritize and map areas important for the conservation of regional biological diversity. The model integrates biological data sets with land use and habitat maps utilizing GIS applications. Information produced is designed to be incorporated within each town Plan of Conservation and Development. A community outreach component to promote the awareness of regional biodiversity is also included. By Henry J. Gruner, Michael W. Klemens, and Alexander Persons. MCA 2006. *PDF available online.*

From Planning to Action: Biodiversity Conservation in Connecticut Towns, MCA Technical Paper No. 10 To counteract sprawl development and protect biodiversity, local land use decision-makers need three items: the scientific information to identify problems, the technical solutions to those problems, and the legal authority to implement those solutions. This resource provides guidance on all three. The twelve primary challenges facing land use decision-makers identified in this publication arose out of the authors' collective experience working with municipal officials, and is a practical guide to making ecologically- and legally-informed development decisions. Although this report focuses on towns in Connecticut, the guidance here applies to other "home-rule" states such as New York. By Michael W. Klemens, Marjorie F. Shansky and Henry J. Gruner, MCA 2006. *$10.00*

Biodiversity Planning through Local Land Use Planning: An Assessment of Needs and Opportunities in the New Jersey Townships of Chester, Lebanon, and Washington, MCA Technical Paper No. 9 Biodiversity Planning through Local Land Use Planning is an assessment of needs and opportunities for New Jersey townships (in particular, Chester, Lebanon and Washington). This assessment is intended to serve as a foundation for adopting and adapting the Biotic Corridor approach which employs wildlife surveys as a baseline layer in the planning process and informs policy and land use decision-making. By Nicholas A. Miller, Michael W. Klemens and Jennifer E. Schmitz, MCA 2005. *PDF available online.*

Southern Wallkill Biodiversity Plan: Balancing Development and the Environment in the Hudson River Estuary Watershed, MCA Technical Paper No. 8 The Southern Wallkill Biodiversity Plan emerged from a partnership between MCA, the NYS DEC Hudson River Estuary Program, and the towns of Chester, Goshen and Warwick, including villages and hamlets within these towns. This report provides policy and planning recommendations to support the establishment of a regional, multi-town approach to the conservation of wildlife and habitats. It includes a map highlighting priority areas for conservation efforts across the three towns. By Nicholas A. Miller, Michael W. Klemens and Jennifer E. Schmitz, MCA 2005. *$8.00*

Croton-to-Highland Biodiversity Plan: Somers Addendum. MCA Technical Paper No. 7-A The research conducted for this volume, an addendum to the original Croton-to-Highlands Biodiversity Plan, extends the biotic corridor discovered in the original CHBP towns to the neighboring town of Somers, New York. Map of Somers Biodiversity Areas are included. By Danielle T. LaBruna and Michael W. Klemens. MCA 2007. *PDF available online.*

Croton-to-Highlands Biodiversity Plan: Balancing Development and the Environment in the Hudson River Estuary Catchment, **MCA Technical Paper No. 7** The Croton-to-Highlands Biodiversity Plan was developed out of a partnership between MCA and the four contiguous New York towns of Cortlandt, New Castle, Putnam Valley, and Yorktown. The report provides policy and planning recommendations to support a multi-town approach to conserve wildlife and habitats and includes a map highlighting priority areas for conservation. By Nick Miller and Michael W. Klemens, MCA, 2004. *PDF available online.*

Habitat Management Guidelines for Vernal Pool Wildlife, MCA Technical Paper No. 6 This document provides habitat management guidelines for maintaining vernal pool biodiversity in forested landscapes, especially in the commercially-harvested forests of northern New York and New England. By Aram J. K. Calhoun and Phillip deMaynadier, MCA, 2004. *$8.00*

Best Development Practices: Conserving Pool-Breeding Amphibians in Residential and Commercial Developments in the Northeastern United States, MCA Technical Paper No. 5 This paper contains techniques to guide local and state land use decision-makers as they attempt to conserve vernal pool habitats and wildlife. It provides a pragmatic approach to conservation that encourages communities to attain a more complete understanding of their vernal pool resources, gather information that enables them to designate exemplary pools worthy of protection efforts, and develop strategies to protect them. By Aram J. K. Calhoun and Michael W. Klemens, MCA, 2002. *$10.00*

Eastern Westchester Biotic Corridor: Bedford Addendum, MCA Technical Paper No. 4-A The research conducted for this volume, an addendum to the original Eastern Westchester Biotic Corridor report, extends the biotic corridor discovered in the original EWBC towns to the neighboring town of Bedford, New York. Map of Bedford's extensions to the biotic corridor are included. By Danielle T. LaBruna and Michael W. Klemens, MCA, 2007. *PDF available online.*

Eastern Westchester Biotic Corridor, MCA Technical Paper No. 4 The Eastern Westchester Biotic Corridor (EWBC) is a partnership between MCA and the three contiguous New York towns of North Salem, Lewisboro, and Pound Ridge. This report provides science-based information and tools to support a regional, multi-town approach to conserve wildlife and habitats. By Nick Miller and Michael W. Klemens, MCA, 2002. *PDF available online.*

Conservation Area Overlay District: A Model Local Law, MCA Technical Paper No. 3 This document provides an innovative tool for improved land use planning—a model ordinance that can be adopted by municipalities to delineate a conservation area overlay district. The ordinance seeks to reduce habitat fragmentation, maintain biodiversity, and protect significant natural features across ecologically sensitive areas. It is based upon New York State law, but can be adapted for use in other states that have strong home rule authority. Prepared for MCA by Pace University, 2002. *PDF available online.*

Open Land Acquisition: Local Financing Techniques Under New York State Law, MCA Technical Paper No. 2 This paper describes the authority that local governments have to raise revenues to purchase or otherwise protect open space. It explores the types of programs that have been established using these techniques. It is intended to assist communities interested in PDR (purchase of development rights) and to decide which of several potential funding mechanisms would be most appropriate. Prepared for MCA by Pace University, 2000. *PDF available online.*

A Tri-State Comparative Analysis of Local Land Use Authority: NY, NJ, & CT, MCA Technical Paper No. 1 This paper investigates the local land use authority that towns within the tri-state region have to protect natural landscapes while making land use decisions and to collaborate with one another on an intermunicipal basis. The document lists and describes statutes and cases that empower municipalities to plan and regulate across municipal lines; to adopt floating zones, overlay districts, and natural resource protection ordinances; and to provide incentives to encourage environmentally-sound development patterns. Prepared for MCA by Pace University, 1999. *PDF available online.*

The Metropolitan Conservation Alliance, a program of the Bronx Zoo-based Wildlife Conservation Society, conserves wildlife and habitats in the tri-state New York City metropolitan region. Rare species and healthy ecosystems abound within a mere 50 to 100 miles of Manhattan, but the ever-expanding suburbs radiating outward from the city threaten these resources. MCA has developed a unique approach to conservation in this context of sprawl, one that bridges the gap between science and land use practice. We translate biological data and conservation concepts into planning tools, creating a new land use planning paradigm for local decision-makers that influences the location, extent, and impact of development. Through our Technical Paper Series, we disseminate these planning tools to our partners and the public. Our goal is to help safeguard our region's biodiversity while respecting the rights of the region's communities to prosper.