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News from Hudsonia

Volume 31, Number 2

Fall 2017

Dear Friends of Hudsonia,

As winter begins, we are grateful for your generous support that has helped sustain Hudsonia through challenging economic and political times. This has been a terrific year for project work, research, and outreach. Hudsonia has provided professional education, training, and technical assistance to hundreds of planners, conservationists, and researchers via reports, publications, consultations, workshops, and presentations.

This year our biologists have made many important discoveries: previously undocumented localities for rare plants and animals, new findings concerning turtle behavior and response to habitat restoration, discoveries about the ecology of environmental weeds, and better ways to communicate conservation needs and methods to local government and NGOs. We have begun several efforts to complete research projects that have languished due to insufficient capacity.

In the next few years we hope to compile and synthesize many years of study of rare species such as Blanding's turtle and goldenclub, and the nonnative weeds common reed, knotweed, and purple loosestrife. If you are interested in particular species, habitats, or practices, feel free to inquire about Hudsonia reports and publications on those subjects.

Hudsonia depends on your assistance via cash donations, gifts of goods and services, and referrals for grants and projects. Scientific leadership and conservation action at the local and regional levels are more important now than ever. Please help us continue to bring sound science to questions of conservation ecology, land management, regulatory policy, and protections for the special places and the rare plants and animals that set this region apart!

With warm regards,

Erik Kiviat PhD
Executive Director

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* Nothing is provided in exchange for your donation except the knowledge that you are helping biodiversity survive. Hudsonia only uses funds for the organization's nonprofit purposes. Our most recent nonprofit tax return (Form 990) is available from the Hudsonia office or the NYS Office of Charities Registration.

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Cover photo: A juniper hairstreak visiting Virginia mountain-mint (*Pycnanthemum virginianum*) in a Dover fen. The caterpillars (larvae) of this butterfly feed on the foliage of eastern red cedar, a native tree species that is especially abundant on calcium-rich soils of oldfields, shrublands, and wetlands of the Harlem Valley and elsewhere in the Hudson Valley. Chris Graham © 2017

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ECOLOGICAL RESTORATION REVISITED: Some Problems and Improvements

By Erik Kiviat*

Humans have done a great deal of damage to the environment, some knowingly, and some thoughtlessly or before we could predict the consequences. The effects of drainage canals that remove water too quickly from the Everglades, and farms that leak phosphorus into that ecosystem, have had severe impacts that were not predicted fifty years ago. Installing tile (subsurface) drains in farm fields to make wet meadows dry enough to cultivate continues, and we have known for many years how drainage alters wetlands. Surface mining has left pits and cliffs with subsoil or broken rock and no vegetation. Intentional or inadvertent introductions of non-native invasive plants and animals have profoundly altered some of our terrestrial and aquatic habitats.

Many ecologists, environmental professionals, and concerned citizens want to undo or repair some of the damage as best we can, and ecological restoration is often seen as the way to heal the environment. *News from Hudsonia* addressed restoration once before,⁶ and there have been many restoration projects and much research on this topic since then.

"Restoration" can mean many different things. Strictly speaking, it often means historical restoration, or returning to a historic (or prehistoric) condition. The large scale restoration of the Everglades is an attempt to move that vast landscape toward a previous condition, by plugging drainage ditches, removing nonnative species such as Brazilian-pepper or melaleuca, and reducing phosphorus inputs from upstream agriculture. However, restoration often means removing just one part of a changed ecosystem, such as a nonnative plant, or a dam that impedes fish migration. Restoration can also mean creating or changing a habitat to make

it suitable for a species of plant or animal of conservation concern, or returning a species of concern itself to an ecosystem. Introducing Alaskan peregrine falcons to New York after pesticides caused the falcon's extirpation in the northeastern states is an example of species restoration. Constructing artificial wetlands from uplands to replace habitat for the Blanding's turtle is an example of species habitat restoration.

Another type is functional restoration which endeavors to create or recreate particular ecological functions or ecosystem services (such as water quality amelioration or carbon sequestration in a marsh). Forest restoration (reforestation) may be intended to produce forest products or wildlife habitat, promote water conservation, or increase carbon sequestration. As it is typically used today, the term "wetland mitigation" involves creating, restoring, or enhancing a wetland to compensate for permitted destruction of a different wetland.

PROBLEMS WITH HISTORICAL RESTORATION

For most sites, there is little information about the vegetation, soils, or fauna that were present more than 50 or 100 years ago,

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*Erik Kiviat is Hudsonia's executive director.

and techniques for obtaining that information are costly and often imprecise. One exception was a detailed reconstruction of three centuries of forest vegetation history on one-tenth of an acre (0.04 ha) in New Hampshire by analyzing remnants of woody plants on and in the forest soil.⁵ Ecological conditions change constantly, and what was here 500 years ago was different than 200 or 100 years ago; the decision about which assemblage of species to restore may be arbitrary. Theoretically there is nothing better about any one period, but ecologists and naturalists often strive for an ideal time when certain species had not disappeared and anthropogenic changes to soils, plants, and waters were less than now (or, if one aims for enough millennia ago, nonexistent).

In some areas of the US, the pre-European period 500 years ago is held to be the best target for restoration, but even then Native Americans had altered the environment by burning, cultivating, and hunting.¹ So many species have been subtracted or added to local nature by human activities, and the climate and environmental quality (e.g., pollution) have been so altered, that it is not literally possible to restore an exact historical assemblage, although in some cases the predominant species, such as prairie grasses, can be restored. Pervasive pollution of waters and soils by nitrate from air pollution and land sources also makes it difficult if not impossible to restore oligotrophic (low-nutrient) systems such as fens and bogs.

PROBLEMS WITH WETLAND MITIGATION

Wetland mitigation is typically intended to replace the functions and habitats lost when a wetland is destroyed for development (i.e., “no net loss” of wetland). Often, a larger than 1:1 ratio of new (or restored) wetland to destroyed wetland is required because the restored wetland may not function, or may take many years to function, at the level of the destroyed wetland. “Mitigation banks” are constructed on a larger scale than individual mitigation projects and credits in the bank are



Coarse woody debris, such as this moss-covered log, is an important component of certain forest and wetland restoration projects. Erik Kiviat © 2017

sold to developers instead of their performing individual mitigation projects. It is thought that mitigation banks are better than many small mitigation projects, because the banks are sometimes constructed prior to development activities and can be certified as effective, and they can provide larger blocks of wetland habitat. Also, mitigation bankers may be able to exercise more care, and banks are required to be monitored and maintained for longer periods than individual mitigation projects. But, relying on a distant mitigation bank instead of local mitigation will nonetheless result in net loss of local wetland ecological functions and services, with potentially significant consequences to local ecosystems.

The regulatory agencies’ criteria of success for mitigation are often weak. For example, they may only require that wetland vegetation cover a certain minimum percentage of the soil and that a threshold percentage of that vegetation be dominated by native plants, for five years. The success of the created or restored habitat for plant or animal species of conservation concern is rarely measured, and the details of habitat (e.g., amount of soil organic matter, soil biota, amount of large woody debris, or slopes of wetland margins) are often not achieved or even assessed. Mitigation that involves only removal of a nonnative weed

such as common reed and the planting of native cordgrass or cattail in its place, results in the net loss of wetland area and function to development, and questionable increase in habitat function of the mitigated (or enhanced) wetland where reed is killed.

UNANTICIPATED OUTCOMES

The development of a restored ecosystem or habitat, and the behavior of the organisms that use it, are only partly predictable no matter how much we know or how much money we spend. For example, livestock grazing has been prescribed to restore vegetation in many northeastern wetlands that support populations of the endangered bog turtle. In a five-year experiment that ended in 2016, Hudsonia and Jason Tesauro used selective cutting of woody plants and light cattle grazing to restore low-growing herbaceous vegetation in such a habitat in New York. One concern in restoration was a dense stand of broad-leaved cattail, generally considered unfavorable for bog turtles. Grazing and trampling nicely thinned and inhibited the cattails and they were replaced by a mixed grass-sedge-cattail-forb assemblage that appeared suitable for the turtles. However, the turtles expanded their activities very little into that area. We determined that the soil beneath the cattails was less suitable

(drier and denser) for bog turtles as a result of siltation from a small stream flowing through a residential area, a pre-existing condition that we hadn't considered. In this case, we monitored the turtles intensively and are able to recommend to other practitioners aiming to restore bog turtle habitat to examine soils more closely before designing such a project.

In 1996-97, Hudsonia and Creative Habitat Corp. advised a school district in Dutchess County about mitigation for the destruction of a small wetland as part of school facilities expansion. Because that wetland was used by Blanding's turtles, we designed replacement wetland and upland habitats for the Blanding's turtle (a Threatened species in New York) and studied the results intensively through 2009. Blanding's turtles quickly began to use the new habitats which are spatially close to pre-existing turtle habitats. During the entire study period (and since, as far as we know based on less intensive monitoring by others), Blanding's turtles used the new wetlands substantially in late spring and summer, but used the new wetlands relatively little in early spring and hardly at all for overwintering. The turtles also nested in newly constructed upland habitats. Turtle behavior is surprisingly complex, and the reasons are unclear for non-use of constructed wetlands for overwintering, but we suspect insufficient depth of organic soils and traditional behavior of the turtles, i.e., their general fidelity to previously-used habitat areas. Despite considerable regional information on this species, we failed to predict fully how it would respond to habitat restoration.

One of the best-studied projects was the restoration of salt marsh in San Diego Bay that aimed at recreating habitat for an Endangered bird, the light-footed clapper rail.²² Wetland fill was removed down to intertidal elevations and native cordgrass (*Spartina foliosa*) was planted. A decade of study showed that the soils lacked sufficient organic matter and nitrogen to produce the 90 cm (3 feet) tall cordgrass stems required for rail habitat, and the stunted cordgrass was susceptible to insect attack.

HOW LONG DOES IT TAKE FOR A BIOLOGICAL COMMUNITY TO ATTAIN A "NATURAL" CONDITION?

Many projects have been completed in the US and worldwide to restore wetlands that had been damaged by drainage, filling, or other actions. In marshes (seasonally or permanently flooded wetlands dominated by herbaceous vegetation), vegetation cover can develop fairly quickly (e.g., 1-3 years) after restoration. The early-establishing species are often common plants that are tolerant of a wide range of conditions. Also, in the first few years, there is often a flush of plant species richness (i.e., a large number of species) that is likely to settle down after one or a few years as larger, slower growing plants replace some of the smaller, faster-growing, more opportunistic species. The "replacement" or "restored" vegetation may or may not fulfill all the ecological functions of the historic vegetation or the vegetation of nearby reference sites that are believed to function at a high level.

Biological "communities" (or assemblages of species) other than vascular plants may not develop as quickly or as fully. If animals of concern are nearby and the restored habitat is suitable, they may re-establish habitat use quickly as the Blanding's turtles did for warm-season use of constructed habitats. However, on the Connecticut coast, various components of the biological community took from 5 to 20 years to approximate the target conditions of relatively natural ("reference") marshes after restoration of saline tidal flow in formerly diked marshes.²¹ A worldwide analysis of 621 wetland restoration projects estimated that ecosystem structure (principally plant assemblages) and function (driven mainly by carbon storage in soil) were still a quarter less than in reference wetlands after a century.¹³ Most wetland restoration or mitigation projects are monitored for only a few years, are assessed only for superficial characteristics, and are then declared successful or unsuccessful. Instead of judging a restoration project at a specific time, progress towards a reference condition or another set of goals can be meas-

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Restored cordgrass (*Spartina alterniflora*) tidal marsh, Brooklyn Bridge Park, NY. Erik Kiviat © 2017

ured on a continuum,²² but some systems may never achieve target conditions or may only do so after many years. Although there are many reasons for time lags in development, the accumulation of organic matter in woody debris, leaf litter, and soil is one such factor.

FUNCTIONS AND HABITATS EASY AND DIFFICULT TO RECREATE

For wetlands, it is relatively easy to establish common marsh plants such as cattails, smooth cordgrass, and some of the bulrushes in a newly created or restored habitat. It is usually easy to create certain water depths and levels, although a specific pattern of seasonal change (the hydroperiod) may be more challenging. Deep organic soils, however, take thousands of years to develop, and a shallow organic layer, such as one that has been moved from another wetland, may never be fully functional in terms of processes like carbon and nitrogen transformations. Groundwater seepage or springs cannot be created unless particular subsurface conditions exist pre-restoration.

Removing fill to restore pre-existing wetlands or vegetated shallows makes a lot of sense and is a popular form of restoration. But such projects can vary greatly in their outcomes because of damage to the once-covered soils or sediments, difficulties recreating surface drainage

patterns, and the response of desired plant and animal species to these and other factors. If “bed lowering” goes too deeply as a result of miscalculation or the removal of the underground parts of invasive plants like common reed, the wetland soil may become unstable and erode. Lowered elevations in coastal wetlands or shallows may make systems vulnerable to sea level rise. Submergent aquatic plants are often difficult to establish and maintain, and may be damaged by storms, floods, animals, or boats.

In theory, certain types of restoration are relatively simple. Shrubland and sapling wood, given some time, will create themselves on oldfields when harvesting, mowing, or grazing ceases.¹⁰ Yet even in those cases, active management and maintenance may be needed to encourage and sustain the plant species composition or vegetation structure that is desirable for target animal species such as New England cottontail or American woodcock.

REMOVING NON-NATIVE INVASIVE WEEDS

Removal of one or more invasive, nonnative plant species is often a proximate goal of restoration. Whether this is done with herbicide or non-chemically,¹⁹ successful removal may require a few or many years of treatments, or even perpetual maintenance as the target weed keeps



Angle-pod (*Matelea obliqua*), a rare native plant, and purple loosestrife (*Lythrum salicaria*), a common nonnative, on the bank of the Olentangy River, Ohio, near a dam removal site. Erik Kiviat © 2017

reappearing or other weeds take advantage of the disturbed soil and reduced competition. Maintenance of a truly native plant assemblage may be impossible because there are so many nonnative plants, including invasive species (species that spread extensively and displace native species), that can be dispersed to a restoration site by wind, water, birds, or even the managers' boots or equipment. And what do we get if this is successful?—often only a small, showcase community that requires constant inputs of labor or chemicals.

INSUFFICIENT STUDY BEFORE TREATMENTS

Most wetland mitigation projects or banks, and probably many other restoration projects, do not invest enough in surveying extant physical-chemical conditions and biodiversity prior to restoration treatments. Admittedly, it can be challenging to predict which species or species groups might be most essential to the local ecology (e.g., fungi, insects, mollusks, plants, etc.), or which species of conservation concern or other importance could occur at a site and potentially be harmed by restoration. Approaches to assessing biodiversity were described for the counties bordering the Hudson River¹² and New York City.¹¹ Although the most diligent and smart assessment may still miss important components of biodiversity, performing such an assessment is far better than none.

A mitigation bank and mitigation project in New Jersey apparently eliminated the habitat of the globally rare Mattox's clam shrimp, altered habitats where northern harriers (Endangered in New Jersey) evidently bred in some years, and destroyed some of the few remaining bluejoint grass meadows in the Meadowlands.⁹ The clam shrimp is not officially recognized as rare by the State of New Jersey or the federal government, despite the species having been found in only a few localities, one of which was a gas pipeline road in the area mentioned.^{15,16} In this case, the survey work had been done but the landowner and regulatory agencies chose to ignore the importance of this rare species. Because the

pipeline road, after being rebuilt in connection with the mitigation bank, has not yet been opened to the public as intended,¹⁴ I have not been able to determine if vestiges of clam shrimp habitat, bluejoint meadows, or harrier use persist.

A dam removal with riverbank and wetland restoration on the Olentangy River in Columbus, Ohio, has proceeded² without consideration of a Threatened plant, angle-pod (*Matelea obliqua*), on the river bank. Possibly the angle-pod population will thrive under the changed conditions, but there is no guarantee, and I have found no efforts to monitor the outcome for the plant.

When the Blanding's turtle habitat restoration project mentioned above was under construction, earthmoving equipment disturbed a winter den of three species of snakes (northern water snake, eastern garter snake, and milk snake) resulting in mortality of 26 individuals and possibly injury to others that were found alive (Rob Brauman, personal communication). Wintering habitats of these species are poorly understood and we probably could not have predicted this particular occurrence without radio-tracking the snakes. Yet this is an example of how creating habitats for one species (Blanding's turtle) resulted in destruction of habitat and individuals of other species.

INSUFFICIENT MONITORING AND RESEARCH AFTER TREATMENTS

Nature management, including ecological restoration, should be "evidence based"; that is, the choice of actions or treatments should be based on monitoring or research data from previous efforts that demonstrate treatment efficacy to produce certain results.¹⁸ The problems with the bog turtle, Blanding's turtle, and clapper rail projects cited above would not have been detected without relatively intensive study, but without detecting problems such as these it is impossible to provide guidance for the next restoration project. Many restoration projects are monitored for only 3-5 years, if at all, and often monitoring data are not readily available to other practitioners or the public (despite that many of those projects are funded with public money). Many managers use techniques that others have used, whether or not successful.¹⁸

BAD THINGS THAT HAPPEN

Many unanticipated things can harm restoration projects. Where an invasive plant has been removed, other unwanted species may colonize. In fresh water, purple loosestrife can become established where common reed has been controlled. Planted plants, such as cordgrasses in brackish tidal marshes, can be stolen, vandalized, or eaten by abundant herbivores such as Canada geese or muskrats. Storms, exceptionally high tides, river floods, droughts, or extreme heat or cold may wash plantings away or kill plants, or cause erosion or deposition of soil that harms a restoration site. The brackish storm surge of Hurricane Sandy in October 2012 breached a berm that separated a freshwater marsh mitigation project in New Jersey from the estuary and also damaged plantings.

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HUDSONIA PROJECT UPDATES, 2017

Biological Assessments

Binnen Kill. Hudsonia and Louis Berger US completed a report on biological surveys and other studies of state-owned and Scenic Hudson conservation easement lands in the Binnen Kill area (**Albany County**) with tidal and non-tidal wetlands, mature forest, active farmland, and oldfields along the Hudson River. We found a number of plants and animals of conservation concern, and unusual opportunities for landward migration of tidal wetlands as sea level rises. Funded by the New York State Department of Environmental Conservation through the New England Interstate Water Pollution Control Commission.

Saw Kill. Hudsonia completed surveys of birds, herpetofauna, vascular plants, and bryophytes along the lower Saw Kill in **Annandale**, Dutchess County. Our data will inform decisions about micro-hydropower development or removal of old dams. Funded by New York State Energy Research and Development Authority via Bard College.



Floodwater after Hurricane Irene overtopping the lowest dam on the Saw Kill, Bard College. This dam is under consideration for removal or micro-hydropower development. Erik Kiviat © 2017

Newtown Creek. At the end of summer we began surveys of higher plants and butterflies around an extensive urban estuary that is a tributary of the East River between **Queens** and **Brooklyn** (NY). The project will continue through next growing season, and involves volunteers from the Newtown Creek Alliance, Bard High School Early College Queens, and other groups. Funded by the Hudson River Foundation Newtown Creek Fund.

Dover Stone Church. In the spring we completed a biological assessment report for the lands recently added to the Dover Stone Church preserve. We collaborated with the Hawthorne Valley Farmscape Ecology Program, Jason Tesauro, and Larry Federman to survey flora, reptiles, amphibians, odonates, butterflies, birds, and bats to help the **Dutchess Land Conservancy** and the **Town of Dover** develop plans for land management, public uses, and public education. We found high-quality forest, ledge, talus, and barrens habitats occupied by rare plants and by animal species listed as NYS Species



Slimy salamander in forested seep at the Dover Stone Church Preserve. Chris Graham © 2017

of Greatest Conservation Need. In June we led a public walk to see some of the distinctive physical and biological features of the site. Funded by the Dutchess Land Conservancy.

Pawling Parks. In September we conducted a preliminary biological assessment of two adjacent town parks—Edward R. Murrow Park and Lakeside Park—in the **Town of Pawling** (Dutchess County), to help the **Oblong Land Conservancy** and the Town of Pawling better understand the ecological landscape before designing trails and interpretive materials for a planned nature center. We found marshes, forested and shrub swamps, woodland pools, upland hardwood forests, and oldfields, as well as less common habitats such as calcareous ledges and a fen. Funded by the Pawling Community Foundation through the Oblong Land Conservancy.

Natural Resource Inventories & Conservation Priorities

This year we completed a Natural Resource Conservation Plan for the **Town of New Lebanon** (Columbia County) in collaboration with the New Lebanon Conservation Advisory Council, and are now in the midst of preparing a Natural Resources Inventory for all of **Columbia County**, in collaboration with the Columbia County Environmental Management Council and the Columbia Land Conservancy. We are also preparing a Natural Resource Inventory for the **Town of Dover** (Dutchess County) as part of their larger Climate Smart Community initiative. These documents illustrate and describe many of the natural resources of those areas (e.g., minerals, water, plants, animals, habitats, scenic areas, recreational resources), and explain their importance to local ecosystems and the human community and how to identify the priorities for conservation. All three projects are funded by the NYS Environmental Protection Fund—the New Lebanon project through a grant to the town from the NYSDEC Hudson River Estuary Program, the Columbia County project through a grant to the Columbia Land Conservancy from the Estuary Program, and the Dover project through a Climate Smart Communities grant from NYSDEC.

We are helping the **Woodstock Land Conservancy** (Ulster County) identify ways to further incorporate climate change into their considerations of conservation priorities. In 2018 we will be working with the **Greene Land Trust** and the **Cornell Cooperative Extension** (Greene County) to complete the Greene County Conservation Priorities project, which will identify, map, and describe natural resources throughout the county, and identify places and features that seem to be most important for conservation. The inventory and analysis will assist the Greene Land Trust in their consideration of land acquisition and conservation easements, and will aid town agencies, landowners, developers, and others seeking to understand the county landscape, the resources of concern, the areas of greatest importance for conservation, and the implications for land use decisions.

Conservation Education

In September we held a three-day short course in *Habitat and Water Resource Assessment for Land Use Planning* in **Albany County** attended by members of planning boards and conservation advisory councils of Albany County municipalities, interns with a stormwater organization, staff of two land trusts, and staff of the NYS parks department. Also in September we held a half-day field workshop at the Mills-Norrie State Park (**Dutchess County**) on recognizing and evaluating important habitats in the Hudson Valley. Despite the rainy start, intrepid attendees included members of planning boards and conservation commissions from nine municipalities in five Hudson Valley counties. We also provided technical assistance to several towns in **Columbia, Dutchess, Orange, and Ulster counties** on habitat assessment guidelines, stream setbacks, and habitat mapping. The short course and workshop were conducted in collaboration with staff of the Cornell Department of Natural Resources, and all of this biodiversity education work was conducted in partnership with the **Hudson River Estuary Program**, and funded by the New York State Environmental Protection Fund.

We surveyed several properties in the **Cragsmoor** community in the Shawangunk hills (Ulster County), and over the next few months will be developing materials for a conservation education program in collaboration with the

Cragsmoor Conservancy. The program will provide information and guidance for landowners on land management to protect Cragsmoor's sensitive habitats, plants, wildlife, and water resources. Funded by a grant to the Cragsmoor Conservancy from the Land Trust Alliance.

Habitat Mapping

We have completed the field work for habitat mapping throughout the **Town of Dover** and the **City of Poughkeepsie** (both in Dutchess County), and have made much progress in a habitat mapping project for the **Town of Pound Ridge** (Westchester County). The habitat maps and reports issuing from these projects will provide information about habitats, plants, and animals of conservation concern, and are intended to help landowners, municipal agencies, and others better understand how to effectively protect biodiversity, water resources, and the natural systems that support the human community. All three projects will contribute to larger Natural Resource Inventories being prepared for these municipalities. Completion of the Dover project is funded by an anonymous donor through the Dutchess Land Conservancy; the Poughkeepsie project is funded by the NYS Environmental Protection Fund through a grant to the city from the Hudson River Estuary Program, and the Pound Ridge project is funded by the Estuary Program and the Westchester Community Foundation

Technical Assistance

We reviewed land use proposals for a "glamour camping" project in the **Town of Gardiner** (Ulster County) and an apartment complex in the **Town of Lewisboro** (Westchester County). Funded by Friends of Gardiner, and residents of Golden's Bridge. We also collaborated with the **Farmscape Ecology Program** and consultants regarding ecological farm management at the Chester Agricultural Center in the Black Dirt peatland of Orange County (NY).

Urban Biodiversity

New Jersey Meadowlands. Hudsonia studies of this urban-industrial area of northeastern New Jersey continued with field surveys, participation in a Citizens' Advisory Group for a flood protection project, presentation at the Super Storm Sandy—Five Years Later conference, and editing a book manuscript.

Other Projects

Mute Swan. The mute swan is an elegant and much-admired bird of ponds, lakes, and the Hudson River, but is non-native in North America and usually considered a pest by ecologists because of consumption of submergent plants and competition with native waterfowl. We conducted an objective analysis of the American and European literature that produced a different picture of this species and a number of questions about methodological problems with the American studies. Funded by Grant & Lyons, Pegasus Foundation, and Pettus Crowe Foundation.

Turtle Studies. Hudsonia's turtle research continued with a third year of radio-tracking painted turtles in the freshwater tidal marsh at **Tivoli North Bay** (Hudson River), as well as analyses of 20 years of data from the Blanding's turtle habitat restoration project in Dutchess County. The painted turtles continued to fascinate and puzzle with their extensive movements in the 350-acre marsh. Several summer interns learned radiotelemetry and other field biology skills. Funded by the Lillian Goldman Charitable Trust.



Hudsonia's newest biologist, Elise Heffernan, with Erik Kiviat at Newtown Creek. Lisa Bloodgood, Newtown Creek Alliance © 2017

PROFITS, POLITICS, AND PSYCHOLOGY

Many attempts at ecological restoration are motivated by good-hearted concerns about fixing human-caused damage to the environment. Volunteers like to help with restoration projects and may not understand the weaknesses of certain methods. Sometimes there are funds that need to be spent by public agencies, and one federal employee told me that the public expected his agency to take action. The private companies that actually do the design, permit applications, earthmoving, planting, and other tasks reap profits from this work whether or not it achieves ecosystem service goals. Instead of science, these political and economic factors are often the driving forces behind restoration projects, and the ideas and methods for restoration are often not supported by up-to-date scientific knowledge.



Five-angled field dodder (*Cuscuta pentagona*) on mugwort (*Artemisia vulgaris*) on a capped landfill, James Baird State Park, NY. Erik Kiviat © 2017

BENEFITS OF SIMPLICITY

In 2002, Hudsonia designed turtle nesting habitat for the capping of a small garbage landfill in James Baird State Park (Dutchess County, New York). We salvaged a rare plant, the small parasitic vine called five-angled field dodder (*Cuscuta pentagona*), with its common host plants and some soil, from the landfill before capping, stored the dodder and hosts in an abandoned gravel pit next to the landfill, and had the hosts and dodder repositioned on the final landfill cover. The hosts and dodder thrived and have been monitored qualitatively every 1-3 years since. This project has succeeded (at least for 15 years) because it was targeted to a single, small, weedy, plant species on a disturbed upland soil, but even in this

simple situation, annual mowing seems necessary to maintain the host plants and the dodder.

RESTORATION IN URBAN ENVIRONMENTS

Urban environments impose many constraints on nature management. Air, water, and soil pollution kills or inhibits many plants, fungi, bacteria, and animals. Certain restoration techniques such as fire may not be allowed. Vandalism is more likely than in rural areas. Attempts at historic restoration, removal of invasive plants, or other management are often not sustainable if they work at all. But some invasive plants, such as the European subspecies of common reed in the eastern US, are superbly adapted to degraded environments and provide many ecosystem services.⁸ British urban ecologist O. Gilbert³ recommended against trying to restore countryside habitats in cities rather than managing the habitats and species that already do well there. The potential exists to gently steer the ecosystem development of urban greenspaces to take advantage of the habitat functions and other ecosystem services provided by these habitats.

WHAT SHOULD WE DO?

The ideal restoration project would be inexpensive, achieve specific goals for biodiversity or other ecosystem services, sustain itself indefinitely with minimal or no long-term human effort, and have very little negative impact on nontarget species or existing ecosystem services. Unfortunately, it is rarely if ever possible to “wave a magic wand” and build such a project. The first requirements are to understand the site (soils, hydroperiod, species, services), find existing (or collect new) scientific and natural history information about the habitats and species to be managed or restored, clarify the goals of restoration, and design a project with specific objectives that appear achievable and sustainable based on good scientific findings from other projects. It’s okay to try something new, but that requires a higher bar for controlled experimentation, use of reference sites, and careful study of restoration outcomes. When possible, it is best to start with small, plot-scale experiments, and gradually scale up as techniques are found to be successful.

Although some practitioners would not call it restoration, simple management techniques such as erecting nest boxes or shelters for certain animals, if done according to evidence-based guidelines, may have a high probability of success (nest boxes may be considered restoration of a critical habitat element, tree cavities that were once in greater supply). But even the commonly built boxes for the eastern bluebird must be cleaned and maintained annually. Many wood duck boxes are inappropriately erected in open marsh, rather than beneath a tree canopy where nest productivity is greater.¹⁷ Similarly, bat boxes, butterfly hibernating boxes, and nesting structures for native bees must be constructed, placed, and maintained properly. Another simple tactic is provision of a host plant for a specialized, plant-associated organism. Planting certain milkweed species for the larvae of the monarch butterfly is a good example.

Reforestation is a well-established type of restoration where there was formerly forest. Many species of trees can be planted and managed to eventually attain certain forest types that are desired for biodiversity or wood products. This is a slow process, and in our region it may take 75 years or more for a forest to reach maturity (defined as a predominance of trees greater than 30 cm dbh [diameter-at-breast-height]) or some other goal. Because of the prevalence of pests and pathogens that attack many tree species (e.g., hemlock, pitch pine, ashes, American beech, American elm, and certain oaks), and the threat of new pest arrivals, as well as the widespread abundance of white-tailed deer that consume the seeds and seedlings of many trees, there is challenge and uncertainty in restoring forests. Some native northeastern tree species can be successful, among them red maple and tupelo; these may not be superb for timber but can provide important biodiversity support and other non-product ecosystem services. Although the Hudson Valley and many neighboring regions have regained extensive forest cover during the past 150 years, the region is also undergoing urbanization, forest harvest, and loss of dominant trees to pests and pathogens, thus reforestation is still a critical need in some areas. It is important to plan on a large scale for the extensive blocks of mature forest, shrubland, and grassland required to support many species of conservation concern.¹⁰

Restoring habitats dominated by weeds, such as European common reed, is a fraught endeavor. Reedbeds are difficult to kill without destabilizing the soil. It often takes multiple years of herbicide treatments and perpetual maintenance to prevent re-colonization from rhizome fragments or seeds, and the herbicides are toxic to other plants and animals. In the United Kingdom, digging large shallow pools within reedbeds is used to manage for birds and plants of conservation concern, and annual or biennial harvest of reeds is also used to thin stands and improve habitat for certain species.⁴ Similar techniques should be tried on northeastern reedbeds.⁸ Water-chestnut, which also forms dense, highly dominant beds in shallow, nutrient rich, fresh waters, might also be managed by harvesting in blocks to create space for other plants and the animals that eat them, as well as reducing the potential for loss of dissolved oxygen in hot weather below the water-chestnut canopy.⁷ Of course, harvest techniques also require perpetual maintenance in reed or water-chestnut beds, but a product (e.g., a bioenergy feedstock²⁰) could repay management efforts.

There are probably many other kinds of successful restoration (broadly defined), but it is difficult to find restoration projects that have been in existence for ten years or more, and have been monitored enough to provide dependable data on project outcomes. There are many restoration types, projects, or project elements that are unsuccessful or only partly successful, and much money and political capital is often spent on those projects. Enough wetland restoration projects have been studied to understand some of the goals and treatments that are realistic, but this information has not filtered adequately into the economic and political systems that produce and foster restoration.



Monarch caterpillar feeding on common milkweed (*Asclepias syriaca*). Erik Kiviat © 2017

Practitioners, other environmental professionals, scientists, and funders should always question the rationale, goals, situations, knowledge, permit conditions, treatments, and monitoring of restoration projects or programs, and the dissemination of information to practitioners and the public. Ecological restoration in its many forms will become increasingly important, especially in periods when environmental protections are being weakened and as urbanization and other land use, resource extraction, and climate change continue. And like anything important, we need to learn how to do the best job.

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AWARDS



Gretchen Stevens.

With twenty-seven years at Hudsonia, Gretchen was honored by Ducks Unlimited with their Dutchess County Conservation Award. Gretchen has directed Hudsonia's Biodiversity Resources Center

since its inception, and is co-author of the Biodiversity Assessment Manual for the Hudson River Estuary Corridor. In addition to conducting numerous field studies throughout the Hudson Valley, she has instructed hundreds of members of Hudson Valley municipal agencies, the staff of land trusts, and others engaged in comprehensive planning, land assessments, environmental reviews, and regulatory decisions in techniques for identifying and protecting biological and water resources. The award especially noted her work in the watershed of the Great Swamp, one of the largest fresh-water wetlands in New York State.



Bob Schmidt.

Hudsonia co-founder and intrepid fish biologist and aquatic ecologist, Bob was recognized by the Hudson River Environmental Society Outstanding Environmental Researcher Award in October. In his long career Bob has studied the ecology and natural history of rural and urban stream systems of the Hudson River, the Mohawk River, and waterways of New England and the Neotropics, and has mentored numerous students in the field of natural science.

Ecological Restoration continued from page 9

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BOTANIST & ILLUSTRATOR

I was sad to learn that Elizabeth Farnsworth died this fall. I first met Elizabeth when she was invited, with several other ecologists, for a field review of Hudsonia's studies at Moore Brook in Salisbury, Connecticut, fifteen years ago, and she then served on Hudsonia's Advisory Board 2002-2017. She was widely known for her research on mangrove ecosystems, for co-revising the Peterson Field Guide to Ferns, for co-illustrating Haines' Flora Novae Angliae, and for her important role in creating the New England Wild Flower Society plants website Go Botany that Hudsonia staff uses on a daily basis. Her absence will be felt throughout the community of northeastern biologists where she was widely known as a knowledgeable and generous colleague.

—EK

SPECIAL THANKS

Julianna Zdunich, for designing our fundraising appeals and managing the Hudsonia website.

Cornell Cooperative Extension-Dutchess County for donating a plotter.

Board members **Jim Glomb** for helping move the plotter, and **Philippa Dunne** for assisting with a bird survey.

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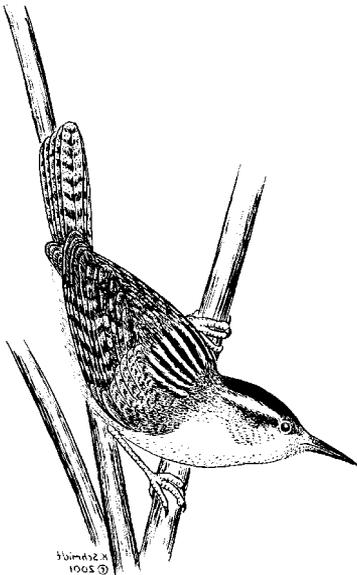


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