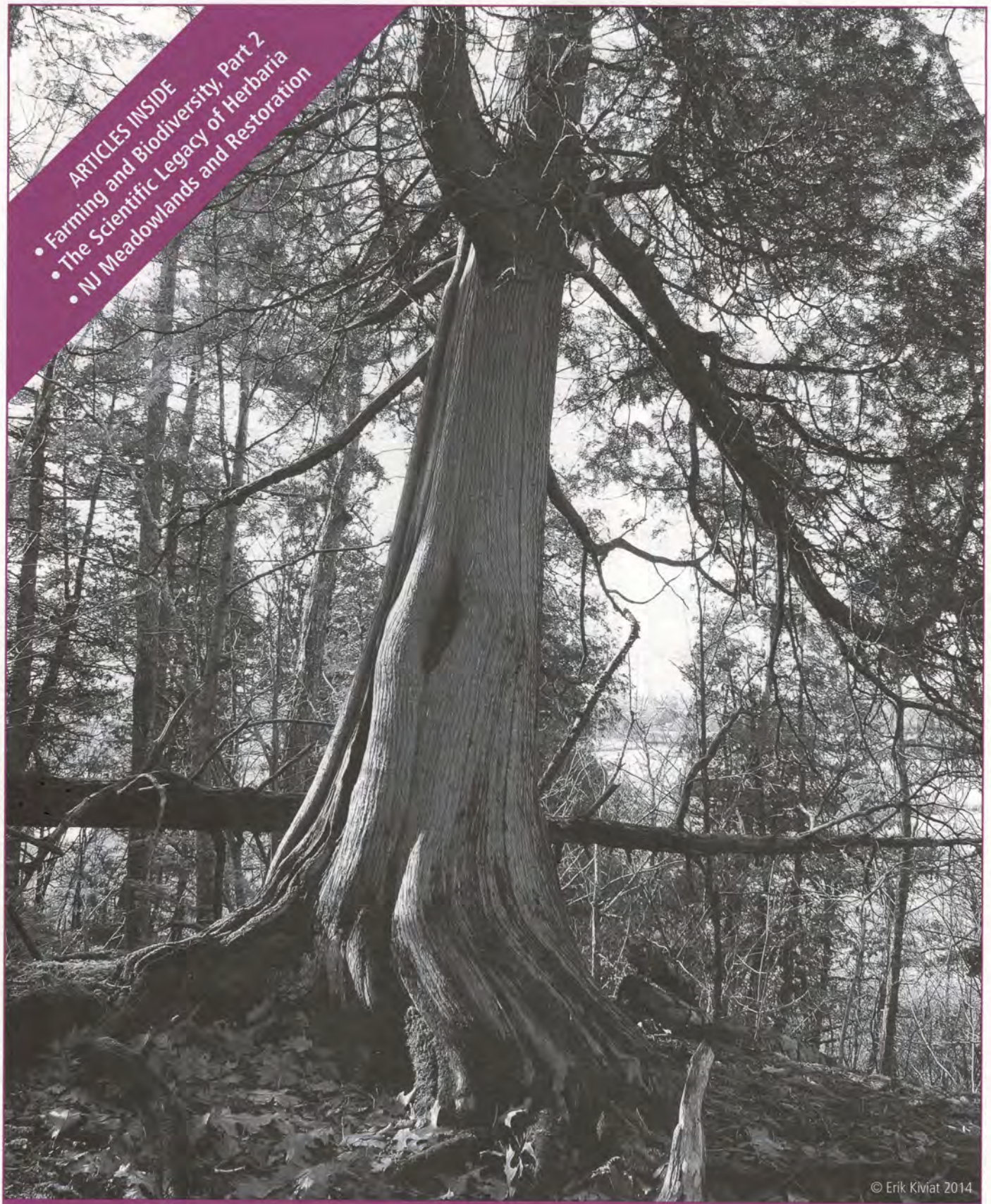

News from Hudsonia

Volume 28, Number 1

Spring 2014

Cover photo: Old eastern red cedar (*Juniperus virginiana*) in hardwood forest on the bluff overlooking Tivoli North Bay (Hudson River). This tree contains a cavity that may be used by nesting or wintering birds, gray treefrog, southern flying squirrel, and many kinds of invertebrates. The base of the tree supports mosses and lichens. The surrounding forest may gradually kill this cedar by intercepting the sunlight; a large dead cedar will continue to support many other species. Erik Kiviat © 2014.

ISSN 1072-8244

Environmental Research and Education
Science for Conservation

News from Hudsonia

A journal of natural history and environmental issues

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Volume 28, Number 1 Spring 2014

Dear friends,


K. Schmidt ©2001

After the melting of snow and ice we are more keenly aware of nature's variety, as well as the human activities that impinge on it.

Through the winter Hudsonia continued to collect observations, analyze data, make maps, write reports, and plan new studies and educational programs for the coming season.

But we need your continued support to solve environmental problems where we all live, work, and play.

Please donate today by check, online at hudsonia.org, or by calling 845-758-7053.

We really appreciate your assistance, and so do the trees, turtles, and lichens!

Happy Spring,

Philippa Dunne
Chair

Erik Kiviat
Executive Director

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In 2013 we published only the spring issue of *News from Hudsonia* (Volume 27, Number 1).

CONTENTS

FARM MANAGEMENT FOR BIODIVERSITY AND PROFIT
Part 2: Water Conservation and Wild Borders

By Kristen Bell Travis*

In the spring 2013 issue of *News from Hudsonia*, I discussed some practices that farmers could employ in their management of hayfields and pastures to help maintain populations of grassland birds and butterflies, box turtles, and wood turtles without compromising farm productivity.[2] In this article, I explore two different aspects of farm ecology: 1) the effects of on-farm water conservation on crop yield, soil health, stream and watershed health, and diversity of aquatic creatures; and 2) the management of borders for native insect diversity to improve pollination, reduce pest problems, and support wildlife. Because the benefits to farms are generally not immediate— building soil and restoring natural pollinator populations, for example, can take several years—conservation incentive programs may be needed to encourage adoption of some of these practices.

WATER CONSERVATION

Farms are important parts of their watersheds: farming practices can either improve or degrade the water and habitat quality of small and large streams, both on the farm and far downstream. Small, intermittent streams, including agricultural ditches, provide microhabitats, supply aquatic organisms and organic drift to downstream reaches, and can be important local water sources for wildlife.[15] Their degradation in just a portion of the landscape can affect the presence and behavior of wildlife populations over a large area.[14] Larger, perennial streams may support diverse communities of fish (such as brook trout and slimy sculpin) and aquatic invertebrates (including mussels, crayfish, and

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* Kristen Travis is a Hudsonia research associate who uses sheep and contoured swales to manage a fruit and nut orchard with her husband and two sons in North Carolina.

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stoneflies) and provide foraging habitat for wood turtle, birds (including belted kingfisher, Louisiana waterthrush, and great blue heron), bats (including Indiana bat), and other mammals such as beaver, mink, and river otter.[10] Common problems caused by agriculture include soil erosion, rapid surface water runoff, reduced groundwater infiltration, and contamination of surface water or groundwater with nitrogen, phosphorus, herbicides, and insecticides. Elevated runoff volumes can lead to erosion of stream banks and streambeds and siltation of stream bottoms. Diminished groundwater recharge can result in low stream flows during dry spells. Any of these changes can degrade the habitat for invertebrates, fish, and other animals in the stream and throughout the watershed.

Water and soils are the two most important on-farm natural resources, and practices that conserve water generally also reduce soil loss and improve soil quality. In well-drained soils, if more water is available to plants, crop yields are increased, the need for costly irrigation is reduced, and susceptibility to drought is lessened. Water conservation is also increasingly important because, throughout most of North America, droughts are predicted to become more frequent and intense[5] and extreme precipitation events more common[9] in coming decades. There are many ways to conserve water, but the most important one is to maximize the amount of carbon (organic matter) in the soil. Carbon content is the most important single quality of a soil: higher carbon results in greater water retention and infiltration as well as better soil structure and strength, more microbial and invertebrate activity, greater nutrient retention, and reduced erosion.[18] Soil carbon in cropland can be increased by adding organic material; minimizing bare soil through crop rotations, cover crops, and leaving crop residue; reducing tillage; and slowing runoff with contour techniques.

ADDITION OF ORGANIC MATERIAL

Almost any organic material added to or left on a field, either composted or uncomposted, will help soil accumulate carbon: crop stubble, poultry litter, leaves, straw, hay, horse bedding, yard waste, wood chips, or cattle manure.[1] Soil amendments such as humic acid and biochar contain carbon in a more stable form.

CROP ROTATIONS

Crop rotations (e.g., wheat-barley-pea, or winter legume-corn-winter grain-soybean) sustain soils by providing continuous carbon inputs both above and below-ground and improving fertility, while also maintaining economic sustainability for the farm.[18] With appropriate rotations, farmers can produce additional cash crops at times when fields are normally left fallow. Cover crops, when grown in rotation with cash crops instead of a bare-earth fallow, increase water retention both while growing and when left as crop residue. A forage cover crop followed by a grazing rotation adds manure directly to the field.[1]

CONSERVATION TILLAGE

Tilling greatly and almost immediately reduces soil carbon: conventional moldboard plowing can release more carbon than was contained in the previous crop's residue after just 19 days.[18] Conservation tillage is a system that retains a minimum of 30% ground cover of crop residue by reducing or eliminating tillage. No- or minimum-till systems also have a drawback—in the absence of using tillage for weed control, farmers often increase their use of herbicides, despite studies showing evidence that no additional herbicide is needed. Non-chemical methods of weed suppression can be successful, when using a combination of crop rotations, increased crop density, and

Leaving late-cut and uncultivated strips in crop fields and hayfields benefits insect pollinators and other wildlife.

cover crops or intercrops (planting two complimentary crops at once). Crop rotations that include a perennial forage rotation (such as alfalfa) are most successful at reducing weeds.[17]

CONTOUR TECHNIQUES

On sloping ground, any barrier (berms made of earth, debris, or mulch; ditches; strips of dense vegetation) placed linearly on contour—that is, perfectly level—will slow runoff and increase infiltration. Tilling on contour makes the ridge between each furrow into a small dam. Grass hedges and micro-basins (small ditches) installed on contour can be effective and cost-effective at reducing runoff and soil erosion.[25] Similarly, vegetated filter strips around field perimeters reduce runoff of herbicides.[11] When combined with other carbon-building methods (above), contour techniques will help the added carbon stay on the field rather than washing away. Other methods to increase infiltration and reduce runoff include creating small stormwater retention basins, rain gardens, and vegetated ditches or overflow areas with small check dams to slow the flow of water. (Streams should not be impounded, however, only stormwater runoff areas.)

In general, using any one of these methods will help to slow the loss of carbon from soils. In order to maintain or build carbon, two or more will need to be employed (e.g., no-till, crop rotations, and manure additions). In some systems, the combination of crop rotations and no-till both increases yields and builds soil carbon.[18]

WILD BORDERS

Many folks think it is a sign of a well-kept farm to have neatly mowed borders around crop fields and along roads, pond margins, and stream banks. This may keep things looking tidy but unnecessarily eliminates habitat for insects (including many beneficial for the farm), birds, and other wildlife. Beneficial insects include native pollinators and natural enemies of crop pests. Leaving these areas wild or less-intensively managed has many benefits, both for the farm and for native biodiversity.

BORDERS ALONG CROP FIELDS, LAWNS, AND ROADS

Strips or patches of natural (unmanaged) forest, shrubland, wetland, and abandoned meadow—as well as wild or planted areas of native, perennial wildflowers and grasses that are mowed annually in the fall—benefit both wildlife and farm productivity. Late-cut meadow strips along forest edges help protect eastern box turtle,[16] black rat snake,[7] and other animals that favor that transition zone. Late-cut strips in between large, open fields benefit nesting grassland birds. Perennial vegetation also provides necessary habitat for myriad insects, providing larval and adult food sources and undisturbed sites for pupation and overwintering. Many of these insects provide crucial support for the farm either by pollinating crops or by controlling insect pests. Native pollinators may be responsible for over 3 billion dollars' worth of vegetable and fruit production annually in the US, and the value of natural insect pest control is an estimated 4.5 billion.[13] Natural enemies (including spiders, wasps, flies, birds, and pathogens) control an estimated 99% of agricultural pests.[6]

As examples of the importance of native pollinators, take tomatoes and squash. Although tomatoes do not need pollinators to produce fruit, native bees can increase fruit set by 45% and fruit weight by nearly 200%. (The non-native honey bee cannot retrieve the pollen and so does not visit tomato flowers.[8]) A study in the mid-Atlantic region found that the native squash bee was three times more abundant on squash and pumpkin crops than the honey bee (and three times more abundant in no-till fields).[19] Pollinator habitat enhancement—mainly increasing the availability of pollen and nectar—is being used increasingly

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Native bees—important pollinators of food crops—benefit from semi-wild areas near crop fields.
Photo © Conrad Vispo 2014.

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IRREPLACEABLE ARCHIVES: The Scientific Legacy of Herbaria

By Gretchen Stevens, Erik Kiviat, and Paul Harwood*

Herbarium specimen of climbing hempweed (*Mikania scandens*), a herbaceous vine of moist thickets. Photo © Erik Kiviat 2014

They have been used to solve crimes; describe the chemistry of soil, water and air in bygone times; assess the effects of climate change; discover the origins of diseases, insect pests, and invasive plants; locate extant populations of rare species; identify fossils; identify prehistoric plant parts found at archaeological sites; learn about distribution and habitats of extinct species; determine native ranges of plant species; and elucidate fungus and insect relationships with plants.[1,2,5]

They are used by historians, artists, agronomists, forensic investigators, and medical scientists, as well as conservation biologists, ecologists, and taxonomists. Herbaria—collections of preserved plant specimens—have rich stories to tell about plants and the world they inhabit.

Herbaria range in size from the small personal herbarium that might contain 100 specimens, to a massive collection such as that of the New York Botanical Garden which contains 7 million vascular plant specimens. The Bard College Field Station herbarium, curated by Hudsonia with assistance from students and volunteers, is a regional collection of over 6000 catalogued vascular plant specimens in addition to several thousand more in process, as well as smaller numbers of mosses, liverworts, lichens, and fungi.

Vascular (higher) plant specimens in a herbarium are typically pressed, dried, and mounted on pH-neutral sheets of stiff paper, and labeled with information on where, when, and by whom the plant was collected, and often some details about the habitat or microhabitat where the plant was found. Mosses, liverworts, lichens, and fungi (the latter two groups are not actually plants) are simply dried, labeled, and stored in small pH-neutral paper envelopes. Specimen data are commonly entered in a computerized database, sometimes accompanied by digital images of the specimen itself.

Why go to all the trouble of preserving things that just grow outdoors?

A herbarium is part of the basic library of botany that allows scientists and naturalists to classify and identify plants, and study many aspects of plant anatomy, chemistry, genetics, and geographic distribution. Although biologists collect plant specimens for a variety of purposes related to immediate scientific research, the value of a preserved specimen with the accompanying data has a much greater reach. Herbarium specimens that are kept in dry, vermin-free environments can last hundreds and perhaps thousands of years, and can thus be available to taxonomic, ecological, anthropological, and genetic research long after they are collected.

A plant specimen provides a permanent record of the species' occurrence at a particular location, in a particular habitat or microhabitat, and on a particular date. Depending on the plant's status and condition at the time of collection, the specimen can provide a record of when the species flowers, develops fruit, or senesces, all of which can influence the interactions of the plant with pollinators, grazers, foraging animals, and detritivores. The timing of these stages can help us understand some of the complex dynamics of ecological communities. Some plant specimens retain physical or chemical markers of climate, air quality, soil characteristics, and water chemistry that can help researchers understand environmental conditions in the span of the plant's life.

Plant specimens can document the ranges of occurrence of particular species—e.g., ranges in habitat types, elevations, geography—and changes in those ranges over time. Specimens can document regional differences in the species' morphology (form and structure) and phenology (timing of, e.g., leafing out, flowering, fruiting). Changes in these characteristics can help us understand and predict some of the consequences of climate change.

Specimens can help to establish when certain plants first arrived in a

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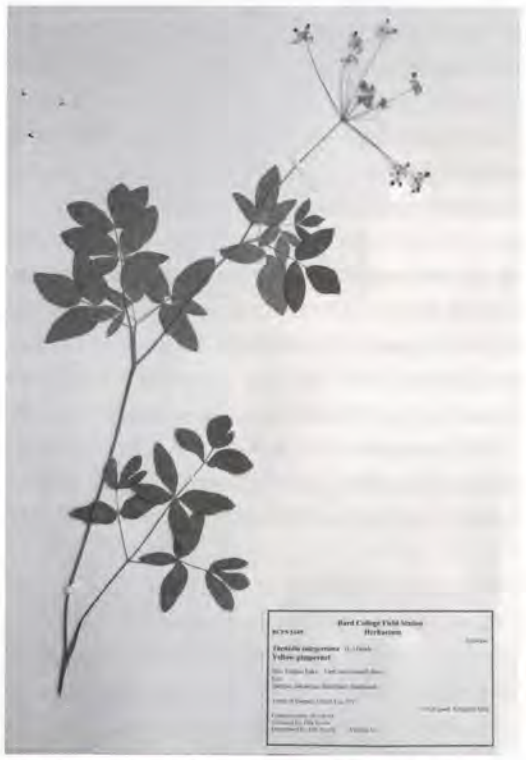
Erik Kiviat is Hudsonia's executive director.
Paul Harwood is a scientific illustrator, and former supervisor of the Brooklyn Botanic Garden Herbarium.

region or at a particular location, which can help ecologists understand aspects of the introduction, ecology, and spread of non-native plant species, for example, and can inform our efforts to control the spread of non-native pests. A reference plant collection can assist with identification of new plant specimens, and help to correct past identification errors.

Some herbaria contain historically important plant collections. For example, specimens collected by the Lewis and Clark expedition in the early 1800s, and now housed in the herbarium of the Academy of Natural Sciences of Drexel University, were used by botanists to describe, classify, and name the plants soon after Lewis and Clark returned to the East, and are still considered an essential reference for botanical studies of the western US.[5]

British researchers, comparing contemporary plant specimens with those collected over the previous century, found that the density of stomatal pores in leaves of native trees in southeastern England had decreased in inverse proportion to levels of atmospheric carbon dioxide.[7] That finding has since been corroborated by other laboratory and field studies, and has been used by climate scientists and paleoecologists to track historic and prehistoric CO^2 levels in other parts of the world.[6]

Herbarium specimens may also provide information about the behavior and distribution of other living creatures. In Puerto Rico, researchers discovered a species of moth whose cocoons mimicked spore dots of certain ferns, thus camouflaging the developing larvae from predation. By examining herbarium specimens of ferns collected in tropical regions throughout the western hemisphere, more evidence was found of the cocoons, but only from herbarium specimens collected in the Caribbean.[3]



Herbarium specimen of yellow pimpernel (*Taenidia integerrima*), a forb of calcareous habitats. Photo © Erik Kiviat 2014

Herbaria are the basis for worldwide systems of plant nomenclature, and are fundamental to plant identification and studies of plant diversity. But despite the foundational importance of herbaria to science, many of the world's herbaria are falling on difficult times. It takes funding and climate-controlled, pest-protected space to create and maintain a herbarium. Although there are virtual herbaria of sorts (websites such as the US Department of Agriculture *Plants Database*, the JSTOR *Global Plants* website, and the New England Wild Flower Society's *Go Botany*), they do not provide all the opportunities for science and natural history that are offered by physical herbaria and the important incidental information that physical specimens contain. Unfortunately, many universities and botanical gardens are either curtailing or outright eliminating their plant science programs or shuttering their herbaria.

But even though there are many examples of herbarium closures, scale-backs, and consolidations, there are some positive developments. Some governments and institutions have made investments in herbaria a priority. The Royal Botanic Gardens, Kew (England) has for many years sponsored a Herbarium Techniques course that travels to developing countries to teach endemic botanists and technicians the proper methods for establishing, building, and maintaining herbaria. Many of these countries are biodiversity hotspots, so establishing herbaria is imperative.

Another bright spot is the Herbarium at the Natural History Museum in Paris, currently undergoing a renovation with funding from the French government. Temperature and humidity controls are being installed and, amazingly, the whole collection of over 8 million specimens is being digitized. Having this all-important collection conserved properly and made available online will be a boon to plant science. The New York Botanical Garden, the Botanical Research Institute of Texas and Harvard University have recently invested in modernizing their facilities as well.

With the acceleration of climate change, invasive species incursions, hydrological changes, land conversions, human population growth and habitat destruction, we anticipate that herbaria will become an increasingly important resource for understanding the natural world and the responses of biological communities to the changing environment. ■

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ALICE IN MEADOWLANDS

By Erik Kiviat*

Ecologists and environmental professionals could learn from Alice in Wonderland.[1] She reported many astute observations about the organisms she encountered, some fanciful, and others realistic including a flamingo, hedgehog, dormouse, two species of rabbits, walrus, lion, oyster, caterpillar, tiger-lily, rose, and a mushroom. When I reflect on my experiences studying biodiversity in the New Jersey Meadowlands, I feel like an urban Alice: observing many fascinating animals and plants, yet sensing a disjunction between the reality of nature and human attempts to manage it.

Many biologists and naturalists think of urban areas, such as the Meadowlands, as poor environments for biodiversity. In some respects, they are, because of pollution and intensive human alteration of habitats. Yet the Meadowlands attract diverse waterfowl, shorebirds, birds of prey, diamondback terrapin, a number of butterflies and dragonflies including the spectacular scarlet males of Needham's skimmer, and both common and rare vascular plants and mosses, all organisms that can cross the urban landscape and find suitable habitats. Why do these organisms seem to thrive here, and how should we be conserving and managing their environments?

The Meadowlands have been intensively used for centuries, for logging, salt hay harvest, agriculture, disposal of garbage and hazardous materials, industry, transportation hubs and yards, and residential development, and have been extensively altered for mosquito control. More recently the Meadowlands have hosted scientific research, ecotourism, and wetland "mitigation." I began studying the biota of the Meadowlands in 2000 when asked to review the environmental documents for a 200 acre fill and development in one of the largest remaining wetlands. This piqued my interest in the region and soon collaborator Kristi MacDonald and I prepared a synthesis of Meadowlands biology,[2] papers for a scientific journal, a nontechnical booklet, and eventually a book manuscript. The more we reviewed published and unpublished information and explored the area ourselves, the more complexity we found in the supposedly simple and unimportant urban habitats. Most of the previous biological study of the region has focused on fishes, birds, and a few plants; I have also surveyed amphibians, reptiles, butterflies, dragonflies, land snails, higher plants in general, mosses, liverworts, and lichens. Most of the conservation and management attention has focused on tidal marshes, although half of the endangered or threatened birds, and many other rare species occur in nontidal freshwater marshes, wet and dry woodlands, rocky crests, and other upland habitats.

Certain taxa (evolutionarily related groups of organisms, such as hawks) and guilds (functionally related groups, such as water birds) are diverse or abundant in the Meadowlands, whereas other native organisms are absent or few in species and low in abundances. Let's call these urban-tolerant and urban-sensitive, respectively. Among the former are water, shore, and marsh birds, diurnal birds of prey, estuarine fishes, and woody plants. Among the latter are amphibians, freshwater fishes, stream insects (stoneflies, black flies, etc.), land snails, liverworts, horsetails, conifers, true sedges (*Carex*), and orchids. Probably the urban-tolerant and urban-sensitive classification can be used to predict biodiversity representation in other cities and industrial regions.

A male "coastal leopard frog" (*Lithobates* [new species]) in a Meadowlands stormwater pond, Moonachie, NJ. Photo © Erik Kiviat 2014

Whether a group of species does well or not in the Meadowlands is related to the species pool available in the surrounding region, the permeability of the Meadowlands landscape to colonizing individuals, and the quality of habitats present for those species. For example, amphibians have difficulty traversing dry or saline areas and many require natural soils for burrowing, characteristics that evidently make the Meadowlands a harsh environment for them. Wild-rice, formerly abundant in the Meadowlands, needs fresh (not brackish) water of good quality and no longer occurs there, and the same is true of Atlantic white cedar.

At the moment it is politically fashionable to manage marshes by killing the frequently dominant common reed (*Phragmites australis*) with herbicide, often removing a surface layer of the soil that contains the bulk of the reed rhizomes, and planting native marsh plants, especially cordgrasses

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(*Spartina*) in brackish water and cattails (*Typha*) in freshwater. The federal wetland permits for these activities generally require a five-year maintenance period; after that the marsh is on its own. Even though marshes treated thusly over the past 25 years have mostly been recolonized by reed (widely viewed as a pest), such "restoration" projects continue in the Meadowlands. And there are other problems with this kind of management; for example, the herbicides used to kill reed are also toxic to desirable plants and animals, so rare and common native species (in many cases unknown) that inhabited the site before management may be lost; with the loss of reedbeds we also lose their superior sediment-anchoring and sediment-building services, which may be increasingly important in the face of rising sea level. Cordgrasses are vulnerable to urban water quality and "saltmarsh dieback" so may be a poor choice in these highly-stressed habitats.

Let's look at a specific example. Nearly six hundred acres of tidal and formerly tidal marsh were preserved as the Richard P. Kane Natural Area to protect them from the proposed development that I first went to study in the Meadowlands. In 2010, more than 200 acres of this site was turned into a "mitigation bank"—a wetland that is created or restored in order to sell credits that allow permitted destruction of wetlands elsewhere. During construction of the bank, all the habitat then known in the state for a globally rare invertebrate (the clam shrimp *Cyzicus gynecia*) was destroyed; the habitat of a rare flatsedge (*Cyperus polystachyos*) was turned into an equipment park; the last known remnants of bluejoint grass (*Calamagrostis canadensis*) wet meadow in the region were killed; the area where the state-endangered northern harrier had bred was greatly altered; potentially invasive nonnative plants (other than reed) were spread by construction equipment; and one of the Meadowlands' most interesting nature watching areas along two-thirds of a mile of gas pipeline service road was closed to public access. Aldo Leopold, often considered the father of ecological restoration, famously said, "To keep every cog and wheel is the first precaution of intelligent tinkering."[3] Well, the cogs and wheels of Kane and the Meadowlands overall are not being saved—we don't even know what many of those parts are.

It should sober our visions of restoring, enhancing, or mitigating wetlands to know that many ecological characteristics of restored wetlands, such as plant communities and carbon storage, on average, are not fully recovered even after a century.[4] Some degraded wetlands are not restorable, and restoration of the complex biology and structure of wetland soils is especially challenging.[6] There is reason for optimism, however, in the relatively diverse biotas, rare species, and ecosystem services already supported by the degraded wetlands of the Meadowlands. Rather than taking these systems apart and attempting to make them whole again, we should try to gently increase certain aspects of wetland structure and function. Whether the ability to improve the quality of degraded wetlands "mitigates" the destruction of other degraded wetlands is open to question.

LESSONS IN NATURE MANAGEMENT

What do the Meadowlands teach about urban biodiversity in general? Many species have come and gone in this area during the past century or two, and there remain no reference sites to tell us what the biological communities of the Meadowlands and most other cities were like before large-scale human impacts. Even now, things change quickly in urban areas; a stonewort pool is here one day and half-filled the next, and a woodcock display ground is here one spring and the next spring is covered with condos. As elsewhere, the climate has changed, sea level has risen, and we have pervasively altered the hydrology and chemistry. Species of northern affinities are under increasing stress, and species of southern affinities (native or not) will colonize from the south. A few northern species may survive in "cool spots" such as the odd sugar maple stand in the shade of the New Jersey Turnpike at Laurel Hill.

Not only are attempts to "restore" habitats poorly informed by historic data, but recreated plant communities such as cordgrass salt marsh or Atlantic white cedar swamp are expensive or impossible to maintain because the conditions that once fostered them have degraded. Hence, we need to learn about and respect what's here now, albeit mostly "novel" communities with mixtures of native and nonnative species, or small fragments of native communities such as hardwood swamp, chestnut oak forest, or bluejoint wet meadow. A viable approach may be to modify the existing reed marshes to improve habitat for some of the many native species that are associated with reedbeds, while retaining the other ecosystem services provided by reed such as sediment stabilization and carbon sequestration. Partial harvest of reed biomass for habitat management could contribute to a mixed bioenergy feedstock along with the lawn clippings, shrub prunings, tree leaves, and other organic waste materials from urban areas.

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Planted cordgrass (*Spartina alterniflora*) at a Meadowlands restoration site. Photo © Erik Kiviat 2014

Alice In Meadowlands continued from page 7

In any case land managers should be aware that "restoration," "mitigation," or "enhancement" projects that are politically popular and most fundable may not be best for biodiversity. We need to document, conserve, and manage urban habitats and species, including the important elements that are not necessarily popular. The Meadowlands are an icon of urban biodiversity and an increasingly hazardous region for human habitation due to flooding, contamination, and other problems. Let's manage the Meadowlands for the nature that survives or thrives there, and the human uses that will continue to be safe and healthful. The same may be said for other areas at the fringes of New York City, the Hudson River wetlands, and greenspaces in many other developed regions.

Two clam shrimp (*Cyzicus gynecia*) from a rain pool in the NJ Meadowlands. Photo © Erik Kiviat 2014

In between her natural history observations, Alice puzzled at the disjunction between the environment and those managing it. She could have been exploring nature and politics in the Meadowlands where perceptions of and efforts at conservation seem not to follow rules. Put another way, Grace Slick[5] bemoaned the death of proportion and logic in Alice's world. To avoid this in other cities and, especially, urbanizing regions such as the Hudson Valley, we should learn to see nature without the distorting influence of convention, money, and politics, and use extant habitats as starting points that can be gently nudged in the direction of improved support for species of conservation concern and higher levels of other ecosystem services. ■

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Farm Management continued from page 3

on farms. Methods include planting annual floral buffer strips around fields, establishing perennial wildflower strips, and restoring native vegetation in adjacent natural areas. Floral diversity contributes to pollinator diversity and abundance,[24] and although pollinators will use non-native floral resources, they prefer native plants. On-farm bumblebee abundance in Columbia County (and elsewhere) is positively correlated with the amount of semi-wild habitat nearby.[22] The ideal resource to boost pollinators, then, is a mix of native perennials with bloom times that cover the whole season. This can be achieved by planting such a mix and/or by conserving diverse habitats nearby.[22,24]

Much research has been devoted to the effects of perennial vegetation on populations of natural enemies of crop pests, and on resultant crop damage. These enemies include carabid, staphylinid, and coccinellid beetles; spiders; parasitoid flies and wasps; predacious true bugs; and others. The effectiveness of many of these groups in pest control is greatly increased with the availability of nectar and pollen, so improving pollinator habitat helps improve pest control as well.[2] The amount and configuration of natural habitat also affects the abundance and efficacy of these arthropods, both at the local (farm) scale and in the broader landscape. In diversified, small-scale landscapes, natural enemies have shorter distances to travel from preferred habitats into crop fields, increasing their diversity and density in the crop fields.[2] For example, in coastal California parasitoid tachinid fly abundance and richness was greater in landscapes with more semi-wild perennial vegetation cover, compared to land dominated by annual cropland.[12] Farms with more complexity (greater crop diversity and wildflower strips) and farms located in landscapes with more surrounding natural areas both had greater pest control of aphids on broccoli.[4] This type of research has mostly been done on organic farms because insecticide use on conventional farms kills natural enemies and disrupts natural pest control systems.

Strips of natural vegetation or planted treelines or hedgerows (also known as shelterbelts) are often used as windbreaks on farms, where they can increase soil moisture and reduce wind erosion, increase crop production, and improve livestock health.[3] Treelines can also provide potential summer habitat for Indiana bat, eastern bluebird, and screech owl, and travel corridors and habitat for mammalian predators. In large hayfield or pasture areas, the best strips between fields are late-cut hay (see previous issue) to benefit nesting birds.

STREAMBANKS

Leaving strips of unmanaged vegetation along streams has many positive effects in addition to the benefits to farms and wildlife described above. Shade along streams keeps water cool, which helps aquatic invertebrate and fish communities. Natural upland and wetland habitats left along streams allow the important exchange of nutrients and organic materials between the stream and the floodplain, and increase the amount and quality of organic detritus available to support the aquatic food web. They can reduce downstream flooding, sedimentation, scour-

ing, and bank erosion. In a temperate agricultural landscape, wooded riparian zones (with at least 28% cover) had higher fish diversity than open zones.[20] Where possible, it is best to leave a naturally vegetated and undisturbed buffer of at least 160 ft (50 m) on either side of all streams.[10] However, a forested buffer of any width may increase faunal richness in streams near farm fields.[23]

POND MARGINS

When farm ponds are less managed, and have a ring or partial ring of marshy vegetation at the border and abundant aquatic vegetation, they resemble native habitats such as beaver ponds and wetland pools and can be important habitats for damselflies such as the sedge sprite and butterflies such as the Baltimore checkerspot. Ponds that lack fish can serve as breeding habitat for vernal pool amphibians such as wood frog and spotted salamander.[22]

There are many methods and systems where profitable farming can be combined with biodiversity conservation, including agroforestry (alley or strip cropping, silvopasture), multispecies grazing, and whole farm planning, which are beyond the scope of this article. Nonetheless, I hope that the ideas presented here have introduced some practical methods to sustain native habitats and species in any type of farm operation. ■

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The Baltimore checkerspot and other butterflies benefit from unmowed wet meadows and vegetated margins of farm ponds. Photo © Conrad Vispo 2014

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Brief Summaries of Some of Our 2013–14 Projects

Biodiversity Assessment Handbook for New York City

Our long-awaited handbook was posted online in 2013 on the **American Museum of Natural History** website. The Handbook emphasizes management of areas already preserved in addition to the assessment and preservation of other greenspaces. We hope to do more surveys and research on greenspaces with degraded habitats, because these areas get little consideration from conservationists yet support important biodiversity, and their study can inform restoration practice.

Biological Assessments

In 2013 we surveyed the plants, damselflies and dragonflies, reptiles, amphibians, and breeding birds at the **Thompson-Mazzarella Park** in the Town and Village of Rhinebeck (Dutchess County), to help the town design the expansion of recreational facilities while protecting important ecological resources on and near the park. In 2014 we are assessing biodiversity resources in the **Binnewater Lakes region** (Ulster County) to help the Open Space Institute and local land trusts assess the conservation potential of this area that is rich in limestone ledges, wetlands, and forests

Biodiversity Education and Technical Assistance

In fall 2013 we held workshops for municipal agencies, land trusts, and conservation organizations on **Biodiversity Assessment and Conservation** in Columbia, Putnam, and Orange counties, and a workshop on **Habitat Assessment Guidelines** in Ulster County. We continued our technical assistance to community groups that were past participants in the Biodiversity Education program, and to towns that have Hudsonia habitat maps. In 2014 we will continue to offer biodiversity technical assistance and will be conducting a six-month **Biodiversity Assessment Training** program for community groups in the City of Newburgh (Orange County) and the towns of Philipstown and Putnam Valley (Putnam County).

Bog Turtle Habitat Management

This is year three of our project to improve and monitor a degraded fen habitat for the **bog turtle (NYS Endangered)**, using grazing dairy cows to remove some of the taller vegetation. Early analysis of 2012-13 monitoring data shows less cattail, more grass, and a shift towards more fen-like vegetation. In 2013, the turtles expanded their activity areas short distances into a heavily grazed cattail stand and other grazed habitats. We expect larger changes in habitat use as the grazing management continues in 2014.

Bog Turtle Habitat Connectivity

In 2012 we embarked on a project to analyze habitat data using "least cost path" modeling to identify a network of **potential travel corridors for bog turtles** between their core wetland habitat areas in Dutchess County. With a small amount of new funding we are expanding the geographic scope and refining our analysis. By identifying key habitat complexes and corridors for this and other species of conservation concern, we can help prioritize conservation efforts in anticipation of wildlife movements with rapidly changing climate and land use.

Columbia County Living Land

We are continuing our work on the multi-year project with the **Farmscape Ecology Program** and the **Columbia Land Conservancy** to survey and describe **ecological communities throughout Columbia County**, study the interactions of people with the land, and convey our findings to the public.

Hydraulic Fracturing

We are seeking funding to expand our studies of **biodiversity impacts of fracking** for natural gas from the Marcellus shale. In spring 2014 we moderated the third symposium on this topic at the Northeast Natural History Conference in Springfield, MA. We are also collaborating on analyses of the impacts of the many gas transmission pipelines proposed or under construction in the northeastern states.

Leopard Frog

With Jeremy Feinberg, we revisited the breeding wetlands of the "new" species of **leopard frog** in the **New Jersey Meadowlands** and on **Staten Island**. Although all sites had been flooded by brackish water from the Hurricane Sandy storm surge in fall 2012, several sites had strong frog choruses in spring 2013. More surveys are underway this spring in collaboration with the New York Natural Heritage Program.

Natural Resource Conservation Plan

We are assisting the **Town of Ancram** (Columbia County) Conservation Advisory Council with development of a Natural Resource Conservation Plan that describes Ancram's natural assets, prioritizes areas for conservation, and recommends measures for protecting water resources, wildlife habitats, farmland, scenic areas, and recreational resources long into the future.

Nonnative Weeds

Hudsonia Research Interns are studying the non-native **purple loosestrife** and the native swamp loosestrife as microhabitats for mosses and liverworts (*Lea Stickle*), and the animals associated with stands of **Japanese knotweed** (*Laura Wyeth*). These studies continue Hudsonia's interests in the ecological integration of abundant, long-present, nonnative plants with native organisms. The information will help improve the ability to selectively manage weeds for biodiversity support.

Strategic Conservation Plan

In 2013 we assisted the **Woodstock Land Conservancy** (Ulster County) with developing a Strategic Conservation Plan to guide their conservation efforts related to biodiversity, water resources, resilience to climate change, farmland resources, and scenic, recreational, and cultural assets in their service area in Woodstock and surrounding towns over the next 12 years.

Editorial Appointment

Erik Kiviat and Research Associate Kristi MacDonald were appointed to the editorial board of the journal **Urban Naturalist**.

Recent Publications

Kiviat, E. 2013. Risks to biodiversity from hydraulic fracturing for natural gas in the Marcellus and Utica shales. The Year in Ecology and Conservation Biology 2012, Annals of the New York Academy of Sciences 1286:1-14.

Kiviat, E. 2013. Ecosystem services of *Phragmites* in North America with emphasis on habitat functions. AoB Plants 2013, doi: 10.1093/aobpla/plt008. 29 p.

UPCOMING EDUCATIONAL EVENTS

Professional Workshops

Professional workshops are a Hudsonia platform for sharing the most recent information from our and others' research. Municipal, state, and federal environmental personnel, NGO staff, land managers, and researchers will find these workshops a valuable way to catch up with current scientific knowledge and problem-solving approaches. The three one-day workshops offered this year are underwritten by the Hudson River Improvement Fund:

Reed (*Phragmites*) Ecology and Management
Thursday 15 May, 9:30 am – 4:30 pm, Lamont Doherty Geophysical Observatory, Palisades, NY.
Taught by Erik Kiviat

Reptiles and Amphibians of the Hudson River
Friday 13 June, 10:00 am – 4:30 pm, Norrie Point, Staatsburg, NY
Taught by Erik Kiviat and Jason Tesauro

Conservation of Urban Biodiversity
Friday 25 July, 10:00 am – 4:30 pm, Rutgers University Newark Campus NJ.
Taught by Erik Kiviat and Kristi MacDonald

Pre-registration is required. The fee is $25 per workshop, payable two weeks in advance. Lunch and course materials are included. Please inquire for more information: Erik Kiviat, 845-758-7273, kiviat@bard.edu.

Special Habitats in Clinton

The Town of Clinton Conservation Advisory Council and the Omega Institute are sponsoring a half-day workshop for landowners in Clinton (Dutchess County) who have special kinds of wetland habitats on their property, such as **kettle shrub pools**, **buttonbush pools**, **acidic bogs**, **circumneutral bog lakes**, and **intermittent woodland pools**. Hudsonia biologists Chris Graham and Gretchen Stevens will introduce the townwide map of ecologically significant habitats, and discuss the ecology of these unusual wetlands, the plants and animals that use them, and conservation measures to protect the habitat quality and sensitive biota. A field trip to some nearby examples is included. The workshop is mainly for invited landowners, but others are welcome if space allows; pre-registration is required. The Omega Institute will host the workshop (free of charge) and provide lunch.

Saturday 26 April. To register, contact Laura Weiland at lauraw@eomega.org or 266-4444 x377.

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Norene Coller, the Town of Clinton CAC, and the Omega Institute for sponsoring a landowner workshop on unusual wetlands.

Steve Hakim for touring Hudsonia staff around his property in the Binnewater Lakes area.

Julianna Zdunich, for designing the fall fundraising appeal and managing the Hudsonia website.

WISH LIST

GPS units (up-to-date, in good working order)

Binoculars (lightweight, good quality)

Natural history and field science books

Heavy-duty garden tiller, self-propelled

(For all items, please inquire first)

FOR SALE TO BENEFIT HUDSONIA

Hasselblad 500CM camera body, film backs, Zeiss lenses, and small accessories. Inquire for price list: kiviat@bard.edu.

Longtime friend and conservationist **Kip Eggert** died just as this issue went to press. Friends and family have requested that in lieu of flowers donations be made to Hudsonia in memory of Kip's love of the Hudson Valley's rivers and mountains.

HUDSONIA MEMBERS, 2013–14

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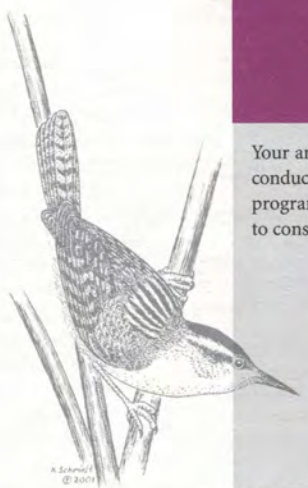

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