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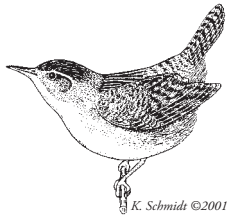
Dear friends,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After the melting of snow and ice we are more keenly aware of nature's variety, as well as the human activities that impinge on it.

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.

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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

Continued on page 2

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Farm Management continued from page 1

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.
Photo © Conrad Vispo 2014.

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

Continued on page 8

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

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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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