Accidental Harvest: The Farmscape Ecology of Columbia County, NY.

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Abstract

As a case study of an approach, this paper describes more than a decade of work on the farmscape ecology of Columbia County NY. For us, "farmscape ecology" signifies a place-based cultural and ecological exploration of how farming influences nature conservation and how wild nature, in turn, influences agricultural production. We describe the recent cultural context of local interest in nature and local agriculture, the results of our studies of the conservation value of regional on-farm habitats, preliminary work documenting the wild organisms of potential agricultural benefit, and the ecological context of farms in the larger landscape. We close be reviewing our experiences in using this format to share perspectives on the land with both farmers and the general public.

Introduction

"Farmscape ecology" is not a widely used term. Although others (e.g, Ehler 2000) have used it to essentially mean the landscape ecology of farms in relation to organisms relevant for agricultural production, we attach a broader meaning to it. Specifically, we use it to denote the two-way interactions between agricultural production and nature conservation in a particular landscape as influenced by the place-specific socioeconomic and ecological characteristics of that landscape over time.

There are several components to this definition. First, by "two-way interactions" we mean that the success of farming in a particular region depends, in part, on the interactions of crops with the suite of relevant local pests and beneficials. Conversely, the conservation of native organisms in that same landscape is affected, in part, by the land cover created or destroyed by regional agriculture and by the ecological needs of the native organisms. When some of those native organisms are crop pests or beneficials, then agricultural production and nature conservation are intertwined even more closely.

Second, a place-based approach is warranted because crops, pests, beneficials, the habitats of conservation importance, the biogeography of native species and the socio-economics influencing production and conservation often vary geographically. A place-specific focus on the interactions of agriculture and nature conservation can thus bring a more precise understanding.

Third, as is widely recognized by those pursuing agroecology broadly defined, ecology and agronomy cannot be divorced from culture or socioeconomics. People don't live in a world of

academic disciplines and while it is important to bring the appropriate techniques and theories to bear on specific questions, it is also necessary to regularly 'reassemble the pieces' so as to not lose sight of the whole.

Finally, history is crucial not only because it provides insights on the origins of current patterns, but also because, as the determinant of the momentum of the moment and as a collection of human/nature interactions in this place, it can provide important insight for guiding current action and anticipating the future.

This paper is meant as an illustrative case study of the farmscape ecology of a particular region (the area in and around Columbia County, NY). We hope to show that this integrated approach can provide a useful perspective on the agriculture and ecology of this place and, while the details would surely vary, suggest that our methodological approach might be informative elsewhere.

Various approaches to agriculture and ecology have been formulated over the past couple of decades from agroecology with its various scales of definition (e.g., Wezel and et al. 2009) to ecoagriculture (Scherr and McNeely 2008). Our definition of farmscape ecology may be comparable to definitions that some have given to these or other terms. Our point here is not to prove that our approach is unique but rather to illustrate its application in a way that provides insight on agriculture and ecology in at least one particular part of the Northeast.

Figure 1. Map showing location Columbia County, NY.

This paper is based on over a decade of work and, as such, is a review paper of our own experiences and studies. We begin by identifying four sociological and ecological themes which are useful in describing the place-specific characteristics of the Columbia County farmscape and in considering ways forward. We continue by briefly summarizing our personal experience in pursuing and sharing this viewpoint in our locale – How has it been received? Has it been useful? What do we see as key research questions? As a continuation of that, we close by trying to distill a few characteristics of an effective farmscape ecology approach.

Background

The roughly 1,600 km^2 of Columbia County lie between and encompass part of the Hudson River on the west and the Taconic Hills on the east (Fig. 1). Altitude in

the County ranges from a few meters above sea level to almost 700 m and it spans about half a degree of latitude. As a result, the length of the growing season can differ by about 3 weeks between the low southwest and higher northeast corners of the County.

The geology of the County can be described as a glacier-worked Taconic rubble pile (Fisher and Nightingale 2006). A series of ancient tectonic plate collisions apparently bulldozed in materials from farther east, including the remnants of shallow sea deposits. As a result, most of the soils are glacial tills, with regular bedrock exposure especially on the thinner soils of the eastern hill country. Some of the till and the bedrock are tinged with ocean-derived limestone.

Although humans probably began walking these lands within a few millennia of the last glaciation, prior to European civilization, there is little evidence of large resident human populations. At the time of colonization, the modest Mahican populations apparently lived mostly in small villages relatively near the Hudson and engaged in hunting, fishing and limited agriculture (Starna 2011).

Looking for furs, the Dutch were the first European group to sail up the Hudson River and establish numerous permanent settlements. The English slowly supplanted them as they or their descendants spread up the Hudson and seeped in from adjacent New England. A small colony of Palatine Germans was established in the early 18th century. When census records for the County first become available in 1790, more than 5% of the population were slaves.

New York City markets have long shaped the County's agriculture. A wheat focus gave way, in the early 1800s, to an emphasis on sheep, hay and rye production followed by apples and dairy through the 20th century. Today, Columbia County farming benefits from its still relatively extensive farmland (it has the highest proportion and absolute area in farms of all mid and lower Hudson Valley counties), its proximity to the City (which means access to City markets and the presence of numerous second-home owners), and current interest in local agriculture.

Land cover in the County has been a roller coaster with presumed nearly complete forest cover from about 12,000 BP through the time of European settlement to a ca. 70% open landscape at the time of maximum agricultural land use around 1870 and on, through a period of extensive farmland abandonment, to a land that is about 60% forested, 40% open today. The natural forests during the past several millennia have been Oak-Hickory and Northern Hardwood forest (Vispo 2014).

A program such as ours is practical because of the level of pre-existing ecological knowledge about the County and region. We have good, regional historical floras beginning with Dewey's 1829 flora of adjacent Berkshire County MA (Anonymous 1829). In the 1930s, an excellent flora was assembled for Columbia County itself (McVaugh 1958). State-wide bird, reptile, fish, and dragonfly atlases help put our observations of these groups in a wider geographic context. There is ample identification material available not only for the plants of the Northeast, but also for the butterflies, dragonflies, bees, ground beetles, ants, birds, herps, mammals and fish. Based on these resources and more than a decade of fieldwork, we have derived our county lists for many of these groups (Hawthorne Valley Farmscape Ecology Program 2016). As field ecologists, this means that we can focus on understanding patterns of biodiversity and its interaction with

farming rather than pioneering its identification. Such a situation may exist for most of North America, but is nonetheless worth acknowledging. The limits of identification continue to restrict our work on such important groups as microwasps, micromoths and microbes.

Below we discuss both agriculture-to-nature effects (i.e., how agriculture may influence nature conservation) and nature-to-farm effects (i.e., how wild nature may influence farm production). Agriculture and nature interact with each other in a wide variety of ways, but, reflecting our own areas of interest and experience, we focus on the influences of and on macro-invertebrates, vertebrates and higher plants. We realize this is far from complete and leaves out, for example, areas such as soil erosion and carbon fixation.

When considering agriculture-to-nature effects, we should define what we mean by 'nature conservation'. For our purposes, the goal is to maintain viable populations of the resident native species, at the regional if not property scale. Although we recognize that non-native species can play important ecological, not to mention agronomic, roles, they do not form part of our nature conservation goals. Although native biodiversity is our primary indicator, we believe that biodiversity will only be maintained when natural ecological process are also upheld.

Farmscape Ecology Themes in Columbia County

What does Columbia County's historical and ecological context mean for the current two-way interaction of nature and agriculture? If our goal is to maximize the synergies between the two, which practical actions are thereby suggested? Below we describe the farmscape ecology of Columbia County in terms of four socioeconomic and ecological themes derived from asking these questions.

In the driver's seat: Changing human perceptions of nature and agriculture

Before delving into the applied ecological aspects of the nature/agriculture interaction, it's important to ask why, in a sociological sense, such a topic is even of interest to the County's farmers and other residents? Several trends have helped to make nature and agriculture a theme of discussion in Columbia County.

First, farmer demographics are shifting. The evolution from predominantly conventional fruit and dairy to increased direct-marketing of niche products that has been occurring over the last four decades and accelerating over the past fifteen years. This has been accompanied by a change in the composition of the farmer community. While that change in the mode of farming has sometimes happened within an established farm family, in many cases, the new farmers have not come from an immediate farm background. In our program's survey of twenty-nine new farmers in the County, almost three quarters of them had had little or no involvement in food production while growing up (Duhon and Moore 2012). Many came from an urban or suburban backgrounds – the nearby NYC and Capital District areas provide not just lucrative farm markets but also farmers.

Perhaps reflective of the news stories which influenced their up-bringing (e.g., climate change, acid rain, extinction of species) and that of their customers, the new generation of farmers seems to be bringing a distinct perspective to farm practices, one that includes more explicit environmental concerns. Most new farmers practice some form of 'low-input' farming, a term we use as shorthand to denote farming that uses little or no synthetic pesticides, herbicides and fertilizers; certified organic farming can be described as a form of low-input farming. In our survey of 15 farmers in Columbia County farmers who marketed directly to consumers (11 of which were "new farmers"), all were using some sort of low-input management techniques (Farmscape Ecology Program Farmer Survey 2010, unpublished).

Customers likewise have evolved. Concerns about the ecological consequences of widespread pesticide use, for which *Silent Spring* (Carson 1962) may be considered a milestone, helped lead to the organic farming movement. Subsequently, partially in response to the standardization and sometime industrialization of organic agriculture and with *Omnivore's Dilemma* (Pollan 2006), the 2008 release of the movie *Food, Inc.* and Michelle Obama's 2009 planting of an organic garden at the White House as milestones, the local food movement arose with its focus on a direct connection to the source of one's food. The result of these trends has been a substantial market for low-input, regionally-produced food as exemplified by the growth of NYC's Greenmarket program and CSA (community support agriculture) programs (e.g., Rosenberg 2013). The NYC Greenmarkets in particular have done much to shape Columbia County agriculture because they are a key outlet of many farms and specifically require that vendors sell regionally-grown products; a policy that has most recently spawned the expansion of Hudson Valley grain production for human consumption.

Direct marketing, of which farmers' markets and CSAs are examples, occurs when a farmer sells directly to the consumer. Direct marketing has become especially popular as (sub)urbanites yearn for greater connection to food, farms and farmers. It provides an immediate route through which consumer aspirations can shape farm practices in a relatively detailed way. To the degree that consumers seek to buy from farms that match their vision of an ecological farm, direct marketing can encourage ecological farm practices. Although consumers rarely distinguish between nature-to-farm effects and agriculture-to-nature effects, they probably connect most readily with the latter – butterflies and birds tend to top ants and small parasitic wasps in charisma. However, more can be and is being done, through the work of organizations like Xerces, to emphasize the nature-to-farm aspects to the public. Consumers react to pretty pictures or the general 'feel' of the place in the case of pick-your-own or on-site farm stands, or CSA pick-ups. Direct marketing is also a conduit for education, meaning that well-thought through farm identities based in part on ecological awareness have the potential to reshape consumer perception of farms and farming, including the nature-farming interface. In our own work, we have repeatedly observed that our efforts to describe on-farm nature are of interest to farmers both as information that may help shape their management and as descriptive material to illustrate their farms and farming methods to consumers.

Although many consumers do now carry environmental or ecological concerns, these values do not top the list of reasons why consumers choose local foods. Our survey of 581 farmers'

market customers in the County indicated that support for the local economy, product freshness and quality, and personal health were all more important motives for buying local than the environment, which was cited by only 7% of the respondents (Duhon 2010). Furthermore, to the degree that 'local' has become the new 'organic', an informal, impressions-based review is replacing a more standardized certification process more closely tied to explicit practices. While this reduces paperwork and increases farmer flexibility, its influence on actual practices remains to be seen.

In terms of nature-to-farm effects, a "low-input" approach can improve the suitability of the farm for beneficials in at least three interrelated ways. First, because pesticides often affect more than just the target pest and can directly kill beneficials, reduced pesticide use will minimize the unintended loss of beneficials. Second, even if a beneficial species is directly harmed by a given pesticide, the prey upon which it relies may be destroyed. Such second-hand effects can be reduced under low-input farming. Finally, a farmer who depends upon pesticides is probably less likely to invest in creating and maintaining on-farm habitats for most beneficials, with pollinators being a potential exception. An example of the last situation comes from our work in Hudson Valley apple orchards (Vispo et al. 2015). That study suggested that, in low-input orchards, trees adjacent to wild habitats had, if anything, slightly better fruit pest control and larger apple size than trees in the orchard's interior. In contrast, in a pair of conventional orchards, apples adjacent to wild areas were, if anything, more heavily affected by pests and smaller. The sample sizes were miniscule and the results not statistically significant, but we believe they help illustrate that how one perceives the role of wild habitats – as reservoirs for beneficials or for untreated pests - depends upon one's style of farming. The growing emphasis on low-input production has thus increased both the potential ability of farmland to contribute 'ecological services' and the potential relevance of those services to production.

It is appropriate to acknowledge here that we have made few direct comparisons of farming style (e.g., organic vs conventional) and ecological impact. Our hesitance is due to the fact that the success of any sort of agriculture in the County depends upon local acceptance of and suitable infrastructure for agriculture in general. If a landscape suburbanizes, for example, there tends to be less willingness to tolerate tractors, farm smells and other agricultural accoutrements. At the same time, if tractor repair shops and agricultural supply stores disappear, local farming becomes noticeably more difficult. Furthermore, especially given the large influx of new, often inexperienced farmers, the continued presence of a dynamic and open farming community is also important. Many organic farmers we know have mentioned learning certain techniques from their conventional colleagues. Because of these factors coupled with the inherent outreach goal of any research we do, we have usually not pursued research that might encourage division in the local agricultural community. That does not, however, mean that we believe farming style is unrelated to ecological impact.

The trend towards low-input farming likewise can bode well for agriculture-to-nature effects. Pesticide application in and around a farm affects more than the target organism, and so overall biodiversity can be reduced by pesticides. However, 'organic agriculture' is not without its impacts on nature, because organic-allowed applications like Bt, Spinosad, and copper can be

fatal to non-target species and the frequent tillage that sometimes replaces herbicides means regular, life-destroying soil upheaval (Mader et al. 2011). Also, as referenced later on, the management of non-production areas, which is not so closely regulated by the organic standards, can be hugely important for determining the ability of a farm to harbor wild species. One of the more diverse farms we worked with in the County was a small-scale conventional dairy whose relatively light management facilitated various biodiverse habitat pockets.

Other cultural aspects of the local food movement have sometimes incidentally influenced on-farm ecology. For example, the recent interest in hard cider, an outgrowth of the microbrew movement and facilitated by changes in New York's brewing laws, has opened new markets to orchardists and, in doing so, facilitated low-input apple production. Apples have been one of the County's most heavily-sprayed crops. The late-19th century use of lead arsenate on county orchards was one of the earliest extensive uses of pesticides, and that has been followed by various chemicals, including alar and atrazine. While pesticide use can directly increase production, it can also help marketability by improving apple cosmetics. However, the recent resurgence of interest in cider production is providing a growing market for cosmetically imperfect apples and so enhancing the local economic practicality of organic apple production.

Although the actual cultural and potential ecological significance of this trend towards low-input farming seems clear, it is harder to gauge its current significance in terms of its influence on the County's farmland acreage. In many cases, the 'alternative' farms are smaller than the 'conventional' farms because many of the former are market gardens and many of the latter are still large-scale orchards, dairy or field crop operations. Total farmland in the County has been estimated at about 385-475 km^2 (Rosenberg 2013, USDA 2012). Of this, USDA's 2015 Cropscape map estimates about 80-100 km^2 of Columbia County land in tilled corn, soybean or alfalfa, almost all of which was presumably managed conventionally. Much of the rest is probably hay field, pasture, orchard, and market vegetables of undetermined management. That said, grass-fed beef and dairy, and organic small grain production are increasing, and our informal estimate of farmlands currently being consciously managed in an organic or low-input fashion is approximately 40 km^2 (i.e., ca. 10% of the County's active farmland). The vast majority of this is hay field or pasture and most of it was formerly conventional farmland. So, although we focus on the potential of low-input farms to benefit from wild organisms and to benefit natural habitats, we should caution that our discussion may be less relevant (although not necessarily irrelevant) to most current farmland in the County.

In sum, 'new' farming provides physical (e.g., field management, lower pesticides), economic (in terms of new markets) and cultural (e.g., public support for local farms) space for a more integrated view of farming and nature in the County. The fact that one can still even consider agriculture of any sort as a relevant land use in the County is due in part to the renewed focus on local agriculture mentioned above. It is this interest which gives traction to the farmscape ecology approach: there is a public interest in the local agricultural landscape and a collection of farmers who are envisioning and acting upon the multi-functionality of their farms.

Looking towards the future, the challenge will be to maintain interest in and encourage applied learning about the habitat aspects of farming. As mentioned, while 'local agriculture' and

direct marketing imply a level of oversight by the consumer, they are less explicitly ecological than, for example, certified organic or biodynamic agriculture. Simultaneously, other important aspects of the food system – such as the economic viability of production, food access, and nutrition/safety – can dominate local discussions. Crucial large-scale issues like climate change and the repercussions of globalization also enter into discussions of agricultural planning. It is the task of programs like ours not to dismiss those valid concerns but insure that the immediate habitat needs of local organisms, both beneficials and agriculturally-neutral organisms, remain on the table.

Habitat analogies: On-farm agriculture-to-nature effects

It is useful to begin our discussion of on-farm agriculture-to-nature effects by considering the pre-agricultural ecology of our landscape. Not because we hope to recreate some pristine ideal nor because ecologies don't change, but rather, because it gives us a starting point for speculating about how native organisms might interact with the different habitats that agriculture may create today.

It is likely that most of Columbia County has been forested for at least the past 10 millennia, but natural open areas – grassy or sedgy areas, shrublands and savanna-like woods - did occur, and many of the native organisms which we consider in this section were inhabitants of those natural openings. That said, one need only consider cornfields to realize that a variety of forest organisms – such as American Black Bear, Northern Raccoon, White-tailed Deer, and Passenger Pigeon – have taken advantage of this 'mast crop' and may likewise also have benefited from other agricultural lands.

We use the term 'habitat analogies' as a way of thinking about how different on-farm areas may resemble particular current or historical natural areas and hence provide habitat for certain species (Vispo and Knab-Vispo 2011; for a similar approach to urban ecology, see Lundholm and Richardson 2010). Others (e.g., Dover and Sparks 2000; Wehling and Diekmann 2009) have termed these surrogate habitats. The term 'analogy' is useful because it stresses both the fact that these are not restorations of some historical ideal and the fact that what works for one species may not work for another. The value of a habitat analogy is in the eye of the beholder, i.e., in the ecological needs of the particular species under consideration. As a result, while agricultural biotopes tend to be novel and in that sense 'non-analogue' (sensu J. W. Williams and Jackson 2007) as a whole, we prefer to see them as partial analogues in that certain wild species may recognize aspects of them as familiar, usable habitat. Below, we consider several of these analogies as illustrations of how modern on-farm habitats have the *potential* to provide homes for both general biodiversity and crop-relevant pests and beneficials. While we need to temper our imaginations, such an approach may help us 'accentuate the positive' by prompting us to envision possible goals and management.

Hay Fields as prairie patches. A 'classic' example of habitat analogies are mature hay fields: to certain grassland birds, fields of 'wild' hay (i.e., mature hay fields that are not annually ploughed and seeded) can, if managed properly, serve as nesting grounds analogous to the Prairies and other natural grassland that once were the demographic heartland of many of these species.

Although the details are unclear, it seems likely that many of our grassland birds did exist in the Northeast prior to the 19th century spread of upland grasslands, but their populations were limited to patchy, sandy natural grasslands and perhaps, in some cases, to wetter openings. They doubtless blossomed in the Northeast as grassland agriculture spread and have declined with its reduction. At present, Bobolink and Savannah Sparrow (in our experience, more of a pasture bird) are the most common grassland nesters in the County, although Eastern Meadowlark are still regularly encountered. There are Columbia County breeding records for Vesper Sparrow, Grasshopper Sparrow, Upland Sandpiper and Northern Harrier, although these have been rarer or absent in recent decades (eBird 2016, Pardieck et al. 2016).

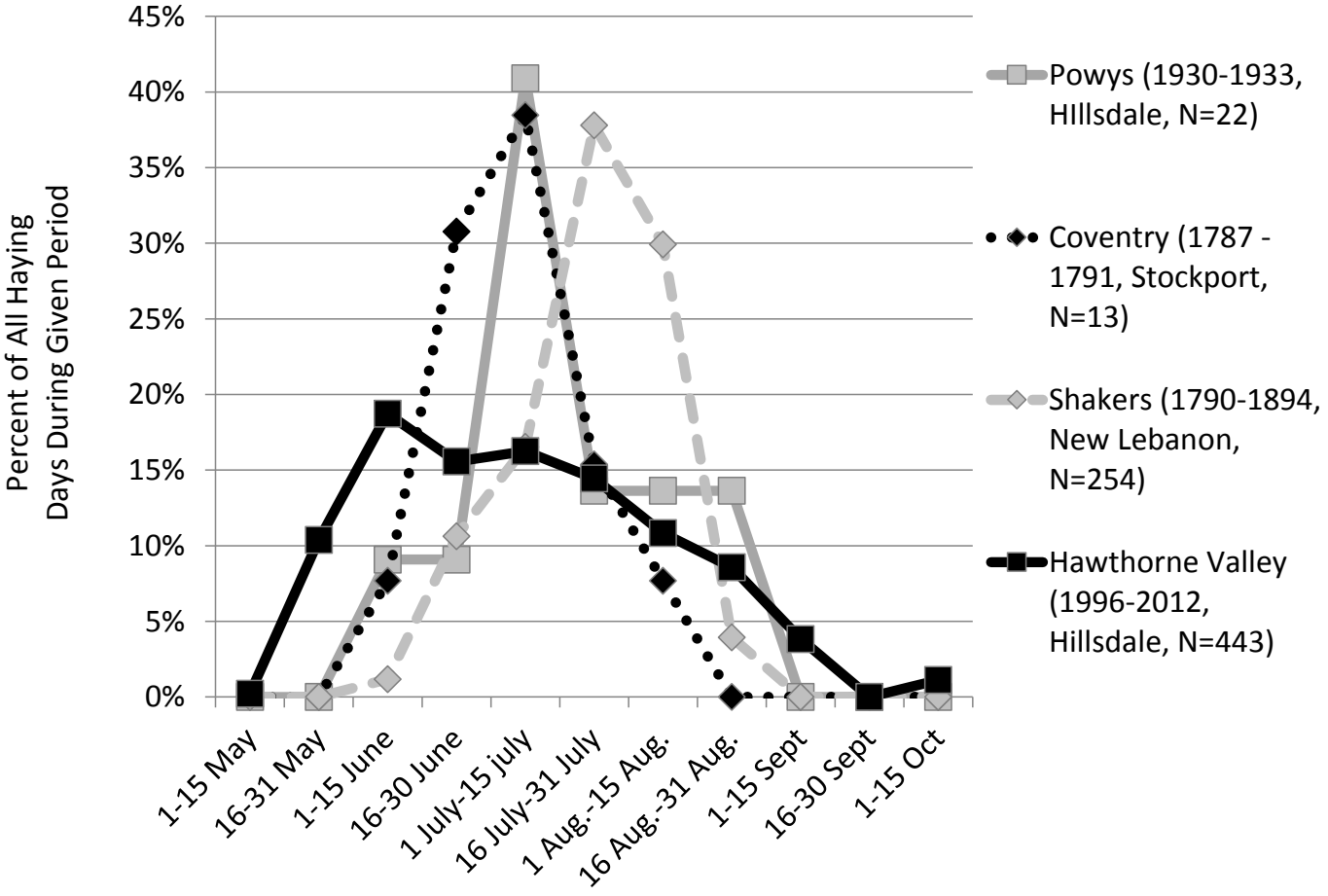

Figure 2. Distribution of haying days across the season for sites in Columbia County. Modified from Vispo 2014.

As has been widely recognized, the key to making mature hay fields work as breeding grounds for grassland birds is the timing of the hay cut. During the late 18th century and into the 19th century, records show that the County's hay cutting usually commenced in July (Fig. 2). Today, facilitated by baleage (which minimizes the need for in-field drying), cutting usually begins in May and is often repeated at least once during the season. Most fledging of Eastern Meadowlark and Bobolink first clutches is not complete before early or mid-July (Bull 1974), and so the suitability of many regional hay fields for grassland birds has declined dramatically since the 19th century. In Bobolink-rich fields hayed by Hawthorne Valley Farm, delaying the

first cut until after the fourth of July seems to have maintained abundant Bobolink populations. Cutting so late negatively impacts immediate hay quality, and there is also some concern about the long term consequences of late cutting for mature hay field plant composition. Work in Vermont (U.S. Department of Agriculture 2010) suggests that although an early cut (i.e., prior to June 1) may destroy nests, if it is followed by an 65-day window, then a second contingent of birds can successfully nest in the cut field. We do not have personal experience with this technique. One characteristic of the County's current socio-economic situation is that many non-farmers own mature hay fields and, in order to get a property tax reduction and maintain open lands, seek farmers willing to cut those fields. As a result, it can sometimes be relatively easy for farmers to gain access to hay fields, and this abundance may allow for more flexibility in hay cutting date if some of those fields are shown to be rich in grassland birds. Furthermore, some mature hay fields are now owned and operated as park lands by non-profits or the State. Management on those lands sometimes emphasizes grassland breeding birds.

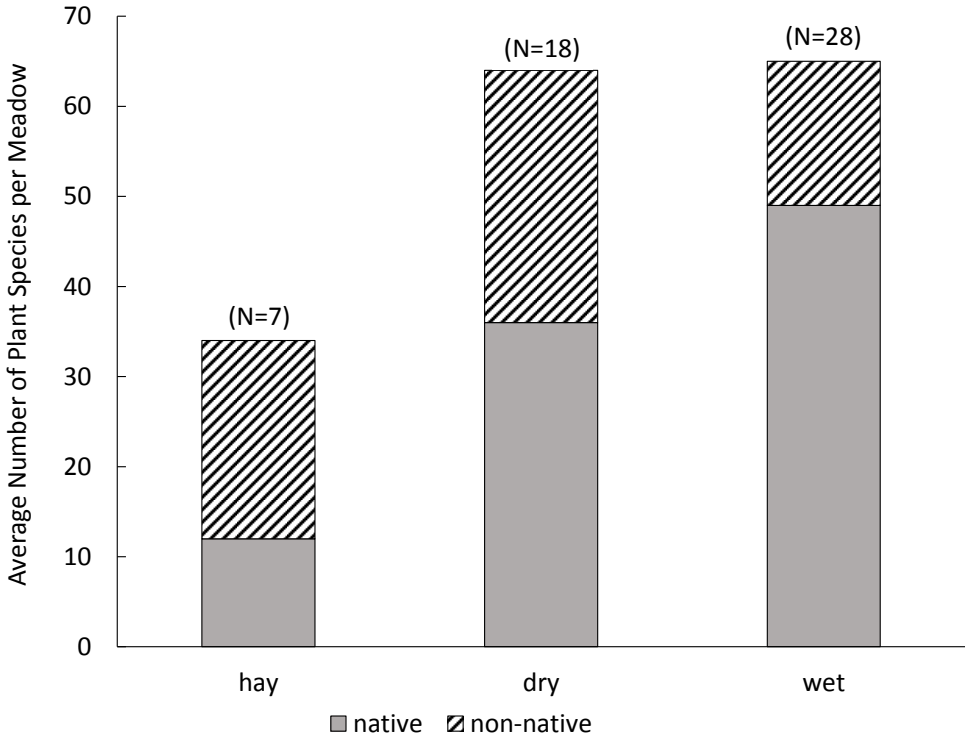

Figure 3. Average number of plant species recorded in hay fields, dry meadows and wet meadows in Columbia County. N refers to the number of sites surveyed in each meadow type.

For grassland birds, this analogy of mature hay field for Prairie or other native grassland can work. However, for many other organisms, even mature hay fields are *not* Prairies. For example, few if any native plants typically grow in such fields. Our plant surveys of mature hay fields in Columbia County show relatively few native plant species (Fig. 3), and those which are present are rarely abundant. Instead, the vegetation in these meadows is mostly composed of European cold season grasses, legumes, and forbs, such as Common Bedstraw, Dandelion, and English Plantain. As we will discuss below, these fields are often too fertile for native meadow plant species to be competitive. Reflecting this relative dearth of native plant species, specialized

native herbivorous insects (such as some butterfly caterpillars) find little food. The butterfly fauna typical of mature hay fields (Table 1) includes generalists, introduced species, native openland species which have switched to non-native foods, and forest butterflies which come into fields to nectar on native and non-native wild flowers (see also Vispo 2013). Other than strays from adjacent habitats, the specialist butterflies of our wet meadows and dry meadows are rarely present.

The role of mature hay fields in nature-to-farm relationships in our area is unclear. There is probably the potential for hay fields to harbor pests of small grains, but they may correspondingly also support pest predators or parasitoids. Mature hay fields can also provide some floral resources for bees and wasps, but nectar is often not abundant because of plant composition (dominance of wind-pollinated grasses) and cutting regime. Grassland nesting birds may feed their young various pests, although that is probably true of most birds.

Wet meadow as Beaver meadow. North American Beaver likely played a major role in the historical creation of the wetland habitats of our region, responsible for not only forming beaver ponds but, as that succession continued, creating beaver meadows. These meadows slowly blinked on and off in the landscape, as new ones appeared when a beaver pond was abandoned and the dam broke, and as old meadows eventually grew back into shrub and then forest. We estimate that historically, at any one time, perhaps some 10-16 km^2 of such meadows existed in the County. These meadows, together with various edge situations kept open by seasonal flooding or ice damage, provided habitat for a diversity of wetland organisms, from wetland plants to dragonflies, butterflies and amphibians. In some cases, those organisms may have also utilized ponded deeper areas (e.g., marshes, kettle ponds), where water depth, absent any beaver work or seasonality, was responsible for the openness. When fur trapping essentially drove the beaver to extinction in the County around 1700, this ecological dynamic was muted. Although beaver have since returned to the County, their populations are probably only about $1/6^{th}$ of historical levels, and even the activities of the existing beaver are regularly curtailed (Vispo 2014). Furthermore, many areas that were periodically wet even without beaver activity were drained during agricultural development. The US Fish and Wildlife Service estimates that between the 1780s and 1980s, New York State lost about 60% of its wetland area, largely to draining (Dahl 1990).

Table 1. Butterflies of open farmlands in Columbia County. Percentages refer to the percent occurrence across all surveyed sites of a given habitat; N is the number of sites surveyed in the given habitat.

	Plowed cropland (N=25)	**Hayfield (N=32)**	**Dry meadow (N=29)**	**Wet meadow (N=69)**
>50%	Cabbage White	Clouded Sulphur Cabbage White Pearl Crescent Least Skipper Common Ringlet Eastern Tailed Blue	Pearl Crescent Cabbage White Clouded Sulphur American Copper Eastern Tailed Blue Common Ringlet	Pearl Crescent Cabbage White Clouded Sulphur Least Skipper
25-50%	Clouded Sulphur Pearl Crescent Orange Sulphur Least Skipper	Monarch Great Spangled Fritillary Black Swallowtail Peck's Skipper Common Wood Nymph	Great Spangled Fritillary Common Wood Nymph Monarch Orange Sulphur	Common Wood Nymph Monarch Common Ringlet Peck's Skipper Eastern Tailed Blue Black Swallowtail Meadow Fritillary Great Spangled Fritillary
10-25%	Monarch Great Spangled Fritillary Common Ringlet Red Admiral Silver-spotted Skipper European Skipper Eastern Tiger Swallowtail Eastern Tailed Blue Peck's Skipper	Meadow Fritillary Silver-spotted Skipper Orange Sulphur European Skipper	Least Skipper Peck's Skipper Viceroy Eastern Tiger Swallowtail Black Swallowtail Meadow Fritillary Little Wood Satyr Silver-spotted Skipper Dun Skipper	Viceroy Eastern Tiger Swallowtail European Skipper Orange Sulphur Baltimore Checkerspot American Copper Silver-spotted Skipper Northern Broken-dash

On-farm wet meadows have the potential to be habitat for some (but hardly all) of the organisms who flourished in the once-extensive beaver meadows and other wetlands. Agricultural wet meadows are usually small, accidental habitats arising in the low parts of pastures or hay fields, where mowing or grazing keeps them open but their size is too small to motivate draining. These are biodiverse lands that can support numerous native species, some of which are now rare elsewhere in the landscape. Native plant species richness in wet meadows is relatively high and, in contrast to mature hay fields, native plants tend to also be common, usually comprising more than 50% of the vegetation cover in wet meadows (Fig. 3). If management allows, there can also be a burst of mid- and late-summer wildflowers. The richness and abundance of native plants can translate into a diversity of native herbivores and other animals. For example, several species of butterflies whose caterpillars are sedge specialists (Table 2) sometimes occur in wet meadows, as do other species such the Bronze Copper and Baltimore Checkerspot, whose caterpillar consume wetland forbs. We have also found the Northern Leopard Frog, a rare species in our County, in an on-farm wet meadow. In most cases, these meadows may be too small to support much bird life, although Red-winged Blackbirds sometimes nest in the shaggier meadows, and we have flushed American Woodcocks from them.

Table 2. The percent of total captures of eight common on-farm ground beetle species according to habitat type; the two non-cultivated habitats were the nearest adjacent patches. Based on a study of 19 vegetable farms in Columbia County. N= number of beetles captured. For more details see Vispo and Knab-Vispo 2012.

	N	Cultivated Vegetables	Grassy / Weedy Edge	Brush / Forest
Anisodactylus sanctaecrucis (Fabricius)	14	93%	7%	0%
Bembidion quadrimaculatum Say	174	74%	25%	10%
Elaphropus anceps (LeConte)	23	78%	22%	0%
Elaphropus incurvus (Say)	127	88%	11%	10%
Harpalus pensylvanicus (DeGeer)	23	57%	43%	0%
Harpalus rufipes (DeGeer)	39	63%	29%	8%
Pterostichus melanurius (Illiger)	5	20%	60%	20%
Stenolophus comma (Fabricius)	7	100%	0%	0%

In terms of nature-to-farm effects, we believe that those wet meadows which are allowed to develop wild flowers in the autumn can, together with goldenrod and aster old fields, be important late-season nectar sources for bees and wasps.

A central management consideration in maintaining wet meadows, aside from not draining them, is the intensity of management. In almost all cases, meadows that are left untouched will, like the beaver meadows, eventually return to forest. On the other hand, if mowing is too frequent or grazing too intensive, native biodiversity will probably be reduced. We have seen biodiverse wet meadows maintained where cutting occurs once every year or two, or where livestock may have access 1-4 times per year as part of their use of a more extensive paddock.

Dry meadows as barrens or hilltop grasslands. The native, upland, open-area plant species in Columbia County were originally part of the flora of fire-prone hilltops of the Taconics and its foothills and/or the former Pitch Pine barrens of the sandy northwest part of the County. These natural grasslands have diminished over the past centuries. Burning as an indigenous and colonial land management tool and as a natural event has been largely eliminated (an event exemplified by the apparent local extinction of Fireweed, a plant denoted as "frequent" in the Taconics of Columbia County as late as the 1930s; McVaugh 1958). The pine barrens of northwest Columbia County were, with the aid of gypsum, converted to agriculture in the late 1700s and early 1800s (Darby 1819, Strickland and Strickland 1972), and many of those fields, given their flatness and proximity to the Capital District, have now been developed for housing.

Those dry meadows that persist today host a variety of native plants which are now found in only a few other dry and open places in our region. For example, the grassy summits of the Taconic Ridge share Little Bluestem and Poverty Oatgrass as characteristic plants with dry meadows in Columbia County. Interestingly, these native grasses and several other common dry meadow plants, such as Early and Gray Goldenrods, Dewberry, Foxglove Beardtongue, Round-headed Bushclover and Pasture Rose, also occur on dry soils in utility right-of-ways and on the broad, occasionally mowed banks of the Taconic Parkway.

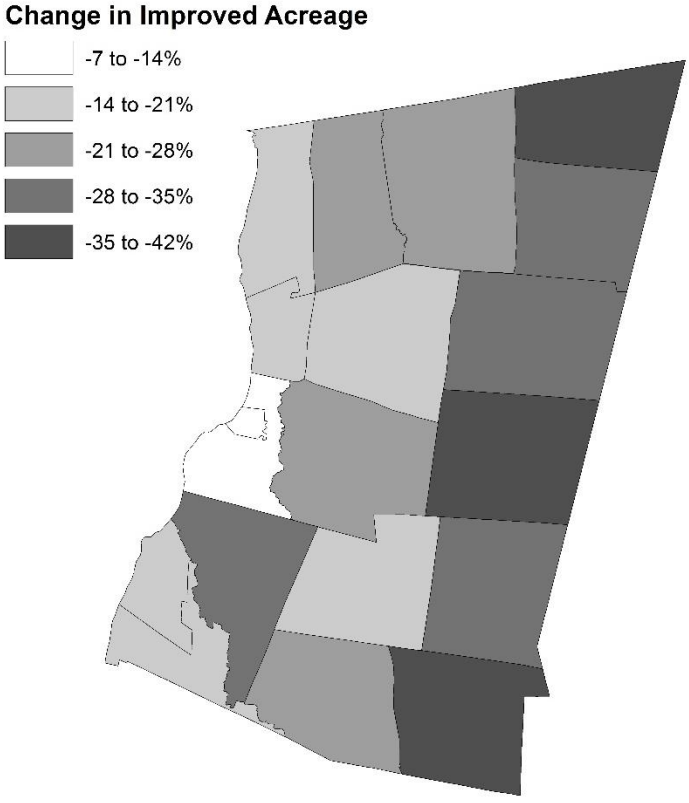

Figure 4. Change in improved acreage between 19th century peak and 1930. Based on US Census data.

All plants we consider diagnostic of dry meadows in Columbia County also occur in the nearest remaining pine barrens, the Albany Pine Bush (Barnes 2003). However, not all plants found in the Albany Pine Bush, and not even all that were historically documented from the sandy soils around Kinderhook in Columbia County (Woodworth 1840), occur in our dry meadows. For example, we yet need to find Wild Indigo growing in an on-farm dry meadow (we do occasionally find this species in utility right-of-ways) or even Wild Lupine, which seems to have disappeared from our County altogether.

Again, most if not all of today's dry farm field communities are not closely analogous to either dry hill tops or pine barrens. Rather, for certain individual species who once found extensive habitat in those natural areas, these fields provide a functional habitat analogy for their natural, historical habitats.

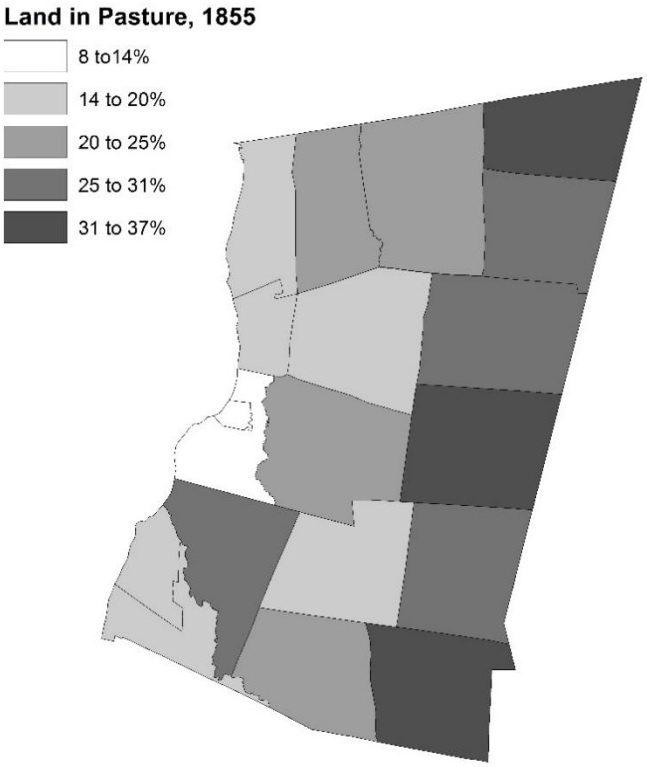

Figure 5. Area in pasture in 1855 by town. Based on US Census data.

Dry, often thin-soiled, nutrient-poor hay fields and pastures have the highest native plant diversity of any upland farm habitat. On richer agricultural meadows, European species such as clovers and cold-season grasses, adapted to millennia of life in Eurasia's relatively rich farm fields, easily out-compete many of the native dryland species (Cooper et al. 1929). It is likely that agriculture combined with naturally low fertility to create some of today's dry meadows. The sheep boom of the first half of the 1800s may have been responsible for the opening or at least continued use of hillside pastures which, over time, suffered from erosion and nutrient depletion. As *From Coastal Wilderness to Fruited Plain* (Whitney 1994) describes it, pastures were the poor "stepchild" in that they received little care. While many of these fields were allowed to return to forest during the agricultural abandonment of the late 1800s and the 1900s (Figs. 4 and 5), some have continued as hay field or lightly used cattle pasture, situations in which they are rarely, if ever, fertilized with other than the manure of the passing cattle.

The most conspicuous indicator plant of dry meadows in our area is the above mentioned native, warm-season grass Little Bluestem. In late summer, dry meadows can be spotted by inspecting aerial photographs or cruising the landscape in search of the Little Bluestem's characteristic rusty orange signature. A quote regarding Little Bluestem from the 1850s (then apparently grouped together with Broomsedge Bluestem, re-emphasizes the marginal agricultural nature of its habitat: "This, and other native species, are remarkably worthless grasses – and are apt to abound in poor old neglected fields. Where they prevail, no further evidence is required to demonstrate the unprofitable condition of the land, or the miserable management of the occupant" (Darlington 1859).

Unlike the mature hay meadows described earlier, these dry meadows do have some of the botany of native grasslands. As a result, they can sometimes support more of the native herbivores. Among the butterflies, these include some of the grass skippers, such as the Cobweb, Indian and Leonard Skippers. In work in Columbia County and nearby northwest Connecticut, we also identified eleven species of leaf miners feeding on native dry meadow plants, although the diet breadth of those species is not completely known. Because of their largely distinct

botany, it is unlikely that dry meadows are major havens for agricultural pests, although Red Cedar, which sometimes grows into such hillside meadows, especially on calcareous soils, does harbor Cedar-Apple Rust. The late-summer flourish of goldenrods and asters provide one source of nectar for native bees and wasps, although the flowers tend to be less abundant than in richer old fields.

Management of dry meadows is largely a matter of toleration and periodic mowing or grazing to keep them open. Perhaps the most difficult aspect of their conservation is that they have little immediate agricultural value (Fig. 6) and so farmers are hesitant to invest in keeping them cleared, at least not without fertilizing them (which would likely eliminate many of the native plant species). One possible, although largely undocumented, agricultural role is in rotational grazing where such fields (which are often somewhat shrubby because of their low use intensity) serve as medicinal leys. These are pastures which, while poor in nutrients and/or biomass and so not suitable for use as a core pasture, provide livestock with access to novel plant chemistries which they may use in self-medication ("herbal leys", Brunetti 2003). From a conservation perspective, regional work has suggested that grazing, when suitably managed, may be a useful tool in controlling invasive plant spread over this and other field types (Kleppel et al. 2011). Because of their relatively slow growth rates (and hence limited need for mowing), high conservation value, and their attractive autumn colors, dry meadows do have a potential role as landscaping around the homes of environmentally-conscious land owners.

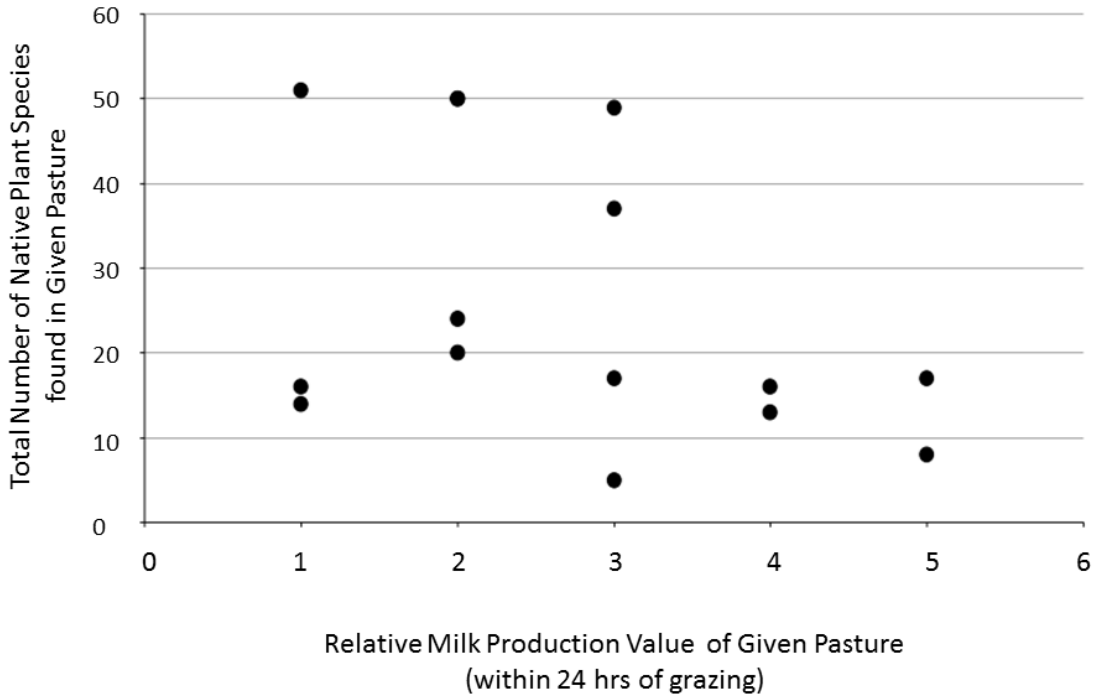

Figure 6. Relative milk production vs native plant diversity on pastures at Hawthorne Valley Farm. The pastures with especially high plant species richness (i.e., above 30) were associated with poor to average relative milk production, but might provide long-term benefits as herbal leys. This work was done in collaboration with farm apprentice Laura Weiland.

We recognize other potential habitat analogies in our landscape, such as that between a shrubby pasture and a post-burn shrubland and that of an old farm woodlot and a primary growth forest. However, the above serve as examples of our approach and the point is not so much to argue the validity of any particular analogy but rather to present them as stories that can help farmers and other land managers envision their ecological role in the landscape.

Habitat as service station: On-farm nature-to-farm effects

The complex term 'animal-mediated agroecological services', here referred to by the short-hand 'agroecological services', can be defined as the production benefits created by various wild animals living on or at least visiting the farm. In our case, we use it to refer to the actions of pollinators, pest-predators and parasites, as well as organisms which enhance soil health. Bees, spiders, birds, bats, parasitic wasps, and earthworms (despite being non-natives and their negative off-farm reputation) are examples of these 'service providers'. Although farmers sometimes introduce such organisms onto their farms (e.g., bee hives, and lady beetle and parasitic wasp releases), our focus here is on those organisms which are free-living and supported by the local landscape.

In many cases, these organisms rely on more than the crop field to complete their life cycles and thus illustrate the value of on-farm habitat diversity. For example, in Columbia County work comparing the bees which visited floodplain forest spring ephemerals with those visiting nearby crops later in the year, out of 84 bee species found in crop fields during the growing season, 24 (or 28%) were also found around spring ephemerals in the floodplain (Holdrege 2009). Because many county farms occupy the richer soils of valley bottoms, floodplain forest woodlots are a relatively frequent part of the landscape on and around farms.

Our own work at Hawthorne Valley (Fig. 7) suggested that semi-wild areas adjacent to crop fields saw early-season population build-ups of spiders that later became more numerous in the crops themselves (Vispo and Knab-Vispo 2012). In more taxonomically precise work looking at the nature of habitats around Columbia County tomato patches, we found that *open* semi-wild lands (e.g., unplowed, only occasionally cut grasslands) were more likely than forest to harbor the ground beetle species we found in the crop itself (Table 2). In work we conducted at seven apple orchards in the Hudson Valley (including two in Columbia County), we found that nearby forest appeared to be associated with increased populations of bees and spiders in the orchards themselves (Figs. 8 and 9; Vispo et al. 2015). In Spring, one need only walk into a forest adjacent to an orchard to find bumblebee queens scouting that landscape for potential nest sites. Similar work elsewhere by others (e.g. Altieri and Schmidt 1986; Miliczky and Horton 2005b; Morandin, Long, and Kremen 2014) has shown how the activity of various beneficials declines as the distance from wilder refuges increases.

It is likely that any particular region's suite of beneficial insects will be somewhat unique given the particular mix of crops and crop management, the wilder habitats common on farms, and the biogeographically-determined suite of wild species. However, we do not yet have a sufficient picture of the biodiversity of the community of beneficials.

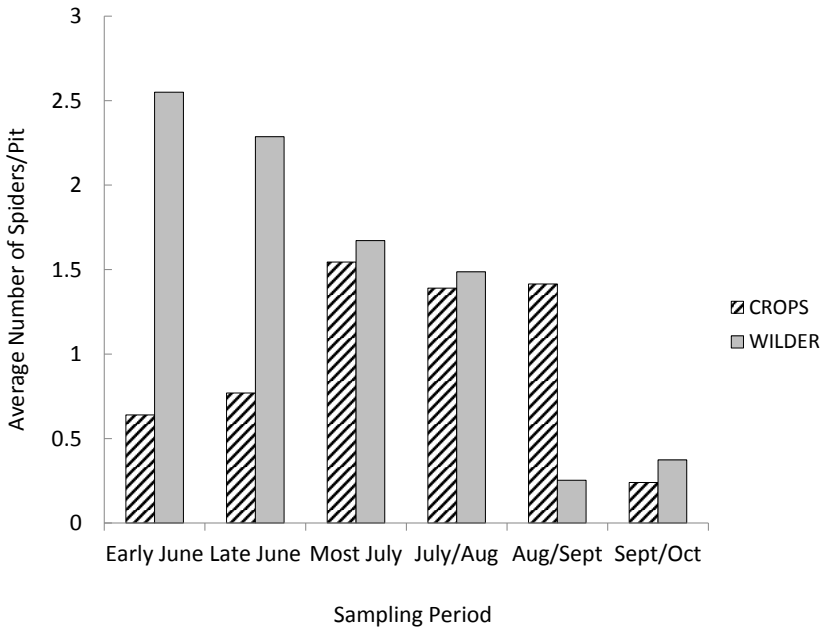

Figure 7. Spider captures in crops and wilder areas around Hawthorne Valley Farm; N= 659 spiders. For more details, see Vispo and Knab-Vispo 2012.

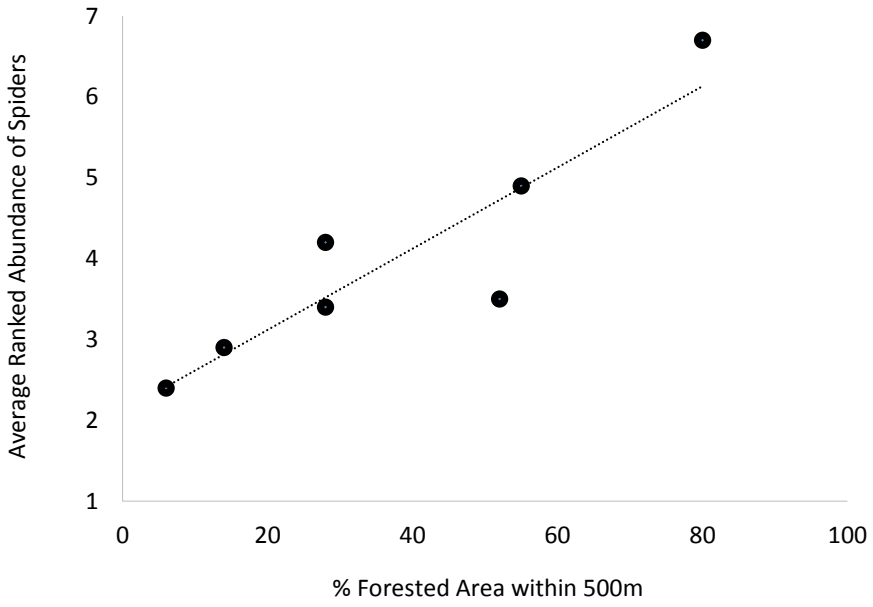

Figure 8. The average ranked abundance of spiders in seven Hudson Valley orchards in comparison to % of adjacent 500m in forest. Abundance was ranked for a variety of sampling periods and techniques and then averaged. Relationship is significant at p<.05 (Spearman Rank Correlation Test), although sample size is too small for robust testing. See Vispo et al. 2015 for more information on study.

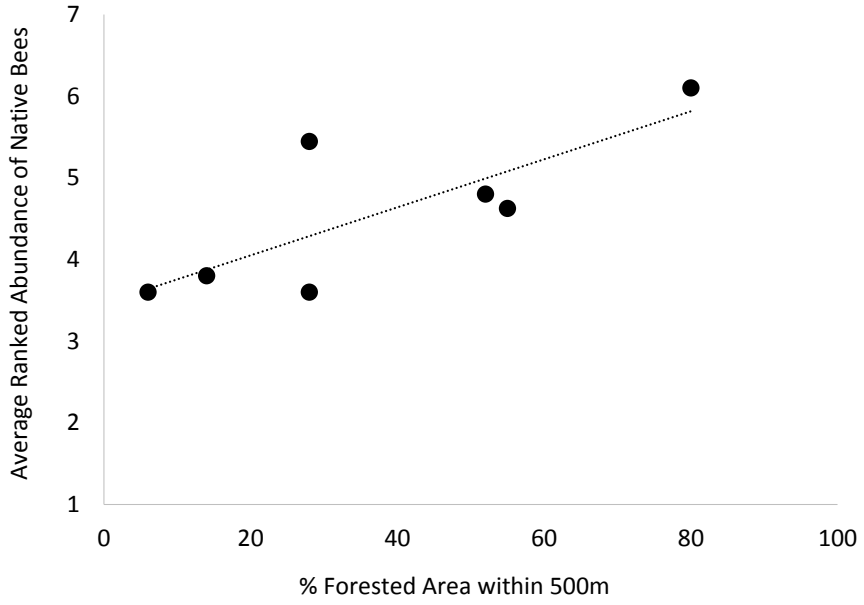

Figure 9. The average ranked abundance of native bees in seven Hudson Valley orchards in comparison to % of adjacent 500m in forest. Abundance was ranked for a variety of sampling periods and techniques and then averaged. Relationship had a p value of around .07 (Spearman Rank Correlation Test), although sample size was too small for robust testing. See Vispo et al. 2015 for more information on study.

Conservation biological control (Gurr et al. 2004), a branch of biological control based on the conservation of habitats for beneficials, is based not only on the identification and maintaining of such habitats but also on the techniques for exposing more of the crop area to the beneficial services. At one time scale or another, many beneficial insects commute between crop fields and wilder areas. Therefore, maintaining the source habitat and facilitating that commute by interdigitating crops and beneficial habitat can be valuable. Techniques such as wild flower strips and beetle banks can provide such conduits. The relatively small size of fields in Columbia County together with our now mostly forested landscape means that, compared to certain other farming areas, Columbia County may already have a relatively healthy 'commuter system'. This might be particularly true for the more mobile organisms such as spiders (many of whom disperse by ballooning) and larger bees. The benefits of habitat inter-digitation may be more evident for organisms with more limited power of dispersal such as ground beetles, small wasps and, potentially, certain soil organisms.

Going forward, key research will be that which describes the beneficial communities relevant to particular crops, documents their habitat requirements, and tests habitat manipulations that might enhance the sharing of their services while minimizing pest impacts. To date, we have done almost no work looking at the production benefits of practices such as wildflower strips, hedgerows and beetle banks, although the habitat work described above is suggestive. There are several important challenges to such work. First, to be truly relevant to the farmer, one needs to measure not just the abundance and distribution of purported beneficials, but also their production benefits or, at the least, an index of their services (e.g. sentinel cards, Grieshop et al.

2012). This means, for example, not just counting bees in an orchard but observing flower visitations and, ideally, assessing subsequent apple production. Second, as the first point implies, while we have spoken broadly about 'beneficials' that term really only has significance when considered from a crop-specific perspective; for example, many crops do not even require pollinators. Furthermore, because wild habitats can harbor not just beneficials but also pests, pest activity should be considered as well. From an agronomic perspective, the ultimate measure is the net effect of both pests and beneficials on production. Lastly, our aforementioned small fields and relatively abundant wild patches may, ironically, make measuring their benefits relatively difficult since the majority of fields are already near forests of one sort or another (Williams and Winfree 2013).

Beyond the fences: The relevance of the larger landscape

Above, we have largely considered farm-scale themes, be that the choice that consumers make among farms; the role of hay fields, dry meadows (degraded pastures), wet meadows and other on-farm patches as habitat for native species; or the ways in which on-farm management might draw in beneficials which commute between wilder lands and crops. However, farms do not exist in isolation from the surrounding landscape. What happens on farms contributes to the overall ecology of the landscape and, conversely, the land *outside* the farm fences influences the ecology *within* the farm fences. In contrast to the above sections on *on-farm* ecology, this section explores a couple of themes which relate to this larger scale.

The County's irregular terrain coupled with three centuries of agricultural history has resulted in the already-mentioned landscape of relatively small fields and forest patches. Although field size apparently increased as tractors took hold after WWII, most fields are still small compared to field size elsewhere in the State and Country. This is an "inefficiency" (from a conventional agronomic perspective) supported in part by the scenic landscape that it creates and the proximity of urban buyers, who are willing to pay more for the 'local' products of such a landscape.

The small fields and the habitat mosaic are important for farmscape ecology, because they offer uncultivated nooks, crannies and patches, which can support biodiversity and beneficials. Although forest-dwelling organisms can find corridors and even habitat blocks in the County, part of the biological richness of such a landscape comes from the semi-natural early-successional habitats, i.e., the old fields, shrublands and edges that such a landscape can offer.

Viewed as a whole, this landscape appears to be getting tidier and potentially less diverse. This is because, as already mentioned, certain important natural disturbances (beaver and fire) have been largely controlled, the burst of shrubland which followed agricultural abandonment in the late 19th and much of the 20th century has abated, and the current aesthetic of land management seems to encourage neatness. While tidiness itself is hard to quantify, shrubland is typical of less-intensively used semi-agricultural areas, and a remote sensing analysis using USDA Cropscape (an admittedly crude form of land use categorization) suggests that 'shrubland' area is 1/5th or less of its peak values in the early 1900s. In fact, not only is less area

passing through shrubland into forest, but, if anything, forest area is now decreasing in the Northeast in the face of non-agricultural development.

Land use aesthetic is influenced by a variety of factors. In addition, land is expensive to buy and pay taxes on, and open land is expensive to maintain. As a result, the non-farmer landowner class in the County is evolving, and 'loose' open areas are diminishing off-farm both because they may not fit the aesthetic of new owners and because tax breaks for agricultural use combined with interest in local agriculture have prompted some landowners to lease their lands to commercial farmers rather than manage it more loosely. The rise of market gardens means that some of this leased farmland goes into intensively managed vegetable crops, but, as mentioned in the section on hay fields and Prairies, even hay fields are being more intensively managed. Indeed, farms appear to have been cleaned of many of their hedgerows in the decades following WWII, probably facilitated by and for the benefit of increased on-farm mechanical horsepower. On most large-scale farms, that trend seems to have only continued. We are thus at a point where not only have all openlands declined significantly, but lightly used openlands (e.g., occasionally or extensively grazed pastures and late-cut hay fields) have declined even more. Although we don't have explicit recommendations in the face of these changes, educational programs that help people understand the inherent 'messiness' of many ecologically-rich habitats and, potentially, even provide specific incentives for certain land management and a recognition of farming's multi-functionality might be useful.

Suburbanization is another form of landscape simplification in which residential development rather than forest provides the matrix around any remaining farmland. Certain parts of Columbia County (e.g., areas around Kinderhook and Hudson) are experiencing suburbanization. There is a largely untested biocontrol hypothesis that beneficials are more sensitive to landscape conditions than pests and that, as a result, along a gradient of increasing (sub)urbanization they would drop out more quickly than pests (Tscharntke et al. 2007). This would occur because, while pests often rely primarily on the presence of their host (i.e. the crop plant that they are pests of), beneficials may tend to have more complex needs or rely on a wider prey base. Reliant on a more complex environment, beneficials are thus more sensitive to landscape conditions beyond the crop fields themselves. The potential for natural pollination and biological control would thus be predicted to decline as the landscape urbanizes. There are European data which hint at this pattern, but we have not yet gathered data directly applicable to this question, and clear exceptions would be those pests which rely on off-field overwintering sites (e.g., Plum Curculio and Brown Marmorated Stink Bug). However, we believe that if the portion of the public which supports low-input local agriculture can internalize the fact that landscape context influences a farm's potential for conservation biological control (and nature conservation), whether that effect actually follows any direct relationship with urbanization or not, then one can broaden the discussion about what it takes to truly support local agriculture. Researching the net agroecological services across landscapes of various use intensity could help make this connection more explicit in the public mind.

Our last consideration of scale is more sociological than ecological. One cannot study agriculture and nature in the County without being conscious of how landscape patterns them.

Such patterns reflect variation in climate, soils and hydrology and, at least historically, access to transport. One can ask what relevance such patterns might have for coordination or cooperation in management at the county scale. For example, much of the County's prime, nutrient-demanding cropland is in the southeastern Harlem Valley and on flats that parallel the Hudson. Hay and pasture can do well farther east where rainfall is slightly higher and summer temperatures slightly lower, although soils are thinner and more sloping. One question might thus be to what degree grass-fed livestock operations in one part of the County might be able to supply manure-based nutrients for another part of the County. In turn, how might these uses influence the habitats created by agriculture and, in conjunction with biodiversity patterning, the wild organisms that might be supported. For example, the New England Cottontail, a species considered (but rejected) for Federal Endangered Species status is known to occur in shrublands in the southeast corner of the County. However, many of the shrublands reflect various stages of agricultural abandonment. Is there any form of extensive agricultural use which might fit into the County's agricultural needs and, coupled with some incentives for biodiversity value, might help maintain these shrublands? For a variety of reasons, including lack of the in-depth ecological and agronomic knowledge needed to make it work and a long history of relatively independent land management at the farm and town scale, such questions may never be more than hypothetical. Nonetheless, as has also been hinted at by the research linking on-farm beneficials to habitat beyond the farm, we should not lose sight of the potential benefits of collaborative thinking at larger geographic scales.

Farmscape Ecology in Practice

As typified by the above discussion, there are several key ingredients in our approach to farmscape ecology: history, a mix of ecology and anthropology, place, recognition of the importance of farming and nature, and community-based research. In what way have those ingredients contributed to whatever effect our efforts have had over the past decade and what hopes do we have? As brief background, the Farmscape Ecology Program was founded in 2003 as part of the Hawthorne Valley Association, an educational non-profit organization. It has been dedicated to research and outreach that help farmers and the general public better understand their ecological role in our semi-agricultural landscape. Our hope is that such understanding will, in practice, lead to greater accentuation of the positive synergies between nature and agriculture. Below, we highlight several generalities that have emerged for us during this work. Before listing those, we offer some general reflections.

As a program operating mainly in the sphere of influencing public perceptions, we have little way to directly gauge our impact, and we recognize that that statement may mask our blatant insignificance. We take heart however from the continued interest in our work from farmers, the general public, and non-profit entities such as land trusts.

Our hope is that going forward, land use can be more conscious. We envision that consciousness to be a mix of government-level actions (e.g., town conservation advisory councils and their influence on town planning), non-profit land programs (e.g., the conservation

of agricultural lands and conservation areas by local land trusts), and private initiative (e.g., what land managers - including but not limited to - farmers decide to do on their own land). For the most part, the creation of on-farm habitat for native species has so far been incidental: hay was cut late, because cutting earlier wasn't practical or profitable; sterile, dry fields were kept open because they were better than nothing, but investing in their improvement didn't make economic sense; in-pasture wet patches were tolerated because they were too small to warrant an investment in drainage; and shrubby pastures were either a passing stage in field abandonment or, at the least, a sign of temporary neglect. If we continue to rely on such 'accidental' rewards, on-farm habitat will, for the reasons outlined earlier (i.e., changing modes of operation and pressure to fully utilize any acreage that stays in agriculture) probably continue to decline.

Alternative land uses – primarily, reforestation and residential development in the County – probably will not offer substantial habitat for openland native species. There are some potentially positive off-farm initiatives, although their significance is yet unclear. For example, interest in landscaping with native plants is growing (e.g., Weaner and Christopher 2016), but it is not evident whether this will make an appreciable contribution to native species conservation in the County. Landscaped wild flower meadows appear to enhance native plant and animal abundance, at least in comparison to typical non-native lawns, where ground-level coverage by native plants was, in one study, $1/5^{th}$ of that on the landscaped properties and native Lepidopteran caterpillar abundance was ¼ (Burghardt et al. 2009). Such meadows thus hold the potential to improve the ecological matrix of farms, at least in suburban areas where they supplant lawns.

Our own preliminary work suggests the impact might be less striking in more rural situations like ours, where landscaped native meadows might be compared to loosely-managed old fields. For example in two regional pairings of landscaped meadows with nearby old field, we estimated proportional coverage of native plants was 72% vs 59%, and native plant diversity was 96 vs. 70 species (in a larger study without such close pairing, we found an average of 51 native plant species in 6 landscaped meadows vs an average of 35 species in various Columbia County old fields). Significance for invertebrates was less clear, with few clear patterns emerging from comparisons across various groups. For example, abundance of native adult butterflies was not significantly higher on old fields vs landscaped meadows. The most consistent pattern was the greater abundance of native bees in the landscaped meadows (twice that of old fields) and of leafhoppers in the old fields (140% of that in landscaped meadows). In any case, the extent of such landscaping in the County is currently negligible, and it will likely expand only when and if less costly approaches become widespread. At present, the creation of an acre of landscaped native wild flower meadow can cost up to $10,000.

Such work has explicitly crossed paths with agriculture in the work of Xerces, a national insect conservation organization. In an encouraging initiative, Xerces is collaborating with NRCS to bring insights from such landscaping onto farms in a practical way. The exciting aspect of this is that, while recognizing the primary commercial aims of the farmer, Xerces and NRCS provide technical expertise and even potential funding for implementation around plans meant to enhance and maintain the habitat value of unused or little-used portions of the farmstead. By

doing so, the hope is to increase the pollinators and natural biological control on farms (Lee-Mäder et al. 2014).

Another approach to landscaping/farming which has regional popularity is permaculture. As with landscaped wild flower meadows, the value of permaculture systems as habitat for native species in our area still needs to be determined (we realize that permaculture aspires to many additional benefits which are beyond our scope). It does have the promise of explicitly melding agricultural and conservation goals, but it remains to be seen if it can adequately fulfill both in our landscape. It is likely that the creation of an agricultural landscape which is structurally but not necessarily botanically more similar to natural habitats will benefit some native species, but how many is unclear. It is also still uncertain if food can commonly be grown at a commercial scale in such systems. Certainly, at the homestead scale in (sub)urban situations it offers many ecological benefits relative to lawns or conventionally-managed gardens.

In reviewing our experiences, we see certain generalities that may be useful to people exploring the interaction of nature and agriculture elsewhere. We close by summarizing those generalities.

1. **Value Human Welfare and Nature Conservation Simultaneously**. Our actions derive from our values. We have found it important to simultaneously value both human welfare (e.g., food production for humans) and nature conservation for nature's sake. We believe that agriculture need not, and indeed cannot, be justified solely by its purported conservation benefits and, at the same time, nature need not and cannot be valued solely based on the services it provides to human endeavors such as farming. We believe that internalizing this perspective has been important to us, because it avoids what we feel are often (although not always) counter-productive attempts to monetize nature and also helps us maintain respect for farmers in and of themselves, largely independent of their ecological role. There is no magic process for reconciling those sometimes divergent values other than recognizing and accentuating synergies and working through and minimizing conflicts. Paralleling this, we have found that people who are interested in our work come to us because they are trying to harmonize their ecological/environmental values and their economic or aesthetic values. More than anything, we see Farmscape Ecology as bringing historical, ecological, and cultural understanding to bear on living that tension in a way that is respectful and honest to both ecology and human needs.

2. **Envision Ecology and Sociology as One.** We find that expressly combining consideration of ecology and human culture is important. Disciplines exist not only in academia but also outside of it for good reason – they let one focus on understanding details that may require in-depth observation. Field guides, for example, rarely span the divide. While fully recognizing the need for practical specialization, we need to consistently work to bridge the two conceptually. Our book on the historical ecology of the County (Vispo 2014) and our upcoming *Cultural and Ecological Field Guide to Columbia County's Habitats* are illustrative of this approach. The risk is that because these themes are often treated separately in the media, we confuse people who are

looking either for straight-forward human history or for natural history in the format of Peterson Field Guides. Farmscape Ecology happens at the interface of ecology and culture and its core questions mix the two, e.g., what might a given cultural trend mean for ecology and agriculture? And how can we bring particular agricultural/ecological realities into cultural consciousness?

In our research, this mix has been very important for involving people in our work: the great majority of people seem to appreciate the chance – when it is presented in an engaging way – of sharing their views on nature. In turn, that information can present us with important insights into the motivations for land uses.

3. **History as Perspective on the Human Story**. Because we are working in the cultural realm as well as the ecological one, it is crucial to understand social expectations, preconceptions, perspectives and practices. For example, for much of the second half of the 20th century, two of the dominant modes of agricultural production in the County – orchard fruits and dairy – were in decline. Many older farmers and farm families had witnessed and been discouraged by this trend. As a result, by the beginning of the 21st century, citizens and policy makers were wont to declare agriculture passé, and, in and of itself, this was an appreciable hurdle to encouraging those people to take an interest in farming.

People love to be part of a story, so when we can combine our ecological message with a historical one, we seem to be able to stimulate the greatest amount of interest, at least amongst the general public. In the above example, by putting current change in the historical context of ever-changing agricultural realities, we didn't deny current hardship, but we did help encourage an alternative to the 'end-of-agriculture' mentality. Effectively, history lets us give our evaluation of how things are without feeling the need to say anything more than, 'see how things have changed'. Related to this history-as-context point, the historical perspective also seems important for certain landowners who, because they spend relatively little time on their property and/or are new to the area, feel a need to better understand their 'place' and their role in it.

4. **Ecological History as a Prime Determinant of Modern Biodiversity**. Ecological history has played a key role in helping us understand which areas of farms might be most diverse and why. Although we would not base our modern ecological conclusions on our historical assessments, our attempts to understand the patterns in what we are seeing is permeated with history, e.g., Why do our native openland plants prosper on thin soils? Why do some forest stands seem to be noticeably richer than others? Given the profound agricultural history of our county, efforts to understand patterns in its biodiversity without attention to its history would be markedly incomplete.

Habitat analogies are the way we have most explicitly incorporated history into our outreach to farmers. That is, one general way to think about encouraging on-farm nature

is by accentuating those aspects of the farm which present the closest analogies to the historical habitats of our native species. While this does not immediately translate into a "how to manual", it seems to present a general logic that is quickly grasped, and can serve as a base from which to make farm-specific decisions.

5. **The Past as a Toolbox for the Present**. There are at least three risks around historical studies: they are derided as irrelevant and stale, they are elevated to a justification for inertia, or they provide the grounds for building a wistful vision of a utopian past. While a full-blown return of some ideal agrarian past is impractically romantic, the past is an agronomic testing ground of sorts. Despite changes in climate, crops and economics, the past can help make wise predictions regarding the sort of agriculture and associated industry that may or may not work in a particular landscape, especially when low-input (and hence more place-dependent) forms of farming are being considered. As we have tried to illustrate with our 'ecological analogies', understanding past ecologies can also help us understand potential future ecologies.

6. **Know the Ecology and Agriculture of your Place**. Agricultural practices reflect a complex blend of farmer knowledge and experience, external economic and cultural pressures, preconceptions, education and tradition, and personal style. We can't know it all, but by creating opportunities for learning about it, we can better anticipate how ecological management suggestions might or might not fit in. At the same time, through evolution, migration, and ecological whimsy, not to mention human action, a given area at a given time contains or has the potential to contain a certain collection of species. Different species interact with land management in different ways. Our discussion would, for example, be quite different if Columbia County were former Prairie land instead of mostly forested. Understanding the biological cast of characters and their ecological behaviors is necessary for making sure ecological suggestions are realistic and have the potential for positive impact.

Related to this is understanding what is being done by other organizations in the area. Cooperative Extension, Colleges and Universities, land trusts, other non-profits, and even active clubs and individuals may all engage in activities which overlap with those described here. The goal is not to compete with these activities but to complement them. For example, Columbia County is relatively distant from any major university, the regional Cooperative Extension has ably and very understandably focused largely on agronomic questions, and the local land trust has no official staff biologist. At the same time, as alluded to, there is ample interest in alternative agriculture. This left a niche for the type of research and outreach that we try to provide.

7. **Research can be a Source of Information and Inspiration.** We believe that outreach and research have to blend, because research that is not shared with or of ultimate interest to the practitioners is largely irrelevant. Research is a central ingredient because it lets us explore (and then share) those themes which, based on our

understanding of the local situation, might be useful but for which there is little or no place-specific information. Research in the form of monitoring lets us ground-truth our actions and make sure we're doing what we hope we're doing. We have also found that research can, indirectly and directly, form a useful 'getting to know you' tool for interacting with farmers, provided that the research is respectful, constructive and not needlessly critical.

Ideally, we see research as a form of accompaniment in that it takes the form of an on-going dialogue between the researcher and the practitioner in which each influences the direction of the other. It is a process in which the way of finding the answer may be as important as any specific answer itself. If, for example, one can involve a farmer or other land manager in ecological research so that it both excites them and informs them, then one may be able to create a mindset that is more important than any specific answer to a particular research question. In our work with orchard ecology, for example, we found that despite not being able to demonstrate clear gradients in edge-to-center pest control, orchardists were most interested to just see data on those aspects of their orchards which they rarely had the time to inspect personally. They were most interested not in well-cooked conclusions but in intuitive and clearly-presented depictions of the data, information which they could then use to make their own conclusions and shape their own management. Unfortunately, such research is hard to get funded because it is relatively labor intensive and cannot promise broadly-applicable conclusions.

None of this is meant to belittle the importance of rigorous research around well-conceived questions – obviously, research has the potential to lead to conclusions with profound implications for management and understanding – but it is meant to raise up the importance, in terms of local impact (which is all we aspire to), of how that research process itself is a way of sharing.

8. **Farmscape Ecology is an On-going Process, Not Just a Set of Discrete Research Projects**. Because of its place-based and cultural aspects, farmscape ecology is about building a relationship with the people of a particular region. While aspects of its pursuit can be formulated as discrete research and/or outreach projects, the ultimate goal is to encourage human behavior that is more conscious of and positive towards nature/agriculture synergies. As such, building trust and relationships is important and that can make it challenging to incorporate short-term projects by 'external' individuals into the process. For example, while the lack of graduate students with the ability to focus on and carry through particular projects is a challenge, a constantly rotating set of faces might make the creation of trust difficult, especially if those students are beholden to distant committees who are disconnected from the area.

9. **Farmscape Ecology should be Inclusive.** Farmscape ecology involves all human users of the landscape, regardless of their mode of production or political persuasion. If one hopes to influence a broad section of those people, then we believe an apolitical, non-

activist approach is useful. In and of itself, the ecology of the land and the source of food is an important and appealing theme for many people. However, linking that to opinions about particular political movements or becoming activists around controversial issues can lead groups of the public to replace one's message of informed compassion for the land with a particular set of expressed opinions.

We by no means believe that political activism is generally wrong or that certain issue are not worth fighting for. Indeed, the risk of the above philosophy is that by trying to please everyone we accomplish nothing but the status quo. However, we feel that if we can respectfully state and focus on our central issues of supporting synergies between food production/producers and nature conservation then that does have the potential to be new and influential.

10. Farmscape Ecology Happens at Various Scales Simultaneously. As we hope this paper has illustrated, farmscape ecology combines understandings of field-scale agro-ecological processes with those happening at the landscape-scale or beyond (e.g., climate change). Equally, the cultural influences can range from the individual personalities and socio-economic conditions of the farmers to the influence of regional markets to the effects of global trends.

11. **Watch for Emergent and Emerging Processes**. Change is one of the few constants. Because farmscape ecology is an applied rather than theoretical field and because its 'success' relies on its continued relevance, it is important to keep an eye on evolving social trends (e.g., the changing relationships of people with agriculture, new market opportunities and pressures) and ecological forces (e.g., new pests, species-scale demographic changes in particular organisms). It is likewise important to think broadly about what larger results might emerge from patterns seen at small scales (e.g., what does it mean that we happen to be noticing certain rare plant species in old farm woodlots?) and how emergent social processes (i.e., movements) might be supported by small-scale actions.

For much of its history, agriculture in Columbia County did not have the explicit role of contributing to nature conservation, and its effects in that regard, good or bad, were more accidental than intentional. Even today that role is, logically enough, a secondary or perhaps even incidental objective. Similarly, aside from the direct effects of pests or disease, nature's role in shaping farming has received, until recent years, diminishing recognition. Nevertheless, intentionally or not, agriculture is part of the natural landscape and so has been playing a role in providing habitat for native plants and animals; and wild organisms can interact in profound ways with agricultural production. Our hope is that the approach outlined here can support both agricultural production and nature conservation by encouraging a more conscious and active understanding of those interactions by the farmer as producer of food, land manager, contributor to farm policy, and de facto educator and by the public as consumer, landowner and participant in shaping public policy.

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Appendix – Scientific names of species mentioned in the text.

American Black Bear *Ursus americanus*(Pallas)
American Copper *Lycaena phlaeas* (L.)
American Woodcock *Scolopax minor* (Gmelin)
Baltimore Checkerspot *Euphydryas phaeton* (Drury)
Black Swallowtail *Papilio polyxenes* Fabricius
Bobolink *Dolichonyx oryzivorus* (L.)
Bronze Copper *Lycaena hyllus* (Cramer)
Broomsedge Bluestem *Andropogon virginicus* L.
Cabbage White *Pieris rapae* (L.)
Cedar-Apple Rust *Gymnosporangium juniper-virginianae* Schwein.
Clouded Sulphur *Colias philodice* Godart
Cobweb Skipper *Hesperia metea* Scudder
Common Bedstraw *Galium mollugo* L.
Common Ringlet *Coenonympha tullia* (Müller)
Common Wood Nymph *Cercyonis pegala* (Fabricius)
Dandelion *Taraxacum officinale* Weber ex Wiggers
Dewberry *Rubus flagellaris*Willd.
Dun Skipper *Euphyes vestris* Boisduval
Early Goldenrod *Solidago juncea* Aiton
Eastern Meadowlark *Sturnella magna* (L.)
Eastern Tailed Blue *Cupido comyntas* (Godart)
Eastern Tiger Swallowtail *Papilio glaucus* L.
Narrow-leaf Plantain *Plantago lanceolata* L.
European Skipper *Thymelicus lineola* (Ochsenheimer)
Fireweed *Chamerion angustifolium* (L.) Holub
Foxglove Beardtongue *Penstemon digitalis* Nutt. ex Sims
Grasshopper Sparrow *Ammodramus savannarum*(Gmelin)
Gray Goldenrod *Solidago nemoralis* Aiton
Great Spangled Fritillary *Speyeria cybele* (Fabricius)
Indian Skipper *Hesperia sassacus* Harris
Least Skipper *Ancyloxphya numitor* (Fabricius)
Leonard's Skipper *Hesperia leonardus* Harris
Little Bluestem *Schizachyrium scoparium* (Michx.) Nash
Little Wood Satyr *Megisto cymela* (Cramer)
Marmorated Stink Bug *Halyomorpha halys*Stål
Meadow Fritillary *Boloria bellona* (Fabricius)
Monarch *Danaus plexippus* (L.)
New England Cottontail *Sylvilagus transitionalis* (Bangs)
North American Beaver *Castor canadensis* Kuhl

Northern Broken-dash *Wallengrenia egeremet* (Scudder)
Northern Harrier *Circus cyaneus* (L.)
Northern Leopard Frog *Lithobates pipiens* Frost
Northern Raccoon *Procyon lotor* (L.)
Orange Sulphur *Colias eurytheme* Boisduval
Passenger Pigeon *Ectopistes migratorius* (L.)
Pasture Rose *Rosa carolina* L.
Pearl Crescent *Phyciodes tharos* (Drury)
Peck's Skipper *Polites peckius* (Kirby)
Plum Curculio *Conotrachelus nenuphar* (Herbst)
Poverty Oatgrass *Danthonia spicata* (L.) Beauv. Ex Roemer & J.A. Schultes
Red Admiral *Vanessa atalanta* (L.)
Red Cedar *Juniperus virginiana* L.
Red-winged Blackbird *Agelaius phoeniceus* (L.)
Round-headed Bushclover *Lespedeza capitata* Michx.
Savannah Sparrow *Passerculus sandwichensis* (Gmelin)
Silver-spotted Skipper *Epargyreus clarus* (Cramer)
Upland Sandpiper *Bartramia longicauda* (Bechstein)
Vesper Sparrow *Pooecetes gramineus* (Gmelin)
Viceroy *Limenitis archippus* (Cramer)
White-tailed Deer *Odocoileus virginianus* (Zimmermann)
Wild Indigo *Baptisia tinctoria* (L.) R. Br.
Wild Lupine *Lupinus perennis* (L.)