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# **Ecology in the Field of Time: The History of the Interaction of Farmland and Native Species Habitat in Columbia County, NY.**

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# INTRODUCTION

It is often said that the lives of everyday people disappear into the background of sweeping historical narratives; the same could also be said of the landscape in which they lived. This paper explores the interactions of natural communities and agriculture in Columbia County, NY. Understanding this on-going dynamic between conservation value and use value can help highlight both potential synergies and conflicts in historical and future landscapes.

Farmland is not randomly spread across the landscape, neither are wild organisms (Figure 1). Within their means, farmers seek out the soils, the topography, the hydrology, and the climate best suited to the crops or livestock they wish to raise. Plants and animals likewise only live in certain habitats, where ‘habitats’ are formed by the species-relevant physical and biological aspects of the landscape. There are two stages of interactions: first, farmers and native organisms will have greater or lesser coincidence in the places they seek; second, farmers may influence the habitat quality for the native species on the land that they work. While there is a dominant one-way flow to this logic (i.e., farming affecting native species), the actual situation is more complex because both farmers and native organisms reflect the offerings of the landscape and hence, as noted, will to some degree covary. To a lesser degree, especially in more modern agriculture, native species may also influence the quality of the farmland (i.e., as pests or beneficials). Finally, changes in natural physical processes (e.g., climate), if not in native species, will selectively affect the viability of certain agriculture.

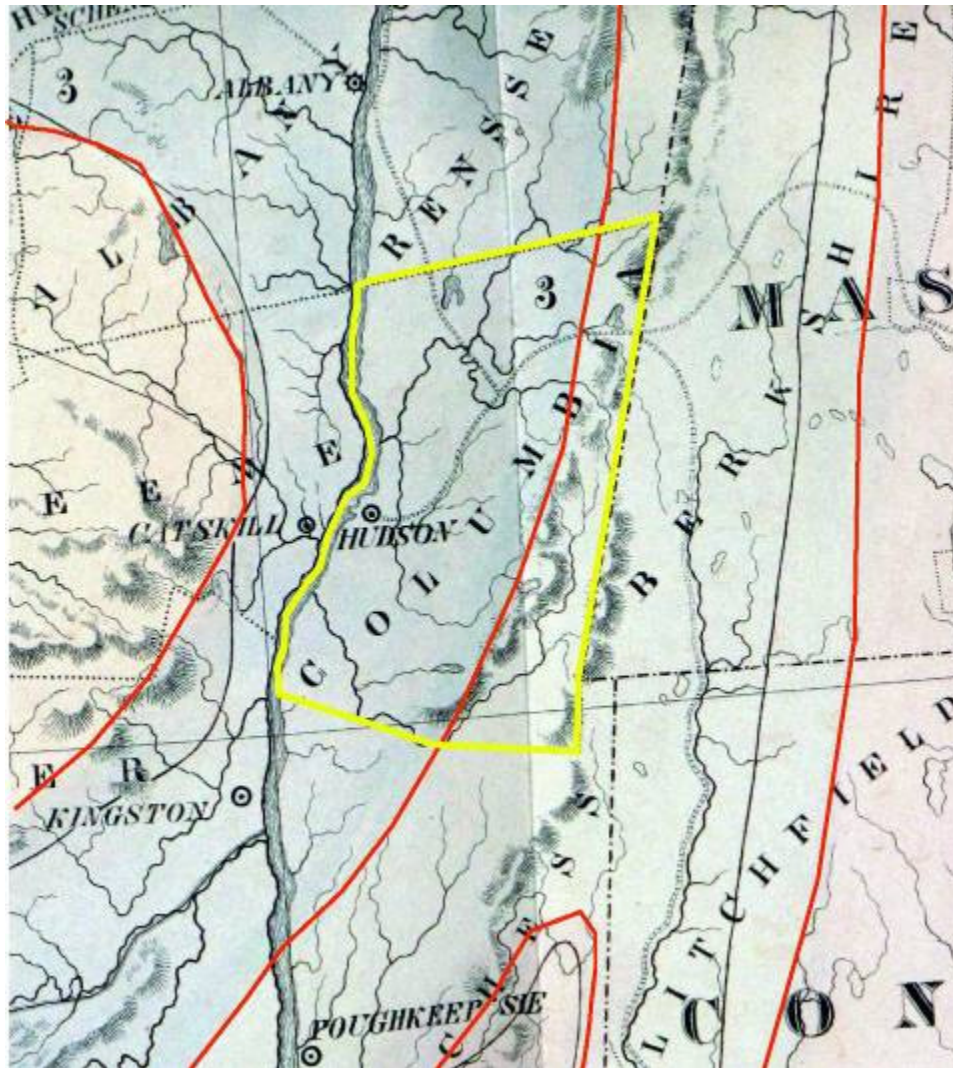


Figure 1. An enlarged and modified version of Emmons' 1843 Agricultural Map of New York. Areas separated by red lines indicate different agricultural regions. Columbia County is highlighted in yellow. Emmons put the eastern side of the County into a distinct agricultural region from the western portion; as the hill shading suggests, this area also has a distinct ecology.

The idea of ecological analogies will be prominent in this paper, and so it bears defining. An ecological analogy in our context refers to human-shaped habitats which, while not the ones that a given organisms co-evolved with, offer enough similarities or analogies to be ecologically functional. For example, wet pastures, while not being beaver meadows, are sufficiently similar to be home for some organism that originally followed beaver; likewise, hay fields are not prairies but yet some fields ‘work’ for certain grassland birds. The value of this approach is that it refines a central question from ‘are we creating/destroying habitat for species X?’ to ‘what was the prehistoric habitat of this species and how have our actions increased or reduced the land’s similarities to that habitat?’ The answers to those questions then become tools for considering how farming and nature conservation might better coincide.

In this paper, we focus on agriculture and natural history in Columbia County NY since about 1820. After providing a description of the ecological, physical and agricultural backdrop, we explore four inter-related aspects of these interactions during the past 200 years:

- 1) **The Starting Point: Establishing Initial Analogies and Breaking the Natural Mold.** Where was Columbia County farming around 1820? What natural habitat did it replace? Which analogies did it create?
- 2) **Evolving Ecological Analogies on Active Farmland.** From the above starting point, farmed land evolved both as new markets and new economic contexts led to new modes of production and as the techniques of agriculture within modes modernized. How did these changes affect the ecological value of farmscape analogies?
- 3) **Abandonment: Wild-Crafted Analogies.** Ecological succession on abandoned farmland led to the creation of new habitats that were neither, strictly speaking, agricultural nor wild. What analogies did these ‘self-expiring’ habitats provide?
- 4) **Where are We Now?** The processes outlined in the first three sections, coupled with events in the non-agricultural component of the landscape, have produced the current farmscape. Which native species does it provide for and how might it evolve?

The first three themes are layers rather than discrete, isolated time periods. While they have chronological components, one should consider the processes as happening to greater or lesser degrees on top of each other. As will be summarized in part four, our current situation is the map resulting from these superimposed layers. Even today, some of the differentiation of agriculture and resulting interactions with nature that are described for the beginning of 19<sup>th</sup> century are still relevant.

Clearly human activities other than agriculture have influenced the ecology of our landscape – early logging for timber, charcoal, tannins, and fuel had direct influence, although it sometimes overlapped with forest clearing for agriculture. However, given that land owned (but not always worked) by farms accounted for more than 95% of the total land in the County during certain periods, these statistics do give us some insight into a substantial portion of the landscape. More recently, trends in landscaping, settlement patterns, road traffic, pollution and other factors have had measurable impacts. For practical reasons, the focus of this paper is on agriculture and we do not discuss these other influences in detail. Agriculture has had a major influence on our land’s ecology; however our focus is not meant to imply that it has been or is uniquely important.

### ***Time Frame and Location.***

Our primary geographic interest is Columbia County. However, in many cases our ecological and agricultural data for the County are insufficient to draw specific conclusions, and so we turn to information collected regionally. As such, our work may be lacking in precision but is, we hope, broadly true for our general area.

Our picture of the Columbia County (and regional) landscape takes on a new level of detail by 1820 and hence we have chosen this date as our starting point. Not only did the census begin to collect much more detailed agricultural information around this time, but in the 1830s and 1840s, New York, Massachusetts, and Vermont all published

natural history descriptions cataloguing their plants and animals. Regional, multi-state zoology and botany works had also become more common by this time – Wilson’s *American Ornithology* (1808/1813), Godman’s *American Mastology* (1828), Holbrook’s *North American Herpetology* (1836/1842) and Audubon’s *Bird’s of America* (1840) were all published during this period. In botany, the work of Amos Eaton (who was born in Columbia County and spent much of his professional life in Rensselaer County) and of his disciple John Torrey began to document the plant world. While the census provides detailed county-specific information of agriculture and not natural history, if we assume that, to a certain degree, there was a common pattern of agricultural production in eastern NY, western MA, and parts of CT and VT, then the regional natural history writings can help us attach ecological information to the agricultural numbers.

The nineteenth century landscape of Columbia County had however already been molded not only by more than 150 years of European colonization of certain regions, but also by centuries of indigenous occupation. Histories of early settlement (Ellis 1878, Spafford 1813) suggest that, at least on the western flatlands and along broader creeks, some European settlement occurred in or near areas previously opened by Native Americans.

Columbia County is located on the East Bank of the Hudson River, southeast of Albany and roughly 120 miles north of New York City. It is bounded to the East by Berkshire County, Massachusetts, to the North by Rensselaer County and to the South by Dutchess County. (Figure 2). Its surface area of approximately 412,000 acres is divided into 19 towns roughly arrayed in three north/south tiers. Confusingly, these towns are named after particular villages that they wholly or at least partially contain. The most important historical works about the County are Ellis (1878) and Stott (2007); these serve as the basis for much of the historical background presented in this paper.



Figure 1. Map of Columbia County, NY indicating current towns.

### ***Ecological Background.***

Since well before the beginning of the time period considered here, Columbia County has been primarily forested. Indeed, pollen records from the region indicate that, after the last glaciation, trees returned to the area roughly 12,000 years ago, and trees typical of our current forest began to appear around 8,000 years ago. Different forest ecologists classify forests in different ways. For example, Howard et al. (2005) describe Columbia County forests as being Central Hardwoods (extreme Southwest), Transition Hardwoods (most of the southwest half of the County) and Northern Hardwoods (throughout most of the northeast half of the County). Others describe the predominant forest as “Beech-Maple” or “Eastern Hardwoods”. Whatever the names, the basic pattern is that of drier-forest trees such as Oaks and Hickories in the lower, southerly and westerly portions of the County, while trees typical of somewhat cooler and moister forests (e.g., Beech and Maple) are more common in the higher, northerly and easterly portions. While White Pine is found throughout the County, it seems most common in the Northeast, and may be joined by Spruce and Hobblebush. Tulip Tree, Hackberry, and Flowering Dogwood are among the woody plants that creep in from the South (e.g., see Figure 2).

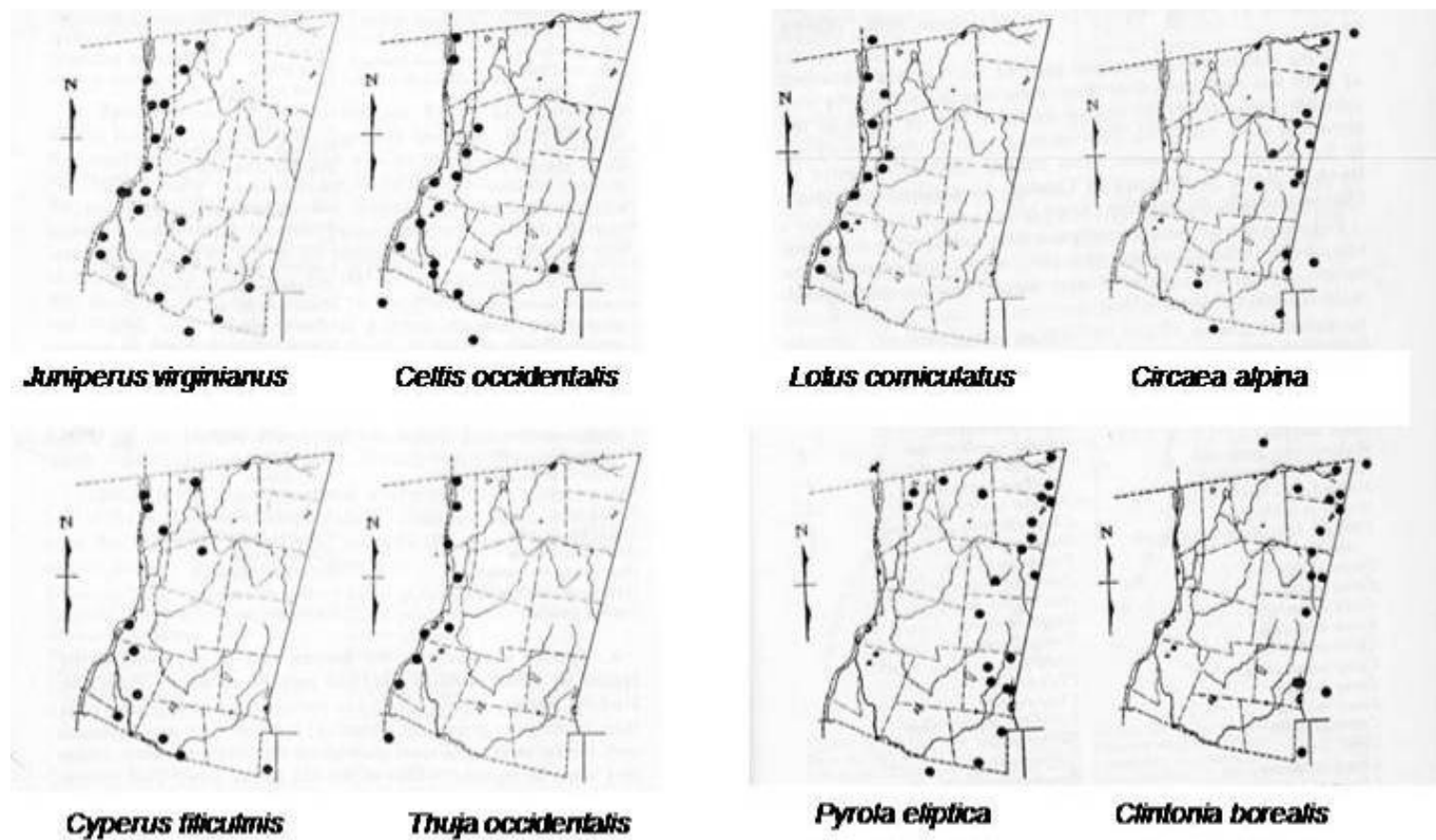


Figure 2. The distribution of certain plants in Columbia County indicating the different botanical affinities of the landscape. Modified from McVaugh 1958.

The lines of faunal separation are sometimes softer because animals tend to be more mobile. However, this juxtaposition of northern and southern elements is repeated with, for example, the northerly Juncos and Canada Warblers breeding in some of the eastern, hillier terrain, while Bog Turtles, Box Turtles, Marbled Salamanders, and Copperheads inch in from the South. Amongst the butterflies, we are at the zone where the more northerly variants of the Red-Spotted Purple (i.e., the White Admiral) and of the Common Wood Nymph overlap with their southerly counterparts. Moose and Fisher extend into the County from the North and East.

Overall, Columbia County lies along what biogeographers describe as a tension zone (e.g., see Cogbill et al. 2002 for map of ‘tension zone’ in Northeast), i.e., a region where two biogeographic zones overlap and elements mix. This backdrop is important to keep in mind as we discuss the influences of agricultural land use on native species: not surprisingly, it was probably the southerly elements, occurring predominantly in the lower, warmer, and flatter

Hudson Valley, which most strongly felt the landscape changes. However, there were more subtleties and those will form the core of this paper.

No doubt the changes that occurred in our landscape over the past 200 years influenced a variety of organisms. However, only some of these were conspicuous enough to attract the attention of contemporary naturalists. Thus our zoological emphasis on vertebrates and a select few, conspicuous insect groups is not meant to imply that these were the only organisms affected, but rather that, given their visibility, they are our best indicators of what happened.

**Demographics**

The beginning of the 19<sup>th</sup> century found Columbia County in the midst of a colonist population boom (Figure 3). The frontier, with its uncertainties arising from poor infrastructure and conflicts with the indigenous peoples, had moved west, and large numbers of Yankees from Massachusetts and Connecticut had been complementing the mainly Dutch and Palatine German populations. In 1800, Columbia County had approximately 30-35,000 people, roughly half of its current population, and roughly 10 times its estimated population merely 50 years before (Columbia County was part of Albany County in 1750; this calculation is based on total Albany County population at that time and the proportion of that total area’s population accounted for by Columbia County at the time of its creation in 1786). By 1870, the population would peak at nearly 48,000. It then dropped to under 40,000 in the early 20<sup>th</sup> century before beginning a rebound as urban workers returned to the farm during the Great Depression (Stott 2007). Population climbed steeply between 1950 and 1990 to reach current levels of roughly 63,000.

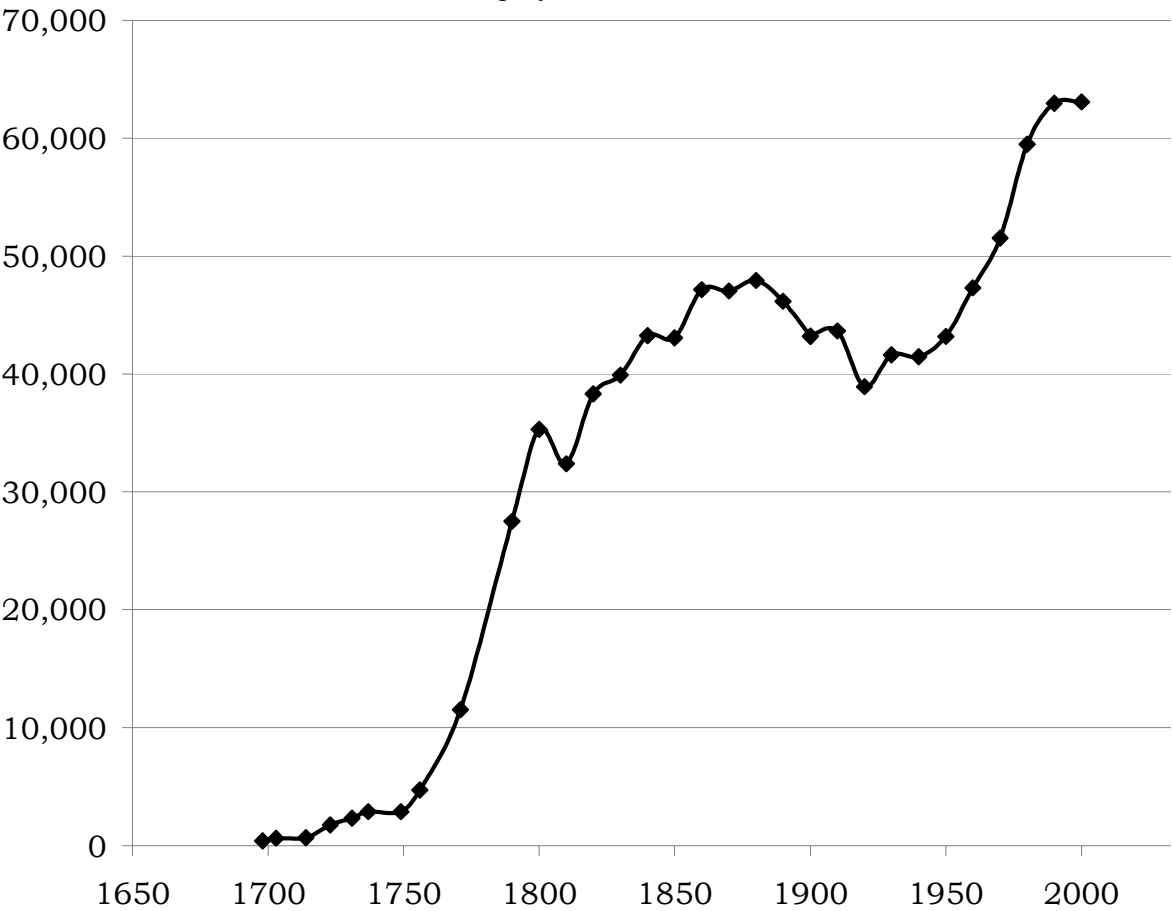


Figure 3. Estimated (most points prior to 1790) and census-based population of Columbia County, NY.

Most settlement prior to 1800 appears to have been in the Hudson Valley portion of the County, extending eastward along valleys and waterways. For example, prompted by the establishment of the Livingston Manor, eastward settlement had spread through the fertile Harlem Valley and up to the then-disputed Massachusetts border by 1800. Settlement, sometimes by ‘squatters’ with no recognized claims to the land, began in the Northeast towns of the County after about 1760 (Ellis 1878), but most towns therein were not officially established until after the revolution.

## Geology

Grossly stated, Columbia County's geological surface is a combination of tumultuous tectonic events that raised mountains, created seas and shoved and folded on a grand scale, and of glaciations that crushed and ploughed the surface, smoothing hills, piling up till, creating and blocking water flows. Given their influence on agriculture and ecology, topography and soils are perhaps the most relevant geological themes for our purposes. They are clearly interrelated.

The County is evenly divided in half, with a western Hudson Valley portion where elevations are generally below 200 meters and the land flat or gently rolling, and the hilly eastern portion where elevations reach 550 meters and much of the land is strongly sloping (Figure 4). Climatology reflects this division with the eastern part tending to be cooler and wetter than the western portion. We have already alluded to some of the consequences of this climate for the distribution of plants and animals; furthermore, slopes, ravines, marshes, vernal pools are all habitats that tend to be more common in certain landscapes and harbor their own sets of organisms. Agriculturally, the growing season varies by more than two weeks between different sections of the County.

Soils in part reflect this topography. The sloping lands tend to have thinner soils because of glacial scouring and of natural and human-accelerated soil erosion and movement. Glacial activity accounts in large part for the variation in soil texture across the landscape with sandy soils especially common on the former banks of Glacial Lake Albany which flooded much of the Hudson Valley. Another major factor influencing soils has been the distribution of limestone bed rock. The presence of limestone increases soil pH (e.g., from an acidic pH of 5.5-6.5 to a "circum-neutral" pH of 6.5-7.5). Within this range, higher pHs tend to make soil nutrients more accessible for plants, influencing both natural and agricultural botany. Limestone is derived from the ancient sea bottoms; it is found primarily along the eastern side of the County (Figure 5), mixed with non-limestone bearing rock in the Taconic Formation. Even where it is not indicated in the bedrock map, smaller bits and pieces of limestone tend to be mixed into the landscape (USDA 1989; Fisher 2006).

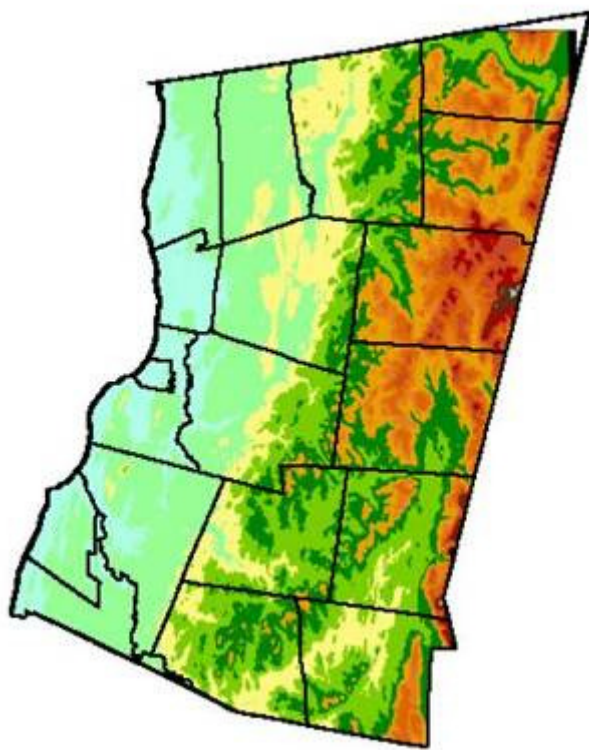


Figure 4. A map showing the topography of Columbia County. Bluish areas on the western edge of the County, along the Hudson, are as low as 10m above sea level. The 'high peaks' along the eastern edge exceed 600m.

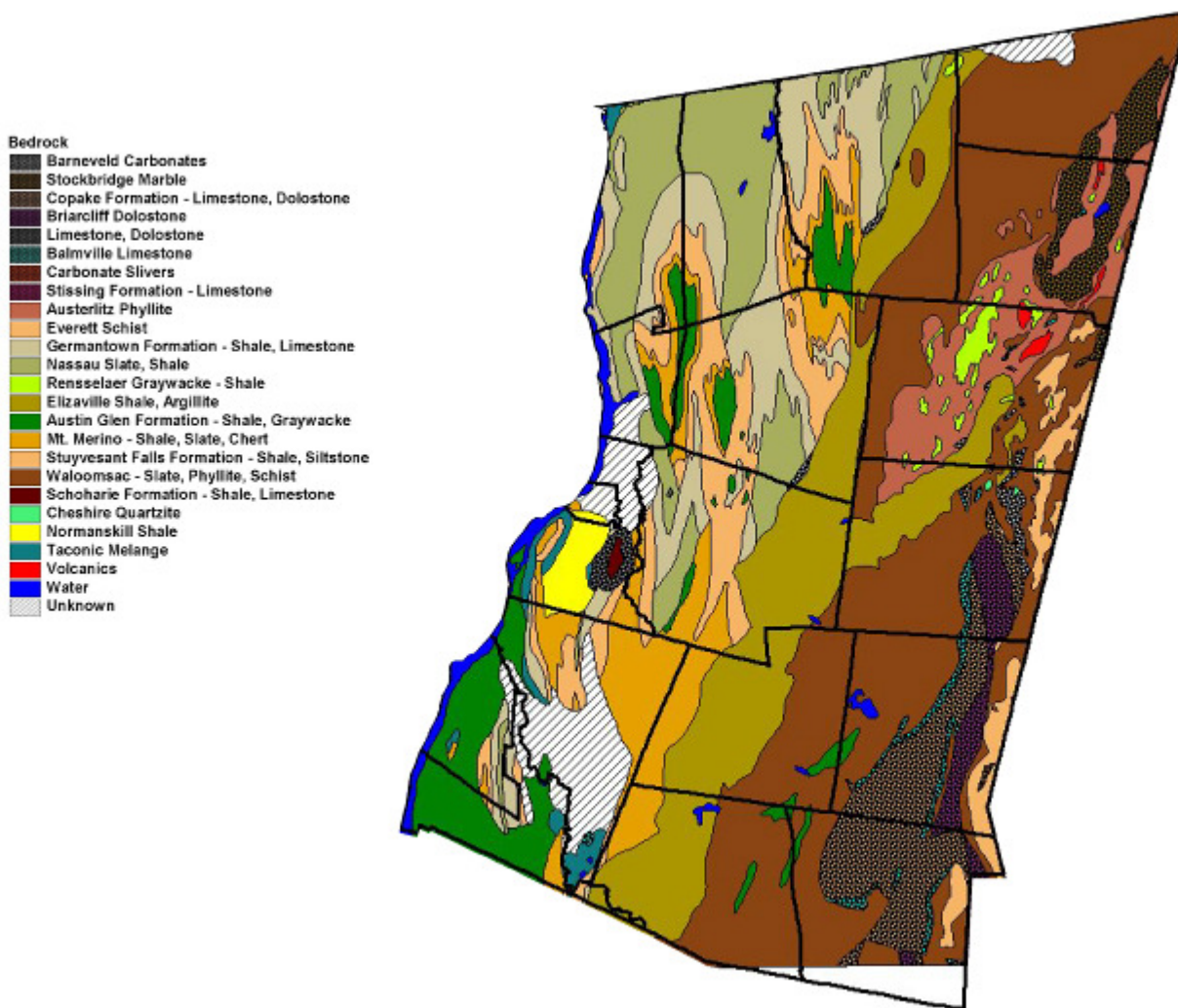


Figure 5. A bedrock geology map of the County. The first eight bedrock types are calcareous. Created from a USGS-created GIS layer of New York State bedrock geology.

### ***Agricultural Evolution.***

This paper will emphasize different themes in the interaction of the ecological and agricultural landscape. As background, we provide a brief overview of Columbia County's agricultural history. The chronology of agriculture and related activity shown in Figure 6 is certainly arguable in detail but provides a rough depiction of the various agronomic activities. Because of the focus of this paper, we have not included indigenous agriculture in this review.

The Dutch who were the first to settle much of the County were initially drawn by the fur trade rather than the prospects of agricultural land. Early farms apparently followed the European model of the time, being diversified farms that focused on providing family needs, although between-farm and even international trade supplemented this production. Already in 1680, Columbia County farmers were sending wheat gathered at least four miles inland down river (Danckaerts 1680/1959) and in 1813 Spafford reports "the state of agriculture in this county ... now supplies a vast amount of surplus products, principally grain, beef, pork and livestock well adapted for the West-India market." Grains (rye, wheat, Indian corn, oats, barley) were joined with small-scale vegetable and livestock production. Later in the colonial period and early in the post revolutionary era, some specialization in wheat production may have occurred, with production sold down river. Ample wool production was apparently occurring by late in the 18<sup>th</sup> century. Early maps (e.g. Figure 7) show the linkage of interior lands to the river causeway (Ellis 1878, Bruegel 2002, Stott 2007). The colonial Dutch and English brought somewhat different farming styles with them to the County (Figure 8), and some of these differences are still visible today (Figure 9).

# A ROUGH CHRONOLOGY OF COLUMBIA COUNTY AGRICULTURAL HISTORY SINCE THE 17TH CENTURY

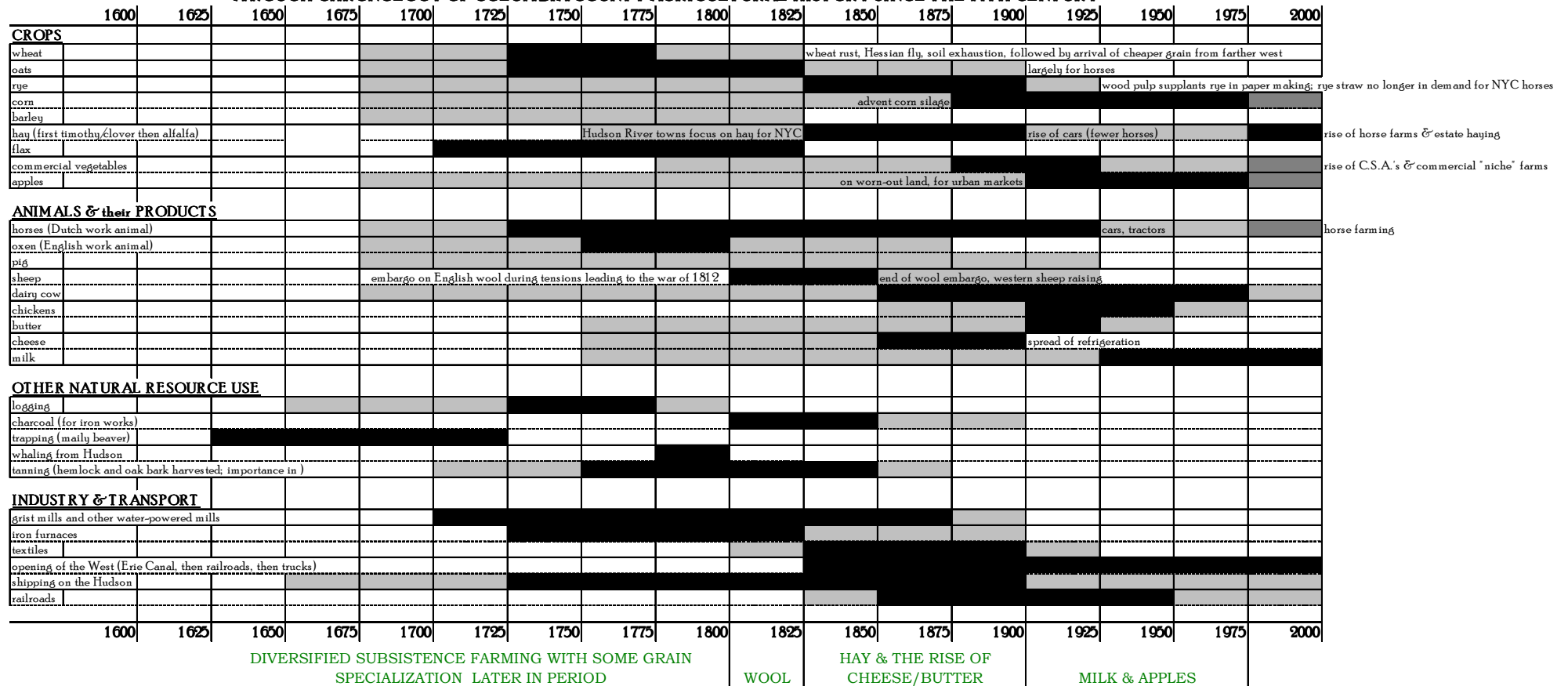


Figure 6. An approximate chronology of agriculture in Columbia County.



Figure 7. Columbia County from DeWitt's 1802 map of New York. The network of roads that 'drained' the agricultural produce of the County westward to the ports along the Hudson is evident.

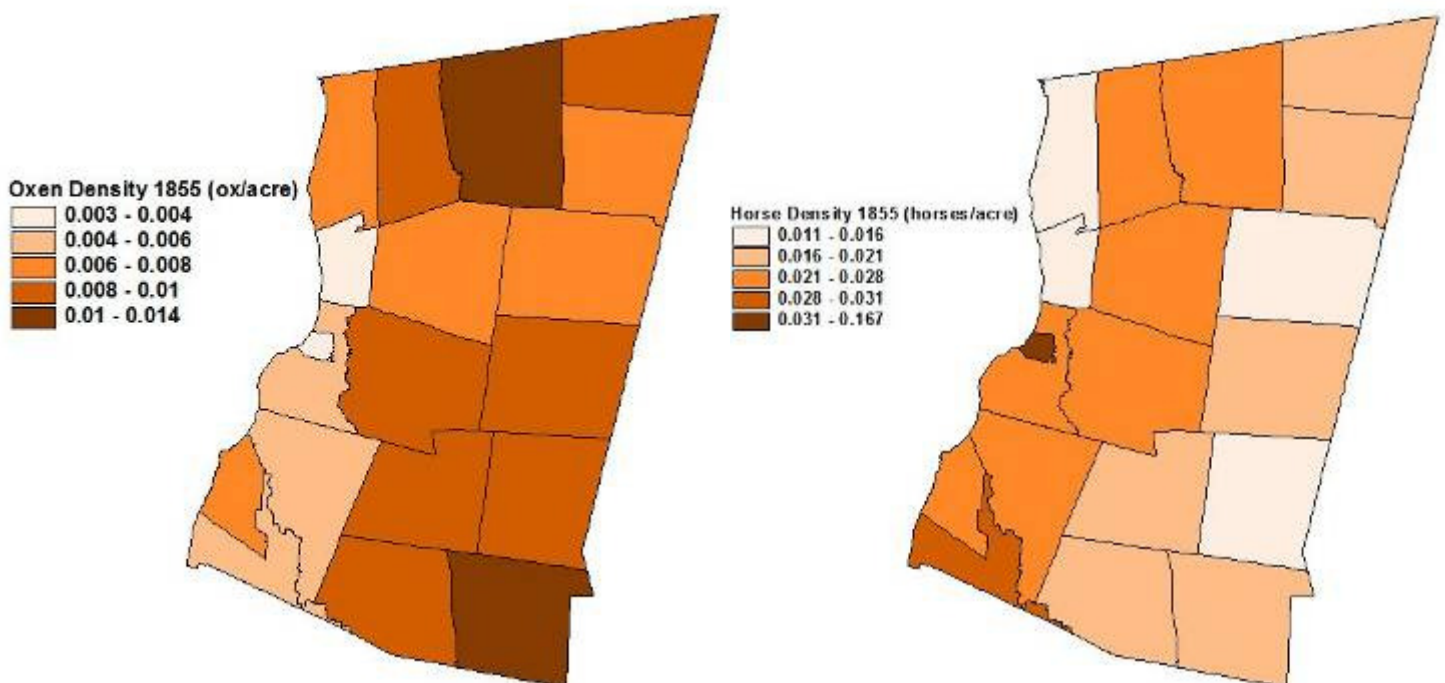


Figure 8. The relative densities of horses and working oxen in 1855. The Dutch (in the eastern and central portion of the County favored horses, while the Yankees (more easterly) favored oxen; obviously, the pattern wasn't hard and fast, but it does seem to be reflective of culture and, perhaps to some extent, topography.

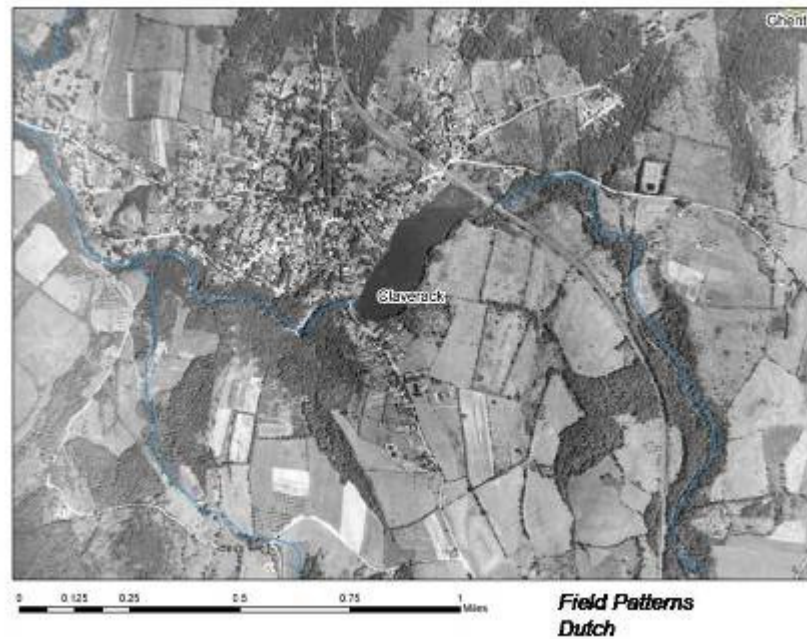
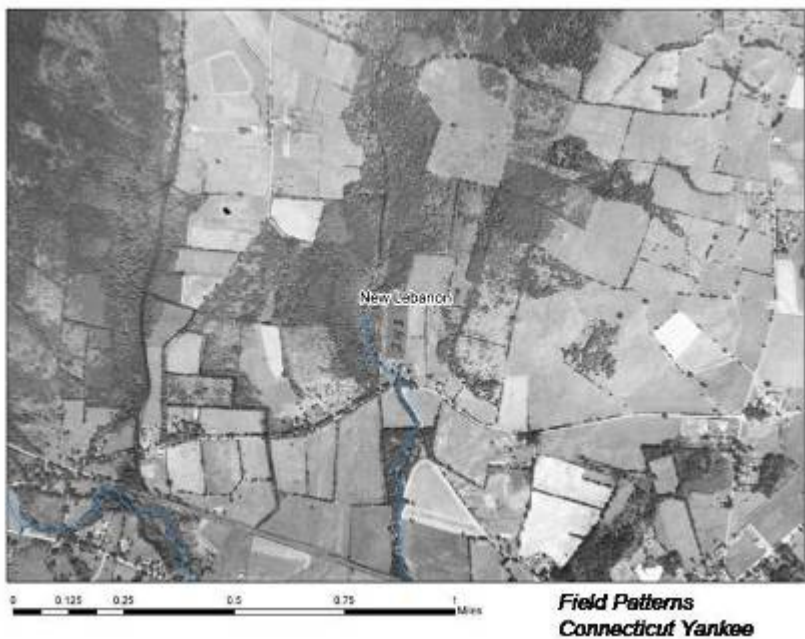
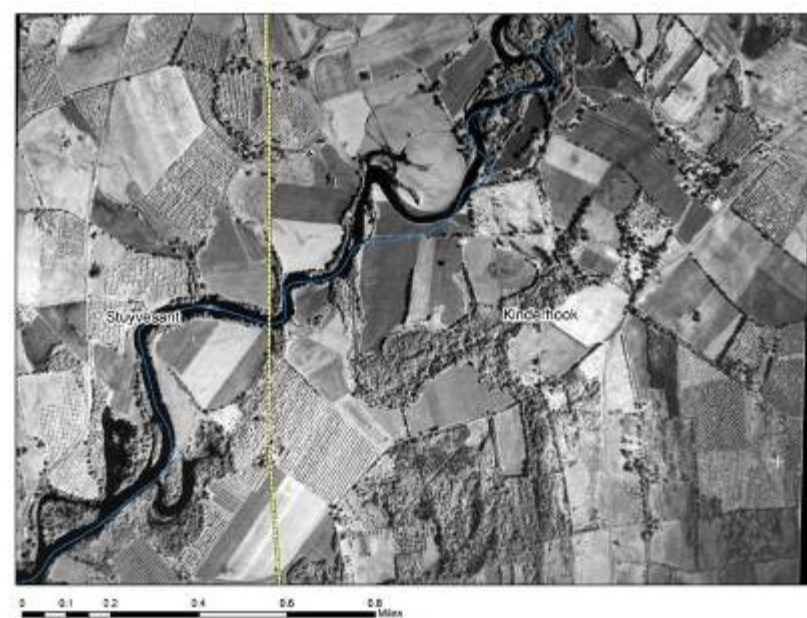


Figure 9. Yankee (left) and Dutch (right) field layout patterns visible in aerial photographs of the County from the 1940s.

Soil exhaustion together with the possibly resultant rise of wheat diseases and pests (e.g., wheat rust and Hessian Fly) began to reduce the importance of commercial grain production by the end of the 18<sup>th</sup> century. The “market transition” beginning early in the 1800s marked the breaking away of farms from a predominantly subsistence model and the growth of specialization (Breugel 2003, Parkerson 1995, Wermuth 2001). Hay – a crop that was both in demand for New York City’s growing horse power and suitable for worn-out soils – began to dominate in the towns along the Hudson, its production farther inland was hampered by the difficulties of transport. Certain grains continued to be important in the central, ‘flatland’ towns. Rye, primarily for paper and rye straw (although some was ground for flour), and feed oats benefited from local industrialization (paper mills in Stockport, Chatham, Kinderhook and other sites) and the needs of urban equines (Stott 2007). Columbia County was, essentially, part of an early ‘oil field’ that fed the growing energy demands of urban transport.

The opening up of markets to agricultural production from farther west in New York and in the Union was heralded by the completion of the Erie Canal in 1826 and by the rapid spread of railroads. For compact, relatively non-perishable goods well-suited to the rich soils, western farms quickly out-competed what Columbia County’s ‘boney lands’ could produce. By 1833, substantial amounts of flour, wheat, barley, and “coarse grain” were brought east on the canal (Hedrick 1933), probably dooming much Columbia County grain production. However, no such western advantage existed for hay, and semi-perishable goods such as butter, cheese, and fruits were still best shipped from nearer to the city markets. The second quarter of the 19<sup>th</sup> century witnessed the sheep boom. In 1835 there were an estimated four sheep for every person living in the County. The sheep boom, which was experienced throughout much of New England, came about for a variety of reasons (e.g., discussion of Russell 1976 and Bruegel 2002). In the tensions around the war of 1812 with England, the British placed an embargo on the United States, prompting local textile industries to begin. Following that war, the US placed tariffs on British wool which lasted until 1846. At the same time, new sheep breeds such as the Merinos were introduced into the County and the Northeast. Robert Livingston, head of the Livingston Manor which occupied the southern third of the County, was instrumental in promoting the new breeds. The boom dissipated as quickly as it had begun as tariffs were lifted and western sheep farming established itself.

The period after the sheep boom and through the Civil War was probably the peak of agriculture in the County. The economic collapse of 1837 brought relative affluence and reaffirmation to farmers – the prices of agricultural products did not drop to the same degree as those of other items and of land. This resulted in both greater buying power for the farmer and a re-emphasis on land as a source of production rather than a unit of speculation. Access to markets was expanding. Much of the Greek Revival architecture found around the County was constructed during this period. Fed by and feeding this agricultural activity was the emphasis on ‘scientific agriculture’. The works of Leibig in Germany, its promulgation by people such as Jesse Buel (Albany-based editor of *The Cultivator*), and the advent of Agricultural Societies and Fairs throughout the state all gave renewed dynamism to New York agriculture. The hay, cheese and butter that had begun to take importance prior to the sheep craze grew into the centerpiece of Columbia County farming, complemented by oat, corn and rye production. Markets for the last grain were boosted by the mid-century advent of rye-straw paper manufacturing and the resulting spread of paper mills in the County (Stott 2007). The Civil War produced little obvious change in agricultural production, although the drain of young men and subsequent urban resettling no doubt influenced farm life. Reduced availability of labor probably encouraged the mechanization that had begun before the War. To give a rough picture of the agricultural landscape at this time, in 1875 a bit more than 1/4<sup>th</sup> of the improved farmland was pastured and nearly 1/3<sup>rd</sup> was hayed; rye was grown on about 15% of the land, oats and corn on 5-10%, and orchards grew on perhaps 5%. (Some land was probably hayed *and* pastured, other land may have produced more than one crop, so these numbers are not strictly additive.)

A series of economic changes resulted in major shifts in agriculture during the end of the 19<sup>th</sup> and beginning of the 20<sup>th</sup> century. Rye paper was replaced by pulpwood paper. The conversion of horse power to gas power meant that the demand for hay, rye straw and oats decreased in the early 1900s, although some rye was still being milled to flour (van Wagner, n.d.). In response to these and other changes, apple production began to increase substantially, with total harvest nearly tripling by 1945. Apple production was apparently promoted as a profitable mode of farming on former rye and potato land (Rogers McVaugh pers. communication; van Wagner, n.d.); the modern distribution of

orchards in the County more closely parallels 1875 land in rye than it does 1875 land in orchards. Facilitated by refrigerated and relatively rapid train service, liquid milk production and transport began to replace the more modest production of butter and cheese but continued to feed the New York markets. Milk bottling began in the County prior to the end of the 1800s. Whereas fruit production rose in the more westerly towns, dairying became the dominant farming in the eastern hill and valley towns, many of which were already the primary locations of livestock raising. Importation of grains from the West helped make high-production dairy farming practical on Columbia County's limited soils (by middle of the 20<sup>th</sup> century, up to 30% of energy supplied to NY dairy cows was coming from purchased grains, Fowler 1952). Orchard and dairy production was the mainstay of the County's agriculture for much of the 20<sup>th</sup> century.

During the last decade or so of the 1900s, the conventional dairy and orchard farms began to dwindle. The introduction of bulk tanks and milk house sanitary regulations in the late 1940s/early 1950s pushed small farmers who were unable to make the required investment out of business (Stott 2007); a drop in dairy farm numbers and a consolidation of farms occurred during that period (Figure 10). While dairy farms still make up the majority of the sales and acres in 2007 (2007 US Ag Census), the most dynamic agricultural sector appears to be the so-called niche farms which supply, for example, vegetables to farmers' markets and Community Supported Agriculture (C.S.A.) initiatives. By 2007, vegetable farms, fruit farms, and dairy farms were all roughly equal in number in the County, whereas in 1992 fruit farms had been 4.5 times more common than vegetable farms and dairy farms had been 6 times more common. The change in these ratios occurred due to both an increase in the number of vegetable farms (from 17 in 1992 to 42 in 1997) and a decrease in fruit (from 79 to 46) and dairy (from 102 to 44) farms over the same period. Former dairy farms were often being purchased whole or in subdivision as residential properties, a trend reflected in the reported increase in "wild hay" harvest from 778 acres in 1987 to over 5000 acres in 1997. Much of this hay acreage probably does not belong to the farmer actually cutting the hay. This overall trend towards concentrated production and away from extensive animal operations is reflected in the steep drop in mean farm size – after having been above 200 acres since 1969, it dropped to 192 acres in 2007 (Figure 6).

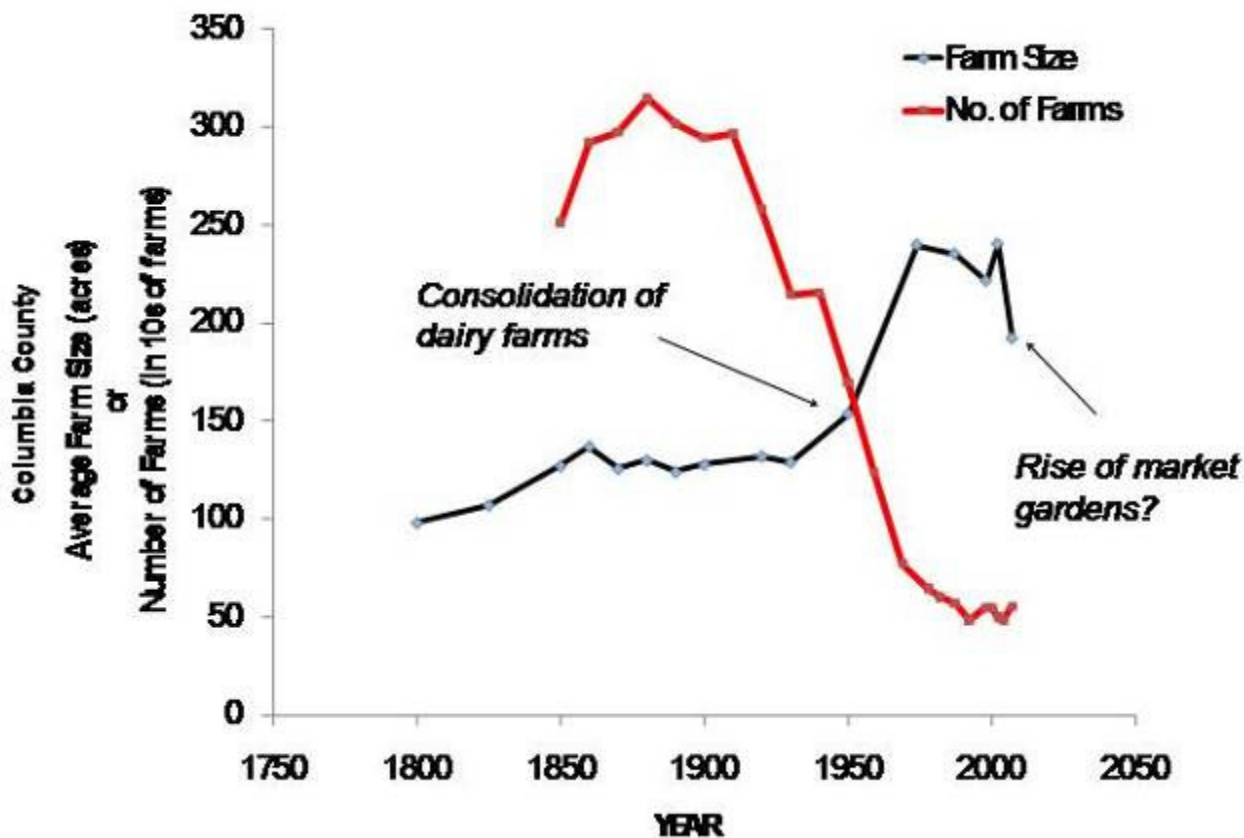


Figure 10. Average Columbia County farm size and number of farms (from state and federal censuses).

# The Starting Point: Establishing Initial Analogies and Breaking the Natural Mold

In 1820, the landscape probably reflected a diversified farm designed to answer family needs, providing surplus for market if possible but without sacrificing the provision of basic requirements. Whereas today, farming is such a reduced activity that farmers tend to pick and choose their land; in the nineteenth century most land was occupied by farms and most families were farming families. Even if farmers were not located on prime soil, they had to make do and so farmers adapted their production techniques to the terrain. Using the detailed census data from 1855 as a point of reference (supplemented by the sparser earlier data), we can basically divide the county into three forms of farming – hay growing in the southwest portion of the county associated with a relative concentration of meadows and hay production (Figure 11); grain production in the north central portion of the county associated with relatively high amounts of ploughed land and grain (mainly oats, rye and corn) harvest (Figure 12); and extensive sheepherding in the eastern hills associated with high concentrations of pasture and sheep (Figure 13). Dairy production as a commercial enterprise was probably still nascent, and what existed was generally in the western portion of the County (Figure 14; see also the east/west distinction emphasized on the title page image). Judging by partial statistics and anecdotal evidence, some these major patterns appeared to have existed earlier, although sheep did find an early hub of activity around Clermont (Robert Livingston was an important promoter of sheep), and early cattle (which included not only milk cows but oxen and beeves) appeared to be concentrated in the Northeast. In 1855, apple orchards appeared to be scattered across the landscape, and probably reflected more of backyard crop for home consumption than a market crop.

Summing up these various activities, “improved acreage” (the census term for opened and managed farmland) seemed to be concentrated in the Valleys of New Lebanon and Hillsdale (at the head of the Harlem Valley) plus old lands of Claverack, Livingston and Clermont. The townships of the northern part of the County were all 50% or more in improved acreage. The southeast corner of the County was noticeably less settled (Figure 15).

As we consider the relation of the farmscape to natural ecology around 1820, we will repeatedly ask two questions: first, where did a given type of agriculture occur and hence which natural habitats was it probably replacing or greatly modifying? And, second, what ecological analogies did the new agricultural habitats create and which organisms were able to take advantage of those analogies? While the natural habitats being influenced by farming, and the new habitats created by farming would evolve over the two centuries that followed, by 1820 60% of the County was already in ‘improved acreage’ since then that percentage has never exceeded 75%. Thus, understanding the starting point helps explain much of what followed on the land and what remains today.

The most commonly designated agricultural cover types were cropland, pasture, and hay meadow. Below, we discuss each of these initial cover-types in turn.

## *Early Croplands*

While families did have vegetable gardens where they produced the likes of cabbage, turnip, and other foods, the most extensive plantings were field crops, often grains, although potatoes sometimes reached large extents. Early farmers in the County also planted flax for homespun linens. Cropland was always ploughed, and the niceties of this cover-type would be determined by the type of crop and the growing technique.

Grains (i.e., wheat, rye, oats, barley, and buckwheat) were probably the most desirable crops both in terms of their central importance, directly or indirectly via livestock, to the home and their marketability. However, grains demanded the best soils. A modern map of “Prime agricultural soils” (Figure 16; admittedly probably differing somewhat from how a nineteenth century farmer might grade the soils), indicates the clustering of good farm soils in a band roughly 2 to 8 miles east of the Hudson and in the Harlem and Lebanon Valleys. These are relatively flat,

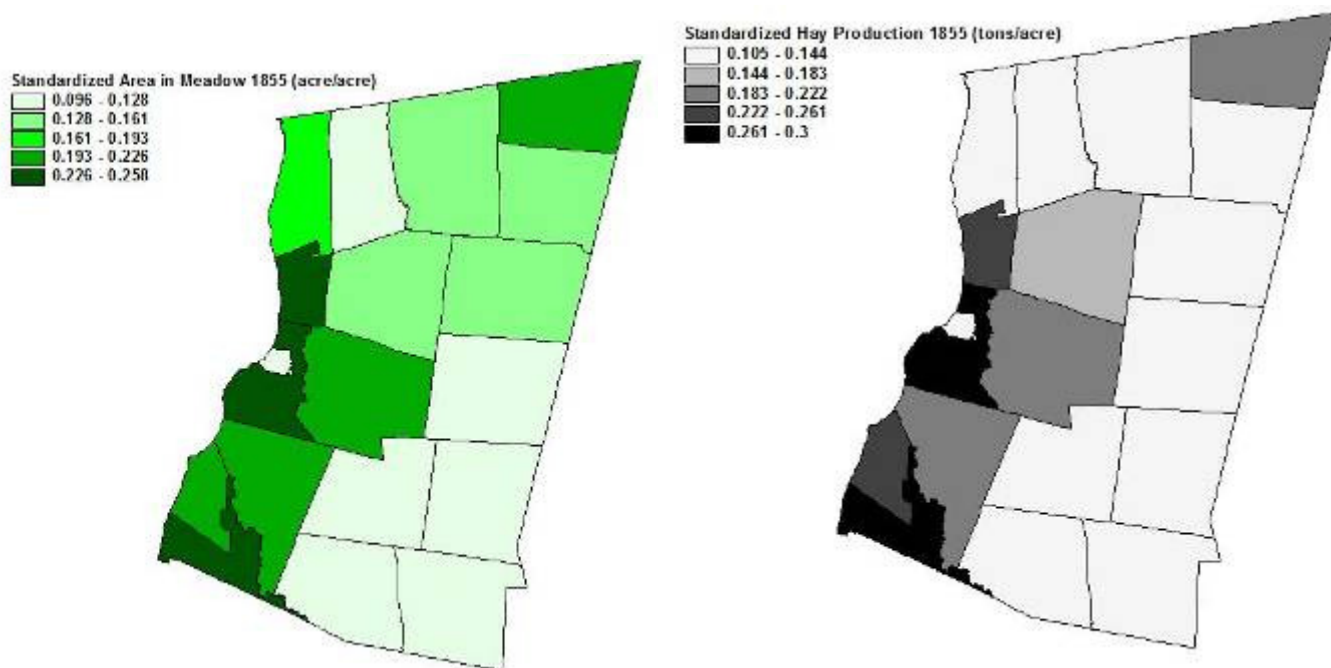


Figure 11. 1855 land in hay meadow (left) and hay production (right). Hay production was concentrated along the Hudson, with an outpost in New Lebanon perhaps associated with the Shakers.

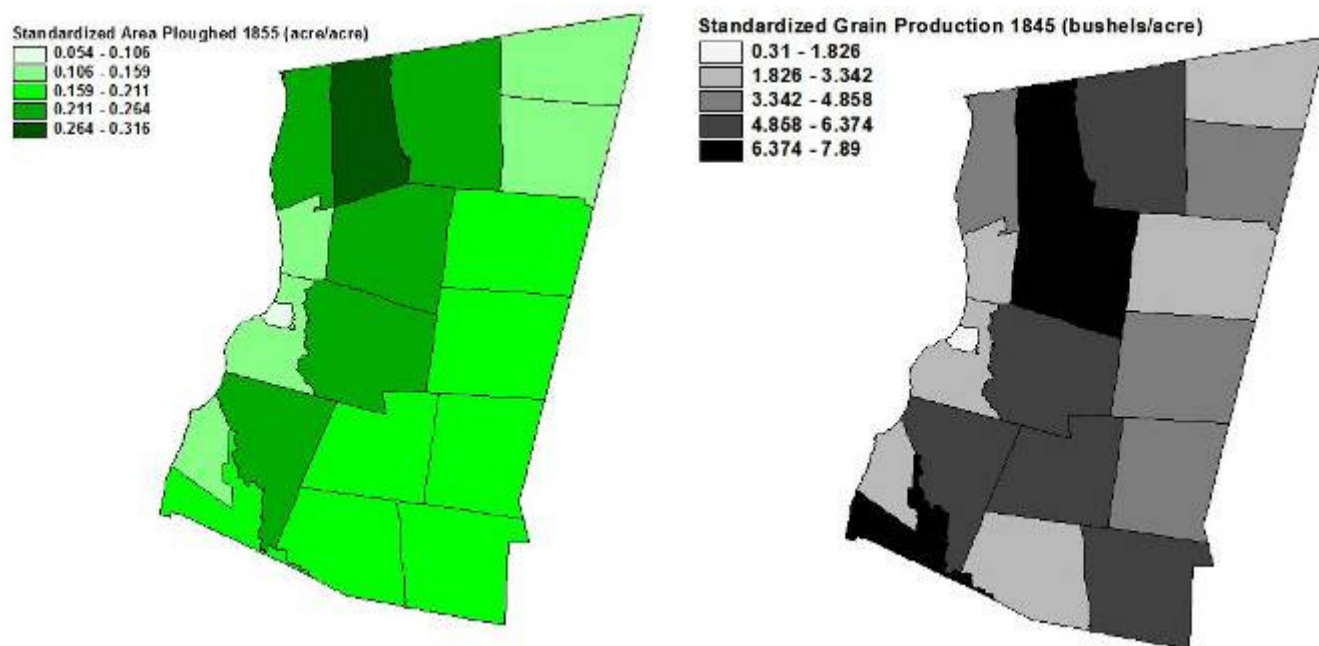


Figure 12. Area of ploughed land in 1855 (left); ploughed land was used largely, although not entirely for grain production (potato production, for example, was also quite high in Clermont. The 1845 distribution of grain (corn, wheat, oats and rye) production is also shown (right).

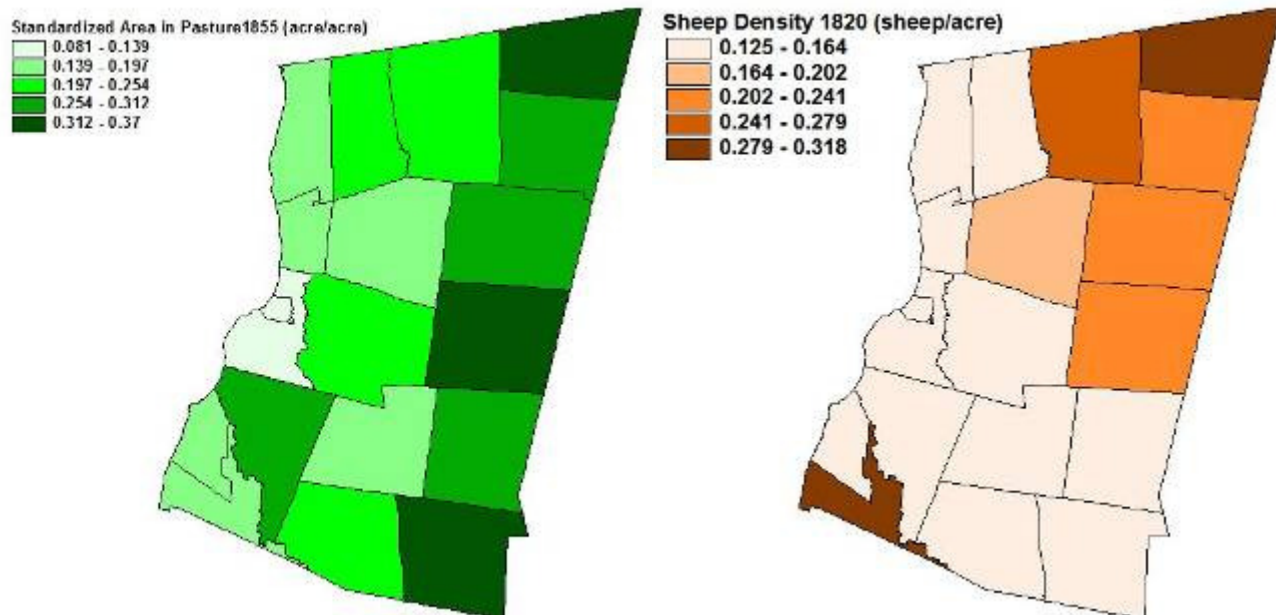


Figure 13. 1855 land in pasture (left) and 1820 sheep density (right). Because we are trying to depict the ‘starting point’, we illustrate the 1820s data when available; pasture area was not measured in 1820. The 1855 distribution of sheep (not shown) was largely similar to that in 1820, although Clermont was relatively less important and, in parallel with the pastures, substantial sheep densities extended along the entire eastern side of the County.

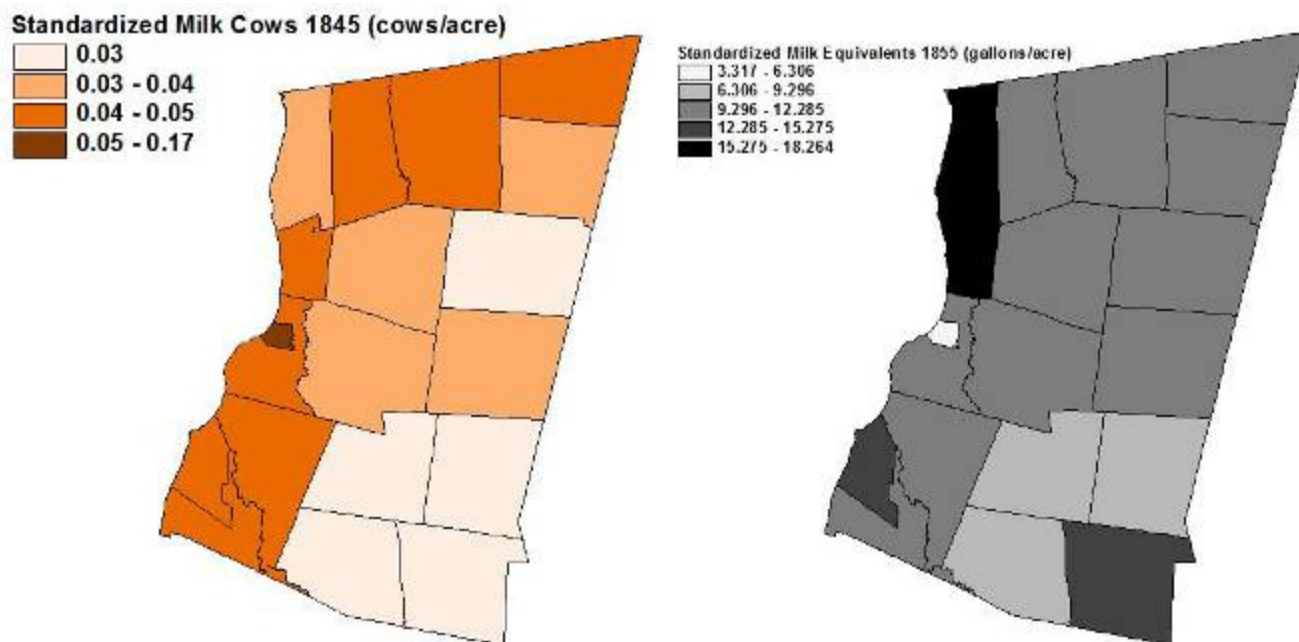


Figure 14. Milk cows in 1845 (left) and dairy production (with butter and cheese expressed as milk equivalents; on the right) in 1855. Again, we use the 1845 data for cows to illustrate the earliest data available, no dairy production data were available for that year. The 1855 distribution of milk cows (not shown) is largely similar although the relative densities in the northwest and southwest are higher. Interestingly, the southeast corner of the County doesn’t show high milk cow densities until the census of 1875.

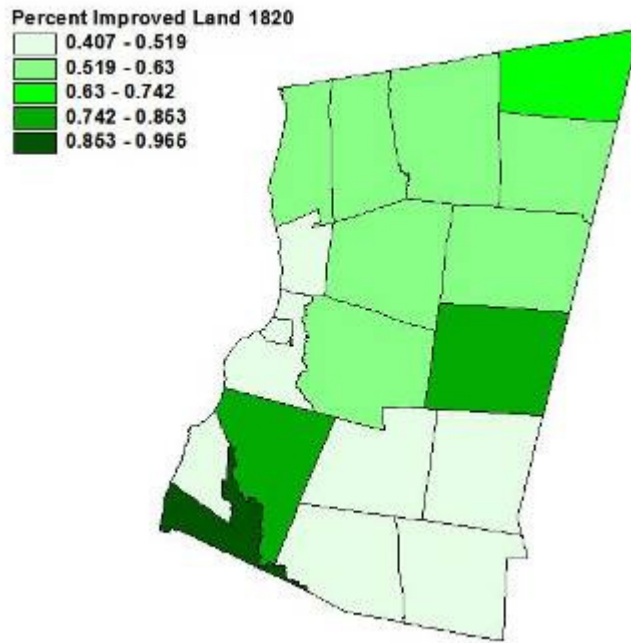


Figure 15. Percent improved acreage 1820 (these are modern county outlines; outlines were somewhat different in 1820 and statistics were re-estimated for modern counties)

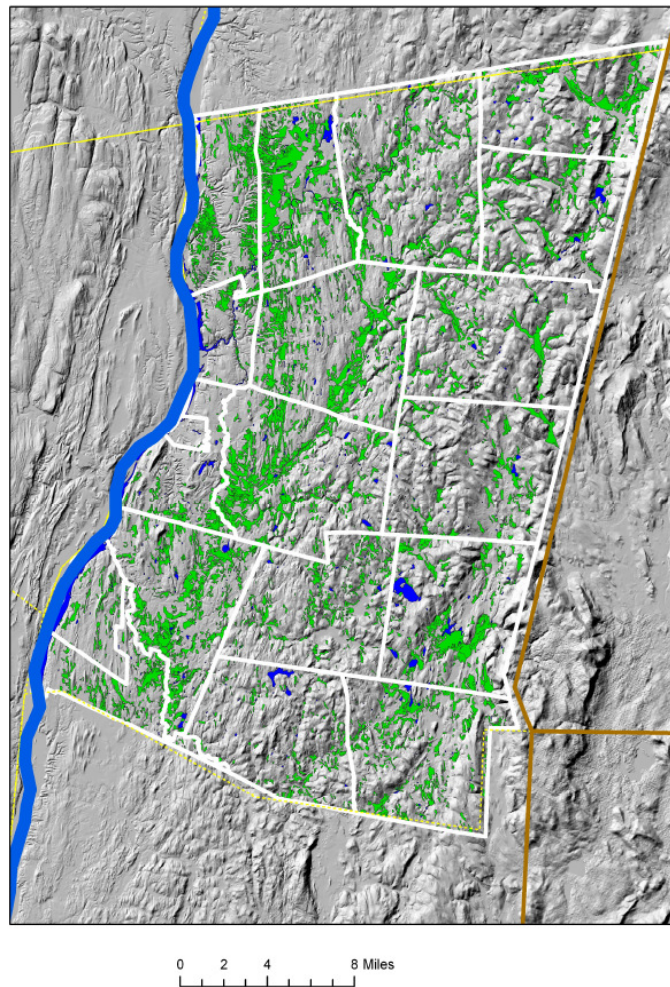


Figure 16. A map indicating the distribution of USDA-designated "prime agricultural" soils in the County. Shading indicates relief, most such soils are located in the valleys.



Figure 17. An 1881 “bird’s eye view” of Valatie in the town of Kinderhook. The Hudson appears to flow along the upper right hand corner of the image. Much cultivation occurred on these relatively flat lands.

well-draining soils. Ploughed land dominated the landscape of the north-central townships being almost 1/3 the landscape of Kinderhook and 1/10 – 1/20 the land of Canaan and New Lebanon. A “bird’s eye view” map of Valatie in the town of Kinderhook gives one an impression of this landscape (Figure 17).

Unlike in the Taconic Hills, where large blocks of forest now exist and hint at what may have been there prior to extensive clearing, much of the best flatland soils are still being farmed and so guessing at their former ecologies is more difficult. Our reconstructions of early forests in the County suggest that Oak (largely White Oak) and Hickory dominated on much these soils (Figure 18). White Oak now appears to be much less common in the County than previously (Figure 19). At least part of this decline can be ascribed to widespread removal of the White Oak-dominated forests on rich farmlands (Figure 20). We have no direct report about the native herbaceous plants that grew in these forests before they were cleared. However, Lucy Braun (2001, p. 253) suggests that the Hudson Valley white-oak forests were similar to forest communities of valley floors in the Harrisburg Peneplain. Her list of plants found in the herb layer of a white-oak forest remnant in Pennsylvania is our best approximation of the native plants that might have been common in our white-oak forests: Wild Geranium, Perfoliated Bellwort, False Solomon’s Seal, Hog Peanut, Blue-stem Goldenrod, Asters, and Tick-trefoil. While these are species that do not thrive well in dry, acidic soils typical of our present-day second-growth oak-hickory forests, they are all still found in pockets of richer forest soil in Columbia County, but their numbers are now probably significantly lower than during pre-colonial times. From our own observations, several species of violets tend to co-occur with above species, and might have been more common in pre-colonial times. Violets are larval food for Fritillary butterflies which may have benefited from their abundance if there were ample nectaring plants available.

Pine forests apparently occurred in the County. Both White Pine and Pitch Pine may have accounted for some of these reports. Mather (1842) describes White Pine forests with “some oak” on the clayey soils along the Hudson. McVaugh (1958) describes a 1933 forest on clayey soils in Stuyvesant where the dominant trees were Hemlock, White Pine and White Oak; some of these trees dated back to the early 1700s. No doubt the composition of this forest type overlapped with the White Oak-dominated forests mentioned above. Inland, at least in the neighborhood

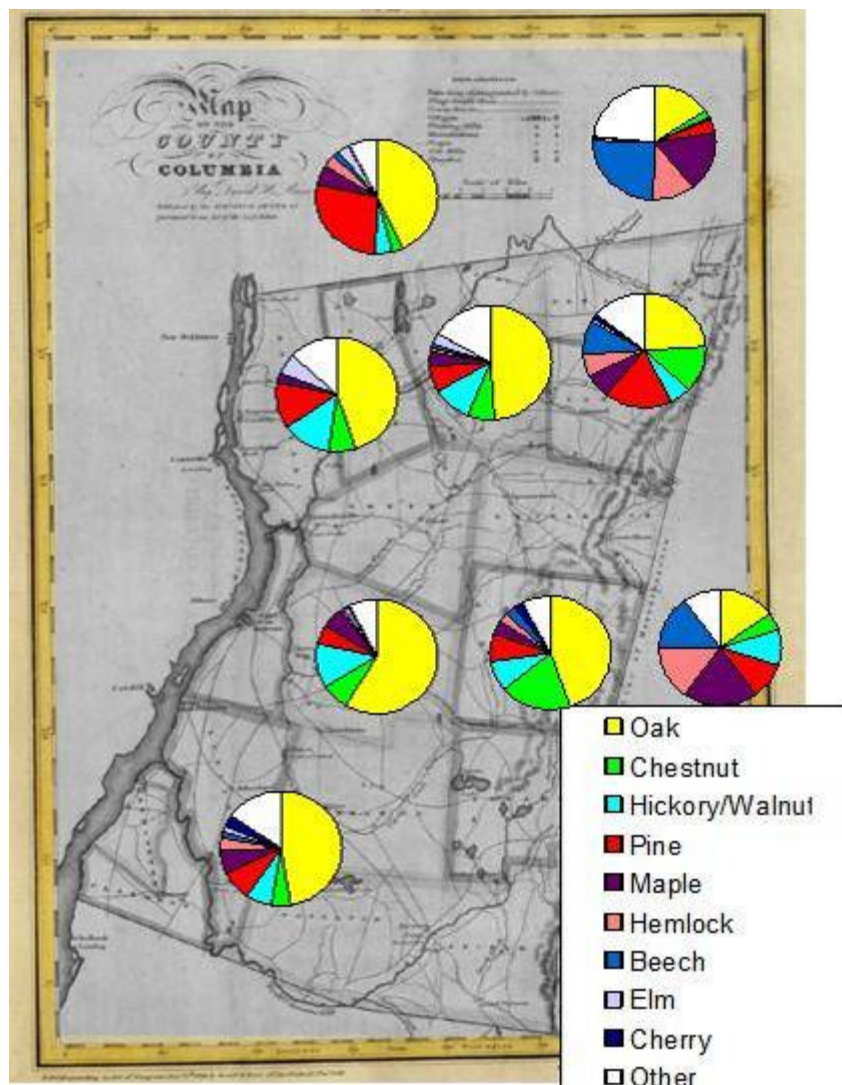


Figure 18. The early (late 18<sup>th</sup> – very early 19<sup>th</sup> century) distribution of trees in Columbia County based upon deed records. Records from outside of Columbia County are from Cogbill et al. 2002.

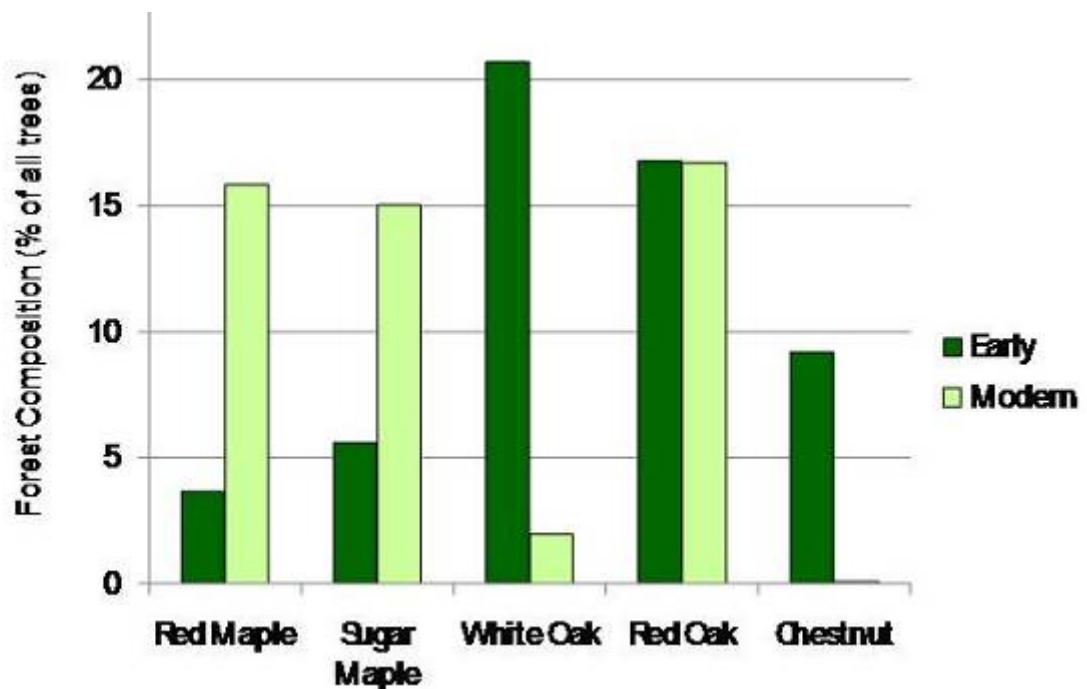


Figure 19. The contrast between historical (based on deed records) and current forests (based on US Forest Service FIA data and our own data).

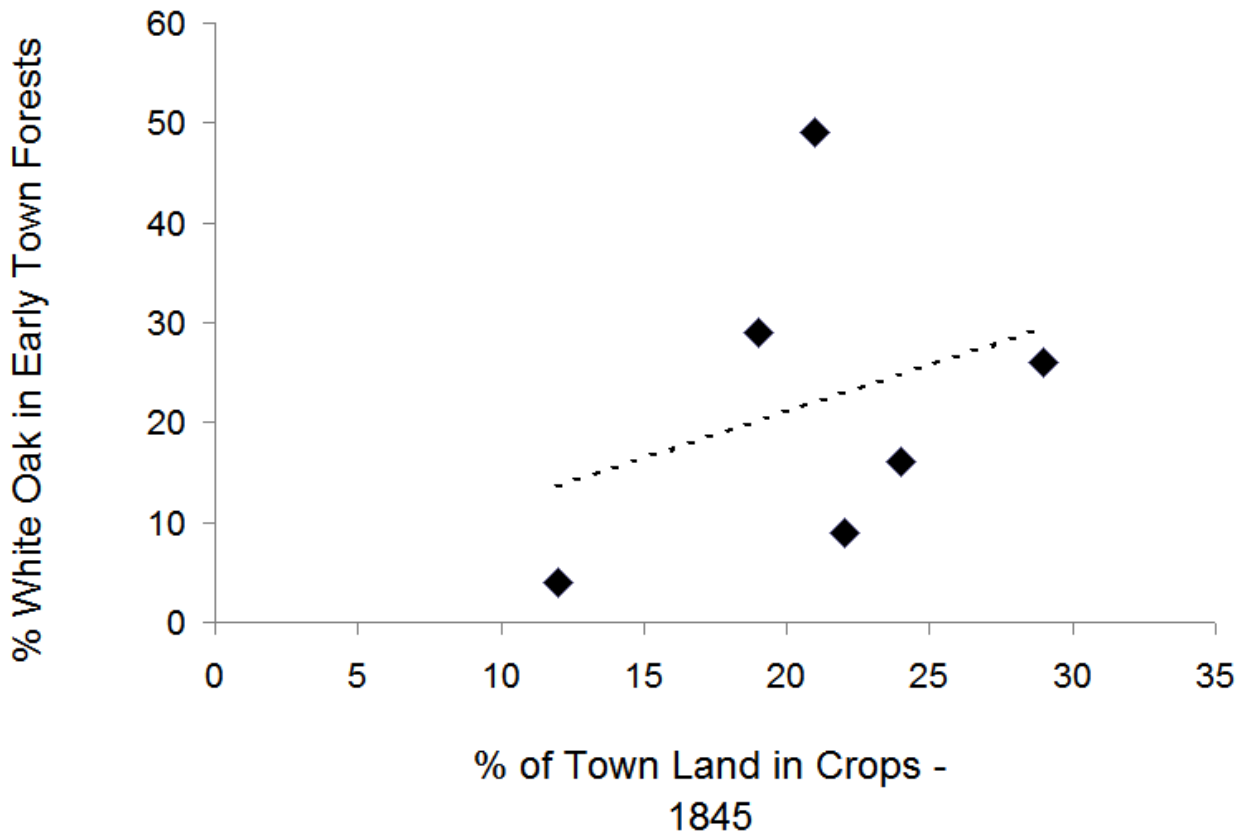


Figure 20. The proportion of land in crops vs. the % of White Oak as markers in early (mainly late 1700s) deeds. Census data from the 1845 towns have been consolidated to reflect the fewer, more encompassing towns that existed in the County in the late 18<sup>th</sup> century. Notice that White Oak apparently occurred on soils favored by early farmers.

of Kinderhook, sandier soils apparently grew Pitch Pine as did some soils in the southwest corner of the County. Wadsworth (1694) and Spafford (1813) speak of pine plains in the neighborhood of Kinderhook. Review of historical forest data derived from deeds, consideration of adjacent Rensselaer County forests, and McVaugh's (1958) comment that Pitch Pine was "very abundant on sandy soil near Kinderhook" suggest that the sandier soils in the northern half of Kinderhook were often occupied by this tree. The tar that could be derived from Pitch Pine was an important "naval store" and prompted the locating of the Palatines in the County. Because of their proximity to the Hudson and good drainage, many of these pine forests were quickly converted to agriculture. The accounts of Warden (1803) and van der Donck's (ca. 1650) suggest these forests may have been regularly burnt by the Native Americans. While many of these forests may have been cleared prior to the early 1800s, some reports (e.g., Warden 1802) suggest that substantial clearing was still occurring during the beginning of our focal period and the percentage of land covered by improved acreage in Kinderhook and Stuyvesant rose from around 55% in 1820 to more than 80% fifteen years later.

Most cropland offers relatively few ecological analogies for animals because they are so heavily managed that they provide shelter for few species. Some species (e.g. Killdeer, Vesper Sparrow) may have sought the open soils in these fields for nesting, although it is unclear how successful nests were. Killdeer, a shorebird that frequently strays inland, may have found analogy between such fields and the beaches it also used. More important than their role in providing structural habitat (and a premonition of the future role of cornfields), grainlands did provide food for wild animals. Early accounts suggest that woodchuck quickly made themselves known (Godman 1834), and a few butterflies, such as the Black Swallowtail (whose caterpillars fed on the parsley and carrots) and our native Whites (on the brassicas, the Cabbage White which later outcompeted them was yet to be introduced) relished some crops. Needless to say, wildlife use was not the farmers' intent, and scarecrows, caterpillar squishing, and shooting were common. At the same time, during the breeding season, most breeding birds are insectivorous, and they helped control crop pests. Contemporary observers quickly noted that the killing of song birds appeared to be resulting in more severe pest

outbreaks (e.g., Kalm 1770, quoting Franklin), and early ornithological works (e.g., DeKay 1844, Peabody 1840) heralded this aspect of bird life.

A handful of native plants that thrive on bare soil adopted cultivated fields and gardens as suitable habitat and joined the league of introduced weeds which had co-evolved with European agriculture for millennia. Common ragweed (in wheat), Bur-cucumber and Devil's beggar-ticks (in gardens and corn fields), Milk purslane and Witch-grass (in corn fields), and Pennsylvania Smartweed (in barn yards) were common enough to be listed as weeds of cultivated grounds by Torrey (1840) and Darlington (1859).

### ***Early Pastures***

"Pasture" referred to lands being grazed by animals; the nature of the pasture depended in part on the livestock being grazed and method of grazing. Early farmers commonly used not only open pasture but also woodland pasture where animals were allowed or encouraged to graze beneath tree cover.

The most extensive pastures in Columbia County were associated with sheep and the clearing of the eastern hills (Figure 13). Pasturing doubtless occurred in places other than the eastern hills, but was not as extensive (in 1855, more than 1/3 the area of some eastern towns, but less than 1/10 that of some western towns were in pasture). Early, largely self-sufficient farmers in the eastern part of the county may have cleared some lands for unsuccessful attempts at growing lucrative grains; once cleared, that land invited pasturing not only as a practical alternative but one that was encouraged by the cooler, wetter climate.

Summaries of early land deed information (Figure 18) indicate that these forests on steeper land tended to be composed of boreal tree species, such as Chestnut and Pine (probably mostly White Pine), and to a lesser degree Hemlock, Beech and Maple, as well as southern species, such as Oaks and Hickories. This illustrates the fact that these were mixed forests, with Oak and Hickory tending to occur on the drier soils, and the more boreal element on deeper, richer soils and in cool micro-habitats. Because these eastern forests were the main habitat for the County's more boreal plants and animals, these species almost certainly decreased (at least temporarily) in numbers as a consequence of the forest clearing for pasture. Birds such as Juncos, Blackburnian, Pine, Black-throated-Blue, and Canada Warblers breed in the higher hills today (personal observation, McGowan and Corwin 2008) and were likely present in larger numbers before forest clearing. Plant species that might have lost a significant portion of their boreal forest habitat in Columbia County to sheep pastures include Hobble Bush, Mountain Maple, Beaked Hazel, Yellow Birch, Paper Birch, Wood Lily, Painted Trillium, Bead-Lily, Trailing Arbutus, Tall Milkweed, Bunchberry, Fly-honeysuckle, Red-berried Elderberry, Whorled Aster, as well as a number of ferns and clubmosses, and shade-tolerant grass and sedge species. (McVaugh 1958, personal observation). Among the herps, Fowler's Toad (personal observation) and, historically at least, Rattlesnakes were probably more common in this region. Our more northerly form of the Red-Spotted Purple butterfly is probably most common in the eastern half of the County (personal observation). This is a forest species whose caterpillars feed on cherries. It seems doubtful that any of these species benefited from the conversion of forest (or cut-over) to pasture.

Scruffier pastures may have provided some analogies to Prairie grasslands and savannahs. However, closely-cropped pastures are often too clean to provide strong analogies to natural grasslands for native vertebrates and plants. Eaton, for example, provides a rather damning description of sheep pasture as bird habitat,

... the principal harm of pasturing, to bird life, is found in the destruction of ground cover which inevitably results in woods and thickets. This is especially noticeable in sheep pastures where all the vegetation is destroyed to a height of three or four feet above the ground. In such pasture land the thickets and undergrowth, which usually support an abundant bird life, are eliminated and the birds must seek other coverts. (Eaton 1914, vol. 2., p35)

The lack of shrubbery and potential close-cropping of the pastures left room for few birds. It does seem likely that a few sparrows (e.g., Savannah, Field) and other birds (e.g., Killdeer, Kingbirds) used these lands, especially when there was scattered brush. Where vegetation crept in along fence rows, Bob White Quail, Yellow Warbler, Song

Sparrow, Catbirds and the like probably entered. Based on an inspection of the engravings in the History of Columbia County (admittedly from a slightly later period), some scrubby pastures appear to have existed at least on the hillsides (e.g. Figures 21, 22a); these pastures may have spread later in the century (see later section on Abandonment). When pastures occurred near denser, wetter vegetation, American woodcocks probably used some of them as displaying grounds.

The intensively grazed pasture land was not likely a heaven for native plants. The flora of eastern North America does not include many species adapted to tolerate intensive grazing. And even the prairie plants that had co-evolved with grazing buffalo and were present in small populations in our region, did not compete well in the eastern climate and soils with the pasture grasses and forbs introduced from Europe. During the initial period of relatively good soil fertility (and sufficient topsoil) in the pastures, native plants likely composed a very small proportion of the pasture vegetation. However, native plant species that we know today from forest edges, field margins and even road-sides, probably found a small niche along the edges of these early pastures. Native insects most likely also were able to utilize the small habitat patches around the margins of the pastures, where native plants provided food and shelter. In sum, the ecological situation for native plants and insects was probably somewhat distinct from that for vertebrates which often need relatively large tracks of suitable habitat. Plants and insects however can settle in these small habitat patches and, through dispersal, 'glue' such patches together demographically.

While not strictly speaking 'grazing', many early pigs foraged widely in the woods. A practice that reportedly stripped squirrels of their winter nut caches (Godman 1831). If pig densities were high, they likely also reduced native herbaceous vegetation and woody seedlings in the forest.

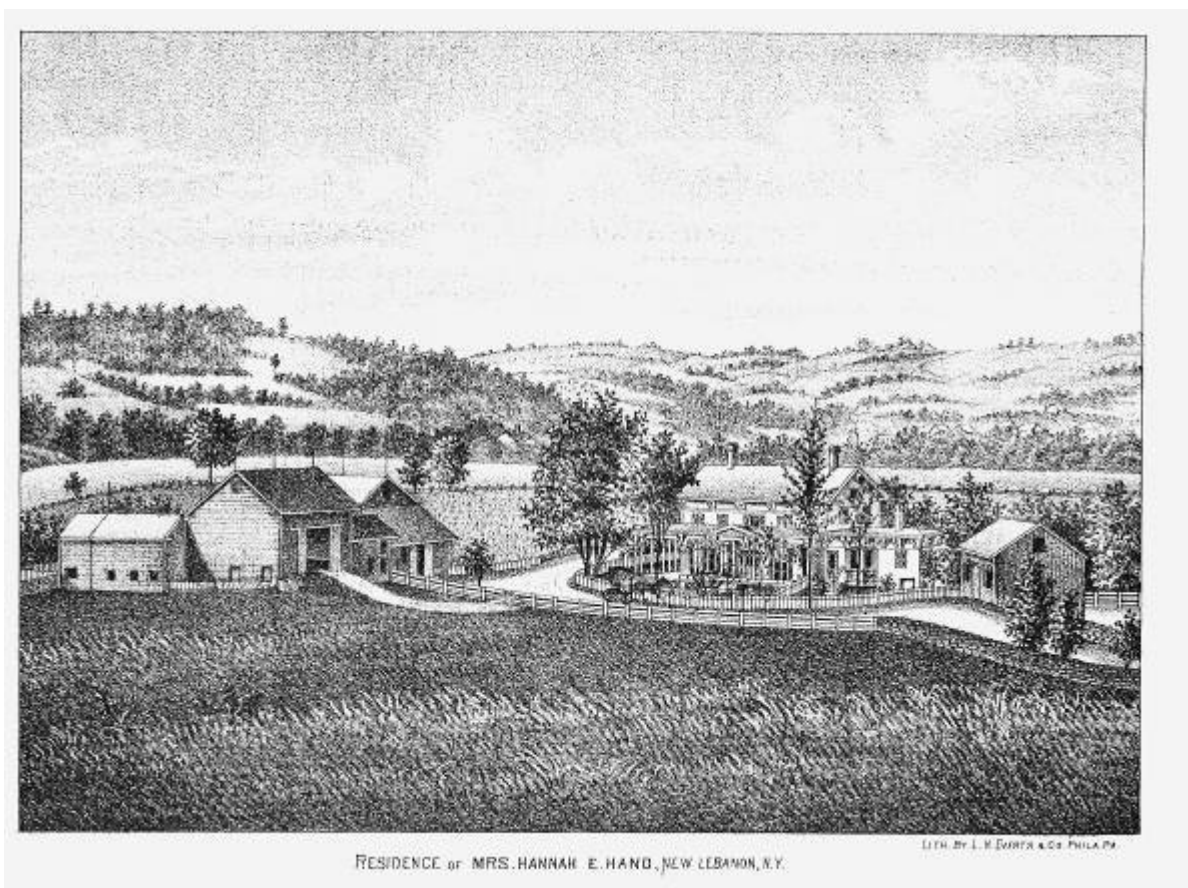


Figure 21. An 1878 farmland image from the eastern part of the County; note the somewhat brushy looking hillsides, from Ellis 1878.



Figure 22a. The Hudson Valley around 1840, note the hilly, rough terrain in the foreground. This was probably used for pasture, from Emmons 1843.

### ***Early Meadows***

“Meadow” initially referred primarily to unplanted hayland. Meadows were often located in wet areas, either kept wet by a high water table or groundwater seeping to the surface, by poor drainage after rains, or by occasional flooding from a nearby stream. Some of these meadows may have been already established in pre-colonial times by natural factors, others were created by clearing swamp or floodplain forests. They were unsuitable for ploughing or intensive grazing, but produced reliable hay crops due to the regular input of nutrients from flooding (indeed, early efforts were made to re-route floodwaters through fields in order to ‘fertilize them by flooding’). Evidence for such lowland hay meadows comes in part from 1830s mapping of adjacent Berkshire County, Massachusetts (Hall *et al.* 2002; Figure 22b). Upland hay meadows were probably also necessary in some areas since hay was required to keep livestock through the winter, although many animals were slaughtered in the fall. As demand for hay increased, upland hay meadows were often ploughed and seeded with Timothy Grass to improve hay quality and yield.

Much of the early haying apparently occurred in the southwest corner of the County (Figure 11). The topography of Germantown and Clermont is dominated by a series of north/south ridges with small wetland valleys in between them; perhaps these were well-suited for use as wet hay meadows. As Spafford (1824) puts it, “The surface is but gently undulated, and the soil is good for grass”. These areas were originally probably occupied largely by swamp forests, possibly Red Maple swamps, similar to those that can today be observed elsewhere in the County. The clayier soils near the Hudson may also have been more prone to water logging and so less suitable for ploughed croplands;

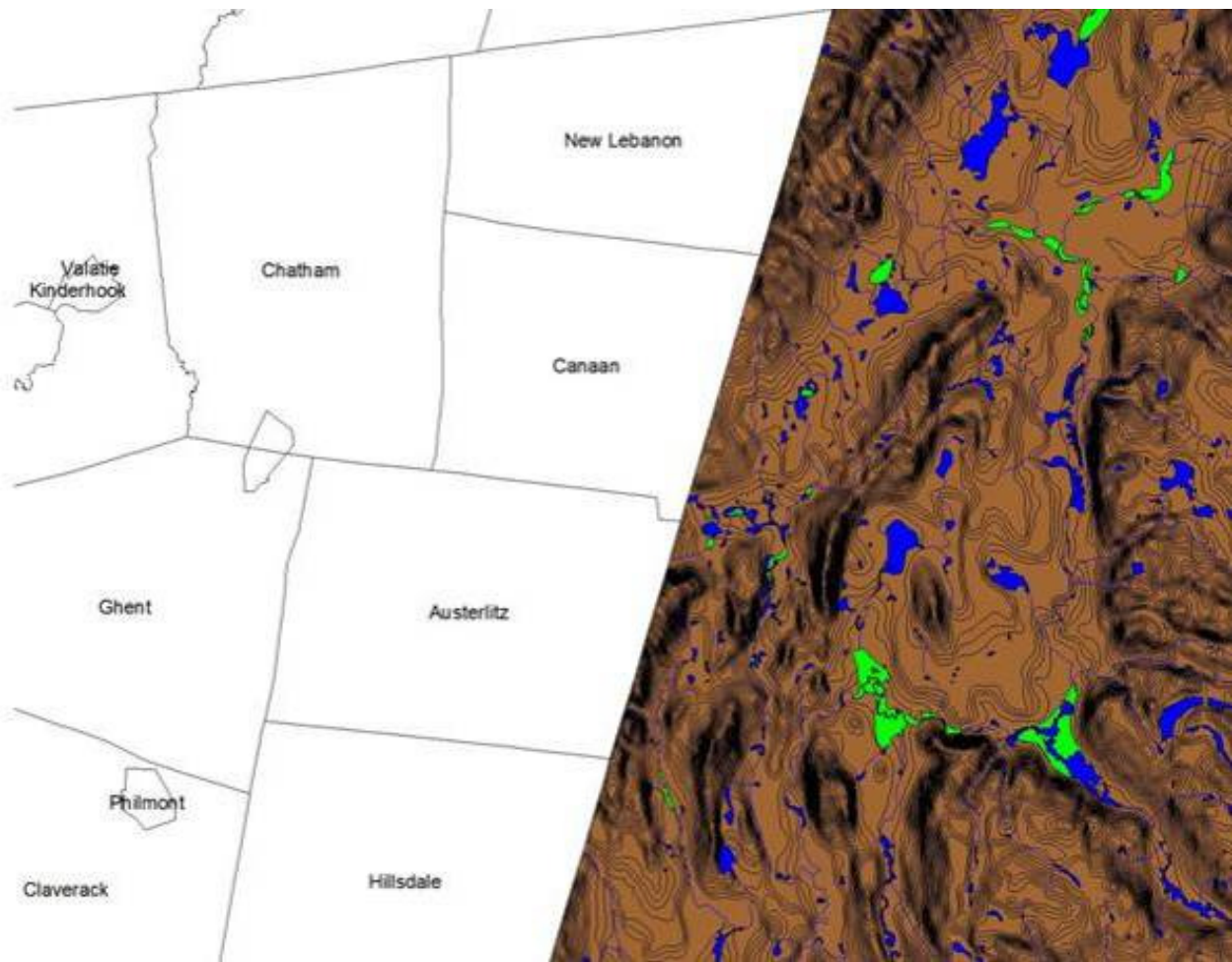


Figure 22b. The location of hay meadows in a portion of Berkshire County, Massachusetts adjacent to northeastern Columbia County. Note how all such meadows appear to be located in lowlands. Data from Hall *et al.* 2002.

However, this water-holding capacity may have helped to maintain green hayfields even during summer dry spells. These natural tendencies were probably emphasized by transportation considerations alluded to in our agricultural profile: bulky hay was difficult to transport to river ports over the initially poor inland roads. However, haying also seemed to have been common in New Lebanon in the northeastern corner of the County, mostly on the floodplains of the Wyomonic and Kinderhook Creek. Spafford (1824) describes that town as “good farming lands, dry and warm or *wet and grassy*” (emphasis added).

Therefore, hay was probably cut on a variety of wetlands, but also on upland patches unsuited for other uses or when hay needs demanded. We are hard-pressed to know what sort of land, if any, was expressly cleared for hay meadow. Judging from the current distribution of hay meadows, it was probably the intermediate land – lots too steep or not of good enough soil quality to be suitable for crops, yet not so steep and rocky as to suggest exclusive use for sheep grazing. Perhaps the only patches opened for hay were swamp and floodplain forests where, once the shading trees were removed, the watering assured a decent hay crop year in and year out. The clearing of floodplain forest would have removed the habitats of floodplain plants such as Silver Maple, Sycamore, Cottonwood, Bitternut, Green Ash, Leatherwood, Marsh Pea, False Mermaid Weed, Ostrich Fern, Green Dragon, Wild Rye species, Canada Brome, and certain sedges (e.g., *Carex davisii* and *C. spengelii*) and animals such as Wood Turtles, select ground beetle and odonate species (Knab-Vispo & Vispo 2009). Tellingly, early descriptions of the Wood Turtle include reports of it occurring in meadows and pastures (e.g., Thompson 1842). Through an examination of the earliest aerial photos available from our county (1940s), we estimate that, at the most, 14% of the original floodplain forest habitat maintained its forest cover over the last 200 years.

However, new wet meadows were in themselves analogies for a habitat that humans had removed from the landscape some 200 years prior: beaver meadows. Beavers were apparently trapped to extinction in the mid Hudson Valley by

around the mid 1600s, and the ecosystems that they had created in the landscape were thus missing. The wet meadows also attracted species which had congregated around natural marshes and fens. Today, at least, numerous native plants and animals are found in wet meadows that were created for or are maintained by agricultural activity. These include numerous rare species such as Bog and Spotted Turtles, Ribbon Snakes, Leopard Frogs, and Harriers. We have found native wetland butterflies including Bronze Copper, Appalachian Brown, Black Dash, Mulberry Wing and Baltimore Checkerspot in and around wet meadows in agricultural land. Examples of the native plants that were listed as occurring in “wet meadows” by Torrey (1840) include species that are still holding their ground in wet meadows on today’s farms, such as Iris, Blue-eyed Grass, Common Monkeyflower, Common Vervain, Sweetflag, Golden Ragwort, Green-headed Coneflower, Yellow Avens, and Meadowsweet, as well as a rich variety of native sedges, grasses, and less conspicuous plants. However, there also seems to have been a group of plants associated with early wet meadows which we now rarely, if ever, see in this habitat: Canada Lily, Mayapple, Ragged-fringed Orchis, Purple-fringed Orchis, Nodding Lady’s Tresses, Blood Milkwort, Canada Anemone, Swamp Saxifrage, Winged Monkeyflower, and the fern Adder’s Tongue.

In the uplands, hay meadows offered prairie-like conditions for the grassland birds that were already well-established in the region by the time of the earliest detailed natural history accounts. These include the traditional grassland birds such as Bobolink, Meadowlark and Upland Plover. The first two were likely common in the County in the mid 1800s. Early hay cutting practice (cut once per year by hand, Emmons 1843 puts the *start* of haying in Hudson around 12 July) probably both maintained these grasslands and minimized damage to nesting birds. As mentioned above, upland hay meadows were often seeded to Timothy and only provided limited habitat for native plants. However, Torrey (1840) lists a number of plant species that occurred in “meadows” and which we still find in “wild” hayfields today. These include Fleabanes, Black-eyed Susan, Spiked Lobelia, Evening Primrose, and Small-flowered Crowfoot. However, he also lists the orchid Slender Lady’s Tresses as “common”, Common Lousewort as “very common” and Blue Toadflax as “not rare” in meadows. None of these latter species are easily found any more in Columbia County.

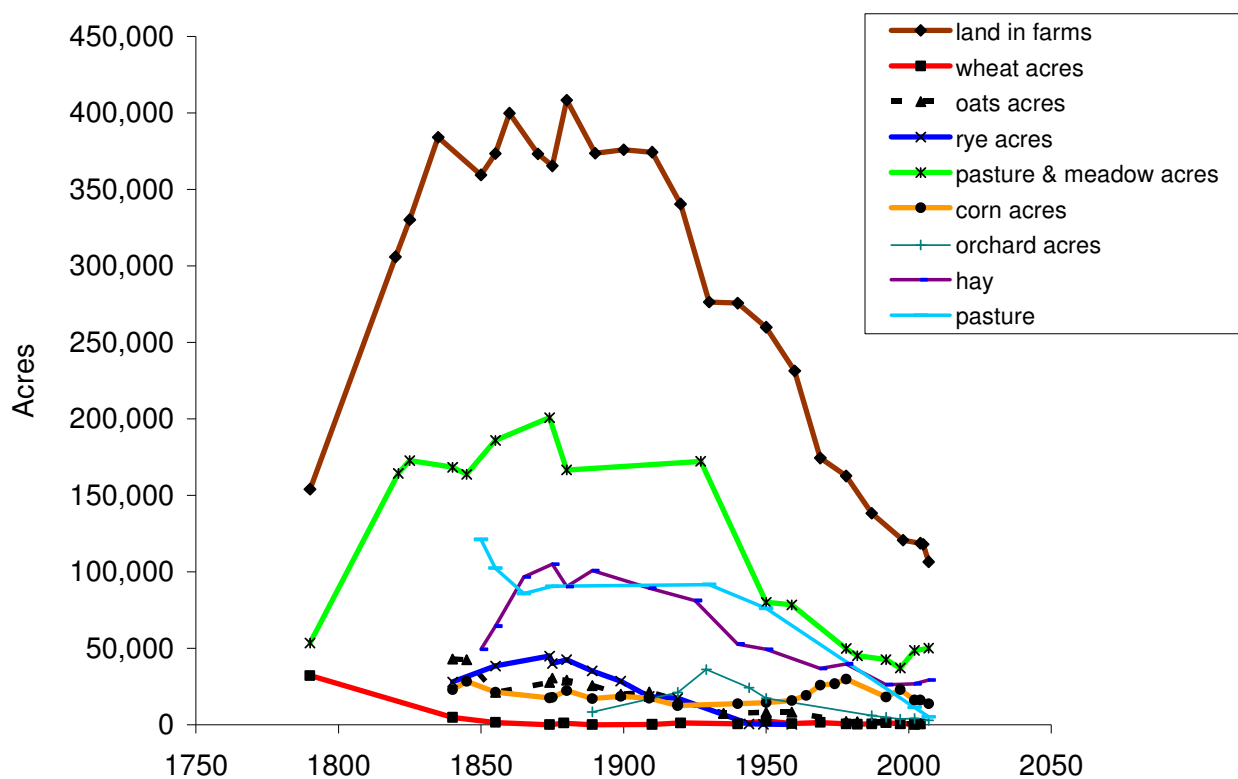


Figure 23. The land in various uses during the recent history of Columbia County, based mainly on state and federal censuses. The earliest information comes from extrapolations based upon per capita consumption and cattle numbers and associated requirements for hay and pasture (conversions numbers are from Breugel 2002).

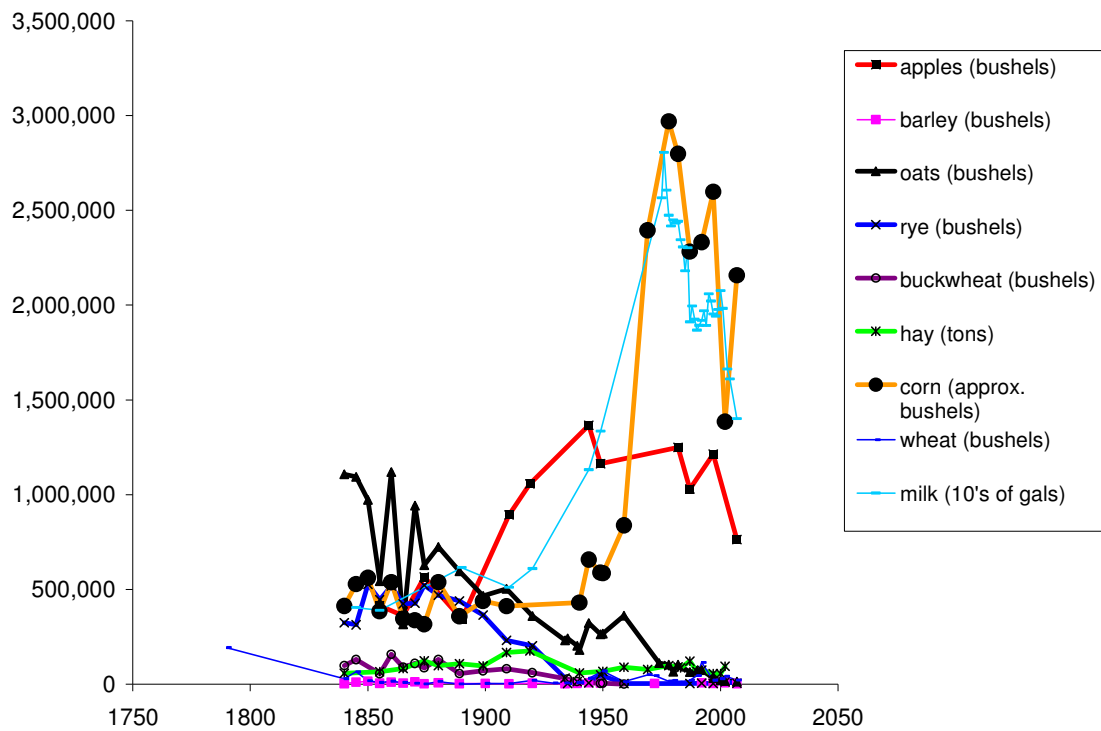


Figure 24. Course of agricultural production in Columbia County, data from state and federal censuses, earliest data on wheat based upon minimum for subsistence given population and per capita consumption from Breugel (2002).

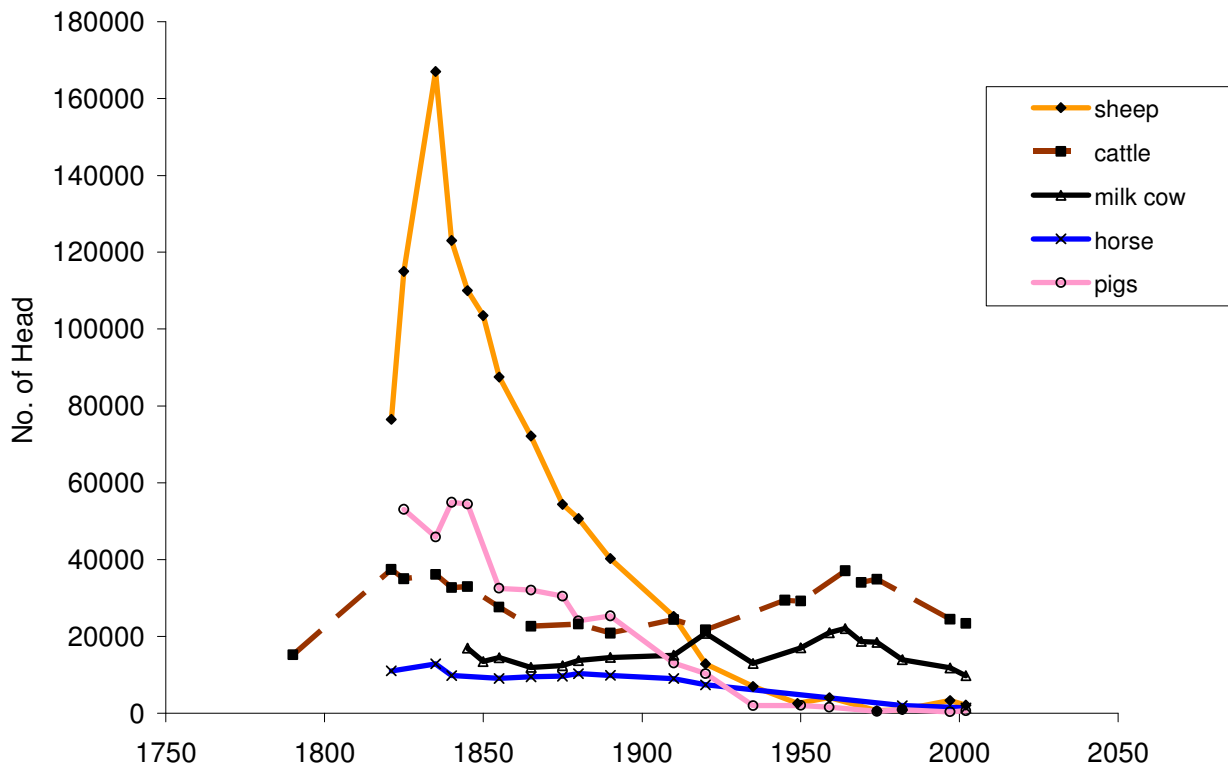


Figure 25. Livestock in Columbia County. Data from state and federal censuses except for earliest estimate of cattle is from number of households and reports on the number of cattle per household at that time (cited in Breugel 2002).

## Evolving Ecological Analogies on Active Farmland

The ecology of active farmlands after 1820 evolved in two ways: first, overall modes of production changed as markets rose and fell, and these changes produced major variation in the proportions of different agricultural cover types of the County. Second, technological developments meant that, even within modes of production, the nature of a cover type and analogies that it offered changed as techniques and practice evolved.

Some types of agriculture reached such extents as to substantially reshape the ecological face of the landscape and/or to be the predominant agricultural habitat during certain eras. Specifically, we will focus on pastures, hayfields, orchards and cornfields. Pastures and hayfields each covered more than 100,000 acres at their peaks. While much more modest in extent, orchards and cornfields were the largest agricultural cover-types of the late 20<sup>th</sup> century, and each probably extended to 30,000 acres or more. Aside from hay, the only other crops that reached such extents during the past two centuries were probably rye and oats which both topped 40000 acres in the 19<sup>th</sup> century, but because this occurred around the peak of pasture and hayfield and because their ecologies are largely unknown to us, we do not focus on them here. Figures 23-25 illustrate the course of agricultural land use in the county and the corresponding production statistics.

Below we describe pasture, hayfield, orchard and cornfield history in Columbia County. For each cover-type, we ask ‘what natural habitats might it have been replacing?’, ‘what new ecological analogies may have been created?’, and ‘how did the agricultural techniques associated with each mode of production vary over time and how did these developments affect habitat values?’.

### *Pastures*

Location: “**Pastures** were New England’s stepchild” states Whitney (1996), implying that they got only the attention and manure that was left for them after cropland and hayfields. The result, in New England at least, was a continuous decline in pasture quality. Indeed, in the botanical literature “hill pasture” seemed to become a shorthand for these nutrient-depleted, open lands. Going along with ecological change because of soil exhaustion were probably changes due to variation in grazing species as sheep gave way to cattle. Around 1910, total “neat cattle” (i.e., cows, steer and oxen) began to make up the majority of Columbia County livestock and sheep entered the minority.

Analogies Created: Cooper *et al.* (1929; Table 1) depict the plant sequence on pastures undergoing progressive soil depletion. As soil quality declines, native plants become *more* common. Most of the introduced agronomic grasses outcompete native ones when nutrients are high, but are unable to maintain themselves as nutrients decline. Many of the native plants that come into these exhausted pastures found analogies to their original, thin-soiled habitats on ridge tops, steep hillsides, or other areas with thin layers of organic matter (e.g., sand barrens). Examples of native plants that seemed to be common on “dry hill-sides” or “sterile fields” and are still found on these degraded lands, today, are: Pussytoe, Gray Goldenrod, Mountain-mint, Sweet Fern, Poverty Oatgrass, Little Bluestem, Pasture Rose, Dewberry, and Arrowhead Violet (Torrey 1840, pers. obs.). Interestingly, again, there seems to have been a group of native plants that were able to take advantage of a certain stage of an evolving agricultural habitat and were listed as “not rare”, “frequent” or even “common” in these poor habitats by Torrey (1840), but have since become quite rare. These include Whorled milkweed, Upland Boneset, Venus Looking-glass, American Pennyroyal, Clammy Cuphea, Yellow Wild Indigo, Wild Sensitive Plant, Rattlebox, Downy Trailing Lespedeza, Virginia Yellow Flax, and Little Sundrops.

Associations	Warm to cool relatively dry regions	Cool moist regions	Cold moist regions
1	Kentucky bluegrass Canadian bluegrass White clover	Kentucky bluegrass Canadian bluegrass White clover	Kentucky bluegrass Canadian bluegrass White clover
2	Bluegrasses Red top White clover	Bluegrasses R. I. bent White clover	Bluegrasses R. I. bent White clover
3		R. I. bent White clover	R. I. bent White clover
4		R. I. bent Sweet vernal White clover	R. I. bent
5		Sweet vernal	
6	Poverty	Sweet vernal Poverty	Poverty
7	Poverty Goldenrod Broom sedge Cinquefoil Trees	Poverty Goldenrod Broom sedge Cinquefoil Moss Ferns Trees	Poverty Cinquefoil Moss Ferns Trees

Table 1. Cooper *et al.*'s (1929) table outlining the course of plant life on progressively degrading pastures under three different climatic regimes. "Broom sedge" is what we refer to as Little Bluestem.



Figure 26. A "shrubby pasture" in Columbia County. Dogwood and Multiflora Rose are invading this pasture.

Sheep pasture and cattle pasture are distinct ecological habitats. In our description of the Starting Point, we have already quoted Eaton's damning description of sheep pastures as bird habitat. Sheep and bovines differ in their grazing behavior. Specifically, some breeds of sheep browse much more intensively than most cattle. The result is that, unless they are regularly brush-hogged, cattle pastures are more apt to fill-in with unpalatable shrubs.

The net effect of both degradation of soil quality and of increases in cattle was the ‘shrubby pasture’ that is still familiar to us today (Figure 26). The woody plants are typically Grey Dogwood, Red Cedar, Hawthorn, and, more recently, the introduced and highly invasive Multiflora Rose ( McVaugh’s “Flora of Columbia County”, which is based on field observations from the 1930s does not yet mention this species). Some of the native herbs listed above can persist in the ground layer. We will discuss ‘shrublands’ and their ecological analogies in greater detail in our section on abandonment; the point here is that pasture as analogy was probably most ecologically valuable when the pastures were marginal – it was these conditions that allowed both native plant species and native shrubland birds to find homes; obviously, in many cases these were the sorts of pastures that farmers *didn’t* want. However, as certain European graziers have long practiced and as some North American grass-based cattle operations are beginning to experiment with, botanically diverse fields may have a role to play as medicinal leys, i.e., areas where cows can find resources to self-medicate (Darrell Emmick, pers. communication). Whether such a potential benefit is high enough to justify keeping some pastures in nutritionally-marginal, botanically diverse pasture is unclear.

Influence of Technological Developments: Pastures imply fencing and hedgerows and so it is useful to consider these technologies here. The first fences in our county were likely timber and relatively rare. Initially, they served to fence free-roaming livestock out of crops. Eventually, as more land was cleared and increasing farms entered the market economy, separation of livestock and their retaining became a prime role of fencing and at about that time (or shortly before) rock walls sprang up as freeze-thaw cycles pushed more rocks to the surface and as timber scarcity led to moderation in wood use (Thorson 2002). Throughout most of the 19<sup>th</sup> century, our fences were usually crossed timbers atop longitudinal rock piles; the neat rock walls of New England seem to have been relatively rare in these parts. By the end of the 19<sup>th</sup> century, wire was becoming popular for fencing and it quickly took hold in the 20<sup>th</sup> century.

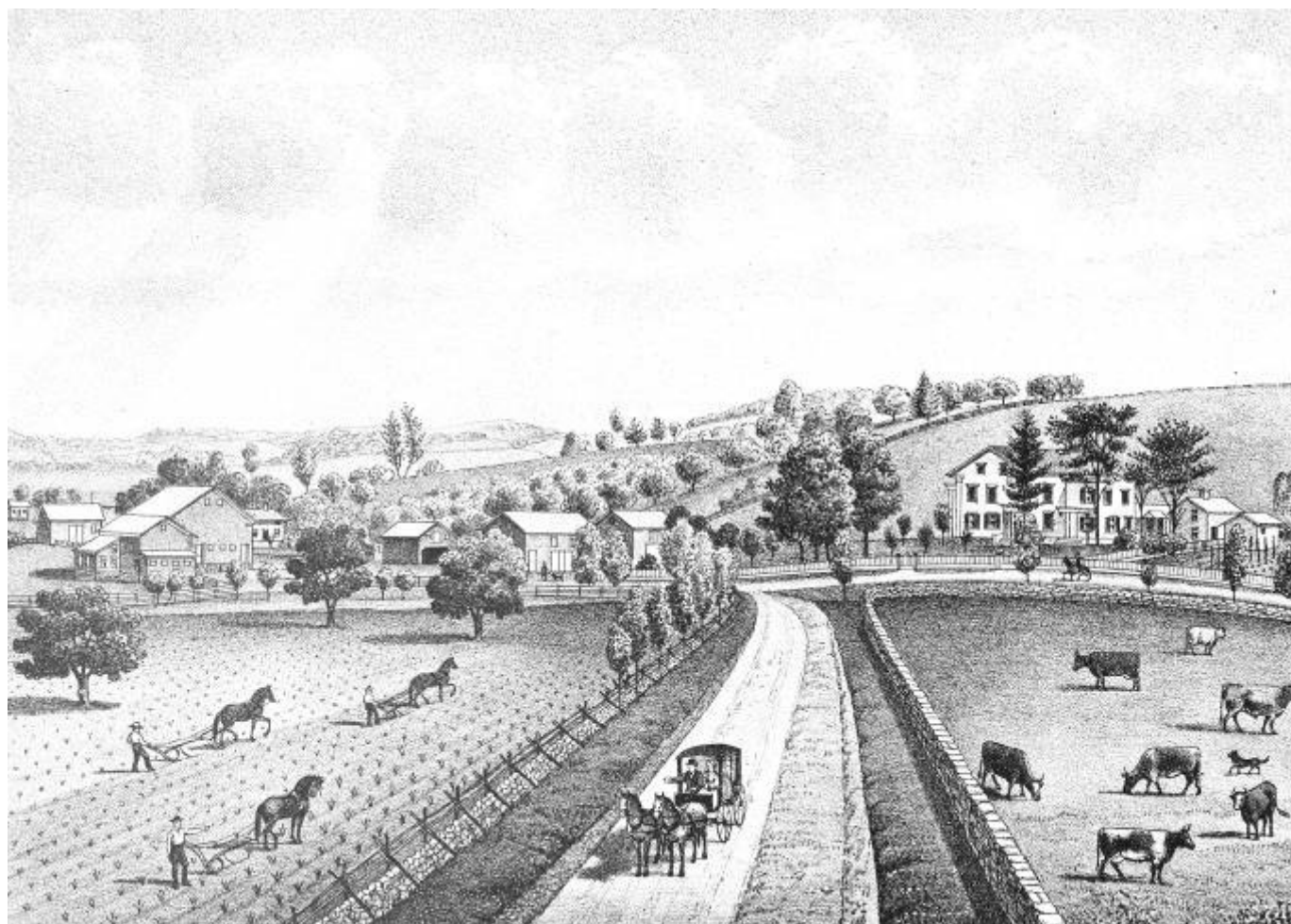


Figure 27. An 1878 lithograph of a Claverack farm. Post and beam, picket, stone and ‘rail-over-rock’ fences are visible in this image.

Different fences create different habitats. Unlike deforested portions of Europe and the Midwest, hedgerows in the forested Northeast and in Columbia County in particular do not currently appear to be major sanctuaries for woodland plants or animals, although they do provide habitat for some and conduits for others; their ecological role may have been somewhat greater during the height of land opening. Columbia County has utilized many types of fence (e.g., Figure 27). Judging by walks through the woods, the rail-over-rock fences were most common (Figure 28), at least in the eastern portions, and those fences provide nooks and crannies for the growth of weeds and shrub (whether the clean farms of the early engravings are true-to-life or reflect some 'touching up' is unclear). One regularly encounters snakes along exposed rock walls. Barbed wire or high-tensile wire creates a fence-line that is easier to maintain. Wire fencing was already being discussed in 'progressive' New York circles in 1858 (Brewer 1858); it was widespread by early in the 20<sup>th</sup> century (e.g., Figure 29). Some have suggested that this 'cleaning up' of the fenceline was partially responsible for the demise of Bobwhite Quail in some parts as their favored covert habitat was removed. Certainly, a reduction of shrubby fencerows would have led to a decrease in some shrubland birds. Likewise, Aldo Leopold (1931) in his survey of the game habitats of the north central states, conducted just as mechanization was arriving to the Midwest, noted the negative effects of tidy farms not only on quail but also rabbit and pheasant (not a native bird). We observed that field-side habitat given by thick hedgerows or stream buffers provides space for both the pests (e.g., groundhogs) that farmers dread and the predators (e.g., red fox) who are their ally in Ground Hog control, although not in chicken rearing.

Aside from providing habitat in and of themselves, fencelines were barriers and conduits for wildlife movement. In some places, they have been decried as significant blocks to the movements of some wildlife. In Columbia County, the effects of hunting and trapping probably preceded those of fencing, so that during the peak of fencing, few large, wild mammals were attempting to move through our landscape. Today, the spottiness of farming and fencing in Columbia County probably means that its ecological effects are relatively minor. More important perhaps is the potential of wooded fencelines to serve as corridors through agricultural land. Many animals prefer to remain in or near shelter, while they may not move within the hedgerow itself (the going is much easier along side), they may well stick close to such corridors so that they can dive for safety when needs be. In our study of corridor use on farms in Columbia County, we regularly photographed Deer and Coyote near such corridors, and, more rarely, Bobcat. Ground Hogs use thick hedgerows as shelter not only for their movement but also for their burrows.



Figure 28. A 1935 photograph just south of the Columbia County line in 1935 showing a dilapidated 'rail-over-rock' fence and scruffy fencerow. Photo courtesy of Rogers McVaugh.



Figure 29. A 1935 photograph of grazing cows in New Lebanon, note the wire fence in the foreground. Photo courtesy of Rogers McVaugh.

### ***Hayfields***

**Location:** Hayfields evolved from being mainly for the production of feed for home-farm livestock into being major commercial ventures that reached their zenith in terms of area around 1875 (Figure 20; maximum production occurred later, presumably due to new practices and inputs). Much of this hay was probably delivered via river to New York City.

While early hayfields may have occurred largely, as mentioned under Starting Point, on wetter ground, upland hay became increasingly common as the century wore on. We have no statistics for Columbia County but Whitney (1996) describes the situation in Worcester, Massachusetts where upland hayfields accounted for 49% of all hay meadows in 1780 and for around 75% by 1850. Between 1850 and 1875, all towns in Columbia County reported an increase in hayfield area (Table 2). A large part of this land may have already been cleared for other purposes, e.g., grains or sheep pasture, but some of this increase may have come as farmers were more active in combining uses (e.g., haying and then pasturing on the same land).

**Analogies Created:** When upland hayfield replaced former sheep pasture, these upland hayfields may have signaled an overall increase in the ecological analogies offered by the farmscape, at least for grassland birds. In distinction to many (but not all) modern hayfields in Columbia County, most 19<sup>th</sup> century hayfields were a prime, consciously managed farm resource. Some farmers' economic survival depended largely on hay production. As such, the majority of hayfields in 1875 were probably planted (with Timothy Grass being favored) and their placement was usually intentional. Today, many hayfields are largely unmanaged and on open land that the non-farming owner wishes to be kept open, but not cultivated. If they are more intensively managed, then they are often being cut three or even four times per year and not infrequently planted with alfalfa. In both the 19<sup>th</sup> and 20<sup>th</sup> centuries, the more intensively-managed hayfields probably offered fewer analogies for native plants and animals.

Table 2. Change in acreage under various agricultural uses between 1855 and 1875, together with an interpretation of the source of increased meadowland.

Town	Change in Plowed Acreage	Change in Pasture Acreage	Change in Improved Acreage	Change in Meadows	Interpretation
Ancram	-1216	-2496	-148	2338	meadow from pasture and perhaps plowed land
Austerlitz	-2447	-2085	-3757	2229	meadow from pasture and plowed land; together with increase in multiple use
Canaan	358	-975	707	1477	meadow from pasture and increase in improved land
Chatham	1082	-523	578	3147	meadow mainly from increase in multiple use?
Claverack	891	-707	-339	3389	meadow mainly double use with some contribution from pasture land
Clermont	352	-481	-743	2242	meadow mainly from increase in multiple use?
Copake	1714	-511	577	2360	meadow mainly from increase in multiple use?
Gallatin	-1517	-376	654	1576	meadow mainly decline in plowed land and some decline in pasture
Germantown	320	-454	952	1719	meadow mainly from an increase in improved land with some pasture conversion
Ghent	-647	-265	2230	3450	meadow from increase in improved land
Greenport	-217	-61	-490	1724	meadow mainly from increase in multiple use?
Hillsdale	-304	-1164	3175	3539	meadow mainly from an increase in improved land with some pasture conversion
Hudson	-34	77	-20	48	minimal change
Kinderhook	-2181	-972	1662	992	meadow from decline in plowed land and/or increase in improved land
Livingston	156	-1057	599	3545	meadow from pastureland, improved acreage and multiple use.
New Lebanon	94	351	1865	899	meadow from increase in improved land
Stockport	353	-91	-100	951	meadow mainly from increase in multiple use?
Stuyvesant	25	-566	1528	2736	meadow mainly from an increase in improved land with some pasture conversion
Taghanick	-885	561	1905	2316	meadow mainly from improved land with some plowed land conversion

A nice summary of the changing bird ecology of our landscape and the role of evolving hayfields comes from Eaton's (1910) work on New York birds,

When the State was first settled [by Europeans], waterfowl fairly swarmed . . . shore birds flocked by the thousands . . . Wild turkeys, Ruffed grouse and Bobwhites were well distributed . . . It is difficult to obtain reliable information in regard to the abundance of small birds, like the warblers, flycatchers, sparrows and thrushes, but the writer believes they were less abundant during colonial times . . .

The general law of variation in abundance seems to be as follows. Birds which prefer the open country begin to increase as the forests are cut off, and many which live in the forests themselves increase as long as clearings are few and scattered. As the cultivation of the country progresses and a large percentage of the forests has been cut off, the hawks, owls, grouse, jays, Pileated and Hairy woodpeckers, tanagers and many wood-warblers and thrushes decrease in number. When the swamps are drained there are fewer nesting places for snipe, rails, bitterns and Marsh wrens. As the pasture and meadow lands increase in area, birds like the Bobolink, Meadowlark, Vesper sparrow, Killdeer and Bartramian Sandpiper [Upland Plover] find favorable nesting places and increase.

But as the modern style of agriculture develops, new dangers arise to threaten the field birds. Late plowing and extensive cultivating and early mowing destroy great numbers of eggs and young birds. A high degree of agriculture is likewise accompanied with danger from the spraying of fruit trees . . . The cutting of all dead limbs and trees also destroys the nesting sites . . . Thus in many ways the increase of native birds is discouraged, unless artificial means is taken to counteract the evil . . .

His scenario, written as it was at the end of the 19<sup>th</sup> century, adds important perspective by placing the timing of decreased on-farm, openland (i.e., to a large extent, hayfield) diversity before the highest rates of farm abandonment, which later added insult to injury. Bank and Elliott (1937) put the beginning of this decline in the Connecticut valley at as early as 1875. As we note in our section on abandonment below, as that scenario progressed, it reversed some of the trends that Eaton describes in his second paragraph.

Certain aspects of some hayfields are ecologically analogous to Prairies, especially the Tall Grass Prairies, that originally extended east into Ohio and Ontario during historical times and, some suggest, stretched well through NY after glaciation. Many of the birds and some of the plants currently and/or historically found in hayfields originally had their demographic heartlands in the Prairies of the Midwest. Bobolinks, Meadowlarks, Dicksissels, Upland Plovers, Vesper Sparrows and Grasshopper Sparrows, amongst others, are all birds that occupy, or at least occupied, eastern hayfields but which probably reached their largest populations on the Prairies. (Note however that they did not all necessarily co-occur in the same types of hay field; pers. observation.) There is debate as to whether or not these species dispersed east as cultivation opened an ecological bridge to the Prairies or whether small populations of these birds already existed along the East Coast at the time of European settlement and then blossomed from those cores. For example, early accounts of the Bobolink in the Northeast (Macauley 1829; Thompson 1842) primarily associate it with low meadows or even marshes where it joined company with Red-winged Blackbirds. Such breeding populations may have expanded their habitat as surrounding lands were opened to cultivation. In any case, whether from *in situ* habitat cores or as part of an eastward expansion, these species were able to take advantage of the fields offered to them by 19<sup>th</sup> century agriculture.

All else being equal, nesting habitat structure and extent seem to be the key parameters determining the occurrence of grassland birds. Most, for example, have relatively unspecialized diets. Such an emphasis on structure means that the structural analogies between hayfield and Prairie are sufficient for these birds, even if the plants in those fields are nearly 100% European and hence almost entirely distinct from the Prairie flora. Vegetation height, thickness, and herbaceous vs. woody nature are among the parameters that ornithologists use to describe and separate the habitats of these species. This is in contradistinction to the breeding butterflies who, given their caterpillars' close links to food plants, are perhaps at least as strongly affected by the botanical composition of a field as by its structure. Adult butterflies are relatively liberal in their taste for nectars, but many rely on the presence of a very few, host species for their caterpillars.

Eaton's scenario of an early (i.e., 1810-1850) flowering of grassland birds probably holds for Columbia County. The initial wet meadow hayfields probably favored the nearly ubiquitous Red-winged Blackbird who seeks just the wet, grassy, reedy or sedgy areas such meadows probably created. Early accounts of Meadowlark and Bobolink also refer to them as being birds of wetter meadows. However, as ground nesters, they were probably most common not in truly wet meadows but instead on moister meadows where good watering made for a thick 'head' of grasses and a good thatch for nesting. As drier upland hayfields expanded, so too did these species and others such as the Upland Plover, Grasshopper and Savannah Sparrows (check who of pastures) joined them on some pastures. In the mid 1800s, Bobolinks were very common (see for example Kent's (1933) description of "great flocks in migration" along the Hudson, cited in DeOrsey and Butler, 2006). However, this boom was soon dampened by the changing calendar and technology of mowing.

Upland hayfields may have changed little in plant composition throughout most of the 19<sup>th</sup> and 20<sup>th</sup> century. They were predominantly composed of non-native grasses, especially Timothy. Timothy grass and Timothy and clover accounted for some 50-60% of haylands in the county at the beginning of the 20<sup>th</sup> century when such statistics first become available. Earlier anecdotal accounts suggest that the use of "English Grasses" was well established by the end of the 18<sup>th</sup> century. The main factor accounting for trends in yield was apparently soil depletion. Russell (1976) cites remarks that good, "new" soil could yield 2-3 tons of hay per acre in the 18<sup>th</sup> century, whereas more exhausted soils in New England produced only 1 ton or less. It is perhaps telling that Columbia County hayfields averaged less than one ton per acre throughout the 19<sup>th</sup> century, rising to more than two tons only in the 20<sup>th</sup> century, presumably at least partially in response to increased fertilization. By the second half of the 20<sup>th</sup> century, alfalfa hay was becoming more common and in 2007 it accounted for nearly one quarter of all hayland, although "other tame hay" including Timothy, still made up 55% of hayland. The value of tame or wild hayland as an analogy for the Prairies was thus probably more influenced by changes in the technique and timing of harvest than by these fields' botanical composition.

Technological Developments: In the first half of the 19<sup>th</sup> century, hay mowing was largely done by hand scythe. Cutting was slow and laborious, it began in July and may have extended for several weeks. A practical, horse-drawn

mechanical hay cutter was introduced before the Civil War, and its use seemed to gain momentum after the War (Figure 30), perhaps in response to the resulting labor shortage. Prior to the end of the 1800s, mechanization and new ideas of progressive agriculture favored and facilitated an early cut in June, possibly followed by a second cut later in the year. Mechanization, for a variety of farm activities besides haying, continued apace in the 20<sup>th</sup> century. Around 1944, the number of horses and mules on US farms was surpassed by the number of tractors. By 1950, for example, of 1517 Columbia County farms surveyed, 19% used only horses, 32 % used both tractors and horses, and 49% used only tractors. Between the mid 1940s and the mid 1950s, many of the smaller fields that had persisted on farms since their initial establishment were consolidated into bigger fields to accommodate this development. Perhaps one of our only county-specific historical statistics on relative farm mechanization is the value of farm machinery as a percentage of the value of farmland and buildings. For Columbia County, this ratio averaged, 3.0% between 1850 and 1860, 12% between 1920 and 1930, and 13% between 1992 and 2002; roughly similar patterns were seen at the state level. These ratios obviously confound changes in land prices and machinery prices with degree of investment, but they do indicate that farmers of the 20<sup>th</sup> century were investing some four times more money in their tools and machinery than those of the mid-19<sup>th</sup> century. Haying itself became even more intense late in the 20<sup>th</sup> century as the concept and technology for early-cut, plastic-wrapped baleage spread in the County during the 1990s. Not only does this permit the May hay cuts that make triple-harvesting hayfields possible, but the fact that hay can be wet-wrapped means that farmers can escape the perpetual demon of haying – lack of drying weather.

The results of these changes in harvesting techniques were momentous for birds and possibly orchids (pers. comm. McVaugh). A key consideration with regards to grassland birds and haying is when the cut is timed in relationship to when the young leave the nest. If the hay cut occurs prior to fledging, then the hayfields become ‘ecological traps’ that entice birds to breed but then deny them reproduction. In Columbia County, for example, we regularly see Bobolink fledglings around the first week of July. When haying *began* at around this time and proceeded slowly, most Bobolink nests probably succeeded. As the start of haying moved back from the second week of July into June and became much more rapid, many clutches did not survive to fledging. As a result, by the end of the 19<sup>th</sup> century, birders in the Northeast were noting steep declines of Bobolink and Meadowlark, and attributing this to changing practices (Eaton 1910, Bank and Elliott 1937). Later in the 20<sup>th</sup> century, some of these effects may have been offset somewhat in the County by the spread of ‘estate’ hayfields – hayfields that are cut once per year, often relatively late, by contracted farmers who invest little time and effort in improvement and are thus sometimes satisfied by a meager, late cut of hay. Whereas in 1910 only slightly more than 1% of hay was “wild”, by 2007 nearly 20% was deemed wild. Yield (tons hay per acre harvested) had also begun to drop from 2.6 tons per acre in 1987 to less than 2 tons per acres in 2007. Aside from benefiting the aesthetics of the property, such a relationship between a non-farmer and

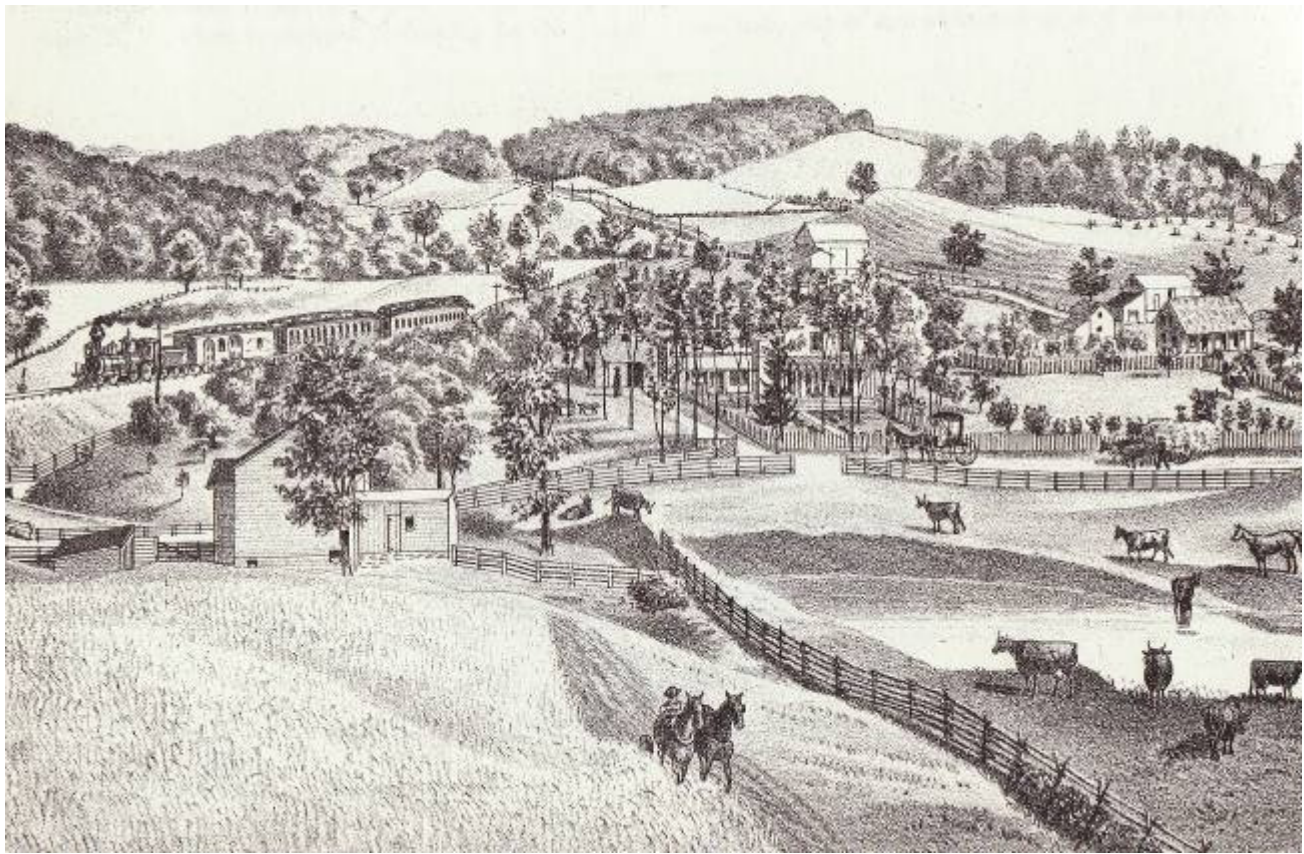


Figure 30. An 1878 image of a farm near Chatham. The horses and driver in the foreground may be haying with a pull-behind hay cutter; note the prominent train in the background – a sign of the times.

farmer helps the former by providing them with an agricultural tax assessment on the hay fields. There has been little effort to coordinate the cutting of these fields so as to protect grassland bird habitat, but late cuts may happen regularly in any case. In the 1930s, Ragged-fringed Orchid still was a common native plant in hay meadows, and McVaugh (personal communication) attributed its drastic decline at least in part to the change in haying schedule.

Butterflies also are affected by the timing of the hay cut. For those species whose eggs and caterpillars are deposited in the fields (e.g., the Grass Skippers and other Prairie butterflies), a cut that is made prior to when the adults take wing can destroy substantial numbers of individuals (Massachusetts Butterfly Club 2008). Although the hayfields that we have surveyed ranked relatively high in diversity (Vispo and Knab-Vispo 2006), we have been surprised at how poor some hayfields are in terms of butterflies. Periodic field mowing (during which the fields are cut higher than is usual for haying) may have few negative consequences and might even be positive (Weber et al. 2008; O'Donnell *et al.* 2007). While there is concern about the long-term effects of early hay mowing (Massachusetts Butterfly Club 2008), data from North America are sparse.

### ***Apple Orchards***

Location: Apple Orchards peaked in Columbia County around 1930 when their area topped 36,000 acres (Figure 23). During the first part of the nineteenth century, apple orchards were scattered throughout the County. Apples and especially apple cider were staples and small orchards were part of many farms. Although small orchards probably were established in various parts of the County as farmers struggled to make sense of a new economic landscape at the start of the 20<sup>th</sup> century, orchards soon concentrated in the western half of the County, where milder weather extended the growing season. Apparently, at least some of these orchards went into the flat, somewhat exhausted grain fields of this region. It seems unlikely that extensive tracks of land were opened expressly for orchards but that, instead, orchards were established on ground already opened for other purposes. As a consequence, few native plants except for select weeds of cultivated ground would have lost habitat to orchards.

Analogs Created: Perhaps the most direct ecological analog of orchards, at least structurally, were the savannahs that marked the edges of the prairies with their combination of low herbaceous vegetation and scattered trees on relatively dry land. Birds benefited from the fruits, insects and, in some cases, nesting cavities. We recorded a variety of warblers and other birds (including Pine Warbler and Indigo Bunting) in and about one organic orchard in the County. In addition, a variety of native bees are known to visit orchards in search of pollen, although the concentration of blossoms in time and space means that orchardists frequently depend on European Honey Bees to service their trees. We did not find any explicit mention of orchards as valuable habitat for native plants in the historical botanical literature, and this fits with our own observations from intensively managed orchards today. The closely cropped herbaceous vegetation under the fruit trees tends to be dominated by introduced plants of haymeadows and pastures. Where hedgerows are tolerated in and around the orchards, they harbor the typical and common native plants of forest edges, field margins and roadsides.

Technological Developments: While the modernization of agriculture was marked by mechanization in the hayfields; for orchards, synthetic pesticides were the main development. Apple trees are susceptible to a range of diseases and insect pests. While hay fields, with all their prairie analogies, were usually more or less balanced ecosystems, the apple orchards provided unnatural concentrations of fruit in relatively simplified environments – food bonanzas that nature was unaccustomed to and to which it responded with a predictable but somewhat unfettered gusto.

Pests and diseases may have been less important for early orchards both because local, relatively resistant (albeit not commercially enticing) apple types could be favored and because the cosmetic standards for home consumption and cider are lower than those needed for fruit marketing. However, once Columbia County apples began to compete on the open market, a new emphasis on pest control likely occurred. Some of the earliest pesticides used in North America, such as the arsenic-laced Paris Green or more descriptively named lead arsenate, were applied to orchards. Subsequently (and for a time simultaneously), DDT was used on orchards. While we don't have direct knowledge of the effects of the early spraying on Columbia County birds, Eaton (1910) reports birds' deaths as a consequence of the spraying of arsenic compounds in orchards, and especially attributes declines in Cuckoos to this cause. DDT has been connected to the death of birds in Columbia County orchards and high concentrations of DDT or its derivatives have been found in the soils of some county orchards (Okoniewski et al. 2006). Many apple orchards continue to be heavily sprayed (e.g. USDA 2008). Some of these pesticides may be relatively benign, but others, such as some of the early concoctions, were lethal not only for pests but also for pest predators. In some cases, the traces of those chemicals remain in orchard soils until the present day (e.g., Peryea 1998, Robinson *et al.* 2007); some former orchard lands in the County reportedly still have high arsenic levels, and information from elsewhere in the Northeast have documented the accumulation of lead in orchards of increasing age. Aside from pesticide applications, commercial pressure meant that trees were kept as cleanly pruned as possible, reducing nest holes for cavity nesters such as blue birds and woodpeckers, a fact bemoaned by Eaton (1910).

Clearly, pesticide spraying in the orchards also had substantial effects on non-target invertebrates, including butterflies (e.g., Cech 2006, Guppy and Shepard 2001), but we do not have specific data for Columbia County or even New York.

### ***Cornfields***

Cornfields provided the major field crop of the 20<sup>th</sup> century. So-called "Indian Corn" (to distinguish it from the English term "corn" which meant any grain) was quickly adopted by colonists and appears to have been widely planted in the County by 1800, mostly for use as cornmeal. Widow's allotments list an average of 4 bushels of corn as annual staple (for humans and livestock), and early diaries contain numerous mentions of the crop (Bruegel 2002). As result, more than 28,000 acres are recorded as planted in 1845. This extent dwindled over the next century until corn took on wide use as fodder for cattle, and dairy farming became a mainstay of the County economy. Corn peaked again around 1970 at almost 30,000 acres (Figure 23). Because of new corn types and farming styles, much more corn was produced from this land than in 1845 (Figure 24). Yield was roughly 79 bushels per acre in 1845; in 1970, it exceeded 400 bushels per acre (Figure 31). We focus our consideration of corn on this later period because 1845 agriculture was diverse and corn was but one crop. By the 1970s no other crop, not even hay, competed with corn for extent in the County. In addition, we have almost no information on the ecology of 19<sup>th</sup> century corn fields

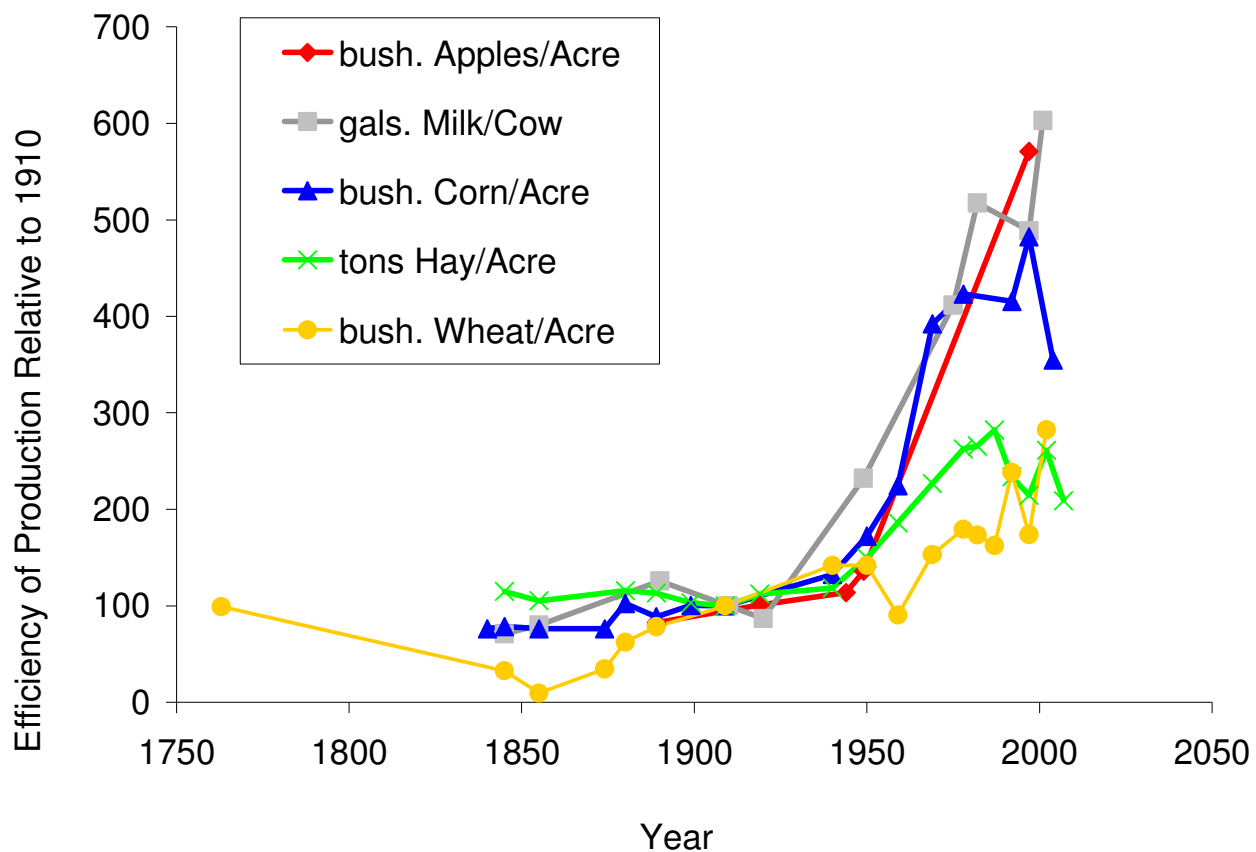


Figure 31. Relative yield of crops in Columbia County. 1910 yields were set at 100% for all products.

(other than, perhaps, which birds plagued them); our information about the corn fields currently evident in almost any drive through the County is somewhat more extensive.

**Location:** As with most grains, corn favors deep, rich soil. It is, perhaps, one of the most demanding field crops currently grown in the County. Much corn is raised on or near floodplains, in valley soils which are relatively deep and flat. During our study of floodplain forests in the County, we found adjacent current or former cornfields at 9 out of 15 sites. Relative to forests, cornfields were usually located on slightly elevated floodplain terraces; however, their proximity was illustrated by the common occurrence of corn stalks or cobs in flood flotsam, and, as will be described later, water studies have shown the significant presence of cornfield chemicals in the waters of some creeks. Such fields may have initially been opened up in the 19<sup>th</sup> century for Indian Corn, other grains or for wet meadows. Their utility for corn production has kept them open into the 21<sup>st</sup> century. Given the current plethora of invasive plant species, returning these fields to floodplain forest might require very intensive restoration efforts. Our own work in Columbia County has suggested that these invasives reduce the presence of native plants in the floodplain (Knab-Vispo and Vispo 2009). The cornfield's proximity to and substitution for floodplain forests can affect those organisms which occur in floodplain forests but might wander into adjacent cornfields (e.g., Wood Turtles). As mentioned above (in the section on Early Meadows), there is also a set of native plants and animals that are nearly confined to floodplain forests and whose habitat area has been significantly reduced by the conversion of floodplain forests to other cover types. However, most cornfields did not directly replace intact floodplain forests, but were created by plowing up hayfields that had previously been established in the floodplain. Either way, the rich, often moist soils of the floodplain have been sought by both farmer and certain native organisms. Recent trends towards heavier summer rains in the County, associated with significant river bottom flooding in both 2008 and 2009, is leading some farmers to re-think their use of floodplain soils; the native species may, in the long term, be better able to adjust to changes in flood regimes

In a regional sense, dairying (with its accompanying cornfield expansion) was probably at least partially associated with the evolution of agriculture in the town of Ancram in the Harlem Valley (see Figure 14). The Harlem Valley is

the location of much of the County's calcareous or limestone-bearing soils (Figure 5), and so the intensification of use on these soils, including the drainage of calcareous wet meadows, and nutrient-enrichment in the remaining calcareous fens and marshes, was probably associated with a decrease in the limestone-loving wetland flora of the region. Species such as Shrubby Cinquefoil, Rough-leaved and Swamp Goldenrod, Grass-of-Parnassus, Kalm's Lobelia, Fringed Gentian, Marsh Bellflower, and Bog Valerian are some examples of regionally-rare species found almost exclusively in calcareous wetlands. It is as a result of these calcareous soils and the extensive calcareous wetlands in this area that state-identified sites of conservation value cluster in this corner of the County (Figure 32).

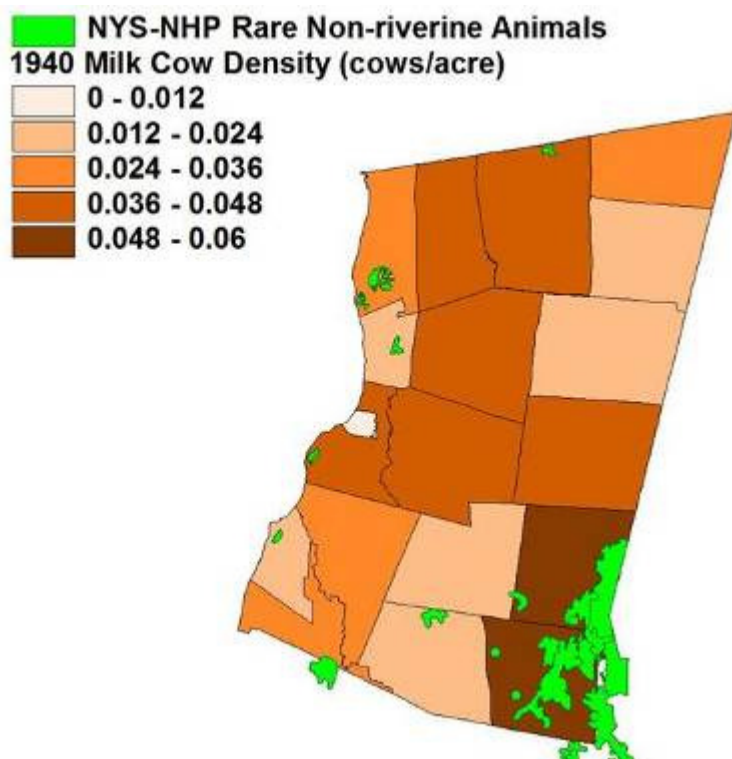


Figure 32. Habitat for rare, non-riverine animals (as mapped by the NY Natural Heritage Program) and cow density in 1940. The center of mid-20<sup>th</sup> century dairy was in the southeast portion of the County. New York State has identified this region as the "Harlem Valley Calcareous Wetland" "significant biodiversity area" (Hudson River Estuary Program 2008).

**Analogies Created:** There are few direct structural analogies between cornfields and the habitats that native plants and animals have known evolutionarily. However, in terms of nutrition, a 'neighborhood' cornfield might be somewhat equivalent to the food resources that wildlife found in mastings forests – chestnuts, acorns, hickory nuts, beech nuts all are produced irregularly but in large quantities. Such "mast years" have long been recognized as important nutritional bonanzas for native wildlife. Indeed, it appears that the Passenger Pigeon's natural history, which included huge flocks that wandered over vast areas, was predicated on taking advantage of such blooms. Other birds and mammals such as Turkey, Bear, Raccoon, Squirrel, Rabbit, Deer and various mice have reproductive strategies that can result in quick increases in fertility when food is flush. As a source of highly localized and concentrated potential food, cornfields might offer certain analogies to masting forests that elicit marked increases in animal fertility. A walk through and around many cornfields indicates the extent to which wildlife makes use of these fields as food sources, although not necessarily as habitat. Working in Illinois, Gehring and Swihart (2004) reported that small mammal biomass in fencerows separating crop fields (mainly corn and soy bean) was four times the levels found in forests. Such uses are not necessarily desiderata of the farmers, yet several we have spoken with in the County recognize the importance of their fields for wildlife and build a certain level of crop loss to wildlife into their calculations. In conjunction with the increase in corn-consumers that such fields facilitate, predators such as bobcat, and coyote may take advantage of the increase in prey (e.g., Gosselink *et al.* 2003, Gehring and Swihart 2004). The use of cornfields by birds (e.g., Blackbirds, Turkeys) is well known. The potential role of cornfields in encouraging predators has probably taken on added significance in the second half of the 20<sup>th</sup> century as the increase in forested area and the reduction in hunting in the County and the Northeast encouraged predators to return. In addition to food sources, the adaptable coyote has also been reported to use cornfields as daytime shelter (Gosselink *et al.* 2003).

**Technological Developments:** We have already alluded to mechanization and technological development in relation to hayfields and apple orchards; those developments were perhaps even more conspicuous in relation to cornfields. At least two specific aspects of agricultural development are worth noting here: drainage and agrochemicals. The influence of mechanization on field size and distribution, also discussed under haying, is likewise relevant to cornfields (and other crop fields, Figure 33). Below, we summarize the data we have found regarding drainage, agrochemical use, and the adoption of no-till techniques in Columbia County.



Figure 33. Aerial photographs from 1948 and 1959 of Kinderhook farmland; note the removal of hedgerows and resulting increase in field size over this ten year period.

Wetlands offer ‘feast and famine’ for agriculture. Swamp soils, (commonly referred to as muck) are often dark with the accumulation of organic matter that has been preserved by water-logged conditions. Likewise, wooded floodplain can accumulate the nutrients and soils that have washed down from higher in the watershed. Such soils are precious for farmers, especially those raising demanding crops such as corn and vegetables; the down side is the regular or occasional overabundance of water. Drainage offered a way for farmers to have their cake and eat it too.

Drainage with clay tiling began to take hold in NYS after 1850. It allowed farmers to claim lands that were previously too wet to support anything more than occasional hay cuts. Once drained, many of these soils were rich in organic matter and offered high yields, at least initially. With the advent of drainage, the floodplain lands became divided into those drained and then used for crops and those that were left in hay and then, with the decline in the hay markets, eventually began to revert to floodplain or swamp forest. While drainage continues to be installed on some

lands, many of the older drains have collapsed and aerial photographs indicated the return of wetlands to many areas between the 1940s and present day.

This history of drainage clearly has interacted closely with natural habitats in the county. Standing water or regular floods impose particular ecological requirements on native organisms and unique habitats result – red maple swamp forests, buttonbush swamps, Sycamore floodplain forests are all shorthands for the unique cover types, with their associated organisms, that can occur on these lands. Based on our own surveys, we estimate that some 40-60% of the plants, birds and butterflies found in our wetlands are deemed of conservation interest because they are rare and/or showing demonstrable population declines. The New England Cottontail, a species whose listing as an Endangered Species is pending, may have favored some of the shrubby cover associated with damper sites (Fuller personal communication). Statewide, wetlands are estimated to have decreased by 60% since 1790 (Dahl 1990). The 1923 soil survey of the County (Lewis and Kinsman 1923) lists 19,328 acres as being in muck and wetland while 1993 remote censusing by the IRIS program of Cornell put wetland area at 5,620 acres. Obviously, the techniques used in these two studies differed, although, substantial wetland decreases are suggested. Associated with dairy farming (and hence, indirectly with cornfields) was the rise of on-farm ponds for erosion control, cattle watering and irrigation. Although that jump in ponds has been eclipsed by landscaping fashion that seeks to emulate the pastoral landscape, pond area probably did increase over this period (Figure 34). However, from a nature perspective, knowing what habitats were replaced (many ponds went into former, more ecologically diverse wetlands) and how those ponds were managed (farm ponds did tend to be more diverse than landscaped ponds in Columbia County, although part of this may have reflected the loosening up of management during agricultural decline) is central and we have little historical information (Vispo and Knab-Vispo 2007).

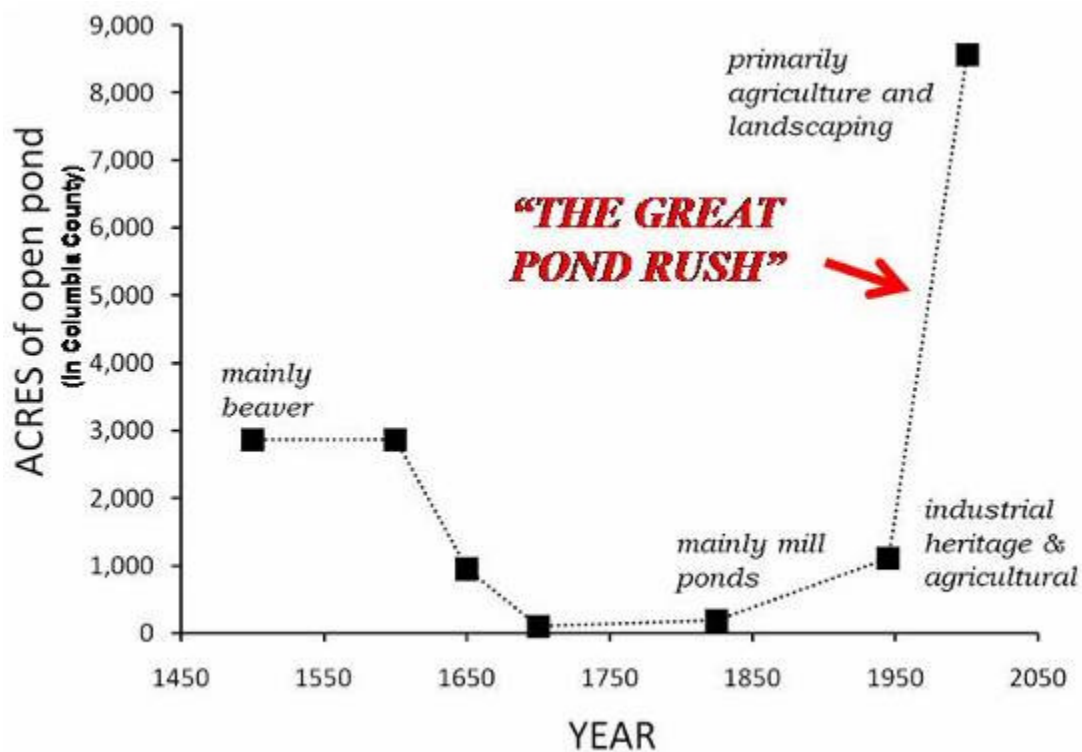


Figure 34. The estimated course of pond area in Columbia County. Most of the increase between 1850 and 1950, and part of that between 1950 and 2000 was probably due to agriculture (see Vispo and Knab-Vispo 2007 for details).

There is a paradox here in that farms have been both the bane and the blessing of wetlands in Columbia County. Certainly, farmland drainage and clearing has resulted in significant loss or modification of wetlands, yet at the same time, because of the agricultural desirability of valley soils, the majority of wetlands do occur on farms. When managed in a compatible way (e.g., occasional grazing), farms can help maintain important wetland habitats, such as the open wet meadows that are ecologically analogous to beaver meadows. Commercial and residential development

is often less kind – few regulations govern the use of wetlands of less than 12 acres, i.e., the small wetlands which, together, probably account for the majority of wetland in the County.

The use of pesticides and herbicides influences the ecological quality not only of cover-type upon which those substances are applied, but also the habitats to which those chemicals spread. Because of the location of many cornfields, agrochemicals applied to cornfields may regularly leach into adjacent streams. Below, we describe the information available regarding agrochemicals in Columbia County waters and their effects (or lack thereof) on local stream organisms.

Prior to the advent of Round-up Ready corn, Atrazine and related chemicals were probably the most commonly applied cornfield herbicides. Because of concern about its potential as a carcinogen, Atrazine has been banned from some EU countries and, in the late 1990s, studies were done in the Hudson Valley to look at the concentrations of these chemicals in surface waters; these studies included waters in Columbia County (Figure 35).

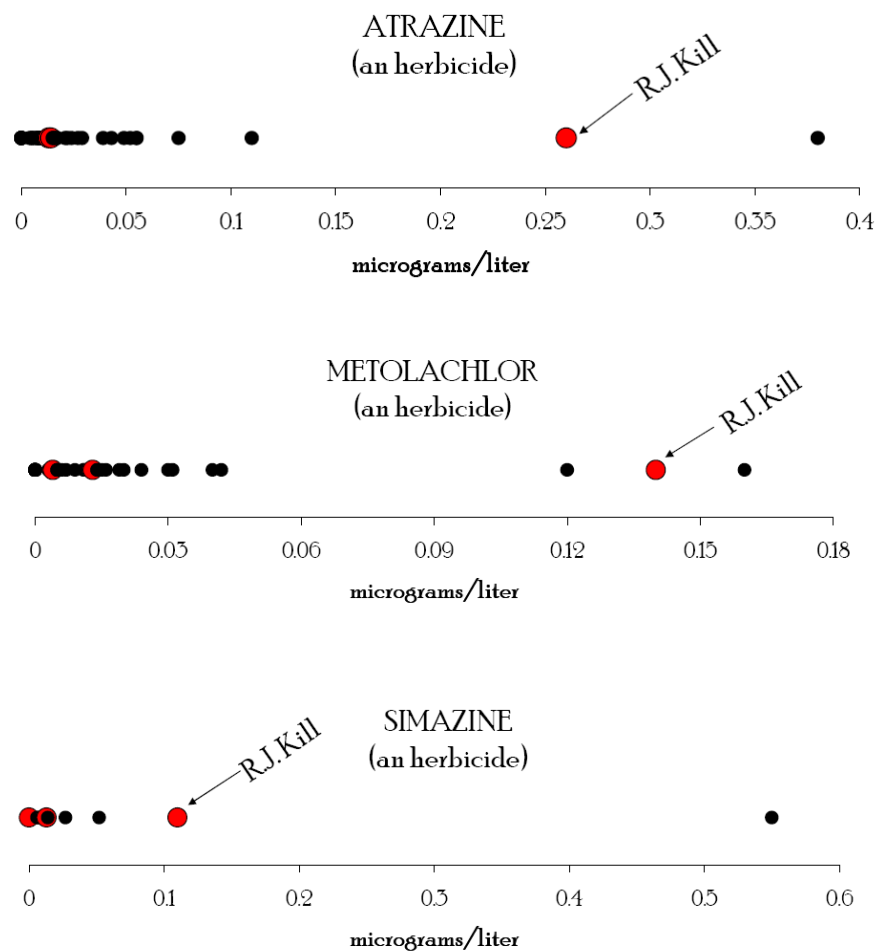


Figure 35. The concentration of various herbicides associated with corn production in the waters of Columbia County (RED circles) and elsewhere in the mid-Hudson Valley (BLACK circles). Date from Wall and Phillips 1997.

The RoJan Kill which drains the major corn-producing lands of Columbia County showed relatively high levels of these three chemicals suggesting that corn production, at the scale practiced in Columbia County, was having measurable influences on water composition, although the levels recorded were less than those believed to threaten stream ecology or public health (Atrazine guidelines <http://www.ccme.ca/sourcetotap/atrazine.html>; drinking water: 5 microg per liter; influence on aquatic ecology: 1.8microg per liter). Recent studies of benthic macroinvertebrates (i.e., largely the aquatic larvae of Mayflies, Stoneflies, Black Flies and other organisms) suggest that stream ecology is generally good. In Columbia County, nutrient enrichment (from agriculture or leaking septic systems) is the primary cause of any impairment rather than herbicides or pesticides, although one study hinted at toxin effect in the Roeliff

Jansen Kill (Hudson Basin River Watch, Murray et al. 2002, pers. observation). Another potential impact of cornfield herbicide use on semi-natural habitats might come through herbicide drift, but we have no data on that for our region. No-till corn production was heralded as a way of reducing not only soil erosion but also herbicide use. It has been accepted by some farmers in the County, although reports suggest that, if anything, it has been associated with increased herbicide use at least when assessed at a national scale (Benbrook 2001).

Some insecticides are also used on corn. Root worm, corn borer, and cut worm are among the insect pests that affect corn, although it appears that insect pest problems are primarily controlled by rotation or other management practices. Short of aerial spraying, cornfield pesticide application is difficult once the plants begin to grow. At present, pesticide sales data suggest that fruit orchards and lawns/golf courses, rather than cornfields, receive most of these chemicals (2005 PRL report, NYS DEC, available on-line at <http://www.dec.ny.gov/chemical/37825.html>).

### Farmland Abandonment: Creating Transient, Wild-crafted Analogies

Improved acreage in the County began a steep decline after roughly 1900 (Figure 36, Figure 37). Abandonment had at least two general ecological consequences: First, it allowed some land to eventually revert to conditions somewhat similar to pre-clearing and, second, in the process, it created extensive new, highly transient habitats of shrubland and old field. These habitats had probably rarely been completely absent from the County, either for natural reasons (fire, flooding, wind-throw) or human-causation. However, such habitats now spread to encompass novel extents of the landscape, and this meant new opportunities for native organisms.

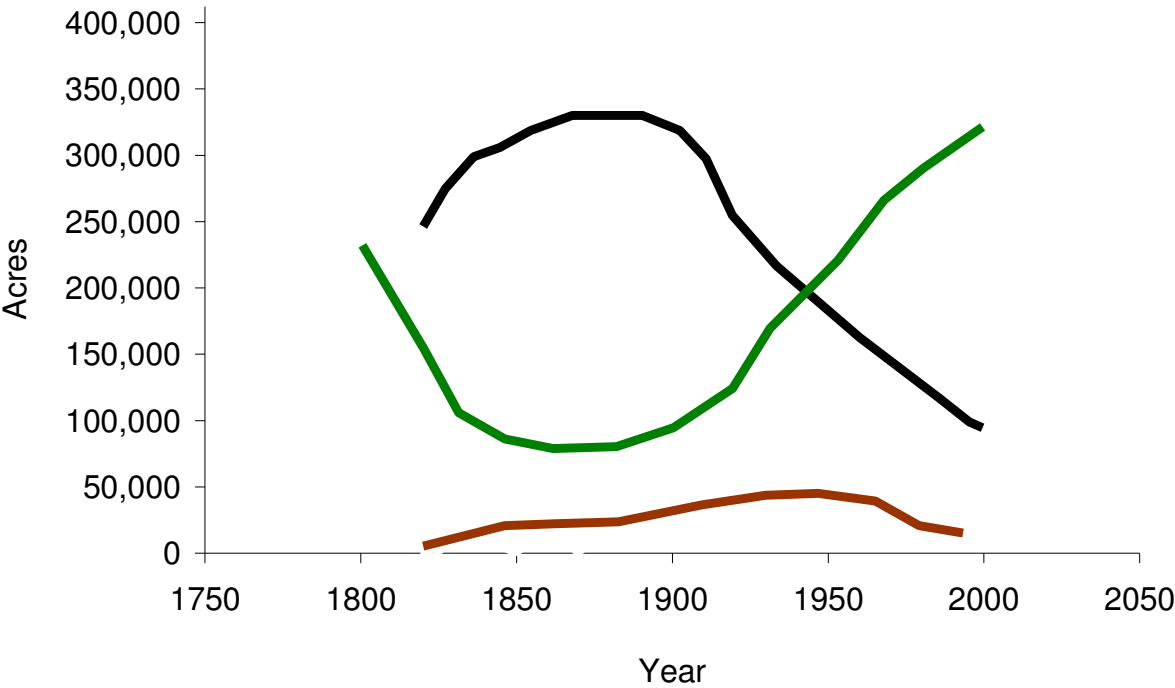


Figure 36. Census data and extrapolations indicating the course of land use in Columbia County. Improved acreage (black line) is from census data, wooded acreage (green) is partially extrapolation from land not in other uses and from forest cover estimates done by the State, shrubland extent (brown line) is estimated based on change in forest extent.

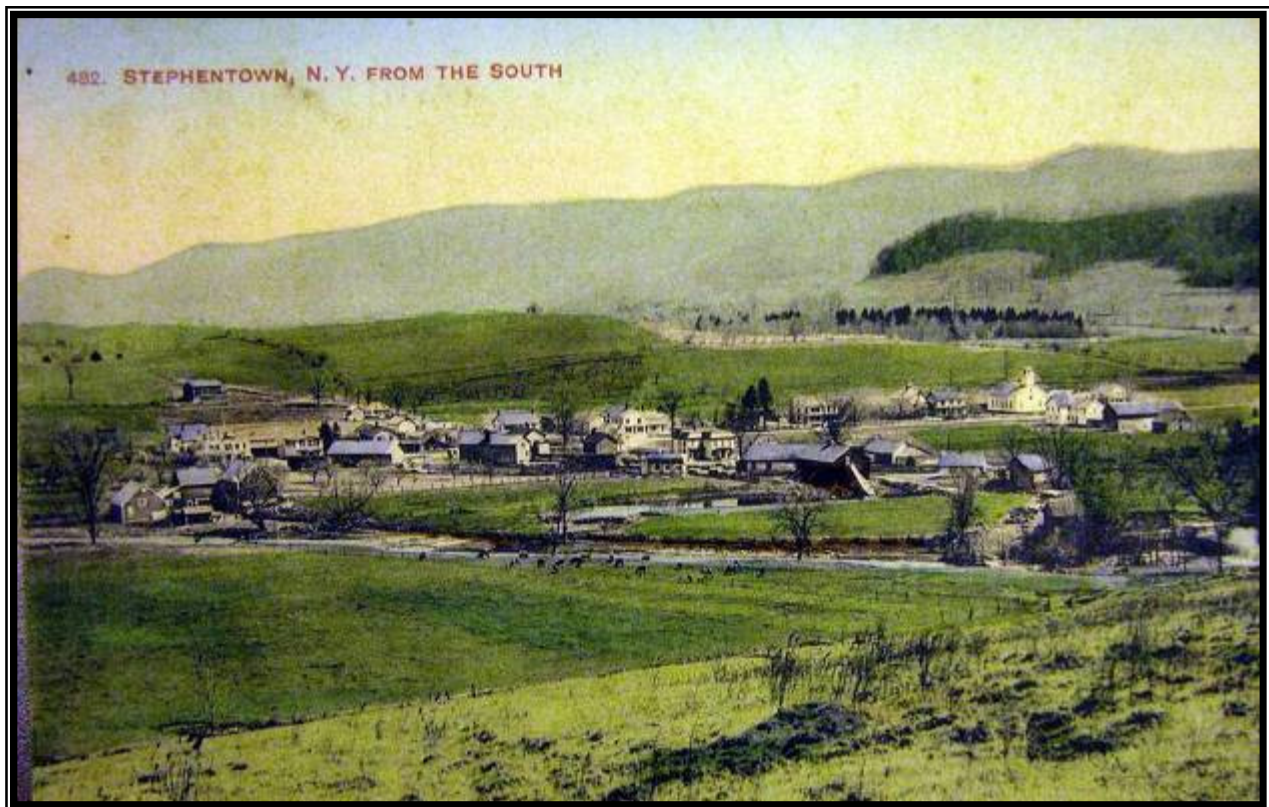


Figure 37. A turn of the 19<sup>th</sup> century, colorized postcard from Stephentown (in Rensselaer County, just north of Columbia County). The land is still very open but note the shrubs creeping into the foreground.

To understand the resulting ecological patterns, it is important to better understand the patterns of abandonment. Table 3 shows how, at least in one eastern town, it was the steeper, higher terrain that was first abandoned (Figure 38a). These also tended to have poor quality soils and were more likely to have a northerly exposure. The 1923 soil survey of the County (Lewis and Kinsman 1923) notes the presence of abandoned farms on the eastern hills; an observation confirmed by the analysis of census data (Figure 38b). The hilltops and ridgelines, rarely used for agriculture or abandoned much earlier, were covered by extensive patches of forest where forest-interior animals, such as those mentioned in our initial description of forest clearing, could experience a sheltered existence until fashion, affluence, and engineering combined to make them favored housing locations.

However, abandonment was not solely determined by suitability for farming. Changing markets for agricultural products and newly emerging demands on former farmland for residential development were among the other factors that patterned which land was abandoned. The rise of grain-based dairying resulted in the abandonment of peripheral

Table 3. A comparison of certain landscape characteristics on abandoned and active farmland in the Town of Hillsdale. Soil quality rank is based on USDA agricultural production data (USDA 1986). Data are based on a GIS analysis of randomly placed points within the Town. Each category was represented by 25 points, and the values represent the averages for each set of 25 points.

	Soil Quality Rank (from 0 to 6 with 6 being best)	Elevation (meters)	Incline (ratio of drop to run)	Exposure (ratio of southern to northern)
<b>Timing of Agriculture</b>				
<b>None Evident</b>	1.6	338	0.24	1.36
<b>Pre-1940s, not 2006</b>	1	314	0.13	1.09
<b>1940s, but not 2006</b>	2.7	269	0.13	4
<b>1940 &amp; 2006</b>	3.9	262	0.13	2

lands previously used for haying or pasturing. Housing development is a growing influence. For example, the series of images from the route 9 corridor in Kinderhook (Figure 39), which is classified as prime farmland, suggests that orchards were the first agricultural grounds to be lost to housing development after the 2<sup>nd</sup> world war, when apples began to be shipped to New York from Washington state or even the southern hemisphere. With the drastic decline of dairy farming since the 1980s, more and more former corn fields were subdivided. These images also illustrate another aspect of farmland abandonment – not all of it reverted to semi-natural habitats. The flat lands of Kinderhook, good for growing and close to the markets of Albany, have also proved good for housing development. They are simple to build on and their location is suitable for Capitol District commuters. The suburban lawns surrounding most such homes are not a suitable habitat for many native plants and animals.

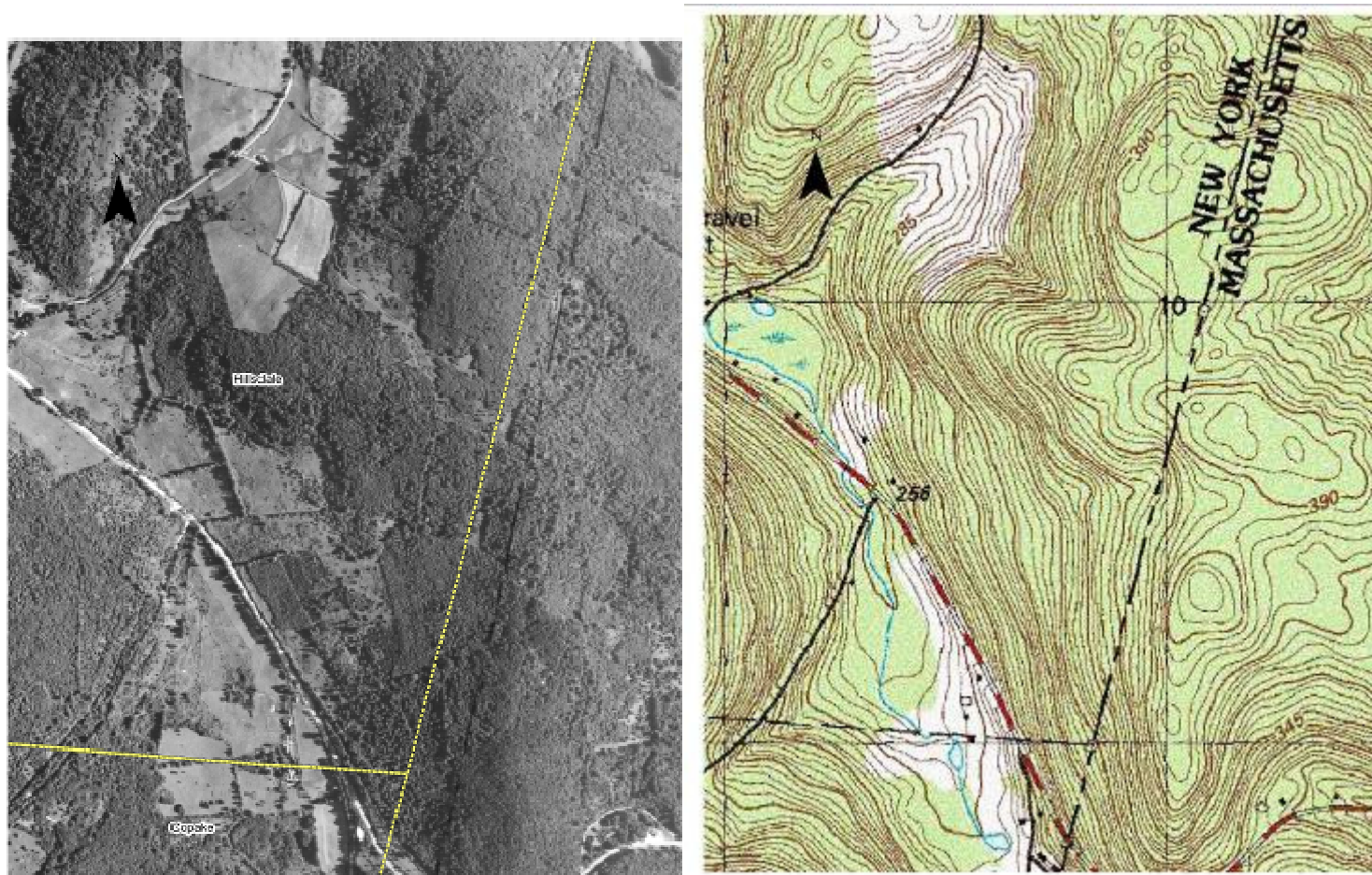


Figure 38a. A 1942 aerial photographs of southeast Hillsdale matched with a topo map of the same area. Notice the outlines of old fields evident in hill portion of the 1942 aerial photograph. Active agriculture remained in the valleys.

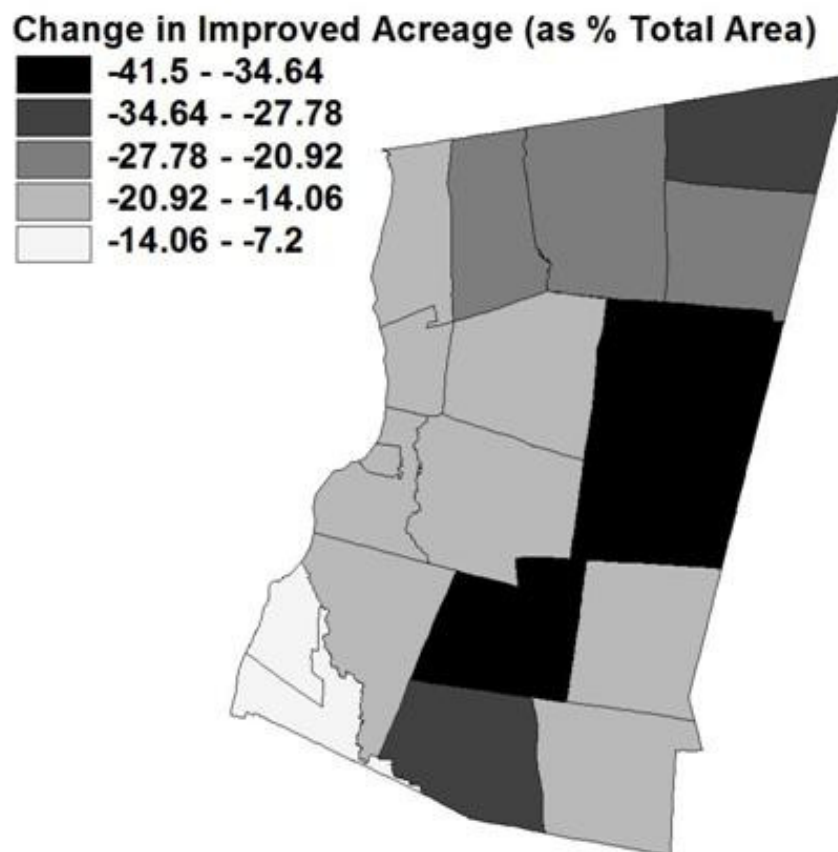


Figure 38b. Change in improved acreage from 19<sup>th</sup> century maximum and 1930, expressed as percentage of total surface area of each town. Data from US Census.

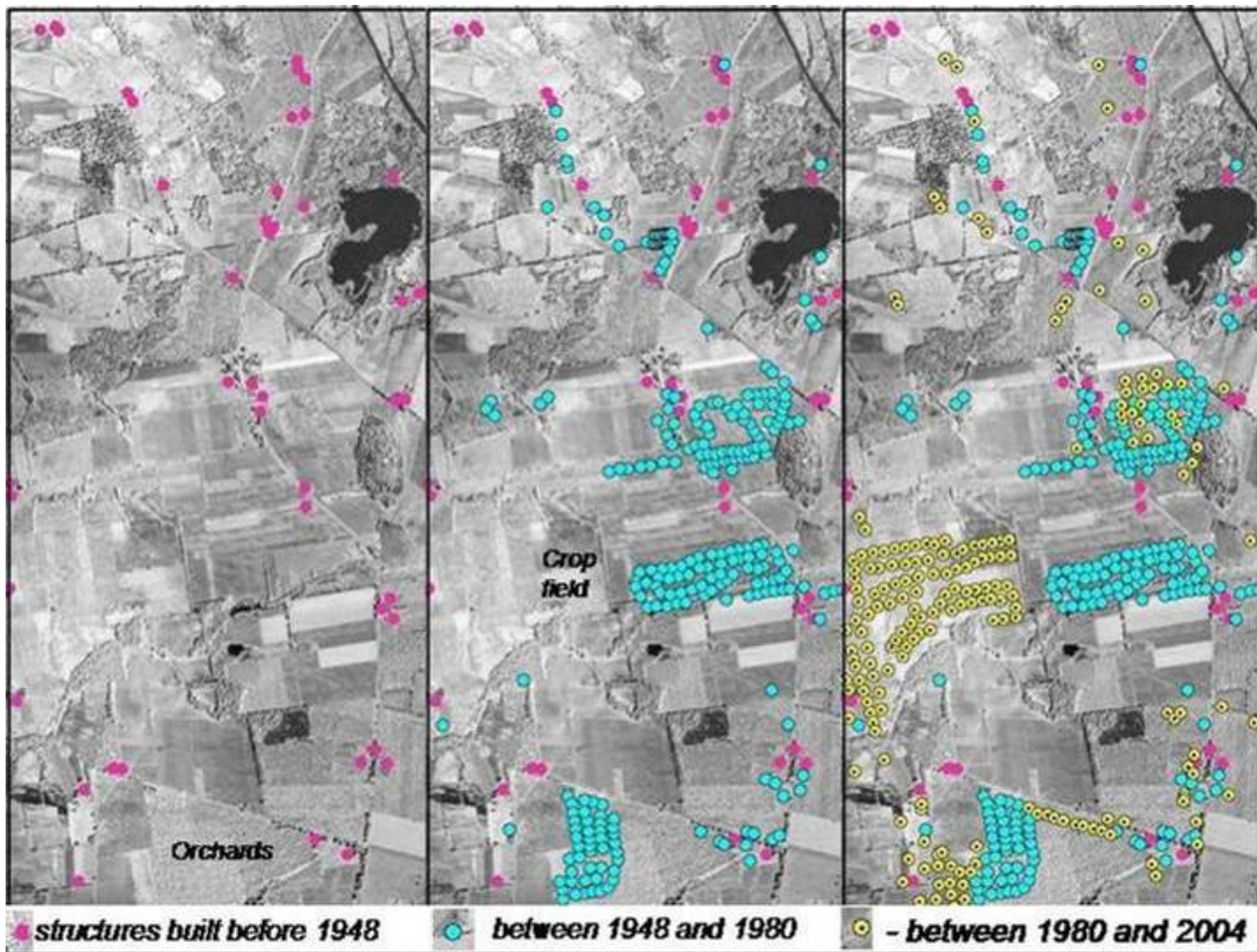


Figure 39. The course of housing development along the Route 9 corridor in Kinderhook. Houses tended to be first built on orchard land, then on field crops.



Figure 40. Aerial photographs from 1942 (left) and 2004 (right) of wetland sites in the Towns of Ancram (top two photos) and New Lebanon (bottom two photos). Yellow arrows on the more recent photos indicate the location of modern wetlands that are much more reduced in the older images; topo lines have been included on the New Lebanon photograph to help with orientation and understanding of land use.

Abandonment not only meant direct changes in surface cover but also abandonment of drainage maintenance. Many fields that were probably wet meadows in the 1820s were likely drier land by the end of the century, and persisted as such until the lack of drainage maintenance or intentional buffering saw them return to larger wetland in the last quarter of the 20<sup>th</sup> century (Figure 40).

The succession, the term applied to the ecological process that occurs as natural communities age, meant that open pastures and hay meadows, if left to their own devices, grew into old fields, filled first with weeds and native herbaceous plants (e.g., goldenrod), then were covered by shrubs (e.g., dogwood), and finally were slowly enveloped by forest (with ‘pioneer trees’ such as Grey Birch, White Pine or Ash often leading the way). However, as early ecologists quickly realized, succession is not a ‘one-size fits all’, deterministic process, but rather a general tendency amply colored by historical baggage, local particularities, and chance (see Wessels 1997 for a nice discussion). For example, pastures, especially those that were gradually abandoned with lighter grazing preceding total abandonment, usually passed through a thorny shrub stage, dominated in our area at least, by Hawthorn, Raspberries and Blackberries, Buckthorn, Multiflora Rose (after its mid 20<sup>th</sup> century introduction) and Red Cedar. Ploughed fields that were abandoned suddenly might, on the other hand, transition rapidly to a forest composed largely of that wind-

dispersed tree species that happened to be nearby and having a good seed-production year at the time of abandonment. Alternatively, hayfields might have stuttered somewhat as tall herbaceous growth delayed the advance of woody plants. These differing scenarios resulted in habitats for differing species.

Figure 36 shows the estimated extent of forest and shrubland in the County. Early forest cover was calculated as the remaining difference after improved acreage and non-wood acreage were subtracted from the total land area; for later dates, direct estimates of forest cover have been published. “Shrubland” was calculated based upon change in forest cover and the assumption that land which was subsequently forested was previously shrubland. Given all these “estimates”, the illustrated patterns are rough, but they do clearly show the rapid reforestation of the county and the shrubland ‘peak’ that occurred in the first half of the 20<sup>th</sup> century. The extent of ‘old field’ is hidden somewhere in the ‘shrubland category’, although it could perhaps be extracted by detailed analyses of historical aerial photographs. A glimpse of this period is provided by pollen core data from nearby Stockbridge Bowl in Berkshire County, Massachusetts (Figure 41). From the late 1700s through the early 1900s, forest trees decline and grasses, native field weeds and native wetland plants increase. Dramatic changes occur between 1900 and 1950, when most field plants drop dramatically, and early forest trees and then mature forest trees begin to increase, along with a slight increase in shrubland vegetation. Aside from helping document the general chronology that we mentioned, these data also hint at substantial ‘weediness’ in fields, implying a somewhat diverse ecological system, perhaps with some ‘space’ for native organisms. The wetland plant peak is intriguing, although it may principally reflect specific land management around the edges of this particular lake.

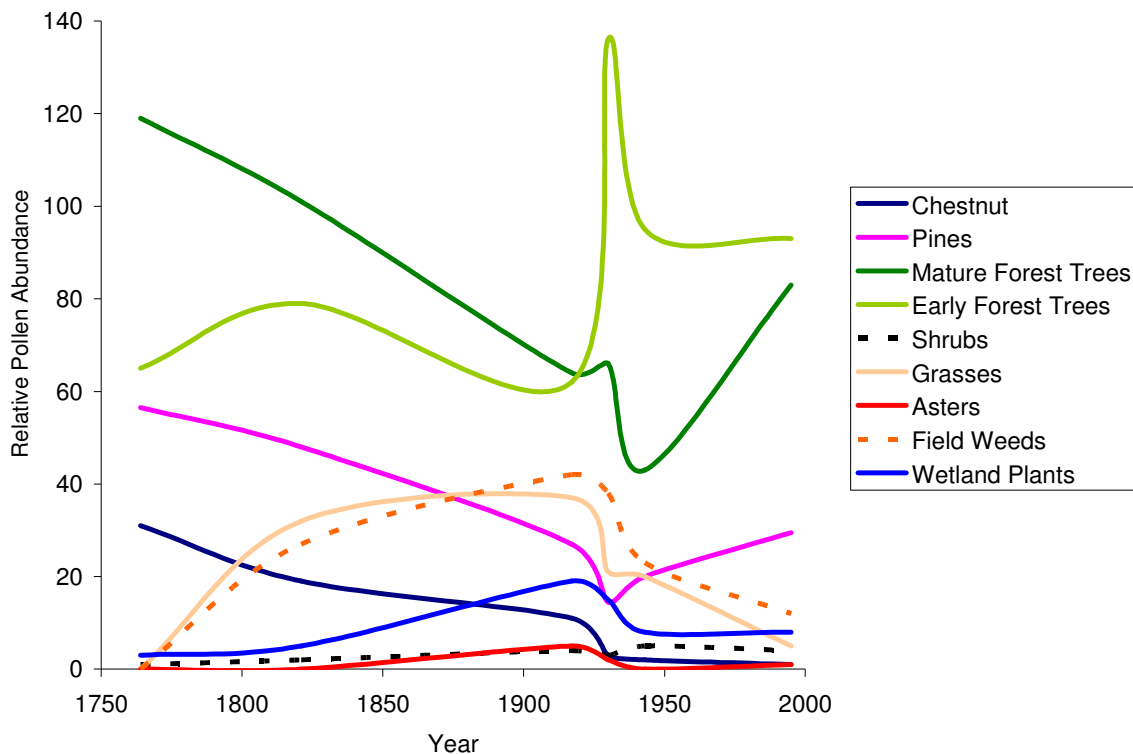


Figure 41. Relative pollen abundances from Stockbridge Bowl in neighboring Berkshire County. Plants differ in the amount of pollen they produce, the dispersal ability of that pollen and its detectability, so comparison of amounts across groups is somewhat meaningless, but comparisons within groups across time have value. (Pollen data provided to the North American Pollen Database, [ncdc.noaa.gov/paleo/napd.html](http://ncdc.noaa.gov/paleo/napd.html), by W.A. Patterson, III.)

From an animal ecology perspective, it is perhaps the shrubland that is most interesting. While ‘mature hayfields’ welcome bobolinks and, sometimes, meadowlarks, these birds did not seem to be particularly common in old fields dominated by rougher native ‘weeds’ such Goldenrod and Ragweed and the beginnings of shrubby vegetation. It appears that the ecological analogies to these birds’ native prairies break down when the fields become dominated by forbs. John Torrey (1843) reported goldenrod as a weed of roadsides and edges; our typical goldenrod-dominated “old fields” are a new thing. Even the butterfly community of old fields seems relatively unspecialized and dominated

by those species typical of edges and hay fields. It may be that natural upland fields were rarely an extensive part of the regional landscape and thus there are few species adapted to them. Similarly, the shrublands that develop from old fields in our area do not contain unique plants that are important for butterflies and moths; the ecologically important shrubs for butterflies and moths are those that are or simulate blueberry and scrub-oak dominated barrens (Wagner et al. 2003). Nonetheless, as noted earlier in relationship to pastures, when these old fields are on dry, poor soil then they do provide home to some native plants (such as the ones mentioned earlier in the section on ecological analogies created by pastures) and, in turn, native butterflies. Wet old fields (i.e., areas reverting to wet meadow) and shrubland do host a variety of native plant and animal species which may find these areas analogous to the succeeding beaver ponds and stream edges they had long co-evolved with. In addition to the wet meadow herbs listed earlier (in the section on Early Meadows), native shrubs such as Dogwood Species, Arrow-wood, Nannyberry, willow species, Swamp Rose, Meadow-sweet and Steeplebush colonize wet old fields. Butterflies such as Mulberry Wings, Long Dashes and Browns are sedge specialists that probably responded to the increase in wetlands. Birds such as Brown Thrasher, Mockingbird, Field Sparrow and others (Figure 42) expanded into wet and dry shrublands.



Figure 42. An image of shrubland birds by Louis Agassiz Fuertes from his illustrations for the *Birds of New York* (1910); the plants illustrated are Hawthorn and Raspberry, typical plants of the middle stages of pasture to woodland succession.

After old field and shrubland came forests. The reforestation of the Northeast, accompanied by reductions in hunting/trapping and intentional reintroductions has had a huge effect on regional wildlife (Foster et al. 2002). Many native species which had largely disappeared prior to 1800 have returned. Moose, Fisher, Bobcat, Black Bear, and Wild Turkey have all become substantially more common in Columbia County during the past 30 years as they spread from historically more wooded refuges or were intentionally reintroduced to a now-more-hospitable landscape (pers. observation; Figure 43). Deer were among the first to return (Figure 44, in part because those old fields and shrublands that followed agriculture provided ideal habitat (as does some current residential landscaping). Hunting has also declined in popularity. The result has been a swelling of deer numbers to the point where forest succession is likely being affected. Coyote, although not originally native to our area, has entered, perhaps as an ecological substitute for the Wolf. However, as we have discussed earlier (Figure 19), these secondary forests are far from complete botanical restorations of pre-European settlement forests. Tree diseases, selective logging, and natural patterns of tree species succession are all factors that contributed to this change in tree species composition. Furthermore, the herbaceous plants in secondary forests usually have to contend themselves with thinner, dryer and poorer soils than those of pre-settlement forests (McVaugh 1958). Although we do not have rich data on the ground flora of pre-settlement forests in the County, we suspect that poor-soil species like Pennsylvania Sedge, Wild Sarsaparilla, Canada Mayflower, and Starflower have become more common overall at the expense of rich soil species such as Blue Cohosh, Bloodroot, Wild Ginger, Jack-in-the-Pulpit, Red Trillium, Wild Leek, etc.

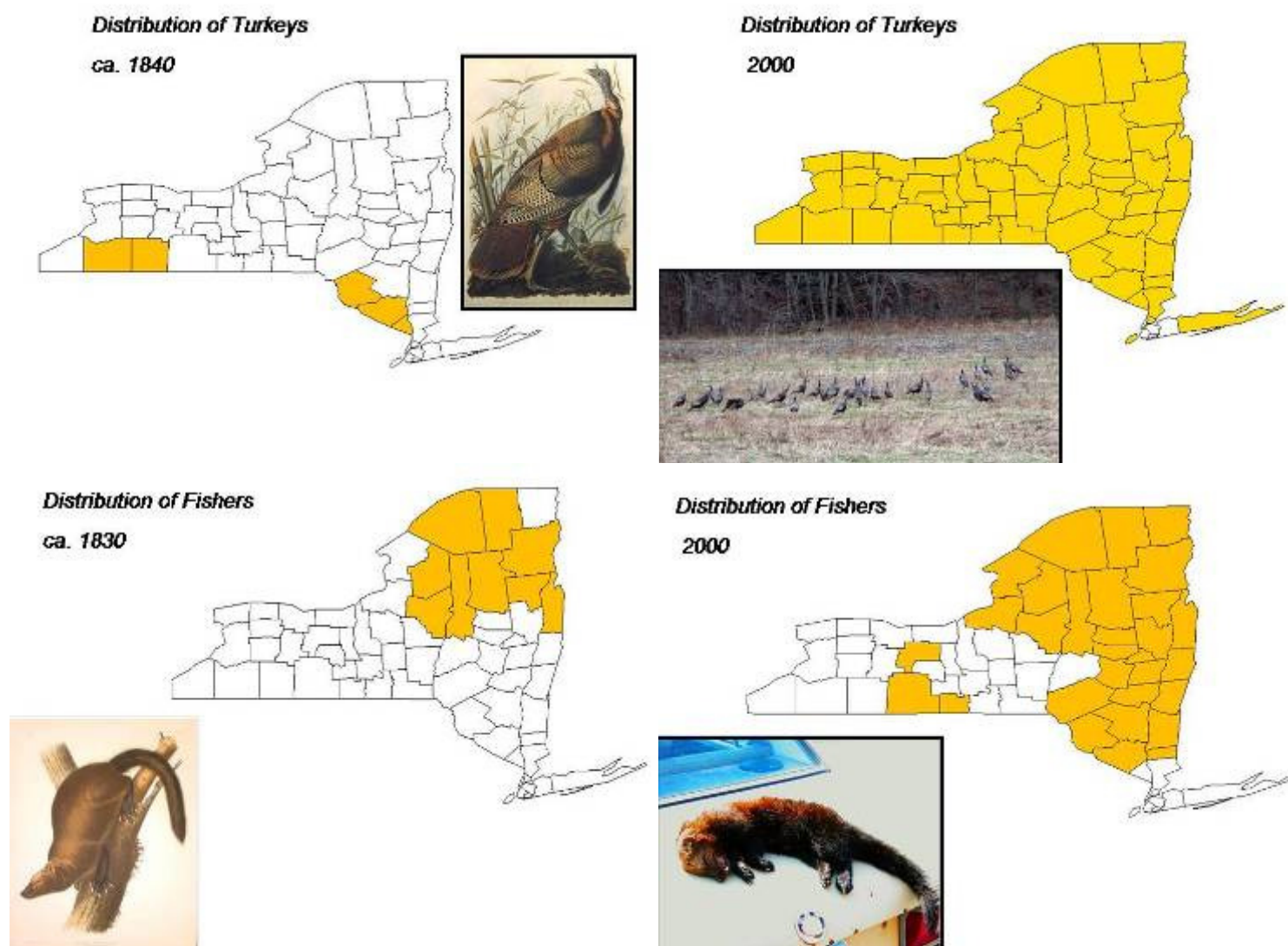


Figure 43. The expanding distributions of two species of forest wildlife, Turkey (top) and fisher (bottom). Historical data from DeKay ; historical images from Audubon; current data from Whitaker (unpublished) and McGowan and Corwin 2008.

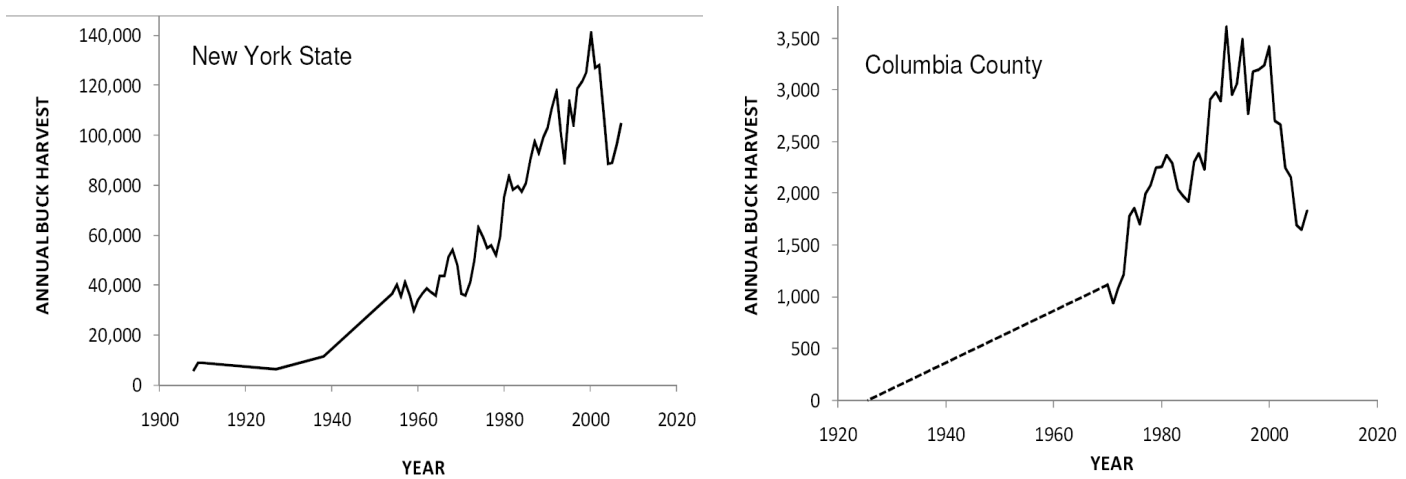


Figure 44. Buck take for New York State (left) and Columbia County (right). At the end of the 19<sup>th</sup> century, almost all deer were confined to the Adirondacks. Recent drops in harvest may partially reflect declining hunter numbers. Between 2002 and 2007, New York State big game license sales declined more than 7%; in Columbia County total, resident hunting license sales declined more than 15% over the same period. Data NYS DEC.

The effects of the County's changing habitats is reflected in breeding bird survey data collected by volunteers in the County during the annual breeding bird surveys (Figure 45a). One group of birds showed marked declines while another evidenced strong increases. However, the two groups are not easily distinguished ecologically. While declining species included some prominent grassland birds (e.g., Vesper Sparrow, Meadowlark, Grasshopper Sparrow and Horned Lark), this group also included at least one (early) woods bird, the Wood Thrush. Likewise, increasing species did include a pair of forest species (Pileated Woodpecker and Turkey), but at least two grassland species (the Bobolink and Savannah Sparrow) and several shrubland birds. The apparent trends probably do reflect real local and regional decreases in many grassland species and increases in forest species, coupled with a mixed bag for shrubland birds. For migratory species, some of these changes may reflect influences occurring far from Columbia County. Recent statewide data (McGowan and Corwin 2008) support these general trends with grassland birds declining noticeably, shrubland birds holding more or less constant, and forest birds increasing noticeably; statewide data also show a gradual decline in Bobolink and Savannah Sparrow numbers, but the authors remark that most other grassland birds have declined much more dramatically.

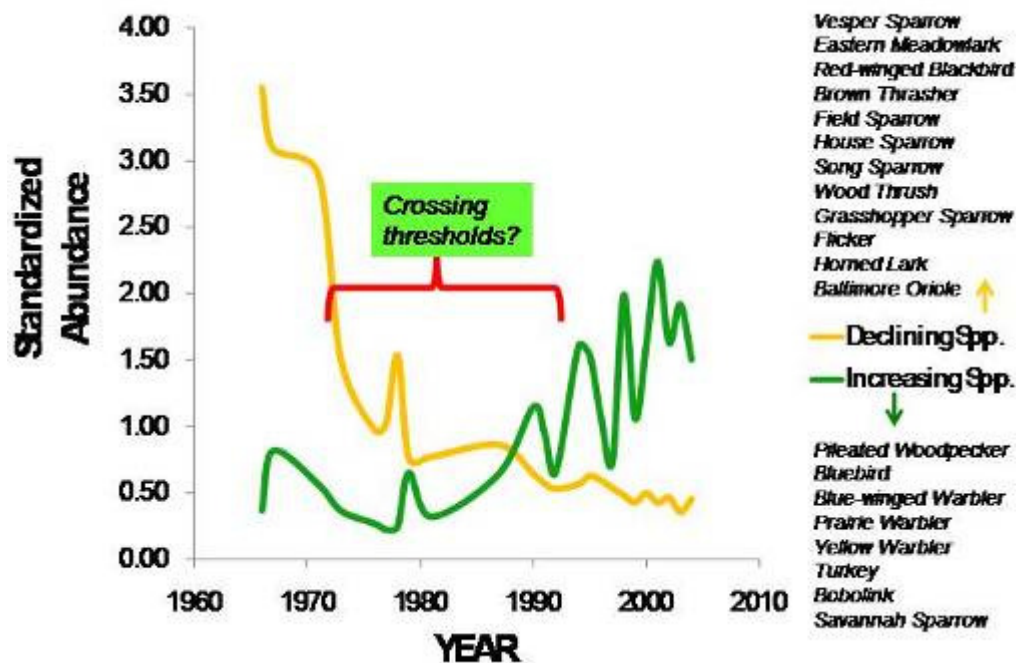


Figure 45a. The standardized abundances of birds along the Ghent and Austerlitz Breeding Bird Survey Routes, 1966 to 2004. Birds were grouped according to demographic trends, with increasing species shown in green and decreasing species in yellow, see text for discussion.

The majority of our farmland has already converted to other uses. We are currently at a stage in the County when relatively little new habitat is being created – the vast majority of lands that will revert to forest have reverted, little new openland is being created, and relatively few existing openlands are being allowed to succeed to brush. Regionally, the main determinants of landscape composition are now residential and commercial development. Current regional conservation foci (e.g., Hudsonia, Audubon New York, the North American Butterfly Association) in part reflect the above distinctions, with growing concern about loss of grassland and shrubland,

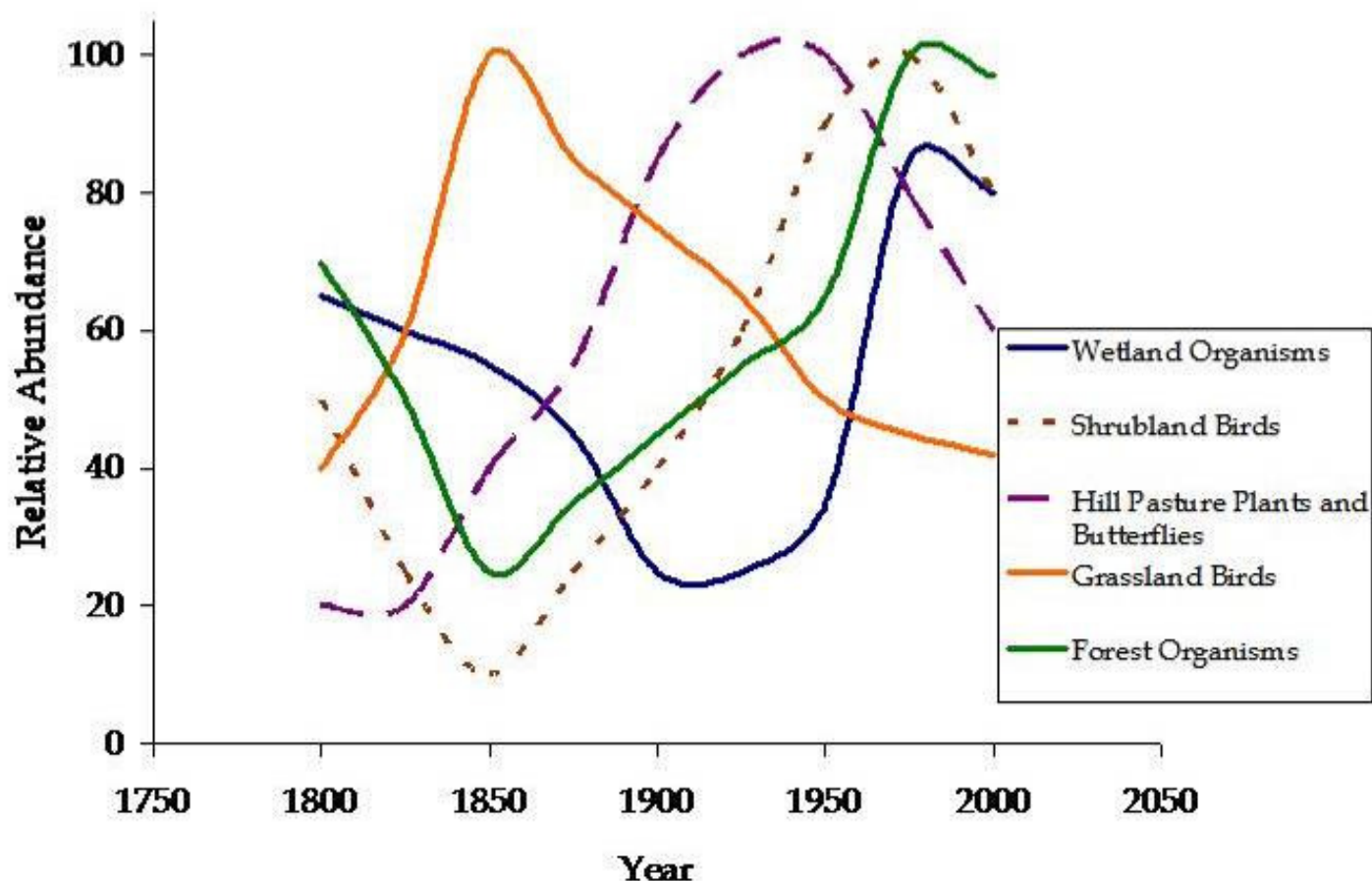


Figure 45b. A graphic approximation of the county-wide relative abundance of select ecological groupings of organisms. Inspired by and compare with the figure in Foster et al.'s (2002) work on Massachusetts.

### Where are we now?

The current farmscape of Columbia County is the result of overlapping historical and ecological processes. Figure 45b outlines our approximation of the county-wide fluctuations in certain groups of organisms. In part, these fluctuations reflect the past interaction of farmers with the land as they searched for the locations and techniques most suitable to the crops they wanted to produce. In part, they reflect the response of native species to both the natural ecology of the landscape and to the alterations introduced by humans. Obviously in a county where land in farms currently accounts for only about 1/4<sup>th</sup> of the surface area, other land uses now play important roles in shaping the ecology. Nonetheless, agriculture remains a relevant factor, especially as one realizes that it is one of the few actions resulting in extensive early-successional habitats (fire and flooding having been largely regulated), that agricultural cover-types are likely more permeable to native species than the residential and commercial development which often replaces them, and that, at a national level, some of the habitats that agriculture can simulate (e.g. the analogies for the Prairies) have declined dramatically.

In this last section, we take an overview of where agricultural land in the County has been, is, and may be going. Paralleling overall declines in farmland, we estimate that all on-farm cover-types in the County have decreased

dramatically (Figure 46), including those of particular interest as native species habitat. For example, permanent pastures are at 6% of their historical maximum, hayfield at 31% of maximum, and old fields, wetlands, shrublands and other such lands (not distinguished in census data) at about 1/3<sup>rd</sup> of their historical peaks.

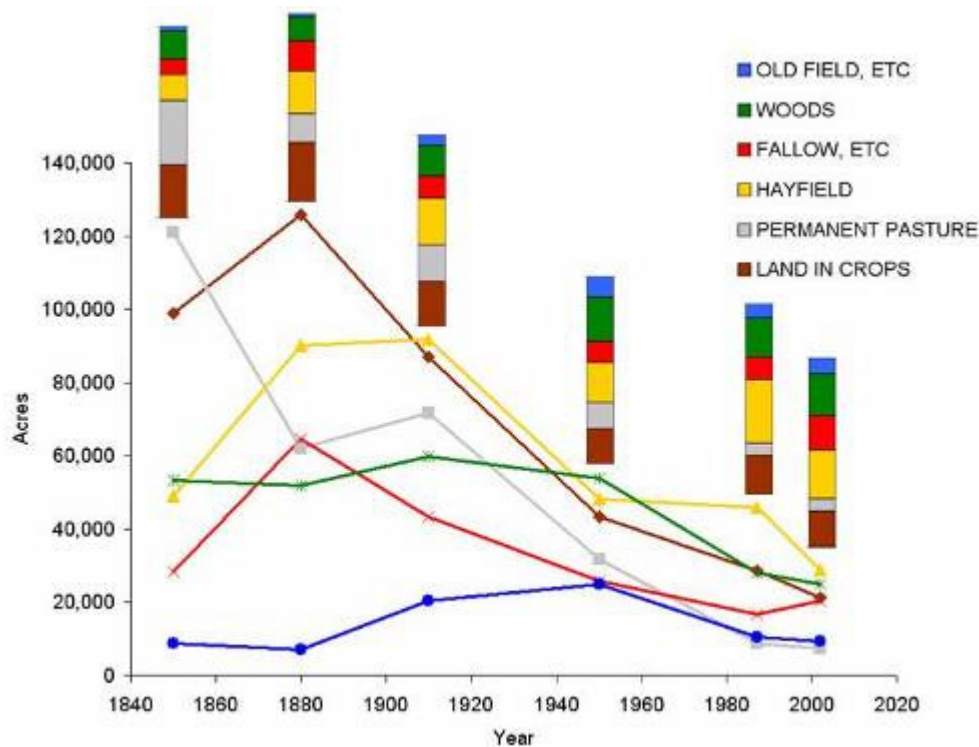


Figure 46. Acres of land in various agricultural cover-types in Columbia County. The bar graphs illustrate the proportion of farmland in each type of use and so summarize the ‘look’ of farmland in each period. “Old field, etc” refers to non-agricultural, non-forested land on farms and so includes not only old fields but also wetlands, shrublands, and farmyards.

To assess the potential ecological role of current agriculture in Columbia County, we conducted surveys of birds, plants, and butterflies on several county farms and used GIS to extrapolate those findings to the County scale (Vispo and Knab-Vispo 2006). We say “potential” ecological role because our sample of farms was composed of a few organic and small-scale conventional operations that are not necessarily typical of the average farm in the County.

We divided on-farm habitats into grasslands, wetlands, woodlands, and shrublands and surveyed each for species of conservation interest (i.e., species who are believed to be rare, worthy of protection, and/or declining at least regionally, Table 4). Not surprisingly given their historical predominance, woodlots house our greatest number of native species; we considered about a third of them to be of conservation interest. While wet meadows, shrublands and grasslands tend to be home to fewer total species (with the exception of grassland butterflies, many of whom are relatively unspecialized openland species), a greater proportion of those species are of conservation interest. Croplands, as we have already alluded to, are home to few native species.

These patterns in on-farm covertypes take on ecological importance because farms are the main sources for some of these habitats in the County. If diverse grasslands (as opposed to lawns) were found extensively outside of farms in the County, then the fate of farmlands would be less relevant for the conservation of grassland organisms. However, this is not the case. Using existing remote sensing data and census information, we estimated what percentage of the total for each cover type in the County occurred on farmland (although not necessarily in land actively used for production; Table 5). Although the land classifications used in the remote sensing analysis and in the censuses are not identical, it is apparent that significant proportions of the open covertypes of interest occurred on farms at least in the early 1990s. It thus seems likely that the continued decline of farms in the County will contribute to a decrease in certain native species. Forests are obviously also important for native species conservation, but farms generally seem to play a minor role in providing habitat for most of these species. Nevertheless, the value of farmland as a

Table 4. The number of native species found in different on-farm cover-types during surveys of seven Columbia County farms. Modified from Vispo and Knab-Vispo 2006. See clarification of the criteria in the table notes.

	PLANTS		BIRDS		BUTTERFLIES		Average % Species of Conservation Interest
	Native Species <sup>1</sup>	% Species of Conservation Interest <sup>2</sup>	Native Species <sup>3</sup>	% Species of Conservation Interest <sup>4</sup>	Native Species <sup>6</sup>	% Species of Conservation Interest <sup>7</sup>	
Woodlots	114	21%	38	32%	5	40%	31%
Wet Meadows, etc.	48	40%	no data	37% <sup>5</sup>	5	60%	50%
Shrubland	13	85%	18	61%	9	25%	57%
Grassland	15	45%	13	92%	26	20%	52%
Cropland	0	0%	few	?	?	low	low

<sup>1</sup> - Native plants found to be exclusive to given habitat in our study of seven farms.

<sup>2</sup> - Plants of conservation interest are either NYS listed species (Young 2008), listed in neighboring states (<http://plants.usda.gov>), considered regionally rare by Hudsonia (Kiviat and Stevens 2001) or uncommon in Columbia County (personal observation).

<sup>3</sup> - Native birds found to be exclusive to be primarily associated with a given habitat during our study of seven farms.

<sup>4</sup> - Birds of conservation interest refers to species showing significant national declines in the national Breeding Bird Survey database (Sauer *et al.* 2007).

<sup>5</sup> - Wetland data refer to % of national species showing declines; we collected no county-specific list for this group.

<sup>6</sup> - Native butterfly species occurring in Columbia County and primarily associated with the given habitat.

<sup>7</sup> - Butterflies of conservation interest refer to those for whom published information (e.g., Cech and Tudor 2005, O'Donnell 2007, Kiviat and Stevens 2001) or personal observation suggest decline or rarity.

permeable corridor between forest blocks (in contrast to the relative impermeability of commercial or residential development) and the fact that on-farm woodlots may be some of our only relicts of certain types of 'ancient forest' mean that, even with regard to forest organisms, the ecological role of farms cannot be discounted.

Subsequent work (Vispo and Knab-Vispo 2007, Knab-Vispo and Vispo 2009) has highlighted the potential importance of land on farms in the management and ecology of ponds and floodplain forests. Much of the former still occurs on land owned by farms because good agricultural soils are concentrated along the river bottoms.

Table 5. A comparison of the estimated on-farm extent of particular cover-types (based on agricultural census data) to the total area of such cover-types in the County based upon remote sensing data (30m-resolution land cover map produced by IRIS at Cornell University).

	1993		
	County-wide remote sensing (acres)	On-Farm census data (acres)	% of Total on Farms
Woods	285,970	27,000	9%
Grassland (hayfield & pasture)	33,670-67,330 <sup>A</sup>	42,511	63%
Shrubland	7,520	9,215 <sup>B</sup>	70%
Wetland	5,620		

<sup>A</sup> - GAP analysis appeared to include most hayfield in its "cropland" category. (i.e., GAP cropland ≈ on-farm census cropland + hayfield).

<sup>B</sup> - This is the category "unimproved, unwooded" agricultural land, i.e., all farmland that is left after cropland, pasture & woods are removed; wetlands and shrublands would be here, but so too would farmyards and roads.

Urbanization would threaten these woodlots; our current study of floodplain forests in Dutchess County suggests that many forests in that county have suffered and continue to suffer extensive modification from non-agricultural uses. Likewise, old farm ponds often contain a more diverse ecosystem than those ponds installed as part of residential landscaping, largely because they are more lightly managed (e.g., less mowing of the surrounding banks, more tolerance of muddy or green waters).

In sum, there is good reason to believe that farmland can play an important positive role in the conservation of plants and animals in Columbia County. This is due to the fact that the County is already extensively forested, whereas openlands are comparatively rare. The relatively benign role of our county's agriculture may also partially reflect 'subdued' levels of current farming. Agricultural activity, especially if it were to be intensified again, certainly has the potential to negatively impact certain native species, and these potential impacts should not be ignored. Nutrient and agrochemical management along with habitat creation and loss need to be assessed on an on-going basis.

In considering the future of the agricultural and ecological landscape in Columbia County, we can look to recent history for trends. The current situation of agriculture in Columbia County is, simplistically put, both encouraged and discouraged by its proximity to New York City. While New York City (see an estimate of the 'foodshed' of New York City in Figure 47) and associated second-home owners (Figure 48) provide huge markets for the County's agricultural production, the land prices determined by the salaries of the urban population are much above what farmers can expect to earn from their land. Currently, farmland in the County is being offered for up to \$15,000 - \$20,000 per acre, obviously the buyers of such land are rarely farmers. Some farmers do establish workable relationships with non-farming landowners or with non-profits and so are able to work farmland that they don't own. Not only do land prices rise, but so does the overall cost of living as retail and service prices adjust to take advantage of the wealthier, urban-linked population. The result is an overall tendency for agriculture to decrease near the City (Figure 49), and for the production that does remain to focus on high-end production that gives relatively high returns per unit land used (Figure 47); often these are intensive, specialized organic vegetable growers or other niche farms whose operation may provide little extensive openland habitat. People continue to move from New York City into an expanding sphere of settlement around the city core (Figure 50). This movement is facilitated by improved transport and enhanced possibilities of telecommuting, and puts direct pressure on farmland. Between 1960 and 2000, the populations of a ring of suburban counties typified by Orange and Dutchess Counties in New York, Litchfield in Connecticut, and Morris County in New Jersey saw their populations rise by an average of almost 70%; during roughly the same period, improved acreage in farms in those four counties dropped by 48%. As with the agricultural land uses before it, residential uses (and their ecological effects) are not spread evenly across the landscape; commuters from the Capital District are, as mentioned earlier, primarily in the northwest portion of the County (about ½ of all employed residents in that region work in the Capital District), whereas the New York City dwellers have tended to buy second homes in the more scenic hills in the east portion of the County (Figure 51).

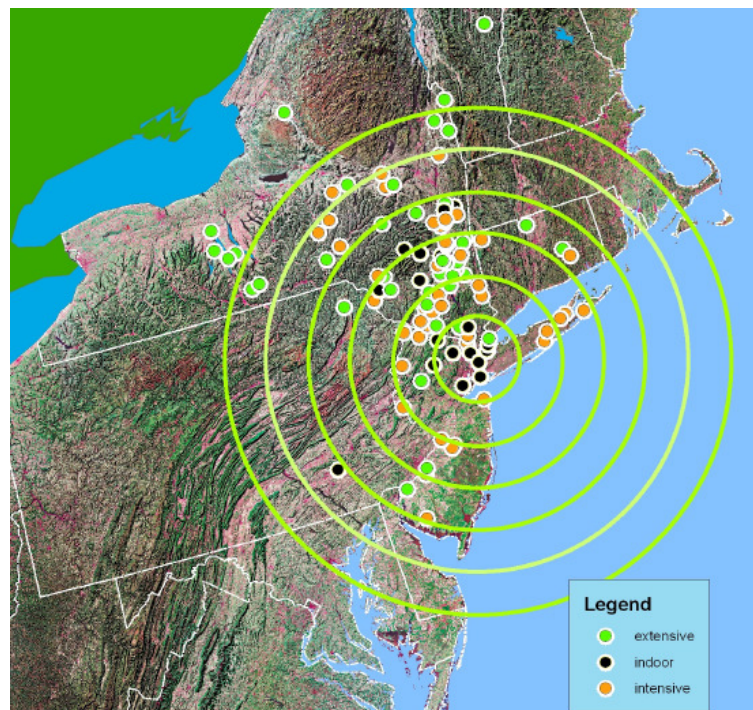


Figure 47. The 'foodshed' of New York City Green Markets. Each circle represents a farm or food producer supplying one or more New York City Green Markets. Farms have been divided into extensive (e.g., livestock raising), intensive (e.g., market vegetables), and indoor (e.g., baking) operations. Each of the radiating circles is separated by approximately 25 miles.

Barring major economic downturns or demographic changes, the agricultural cover-types and the associated natural habitats of Columbia County will persist only if there is a substantial reformulation of residents' approach to land use. There is an active interest in promoting local agriculture, but tension exists between the scenic desires of urban émigrés and the practicalities of farming, and between the rising costs of living and the realities of farm economics. To date, concepts of *sustainable* farming in this region have focused largely at the farm scale. The farming techniques of specific farms are relevant to the ecologies of particular pieces of land. However, as this paper has tried to illustrate, the role of farms in nature conservation at the County level needs to include a consideration of net effect – what is the resulting landscape? Who fits into it? One ecologically-managed farm surrounded by acres of housing or commercial development provides little meaningful habitat to native species. It is only when one seeks an overall view, across a sweep of time and land, that “sustainable” agriculture can take on true ecological relevance. Achieving such an agriculture will require working through tricky agricultural, socio-economic and ecological issues.

The distribution of agriculture in Columbia County has been largely shaped by variation in the physical landscape. That variation has also been an important determinant of habitat availability for native species. As a result, agriculture has played a large but predominantly unintentional role, sometimes positive, sometimes negative, in the ecologies of native species. In this paper, by tracing that interplay, we try to provide a more nuanced appreciation of the role of agriculture in our landscape and to give background that may provide tools for a more conscious management of that role in the future.

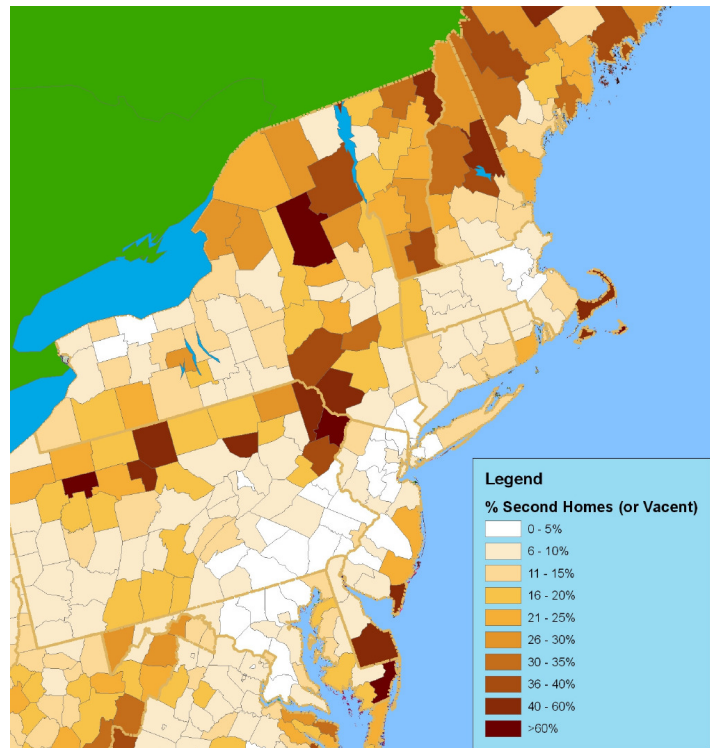


Figure 48. Percent of all houses which are not occupied full-time as identified by the 2000 US census; many of these houses are second homes.

## Coda: When Analogies Become Reality

One central theme of this paper has been that the value of agricultural land as habitat for native species depends at least in part on the degree to which the agricultural cover type is analogous to the habitat with which the given species co-evolved. Such an approach presumes that evolution happens at a much slower rate than the recent changes in cover that can be attributed to agriculture. While such a presumption may hold in many cases, there evident examples of organisms which have begun to co-evolve with agricultural cover types, so that such cover types are no longer analogies of their natural habitats but *are* their natural habitats. The Colorado Potato Beetle, for instance, was

a relatively innocuous, Mexican and Southwestern insect whose favored foods were native plants in the tomato family. Over time, however, the beetle acquired a fondness for potatoes (in the tomato family but apparently not a major part of its original diet) and became the well-known crop pest of today (Neck 1983). While not considered pests, such evolving diets explain the resurgence of Baltimore Checkerspot (formerly confined to Turtlehead, now including Plantain in its diet) and Wild Indigo Duskywing (whose caterpillars formerly ate mainly its namesake plant; it now also feeds on alfalfa, Cech and Tudor 2005). Such diet shifts are obvious examples of evolution; whether or not more subtle changes are occurring in other organisms is more difficult to determine. It has probably been many generations since water edges were the main habitat of Killdeer, for example; one can only wonder what changes in behavior, physiology or even morphology have resulted.

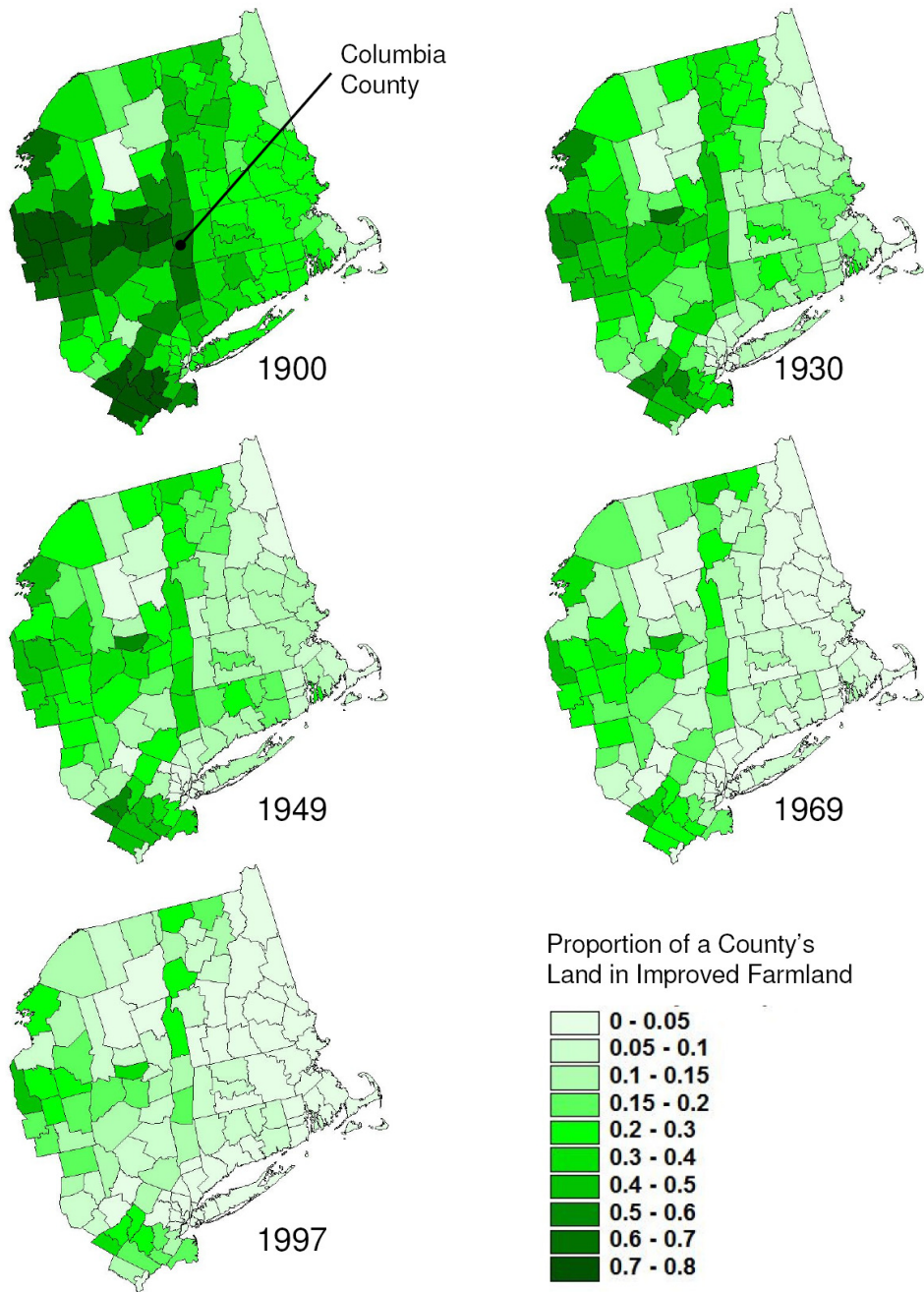


Figure 49. Improved farmland in a portion of the Northeast. Notice the loss of farmland especially in the neighborhood of large cities.

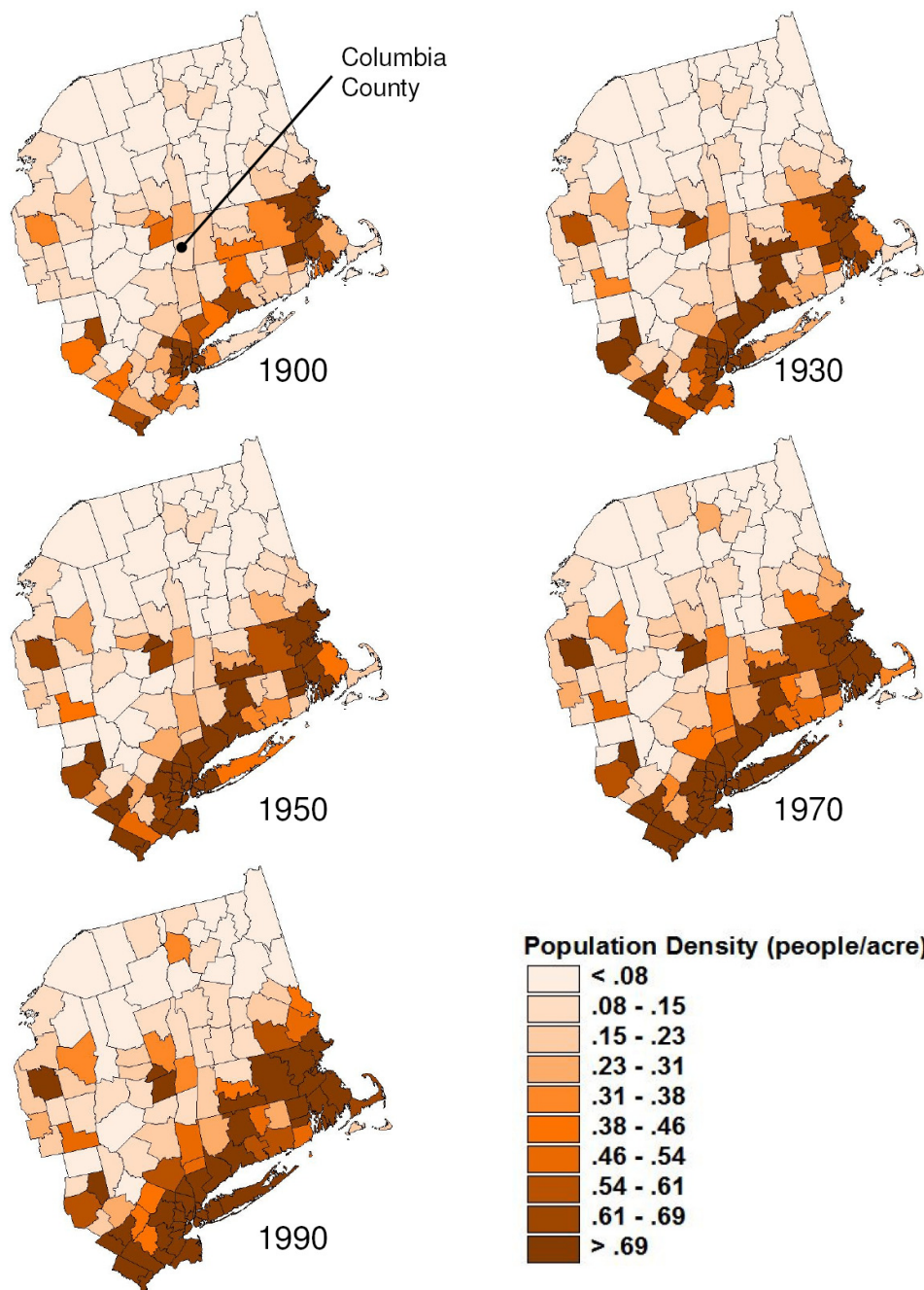


Figure 50. Population density in a portion of the Northeast. Columbia County lies between the demographic outgrowths of New York City, Boston, and Albany.

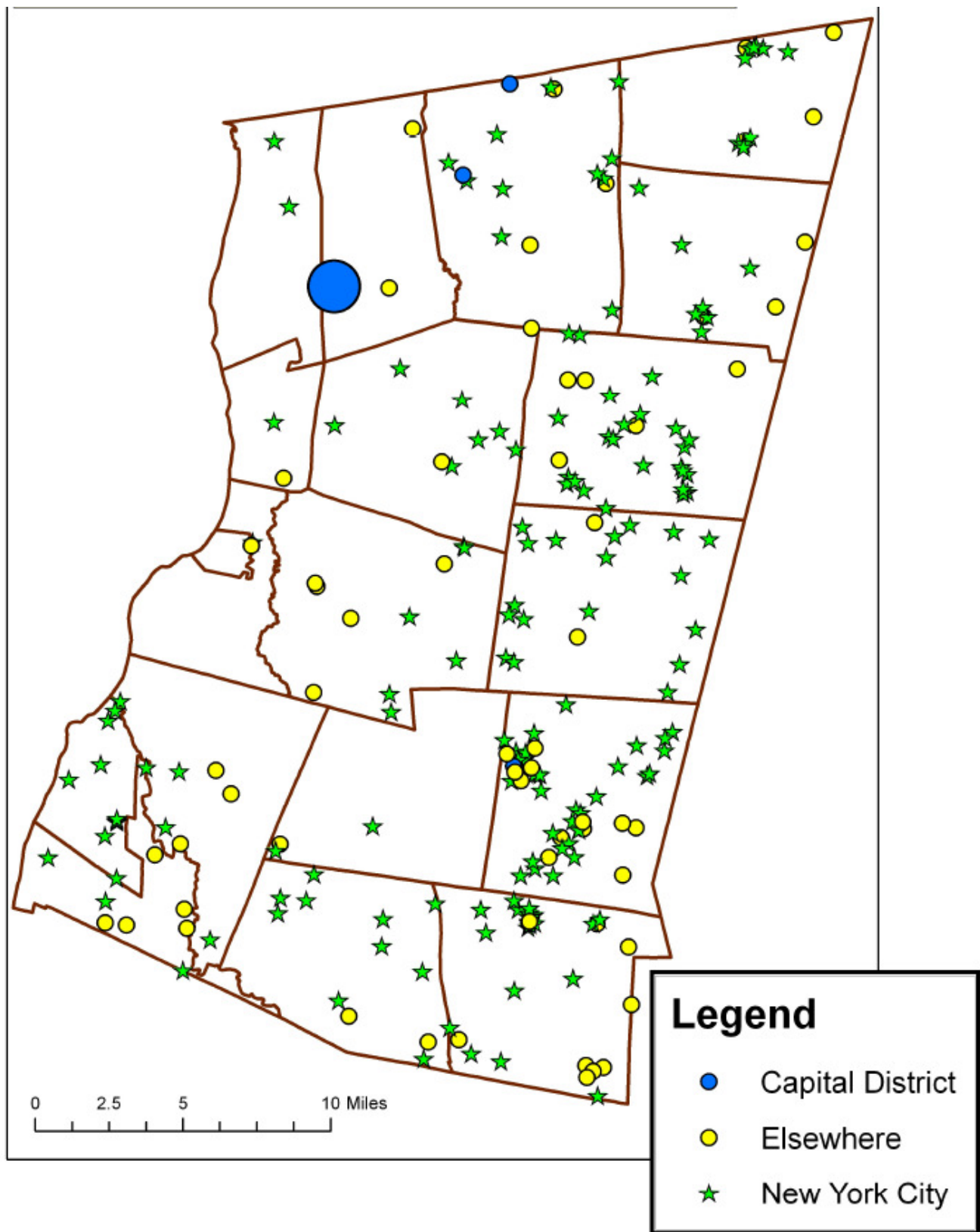


Fig. 51. Recently-constructed (2000 – 2005) houses owned by individuals from outside the County (ca. 15% of all owners of such houses) according to Columbia County tax rolls. The large blue dot indicates the location of 10 homes. Data from NYS Office of Real Property. Like farming, such houses are not randomly distributed on the landscape.

## Summary and Conclusions

By way of conclusion, we present a few generalizations:

- The influence of agriculture on native organisms can be considered from two perspectives: the destruction of natural habitats and the creation of novel, sometimes ecologically analogous, ones. For example, in Columbia County, the early and continued farm use of the flat, center-of-the County cropland probably has meant that the creatures of rich, white-oak woods are relatively uncommon in our county, although, in their place, grassland birds have arrived on some of the extensive hayfields. Likewise, the Natural Heritage Program's registry of rare species highlights the limey valleys of the southeastern corner of the County – those soils have favored agriculture and so specifically impacted the plants and animals of those lands.
- The influence of nature on agriculture has perhaps been more physical than biological. While certain organisms present real benefits or threats to local agriculture (e.g., the benefits of native pollinators, the losses from deer and ground hog), these may not have shaped the location of agriculture as much as soil conditions and topography, factors which, in turn, also influence the occurrence of native species. Thus, the location of certain agricultural and natural habitats may co-vary not because of the direct determination of one by the other, but because they are both responding to the same physical cues. Thus, the ranges of Poverty Oat Grass, Hair Grass, and Little Bluestem in the County may tend to coincide with that of early sheep farming not because they were crucial forage plant for sheep, but because the thin, drier soils which harbor these species were most amenable to sheep when farmers strove to make a living from that landscape.
- The ecological analogies offered by agriculture are taxa-specific. In Columbia County, for example, hay fields, while often harboring little in terms of native butterflies, offer functional structural analogies for birds if they are extensive enough. Their mainly non-native plants offer few food sources for native caterpillars. On the other hand, butterflies, which can usually settle on smaller areas than birds but whose food requirements, when young, are more specific due to their chemical ecology, sometimes can take advantage of the scattered native plants that may come into pastures on poor soils (e.g., Little Bluestem).
- Analogies evolve. An agricultural cover type may serve as important habitat for native species for a certain period but changing agricultural practice may subsequently eliminate the analogy. For example, late-cut hay fields in the County used to be suitable grassland bird breeding habitat, but may become unsuitable habitat or even ecological traps when cut early and often.
- Agriculture creates and destroys habitat. The net benefits can only be judged by consideration of what native habitats were likely lost, what analogies were created, and the overall context of both agriculture and nature conservation. For example, Columbia County is now roughly two thirds forest-covered; 150 years ago it was more than two thirds open land. Much the same pattern holds throughout the Northeast, with developed, non-agricultural land accounting for a substantial portion of what is not wooded. Today, conservation includes the maintenance of the early successional grassland and shrubland habitats that are becoming rare; 150 years ago, forest would have been the rare and valued cover type.
- To a very large degree, the intertwining of native species and agriculture over the past 200 years has been due to happenstance rather than conscious efforts. It was farm economics that shaped the land and that, incidentally, created or destroyed habitat for native species. Today, farming largely continues in that fashion, although increased interest in sustainable farming suggests this process might become more conscious. However, the main modern regional influence on native ecologies is not agriculture, but rather the residential development that has become the County's economic engine. That process continues apace with much of the same ecological ambivalence that shaped agriculture but with, given the state of the environment, perhaps less room for error. The native organisms of the Columbia County landscape will only consistently benefit from the potential positive ecological analogies that humans can create when the overall course of land use becomes more conscious and deliberate.