Agricultural Systems in Transition to Organic Production: A Progress Report

What began as a dream ("if we plant it, the research support $$ will come") became reality in 2003 for researchers at the Illinois Natural History Survey (INHS) and University of Illinois trying to jump-start a multi-disciplinary program on organic farming systems. Feedback from organic growers during an INHS-sponsored workshop was key to development of the farming systems strategies that form the basis of the research. Also important was availability of land for long-term organic research [INHS Reports No. 375:1,8 (2003)]. We submitted a proposal in March, initiated crop rotations for the research at the Champaign field site in June, collected baseline data, and waited to hear if the proposal would be funded. The gamble paid off: USDA grant support for the four-year project on organic transition was awarded in September 2003.

During the three-year transition from conventional to organic production, growers must adopt practices that increase crop diversity, enhance soil biological activity and nutrient cycling, support beneficial organisms, and rely on cultural and biological methods of pest management. Based on their individual farm operations, growers have several options to choose from in deciding how to transition their land for organic certification. The farming systems approach of our project compares nine transition schemes that differ in management intensity (i.e., frequency of disturbance through tillage, increased number of crops) and organic matter inputs. Three treatments (farming systems) represent different cropping intensities: 1) high-intensity transition (intensive vegetable production), 2) intermediate-intensity transition (organic cash-grain), and 3) low-intensity transition (perennial pasture mix). Within these are three sub-treatments (types of amendments) representing different strategies for organic matter and fertility management: a) plant inputs only (cover crops providing all organic inputs and nitrogen fertility), b) plant inputs plus composts, or c) plant inputs plus manure. Our research objective is to determine how these transition schemes affect ecosystem components such as weeds; soil organic matter and nutrient availability; soil invertebrate communities; and the relationship among soil fertility, plant health, and insect/disease pressure.

Now at its midway point, the project has been quite a learning experience. We have consulted...
Creating an Emiquon Corps of Discovery

“Glacially slow, combines engulf the golden vegetation, leaving nothing behind but dust—twenty-first century loess—a dusty, dirty ballet, choreographed in green and brown, producing rivers of gold. The dust will soon settle, just as it did 10,000 years ago, to create a new beginning of infinite possibilities. Not thirty seconds after the final combines have passed, a mayfly alights on my back, poised and ready for a river of a different kind—the long process flutters away to rest on a windswept bit of grass. What it looked like perched on corn, as it obviously was a few seconds ago . . . I can only speculate.”

—Excerpt from the author’s journal and an example of descriptive writing practiced by Emiquon Corps of Discovery members.

The restoration of The Nature Conservancy’s (TNC) Emiquon Preserve over the next decade provides a unique opportunity for dedicated citizens to participate in the documentation of the dramatic changes that are likely to occur. The Emiquon Preserve, once a spectacular lake/wetland complex (consisting largely of the former beds of Thompson Lake), was leveed and drained in the early part of the 20th century and has been farmed ever since. The 7,775 acres, purchased by TNC in 2000, are now in the early stages of restoration. While the demise of these historic wetlands was documented by Illinois Natural History Survey Scientists (INHS), and its restoration will also be closely monitored by them, we felt Emiquon needed an additional perspective. It is perhaps ironic that 200 years ago Illinois served as the start of one of the greatest explorations undertaken on the North American continent—the Lewis and Clark Expedition. This two-year exploration of the American West generated the most famous nature journals ever compiled. To document the evolution of Emiquon over the next decade, we developed an “Emiquon Corps of Discovery” (ECD), consisting of individuals trained in the skills of photography, descriptive writing, and sketching/drawing who will create a total aesthetic picture of Emiquon. The 2005 ECD differs from the Lewis and Clark expedition in a fundamental way. That Corps of Discovery traveled thousands of miles to document the landscape and its organisms. At Emiquon, it is the landscape that will evolve and change and the individuals who will stay put.

This project developed as a unique partnership among INHS, TNC, and the Dickson Mounds Museum, Lewistown, IL. Members of the ECD were trained in a series of workshops at the museum, beginning in January 2005. The 45 students, citizens with a diversity of skills and experience, attended four all-day Saturday workshops in late winter and early spring. Course instructors (all from INHS) were Dr. Michael R. Jeffords, photography; Susan L. Post, descriptive writing; and Carolyn P. Nixon, sketching and drawing. The basic idea for the ECD was put forth by Jo Skoglund, TNC, while the instructors at INHS developed the course entitled “Communicating Nature.”

The ECD has not ignored science, however, merely for the sake of aesthetics. To provide a systematic approach to the Emiquon documentation, a series of Aesthetic Points and Pathways (APPs), analogous to scientific sampling points and transects, were developed for the ECD. Thus, over time, corps members will be able to show systematic change at Emiquon, filtered through their own creativity. There are no rules governing the APPs, except that the time, date, and direction of the observations be noted. The ECD is a long-term project with additional opportunities for members to experience further creative growth following the completion of formal training. To showcase the changes that occur, the ECD, in conjunction with the instructors and museum staff, will develop a yearly exhibit of their works for display at Dickson Mounds Museum.

We believe this project provides powerful motivational activities that not only promote an understanding of the basic science involved in major restoration, but also create an environment where issues such as biodiversity, conservation, and environmental ethics can flourish. We aim to add a creative dimension that will contribute to the total picture of the evolving landscape that is Emiquon.

Historically, scientists, restoration specialists, and land managers have communicated their research findings through scientific literature, book chapters, textbooks, summary articles, and technical reports. These venues have often been the only outlet for their work, realistically meaning that most science is generally not available to a lay audience. Such venues also fail to engage the community at large in the restoration process.

In communicating scientific findings, we have found that journal articles seldom succeed in presenting the total complexity or aesthetic appeal of nature to a wider audience. An important dimension is left undescribed. Communicating this dimension requires a different skill set than those typically taught to scientists. These skills are more closely associated with the artistic realm than with the scientific. Today’s higher educational system seldom places value on these artistic skills that are invaluable for education and outreach. Thus, graduates are not prepared when opportunities and necessities arise for them to present their work outside the scientific world.

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Michael R. Jeffords, INHS Office of the Chief
On-line Identification Tools for Leafhoppers

The Leafhoppers, or Cicadellidae, of Illinois, by D.M. DeLong, published in the Bulletin of the Illinois Natural History Survey in 1948, included descriptions and identification keys for approximately 350 species known to occur in the state. Although nearly 60 years out of date, this work remains the most comprehensive guide to this diverse and economically important group of insects in the midwestern U.S. Excluded from this work was the large leafhopper subfamily Typhlocybinae, which comprises at least another 600 Illinois species and includes agricultural pests such as the potato leafhopper and various grape leafhoppers.

No attempt at a comprehensive taxonomic treatment of Illinois Typhlocybinae has ever been made, in part because the group comprises some very large and taxonomically difficult genera, each containing several hundred species. One of these genera, Erythroneura, comprises 600 described species, 441 of which are recorded from Illinois, and 52 of which are, so far, known only from this state. Species of this genus are distributed throughout the temperate regions of the Northern Hemisphere.

Rapid and accurate identification of species in such groups is crucial to early detection of invasive species and effective management of natural resources, but remains difficult or impossible because of the lack of user-friendly identification tools and the shortage of expert taxonomists. Fortunately, technologies now exist to streamline the process of synthesizing and managing taxonomic information (e.g., nomenclature, comparative morphological data, specimen distribution records), enabling biologists to create efficient tools for identifying species even in hyperdiverse groups such as insects.

With funding from a National Science Foundation initiative called “Revisionary Syntheses in Systematics (REVSYS),” INHS Center for Biodiversity entomologists Dmitry Dmitriev and Chris Dietrich are addressing these problems by developing new Internet-accessible tools for identifying insects and summarizing information on their geographic distributions and ecological associations. Their initial efforts are aimed at synthesizing morphological, distributional, and ecological information for leafhoppers, with particular emphasis on species of the genus Erythroneura.

Among the tools being developed are illustrated interactive identification keys. Unlike traditional dichotomous keys that require the user to examine sometimes obscure morphological features in a particular order, the user of an interactive key may select any morphological feature in any order. Each feature mentioned in the key is linked to one or more images that facilitate interpretation of terminology. This greater flexibility and user-friendliness minimizes mistakes because the most distinctive features of a specimen may be taken into account first when attempting an identification. Additional tools linked to the on-line keys automatically create species descriptions, distribution maps, and tables of host plant associations using information retrieved from a specimen database.

So far, label data have been entered and geo-referenced for over 80,000 Erythroneura specimens from collections throughout the U.S. and Canada, nomenclatural information has been compiled for 1,890 species of Erythroneura and related genera, and an archive of more than 6,300 digital images has been created. A dataset comprising more than 100 morphological features for each species is also being compiled and these data are being used to construct an interactive identification key for Erythroneura species and to estimate the phylogeny of the genus. The taxonomic tools developed as part of this project will not only facilitate the first comprehensive treatment of Erythroneura species, but will also provide infrastructure to support future projects focusing on a wide variety of diverse but poorly studied organisms. Example interactive keys and other taxonomic tools are available on-line at: http://ctap.inhs.uiuc.edu/dmitriev/.

Chris Dietrich and Dmitry Dmitriev, Center for Biodiversity

Sample screen from on-line interactive key for leafhoppers at http://ctap.inhs.uiuc.edu/dmitriev/.
Aerial Inventories of Waterfowl in Illinois

I’ve often wondered if Dr. Frank Bellrose knew he would be starting an Illinois tradition when he climbed into a military aircraft in 1946 and experimented with estimating waterfowl abundance from the air. Indeed, Bellrose’s technique was a good one; his foresight preceded the aerial surveys conducted annually throughout the U.S. and Canada, and the Illinois Natural History Survey (INHS) has conducted these flights in Illinois regularly since 1948. At the INHS Forbes Biological Station, we informally mark the onset of fall when our phone starts to ring frequently with hunters inquiring about the latest counts.

Although hunters are keenly interested in fall inventories of waterfowl, these inventories serve a greater purpose than satisfying curiosities. For example, the Illinois Department of Natural Resources relies on these data to guide selection of waterfowl hunting season dates and frameworks each year. Additionally, these data were used extensively by Dr. Steve Havera to describe abundance and distribution of ducks and geese in his 1999 book, Waterfowl of Illinois: Status and Management. And since I was hired by the INHS about a year ago, we’ve been digging deeper to see what else this long-term data-set might tell us about these economically and ecologically important birds.

The most obvious use of these data is for identification of trends in waterfowl abundance over time and space. However, this task may not be as straight-forward as it sounds. For example, the INHS waterfowl inventories, as currently conducted, only provide an index of abundance, not a formal population estimate. Additionally, observers may be differentially biased in their duck counts; fortunately, there have only been 3 observers in 56 years of inventories.

Finally, duck abundance fluctuates over time, and trends are typically not linear. To address these issues we are estimating waterfowl population trends using recent advances in mathematical modeling, referred to as Generalized Linear Mixed models. This class of statistical models allows us to fit nonparametric trends to the data that incorporate random effects (in this case as an “observer” effect) and account for temporal autocorrelation (i.e., repeated measures within inventoried sites). These techniques are more than statistical “smoothing;” to the contrary, they offer a robust method to address analysis of long-term trend data without ignoring important caveats such as nonlinearity and bias.

Preliminary results may not surprise many folks. For example, Mallard abundance decreased about 3% per year from 1948–2000 in the Illinois River valley. Interestingly, other dabbling duck species appear to have increased significantly over time. For example, Gadwall abundance increased an average of 8.1% per year during the period 1948–2000 in the lower Illinois River valley, likely reflecting dramatic continental population increases during the last two decades. Other trends seemingly reflect restoration successes. Specifically, Canada Goose abundance increased about 3% per year on the inventoried portions of both the Illinois and Mississippi rivers.

Continued on next page

Trend of Mallard abundance (fall use-days) in the upper Illinois River valley, 1948–2000. Index values (y-axis) were computed using 1948 use-day estimates as the base year. The average annual decline in abundance was significant (-3.6%; 95% CI = -5.9 to -1.3%; P = 0.0027).
Of course, there are many possibilities to incorporate the existing data into other analyses. Currently, we are attempting to model waterfowl abundance during fall and spring in relation to wetland characteristics to explain variation in abundance among surveyed locations. We are also using these data as covariates in an analysis of waterfowl hunter success on some public hunting areas in Illinois. In the future we hope to model waterfowl abundance in spring and fall in relation to annual, site-specific wetland conditions derived from historical aerial photographs and other data. Although our efforts to further analyze this dataset are ongoing, one thing is certain: this fall we’ll begin our 57th year of aerial inventories!

Joshua D. Stafford, Center for Wildlife and Plant Ecology

Trend of Gadwall abundance (fall use-days) in the lower Illinois River valley, 1948–2000. Index values (y-axis) were computed using 1948 use-day estimates as the base year. The average annual increase in abundance was significant (8.1%; 95% CI = 5.6 to 10.7%; P < 0.0001).

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The Black Vulture is a large, broad-winged, soaring scavenger, most abundant in the southeastern United States. In Illinois it can usually be found year-round in extreme southern Illinois. The birds’ requirements are simple—a steady supply of carrion and sites for nesting and roosting. Its scientific name, *Coragyps atratus*, is a combination of Greek and Latin. The genus name comes from the combination of two Greek words, *korax* (raven) and *gyps* (vulture), while the species name, *atratus* (clothed in black), is Latin.

Black Vultures are about 25 inches in length and have 57-inch wingspans. Their tails are short and squared off. The birds have been described as looking like “shabby undertakers.” They are black overall with gray, featherless heads and necks. Their naked heads and necks prevent the fouling of their feathers while the birds feed on decaying carcasses and the bald heads may also be an adaptation to help the birds regulate body temperature. They have dark, meat-tearing beaks and thick gray legs. Their feet are adapted for walking on the ground and, in contrast to their flight, their movement on the ground is not graceful. To walk, they slightly spread their wings, take a long step with one foot then put the other foot down, so that the birds give the impression of hopping.

Their wings are black, except for a few outer flight feathers (primaries), which are white. When the wing is extended these primaries appear as white patches near the outer edges of the wings. Black Vultures are silent birds as they lack a syrinx, the vocal organ of birds. Hissing, grunting, and blowing are the extent of their vocabulary.

Black Vultures spend most of their days in flight searching for carcasses. They usually feed on roadkill, and will visit farms, ranches, land fills, and shorelines; any areas where carrion can be found. Live prey can be taken and there are records of them feeding on baby turtles, nestling herons, and even newborn calves. Unlike their close relative the Turkey Vulture, Black Vultures do not have a well-developed sense of smell so their foraging strategy depends on keeping other foragers such as the Turkey Vulture in view. They will follow other birds and soon large feeding aggregations will form. Black Vultures will even dominate Turkey Vultures at a carcass.

Once food is located, the birds use their strong beaks to rip the meat off a carcass while holding it down with their feet. To reach the internal organs they insert their heads and necks entirely into the carcass. While they prefer fresh dead, they will eat meat in various stages of putrefaction. There is something in the birds’ gut that provides resistance to microbes and toxins found in decaying flesh. Thus the belief that vultures spread anthrax is false. Due to the uncertainty of their next meal, these birds can rapidly ingest large quantities of food and then go for days without feeding.

Black Vultures form long-term pair bonds after a courtship ritual. In 1840 Audubon described this ritual as, “the gestures and parade of the males are extremely ludicrous. They first strut about somewhat in the manner of the Turkey Cock, then open their wings, and approach the female, lower their head, its wrinkled skin becoming loosened, so as entirely to cover the bill, and emit a puffing sound, which is by no means musical.” Black Vultures are solitary nesters using dark caves, deep crevices in cliffs, hollow trees, or abandoned buildings to lay their eggs (usually two). No nest is made. Once the eggs hatch, the adults will feed the young regurgitated food from their crops. The chicks fledge at 8 to 13 weeks but may still associate with the parents for several more months.

Black Vultures are not birds of prey. Their claws are weak, they do not catch what they eat, and their beaks are not strong enough to rip fresh meat. Instead, vultures are in the same order as storks and herons. Like members of this group, vultures practice urohydrosis, where they squirt liquid excrement onto their legs for an evaporative cooling effect.
Black Vulture Word Search

The words that are in ALL CAPITAL LETTERS in the list below are hidden in the vulture shape. See how many you can find.

**Classification of Black Vultures:**
AVES (class of animals that includes all birds)
CICONIIFORMES (order of birds that includes vultures, herons, and storks)
CATHARTIDAE (family of birds that includes vultures and condors)
CORAGYPS ATRATUS (species name for Black Vulture)

**Common names for Black Vultures:**
BLACK VULTURE
CARRION CROW
BUZZARD

**Black Vulture feeding habits:**
SCA VENGER
CARRION
GARBAGE
DEAD ANIMALS
ROTTING

**Habits and features of Black Vultures:**
MIGRATION
SOARING
KETTLE (a group of vultures soaring on thermals)
THERMALS
UROHYDROSIS (a not so pleasant vulture method of keeping cool)
ROOST
BARE HEAD

**Black Vulture nesting sites:**
TREE CA VITY
HOLLOW STUMP
ROCKY SHELF

**Sounds that Black Vultures make:**
HISS
GRUNT
WOOF

**Black Vulture wintering places:**
CENTRAL AMERICA
SOUTH AMERICA

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“The Naturalist’s Apprentice” presents educational activities for middle school students. Teachers are invited to photocopy this page for classroom use.
Organic Crops

frequently with our organic grower advisory board to choose specific crops in each rotation, develop management philosophies for each farming system, and carry out field operations appropriately within the context of organic certification. Crops grown to date are Romato (high-intensity system) and food-grade soybean (medium-intensity system), 2003; broccoli/cabbage (high-intensity) and winter wheat (medium-intensity), 2004; and winter squash (high-intensity) and field corn (medium-intensity), 2005.

We have already noted some early trends or significant differences within a given season among the cropping intensity treatments and/or amendment sub-treatments. A few examples from 2004 illustrate these findings. Fungivorous nematode populations were stimulated by type of amendment application but were reduced by the level of system disturbance. Plant-parasitic nematodes were also reduced by system disturbance but were unaffected by amendment applications. Incidence of leaf rust on grasses in the low-intensity treatment (perennial pasture) was most severe in manure-amended sub-plots, but type of amendment did not influence insect pest populations in broccoli-cabbage plots. Density and diversity of ground-dwelling insect predators and seed-feeders were greatest in the low-intensity treatment.

For most of us, however, our most important data collections will be made after transition. We are following certification guidelines so that the field site can be certified for organic research at the conclusion of the transition period (2006). In 2006 and 2007, the same vegetable crops will be planted across all plots regardless of farming system history. This will allow us to evaluate how the transition schemes initiated in 2003 have affected soil fertility, crop productivity, weed communities, beneficial insects, and pathogen/insect pest problems.

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