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ILLINOIS NATURAL HISTORY SURVEY

Reports

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INSIDE

Cowbirds Use Mafia Tactics and Farming Behavior as Part of Their Parasitic Racket

Avian brood parasites lay their eggs in the nests of other birds (called hosts) that subsequently incubate the parasitic egg and raise the parasitic chick. Hosts of avian brood parasites pay severe costs for rearing these unrelated young, often producing few or none of their own. Hosts of parasitic cuckoos (*Cuculidae*) typically eject eggs that do not mimic their own. Why then do most hosts of parasitic cowbirds (*Molothrus spp.*) accept eggs that differ dramatically in appearance from their own? At least two nonexclusive hypotheses have been suggested to resolve this paradox of nonrejection in the face of costly brood parasitism: (1) evolutionary lag (short time of coexistence between host and parasite); and (2) evolutionary equilibrium through cognitive and physiological constraints on detection and rejection (rejection costs and errors in the host).

Proponents of evolutionary equilibrium tend to focus on the limited abilities of hosts to recognize or reject parasitism. Few have explored the possibility that avian brood parasites could enforce acceptance by destroying eggs or nestlings of hosts that eject parasitic eggs. This "mafialike" retaliatory behavior has been reported in one species of parasitic cuckoo, but there has never been an experimental test of whether parasites themselves are destroying nests of hosts that eject parasitic eggs. Mafia behavior has not been documented in parasitic cowbirds, but results from a few studies suggest that Brown-headed Cowbirds (*Molothrus ater*) may occasionally depredate nonparasitized host nests thereby creating opportunities to parasitize those hosts' renesting attempts ("farming").


Male Prothonotary Warbler at nesting box. Photo by Jeff Hoover, INHS

For over a decade we have studied the effects of cowbird parasitism on a cavity-nesting host, the Prothonotary Warbler (*Protonotaria citrea*), in the Cache River watershed in southern Illinois. During 1996–2002, we attempted to make some nests (n=472) predator-proof by attaching nest-boxes to pieces of greased conduit (instead of trees) and we never removed Brown-headed Cowbird eggs from the parasitized warbler nests (n=230). As a result, nearly all (>95%) nests in predator-proof nest-boxes were successful regardless of parasitism status. In 2002, as part of a separate study, we removed cowbird eggs from some parasitized predator-proof nests (n = 50) and only 60% were successful, indicating that cowbirds may depredate nests in response to our rejection of their eggs (mafialike retaliation). This finding led us to test experimentally for both mafia and farming behaviors in cowbirds.

We devised an experiment where we removed (rejected) or accepted cowbird eggs and controlled cowbird access to otherwise predator-proof nests of Prothonotary Warblers to determine if cowbirds were retaliating

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Female Brown-headed Cowbird. Photo courtesy of C. Young

A Change in the Population Dynamics of the Zebra Mussel in the Hudson River, NY

Invasive species are organisms that become established and reproduce successfully outside their native, historical ranges. The zebra mussel, *Dreissena polymorpha*, is an invasive species that is thought to be one of the most aggressive aquatic invaders worldwide. Since the introduction of the zebra mussel from its native Black Sea to the waterways of the United States via ballast water, this mussel has spread throughout Illinois and the Great Lakes region, resulting in profound economic (clogging and damage to water intake pipes) and ecological impacts (reductions in oxygen concentrations, native species abundance, and disruption of food webs). The zebra mussel has now been sighted as far south and west as Louisiana and California. Zebra mussels have accomplished this dispersal feat in the U.S. in only 20 years, causing scientists to wonder what makes these small, less than 5-cm-long, creatures so successful.

The success of the zebra mussel has been mainly attributed to a life history strategy that includes a planktonic larval stage. The larval stage is microscopic and easily carried by water currents, thus larvae may drift for miles before eventually settling out of the water column onto suitable hard surfaces to metamorphose into the adult form. However, despite speculation of a critical role for the larval stage in the success of this invader, most studies of zebra mussel population dynamics have paid little or no attention to early life history stages.

Helen Bustamante and Dr. Nils Carlsson preparing to deploy exclusion cages at Norrie Point, NY. Photograph courtesy of Sarah Fernald, Research Coordinator, Hudson River National Estuarine Research Reserve, Norrie Point, NY

Helen Bustamante, a graduate student based at Illinois Natural History Survey and her advisor, Dr. Daniel Schneider, are paying attention to the early life history stages. They intend to decipher the role of early life stages to the abundance and distribution of this highly successful invasive species in the Hudson River. For the past three years, Helen has been collecting information on abundance, growth, and survivorship of all life stages of zebra mussel populations in the Hudson River. One trend she discovered surprised her: virtually all adult zebra mussels disappeared during late summer each year of her study. A dynamic on this scale, repeated in consecutive years, had never been seen in the Hudson River previously. Large numbers of small animals that do not survive longer than one year now comprise the population. Previously adults lived around two to four years and animals of different sizes and ages had comprised the population. Helen asked what could have led to such a drastic change in the population structure? The cause appeared to be a major predation event rather than water quality as some animals survived in sheltered nooks and crannies that presumably offered a refuge from predation.

Photograph showing a blue crab caught in a typical crab pot at Norrie Point, NY. Photo by Helen Bustamante, INHS

In April of 2008, Helen presented her findings at the Northeast Natural History Conference in Albany, NY. Her talk generated much interest and led to her collaboration with Dr. Nils Carlsson at the Cary Institute of Ecosystem Studies, Millbrook, NY. Helen and Nils designed an exclusion experiment to investigate predation on Hudson River zebra mussels. At two sites in the Hudson River, they deployed cages containing rocks with attached zebra mussels (collected previously from the river using SCUBA). Half the cages were open to predators and half closed to predators. Every three weeks they removed a set of cages and calculated how many zebra mus-

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INTRODUCING OUR PUBLICATION SALE CALENDAR

ILLINOIS NATURAL HISTORY SURVEY

1867

We are happy to introduce our annual publications sales calendar. This issue will highlight the first four months of 2009 special pricing. If you would like additional information or a copy of the entire calendar, either e-mail or telephone us at the contact information listed below.

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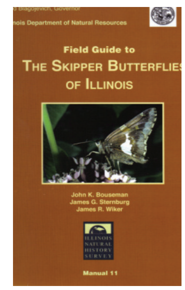

Regular price $20—Sale price $15:
- Field Guide to Amphibians and Reptiles of Illinois
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The Transition to Organic Production: Summing Up

Six short years ago we plowed down conventional soybean stubble and seeded the rye cover crop that began an organic transition research and outreach project involving scientists and extension educators at the University of Illinois, Illinois Natural History Survey, and University of Wisconsin. We posed two research questions: 1) For lands transitioning from conventional to organic production, are there ways to structure the transition process to aid the goal of balanced soil biological processes when the required three-year transition ends and the land can be certified for organic production? 2) How do biological systems in transitioning systems change as soil organisms become more diverse and as growers rely on ecological processes rather than synthetic inputs to build soil organic matter and reduce pests?

Part of the organic research team and helpers take a welcome photo break (and a chance to stand up) while transplanting butternut squash in 2005. Pictured on the back row (L to R): Michelle Kiang, Eric (last name unknown), Ed Zaborski, Dan Anderson, Chris Gittings, (name unknown), Ayna Salas, and Grifith Lizarraga. Pictured on the front row (L to R): Carmen Ugarte, Emily Marriott, Michelle Wander, Cathy Eastman, and Darin Eastburn. Photo taken by Ed Zaborski.

With help from an advisory board of organic growers and a Unites States Department of Agriculture (USDA) Organic Transitions Program grant, we established research plots on a six-acre site in Champaign in 2003. The experiment compared three farming-system treatments—vegetable crops, cash grain crops, and perennial pasture—with different levels of soil disturbance (i.e., cropping intensity) that represent useful strategies for Midwest growers transitioning land for organic certification. There were also three sub-treatments differing in organic matter and fertility management. These treatments were in place during the 2003–2005 transition growing seasons. Post-transition (2006–2007), the treatments were disbanded and the same crops (organic tomato and pepper varieties in 2006, organic soybean in 2007) were grown in all the research plots, which then differed only in farming system treatment history. This allowed us to evaluate how the three transition schemes initiated in 2003 have affected soil fertility, crop productivity, weed communities, beneficial insects, and pathogen/insect pest problems.

We are now in the assessment phase, pondering reams of data and identifying linkages among them. While there is much yet to be analyzed, here are some highlights.

First, all three transition strategies improved soil fertility following conversion from conventional to organic management and were similar in their ability to build soils. The only difference was in soil pH, which was increased in the low-disturbance (perennial pasture) treatment compared to the vegetable (high-disturbance) and cash grain (intermediate) treatments. Fertility sub-treatments (cover crop residues alone, residues plus compost, residues plus manure) did not alter soil fertility significantly.

Second, there were effects of type of sub-treatments on some diseases during the transition (e.g., increased rust in grasses in the perennial pasture system and corn in the cash-grain system plots amended with manure). There were also differences in disease levels in tomatoes in 2006 (the first year after transition) associated with farming-system treatment and amendment sub-treatment, with lowest disease levels in tomatoes grown in the former pasture system plots that were amended with manure. In related greenhouse experiments with soil taken from the research plots, the farming-system treatments were similar in terms of enhancing the disease suppressiveness levels of soybean with the pathogens causing damping-off and sudden death syndrome.

Third, the perennial pasture treatment had the fewest weeds. While the number of weeds per plot decreased between the first and fourth growing seasons, weed

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Organic Production

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species diversity and weed seed bank diversity increased.

Fourth, in the first year after transition (2006), tomato yields were significantly higher in the former perennial pasture treatment compared to other treatments for the Classica and Bellstar varieties, but only marginally higher for the Roma variety. For soybean in the second year following transition (2007), yields were 42% higher in the former perennial pasture treatment.

While the number crunching and data interpretation phases of the research are in high gear, the hubbub of field activities is silenced. Covered in a pasture mix planting of timothy, orchardgrass, alfalfa, and red clover, the research plots are now in a holding pattern as we await the field inspection process to certify the site for organic research. Land certified for organic research is sorely needed; the Organic Farming Research Foundation (2003) reported that organic research is being conducted on only 0.13% of the total research acreage at land-grant institutions. What the next organic research projects might be at the research site are open questions. To quote Alice M. Coats, "It is apparent that no lifetime is long enough in which to explore the resources of a few square yards of ground."

Acknowledgments: Funding for this project was provided primarily by grant number 2003-51106-02086 from the Organic Transitions Program of the USDA's Cooperative State Research, Education, and Extension Service.

Cathy Eastman takes a look at the Austrian winter pea cover crop in 2004. Photo taken by Debra Levey Larson.

Cathy Eastman, Division of Biodiversity and Ecological Entomology with Edmond Zaborski, Michelle Wander, Darin Eastburn, John Masiunas, Leslie Cooperband, Deborah Cavanaugh-Grant, Dan Anderson, Carmen Ugarte, Shin-Yi Lee, and Isabel Rosa (Department of Crop Sciences and Department of Natural Resources and Environmental Sciences, University of Illinois), and Jonathan Lundgren (USDA Northern Grain Research Laboratory, Brookings, South Dakota)

Zebra Mussels

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sels had been eaten by predators. Traps and an underwater video camera enabled them to monitor the numbers and types of predators around the cages. Helen and Nils found that zebra mussel mortality increased dramatically as soon as blue crabs, *Callinectes sapidus*, appeared in their traps. Blue crabs migrate northwards, arriving into the freshwater part of the estuary (where study sites are located) around mid- to late summer and the timing of the mortality appeared to coincide very well with blue crab migration. In addition, there was a lag between zebra mussel mortality at the southernmost site, where blue crabs were caught first, and zebra mussel mortality at the second site which was 15 miles further north, where blue crabs did not arrive until later. These results strongly suggest that blue crab predation is responsible for much of the disappearance of adult zebra mussels in the Hudson River. The outcome suggests that, in the long term, the Hudson River ecosystem may be more resilient than initially thought to zebra mussel invasions and that native organisms "learn" to make use of invaders. This finding contradicts the conventional view of invaders having solely negative impacts on native organisms and their ecosystems and indicates that there is still much to be learned about invasions.

Helen Bustamante and Dr. Nils Carlsson using epoxy putty to secure rocks with attached zebra mussels inside their exclusion cages at Norrie Point, NY. Photo by Sarah Fernald

Photograph showing zebra mussels inside cages, one type excludes predators and the other type allows predators access to the zebra mussels. The cages are being prepared to be deployed at Tivoli field site, Hudson River, NY. Photographer: Dan Stich

Helen Bustamante, Division of Ecology and Conservation Sciences

Species Spotlight

Gray Tree Frogs

Susan Post

It's a perfect April day and I have just gotten out of the van at La Rue/Pine Hills snake road. Tiger and zebra swallowtails are nectaring on the abundant larkspur and all around cricket frogs are clacking. Yet I also hear a trill. Who could be making that noise and where is it coming from? The call resonates. I'm searching, searching. Finally one of the instructors calls, "Look at the oak. Go over to the knot, where the branches cross." Bingo! A well-camouflaged gray tree frog that for the untrained looks like just another knot on the tree.
—Illinois Wilds Institute for Nature, Field Notes, April 12, 2006

Illinois has two species of gray tree frogs—*Hyla versicolor* (common gray tree frog) and *Hyla chrysoscelis* (Cope's tree frog)—which can be distinguished only by studying their voices and chromosomes. *H. chrysoscelis's* mating call (trill rate) is faster and it is diploid (has 24 chromosomes). *H. versicolor* is tetraploid (has 48 chromosomes). These frogs are found throughout Illinois and range east of the Great Plains. The two species are found in mixed woods and temporary wetlands where they prefer to remain out of sight in woodland trees, sleeping by day. They may be glimpsed near suburban or rural homes, perched in tree cavities, hollow stumps, or on decks and swimming pools

A gray tree frog of the complex Hyla chrysoscelis/versicolor. Photo courtesy of Michael Redmer

Hyla versicolor in Latin means "color-turning." Common names include dusky tree toad, chameleon tree frog, common tree toad, tree toad, and changeable tree toad. *Hyla chyrsoscelis* comes from a Latinized word meaning "gold-colored," and common names include northern tree toad. The common name of tree toad for both species refers to the frog's skin, which has a rough, granular, dry, warty appearance that people usually associate with toads.

The skin color of both species varies from brown to greenish gray with darker blotches and bright orange on the undersurfaces of the hind legs. They have a white spot just below each eye. The frogs' overall coloration disguises it among the lichens and rough bark. Another common name —chameleon tree frog—refers to the frogs' ability to change colors. These color changes are brought about by the change in shape of the pigment cells. Low temperatures or subdued light will cause the cells to expand and the skin to assume a dark color. High temperatures or bright light has the opposite effect.

Large, rounded, adhesive toe disks enable these frogs to climb and also distinguish this species as a tree frog. These toe pads allow the frog to cling to rough and smooth surfaces, even glass!

The mating season is usually from April to August. The males will seek out shallow ponds or creeks and begin to sing. Their calls are short, resonant trills that are lower pitched and of shorter duration than those of American toads. These calls have been described as "the charm of contentment; in fact, it is much like the purring of a cat only louder. At a distance, it sounds something like the bleating of a lamb." They give their calls from perches, which are thought to enhance the males' chances of attracting females. Horizontal branches with few leaves arched over a pond are strategic perches. Females attracted to the males' calls will walk, not hop, toward them. A female will choose a male by touching him with her nose or even leaping upon him.

While the courtship and breeding season may last for several weeks, a female will mate only once. Females lay up to 2,000 eggs attached, singly or in small groups, to vegetation at the surface or beneath the water. The eggs hatch after two to five days. The tadpoles are an olive-green color with a bright, orange-red tail. The tadpole stage lasts from one to two months. When gray tree frog tadpoles emerge from the water as froglets, they are about 1.5 inches long and a bright shade of green, which helps camouflage them on their journey from pond, through grass, to a tree. The frogs are sexually mature after two years and will be 2.0 to 2.5 inches in length.

Gray tree frogs usually hibernate on the ground beneath fallen leaves, rocks, or in underground crevices. They have the ability to withstand subfreezing temperatures—to as low as -20° F—by manufacturing glycerol in their blood.

The Naturalist's Apprentice

Mimic Frog Calls

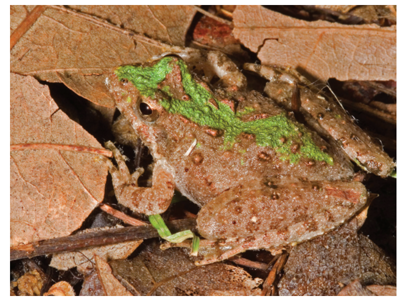
Carolyn Nixon

Mimic Frog Calls

There are 21 species of frogs and toads in Illinois, and each has its own unique song or call. You can listen to recordings of these calls on a CD or the Internet. Many people learn to identify frogs in the field by their calls. Some frog and toad calls can be mimicked by humans, either by voice or by some mechanical device. Here are some you can try. First listen to a recording of the frog or toad and see how closely you can copy it.

Western chorus frog and upland chorus frog—run a finger over the teeth of a comb. The harder plastic combs make a more chorus froglike sounds than a softer nylon, although either type will work.

Cricket frog—click two marbles together quickly. Holding them in one hand and quickly clicking them by moving your fingers in and out works very well. Make the marbles both click and scrape against each other.



cricket frog

Northern leopard frog—rub a wet hand over an inflated balloon to make it squeak.

Wood frog—quickly move wet finger tips over the surface of a wet balloon, much like a person picking a banjo or guitar.

Spring peeper—scrape a finger nail or a piece of chalk on a blackboard until it squeaks to mimic a single frog, or shake a string a sleigh bells to sound like a group of spring peepers.

Green frog—stretch a rubber band across a hole cut in the top of a cardboard box. First attach the rubber band to one end of the box by hooking it over a pushpin. Pluck the rubber band like a banjo string. You can vary the sound by stretching or relaxing the rubber band or by using different thicknesses of rubber bands. See the diagram below.

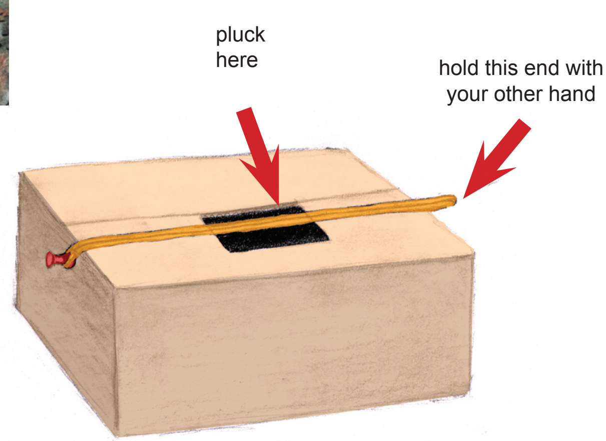
American toad

American toad—make a trilling sound with your voice and your tongue.

Listen to the recordings as you are trying to mimic them, and make adjustments to try to match them more closely. Also, listen to other frog and toad calls and try to find ways to copy their songs as well.

green frog

Photos by Michael Jeffords
Drawing by Carolyn Nixon



Box for mimicking green frog calls.

spring peeper

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Cowbirds

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(mafia), farming, or having no predatory effect on the warbler nests in our study system. When cowbird access to parasitized nests was allowed, 56% of "rejecter" nests were subsequently ransacked compared to only 6% of "accepter" nests. No nests were ransacked when we removed cowbird eggs ***and*** denied cowbirds further access to nests (by reducing the size of the nest-box opening) or when cowbird access was never allowed. Mafia behavior in brood parasites can hold hosts in an evolutionary state of acceptance only if hosts that accept parasitic eggs have higher reproductive output relative to hosts that reject parasitism and suffer the penalty. This requirement was met in our experiment and the predatory tactics of cowbirds significantly reduced the average number of warbler offspring produced per nest in rejecters (1.2) compared to accepters (2.7). Nonparasitized nests (cowbird accessible) were ransacked 20% of the time, suggesting that cowbirds are also farming these warblers. Renesting attempts of female warblers whose nests were ransacked were parasitized at a very high rate (85% versus ambient rate of 36%), suggesting that cowbirds do benefit from their own predatory behaviors.

Collectively, these results provide the first experimental evidence that cowbirds employ both mafia and farming behaviors and show that the predatory tactics of female cowbirds are much more sophisticated than previously thought. Arguably, loss of habitat along with increases in nest predation (by generalist nest predators) and cowbird parasitism linked to breeding habitat fragmentation pose the greatest threats to populations of birds that serve as cowbird hosts. However, farming and mafia behaviors in cowbirds could exacerbate these threats and further jeopardize populations of some cowbird hosts. In addition, if mafia behavior is widespread or becoming more prevalent in cowbirds, it could factor prominently in delaying the evolution of ejection behaviors in some of the more than 100 species that currently accept cowbird parasitism.

Jeff Hoover, Division of Ecology and Conservation Sciences