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INSIDE

Cache River Watershed

This issue of *Illinois Natural History Survey Reports* highlights some of our research, education, and outreach efforts in this unique habitat in southern Illinois. A number of the staff reporting on their work in this issue participated in the Cache River Symposium, which focused on highlighting work over the last 10 years to advance the restoration of this internationally significant wetland ecosystem. I was pleased to participate on the planning committee for this conference. The Illinois Natural History Survey (INHS) is proud to be a part of the major restoration efforts occurring on the Cache, and to continue to be involved in the development of this ecologically significant habitat.

I have had the pleasure in my tenure as Chief of the Survey to join various staff members on the Cache. An outstanding memory is walking on a cold December morning to the overlook at Wildcat Bluff. There we started counting all birds heard and sighted for the annual Christmas Bird Count, and as the first light dawned we looked over the expanse of bottomland forests with the Cache River winding through it and saw basically only wild America. You really felt that you were in Illinois a few hundred years ago, and that the Pileated Woodpeckers we saw flying below us could have been Ivory Billed Woodpeckers. And later, walking the bottomland forest we could appreciate the diversity of trees and the many species of birds that used this area for overwintering, or as an important stop on their migrations south. One year our group recorded over 350 Red-headed Woodpeckers overwintering in this portion of the Cache—a large number for this species whose global population continues to decline.

The Cache River watershed in winter as seen from Wildcat Bluff. Photo by James Anderson

I also remember being at Grassy Slough in the spring when a large number of Willets and other shorebirds were present, and one late fall when Short-eared Owls, Northern Harriers, and other hawks worked the fields and wetlands. The Cache has a great diversity of habitats, and each year brings additional changes in the flora and fauna as restoration and succession continues.

Survey research over the last 15 years in the Cache and Shawnee Hills has demonstrated the impact of habitat fragmentation on Neotropical migrant birds, and has lead to management changes that are resulting in more unbroken forest habitat which will enhance the reproductive success of a number of forest nesting species. The work reported here by Dr. Jeff Hoover has lead to increased appreciation of the need to manage water levels to enhance the reproductive success of the Prothonotary Warbler and other wetland species. We will continue to look for opportunities to inform those involved in the restoration of this area and other wetland areas around the state through our research and outreach efforts.

David L. Thomas, Chief of INHS

INHS Research Assists Restoration Efforts in the Cache River Watershed

Floodplain forests and their associated wetlands are among the most productive, biologically diverse habitats in the world. In bottomland forest ecosystems, the interplay of topography and hydrology creates and maintains a complexity of habitats and promotes high levels of biodiversity. Intact bottomland forest ecosystems are especially valuable because they support a high diversity and density of numerous organisms, including breeding Neotropical migratory birds. Bottomland forests are, however, an example of a habitat in peril. In the U.S. less than 20% of a historical area of over 100 million ha of bottomland forest remains and the loss of bottomland hardwoods is nearly five times greater than for any other major hardwood forest type. During the past 150 years, the combined effects of logging, draining, and farming have altered and fragmented many bottomland forest ecosystems. Those bottomland forests that remain are often degraded and functioning poorly for organisms residing therein. In recent years, the importance of bottomland forests has been recognized and efforts are now being made to acquire, restore, and conserve this habitat type.

The Cache River watershed is home to the northernmost cypress swamp in North America. Photo by Jeff Hoover, INHS

The Cache River Wetlands Restoration Project, located in the southern tip of Illinois, is one of the largest high-profile habitat restoration projects in North America. The ultimate goal of the restoration project is to acquire, restore, and manage over 60,000 acres of land as bottomland forest within the Cache River watershed. The project is a joint venture involving the U.S. Fish and Wildlife Service (USFWS), The Nature Conservancy (TNC), the Illinois Department of Natural Resources (IDNR), and Ducks Unlimited (DU). Presently over 32,000 acres of land are managed by the joint venture partners, much of which has been taken out of agriculture and planted with a mixture of bottomland tree species during the past 14 years.

Scientists from the Illinois Natural History Survey (INHS) have been conducting research in the Cache River watershed for many years. Scientific research is an important component of conservation plans and restoration efforts. Research on the bird community in the Cache River watershed of Illinois has provided a unique opportunity to document the effects of conservation actions and provide direction for restoration practitioners. Research efforts during 1993–1995, prior to the bulk of the restoration, determined that bird species diversity increased with bottomland forest width and that nesting success was highest (relatively low rates of nest predation and cowbird parasitism) in the least fragmented forests within the Cache River watershed. More recently on our study sites that were adjacent to agriculture (row-crop or pasture) but now are adjacent to early-successional forests (as a result of land acquisition and reforestation), we have seen a 20–40% reduction in rates of cowbird parasitism compared to sites that still are adjacent to agriculture and have consistently high rates of cowbird parasitism. These results have helped the joint venture partners establish land acquisition priorities. Land acquisition that increases the amount of forest interior (forest greater than 500 m from agricultural land use) by widening or consolidating preexisting bottomland forests should greatly benefit birds breeding in the Cache River watershed.

The Prothonotary Warbler has been a focal species for studying how natural processes such as hydrologic fluctuations affect the function and value of bottomland habitat for songbirds. Prothonotary Warblers require forested wetlands for breeding and prefer to nest over water (in tree cavities or nest boxes). Since 1994 we have monitored over 5,000 warbler nests and we now know that fluctuations of water levels in swamps and forested wetlands influence nest predation, in turn affecting the season-long productivity of these warblers. Raccoons were responsible for the majority of nesting failures and rates

Continued on page 5

Warblers Provide Link Between Behavioral Ecology and Conservation Biology

Studies of the behavioral ecology of Prothonotary Warblers in the Cache River watershed have allowed us to gain a better understanding of some of the most important yet poorly-known aspects of migratory songbird behavior that profoundly affect their population dynamics. These behaviors include the between-year fidelity of adult warblers to breeding sites and the dispersal of warbler offspring away from their place of birth (natal dispersal). The Prothonotary Warbler is a migratory songbird that winters in the Neotropics (Central America to northern South America) and breeds in forested wetlands throughout parts of the eastern half of the United States. This species is territorial during the breeding season, nests in secondary cavities and nest boxes, and prefers to nest over standing water in bottomland and swamp forests. Prothonotary Warblers are also easy to capture, individually mark, follow for an entire breeding season, and relocate in subsequent years. These characteristics make the warbler ideal for studying site fidelity and natal dispersal of a migratory songbird in a bottomland forest ecosystem.

A Prothonotary Warbler that nests and breeds in the Cache River watershed. Photo by Jeff Hoover, INHS

By experimentally improving nesting success for some pairs of warblers but not others, we demonstrated that individual male and female Prothonotary Warblers decide whether or not to return to sites within the Cache River watershed based on their reproductive performance. Individuals producing two batches (broods) of offspring in a breeding season returned to the same habitat patch the following year at a rate of 80%. Individuals producing one brood returned at a rate of 50% and only 25% of those producing no offspring returned the next year. The warblers use their own nesting success as a cue to return to good sites and to avoid returning to bad ones. These "decision rules" lead to increased densities of warblers on good sites because many of the breeding adults return year after year, and also because the presence of these returning adults is attractive to other warblers (including older birds who were on a bad site the previous year and 1-year-olds breeding for the first time) looking for a good place to breed. The effect of the presence of individuals of the same species on the settlement pattern of others is called "conspecific attraction." The presence of many returning adult birds on a site may indicate to new birds that it is good-quality breeding habitat much in the same way that a crowded restaurant likely indicates to passers-by that the food is good there.

The results of this initial study provided a link between behavioral ecology and conservation biology by showing the inter-connections between several features of the bottomland system and the behavior of the warblers. Habitat fragmentation and degradation in bottomland forest ecosystems increase raccoon densities (the primary nest predator), and affect hydrologic fluctuations that influence raccoon movements and rates of nest predation. Nest predation by raccoons limits the nesting success of Prothonotary Warblers, the subsequent return of warblers between years, and ultimately the local population dynamics of the warblers. By consolidating forests and managing hydrology in forested wetlands (maintaining deep water during the breeding season), local populations of warblers will thrive and be highly productive.

Natal dispersal, the movement from a natal site (place of birth) to a new breeding site, is probably the most important and least understood

Continued on page 5

Molecular Phylogeny of *Cuerna* Leafhoppers Suggests Hybridization

Although using DNA sequences as unique signatures (barcodes) for identifying species is becoming increasingly popular, numerous recent studies have warned that exclusive reliance on sequences of one or several genes may lead to errors. Occasional hybridization or retention of ancestral variations can result in different species sharing identical sequences or, alternatively, different populations of the same species displaying highly dissimilar sequences. Here we describe examples of both such patterns encountered during our study of the systematics and evolutionary biology of the widespread North American leafhopper genus *Cuerna*. In this National Science Foundation—funded research we sequenced 2 mitochondrial genes from 140 individual leafhoppers representing 25 of the 31 known species of the genus.

Two southwestern species, *C. curvata* O. and B. and *C. yuccae* O.and B., differ from one another in the structure of both male and female genitalia (Fig. 1). Gene sequences sampled from four populatons of *C. yuccae* were significantly (2–2.5%) divergent from those sampled from three populations of *C. curvata*. However, a population of *C. yuccae* from Snow Canyon State Park in Utah had mitochondrial sequences identical to those of *C. curvata*. This area is one of the few where these species occur together. While *C. yuccae* feeds on Joshua trees and *C. curvata* on single-leaf pinyon pines, apparently in both species mating and laying eggs take place on the same herbaceous plants near the ground. We hypothesize that mitochondrial genes of *C. curvata* have introgressed into the population of *C. yuccae* via a rare hybridization event, which must have occurred despite differences in the structure of the genitalia of the two species.

Extinction of one of the species involved in introgressive hybridization or incomplete sampling can result in discrepancies between morphological and molecular traits, which can be difficult to interpret. This can be illustrated by the example of *C. alpina* O. and B., which

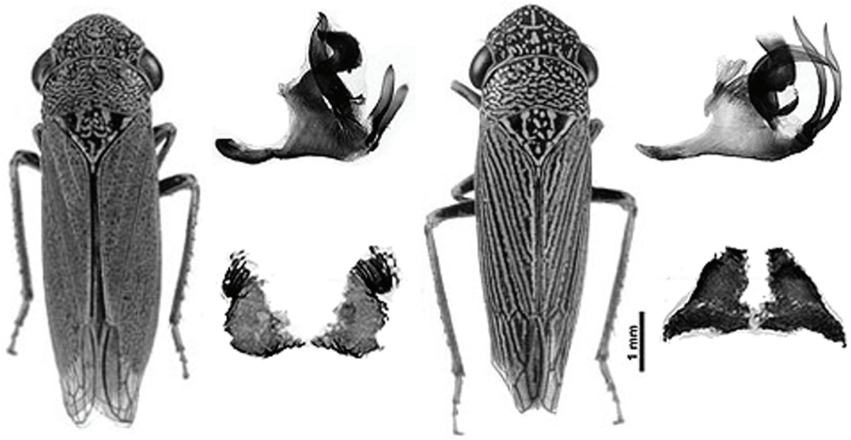


Figure 1. Cuerna curvata *(left) and* Cuerna yuccae *(right). The two species differ in the structure of the male (top) and female (bottom) genitalia.*

we have rediscovered in Illinois. This grassland species (Fig. 2) occurs in the Rocky Mountains and western prairie states, including New Mexico, Kansas, Nebraska, and the Dakotas. An earlier study of the genus also included Illinois in the species' range, but, because no specific locality was given and no specimens of *C. alpina* were found in Illinois museums, this isolated record from the Midwest appeared erroneous until we actually found specimens from Illinois among material borrowed from the Canadian National Collection. They were collected in 1950 and 1962 at Prairie du Rocher and Fults (Randolph and Monroe counties) by Illinois Natural History Survey (INHS) entomologist Herbert Ross and botanist Robert Evers, who at the time were conducting a survey of hill prairies of Illinois. In September 2005, we found *C. alpina* at Fults Hill Prairie Natural Preserve on a Mississippi River bluff. This population is 350 miles east of the nearest previously known locality of this species. The mitochondrial gene sequences from the Illinois specimens turned out to be very different (4.2–4.6%) from sequences obtained from *C. alpina* collected in New Mexico, Colorado, Nebraska, and Montana. In the phylogeny of the genus, reconstructed from these sequences, the Illinois population appears as a distinct lineage, not closely related to the cluster of western populations or to any other *Cuerna*. A possible explanation is that some populations of *C. alpina* may have acquired mitochondrial DNA through hybridization with a different species, which is either not represented in our dataset or is extinct. The genetically unique population of *C. alpina* in southern Illinois sheds light on the convoluted history of the genus and deserves both preservation and study. Further research is needed to elucidate the possible role of hybridization, previously undocumented, in the evolution of *Cuerna* and related leafhoppers.

Figure 2. Cuerna alpina.

Roman Rakitov and Sindhu Krishnankutty, INHS Division of Biodiversity and Ecological Entomology

Cache Restoration

Continued from Page 2

of nest predation decreased with increased depth of water beneath nests. Nests over water deeper than 60 cm (2 feet) were particularly successful because raccoons apparently like to wade but not swim in water when foraging for crayfish and other aquatic organisms. The nesting success of these migratory warblers drives the site fidelity of the adults, the dynamics of local populations, and whether the watershed is a "source" or a "sink" for the species. Forested wetlands and swamps that have deep water in them for a long (1–3 months) duration during the warblers' breeding season (May–July) are critical to the nesting success and maintenance of healthy populations of Prothonotary Warblers.

Channelization of rivers and streams threatens bird species dependent on forested wetlands because it can lead to the formation of lateral gullies that connect streams to adjacent wetlands and drain the wetlands. These wetlands may fill during spring floods and be attractive breeding habitat for birds, but the unnaturally rapid draining of the wetlands early in the breeding season may lead to high rates of nest predation. When wetlands are drained by gullies, the water beneath Prothonotary Warbler nests becomes shallower, exposing the nests to increased rates of nest predation by raccoons. Habitat fragmentation, the draining of wetlands, and stream channelization may act synergistically to elevate rates of nest predation in forested wetlands. Conservation actions designed to stop or reverse these processes will be especially beneficial to birds breeding in bottomland forest ecosystems.

Conservation partners (IDNR, TNC, USFWS) in the Cache River watershed are attempting to reduce habitat fragmentation and consolidate bottomland forests through land acquisition and reforestation. They are also restoring "natural" hydrologic processes by reducing the effects of stream channelization and by plugging some of the lateral gullies that currently drain adjacent (off-channel) forested wetlands. When these gullies are plugged, the water is held in the wetlands at a greater depth and for a longer duration, resulting in increased nesting success for Prothonotary Warblers. As habitat restoration in the Cache River watershed proceeds, we are poised to document how changes in land-use, landscape composition, and specific management practices affect the bottomland forest bird community. Continued research in this system will expand our knowledge and increase our ability to effectively and efficiently restore and manage bottomland forests. It will also provide a means to measure the success of restoration activities in the Cache River watershed and inform conservation plans and restoration efforts in other bottomland forest ecosystems.

Jeff Hoover, INHS Division of Ecology and Conservation Sciences

Cache Warblers

Continued from Page 3

life history trait. It is fundamental to the ecological understanding of landscapes, populations, and organisms, and a necessary consideration when devising conservation plans. Natal dispersal has remained a mystery in migratory songbirds, largely because few of the nestlings banded on study sites ever return to those sites in subsequent years. This has left researchers and conservation practitioners wondering if the birds not returning are dead or if they have dispersed to locations (nearby or distant) outside of the study or management area.

During the past 11 years, we have banded more than 4,000 Prothonotary Warbler nestlings in the Cache River watershed, and searched for them in subsequent years to get an idea of natal dispersal distances (distance between birthplace and location of first breeding). We expanded our search during the past two breeding seasons to include other appropriate habitat within the watershed, and also to habitat 20–40 km away from the primary study area. To date, over 300 warbler nestlings have returned to breed. We have found that the vast majority (>80%) of returning nestlings breed within 3 km of where they were produced. We viewed over 2,500 breeding adult warblers 20–40 km away from the study area and not a single one was banded. Warbler offspring appear to recruit into the population near where they were produced. Simply put, it seems that birds produced in the Cache return to the Cache. The great management implication of this result is that local conservation efforts that improve nesting success (e.g., land acquisition, restoration, consolidation of forests, managing water levels) will benefit local population dynamics and provide an even greater benefit to the local bird community.

In association with the natal dispersal research, we are now poised to use stable-isotope analysis techniques to address the question: Are local populations of Prothonotary Warblers maintained by local reproduction or by birds that are dispersing into the system from distant sources? Hydrogen isotope ratios in birds' feathers reflect those of local precipitation. This measure has been useful in assessing the origins of migratory species because there is a strong north to south gradient in hydrogen isotope ratios. The stable-isotope signature is assimilated into feathers through the food chain: plants take up rainwater, insects eat plants, and birds eat insects while growing their feathers. Once the feather is grown, its stable-isotope signature does not change. Therefore, a feather grown by a juvenile bird on the breeding grounds (at its birthplace) will bear the stable-isotope signature of that location. One difficulty, however, is that most migratory birds molt their natal (juvenile) feathers prior to returning to breed for the first time. The Prothonotary Warbler is one of few migratory songbirds that retains its natal tail feathers through the first breeding season, therefore allowing us to determine its point of origin. Stable-isotope analysis of tail feathers collected from 1-year-old warblers will allow us to determine the proportion of new recruits in the breeding population that are from local versus distant sources, and assess the effectiveness and benefits of local conservation actions in the Cache River watershed for migratory birds breeding there.

Jeff Hoover, INHS Division of Ecology and Conservation Sciences

A Cache Full of Activity

A small, wiry man with a gray pony tail sits on a small hill, diligently sketching the landscape before him while a line of canoes stretches off into the distance, quietly invading the dense, deep, primeval swamp.

A sea of children, disembarking from a bevy of yellow school buses lines up and proceeds through an arch decorated with large photos of Illinois insects and into a college gymnasium. Their fervor and excitement precede them like a palpable wave.

A large, white van with colorful graphics sits chugging with a not-so-quiet generator in the parking lot of the new Henry N. Barkhausen Wetlands Center, while children and adults in a long line await their turn to enter.

What do all of these seemingly unrelated events have in common? They are all activities and programs involving education/outreach activities in the Cache River, initiated by the Illinois Natural History Survey in partnership with the Cache River State Natural Area and the Cypress Creek National Wildlife Refuge.

This Cache Corps of Discovery (CCD) was created in early 2006 and was modeled after the Lewis and Clark Expedition. Survey scientists Dr. Michael Jeffords, Susan Post, and Carie Nixon developed the idea to create a volunteer group of citizens who would be trained in the skills of nature photography, descriptive writing, and sketching/drawing. Following training they would be "turned loose" on their adopted landscape, in this case the Cache River ecosystem, to aesthetically document the biodiversity of this unique area and the changes that are taking place as restoration efforts proceed. Twenty-nine individuals make up the CCD and are working on various special projects, including creating an interpretive trail for the new visitor's center and a yearly exhibit of their work. A series of points and transects have been established to aid in their observations. These are termed Aesthetic Points and Pathways.

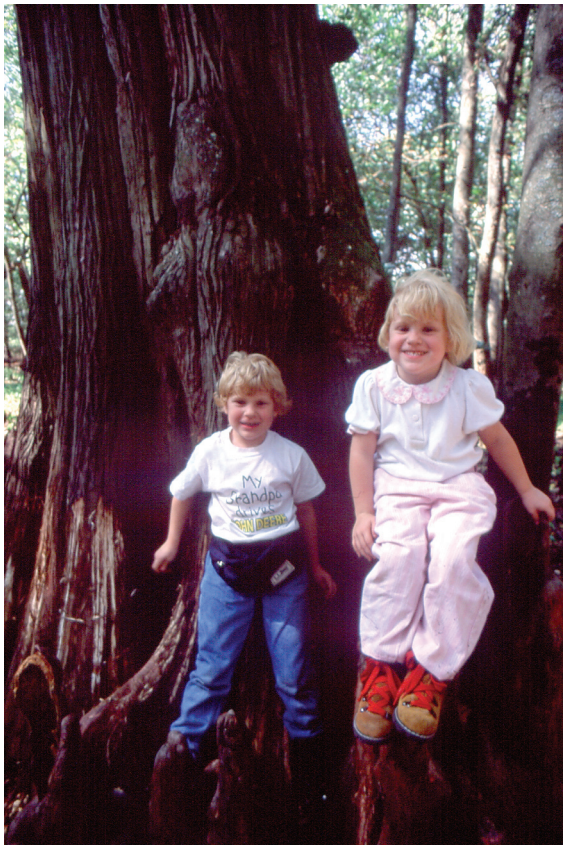
The INHS Mobile Science Center is one of two travelling educational units that bring natural science to the citizens of the state. Photo by Michael Jeffords, INHS

Every two years, the partners listed above, with help from the local Regional Office of Education, put on an Insect Expo for elementary school-age children from the region. The event is held in late March, and attracts from 1,500–3,000 children from a 100-mile radius of the host site at Shawnee Community College. The one-day event features 30–40 interactive exhibits on insects and arthropods and includes several performances of Insect Theatre. All the activities are loaded in a large trailer and brought to the area from Champaign the day before. Local citizens and high shool students help staff the booths. The event is always very popular and provides scientific content to schools in a very underserved region of Illinois.

The INHS Mobile Science Center (MSC) makes regular visits to the Cache River area, usually in conjunction with the Southern Illinois Birding Blitz, held each April. In 2006, Cypress Creek National Wildllife Refuge provided funds to create an exhibit that focused specifically on the biodiversity of the region with special emphasis on the avian fauna. The MSC often spends the week in the area, also visiting the Environmental Days held at the UI Dixon Springs Forest Resource Center.

The Cache River area is, and will continue to be, a focus of INHS outreach because it is one of the most unique systems in the state, country, and the world. It has been designated a "wetlands of international importance," and it also lies in one of the areas of Illinois that has little access to museums and other scientific institutions that provide hands-on interaction with science and scientists. The Survey is in a unique position to provide what Stepehen A. Forbes called "science for the people."

Michael R. Jeffords, INHS Office of the Chief



Children enjoy a hands-on introduction to cypress trees in the Cache watershed. Photo by Michael Jeffords, INHS

Workshop participants are encouraged to work "up close and personally" with their natural subjects. Photo by Michael Jeffords, INHS

Children are not the only ones enticed to the Cache. Above, participants and instructors in an INHS nature photography workshop pause for a group portrait. Photo by Michael Jeffords, INHS

INHS herpetologist John Petzing conducts education/outreach field trip for workshop participants in the Cache watershed. Photo by Michael Jeffords, INHS

INHS Researcher to Be Inducted into Illinois Outdoor Hall of Fame

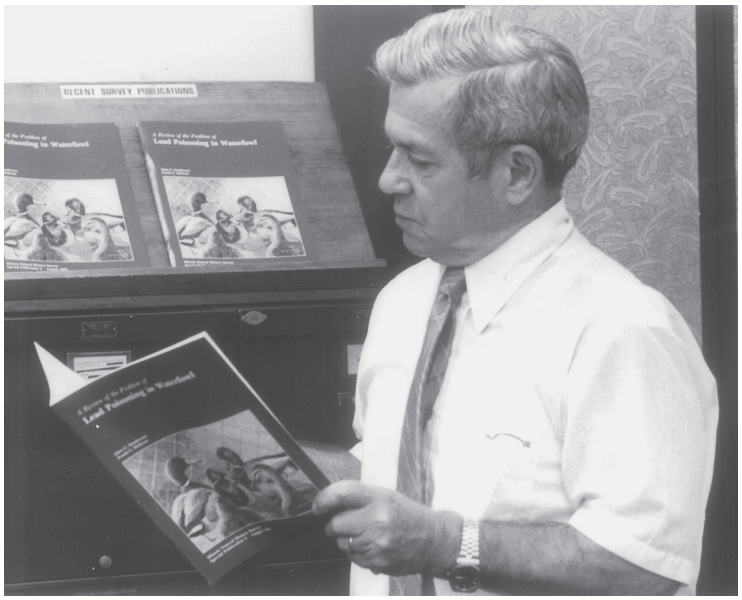
INHS mammalogist Dr. Glen C. Sanderson will be one of four new inductees of the Illinois Outdoor Hall of Fame on February 3, 2007. The hall of fame is a program of the Illinois Conservation Foundation.

These four individuals are being recognized for distinguished service and commitment to natural resource protection and outdoor recreation in the state. "They have records of service to the citizens of Illinois and to their communities that make them ideal choices for selection to the Illinois Outdoor Hall of Fame," said Illinois Department of Natural Resources Acting Director Sam Flood, who serves as the chairman of the board of directors of the Illinois Conservation Foundation. "Each of them has been honored many times for accomplishments in their individual careers. We are proud to add to the lists of honors the selection to the Outdoor Hall of Fame."

Glen C. Sanderson of Champaign, a renowned wildlife biologist with more than 50 years of service to Illinois, is considered one of the world's leading authorities on the biology and ecology of raccoons and one of the country's leading advocates for development of nontoxic shot to alleviate lead poisoning in waterfowl.

Renowned INHS waterfowl biologist Frank Bellrose wrote that Sanderson was selfless in placing the research of others ahead of his own. According to Bellrose, Dr. Sanderson conducted several important laboratory studies on nontoxic alternatives to lead shot. One of these alternatives was bismuth, which is being used to this day for such purposes.

Dr. Sanderson is also well known for his leadership of the preservation of the endangered prairie chicken in southeast Illinois. For almost 30 years he coordinated efforts of the Illinois Nature Conservancy, the Illinois Department of Conservation, and INHS that resulted in innovative methods of land acquisition and management for prairie chicken habitat. Under his leadership, two remnant and endangered flocks were preserved for posterity.



Sanderson produced more than 90 scientific publications including 55 scientific papers on the population biology of raccoons, the impacts of lead poisoning in waterfowl, the effectiveness of steel shot for hunting, and other topics. He also edited a number of journals and symposia proceedings such as *Journal of Wildlife Management*, *Midwest Furbearer Management Symposium*, *Migratory Shore and Upland Game Birds of North America*, *the Wild Turkey Management Symposium*, and *A Review of the Problem of Lead Poisoning in Waterfowl*—an INHS special publication.

Among the organizations that Glen served in a volunteer capacity are the University of Illinois Natural Areas Committee, the Illinois Chapter of of The Nature Conservancy Stewardship Committee, the Champaign County Forest Preserve District Advisory Committee, and the Illinois Conservation Police Merit Advisory Committee.

Dr. Sanderson received the prestigious Aldo Leopold Award for distinguished service to wildlife conservation from The Wildlife Society in 1992, the highest honor that can be bestowed on wildlife professionals. In addition Sanderson is listed in "Who's Who in America" and the recipient of American Motors' Conservationist of the Year, The Nature Conservancy Oak Leaf Award, the North Central Section of the Wildlife Society Appreciation Award, and the Illinois Chapter of The Wildlife Society Professional Award of Merit.

A World War II veteran, Sanderson began work in 1949 as a wildlife biologist in Iowa before joining the Illinois Natural History Survey in 1955. He became the INHS Center for Wildlife Research director in 1964 and was later named to the rank of Principal Scientist in 1989. At that time, he was one of only three scientists in the history of INHS who had achieved this rank. Since his retirement in 1990, Dr. Sanderson has remained an active researcher and mentor.

According to nomination letters for his induction into the Illinois Outdoor Hall of Fame, Glen Sanderson brought thousands of dollars of research grants for conservation into the state. Students, researchers, educators, policy makers, and elected officials have all been recipients of his guidance and expertise on the natural resources of Illinois. He set high standards of professional conduct for his staff by working harder than everyone else. He ways always willing to invest the time and energy to mentor and assist those in his charge.

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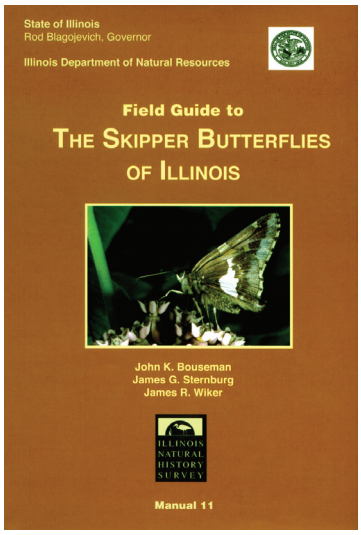

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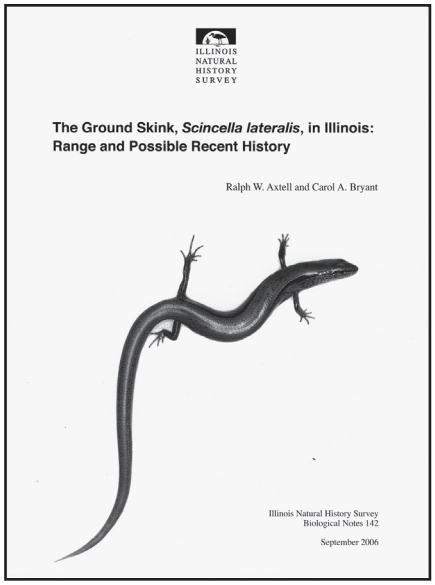

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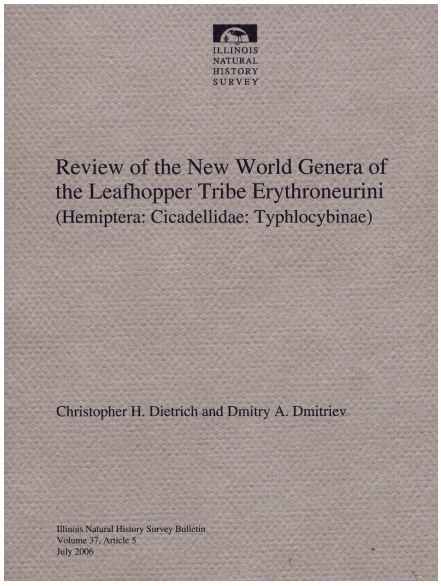

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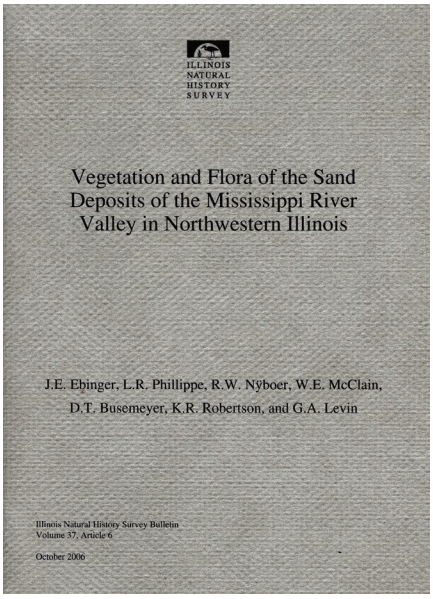

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Species Spotlight

Jack-O-Lantern Mushroom

Darrell Cox and Andrew Miller

The Jack-O-Lantern mushroom, *Omphalotus olearius*, (also known as *Omphalotus illudens*) is a common late-summer-to-fall mushroom of the midwestern and eastern United States. It gets its common name not only because of its bright pumpkin orange color and its occurrence around the time of Halloween, but also because it can exhibit an eerie glow known as bioluminescence—the production of light by a living organism—in this case, a fungus. *Omphalotus olearius* is especially appropriate here in Champaign-Urbana since it is among the few mushrooms which display the "Illini orange" color.

The Jack-O-Lantern fungus produces large clusters of mushrooms around the bases of dead hardwood trees and stumps. They can also grow from buried roots. The yellow-orange to orange cap is first convex in shape, becoming flat and then finally funnel-shaped with a margin that turns downward. Underneath the cap are found similarly-colored narrow, decurrent (running down the stalk) gills, and a pale orange, thick stalk.

Jack-O-Lantern mushrooms. Photo by Darrell Cox, University of Illinois

Jack-O-Lanterns are attractive and have a pleasant odor, but are POISIONOUS! They are sometimes mistakenly eaten by people who think they are chanterelles. Chanterelles are similarly colored, can occur around the same time of the year, and are good edibles. However, chanterelles are smaller in stature, have gills that are not well developed (appear more like veins), and usually grow solitarily on soil. Experiencing poisoning by *O. olearius* has been described as at first being afraid you're going to die, then being afraid you're not going to die, and finally, after several hours of abdominal pain and vomiting, you begin to feel better.

So if you can't eat it, and other than being a cool, charismatic mushroom and an organism worthy of appreciation and scientific curiosity, what good is it? Would you believe it's a cancer killer? Illudin S, a compound produced by Jack-O-Lantern mushrooms was known to have anti-cancer capabilities over 30 years ago, but it was also too toxic for humans to endure. More recently, researchers at the University of California-San Diego synthesized an anti-cancer compound from the toxins of the Jack-O-Lantern, which shows promise in treating a number of human cancers. The new drug, Irofulven, has the capability of causing programmed death of cancer cells, and is currently being tested in clinical trials as a chemotherapy agent for a number of different cancers.

Omphalotus olearius is also one of more than 40 species of bioluminescent fungi. The eerie light emitted by these mushrooms or by the actively growing mycelium of these fungi growing in decaying wood is a phenomenon referred to as "foxfire" and was reported as early as 382 B.C. by the Greek philosopher Aristotle. The recognition that luminous wood was actually caused by fungi was reported in 1823, and people in the far north are reported to have marked forest trails with pieces of rotten, glowing wood to enable them to find their way back at night. It is the gills of the Jack-O-Lantern mushroom that exhibit bioluminescence. This phenomenon can be demonstrated by bringing fresh and actively growing mushrooms into a dark room at night—the darker the better. Stare at the gills of the mushrooms until your eyes become accustomed to the dark, and you may eventually see the greenish glow given off by them. Although the reason, if there is one, that fungi glow is unknown, some suggest it functions to attract animals or insects that eat the mushroom and aid in the dispersal of its spores.

The Naturalist's Apprentice Teacher's Page

Notes to the teacher: If the room is very warm, the mushroom may deteriorate quickly and be difficult to remove from the paper. In this case, if it is possible, place the paper with the mushrooms on it in a refrigerator. This will slow down the deterioration. It may also slow the release of the spores.

To write a date and location on the black paper, use a white- or yellow-colored pencil.

The Naturalist's Apprentice

Make a Mushroom Spore Print

Carolyn Nixon

Mushrooms are the reproductive bodies of a fungus. Their purpose is to produce spores, which are like the "seeds" for a fungus. Different species of fungi have different types and colors of spores, and mushrooms release the spores in different patterns, depending on the shape and pattern of the underside of the mushroom cap. Some caps are smooth on the bottom with many tiny pores. These release the spores evenly across the surface. Others have gill-like structures that tend to release spores in a raylike pattern.

Mycologists (scientists who study fungi) use spores as one of the characteristics in identifying a fungus. The color of the spores, their shape and surface texture, and the pattern of how they are released are all important. While the size and shape of the individual spores are only visible with a high-powered microscope, the color and pattern of release are easy to determine by making spore prints.

mushroom showing gill pattern on underside

To make spore prints from mushrooms, you will need:

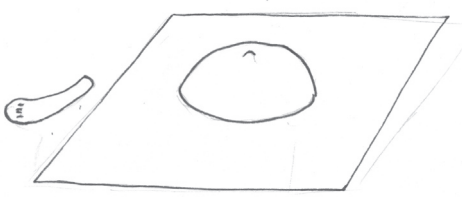
- heavy weight paper in both white and black
- fresh, mature mushrooms that are not deteriorating
- damp cotton balls or pieces of paper towel
- bowls or glasses large enough to fit over a mushroom

If you want to save your spore prints, you will also need:

clear acrylic spray, laminating film and laminator, or clear contact paper

To produce a spore print from a mushroom:

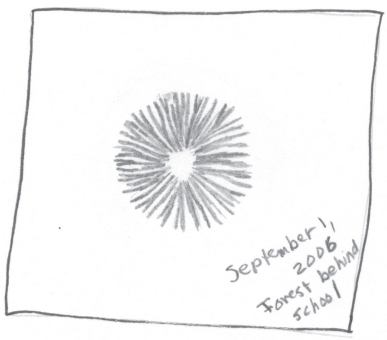
1. Cut or pull the stem from the mushroom cap.
2. Place the mushroom cap, top side up, on a piece of white or black paper. If you have more than one of the same type of mushroom, place at least one on each color of paper. Note: be sure to write the date and location where the mushroom was collected on the piece of paper.
3. Place a damp cotton ball or piece of damp paper towel on top of the mushroom. This will help keep it fresh longer.
4. Place an upside-down glass or bowl over the top of the mushroom to help keep the mushroom moist.
5. If possible, check the paper in a couple of hours to see if spores are deposited on the paper. It may take from 2 to 24 hours to collect the spores.
6. Remove the glass or bowl and the cotton ball or paper towel. Carefully lift the mushroom cap up from the paper. You should now have a spore print!



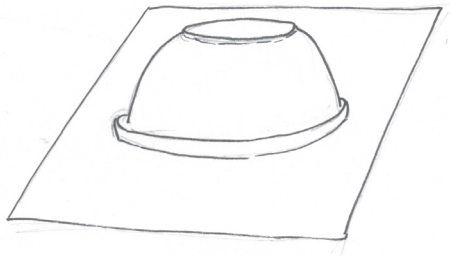
remove the stem and place the cap right-side-up on a piece of paper

To preserve you spore print once the paper is dry, spray it with clear acrylic, laminate it, or cover it with clear contact paper.

Drawings by Carolyn Nixon of INHS.



the spore print, labeled with date and collection location



cover with a bowl or glass

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