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Bio Blitz Collects 2000+ Species in 24 Hours

During June 29–30, the Survey undertook a unique exercise—a 24-hour, all-taxa survey of a designated site in central Illinois—the Biodiversity Blitz. The Survey has been in the biological inventory business for over 140 years, amassing enormous collections and data centered around Illinois biodiversity, but

chosen because it has a diversity of habitats, is virtually an island surrounded by agricultural lands, and was large enough to be challenging yet small enough to be doable.

ornithologists, 7 mammalogists, 5 herpetologists, and even a lone sponge specialist! Scientists were divided into two groups. Level One scientists were leaders of groups and were responsible

for the identification of the organisms they found.

Level Two scientists served as collectors, curators, and other types of field assistants.



this event presented several challenges. Exactly what does it take to do an all-species inventory in a defined time slot? The answer is not so simple.

First, a suitable site is needed, in this case, the University of Illinois' Robert Allerton Park near Monticello, IL. Allerton was

Second, it takes a cadre of scientists with a great variety of knowledge and skills—everything from protozoology to mammalogy. For the Blitz, over 160 scientists participated. The entomologists had the most scientists, 47, but other groups were well represented. The list included 16 botanists, 8

Third, it takes dedication and organization. The Illinois Natural History Survey, with help from the Illinois Department of Natural Resources and the University of Illinois, provided that. A Survey committee organized the event

Continued on back page

Effects of Exotic Plants on Bird Nesting Success

Invasive species have been implicated as a major or contributing cause of declines for nearly half the endangered and threatened native species in the U.S. In Illinois, the number of exotic or invasive plants is unknown, but several (garlic mustard, kudzu, autumn olive) seriously threaten Illinois habitats.

Wetlands in Illinois, already reduced by 85%, are invaded due to disturbance from development, altered hydrology, or runoff. Purple loosestrife (*Lythrum salicaria*), a Eurasian plant that invaded North American wetlands in the 1800s, now dominates many Illinois wetlands. Due to the ineffective management of loosestrife through other methods (e.g., herbicides, burning, flooding), purple loosestrife has been the target of biological control agents (natural enemies such as insects and pathogens) imported from Europe.

Illinois has one of the nation's most



Researchers dwarfed by purple loosestrife plants. Photo by J. Dylan Maddox, UIUC

active biological control projects against purple loosestrife, with nearly 2 million agents released and apparent success seen at several sites. However, the national loosestrife biological control program has been criticized as unnecessary. Critics claim purple loosestrife poses little threat to na-

tive species, especially birds, because nesting females have been observed in loosestrife-infested wetlands.

Data regarding the effects of invasive plants on birds are limited. Numerous factors could result in lower (or even higher) reproductive success, but we believe two stand out: limited prey abundance and elevated predation rates. Exotic, invasive plants thrive in new areas not because they are intrinsically superior to their native counterparts, but because their natural enemies are absent. Natural enemies, usually insects, control plants in their native distributions, but most are never introduced with their host plant. Thus, large stands of purple loosestrife may contain fewer insect prey, which could result in increased starvation by nestlings relying on insect prey as food. This notion is supported by the finding that about 120 species of insects are found feeding on purple loosestrife in Europe, whereas only 12 were found in a study in southern Manitoba.

Nest failure is largely the result of nest predation, and predation rates are greatly influenced by vegetation characteristics of nest sites. The encroachment of an invasive species will, to some extent, modify vegetation characteristics and perhaps render nests more susceptible to predators. For example, a 1999 study by Schmidt and Whelan showed that birds nesting in exotic plants experienced higher predation rates and lower reproductive success than nests built in comparable native shrubs. These elevated predation rates were attributed to structural differences of exotic plants. Structure of purple loosestrife differs drastically from native wetland plants.

In cooperation with the Chicago Department of Environment, Illinois Natural History Survey scientists initiated a two-year study in the Lake Calumet region of northeastern Illinois to examine the effects of purple loosestrife on wetland birds. Preliminary data of approximately 90 nests found during the 2000 breeding season suggest

1. Red-winged Blackbirds nesting in purple loosestrife were less likely to succeed



Red-winged Blackbird nest with eggs. Photo by J. Dylan Maddox, UIUC

(31% nest success) than birds nesting in cattail (37% nest success);
2. Redwings avoid nesting in purple loosestrife until early to mid-June, whereas nests in cattail were initiated in early May;
3. Starvation was equally common in loosestrife and cattail habitats;
4. Marsh Wrens were never found nesting in loosestrife, only cattail.

Also, in 2001, one of the wetland sites was burned. Although large stands of loosestrife did not burn, all cattails burned, leaving no plant structure for nesting. At that particular site, neither Red-winged Blackbirds nor Common Grackles nested in loosestrife until after June and Marsh Wrens were entirely absent. This anecdote seemingly further supports our assumption that loosestrife is not suitable habitat for nesting birds at least until later in the breeding season.

It appears that elevated predation rates in loosestrife are not related to predation patterns commonly reported in other nest predation studies, e.g., edge, plot, or seasonal effects. Our results may indicate findings similar to those of Schmidt and Whelan in that vegetation structure might facilitate the movement of predators in purple loosestrife. We hope current data collection will provide more insight to these findings.

J. Dylan Maddox, NRES-UIUC, and Robert N. Wiedenmann, Center for Economic Entomology

Land-cover Classification for Forests

A land-cover map depicting major vegetational communities is one example of how satellite imagery is used in natural resource mapping. For many projects at the Illinois Natural History Survey (INHS), the creation of maps and databases that allow analyses of landscapes begins on a computer screen. While many scientists at INHS conduct research on ecology or some other area of biology, others classify satellite imagery, a difficult task.

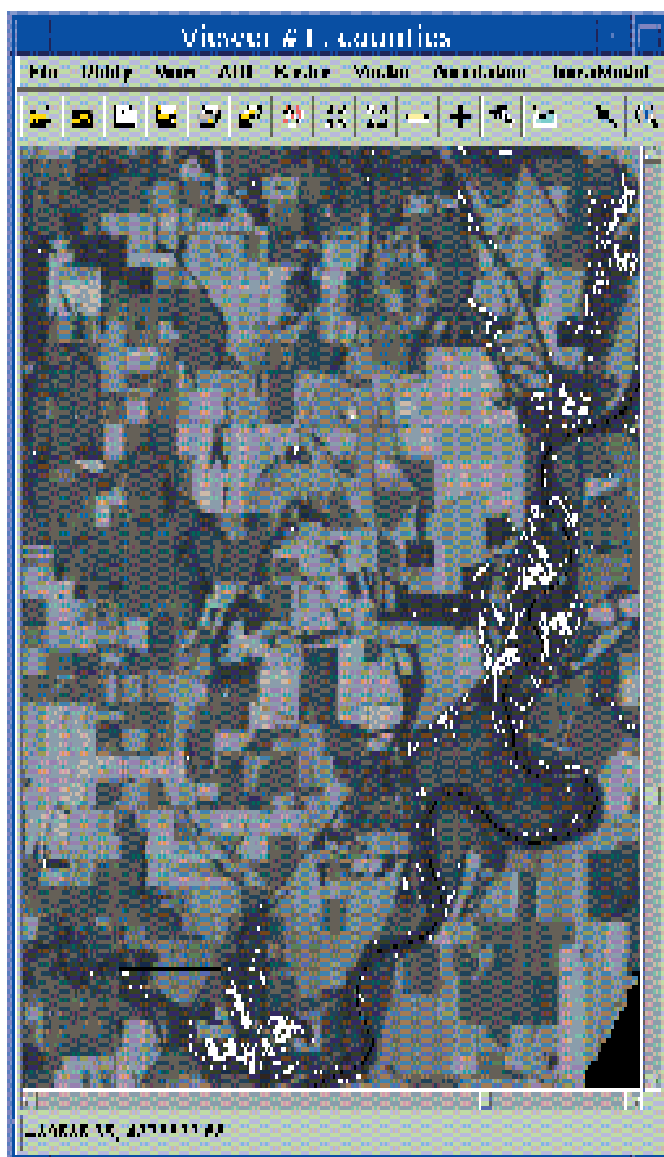
Satellites actually measure the reflectance of visible light and other electromagnetic radiation off the land. As a satellite looks down upon the earth, it records data in pixels. Each pixel is about the size of a baseball diamond (30-m square) and must be classified based upon its reflectance of different wavelengths of light and other radiation. All these data are recorded and classified into similar categories. Additional processing is needed to determine what the various classifications mean in terms of ground vegetation.

The task of classifying the land cover of the state—a daunting task—is being shared. Don Luman and others at the Illinois State Geological Survey have classified the agricultural portion of the state (about 75% of the land area) as part of an agreement with the National Agricultural Statistical Service. INHS researchers are in the process of classifying the forests, wetlands, and grasslands of Illinois. The project is about half complete in generating a full land-cover map of Illinois based upon imagery acquired in 2000. Eventually this land-cover map will be used to model wildlife habitats and to evaluate land-cover conditions. The land-cover map will be used to examine land-use practices in Illinois, with hopes of assisting state agencies as they plan conservation measures including acquisitions, stewardship programs, and incentive programs.

The forests of Illinois are a particular challenge in classification. Because many wildlife species make their homes in forests, we have found that detailed mapping of the forests is very desirable. One of the difficulties in mapping the forests is identifying the dominant plant community in any given area. Because each pixel represents an area of 30 meters by 30 meters, some pixels may include more than one plant community. To improve interpretation of land-cover type from the imagery, we

use “spatial patterning,” that is, we look for patterns in the landscape that indicate dominance of a specific tree species in that area.

For example, we are currently examining the area around the Wabash River from the southern part of Edgar County to the northern part of White County to the western edge of Effingham County. A computer program statistically places pixels into different classes based on the reflectance characteristics, grouping similar pixels together. Next, we examine the classes created by the computer program and assign each a name. For example, many forests around rivers have different spectral and spatial patterns than forests in upland areas (see photo). Researchers may also use an elevation model to determine the trees in upland versus bottomland locations. Soil surveys and aerial photographs are also very helpful in defining tree species based on location and soil type, but the work may not end there. We also rely on experts to tell us whether our analysis is reasonable. With the challenges of this



work, a land-cover map specialist at INHS becomes part scientist, detective, computer jockey, and naturalist. Who says computer work is boring?

Brooke Bahnsen and Patrick Brown, Center for Wildlife Ecology

Biotic Inventory of Kyrgyz Grasslands

Temperate grasslands are the most threatened of the world's ecosystems. In Illinois less than 0.1% percent of our original native prairie vegetation remains and most of the loss has occurred within the last 150 years. Native grasslands harbor an enormous diversity of species, including the most important food plants of humans and domestic animals. Consequently, they also harbor the herbivorous insects that consume these plants, some of which are now considered agricultural pests, as well as the natural enemies of these pests. Thus, study of native grassland biotas is desirable not only because they are rapidly disappearing worldwide, but also because of the economic importance of grassland organisms.

Despite the importance of grasslands to human civilization, basic knowledge of the grassland biota is still very incomplete. New species, particularly of diverse groups such as



INHS research assistant Dmitry Novikov (lower right) vacuums insects in a mountain meadow in the Trans-Alaj Range of southern Kyrgyzstan. Photo by Christopher Dietrich, INHS Center for Biodiversity

insects, continue to be discovered, and the interactions among grassland plants and animals, such as the relationship between plants and their insect pollinators, remain poorly understood. The relationships among the floras and faunas of different grassland regions are also incompletely known. Such knowledge is crucial to an improved understanding of the factors that create and maintain native grasslands as functioning ecosystems. Globalization of the economy and the increasing impacts of non-native species provide additional impetus for the study of grassland biotas. Many North American grasslands are dominated by plant and animal species introduced from Eurasian

grasslands, and accidental introductions of exotic species are becoming more frequent.

Although intensive study of the remaining Illinois prairies continues to be a top priority at the Illinois Natural History Survey, studies of grasslands in other parts of the world are also necessary to provide baseline data on poorly sampled regions and to help place the Illinois biota in a global perspective. Central Asia has some of the world's most extensive remaining temperate grasslands, most of which are encompassed within the borders of the former Soviet Union. The breakup of the Soviet Union has facilitated closer collaboration between U.S. and former Soviet scientists and provided opportunities for fieldwork in regions formerly off limits to U.S. researchers. Entomologists and botanists from INHS took advantage of this to conduct an inventory of the grassland vascular plants and arthropods of a former Soviet Republic, Kyrgyzstan, during the 1998–2000 field seasons.

Kyrgyzstan is a country about the size and latitude of South Dakota, situated to the northwest of China and bordering the other former Soviet central Asian republics of Tajikistan, Uzbekistan, and Kazakhstan. The main physiographic features of Kyrgyzstan are the Tien Shan, a mountain range consisting of a series of east-west trending ridges including numerous peaks over 5000 m tall, and Issyk-Kul, a large freshwater lake in the northeastern part of the country. Kyrgyzstan is an attractive place to study grasslands because it has a wide variety of grassland types arranged along relatively steep elevational and moisture gradients. Forests in Kyrgyzstan are almost entirely restricted to riverbanks and to the ridges surrounding Lake Issyk-Kul.

The goals of our project were: (1) to document the vascular flora and arthropod fauna of Kyrgyz grasslands, (2)

to collect specimens of as many species as possible for use in basic systematic research, (3) to obtain quantitative data on arthropod and plant species richness and vegetative cover, (4) to document ecological interactions among arthropods and plants; and (5) to create a specimen-level relational database for the specimens collected.

Our sampling plan involved visiting as many sites as possible that represented a variety of grassland types and elevational classes during three month-long expeditions conducted over three years (1998–2000). Some sites were sampled repeatedly over the three years and some were visited only once. At 42 sites, we established 100-m transects for quantitative sampling of both plants and insects. Within these transects we sampled plants in 20 3/4-m² quadrats, recording species occurrence and percent cover. We sampled insects along these same transects using a sweep net and by vacuuming. We also made many additional collections of plants and insects by walking each site in an attempt to document the flora and fauna as thoroughly as possible.

Over the three years of the project, we sampled 119 sites and collected 579 insect samples containing approximately 100,000 individual insect specimens. We also collected about 2,300 plant specimens. The processing of these samples and identification of species have been the most time-consuming part of this work. We are currently distributing plant and insect specimens to specialists for identification and constructing a relational database that will include a record for each specimen collected linked to information on the locality. Eventually, we plan to incorporate our data and specimens into a variety of analyses. These analyses will include the estimation of species richness, diversity, and complementarity; cladistic biogeographic study of Holarctic grasslands; study of community structure and its determinants using ordination; and basic systematic research including phylogenetic analysis and the description of new genera and species.

Chris Dietrich, Center for Biodiversity

The Endangered Hine's Emerald Dragonfly

The Hine's emerald dragonfly is the only federally endangered dragonfly species in the United States. The species occupies wetland marshes and sedge meadows fed by shallow groundwater. Like many endangered species, the major reason for its endangered status is habitat loss. Wetland loss is widespread in the United States and in Illinois over 90% of wetland acreage has been lost. Populations of Hine's emerald dragonflies survive in some of the remaining wetlands in Illinois, Wisconsin, Missouri, and Michigan, while the historical range is believed to cover a much larger and more continuous area. The majority of what is known about the Hine's emerald dragonfly's habitat requirements, behavior, and ecology has followed its listing as an endangered species in 1995. Larval habitat use has been studied intensively; however, adult habitat use has proven to be more challenging. The adults are fast fliers and difficult to capture. Studies have shown a male bias in the adult sex ratio and there is limited information on female activity patterns and distribution. Our current research has provided a better understanding of female distribution that contributes to our knowledge of habitat use.

Larval monitoring in Illinois and Wisconsin has shown that the larvae spend two to four years in the aquatic habitat, avoiding predation from crayfish and periods of drought. The lucky survivors crawl out of the water onto emergent vegetation and break out of their larval skins, or exuvia. Exuvia are left behind by the emerging dragonfly and the careful observer can find these skins and determine useful information about the ecology of the species at this stage. Our recent research has suggested an equal number of males and females at emergence

despite high male biases in the adult stage.

The adult stage can last several days to several weeks. During the adult stage, males patrol temporary territories in the wetland habitat and females must come into the habitat to lay their eggs. Adults feed on small aerial insect prey in the wetland, in dry meadows, along lakeshores, and in forest clearings. Previous adult studies by researchers at both the Illinois Natural

History Survey and the Illinois State Museum have reported a high male bias in the sex ratio. These surveys have, however, been concentrated in the wetland habitat. As a result, it is unknown whether this sex ratio is a reflection of differences in male and female habitat use

or higher female mortality rates. Differences in habitat use may result in female avoidance of areas with high male densities and possibly male harassment. Higher female mortality may result from the extra costs associated with producing and carrying eggs. The question is, Where are the female dragonflies? This is a common question in dragonfly biology as well as being an important question when considering conservation of this species.

Knowledge of the adult sex ratio and female habitat use is important for two reasons. First, if males are more abundant than females, the genetic variability will be compromised in later generations. Ultimately, the lack of gene variability will threaten local populations during outbreaks of disease, severe weather, or other environmental stresses. Second, if females are using different habitats than males, then it is critical that both

habitats be protected to ensure survival of the Hine's emerald dragonfly.

Last summer adult populations were monitored in wetland and dry meadow habitats to determine if there is a difference in habitat use between males and females.

Dragonflies were caught in insect nets and individually marked

with bee tags. We determined that the overall adult sex ratio was equal, and differences in male and female habitat use were confirmed. Males were more abundant in the wetland habitats and females were more abundant in the dry habitats. These differences in habitat use may result from male harassment or differences in food availability. Although we observed mating pairs in both habitat types, no male harassment was observed in the

dry meadow habitat. Low levels of male harassment limited our ability to make strong arguments for or against this explanation. Insect prey (flies and in particular midges) collected on sticky insect traps were more abundant in the wetland habitats, suggesting that when females avoid these habitats it is not because they have less food. Other untested differences in the habitats may be influencing female distribution patterns.

Whatever the reason for the observed patterns of male and female distribution, sampling in alternative habitats has provided us with a greater understanding of Hine's emerald dragonfly habitat use than exists for most dragonfly species. Populations of males and females occupy a larger area of habitat than wetlands, and both wet and dry habitats are necessary for the survival of this species. This work demonstrates how habitat use by both sexes is an important consideration for species conservation.

Sophie E. Foster and Daniel A. Soluk, Center for Aquatic Ecology



Hine's emerald dragonfly with bee tag.
Photo by Sophie Foster, INHS Center for Aquatic Ecology

Fireflies

Susan Post

Here come the real stars to
fill the upper skies,
And here on earth come
emulating flies
That, though they never
equal stars in size
(And they were never really
stars at heart),
Achieve at times a very star-
like start.
Only, of course, they can't
sustain the part.

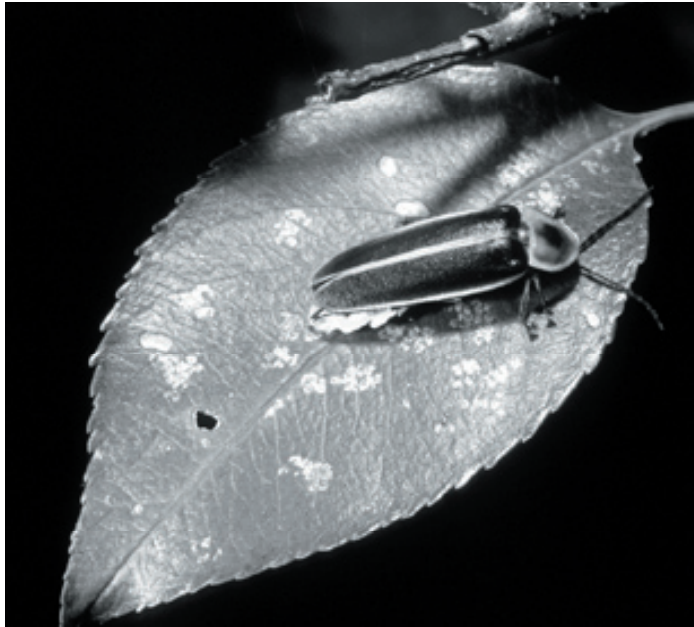
Robert Frost,
"Fireflies in the Garden"

Fireflies herald both the beginning and end of meteorological summer. We notice their flashing in early June when the nights are long, and by the time the cicadas and katydids loudly serenade us, the fireflies have disappeared and it is fall.

Fireflies are not flies, nor are they bugs as their other common name (lightning bug) denotes. They are beetles, members of the insect family Lampyridae, which means "shining fire." A firefly is an elongate, soft-bodied insect whose pronotum (the upper surface of the first thoracic segment) extends over its head, concealing it when viewed from above. A firefly is usually brown or black with red or yellow markings on its large, shieldlike pronotum. In North America there are 20 genera

and at least 136 species of fireflies.

While other luminescent insects glow continuously, fireflies flash their lights on and off. The segments near the end of the firefly abdomen are able to produce light. These luminous segments can be recognized, even when the insect is not glowing, by their yellowish-green color.



A firefly. Photo by Michael Jeffords, INHS Center for Economic Entomology

Fireflies produce cold light. A cold light is one that produces no heat as a by-product. In the fireflies nearly 100% of the energy given off appears as light, whereas with an electric light bulb only 10% of the energy is light and the other 90% is given off as heat. Fireflies generate their light by combining a chemical, luciferin, with an enzyme, luciferase, and oxygen. Luciferin is stored in the cells of the light organs, which are richly supplied with air tubes. Fireflies control light production by regu-

lating the oxygen supply to the light organs. The light produced is merely a by-product of this chemical reaction—a brief release of energy. The "fire" is actually cool, containing virtually none of the infrared wavelengths possible within the spectrum of light. It is also nearly all-visible, containing almost no ultraviolet components. This light is attractive to other fireflies, as well as us, and it makes them one of a few groups of insects to use

sight instead of smell to find mates.

Midwestern fireflies are solitary, each searching independently for a mate. Both sexes flash, but the male's is brighter and more frequent and each firefly species has its own unique male signal and female response. From dusk until the fall of total darkness the males will fly, crisscrossing an area, flashing rhythmically while the female remains stationary on the ground or in a bush and responds to the male with her own flashes. When the male receives an answer, he hovers and orients his lantern toward the female. Eventually he lands near her and

they mate.

Each species of firefly has its own pattern of flashing light. These patterns may be as plain as a series of dashes or dots or more elaborate, such as a swooping "J." There are differences in the duration of the flash, time between flashes, color of flashes, the number, rate, and intensity of the flashes, and how far the firefly travels between flashes. Some species are active just before sunset, others just after.

Temperature also affects fireflies—as it gets warmer they flash more often and the flash appears brighter.

Fireflies overwinter as larvae buried in the soil. The larvae are predaceous and have elongated, sickle-shaped jaws that are used to inject a toxin into their prey. This toxin also aids in liquefying the prey's body contents so the firefly larvae can suck their victims dry. The larvae feed chiefly on land snails, earthworms, caterpillars, and other soft-bodied invertebrates. They are nocturnal and are found on the ground in moist areas, usually under bark or stones or in decaying vegetation. Some of the larvae are luminescent. The larva surrounds itself with mud and pupates; and the adults will emerge 10 days later.

While just seeing fireflies flash during the summer gives pleasure, fireflies also provide practical benefits to humans. Their luciferase is an enzyme that can help in screening for human tumors, in testing for blood problems, and as a fast-acting detector of an infection. It has been on the market in a genetically engineered form for over 10 years.

Susan Post, Center for Economic Entomology

Communicate With Light

Both male and female fireflies flash lights to attract mates. These “cold” lights are produced by a chemical reaction within the abdomen of the firefly. The males fly close to the ground and emit flashes of light while performing acrobatics. Each species has its own characteristic pattern. For mating to take place, the female firefly (of the same species as the flashing male) must respond with pulses of light at exactly the correct time interval after the male’s flashes before he will fly over to her to investigate.

You can learn to communicate with flashing lights similar to the way fireflies do. All you need is a flashlight (one with a button that you push to turn it on and that will turn off when you release it works best) and a knowledge of International Morse Code (shown below). Practice the letters shown below by shining the flashlight on a wall in front of you so you can easily see a spot of light. For a dot, press and release the button on the flashlight quickly. For a dash, hold the button down longer, usually three times longer than you do for the dot. Pause between letters (a pause about the length of time as a dash works well), and pause at least three times longer between words. Try learning a few simple words first, your name, and then a short sentence.

Practice with a friend. Once you both learn Morse Code, you can communicate with each other with a flashlight. Do not try to remember the letters as they are sent to you; instead, use a piece of paper and a pencil to write down the letters as you receive them. That way you can concentrate on one letter at a time and not worry that you will forget those letters that were already sent to you.

International Morse Code

Letter	Code	Letter	Code	Digit	Code	Punctuation Mark	Code
A	.-	N	-.	0	-----	Period	.....
B	O	---	1	-----	Comma	-----
C	P	....	2	-----	Question mark	.....
D	Q	----	3	....-	Apostrophe	.....
E	.	R	... .	4	....-	Hyphen	.....
F	S	... .	5	.....	
G	T	- .	6	.....	
H	U	... -	7	.....	
I	..	V	....-	8	.....	
J	....-	W	... -	9	.....	
K	... -	X-				
L	Y-				
M	--	Z	----				

Suggestions for Teachers:

Divide the class into small groups (two to five students) for practice. Have one student at a time in each group code a word and flash it on the wall or the side of a board or notebook that is propped up. The other students in the group should try to decode the word. Allow them to use the printed code sheet until they know the code. Make sure all students get practice at both sending and receiving messages. When they get proficient at decoding words they should code sentences, and eventually whole messages.



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Bio Blitz

continued from front page

over a period of nine months. Many details associated with the event had to be dealt with in a relatively systematic way.

Fourth, it takes motivation and the desire to do something special. The Survey undertook the first-ever midwestern Biodiversity Blitz for several reasons:

- to determine the overall biodiversity of Allerton Park
- to bring the issue of biodiversity to the attention of Illinois citizens
- to showcase how biological surveys are conducted
- to provide a unique natural resource event to usher in the new millennium
- to break the temperate zone blitz record for species found in 24 hours, 1,905 species found at Walden Pond in 1998.

All of the above came together at the historic Red Barn at Allerton Park. The goal was simple—to find as many different species as

possible within the park. The fact that the Walden Pond record lurked on the horizon was also part of the motivation for our event. For 24 very special hours the Red Barn was turned into a taxonomy laboratory with wave after wave of scientists working at preparation and identification of specimens. In addition, field crews of ornithologists, mammologists, herpetologists, ichthyologists, and malacologists surveyed Allerton for sightings or signs of organisms in their groups.

In addition to all the scientific work, a series of outdoor presentations on various topics were given for the general public during daylight hours on both days of the blitz. Each of the 10 presentations was well attended and allowed citizens to directly interact with the scientists. A further activity was field excursions whereby citizens could accompany scientists into the field and assist with their work. Perhaps the most popular excursion was mist-netting for bats. The

participants were treated to the capture and release of two species of Illinois bats.

To record all this information in a systematic and scientifically valid manner required the modification of an existing database and setting up a portable computer network system within the Red Barn. Database entry people came from the Survey administrative staff and from a local high school. The 24 hours of intense biological labor resulted in a mass of data that overwhelmed the data entry folks for a time. Everyone left the event satisfied with their effort, but wondering if they indeed had the record. Although the final count is not yet in, the tentative number is over 2,000 species! In short, Allerton Park is one very diverse and special place.

Michael Jeffords, Center for Economic Entomology

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