

RESULTS OF THE 2014 EAGLE MARSH BIODIVERSITY SURVEY, ALLEN COUNTY, INDIANA

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ABSTRACT. Eagle Marsh, a 289.8 ha (716-acre) wetland nature preserve located on the southwest border of Fort Wayne, Indiana, is one of the largest wetland restorations ever undertaken in Indiana. The Little River Wetlands Project (LRWP) began acquisition, planning, and restoration in 2005 to 2007. The first biodiversity survey (also known as a bioblitz) of Eagle Marsh was conducted on 31 May and 1 June 2014. Over 125 scientists, naturalists, students, and other volunteers on thirteen different taxonomic teams observed and reported 728 taxa during the event. The thirteen taxonomic teams included aquatic macroinvertebrates, beetles, birds, butterflies, dragonflies and damselflies, fish, freshwater mussels, herpetofauna, small mammals, mushrooms/fungi, singing insects, snail-killing flies, and vascular plants. This manuscript presents both a brief history of Eagle Marsh and a summary overview of the results gathered by the thirteen taxonomic teams.

Keywords: Bioblitz, biodiversity survey, Eagle Marsh, state-endangered, county records

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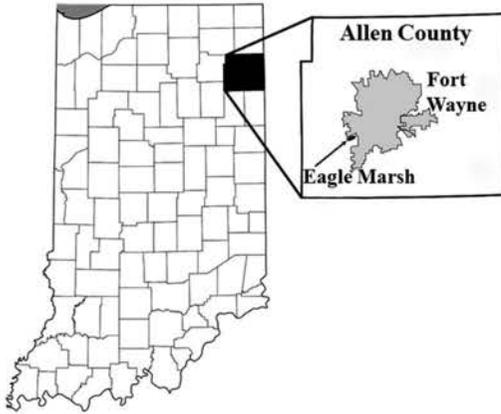


Figure 1.—Map of Indiana showing the location of Allen County (left) and Eagle Marsh within Allen County (right).

INTRODUCTION

Eagle Marsh, a 716-acre wetland nature preserve, is located on the southwest border of Fort Wayne, Indiana (Fig. 1). The wetland preserve has over 11 miles of trails allowing hikers access to the preserve's variety of habitats which include permanent ponds, ephemeral open bodies of water, marsh, sedge meadow, wet to mesic prairie, shrubland, and a mature swamp woodland. Eagle Marsh is one of the largest wetland restorations ever undertaken in Indiana. With the support of the federal Wetlands Reserve Program, the Indiana Heritage Trust of the Indiana Department of Natural Resources, The Nature Conservancy of Indiana, various foundations, and others, Little River Wetlands Project (LRWP) acquired Eagle Marsh (then 676 acres) in 2005. The restoration included digging shallow areas deeper, breaking drain tiles, and removing pumps to increase the volume of water on the land, thus restoring some elements of wetland hydrology. Over 500 acres were seeded with native rushes, grasses, and wildflowers and more than 45,000 native trees and shrubs planted. Between 2007 and 2010, the 40-acre mature swamp woodland was added to the preserve, thus bringing the total acreage to the present day 716. In addition to expanding floral diversity, the swamp woodland provided important habitat for many birds and other fauna that required large trees, sandy soil, or leaf litter to complete their life cycles (LRWP 2016a). Furthermore, the acquisition of this woodland allows for future protection of this important site.

The first biodiversity survey (known as a bioblitz) of Eagle Marsh was conducted on 31 May and 1 June 2014. The information gathered during the Eagle Marsh BioBlitz significantly increased our understanding of the vast biological resources at the site. Additionally, it allowed members of LRWP to evaluate the success of their efforts to restore the biodiversity of the site and it provided valuable information to determine future management strategies.

This paper presents a brief history of Eagle Marsh, results, and a summary overview of the information gathered by the thirteen taxonomic teams. The history of Eagle Marsh was provided by Judy Nelsen and Tony Fleming.

A BRIEF HISTORY OF EAGLE MARSH

Around 15,000 years ago, a huge lake formed between the melting Wisconsin glacier and a recently-deposited moraine, which acted like a dam to impound the lake. About 14,000 years ago, the lake overtopped the moraine near what is now downtown Fort Wayne and eroded a large outlet, unleashing a flood of unimaginable proportions, commonly called the "Maumee Torrent". In a matter of days or weeks, billions of gallons of water scoured out an existing river channel into a valley up to two miles wide. Related geologic events later changed the course of nearby waterways and location of a continental divide. The valley, stretching between present-day Huntington and Fort Wayne, developed into a fertile 25,000-acre wetland where wildlife thrived and Native Americans hunted.

When settlers arrived, this vast wetland became known as the "Great Marsh," and one of the streams traversing it was called the Little River. This river was of great strategic value because, in all but the driest times, one could canoe up it from the Wabash River to a place near present-day Fort Wayne where a shorter or longer portage (depending on the season) allowed passage to the St. Mary's River and Lake Erie. A "golden gateway" between the Mississippi River and the Great Lakes had been found. The continental divide near the portage later became the high point along the Wabash & Erie Canal.

By the 1870's, Fort Wayne had grown from a small outpost to a town of 18,000. Farmers and others began pushing for the Great Marsh to be drained. After several attempts, by the late 1880's the job was largely done, mostly by creating three main drainage ditches and many minor ones. One of the larger efforts was the Graham-McCulloch

Ditch, which crosses what is now Eagle Marsh. Agriculture quickly expanded across the fertile soil of the old marsh, at first with crops such as onions, lettuce, and celery; then, after World War II, with the grain crop rotation of corn-soybeans-wheat. However, even extensive systems of closely spaced drainage tile, ditch laterals, and large pumps running 24 hours a day were sometimes not enough to prevent crops from being flooded out.

In 1990, Little River Wetlands Project (LRWP) was formed with the mission of restoring and protecting some of the lost wetlands of the Little River valley (later watershed). Between 2000 and 2004 the organization had acquired two restored wetlands a few miles southwest of Fort Wayne. The owner of the land that was to become Eagle Marsh had enrolled it in the Wetlands Reserve Program, a federal program that paid farmers to let the government restore wet agricultural land back to wetland and place it under a conservation easement in perpetuity. The original 676 acres consisting of farmed portions, a wooded fringe, barn and parking area were sold to LRWP in 2005. The Indiana Heritage Trust, The Nature Conservancy in Indiana, local foundations and generous donors helped fund the purchase, with the Indiana Department of Natural Resources (of which the Indiana Heritage Trust is part) retaining partial ownership.

After extensive planning by the Wetlands Reserve Program and LRWP, one of the largest contiguous wetland restorations ever undertaken in Indiana began at Eagle Marsh in late 2006. It was designed to emulate the original bottomland communities of the marsh, while adapting to a condition of relative water scarcity because hydrologic changes in the valley have limited the flow of water to the area. In addition to breaking tiles, plugging ditch laterals, and removing pumps to hold water on the land, earth was moved to enhance or recreate some of the old meander scrolls. These basins retain water that might otherwise run off and serve as crucial habitat for wildlife ranging from the tiniest insect larva to large shorebirds. The restoration incorporated extensive prairie areas along with what could be considered true marsh. A highly diverse mix of plants was used to increase the probability of success given the land's variable hydrology. Virtually all the property was seeded with a combination of native grasses, sedges, and wildflowers and approximately 45,000 native trees

and shrubs were planted, with the initial restoration completed in 2009.

Over time the new native vegetation has become established to create a varied habitat of shallow water wetlands, wet and drier prairie, a sedge meadow, and areas of newly planted native trees. Forty more acres of mature forested wetland were added to the preserve between 2007 and 2010, bringing it to its present size. The mature wet woods provide important habitat for many birds and remnant populations of native amphibians, reptiles, and insects. Since the restoration, LRWP staff has sought to deal with invasive plant species that appeared. Prescribed burns, mowing, hand-pulling, and use of herbicides are part of the annual invasive management effort.

Today more than 11 miles of nature trails allow the preserve's many visitors to enjoy its varied habitats and the extensive free nature programming offered there. A total of 227 kinds of birds and numerous other wild creatures, many of them endangered or of special concern in Indiana, have been seen at Eagle Marsh. Bald eagles have nested recently just outside the preserve boundary, and are often seen there with their young. With the adjacent Fox Island County Park and other privately owned natural properties, Eagle Marsh creates almost two square miles of natural habitat for native wildlife. (For further information see "Geology of the Little River Valley" (LRWP 2014), "From a Peaceful Stream to a Power Pawn" (LRWP 2016b), and "Results from the 2014 Eagle Marsh Biodiversity Survey, Allen County, Indiana", pages 10–20 (Ruch 2014).

SUMMARY OF RESULTS AND METHODS

The Eagle Marsh BioBlitz, conducted 31 May and 1 June 2014, attracted over 125 scientists, naturalists, students, and others volunteering their time and expertise to make the event an overwhelming success. Thirteen taxonomic teams and their leaders reported 728 taxa (Table 1). To obtain a complete picture of the biodiversity found at Eagle Marsh, long-term seasonal surveys are necessary. Even so, this two-day survey provided a "snapshot in time" and has revealed the remarkable species richness and the inherent value of this nature preserve. An overview of the results from the thirteen taxonomic teams follows. To view the complete results, go to the Indiana Academy of Science website at <http://www.indianaacademyofscience.org/>, lay the cursor over

Table 1.—Summary of the 728 taxa reported at the 2014 Eagle Marsh Biodiversity Survey, Allen County, Indiana.

Team	Leader	Taxa observed
Aquatic Macroinvertebrates	Ross Carlson	99 taxa: representing 16 classes, 43 families, and at least 67 genera
Beetles (Coleoptera)	Jeff Holland	64 taxa; common species
Birds	Don Gorney	88 species; 6 state listed species [3 endangered]
Butterflies	Kirk Roth	18 species; common species
Dragon- and Damselflies	Paul McMurray	12 taxa; 1 Allen County record
Fish	Brant Fisher	31 species; no state/federal listed species
Freshwater Mussels	Brant Fisher	2 species; no state/federal listed species
Herpetofauna	Mark Jordan & Bruce Kingsbury	15 species; (1 state endangered)
Mammals	John Whitaker, Jr.	21 species; [6 small mammals, 15 other mammals]
Mushrooms/Fungi	Steve Russell	31 taxa [30 species]; all common
Singing Insects	Carl Strang	13 species; 3 singing insects, 10 other species
Snail-killing Flies	Bill Murphy	15 species; 12 Allen County records
Vascular Plants	Paul Rothrock	320 species; 243 native, but the non-natives have visual dominance at the site

Events at the top of the page and then click BioBlitz Archive.

Aquatic macroinvertebrates.—Aquatic macroinvertebrates recorded for the Eagle Marsh BioBlitz were collected within preserve boundaries on 31 May and 1 June 2014. Collections were made at seven sites (for location of the sites see Ruch 2014) using a D Frame dip net with a mesh size of 500 μ m. Sites represented both lotic and lentic systems and comprised a variety of habitats (i.e. pools, riffles, emergent vegetation, and open water). Specimens were placed into jars of 70% isopropanol for storage. Representative voucher specimens were deposited in the Purdue Entomological Research Collections, Department of Entomology, Purdue University, West Lafayette, Indiana.

Collected specimens were identified to lowest practical taxon by use of standard texts (Merritt et al. 2008, Thorp & Covich 2001). In total 99 taxa were recorded, representing 16 classes, 43 families, and at least 67 genera. Taxa found were characteristic of aquatic wetland systems with no new or surprising species found.

Beetles (Coleoptera).—Most collecting occurred on-site during the event. To supplement these collections, several traps were set out two weeks prior to the event and trapped insects were harvested during the event. The traps consisted of two multiple-funnel Lindgren traps, two Intercept panel traps, two window

traps, two purple sticky traps, and two pitfall traps. The pitfall traps were baited with dung and placed at the periphery of the parking area, while the other traps were spaced along the main trails through the wooded areas. The Lindgren, Intercept, and window traps were baited with ethanol, while the purple sticky traps were left unbaited.

Sweepnets were used during the bioblitz to capture beetles from vegetation in all areas of Eagle Marsh. During one evening of the event, several lights were used to attract beetles that were hand collected from sheets placed under the lights (Fig. 2). These lights were placed around the periphery of a pole barn that served as the base of operations for the bioblitz. The lights, which consisted of two 1000 W metal halide lights, one 175 W mercury vapor light, and four UV lights, were operated for approximately five hours. However, the mercury vapor light ran continuously until dawn with a collecting bucket under it to capture beetles. Representative voucher specimens were deposited in the Purdue Entomological Research Collection, Department of Entomology, Purdue University, West Lafayette, Indiana.

The number of species of beetles collected at Eagle Marsh was lower than first predicted, with many representatives of the same species. In hindsight this was not surprising since most species were collected at night with lights and the lighted area was effectively an island of dry



Figure 2.—Midnight collecting by the beetle team — beetles are attracted to a 1000 W metal halide light during the Eagle Marsh BioBlitz. (Photograph by Jason Kolenda)

ground surrounded by marsh. Thus, collections were made on a small patch of dry ground, while the more abundant aquatic beetles were dominated by a few species. The wooded areas did contain a rich diversity of longicorn beetles and bark beetles for a rapid survey, although these mostly came from the traps left for two weeks. As with any rapid survey however, these species will represent only a small proportion of the total beetle fauna of Eagle Marsh. No rare species were found. However, some very charismatic beetles were present, including the eyed click beetle *Alaus oculatus* (Fig. 3) and the clover stem borer *Languria mozardi*. Lastly, while five species of exotic beetles were found, i.e., one exotic lady beetle and four exotic bark/ambrosia beetles, none were unusual or emerging threats.

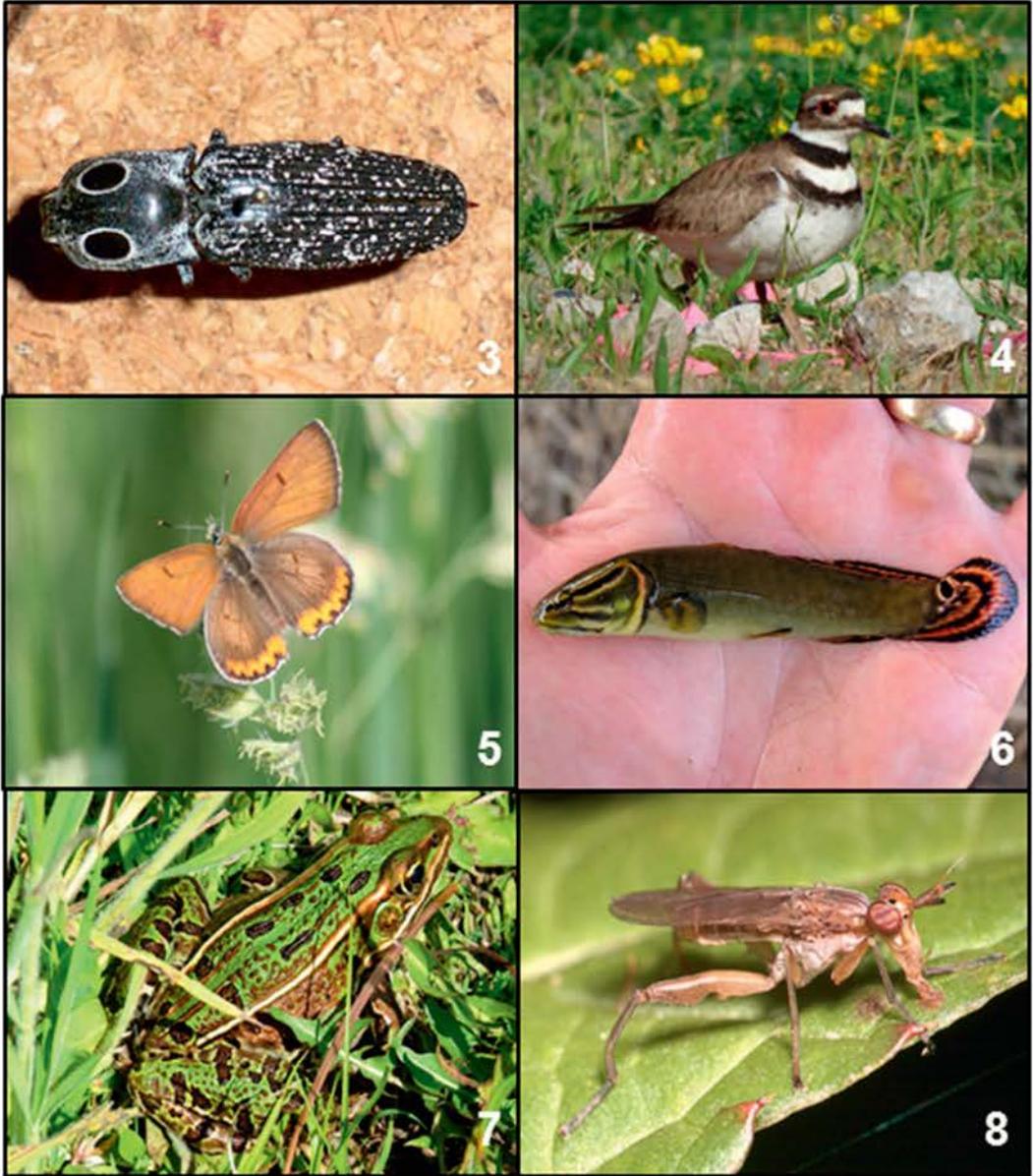
Birds.—Eagle Marsh was divided into four territories and a team assigned to each. Teams maintained a tally of the species and the number of individuals encountered by sight or sound. On the first survey day, a few teams

began before dawn and all teams finished by late afternoon. Thereafter, surveying during the evening of day one and on the morning of day two was primarily completed by the team leader who revisited locations that were productive. The focus of the team leader was to identify species new to the survey rather than counting additional individuals of species already detected. Reports of birds were also received from individuals who participated on other taxon teams. The complete effort by the team was approximately 87 person-hours.

The late May–early June date for the biodiversity survey was ideal for detecting birds as it coincided with the beginning of peak breeding activity. Nevertheless, a noteworthy number of species found were birds still migrating, using the site only for foraging or resting, or non-breeding individuals. Birds were identified by sight or by song or call note. Consequently, the survey is not limited to territorial or singing males, but this demographic constitutes the majority of the records. In an attempt to capture as much baseline data as possible, team members counted individual birds and noted any specific breeding activity by species. Bird diversity was found to be high with a total of 88 species observed on or flying over the property.

Birds at Eagle Marsh benefit from a mixture of habitats and the presence of additional suitable habitat at the adjacent Fox Island County Park. In particular, wetland- and shrubby field-dependent or associated species greatly benefit from restoration efforts and were found in robust numbers. These species include Wood Duck, Great Blue Heron, Marsh Wren (wetland species), Willow Flycatcher, Gray Catbird, Common Yellowthroat, Yellow Warbler, and Song Sparrow (grassland and shrubby field species). The Barred Owl heard calling is a new species for the property. The Killdeer (*Charadrius vociferous*) is seen in Fig. 4.

Of the 88 species detected, approximately 75 percent are presumed to be nesting at Eagle Marsh. The elevated percentage of nonbreeding species to total species is an indication that birds find the site attractive as a migratory stopover location and, for birds that nest near the site, as foraging grounds. A majority of the nonbreeding species found, including members of the duck, heron, and shorebird families, are wetland-associated species. The attractiveness of Eagle Marsh to migrating birds and individuals nesting off the property is presumed to be a lack of similar



Figures 3–8.—Images of various organisms observed during the Eagle Marsh biodiversity survey. 3. *Alaus oculatus*, the eyed elater, a large and charismatic species of click beetle. (Photograph by Jeff Holland) 4. A Killdeer, *Charadrius vociferous*, at its nest. (Photo by Don Gorney) 5. A male Bronze Copper, *Lycaena hylus*, butterfly. (Photo by Kirk Roth) 6. A Bowfin (*Amia calva*). (Photo by Brant Fisher) 7. A Northern Leopard Frog, *Lithobates pipiens*, a species of special concern in Indiana; it was very abundant and found in most habitats across the property. (Photo by Bob Brodman) 8. A male *Sepedon armipes*, it was the most abundant sciomyzid (snail-killing fly) collected during the bioblitz. It's one of the easiest sciomyzids to identify – the male has a deep notch and some peg-like protuberances on the hind femur. The fly is about 5 mm long. (Photo by Steve Marshall, Guelph, Ontario)

large palustrine wetland sites in northeast Indiana and northwest Ohio.

Six state-listed species were detected. State-listed endangered species were Black-crowned Night Heron, Black Tern, and Marsh Wren, while species of special concern were Great Egret, Bald Eagle, and Common Nighthawk. Of the six species, only Marsh Wren is believed to be breeding on the site, although a pair of Bald Eagles nests just off the property. Virtually all 14 Marsh Wrens detected were singing males, indicating that Eagle Marsh is an important breeding location for the species in Indiana.

Butterflies.—At the time of the bioblitz, few high quality nectar sources, such as milkweeds (*Asclepias* spp.), mountain-mint (*Pycnanthemum* spp.), wild bergamot (*Monarda fistulosa*), purple coneflower (*Echinacea purpurea*) and others, were noted to be in bloom, although some of these (especially milkweed) were common. When in bloom, these plants are attractive to larger species of butterfly. Instead, most nectaring butterflies were found feeding on dame's rocket (*Hesperis matronalis*) and butterweed (*Packera glabra*), and those were almost exclusively grass skippers, with the exception of two Bronze Coppers (*Lycaena hylus*). The types of nectar sources available during the dates of the bioblitz may account for the relative abundance of skipper observations over other types of butterflies. Cabbage Whites (*Pieris rapae*) and some Grass Skippers were noted on white clover (*Trifolium repens*) and a Red Admiral (*Vanessa atalanta*) was seen nectaring on willow (*Salix* sp.) blooms. Though red clover (*Trifolium pretense*) was blooming in several areas, the only butterfly species seen nectaring on it was Peck's Skipper (*Polites peckius*).

Bronze Copper was the third most abundant species (Fig. 5). In Indiana, this species is restricted to wetland habitats and uses dock (*Rumex* spp.) as a host plant (Belth 2013; Shull 1987). The Bronze Coppers were widely distributed throughout Eagle Marsh however, there were clusters of individuals in Management Unit I near the Engle Road Trailhead and in Unit F south of the barn adjacent to a long pond. Copulation was noted on the grasses bordering this same pond in Unit F at 5:35 p.m., May 31. Shull (1987) remarked that he had found three pairs *in copula* in Indiana in June, July, and September. All of Shull's records were in Wabash

County among blue flag (*Iris versicolor*) during afternoon hours.

One Monarch (*Danaus plexippus*) egg was found on a milkweed. The single Eastern Tiger Swallowtail (*Papilio glaucous*) observation was of a dark form female. Observations of Peck's Skippers were scrutinized and photographed whenever possible for similar, rarer species, such as Indian Skipper (*Hesperia sassacus*), Leonard's Skipper (*Hesperia leonardus*), or Long Dash (*Polites mystic*), but none of these species were detected.

Dragonflies and damselflies (Odonata).—Most of the 12 odonate species observed at Eagle March were common species with distributions across northern Indiana. However, the damselfly *Ischnura hastata* (Odonata Central Record # 428032) was a new record for Allen County in which 79 species are currently recorded (Abbot 2007). *Ischnura hastata* has been previously recorded in adjacent Wells County, Indiana and Paulding County, Ohio and is widely distributed across eastern North America (Abbot 2007).

Fish.—Thirty-one species of fish representing eight families were recorded from Eagle Marsh. Only three species, Black Bullhead (*Ameiurus melas*), Central Mudminnow (*Umbra limi*), and Green Sunfish (*Lepomis cyanellus*), were collected from more than three of the seven locations sampled. Two non-native species, Goldfish (*Carassius auratus*) and Common Carp (*Cyprinus carpio*), were relatively common and reproducing, however, no Asian Carp were collected. The three lotic sites sampled were the most diverse with between 17 and 23 fish species found in each. Thirteen species were collected from all three lotic sites, i.e., Spottfin Shiner (*Cyprinella spiloptera*), Redfin Shiner (*Lythrurus umbratilis*), Bluntnose Minnow (*Pimephales notatus*), Fathead Minnow (*P. promelas*), Creek Chub (*Semotilus atromaculatus*), White Sucker (*Catostomus commersonii*), Black Bullhead, Yellow Bullhead (*Ameiurus natalis*), Blackstripe Topminnow (*Fundulus notatus*), Tadpole Madtom (*Noturus gyrinus*), Green Sunfish, Bluegill (*Lepomis macrochirus*), and Longear Sunfish (*L. megalotis*). These taxa are typical of small streams/ditches in northeast Indiana. The wetland sites sampled had low diversity (3–5 species) and were dominated by young-of-the-year individuals of the species found. Two species, Bowfin (*Amia calva*) (Fig. 6) and Redfin Pickerel (*Esox americanus*), were



Figure 9.—Male and female Blanding's Turtle (*Emydoidea blandingii*) held by Betsy Yankowiak, LRWP and bioblitz coordinator. The Blanding's Turtle is a state endangered species. (Photo by Bruce Kingsbury)

only collected from the wetland sites, but also likely inhabit the lotic sites of Eagle Marsh. No state/federal endangered or special concern fish species were collected.

Freshwater mussels.—Evidence of only two species of freshwater mussels was found from the seven locations sampled. No state/federal endangered or special concern freshwater mussel species were collected. Neither of the two species collected were found live, although the non-native Asian clam (*Corbicula fluminea*) is likely live on the property as fresh dead shell material was collected. Only weathered dead shell material was found for cylindrical paper-shell (*Anodontoidea ferussacianus*) and it is not likely still living on the property. The low freshwater mussel diversity found on Eagle Marsh is not a surprise considering the ephemeral nature of many of the wetland habitats and the limited mussel habitat available in the lotic habitats.

Herpetofauna.—The herp team, a group that included 34 volunteers, observed a total of 15 species and at least 119 individuals in a survey that encompassed aquatic and terrestrial habitats representative of Eagle Marsh. Amphibians were more diverse ($n = 10$) than reptiles ($n = 5$), and the eastern side of the property appeared to have more species overall. A highlight of the survey was the capture of two Blanding's turtles (*Emydoidea blandingii*) (Fig. 9), a state-endangered species that is also in decline across much of its geographic range. Further work will need to be done to determine

whether these adults are part of a breeding population. Another important observation was the Northern Leopard Frog (*Lithobates pipiens*) (Fig. 7), a species of special concern in Indiana; it was very abundant and found in most habitats across the property.

Mammals.—Mammal data collection was concentrated on small mammals. Only five species were taken during the biodiversity survey at Eagle Marsh; this was probably because up until approximately 2005 most of the land was farmland. There may be other species present, but it is likely that the five species taken are the most common on the property. Additionally, it is likely that these five were present before Eagle Marsh was formed.

The meadow vole (*Microtus pennsylvanicus*) is most commonly found in lush grassy cover and was the most common species taken at Eagle Marsh. It was most abundant in burned prairie, followed by pond edge, wet prairie, and brushy field - all had goodly amounts of cover. The burned prairie would normally provide heavy cover but during this study the cover was much less due to a recent burn of the area. The white-footed mouse (*Peromyscus leucopus*) is normally most abundant in woods and brushy field near woods. Only three were taken in woods, but there was only one trap line set out in a wooded area during the study, whereas there were six trap lines in brushy field habitat. The short-tailed shrew (*Blarina brevicauda*) is most common in woods, but is found in many habitat types. In this case three were found in woods and two were captured in other habitats. Masked shrews (*Sorex cinereus*) are found in most areas. During this study three were captured in wet prairie and another along the edge of a pond. Meadow jumping mice (*Zapus hudsonicus*) are found in grassy fields and in this case both were found in that habitat, one along a pond's edge.

Mushrooms and fungi.—The mushroom team reported 31 taxa, including 30 species, of fungi, mostly mushrooms. Early June is nearing the end of a lull in the fungal world. The spring mushrooms are coming to an end, but the summer mushrooms have yet begun to fruit in abundance. That being said, Management Unit F, the woodland at Eagle Marsh, provided a good species diversity for the time period. Most of the fungi reported are lignicolous, that is, wood rot fungi. Two collectors spent a total of about six hours on the property collecting the

listed species. The majority of the species encountered are found commonly throughout much of the state. No specific genera were over-represented in numbers on the grounds.

Singing insects.—The date of the bioblitz was early in the season for singing insects. The team found all three of the common, widespread species that were likely to be found. Other possible species are much less common, and may or may not occur at the site. Green-striped grasshoppers (*Chortophaga vitripennis*) were common in all non-wetland grassy habitats. Spring field crickets (*Gryllus veletis*) were common in the railroad right-of-way and in drier habitats within easy dispersal distance from that right-of-way. The railroad bed is the likely oviposition site for this cricket, which avoids the wetlands and woodlands that dominate the Eagle Marsh site. The third species, Roesel's katydid (*Metroptera roeselii*), was approaching maturity but not yet singing. One cluster of nymphs was found but they probably are more widespread in the site's grasslands.

Snail-killing flies (Sciomyzidae).—Ninety-one individuals of 15 species of Sciomyzidae (sciomyzid flies) were found during the event. Eagle Marsh clearly is a paradise for snail-killing flies. It offers suitable habitat that ranges from open freshwater marsh (perfect for non-operculate snails such as *Lymnaea* and *Physa*) to mature deciduous woodlands (ideal for *Succinea* snails and for slugs), with extensive edge and transitional areas dominated by sedges and cattail (*Typha* spp.). Sciomyzids were plentiful in the eastern (older) part of the marsh and quite scarce in the western (newer) part. Challenges to collecting included high daytime temperatures (sciomyzids in general are cold-adapted) and thick reed canary grass (*Phalaris arundinacea*). Canary grass slices the cloth rim of the net, destroying it within a single day of use if it is not protected by a covering of tough duct tape. The number of species found was among the highest for any site yet sampled in Indiana, higher in fact than the total number of species found so far in 76 of Indiana's 92 counties. Twelve of the species found were new for Allen County, from which 17 sciomyzid species are now known. A male *Sepedon armipes* is seen in Fig. 8.

Vascular plants.—Overall, 320 species were recorded with 243 being native to Indiana. Since most units of Eagle Marsh were restored

from agricultural use during the past decade, it is of interest to note that collectively these areas had about 210 native species and three of the eight units had in excess of 100 native species. Not surprisingly, though, there still remains an abundance of non-native species, especially in the western units where *Phalaris arundinacea* and *Typha* × *glauca* were among the dominant species. A Floristic Quality Assessment of the restoration units (Units A, B, C, D, E, G, H, and I) generated a mean C for native species of 3.1, a value in keeping with the early to mid-successional status of the property. When non-native species were included in the analysis the mean C dropped to 2.3. This difference in mean C values indicates that non-natives have a meaningful impact on plant community structure and function at Eagle Marsh.

Several native graminoids were frequent in wetter habitats, including *Carex tribuloides*, *C. vulpinoidea*, *Leersia oryzoides*, *Scirpus cyperinus*, and *Sparganium eurycarpum*. The composite family member *Symphotrichum lanceolatum* was also abundant and the sedge *Carex stipata* locally abundant. Common native species of drier habitats were *Solidago altissima* and, in eastern units, *Helianthus grosseserratus*. Native shrubs, *Cornus obliqua* and *C. racemosa*, were abundant in Unit C, a mix of oak species (*Quercus*) and *Cephalanthus occidentalis* in Unit D, and the shrubs *C. occidentalis* and *C. obliqua* in Unit H.

Within Eagle Marsh, one unit (designated as Unit F) supports a swamp woodland. The overstory was dominated by soft maples, *Acer negundo* and *A. saccharinum*. Dominant herbaceous species included *Cinna arundinacea*, *Geum vernum*, *Pilea pumila*, and *Symphotrichum lateriflorum*. In this unit 115 native species were observed along with 20 non-native species. However, due to the presence of restoration habitat within this unit, its mean C for native species was only 3.1, somewhat below a level typically associated with remnant natural quality. On the plus side the presence of non-native species was clearly more constrained since total mean C only dropped to 2.6. Among the more conservative species present in this unit, that were lacking elsewhere at Eagle Marsh, were *Actaea pachypoda*, *Amphicarpaea bracteata*, *Arisaema dracontium*, *Carex conjuncta*, *Dryopteris carthusiana*, *Galium triflorum*, *Lindera benzoin*, and *Persicaria arifolia*.

Overall Eagle Marsh now supports a remarkable diversity of plant life and habitats given its

recent intensive use as agricultural land. Many hardwoods, shrub plantings, wetland restoration species, and tall grass prairie species have been successfully established.

ACKNOWLEDGMENTS

We would like to express our sincere appreciation to the Little River Wetlands Project and the Indiana Academy of Science for hosting this event. Through their generous support, food and lodging was provided for the participants. We applaud the more than 120 scientists, naturalists, students, staff and community volunteers that participated in the event. We especially thank Betsy Yankowiak, local coordinator, for without her dedication, the event would not have occurred. Lastly, the participants express their appreciation to the Division of Nature Preserves, and especially Roger Hedge, for providing a permit allowing the event to occur.

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