

## RESULTS OF A BIODIVERSITY SURVEY AT GOOSE POND FISH AND WILDLIFE AREA, GREENE COUNTY, INDIANA

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**ABSTRACT.** Presented here are the results of a biodiversity survey held on July 16–18, 2011 at the Goose Pond Fish and Wildlife Area, Indiana Department of Natural Resources, in Greene County, southwestern Indiana. Fifteen teams (14 taxonomic teams and a biogeochemistry team) surveyed the flora and fauna of ponds, marshes, fields and forest of the ~8,000 acre site and reported 896 taxa: 862 species [20 amphibians and reptiles, 37 bees, 73 beetles, 122 birds, 48 butterflies, nine damselflies, 21 dragonflies, 39 species of fish, four freshwater mussels, five fungi and allies, 27 mammals, 74 moths, four snail-killing flies, 379 vascular plants), 16 families of aquatic macroinvertebrates, and 18 genera of plankton. A total of 215 new county records and numerous state-listed species were recorded. The baseline information provided by the survey will inform future management decisions and indicates that the restoration is maturing rapidly and successfully capturing the biological diversity of this portion of southwestern Indiana.

**Keywords:** biodiversity, wetland restoration, Goose Pond Fish and Wildlife Area, Indiana

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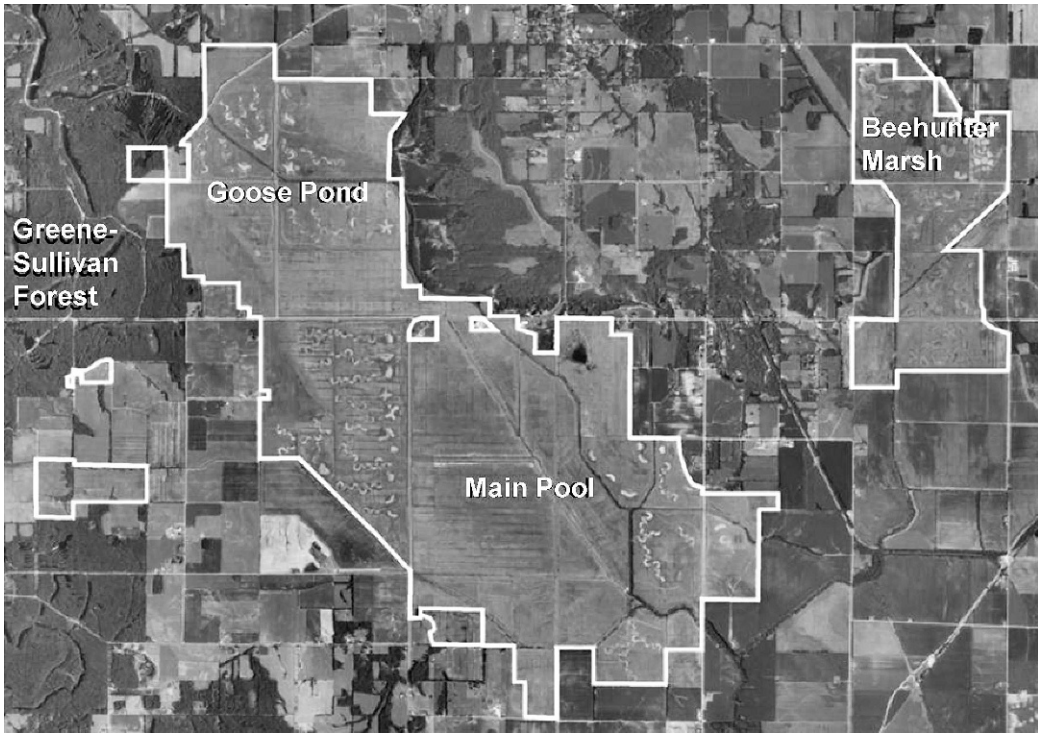


Figure 1.—Aerial photograph of the Goose Pond Fish and Wildlife Area showing the property boundaries of the Goose Pond and Bee Hunter Marsh units and adjacent small parcels. Goose Pond FWA is located immediately south of Linton, Indiana, in Greene County.

The participants of the Goose Pond Fish and Wildlife Areas biodiversity survey wish to dedicate this manuscript to Dr. Daryl R. Karns who passed away suddenly on June 7, 2011.

#### INTRODUCTION

The extensive loss of wetlands on a global basis has prompted the development of many wetland restoration projects, each with their own special set of challenges (Whigham 1999; Zedler & Kercher 2005). Goose Pond Fish and Wildlife Area (FWA) is an extensive wetland restoration in southwestern Indiana, located south of Linton in Greene County, and is maintained by the Indiana Department of Natural Resources. Indiana's largest wetland restoration, Goose Pond FWA was constructed under the Natural Resources Conservation Service (NRCS) Wetlands Reserve Program (WRP), United States Department of Agriculture (USDA), and is the 7<sup>th</sup> largest wetland restoration in the United States (Goose Pond Fish and Wildlife Area 2010). The restoration covers 7138 acres located in two adjacent tracts

of land, i.e., Goose Pond (5945 acres) and Beehunter Marsh (1193 acres), that are both part of Goose Pond FWA (Fig. 1); in addition, there are approximately 800 acres owned by Goose Pond FWA that are not part of the WRP easement. The diverse habitats include ~ 4000 acres of shallow open water, 400 acres of bottomland tree plantings, and 1380 acres of tall and shortgrass prairie plantings. Goose Pond was once a shallow glacial basin and part of the historic Blackwater Marsh; the adjacent Beehunter Marsh was also marshland. Clearing the land, installing tile drainage, and ditching for agriculture began in the late 1890's and continued until 1999 when the property was enrolled in the WRP. In 2000 the last crops were harvested and restoration began. Over 30 miles of tile excavation and removal, more than 35 miles of levees, and 42 water control structures were required. The Beehunter Marsh restoration was completed in 2004 and the Goose Pond restoration was completed in 2009 (Goose Pond FWA 2010; Friends of Goose Pond 2010).

Presented here are the results of the first biodiversity survey of Goose Pond FWA. The survey took place mostly on July 16–18, 2010. A number of agencies including the Indiana Academy of Science, the Rivers Institute at Hanover College, the Friends of Goose Pond, the Amos W. Butler Audubon Society of Indianapolis, and the Greene County Soil and Water Conservation District partnered to organize and facilitate a preliminary assessment of the biological diversity of this important Indiana wetland restoration area. The goal of the survey was to provide baseline information and lay the groundwork for future studies. One hundred scientists, naturalists, students, and other volunteers participated in this event. Although similar to a BioBlitz, this survey was conducted as a formal rapid assessment of the biodiversity of Goose Pond FWA. BioBlitz events vary considerably, but typically have a significant educational component with public participation in various phases of the event (Lundmark, 2003; Karns et al. 2006). In contrast, the Goose Pond survey consisted of 15 teams (14 taxonomic teams and a biogeochemistry team) assembled by experts in their respective fields and was not open to the public. The survey was operated under the approval of the Indiana Department of Natural Resources and participants obtained proper permits to do their work.

## RESULTS AND DISCUSSION

The 14 taxonomic teams reported 896 taxa (862 species, 16 families of aquatic macroinvertebrates, and 18 genera of plankton) summarized in Table 1. The complete species lists for the Goose Pond FWA survey are on the Indiana Academy of Science Website ([indianaacademyofscience.org](http://indianaacademyofscience.org)) in the IAS BioBlitz archive along with previous BioBlitz events sponsored by the Indiana Academy of Science, the Rivers Institute at Hanover College, and other agencies. Notable taxonomic observations included the Purple Fringeless Orchid, *Platanthera peramoena* (A. Gray) A. Gray (Fig. 2), American Ruby Spot dragonfly (*Hetaerina americana*), Bog Lemming (*Synaptomys cooperi*), and Barn Owl (*Tyto alba*). Of the 30 species of dragonflies and damselflies, seven dragonflies and six damselflies were new Greene County records. The vascular plant team reported 123 potentially new county records. Of particular interest to the plant team

Table 1.—Summary list of taxa reported by 14 taxonomic team for the Goose Pond Fish and Wildlife Area Biodiversity Survey, July 16–18, 2010, Greene County, Indiana.

Team	Report summary
Amphibians & Reptiles	20 species
Bees	37 species (20 new county records)
Beetles	73 species, 19 families
Birds	122 species
Butterflies	48 species
Dragonflies & Damselflies	21 dragonfly species (7 county records) 9 damselfly species (6 county records)
Fish and Freshwater Mussels	39 fish species, 4 freshwater mussels
Fungi	4 species (+ 1 species water mold)
Macroinvertebrates & Plankton	16 families of macroinvertebrates 18 genera of plankton
Mammals	27 species
Moths	74 species (+ 6 unidentified) (3 state and 59 new county records)
Non-vascular plants	0 species
Snail-killing flies	4 species
Vascular Plants	379 species (123 potential new county records)

was the diversity of wetland plants present through natural recruitment, since no wetland vegetation was planted at the beginning of the restoration. The butterfly and moth team reported three state and 59 new county records for moths. The amphibian and reptile team saw many turtle nests and found five species of turtles. In addition, a team from the IUPUI Center for Earth and Environmental Science conducted a biogeochemical survey of Goose Pond FWA as part of a continuing project to document carbon storage in the restored wetlands. Results of their work will be presented as a separate article.

The following taxonomic sections (in alphabetical order) present a summary overview of the report of each taxonomic team. The name(s) in parentheses indicates the team leader(s) for each survey group. The IAS website, in addition to the species lists, contains maps, information on collecting methods and effort, deposition of voucher specimens (taken for some groups), and additional information



Figure 2.—*Platanthera peramoena* (A. Gray) A. Gray, the Purple Fringeless Orchid. Two populations were found in old-field along a forest edge. This orchid is on the State Watch List for species of conservation concern. (Photo by Scott Namestnik).

and commentary. This report provides a summary overview of the Goose Pond FWA biodiversity survey.

**Amphibians and reptiles (Daryl R. Karns).**—The amphibian and reptile survey recorded 20 species (eight anurans, five turtles, six snakes, one lizard). The team physically observed or heard calls of most of the species that would be reasonably expected to be found in the Goose Pond FWA in July. In addition, Daryl believes nine other species are likely present at Goose Pond (see IAS website). Due partly to the time of year, no species of salamanders were found. Neither state or federally endangered species nor any records of geographic range extensions for any species were found. The state endangered Crawfish Frog, *Lithobates areolatus*, has been recorded from the site, but was not observed during the survey. Goose Pond FWA provides a tremendous resource for amphibians and reptiles due to its size, habitat diversity and management practices. It is important to develop and maintain isolated pools that do not have fish, since this practice promotes the

reproductive success of a number of amphibian species, such as the state-endangered Crawfish Frog. This practice will promote reproductive success of a number of amphibian species. The area is ideal for turtles, and five species and numerous turtle nests were observed (Fig. 3). The section of Highway 59 through the middle of Goose Pond FWA is an obvious source of road mortality. It would be worthwhile to do road cruise mortality surveys and locate crossing “hotspots.” Goose Pond FWA may want to consider sign posting (indicating amphibian/reptile crossing sites) or under-the-road crossing structures; these devices have been used successfully at other localities.

**Bees (Robert P. Jean).**—Thirty-seven species, constituting ~ 8% of the bee species known for the state, were collected during the two days of the survey. Three species were characteristic wetland species taken from flowering *Ludwigia peploides* and *Hibiscus moscheutos*. Two other species were characteristic of prairie habitats. For several species, the Goose Pond records are range extensions with respect to in-state knowledge of bee distribution. Also notable were two species (*Florilegus condignus* and *Augochlorella persimilis*) that had not been collected in Indiana for 30 or more years. These species demonstrate the importance of Goose Pond FWA for bee conservation and habitat.

**Beetles (Jeffrey D. Holland).**—The beetle survey team collected 73 species, representing 19 families of coleopterans. The diversity of diurnal species was very low due to the lack of plants in flower in mid-July at the site. This is the same trend noted in ongoing summer-long projects at other locations. The diversity of day-active species is likely much higher than our sample indicates. Nocturnal species were abundant and diverse. The survey team likely only sampled a small percentage of the diversity present because our light arrays were not portable enough to allow us to move to different sites. The diversity of ground beetles and longhorned beetles was impressive for a single evening. Sampling with lights and sweepnets in May and September would do much to improve the understanding of beetle biodiversity at Goose Pond FWA. Only one invasive beetle species, the Ladybird Beetle, *Harmonia axyridis* (Pallus), was found.

**Birds (Lee Sterrenburg).**—The bird survey recorded 122 species. The timing of the biodiversity survey in mid-July was late for



Figure 3.—*Chelydra serpentina*, the Common Snapping Turtle. This turtle is a common wetland species and one of five turtle species reported during the survey. Turtle nests were abundant on the property. Several other species of turtle are likely to occur on the property. (Photo by Andrew Hoffman).

some resident breeding bird species, but the fall migration for southbound shorebirds and post-breeding dispersal for wading birds was underway. The species list was very good for July on a property that is mostly open terrain, has almost no woodlands, and only four species of resident warblers; however, the property does have the largest shallow water wetland complex in Indiana. The most notable survey results for birds were 21 species that are listed by the Indiana DNR as being of Greatest Conservation Need. They included 13 species listed as State Endangered and eight more species listed as Special Concern (see IAS website). The Acadian Flycatcher (*Empidonax virescens*) observed was a new species for Goose Pond and raises the overall Goose Pond FWA property bird list to 261 species. A Barn Owl (*Tyto alba*) was the outstanding observation of the bird survey. This is the first breeding season record for Barn Owls on the Goose Pond FWA property.

**Butterflies and moths (Butterflies: Don Gorney; Moths: Megan McCarty).**—Forty-eight butterflies and 74 (plus six unidentified) moths were recorded. The 48 species of butterflies represent almost all species that could reasonably be expected from southwest Indiana in mid-July. Individual numbers were above expectations with 2,705 butterflies recorded. As typical with butterfly surveys, certain species predominated and accounted for a large percentage of the total. The top five most abundant species, led by Pearl Crescent (*Phyciodes tharos*) with 1,023 individuals, accounted for 66 percent of total individuals. Butterfly richness at Goose Pond FWA is attributed to the extensive prairie plantings containing both nectar sources and larval host plants, isolated woodlots on the property, and forest cover in nearby Greene-Sullivan State Forest and on adjacent private land. Although wildflowers in bloom were present at both Goose Pond and Beehunter Marsh, the Goose Pond units had

larger, and therefore generally more productive, stands. The Northern Pearly-eye butterfly (*Lethe anthedon*), designated as rare, was the only state-listed butterfly species observed. Although many butterfly county records would have been recorded, surveying for butterflies was completed through visual observation only; no vouchers were taken. The single-night, single-location of moth surveying produced 74 identified and six yet unidentified moth species. At least 59 of the species were county records and at least three are new state records. *Cynia inopinatus* and *Lesmone detrahens*, both designated as rare, were the two state-listed moth species observed.

**Dragonflies and damselflies (Amanda Belian).**—Twenty-one species of dragonflies and nine species of damselflies were observed. Seven species of dragonflies and six damselflies were new county records for Greene County. The state endangered Turquoise Bluet (*Enallagma divagans*) was not observed during this particular survey. However, a Swift Setwing (*Dythemis velox*), not previously reported for Indiana, was observed hovering over a pond. A pair of Dragonhunters (*Hagenius brevistylus*), one of the most sought after dragonfly species because of its size, was observed. Goose Pond FWA is rich in dragonfly and damselfly diversity which indicates overall good habitat health.

**Fish and freshwater mussels (Brant E. Fisher).**—Thirty-nine species of fish, representing 11 families, were recorded from 13 locations at Goose Pond FWA. The fish community was dominated by the following 11 species: Gizzard Shad (*Dorosoma cepedianum*), goldfish (*Carassius auratus*), common carp (*Cyprinus carpio*), black bullhead (*Ameiurus melas*), western mosquitofish (*Gambusia affinis*), green sunfish (*Lepomis cyanellus*), warmouth (*Lepomis gulosus*), bluegill (*Lepomis macrochirus*), largemouth bass (*Micropterus salmoides*), white crappie (*Pomoxis annularis*), and black crappie (*Pomoxis nigromaculatus*). These species were all found from eight or more of the 13 locations sampled and are taxa typical of a wetland/lake complex in central Indiana.

Only four species of freshwater mussels were collected from the 13 locations sampled and none were state or federally endangered or of special concern. Two species, Lilliput (*Toxolasma parvus*) and Pondhorn (*Unio merus tetralasmus*) were found at only one location, although of the two, only Lilliput was found

live. Giant floater (*Pyganodon grandis*), one of the most common freshwater mussel species inhabiting Indiana waters, was found live at four locations, and the exotic Asian Clam (*Corbicula fluminea*) was found live at five locations.

**Fungi and fungal allies (Donald G. Ruch).**—Four species of true fungi were found in Goose Pond FWA Unit 13 forest. They were Red & Yellow Bolete (*Boletus bicolor* Peck var. *bicolor*), Frost Pale Bolete (*Boletus pallidus* Frost), Mossy Maze Polypore (*Cerrena unicolor* (Bull.) Murrill), and the Tender Nesting Polypore (*Hapalopilus rutilans* (Pers.) P. Karst). The fungal ally, *Saprolegnia parasitica* Coker, a water mold, was observed in all large pools as a parasite on fish. The four true fungi are common species and widespread across the state.

**Aquatic macroinvertebrates (William W. Jones).**—The aquatic macroinvertebrate survey collected 211 specimens representing 16 families. The Macroinvertebrate Index of Biotic Integrity (mIBI) developed and used by the Indiana Department of Environmental Management for rivers and streams was used as a good summary and comparative metric. The mIBI is a family-level index, thus taxa are reported as families. High mIBI metric scores are “better” than lower scores. The Main Pool scored 2.7 = Moderately Impaired, and Goose Pond Unit 7 scored 4.0 = Slightly Impaired. Sediment samples contained no live aquatic macroinvertebrates, likely because of the anoxic dissolved oxygen concentrations in the sediments. In total, 133 individuals were collected from the margins of the GP 7 Pool and 78 individuals from the margins of the Main Pool. Overall, the Main Pool received lower scores because it had lower family richness (11 vs. 13), more tolerant taxa (Hilsenhoff Biotic Index score of 6.06 vs. 4.74), and fewer EPT individuals (14 vs. 32). EPT refers to Ephemeroptera, Plecoptera, and Trichoptera taxa that are less tolerant of organic pollution and thus, are indicators of higher water quality (Peckarsky et al. 1990).

**Mammals (John O. Whitaker, Jr.).**—The mammal survey recorded 27 species. A total of 305 small mammals of eight species was recorded using mouse-traps. A colony of Little Brown Bats (*Myotis lucifugus*) was documented in the barn adjacent to the Goose Pond FWA headquarters area, totaling over 600 bats. Two

additional species of bats were taken during mist-netting, a Red Bat (*Lasiurus borealis*) and an Eastern Pipistrelle (*Perimyotis subflavus*). Reports on other species, mostly larger mammals (e.g., Red Fox, *Vulpes vulpes*; Beaver, *Castor canadensis*; Bobcat, *Lynx rufus*) totaled an additional 16 species. The total number of mammals currently known to be living wild at Goose Pond is 27. For comparison, there are 59 species of mammals known to be living in Indiana, thus Goose Pond FWA is currently home to at least 47 percent of the species of mammals in the state. No state records and no endangered species were observed during the survey. The two most interesting species recorded at Goose Pond were the bog lemming, *Synaptomys cooperi*, and the least shrew, *Cryptotis parva*. Species expected, but not found were the masked shrew, *Sorex cinereus*, the meadow jumping mouse, *Zapus hudsonius*, and six other taxa. The distribution and abundance of three of the species present at Goose Pond, the House Mouse (*Mus musculus*), the Prairie Vole (*Microtus ochrogaster*), and the Prairie Deer Mouse (*Peromyscus maniculatus*) were probably greatly affected by the agricultural history of the area. A complete report on the mammals of Goose Pond FWA will be presented as a separate article.

**Nonvascular plants (William N. McKnight).**—No nonvascular plants were found. The absence of these plants during the survey was due to the hot weather and limited forest areas.

**Plankton (William W. Jones).**—Eighteen genera of plankton were reported at Goose Pond FWA. The Main Pool had a visible algal scum at the surface dominated by cyanobacteria (*Anabaena* and *Planktothrix*). Of surprise was the high richness of zooplankton present (nine genera). The cyanobacterial bloom would suggest an excess of nutrients. The GP7 Pool was dominated by green algae and diatoms, but these were in low densities. This site also exhibited a high level of zooplankton richness (five genera). Both pools had lower phytoplankton species richness than was expected, possibly due to low water levels, low light intensities, and flowing water. The water temperatures at both sites were typical of summer and showed no thermal stratification. Dissolved oxygen (DO) in the Main Pool was under-saturated, which is surprising given the algal bloom that was occurring; this shows that respiration exceeded photosynthesis. Further

evidence of high levels of respiration, likely bacterial, occur at 1 and 1.5 meter depths, which are anoxic, despite mixing with the atmosphere that should drive DO saturation toward equilibrium, or 100%.

**Snail-killing flies (William L. Murphy).**—Four species of Snail-killing Fly (Sciomyzidae) were recorded. The suite of species observed represents an early successional series of some of the regionally most common and least specialized species of snail-killing flies. Analysis of one species (*Sepedon fuscipennis* Loew) showed that the race present at Goose Pond (*S. f. fuscipennis* Loew) originated south of central Indiana. No individuals were found with characteristics of the race occurring from central Indiana north (*S. f. nobilis* Orth). In general, sciomyzid flies were far less common than would be expected in a mature wetland environment. Possible reasons for this include exceptionally high temperatures during the survey period, surveying after the peak sciomyzid flight period (April–June), a groundwater pH above 7.0 (which greatly restricts snail shell development), and pesticide overspray or runoff from adjoining agricultural areas. The only other areas in Indiana where sciomyzids have been found in such low numbers in seemingly suitable habitat are the adjoining strip-mined counties of Clay, Knox, and Sullivan.

**Vascular plants (Scott Namestnik).**—The plant survey recorded a total of 379 vascular plant taxa (371 identified to at least the species level) at Goose Pond FWA, of which 286 (76%) are native to Indiana. The vascular plant families represented by the most taxa were the Aster Family (Asteraceae, 53 taxa), the Grass Family (Poaceae, 48 taxa), and the Sedge Family (Cyperaceae, 37 taxa); the Sedge genus *Carex* was the most well represented genus, with 18 species observed. A total of 123 potential Greene County records were identified. Nine of these species are on the list of Indiana Endangered, Threatened, Rare and Watch List species. Disk Waterhyssop (*Bacopa rotundifolia* (Michx.) Wettst.), Bush's Sedge (*Carex bushii* Mack), and Marsh Flatsedge (*Cyperus pseudovegetus* Steud.) are of particular interest because they are likely to be naturally occurring at the site and their populations are currently tracked by the Indiana Department of Natural Resources – Division of Nature Preserves. The vascular plant communities at

Goose Pond FWA consist primarily of early successional marsh and prairie communities dominated by common, disturbance-tolerant plant species. This is supported by the mean Coefficient of Conservatism (C) value of 2.2 and Floristic Quality Index (FQI) of 42.3, as plant species with C-values of 0–3 “provide little or no confidence that [their] inhabitation signifies remnant conditions” (Rothrock 2004), and sites with FQI values of less than 45 are not thought to possess natural area potential (Swink & Wilhelm 1994). It is interesting that no seeding or planting was conducted in the marsh communities; all vegetation present has arisen as a result of seed bank resurgence, volunteering vegetation from nearby areas, or seed introduced by visiting waterfowl. Considering this, the resulting species richness within ten years of restoration is rather impressive. In the prairie communities, native tallgrass and shortgrass prairie species were introduced through seed. In part because many of these prairies have been installed in areas that were forest at the time of European settlement, an appropriate seed bank does not exist, and the resulting communities consist of seeded species interspersed with generalist volunteers. Invasive species often pose the greatest threat to new restoration areas; with the exception of Hybrid Cattail (*Typha × glauca* Godr.), non-native invasive species are not currently dominant in the units of Goose Pond that were surveyed by the vascular plant survey teams. In the marsh communities, Common Reed (*Phragmites australis* (Cav.) Trin. ex Steud.) and Reed Canarygrass (*Phalaris arundinacea* L.) were observed in a few scattered locations, and few plants of Purple Loosestrife (*Lythrum salicaria* L.) were observed. In prairie communities, Sericea Lespedeza (*Lespedeza cuneata* (Dum. Cours.) G. Don) and Johnsongrass (*Sorghum halepense* (L.) Pers.) were scattered in some of the units, but Canada Goldenrod (*Solidago canadensis* L.) appeared to be the most abundant plant species and likely presents the greatest threat to the long-term success of the seeded native species.

**Biogeochemistry (Lenore P. Tedesco).**—A series of six sites established in 2006 were re-sampled to assess carbon sequestration and wetland soil development in the wetland complex. Sites in both Beehunter Marsh and Goose Pond FWA were selected to document the effects of different depth and duration of

flooding as well as restoration age. The team revisited all six sites and repeated the sampling. Results are not yet available but the team did find that up to 4–6 inches of organic muck had already accumulated in some areas showing rapid development of wetland soils.

**Conclusion.**—The Goose Pond FWA biodiversity survey provided baseline information on the biological diversity of this important natural resource. Although of short duration and conducted during hot, mid-July weather conditions, the survey documented hundreds of species and noted many county records, as well as numerous state-listed species. These results are encouraging, given the recent restoration of the Goose Pond area. In less than a decade, the area is becoming a well-established habitat mosaic of wetlands, fields, and forest and being recognized as a biodiversity “hotspot” in Indiana. Other wetland restoration projects in Indiana, such as the Kankakee Sands project in northwestern Indiana (Brodman et al. 2006) and the Lobolly Wetland Marsh Preserve in northeastern Indiana (Ruch et al. 2010) are also developing into important natural areas.

Short-term surveys provide a snapshot of the flora and fauna at one time of the year and have limitations, but they provide a wealth of data that would not otherwise be available. There was a general consensus among participants that a repetition of this biodiversity study in approximately 5 years, during the same time period, would be useful in assessing the progression of the restoration. To continue to build upon the inventory of plants and animals begun with this study, another biodiversity study in a different season would be of benefit, recognizing that some early and late season and winter species were undoubtedly missed. The large scale and habitat diversity of the ~ 8000 acres of wetlands, prairie, open water, and bottomland tree plantings found at the Goose Pond Wildlife Area offer opportunities for a wide range of research projects.

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