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RESULTS OF THE 2019 BIODIVERSITY SURVEY AT THE POOR HANDMAIDS OF JESUS CHRIST MINISTRY CENTER, MARSHALL COUNTY, INDIANA

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ABSTRACT. The Biodiversity and Natural Areas Committee of the Indiana Academy of Science organizes a 24 hr biodiversity survey, or bioblitz, each summer. In 2019 the Academy of Science held a bioblitz at the Poor Handmaids of Jesus Christ Ministry Center, in Marshall County (north-central Indiana) on June 29 and June 30. This survey brought together 14 taxonomic teams and an aqueous geochemistry team. The survey resulted in 983 species being recorded across the various taxa.

Keywords: bioblitz, Poor Handmaids of Jesus Christ, state records

INTRODUCTION

The Indiana Academy of Science (IAS) conducted its 2019 biodiversity survey at the Poor Handmaids of Jesus Christ Ministry Center, Marshall County, Indiana. This survey brought together 36 scientists and naturalists to survey for 14 different taxonomic groups. The survey occurred over a 24 hr period, with some set-up and identification activities falling outside the

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Figure 1.—Map of property with the seven Zones A – G used to reference locations of survey records and collections. Roads are in black while streams, ditches and the scale bar are in gray. Cross north of Gilbert Lake shows the location of Catherine Kasper Home for reference. Solid circle shows the location of the base camp.

time of the main survey. The conditions were ideal for many of the groups censused, with warm and humid conditions and a new moon.

The Ministry Center is the headquarters of the American Province of the Poor Handmaids of Jesus Christ, a religious community of women. Located approximately 3 km south of Donaldson and 10 km west of Plymouth, Indiana, it is close to the Menominee Wetland Conservation Area which is located to the southeast. The Center is home to Ancilla Beef & Grain Farm, Ancilla College of Marian University, Catherine Kasper Life Center, Lindenwood Retreat & Conference Center, and MoonTree Studios. The Ministry Center sits at the boundary of the Kankakee Drainageways and the Plymouth Morainal Complex (Homoya et al. 1984) and is composed of 429 ha of agricultural fields, cool-season grass cattle pastures, hay fields, herbaceous wetlands, tallgrass prairie restorations, flat woods, oak woodlands, Gilbert Lake (a 12 ha kettle lake), and landscaped areas. The property was divided into seven zones, labelled A – G, for the survey (Fig. 1).

SUMMARY OF SURVEY METHODS AND RESULTS

The 14 taxonomic teams reported 983 taxa (Table 1). Summaries of these findings are organized below by taxon. The complete list of observed taxa can be obtained at the IAS website, at https://www.indianaacademyofscience.org/, then click on Resource Center | Bioblitz Events

Table 1.—Summary list of taxa survey results. The genus *Ishnura* is one taxon reported by the macroinvertebrate team that is included in % calculations in the text but is omitted from the total in the online complete list tally since two species in this genus are reported in other places. Two teams surveying for adult dragonflies and damselflies found 16 species but two are found listed by the macroinvertebrate team in the nymph form. These two species are thus only counted once in the taxa total number.

Taxon	Count	Team Leader
Ants	23	Matthew Dittman
Aquatic macroinvertebrates	35	Paul McMurray
Bees	10	Robert Jean
Beetles	186	Jeffrey Holland
Birds	64	Timothy Rice
Dragonflies & damselflies	14	Carl Strang
Fish & mussels	16	Brant Fisher
Fungi	36	Stephen Russell
Herptofauna	14	Michael Finkler
Mammals	15	Jeremy Sheets
Moths & butterflies	34	Carl Strang
Singing insects	5	Carl Strang
Spiders	83	Marc Milne
Vascular plants	448	Collin Hobbs
TOTAL	**983**	

and Data | Donaldson Bioblitz. A team also measured the aqueous geochemistry and these results are included among the taxon reports below. The survey teams and the resulting reports are mainly delineated by surveyors' interest rather than strict taxonomic groupings. This results in some groups that are not strictly taxonomic, e.g., aquatic invertebrates versus dragonflies and damselflies. Both suborders of the Odonata are aquatic in their immature stages, but the adults and immatures were sampled differently. When the same species occurred in different species tallies because of this, they were only included in the overall total once.

Ants.—Ant specimens were sampled by hand collecting and aspirator at each of the sites visited. This sampling effort was done by a single person and took place for nine hours on Saturday and three hours on Sunday for a total twelve person-hours. There was a diversity of field-nesting species near base camp itself and the adjacent fields, as well as woodland-nesting species as the treeline was approached. Sampling at additional woodland sites uncovered a similar suite of species. The Poor Handmaidens bioblitz site had the highest diversity of woodland nesting ant species compared to prior bioblitzes, which implies that the woodland habitats are relatively undisturbed despite fragmentation and human development. In regards to field sites, while the area sampled was limited to the area surrounding base camp, there was a good diversity of specimens present, including the first recording of a *Pheidole* species at an IAS bioblitz. There were 23 ant species found during the bioblitz (Table 1).

Aquatic macroinvertebrates.—Aquatic macroinvertebrates were collected from three locations on and near the Donaldson Center property: 1) a ditch draining constructed wetlands, 2) the east end of Gilbert Lake, and 3) Carl Gjemre Ditch. A D-frame aquatic dipnet with 500 μm mesh was used to collect a sample from all available habitats in a 25 – 30 m section of the waterbody at each site. The collected macroinvertebrate samples were elutriated through a 500 μm mesh sieve and then picked in the field for 15 min. Collected specimens were identified to lowest practical taxon (usually genus or species) by use of standard texts (i.e., Merritt et al. 2008; Thorp & Rogers 2015). Adult odonates (i.e., dragonflies and damselflies) were also collected with an aerial net at various locations around the Donaldson Center and were identified using Curry (2001) and Lam (2004).

Altogether, 36 macroinvertebrate taxa were identified from the three sites, none of which are known to be species of special concern in Indiana or an exotic or invasive species (Table 1 states 35 taxa because one was also found as an adult by the dragonflies and damselflies team and this avoids double-counting in generating a total number of species). Only one taxon (Caenidae: *Caenis*) from the insect orders Ephemeroptera, Plecoptera, and Trichoptera (EPT), which are generally considered pollution intolerant, was collected. Thirteen of the 36 taxa (36%) were Chironomidae (midge fly) taxa, which are generally tolerant to pollution. Site 1, a small stream draining the constructed wetlands on the Donaldson site, yielded 15 macroinvertebrate taxa while Site 3 on Carl Gjemre Ditch only contained six taxa. Site 2, located on the northeastern edge of Gilbert Lake, had the highest number (27) and was the only site to have any EPT taxa. In general, the lotic sites on the Donaldson Center property featured little

diversity, possibly owing to their potentially ephemeral nature or lack of suitable macroinvertebrate habitat.

Thirteen odonate taxa were collected from the macroinvertebrate sampling sites and other areas on the Donaldson Center property with two taxa found as both immatures and adults (Table 1). None of these species were exotic or invasive. With the exception of *Calopteryx maculata* and *Argia fumipennis*, all are commonly found on or near lentic waterbodies. Odonate taxa were surveyed also by the singing insect team, and the adult records have been combined with that survey to avoid double-counting species.

Aqueous geochemistry.—A two person aqueous geochemistry team collected 45 water samples from around Gilbert Lake and associated small inflows and outflows at its southwestern and eastern proximities. Water samples were analyzed on site for dissolved inorganic phosphate (Pi) using a Biotech Epoch2 microplate reader and a malachite green assay for Pi modified for use on a microplate (Carter & Karl 1982). Water samples were collected from surface waters in 50 ml syringes. Immediately following collection, samples were filtered to 0.22 μm to retain the predominantly dissolved fraction from each sample. All lake water samples analyzed were below 0.025 ppm Pi at the time of testing, with an overall median Pi concentration of 0.016 ± 0.002 ppm. All stream samples were below 0.04 ppm Pi, with an overall median Pi concentration of 0.021 ± 0.001 ppm. These findings are consistent with natural waters in many places across Indiana and are below levels of concern for detrimental eutrophication set by the U.S. Environmental Protection Agency (Gibson et al. 2000).

In addition to surface water Pi analysis, select electrochemical profiles of sediment cores from streams near Gilbert Lake were conducted. Electrochemical profiling is useful for visualizing dissolved oxygen, manganese, sulfide, sulfur, iron (II), and iron (III) complexes, and thus provides valuable information about redox activity and chemical speciation along environmentally important gradients. This profiling used cyclic voltammetry with a gold/mercury amalgam working electrode, a platinum counter electrode, and a Ag/AgCl reference electrode following methods presented in Brendel & Luther (1995) and Luther et al. (2008). All electrochemistry was conducted using a DLK-70 WebPstat [Analytical Instrument Systems (AIS), New Jersey, United States] coupled to a LabMan micromanipulator (AIS). All electrochemical profiles were conducted on the upper 10 cm of saturated sediments.

Electrochemical profiles from saturated stream sediment revealed oxygenated sediments to a depth of 6 cm in the center of the stream, suggesting a regular oxygenated discharge. Near stream edges, oxygen penetrated to roughly 1.2 cm in depth. Dissolved manganese was present starting from 1.2 cm to 10 cm and dissolved iron (II) from 2 cm to 10 cm. Complexed iron (III) was present from 2.1 cm to 10 cm in depth. The presence of dissolved metals closer to the sediment-water interface (elevated redox-cline) is expected where the stream discharge lessens at or near stream banks. The presence of dissolved manganese and iron is also in-line with stream sediments from much of northern Indiana, where groundwater leaches from glacial till, sand, and gravel deposits rich in minerals containing these metals. Sulfide and sulfur were not detected in any profiles.

The results of the Pi survey and electrochemical sediment profiles suggest a system with typical aqueous geochemical characteristics for northern Indiana, when also surrounded by agriculture land use. Based on the data collected during this event, Gilbert Lake would be considered below, but close to, EPA levels for a eutrophic system (Gibson et al. 2000). Iron dominated redox chemistry within inflow sediments suggests iron mineralogy, especially formation and reduction of iron oxyhydroxides, likely plays an important role in nutrient cycling and bioavailability both in area streams and Gilbert Lake itself.

Bees.—Ten bee species, approximately two percent of the Indiana bee fauna, representing eight genera and all five common bee families known from Indiana were collected during the survey (Table 1). Three areas were sampled 29 June 2019: Zone A, Zone B, and base camp (Fig. 1). Approximately six hours of aerial net collecting were performed by the bee team. Net collections were not executed in other areas due to the lack of floral availability or density.

Overall floral diversity was somewhat low, as was bee activity. Bees in the family Apidae represented a large portion of the species richness (4 spp.) but sweat bees in the family Halictidae were most abundant (n = 6, 43% of all bees collected). Two bumble bee species were collected: common eastern bumble bee (*Bombus impatiens*), and brown belted bumble bee (*B. griseocollis*), with the latter being more common, occurring in

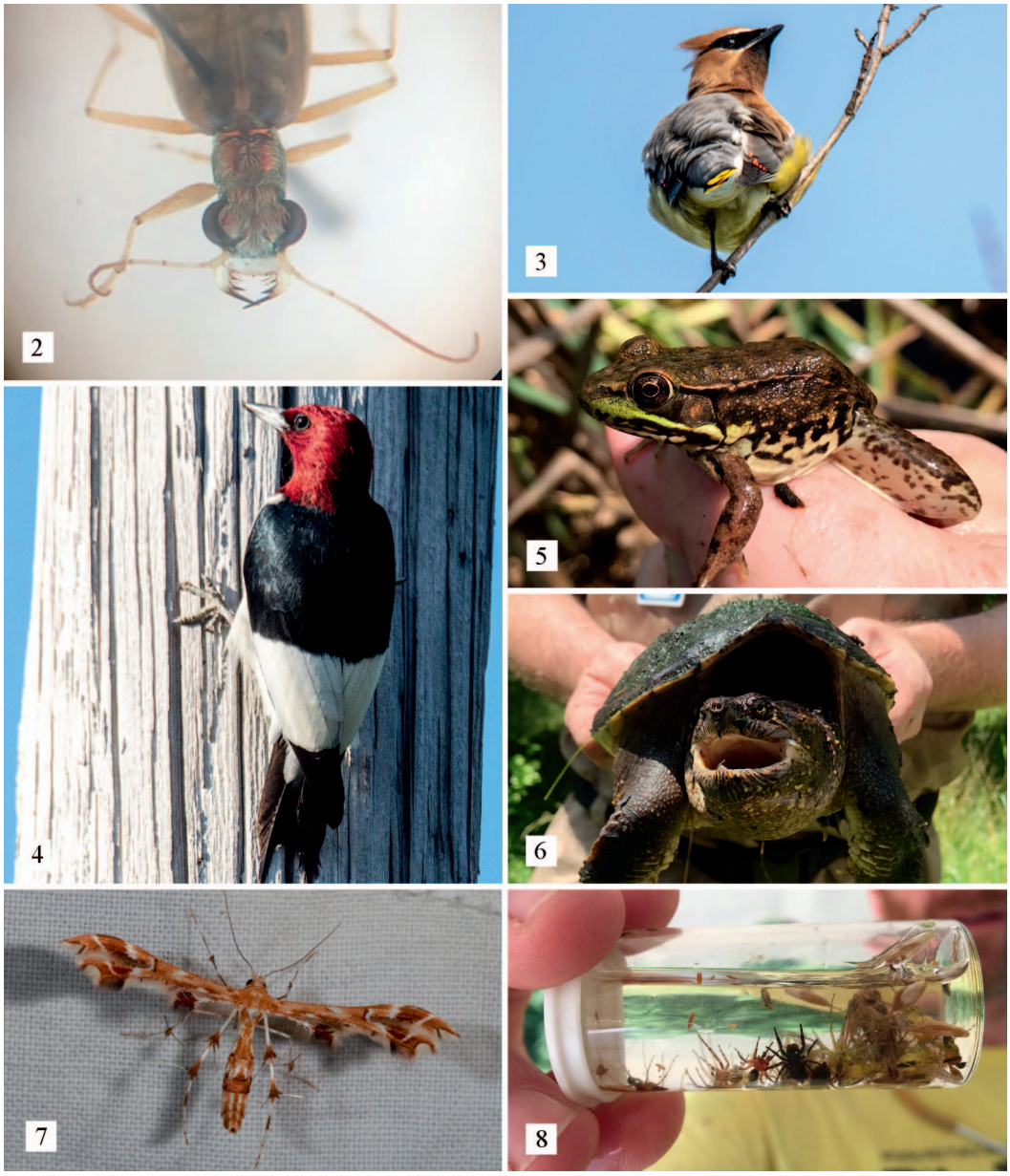
Zone A and base camp. The sweat bee *Halictus confusus* was the most common species and was represented by four individuals collected at the base camp. Colletid bees were represented by a single species with one individual. In general, most species encountered were common and expected in most collections throughout the state. Interesting species included *Lasioglossum vierecki*, a species associated with sandy soils for nesting, and *Andrena rudbeckiae*, a mining bee that collects pollen from species in the Asteraceae. Two nonnative species, the European honey bee (*Apis mellifera*) and *Anthidium oblongatum*, were collected but they were uncommon and represented by a single specimen each. These collections provide baseline data of the bee species richness and relative abundance and demonstrate the importance of natural habitat for bee conservation. Further management to increase native wildflower species richness and availability and reduce invasive plant species will likely enhance bee populations and thus local pollination and ecological services. Collections in these areas earlier and later in the year will likely add many more species as many solitary bee species are highly seasonal and some social bee species are only active until mid-late August. Voucher specimens are housed in the Environmental Solutions & Innovations, Inc. (ESI) entomology collection in Indianapolis.

Beetles.—Two weeks prior to the bioblitz eight traps were set in forested areas of the site. At each of four locations a single Lindgren multiple funnel trap and a window flight intercept trap were placed 5–10 m apart. These were hung at eye level from tree branches and baited with an ethanol lure. Beetles were removed during the bioblitz event. In addition, beetles were captured by hand and sweep-net in various habitats and plantings throughout the day Saturday and Sunday morning. Collecting amounted to approximately 35 person-hours. The large majority of beetle species and individuals were collected at light sites at night. On Saturday evening an array of lights consisting of two UV lights, one 150 W mercury vapor light, and a 1000 W metal halide light were used to attract beetles. White sheets served as a substrate from which these were collected. The conditions for lighting were ideal: the temperature remained warm, the air was humid, and a new moon meant our lights had no competing moonlight. The cloud of beetles around the metal halide drew astounded exclamations from those that visited to see the night collecting. It was the best light collecting event that the beetle team leader had ever experienced. The lighting ended after approximately four hours. At this time, the beetles blanketing the white sheets below the metal halide light were emptied into graduated jars to be measured. The beetles present at that time filled one half-liter.

The beetle crew found 186 different taxa of beetles. The species richness of ground beetles (Coleoptera: Carabidae) was unusually high for a 24 hr survey in Indiana. The highlight from this family was a ghost tiger beetle, *Ellipsoptera lepida* (Fig. 2). The number of species in the longicorn beetle family (Coleoptera: Cerambycidae) was also high for a 24 hr survey at 14 species. This species richness was enhanced by the traps set out before the bioblitz.

Birds.—The bird survey was executed by a single person. Observations were supplemented by reports of birds from members from other teams. The bird survey began at approximately 0730 hr on 29 June 2019. The weather was hot and humid, with temperatures reaching above 85° F. The survey continued until 1200 hr, resumed approximately 1300 hr until 1800 hr, and 1930 hr until light was insufficient to see birds, at approximately 2030 hr. On 30 June the survey continued at approximately 0800 hr, and sought species not detected the previous day and to spend time at the feeders at MoonTree Studios. In particular, on 30 June, there were additions of bobolink (*Dolichonyx oryzivorus*) and a ruby-throated hummingbird (*Archilochus colubris*).

The bird surveyor was pleased with the bird diversity. A total of 64 species were detected (Table 1). Most species observed would be expected from this type of mixed habitat, i.e., woodland, lake, and meadow (Figs. 3–4). The most common and most widespread species was red-wing blackbird (*Agelaius phoeniceus*); these were found in all zones and were frequent visitors to the bird feeders at the Headquarters. Other common species found in most or all zones included American robin (*Turdus migratorius*) and house wren (*Troglodytes aedon*). The two invasive species, house sparrow (*Passer domesticus*) and European starling (*Sturnus vulgaris*), were not abundant and were confined to zones with buildings, such as Ancilla College's campus. Because these two invasive species were rarely



Figures 2–8.—Photographs of taxa found during the survey. 2) Ghost tiger beetle; 3) cedar waxwing; 4) red-headed woodpecker; 5) green frog; 6) snapping turtle; 7) grape plume moth; 8) vial of spiders. (*Photos 2 and 8 by Adam Thada; 3 and 4 by Timothy Rice; 5 by Jim McLister; 6 by Payton Fischer; and 7 by Carl Strang*)

observed in natural areas, they are hopefully having little impact on native species.

One might expect to find grasshopper sparrow (*Ammodramus savannarum*) and Henslow's sparrow (*Ammodramus henslowii*) in this type of open habitat. However, these were not observed. There were reports of sedge wren (*Cistothorus platensis*) vocalizations in zones with fields. These fields were driven around on 29 June and 30 June, and some were walked through. The sedge wren has a call similar to the dickcissel (*Spiza americana*), which was seen in abundance. Several dickcissel were spotted while they were calling and therefore the calls and individuals could be associated.

However, no sedge wren individuals were seen, and therefore vocalizations were likely those of dickcissel.

Dragonflies and damselflies.—A total of 15 odonate taxa was collected from the macroinvertebrate sampling sites and other areas on the Donaldson Center property by the dragonflies and damselflies team. This number includes not only adults, but additional species found only as nymphs in the macroinvertebrate list (Table 1 lists 14 taxa because one species is also listed by the aquatic macroinvertebrate team). None of these species were exotic or invasive and, with the exception of *Calopteryx maculata* and *Argia fumipennis*, are all commonly found on or near lentic waterbodies.

Fish and freshwater mussels.—Fish were sampled with a combination of backpack electrofishing and seining techniques, depending on the habitat being sampled. Two people sampled for approximately three and a half hours, for a total effort of 7 person-hours. A total of 16 species of fish were collected from the three sites sampled in Carl Gjemre Ditch (two sites) and Gilbert Lake (one site) (Table 1). No species were common to all three sites. Only two species were collected from the most upstream site on Carl Gjemre Ditch, while eight species were collected from the lower site. Gilbert Lake had the greatest diversity with 12 species sampled. Eight species were unique to the lake habitat. Creek chub (*Semotilus atromaculatus*), central mudminnow (*Umbra limi*), mottled sculpin (*Cottus bairdii*), and johnny darter (*Etheostoma nigrum*) were limited to the sites sampled in Carl Gjemre Ditch. No state listed fish species were collected and fish communities were typical for smaller streams and natural lakes in the upper Kankakee River drainage of Indiana. Most of the fish species collected are highly tolerant of a wide range of environmental conditions, and can be found in a variety of aquatic habitats. The most interesting find was the Iowa darter (*Etheostoma exile*) from Gilbert Lake. It has only been documented from a few other natural lakes in the Kankakee River drainage of Indiana, but is a relatively common species in natural lakes from other drainages across northern Indiana.

The fish team also checked for freshwater mussels in the locations where fish surveys were carried out, but none were observed.

Fungi.—Two locations were surveyed by one person over the course of two hours during this event. The survey areas included the woodlands to the north and east of the Lindenwood Retreat and Conference Center, as well as the woodlands on the western edge of the property, south of 9B road. A total of 39 observations of macrofungal fruit bodies were made, covering 35 species across 33 genera (Table 1). Samples were collected for 16 of the species that were encountered. They are currently housed at the Kriebel Fungarium at Purdue University in West Lafayette, IN. DNA sequencing was attempted for all samples and was successful for 14 (87.5% success). Raw sequence data can be found in the MycoMap project (https://mycomap.com/projects/ias-ancilla-college-2019). Color photographs and exact GPS coordinates can be found in the iNaturalist project (https://www.inaturalist.org/projects/2019-ias-bioblitz).

Most of the species that were encountered during this event are fairly common for the early-summer season, including *Artomyces pyxidatus*, *Megacollybia rodmanii*, *Mycena leaiana*, *Lactarius quietus* var. *incanus*, and *Sarcoscypha occidentalis*. The most impressive specimen encountered was *Pluteus eludens*. It was recently described based on specimens from Russia, Portugal, and Illinois (Justo et al. 2011). The specimen encountered at this event appears to represent the second North American collection of the species. *Yuchengia narymica* is a crust fungus that is infrequently reported, with only one other collection in the Midwest outside of Indiana. The team leader, however, has encountered it at least four times across Indiana, including at this event. *Inocybe subradiata* is another uncommonly reported species. Although previously known only from Tennessee and Florida, it appears to be somewhat common across Indiana and was fruiting prolifically in the mixed pine woods north of the conference center. Finally, *Skeletocutis semipileata* was encountered. A recent revision of the *Skeletocutis nivea* complex was completed by Korhonen et al. (2018), and it appears that most past Indiana collections of *S. nivea* should be updated to *S. semipileata*.

There were a couple other interesting specimens that lacked reasonable species names, despite obtaining DNA sequences. The sequence for *Russula* "sp-IN59" is novel to public DNA sequence repositories and represents the 59th putative species of *Russula* from Indiana that has yet to be linked to a species epithet. A species informally referred to as *Sarcosomataceae* "sp-

IN01" was also encountered. It is a small, brown, gelatinous cup fungus that grows from wood and can be found fruiting across the state during May and June. It is morphologically similar to *Galiella rufa*, but with a unique DNA sequence. It may represent an undescribed species of *Galiella*, or a taxon of another closely related genus.

Herpetofauna.—Amphibian and reptiles were surveyed using multiple methods. Minnow traps were deployed along the perimeter of Lake Gilbert as well as in small ponds, ditches, and vernal pools with standing water in order to sample turtles and amphibian larvae. Dip nets were used to collect amphibian larvae in vernal pools and calling anurans (frogs and toads) were identified. Animals in terrestrial habitats were located with visual searches and by sampling cover objects.

A total of eight anuran species (Fig. 5), four turtle species (Fig. 6), and two snake species were found during the survey (Table 1). Most are common in the region (Minton 2001), although one species of anuran, the northern leopard frog (*Lithobates pipiens*), is a species of special concern in Indiana.

The relatively cold and wet weather during the spring of 2019 appears to have delayed reproduction in at least some of the anuran species at the site. A full breeding chorus of Fowler's toads (*Anaxyrus fowleri*) was heard the night of June 30th, which is later than usual for the species (Minton, 2001). Similarly, larval wood frogs (*Lithobates sylvaticus*) and spring peepers (*Pseudacris crucifer*), species that normally breed in the late winter and early spring and generally complete metamorphosis in late May through late June (Minton 2001), were still present in vernal pools.

Mammals.—Fifteen and a half person-hours were spent surveying for mammals. A total of 15 mammal species were observed during the bioblitz with 11 species identified by sight or sign (e.g., tracks, feces) during a daytime meander survey (Table 1). A mist-net survey was conducted and resulted in a single species of bat, big brown bat (*Eptesicus fuscus*). Additionally, a single bat detector was set out during the mist netting effort and detected three bat species: evening bat (*Nycticeius humeralis*; state endangered), hoary bat (*Lasiurus cinereus*; state species of concern), and eastern red bat (*Lasiurus borealis*; state species of special concern).

Moths and butterflies.—The Baltimore checkerspot (*Euphydryas phaeton*), a few of which were reported in the fen of Zone E, is relatively uncommon. Otherwise, the 11 observed species of butterflies and 23 species of moths are common and widespread (Fig. 7, Table 1). The diversity, with 12 families of Lepidoptera represented, is reasonable given the habitats and sampling effort.

Singing insects.—The bioblitz took place too early in the season for many singing insects to have matured. Two of the five observed were common spring species reaching the end of their activity period, and two were common early summer species just getting started (Table 1). The fifth, a single male eastern striped cricket (*Miogryllus saussurei*) singing in the northern portion of the survey area, has been observed at only five other sites in northern Indiana, and this one is the easternmost. Either they are spreading from the west or south, where numbers are higher and locations have been known since the first third of the 20th century, or they are so thinly scattered in the fringes of their range that they have not been noticed in northern Indiana before. One non-singing orthopteran, the locally abundant narrow-winged grasshoppers (*Melanoplus angustipennis*), was found on the sandy hill adjacent to the bioblitz base camp. This sand soil specialist is not considered particularly rare in Indiana. This species was not included in the species tally in Table 1.

Spiders.—The four-person spider team had a successful day of capturing specimens at this bioblitz (Fig. 8). We expected to find approximately 80–100 species through one day of searching (~32 person-hours). The post-bioblitz lab identifications yielded a tally of 83 species (Table 1). Among the species were several deemed rare or infrequent in Indiana. Moreover, five new distribution records were discovered for Indiana (spiders that have never been recorded from the state). These notable species were as follows:

Glyphesis scopulifer – dwarf spider (Linyphiidae): This is a northern species that occurs throughout most of Canada and a few northern and midwestern states. Indiana is on the southern edge of its range but, given previously reports from Illinois and Michigan, its presence in Indiana is not unexpected. This spider exists within the erigonine subfamily, spiders that

build small sheet-webs among leaf litter close to the ground. One female was found.

Tapinopa bilineata – sheet-web weaver (Linyphiidae): This species occurs throughout eastern North America, including throughout the Midwest. It commonly lives in leaves or underbrush near the ground where it builds sheet-webs to capture small arthropod prey. One immature male and four immature females were located.

Scotinella madisonia – ant-mimic spider (Phrurolithidae): This weak ant-mimicking spider occurs throughout the Midwest and north to Canada but was previously not known to Indiana. These spiders vaguely resemble ants in what is possibly Batesian mimicry as many predators find ants distasteful. There are many other species of ant-mimicking spiders in Indiana, within and outside of this genus. One female was collected.

Robertus eremophilus – comb-footed spider (Theridiidae): This species occurs throughout the Midwest and some nearby states and provinces. Not much is known about this genus, but they are often yellowish-brown or reddish-brown and of rather small size (2–5 mm). Their habits are poorly known, but live close to the ground, occasionally under rocks and logs and among moss. We found one female.

Theridula emertoni – Emerton's bitubercled cobweaver (Theridiidae): This small (1–3.5 mm) cobweb weaver is widespread in eastern North America as well as most of Canada. It is morphologically similar to its sister species, *Theridula opulenta*, but differs by structural aspects of its genitalia. Females of both species are recognized by an abdomen that is wider than long and often colored with bright red, yellow, or orange with black spots. These spiders often build tangle webs on shrubs and bushes. One female was collected.

The spider species richness at the Center is likely higher than reported here due to the short sampling period and effort. Much longer sampling times and higher effort (person-hours) are required to accurately determine the spider species richness of any large habitat. Moreover, we captured only 316 spiders during the bioblitz, and this is too few to give an accurate estimate of species richness of any arthropod group, let alone one as diverse as the spiders (accurate species richness curves often collect 10–20 times as many). Even though we collected few spiders, it's a testament to the species richness of the Center that we were able to find five new state records. In the future, it would be productive to sample the Center at various times of the year as spiders exhibit seasonal variation. Our 83 species likely represent summer-active spiders but missed winter-active ones such as some erigonines and fall-active ones like many funnel-weavers (Agelenidae).

The Center possesses a healthy temperate forest with high spider species richness. It is a gem of biodiversity in Marshall County, which is dominated by agricultural lands and deforested areas. The continued conservation of The Center at Donaldson would help preserve arthropod biodiversity in northern Indiana.

Vascular plants.—The vascular plant teams sampled five of the bioblitz units (A, B, D, E, & G), which represented a diverse range of habitats including oak woodlands, emergent wetlands and meadows, a fen, sedge meadow, mesic forests, old fields, and lake-edge wetlands. A total of 448 taxa identified to species were reported from the bioblitz area (Table 1). Of these 332 (74.1%) were native and 116 were non-native. Seven of the reported species are listed on the Indiana DNR's May 14th, 2021 list of Endangered, Threatened, Watch List, and Extirpated Plants of Indiana (IDNR Nature Preserves 2021), although three (*Pinus strobus* [state threatened], *Taxodium distichum* [state threatened], and *Catalpa speciosa* [stated threatened]) are undoubtedly planted specimens or escapes from introduced populations. Of the remaining four, one is state threatened (*Carex bebbii*) and three are on the state watch list (*Carex alata*, *Carex leptalea*, and *Platanthera lacera*).

The ten vascular plant families with the most species were, in order, Asteraceae (75), Poaceae (45), Cyperaceae (37), Rosaceae (23), Fabaceae (22), Apiaceae (16), Polygonaceae (13), Brassicaceae (12), Lamiaceae (12), and Salicaceae (9). Together these 10 families represent 54.1% of the species identified. A physiognomic analysis across all sites shows that 90 species (20.1%) were woody (trees, shrubs, and woody vines), 266 species (59.4%) were herbaceous (herbaceous forbs and vines), 82 (18.3%) were graminoids (grasses and sedges), and 10 (2.2%) were ferns and their allies.

Of the five units surveyed, Unit E was the most diverse with 233 total species (of which 176 were native). Unit E consisted of an approximately 6 ha

Table 2.—Floristic matrices for the five bioblitz units individually and combined. C = Coefficient of conservatism, MC = mean C value, FQI = floristic quality index, Gross = all species, native + non-native, Native = native species only.

Unit: Habitat	Species richness	% Native	Species C ≥ 7	Gross MC	Native MC	Gross FQI	Native FQI
A: Oak woodland & old field	187	65.8%	12	2.1	3.2	28.9	35.6
B: Mesic forest & pasture	144	63.2%	9	1.9	3.0	22.5	28.3
D: Mesic forest & wetland	118	75.4%	2	2.0	2.6	21.6	24.9
E: Fen & sedge meadow	233	75.5%	26	2.7	3.5	40.6	46.7
G: Lakeshore wetland	191	70.7%	14	2.4	3.4	33.0	39.2
Overall (combined)	448	74.1%	54	2.9	3.9	61.0	70.9

wetland fen and sedge meadow complex with scattered trees and an agricultural ditch. Floristic quality assessment of each unit separately revealed that for all species Unit E had the highest mean coefficient of conservatism (MC) value at 2.7, and floristic quality index (FQI) of 40.6 (Table 2). These values are, however, still below thresholds established by Swink & Wilhelm (1994) for describing sites possessing natural area potential. Despite this, 37% (20 of 54) of the reported species with C ≥ 7 were found *only* in Unit E, including the state threatened *Carex bebbii* and state watchlist *Carex leptalea*.

Other habitats surveyed during the bioblitz included Unit A with a 16 ha oak woodland, burned in spring of 2019, with adjacent emergent wetlands and an old field (187 total species, 123 native, with a mean C = 2.1 and FQI = 28.9 for all species). Unit B comprised of dry to mesic woods, cattle pastures, and emergent wetlands adjacent to a lakeshore (144 total species, 91 native, with a mean C = 1.9 and FQI = 22.5 for all species). Unit D consisted of an emergent wetland intergrading into a mesic forest which was partially grazed by cattle (118 total species, 89 native, with a mean C = 2.0 and FQI = 21.6 for all species). Finally, Unit G was a relatively small unit of lakeshore wetland and adjacent mesic forest (191 total species, 135 native, with a mean C = 2.4 and FQI = 33.0 for all species). It should be noted that surveying time and effort were not equal at each of the five units and this may be partially responsible for observed differences in the FQA values between units.

Only 26 species were found across all five units, of which nine were non-native. Six of the non-native species found in all units were grasses, such as *Phalaris arundinacea*, and the remaining three were the forbs *Cirsium arvense*, *Rumex crispus*, and *Trifolium repens*. Just over half of the species identified (239, or 53%) were found in only a single unit, albeit different units.

Of the 332 native plant species reported, 54 had a C-value greater or equal to 7, representing 16.3% of native species documented. The mean C and FQI for all species from all five units combined was 2.9 and 61.0, respectively. The overall mean C rose to 3.9 and the FQI to 70.9 when only natives were considered (Table 2). The increase in mean C by 1.0 unit when non-natives are excluded indicates that the quality of our study area may be compromised by their prevalence (Rothrock & Homoya 2005). However, many of the natural areas surveyed did not appear to be heavily invaded by non-natives, with the exception of disturbed old-fields, ditches, roadsides, etc. Ongoing management practices, such as controlled burns and selective herbicide applications, may continue to reduce the influence of non-native plants in the more established natural areas.

In summary, the Center compares favorably with other sites recently surveyed during IAS biodiversity surveys. Of the six biodiversity surveys conducted between 2013 and 2017, only the 2015 Hills of Gold survey (Ruch et al. 2016) resulted in higher overall mean C and FQI values for all species. The high number of total species is likely a reflection of the diverse range of habitats present at the Poor Handmaids site. While none of the units exhibited exceptional levels of natural quality, Units A, E, and G in particular contained multiple species with high C values indicating these areas contain, at the minimum, elements of high-quality habitats.

The 2019 bioblitz at the Poor Handmaids of Jesus Christ Ministry Center was widely regarded as a great success by the participants. Several team leaders expressed the opinion that they had captured a greater richness at this event than at previous such events. For the beetles, this was partly attributed to the new moon and warm conditions that created ideal night lighting

conditions. But it was more than timing and temperature. The Center contains a very heterogeneous mix of vegetation and land uses that form a mosaic that is more diverse than that found in most of the state of Indiana. The staff at the Center is to be commended for the stewardship they are performing.

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