

RESULTS OF THE 2017 RED-TAIL LAND CONSERVANCY BIODIVERSITY SURVEY, DELAWARE AND RANDOLPH COUNTIES, INDIANA

Donald G. Ruch¹: Department of Biology, Ball State University, Muncie, IN 47306 USA

Barry Banks: Founder and Executive Director Emeritus, Red-Tail Land Conservancy, 125 E Charles Street, #200, Muncie, IN 47305 USA

Robert Brodman: School of Science, Buena Vista University, Storm Lake, IA 50588 USA

Tim Carter: Department of Biology, Ball State University, Muncie, IN 47306 USA

Linda Cole: Brown County Indiana Naturalist, 635 Oak Run Drive, Nashville, IN 47448

Mathew Dittmann: Department of Entomology, Purdue University, West Lafayette, IN 47907 USA

Brant E. Fisher: Atterbury Fish and Wildlife Area, 7970 South Rowe Street, Edinburgh, IN 46124 USA

Jeffrey D. Holland: Department of Entomology, Purdue University, West Lafayette, IN 47907 USA

Kamal Islam: Department of Biology, Ball State University, Muncie, IN 47306 USA

Robert P. Jean: Environmental Solutions & Innovations, Inc., 1811 Executive Dr., Suites C-D, Indianapolis, IN 46241 USA

Megan McCarty: Department of Entomology, Purdue University, West Lafayette, IN 47907 USA

Paul D. McMurray, Jr.: 6231 West 300 South, New Palestine, IN 46163 USA

Marc Milne: Department of Biology, University of Indianapolis, 1400 East Hanna Ave., Indianapolis, IN 46227 USA

William L. Murphy: 7835 Tufton Street, Fishers, IN 46038 USA

Kirk Roth: Corradino, LLC, 200 S. Meridian Street, Suite 330, Indianapolis, IN 46225 USA

Stephen Russell: PhD Student, Purdue University, 820 Elm Dr., West Lafayette, IN 47906 USA

Carl Strang: 3S126 Briarwood Drive, Warrenville, IL 60555 USA

John Whitaker, Jr. and Angie Chamberlain: Department of Biology, Indiana State University, Terre Haute, IN 47809 USA

ABSTRACT. The Red-Tail Land Conservancy (RLC), the Indiana Academy of Science (IAS), the Robert Cooper Audubon Society, and the Oakwood Retreat Center hosted a biodiversity survey or bioblitz in east-central Indiana on the 10th and 11th June 2017. The event was held on two properties owned or maintained by RLC; i.e., White River Woods, a 47.4 ha preserved located 9 km southeast of Muncie, Indiana in Delaware County, and McVey Memorial Forest, a 100.4 ha forest located 11 km north of Farmland, Indiana in Randolph County. Over 75 scientists, naturalists, students, and other volunteers on 19 different taxonomic

¹ *Corresponding author:* Donald G. Ruch; 765-285-8820 (phone), 765-285-8804 (fax), druch@bsu.edu.

teams observed and reported 1086 taxa during the event. The nineteen taxonomic teams included ants, aquatic macroinvertebrates, bats, bees, beetles, birds, butterflies, odonates, fish, freshwater mussels, herpetofauna, small mammals, moths, mushrooms/fungi and slime molds, non-vascular plants (mosses), singing and non-singing insects, snail-killing flies, spiders, and vascular plants. State endangered species included the northern long-eared bat (*Myotis septentrionalis*; also federally threatened), the Indiana bat (*Myotis sodalists*; also federally endangered), the cerulean warbler (*Setophaga cerulea*), the osprey (*Pandion haliaetus*), and warty spurge (*Euphorbia obtusata*). In addition shell material of the federal and state endangered Northern Riffleshell (*Epioblasma torulosa rangiana*), Clubshell (*Pleurobema clava*), and Rayed Bean (*Villosa fabalis*) was found but none are still known live on either property. The spider team recorded six state records: *Embylna hentzi* (meshweaver), *Gladicosa bellamyi* (wolf spider), *Pirata triens* (pirate wolf spider), *Schizocosa mccooki* (wolf spider), *Oxyopes scalaris* (western lynx spider), and *Xysticus fervidus* (ground crab spider). In addition many Delaware County and Randolph County records were reported. This manuscript presents both a brief history of the bioblitz sites and a summary overview of the results. Detailed results are available on the IAS website.

Keywords: Bioblitz, biodiversity survey, White River Woods, McVey Memorial Forest, Red-Tail Land Conservancy, Indiana state records, Delaware County records, Randolph County records

INTRODUCTION

The Indiana Academy of Science's 2017 biodiversity survey, or bioblitz, was held on two properties owned or maintained by the Red-Tail Land Conservancy (RLC). The two sites were White River Woods (WRW) in Delaware County and McVey Memorial Forest (MMF) in Randolph County; the sites being approximately 24 km (15 mi) apart (Fig. 1). Since east-central Indiana, the home of the RLC, is located in the Central Till Plain Natural Region (Homoya et al. 1985), most of the non-urban land is agricultural. As a result, natural areas in the region are small, scattered, and usually isolated islands. Therefore, in order to have a site large enough to conduct a bioblitz, two natural areas were included.

The two sites have a combined area of 148 ha (365 ac). White River Woods, a 47.4 ha (117 ac) site (Fig. 2), lies 9 km (5.6 miles) southeast of downtown Muncie, Indiana and 480 m (0.3 miles) north of Prairie Creek Reservoir. McVey Memorial Forest, a 100.4 ha (248 ac) forest (Fig. 3), lies on State Road 1 approximately 11 km (7 mi) north of Farmland, Indiana. Edna McVey established this nature park in her will so that generations to come could enjoy it.

The biodiversity survey, the first held on RLC property, was conducted on 10–11 June 2017. The bioblitz attracted more than 75 scientists, naturalists, students, and others volunteering their time and expertise to make the event an enormous success. Food and lodging for the participants were provided through the generous support of the Red-tail Land Conservancy, the Indiana Academy of Science, the Robert Cooper Audubon Society, and the Oakwood Retreat Center.

This manuscript provides a brief history of the bioblitz sites and a summary of the biodiversity results. For additional details see the Red-Tail Biodiversity Survey Final Report (2018) on the Indiana Academy of Science website.

BRIEF HISTORIES OF MCVEY MEMORIAL FOREST AND WHITE RIVER WOODS

Red-tail Land Conservancy (RLC) is a 501(c)(3) land trust whose mission is to preserve, protect, and restore natural areas and farmland in east-central Indiana while increasing awareness of our natural heritage. RLC accomplishes its mission by offering conservation options to landowners and providing nature education programs and events to the general public. RLC was launched in March 1999. RLC's successes and accomplishments are well chronicled on its website at www.fortheland.org.

McVey Memorial Forest is a 100.4 ha (248 ac) wildlife sanctuary along Indiana Highway 1 South and adjacent to the Mississinewa River.

In 1958, Edna McVey set up a perpetual trust under the authority of the Randolph Circuit Court with a number of Successor Trustees appointed by the court over the years. In September 2012, the Randolph Circuit Court appointed RLC the Successor Trustee to McVey Memorial Forest.

The park shares a common property line with an IDNR Fish and Wildlife Preserve of 141.6 ha (350 ac) north of the Mississinewa River, making this the largest protected natural area in east-central Indiana. It is open to the public and has a trail system, shelter, and off-road parking. In 2017, RLC designed and installed a new trail



Figure 1.—Map illustrating the counties of Indiana. D = Delaware County; R = Randolph County. The dot in Delaware County indicates the location of White River Woods and the dot in Randolph County illustrates the location of McVey Memorial Forest. The two sites are approximately 24 km (15 mi) apart.

system on the northern section, north of CR 750N, which includes a third parking area and canoe launch on the river. The land types are quite diverse, with a riparian area along the Mississinewa River and Bush Creek, a mature upland wooded area dominated by shellbark hickory, and a 30 year-old planting of native hardwoods along the western side. Moreover, there are numerous wetland areas along the river and in the creek bottom.

The other 2017 bioblitz site is along the White River in Delaware County, just north of Prairie Creek Reservoir. This site permanently protects the east bank/riparian zone of 0.8 km (0.5 mi) stretch of the river along with a splendid 12.1 ha (30 acre) mature upland flatwoods that is open to the public with a trail system and parking lot. This site was brought to the attention of Barry Banks, founder and Executive Director of RLC, by

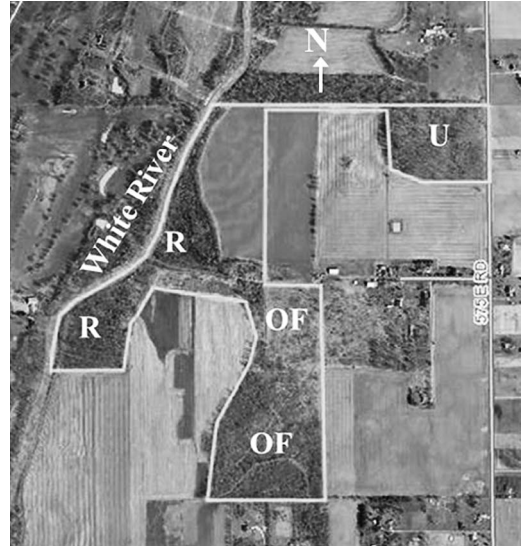


Figure 2.—White River Woods (outlined) is a 47.4 ha (117 ac) preserve located in Delaware County, Indiana. The White River runs along the west border. R = riparian woodlands; U = mesic upland forest; OF = old-fields in various stages of development. Figure modified from RLC image.

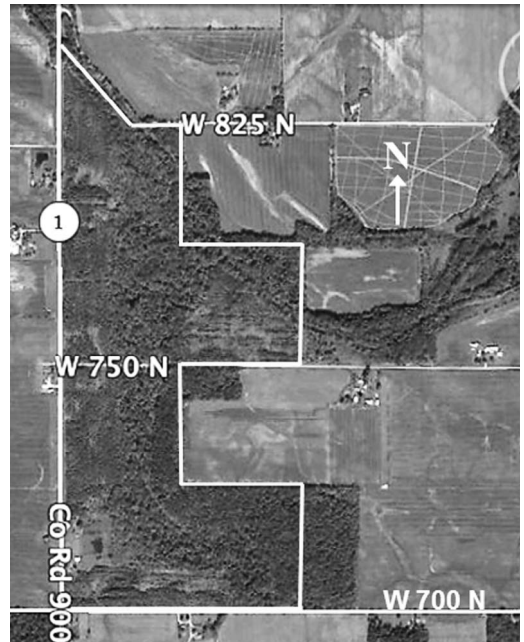


Figure 3.—McVey Memorial Forest (outlined) is a 100.4 ha (248 ac) primarily forested preserve located in Randolph County, Indiana. State Road 1 defines the western border, County Road W 700 N is the southern border, and the Mississinewa River runs along most of the northern border.

Rainbow Farm director Donna Blodgett in 2004. She invited Barry to walk the woods at a time when the riparian area was sporting acres of Virginia bluebells in full bloom. Barry was “thrilled” by the natural beauty of that flood plain. The entire farm was owned at that time by Emissaries of Divine Light. Following years of negotiation with that organization, in 2009 they decided to sell a number of their real estate holdings around the world. RLC is most fortunate to have had funding available via the Bicentennial Nature Trust and the Land Conservation Fund with which it purchased 47.4 ha (117 acres) in December 2014.

The Oakwood Retreat Center, who bought their campus from the Emissaries, co-hosted the participants of the 2017 bioblitz in their equipment storage barn. It was the perfect setting for the morning gatherings and evening wrap-ups of the dozens of natural scientists and volunteers who participated in this wonderful event.

SUMMARY GEOMORPHOLOGICAL ASSESSMENT OF WRW AND MMF

Matthew Purtill, Applied Anthropology Laboratories, Ball State University, graciously prepared the following geomorphological assessment of the sites. Both the McVey Memorial Forest and White River Woods are located upon, geologically speaking, a young landscape still adjusting to its glacial past. As little as 16,000 years ago, both areas would have been directly beneath the Late Wisconsin glacial ice sheet associated with the East White sublobe of the Huron-Erie Lobe. Both the White and Mississinewa Rivers that border the nature preserves have gravel-to-cobble dominated bedload, moderate sinuosity, low gradient, and moderate entrenchment ratios. These streams likely would be classified as a Type E or F stream following Rosgen methodology. LiDAR data reveal abundant relict braid bars and abandoned channels that reflect a time when both rivers were still transporting coarse bedloads associated with glacial outwash from retreating glaciers. MMF is situated on the edge of the Mississinewa Moraine that provides noticeable relief and well-drained soils. A prominent geomorphological feature at McVey is the remains of a large, now abandoned, meander bend of the ancient Mississinewa River. This infilled channel scar extends through the central portion of McVey and is characterized by gleyed soils indicative of high water-holding soil capacity. This meander undoubtedly provides a localized micro-habitat for modern plants and

animals. Modern-day Bush Creek flows through a portion of this abandoned meander before it enters the Mississinewa River. Based on meander scars readily visible, and review of 1960s USGS topographic maps, it is apparent that portions of Bush Creek that run through McVey have been artificially straightened sometime over the last 50 years. Possible alteration in hydrology and erosion due to stream straightening were not studied.

CULTURAL RESOURCES ASSESSMENT OF THE MCVEY MEMORIAL FOREST

James Martin and J. Ryan Duddleson, Orbis Environmental Consulting, kindly provided the following cultural resources assessment of MMF. Volunteers from Orbis Environmental Consulting conducted an above ground survey for potential archaeological and historical resources in the MMF. The team identified known cultural resources such as a pioneer cemetery but also located the original location of County Road West 750 North as it once followed the Mississinewa River. This original layout of the county road also crossed Bush Creek and the team found the remains of a bridge there. Historic records show an old pioneer town, known as Steubenville, in the McVey Forest. Our survey did not observe any remnants of historic structures in this area, but this location contains recently planted trees which might obscure historic foundations and/or artifacts. Additional survey may locate remnants of this former town. There also are known prehistoric archaeological sites within the forest property and the team was able to identify numerous areas in the forest that are likely to contain additional unidentified prehistoric sites.

SUMMARY OF RESULTS AND METHODS

The Red-Tail Land Conservancy bioblitz attracted over 75 scientists, naturalists, students, and other volunteers. Nineteen taxonomic teams reported 1086 taxa (Table 1). This two-day survey provided a floral and faunal “snapshot in time” of the natural resources at these sites and exposed the remarkable species richness present. Of course to obtain a complete picture of the biodiversity present at these sites, long-term seasonal surveys are necessary. An overview of the results from the nineteen taxonomic teams follows; see Table 1 for a summary. To view the complete results, visit the Indiana Academy of Science website at <https://>

www.indianaacademyofscience.org/, lay the cursor over Resource Center at the top of the page, click BioBlitz Events and Data, then select Red-Tail Conservancy BioBlitz complete report.

Ants.—There were no surprises in the ant species found at the sites, with all of them being either found across the country or in the eastern United States specifically. The taxa found at both sites tend to be either generalist species or ones that prefer forested environments, but there were some exceptions. *Lasius alienus* prefers open fields and the presence of agricultural fields surrounding both survey sites likely explains its presence. Similarly, *Tapinoma sessile* thrives in disturbed habitats, so its presence at the White River site is unsurprising. The rest of the species occupying the White River site all tend to be more tolerant of the shrub and woodland ecosystems present there, while the species present solely at the McVey site all favor older, more pristine wooded habitats.

Aquatic macroinvertebrates.—A 500 µm mesh D-frame aquatic dipnet was used to collect samples from riffles, then all additional in-stream habitats in a 50 m section of the stream at each site were sampled. Samples were combined, elutriated through a 500 µm mesh sieve and then picked in the field for 20 minutes. Collected specimens were identified to lowest practical taxon by use of standard texts (Merritt et al. 2008; Thorp & Covich 2001).

Aquatic macroinvertebrates were collected from three locations, two in MMF and one in WRW. The first site, located on the White River at WRW, was approximately 500 m west of the Oakwood Retreat Center barn. At this location the White River was ~ 15 m wide in the riffle, widening to 25 m in the slower run areas. Substrate within the sampled area was composed primarily of gravel, small cobble, and sand with several submerged logs, emergent vegetation, and root wads located within 1 m deep pools along the east bank. The sample collected at this location on the White River was the most diverse with 67 taxa, including 17 taxa of the Ephemeroptera, Plecoptera, and Trichoptera (EPT; mayflies, stoneflies, and caddisflies). In terms of the macroinvertebrate diversity, this sample contained a greater number of taxa than 98% of the macroinvertebrate samples collected by the Indiana Department of Environmental Management (IDEM) using this method from 2004–2013 (Todd Davis,

IDEM Office of Water Quality, Pers. Comm., 11 August 2017); this site also ranked in the top 5% of IDEM samples in number of EPT taxa collected.

The second site, located on the Mississinewa River, was ~ 150 m north of the parking area located on County Road West 750 North in MMF. At this location the Mississinewa River was ~ 15 m wide in the riffle, widening to 30 m upstream and downstream of the riffle. Substrates within the sampled area were composed of cobble, gravel, and a greater amount of silt than was seen at the White River site. Pools were not present but there was a larger accumulation of woody debris on the shoreline. The sample at this location was relatively diverse with 50 taxa including 11 EPT taxa.

The third site, located on Bush Creek at MMF, was ~ 50 m north of the County Road West 700 North bridge crossing. Brush Creek was much smaller than the other sites, narrowing from eight to two m wide over the length of the sampled zone. Substrate in this stream was composed entirely of sand with some gravel and silt in depositional areas and almost no additional habitat types. The macroinvertebrate community was reduced at this site with only 27 taxa with three EPT taxa.

In summary, a total of 573 individuals were collected and identified, representing 91 macroinvertebrate taxa. None of the taxa are known to be species of special concern in Indiana.

Bats (order Chiroptera, family Vespertilionidae).—Using mist nets to capture bats, Tim Carter sampled the White River at WRW and Jeremy Sheets sampled the Mississinewa River at MMF. Tim Carter reported three species, i.e., Indiana bat (*Myotis sodalis*), little brown bat (*M. lucifugus*), and big brown bat (*Eptesicus fuscus*). Jeremy Sheets reported three species, i.e., big brown bat (*E. fuscus*), hoary bat (*Lasiurus cinereus*), and eastern red bat (*L. borealis*). Additionally, the historical records of bat collections (2009 and 2015) from MMF were examined. Including the three species reported by Jeremy Sheets above, a total of eight species have been reported. The additional five species were the Indiana bat (*M. sodalis*), little brown bat (*M. lucifugus*), northern long-eared bat (*M. septentrionalis*), evening bat (*Nycticeius humeralis*), and Seminole bat (*Lasiurus seminolus*).

Both of these sites support a wide array of bat species. Indiana bats are a federally endangered species and have been documented at both

Table 1.—Summary of the 1086 taxa reported at the 2018 Red-Tail Land Conservancy Biodiversity Survey, Delaware and Randolph Counties, Indiana. WRW = White River Woods; MMF = McVey Memorial Forest.

Team	Leader	Taxa found
Ants	Mathew Dittmann	15 species, all common
Aquatic macroinvertebrates	Paul McMurray	91 taxa, none of special concern in Indiana
Bats	Tim Carter	WRW: 3 species (1 federally endangered species, 1 federally threatened species); MMF: 3 species during the bioblitz and 8 species (including the 3 noted during the bioblitz) at MMF from historical records
Bees	Robert P. Jean	36 species (32 from WRW and 20 from MMF); 18 Delaware County and 19 Randolph County records
Beetles (Coleoptera)	Jeffrey D. Holland	92 taxa, none unusual or unexpected
Birds	Kamal Islam	78 species (47 common to both sites); highlights included cerulean warbler and osprey (both state endangered species), bald eagle (state species of 'Special Concern'), bobolink and dickcissel (species with declining populations rangewide), and 34 species of long-distance migrants that winter in Central and South America and breed in Indiana
Butterflies	Kirk Roth	22 species; 4 Delaware and 5 Randolph County records; range extension south for the eyed brown (<i>Lethe eurydice</i>)
Odonates (dragonflies and damselflies)	Kirk Roth	28 species of odonates (18 dragonflies and 10 damselflies); 14 Delaware County and 15 Randolph County records
Fish	Brant E. Fisher	47 species (42 species from MMF and 37 from WRW); 2 non-native species; no state listed fish species were collected
Freshwater mussels	Brant E. Fisher	25 species; evidence of 3 federal/state endangered species and 3 species of state special concern were reported; although a relatively diverse freshwater mussel community still persists, both sites have lost around a third of their historic diversity.
Herpetofauna	Robert Brodman	12 species (5 reptile and 7 amphibian species); 2 Delaware County and 4 Randolph County records; 2 species of special concern.
Small Mammals	John Whitaker, Jr. & Angie Chamberlain	7 species, all common
Moths (Lepidoptera)	Megan McCarty	51 taxa (including 38 species, 3 to genus, and 10 unidentified); none unusual or unexpected
Mushrooms	Stephen Russell	56 species in total from both sites representing 46 genera, mostly wood rot fungi; interesting finds included the mushrooms <i>Rhodotus palmatus</i> , <i>Pluteus americanus</i> , and the slime mold <i>Reticularia (Enteridium) lycoperdon</i> , only the second report of this species from Indiana
Non-vascular plants	Linda Cole	30 species (29 mosses and 1 liverwort); 16 species occurred at both sites; the mosses are characteristic of shaded, moist, calcium-enriched sites
Singing and non-singing insects	Carl Strang	11 species (4 species of singing insects and 7 species of non-singing insects), all common
Snail-killing flies (Diptera: Sciomyzidae)	William L. Murphy	11 species: 2 species from the tribe Sciomyzini, 9 species from the tribe Tetanocerini; 6 Randolph County records; total number of Sciomyzidae species now known from Randolph County, 19.
Spiders	Marc Milne	81 taxa; 6 state records

Table 1.—Continued.

Team	Leader	Taxa found
Vascular plants	Donald Ruch	476 taxa (406 at MMF and 289 at WRW; 218 taxa occurring at both sites, 71 only at WRW, and 187 only at MMF); 22 potential Delaware County records and 24 potential Randolph County records; 1 endangered species, <i>Euphorbia obtusata</i> , at WRW.

locations. Northern long-eared bats are a federally Threatened species and have been documented at McVey and are, or were likely present at White River. The capture of a Seminole bat at McVey in 2015 is a very unusual occurrence. This species is typical of the southeastern US and its range is usually the Gulf Coast States and SE Atlantic States. This is only the second record from Indiana of which we are aware.

The bat community in this region has been severely impacted by the disease White-Nose Syndrome (WNS). Historic netting efforts in McVey in 2009 prior to WNS resulted in 70 bats in two nights. Those same sites were trapped post WNS in 2015 and only 13 bats were captured. Netting at WRW in 2017 resulted in only four bat captures in two nights. Both McVey and White River represent excellent bat habitat, including excellent roosting and foraging habitat for all bats. The rivers are in good condition with strong insect communities. Both sites will likely continue to support remnant populations of bat species that are affected by WNS and strong populations of bats not affected.

Bees.—Bee sampling was conducted on 27 June 2017. Bee surveys were performed at a later date than other taxonomic groups due to scheduling conflicts and weather conditions. Bees were collected using passive (bowl trapping) and active (netting at flowers) sampling techniques. WRW was passively sampled using 30–12 oz bowls (ten white, ten fluorescent blue, and ten fluorescent yellow) separated by 5 m each in random color order (for a total of 60 bowls) along two-75 m transects. One transect was setup in an old field area with several flowering species and the other was positioned along a forest edge with flowers present. MMF was sampled with a single 75 m transect comprised of 30 bowls along the open grassy area near the pond. Bowls were placed out in the morning and then collected in the late afternoon. Each site was net collected for approximately 3 hours for a total 6 hours

across both sites. Voucher specimens are housed in the Environmental Solutions & Innovations, Inc. (ESI) entomology collection in Indianapolis.

Thirty-six species, ~ 8% of the Indiana bee fauna, representing all five common bee families in Indiana were collected. Overall floral diversity was moderate and bee activity was low. Flowering was mainly concentrated in openings, forest edges, old fields, and a prairie restoration (MMF) and these were the focus of the net collections. Thirty-two bee species were collected at WRW of which 18 were Delaware County records. Twenty bee species were collected at MMF of which 19 were Randolph County records (as only one bee species had been vouchered from Randolph County in the past).

In total, 36 bee species were collected from both sites with 16 species collected only in Delaware County and 4 species collected only in Randolph County. Overall bees in the families Apidae and Halictidae represented a large portion of the species richness (13 spp. and 16 spp. respectively) and much of the bee abundance (44% and 49% respectively; 93% collectively). Interesting species include *Andrena persimulata* Viereck, 1917, *Andrena wilmattae* Cockerell, 1906, and *Melissodes illatus* Lovell and Cockerell, 1906 all of which have been rarely recorded in Indiana. Overall, even with the relatively low diversity, a combined 37 new county records were noted demonstrating these areas had been little collected in the past. There were two introduced bee species, including the honey bee (*Apis mellifera* Linnaeus, 1758) and the giant resin bee, *Megachile sculpturalis* Smith, 1853. For the latter species these are among the first records of this species using natural areas in the state as it is often found in urban settings. In addition, this is one of the first published records of the *M. sculpturalis* for the state although it has been collected in a few other counties and has been suspected of occurring throughout the state.

These collections demonstrate the importance of WRW and MMF for bee conservation and



Figure 4.—Beetle team at work after sunset. (Photo by John Taylor)

habitat and they help fill in some areas of the state that have been very poorly collected in the past. Further management to increase native wildflower diversity, expand prairie plantings, maintain some openings, and reduce invasive plant species will enhance bee populations even further. It should be noted that the forests in these areas likely provide valuable nesting and overwintering resources for native bees and likely provide floral resources for bees in the spring when flowering is lower in other habitats. Collections in these areas in spring and fall will likely add many more species and should be considered to establish a baseline for these important pollinators.

Beetle (Coleoptera).—The Coleoptera were surveyed using a variety of methods. Two flight intercept type traps were left for a week to collect beetles at both sites. The traps at each site consisted of a clear acrylic plastic window trap and a black panel trap (Advanced Pheromone Technologies, Inc., Marylhurst, USA) at each site. An ethanol lure was used in all traps. Beetles also were collected at a 175 W mercury vapor light at MMF during 9–12

PM Saturday evening (Fig. 4). During the day on Saturday and Sunday morning, the beetle team hand collected, aspirated small beetles from plants, and used sweep nets to sample beetles from vegetation.

Ninety-two taxa (species or genera) were detected during the beetle surveys. These came from 29 different beetle families. None of the species were unusual or unexpected. By far, the most abundant species seen was a soldier beetle, *Chauliognathus pensylvanicus*. This species was very abundant on the flowering vegetation at both sites. One very attractive specimen was the six-spotted tiger beetle (*Cicindela sexguttata*; Fig. 5) observed at WRW. Voucher specimens have been deposited in the Purdue Entomological Research Collection.

The number of species detected is slightly lower than expected for this amount of collecting effort. Mid-June is a very good time of year for beetle collecting with many species active in Indiana. The low number of species is likely due to the location of the conservation areas that were surveyed. The surrounding landscape is dominat-



Figures 5–10.—Images of various organisms observed during the Red-Tail Land Conservancy biodiversity survey. 5. Six-spotted tiger beetle (*Cicindela sexguttata* Fabricius; family Carabidae) observed at White River Woods. (Photo by John Taylor) 6. Eyed Brown (*Lethe eurydice*) at White River Woods which represents a range extension for the species. (Photo by Kirk Roth) 7. Handsome Clubtail (*Gomphus crassus*) photographed at McVey Memorial Forest. (Photo by Paul McMurray) 8. Northern watersnake (*Nerodia sipedon*) in the White River. (Photo by Paul McMurray) 9. Green-striped grasshopper (*Chortophaga viridifasciata*) at McVey Memorial Forest. (Photo by Carl Strang) 10. A species of marsh fly, *Limnia boscii* (Robineau-Desvoidy), was the most abundant species of Sciomyzidae collected from the margin of the pond at McVey Memorial Forest. (Photo by Steve Marshall, used with permission)

ed by intensive row crop agriculture. This makes colonization of the habitat less likely, leading to a reduction in the number of species. As well, much of the forested area is recent second-growth forest.

The actual forest area was much smaller 40 years ago, thus the beetle fauna likely represents what would be found in a small, isolated forest and may increase over time.

Birds.—Seventy-eight species of birds were recorded during the 2-day event with 47 species common to both properties. Reports of birds from individuals participating on other taxonomic teams were included in the final tally. All birds observed or heard appeared to be on territory and were considered potential breeders. Highlights of the count included Cerulean Warbler and Osprey (both state endangered species), Bald Eagle (state species of ‘Special Concern’), Bobolink, and Dickcissel (species with declining populations rangewide), and 34 species of long-distance migrants that winter in Central and South America and breed in Indiana.

On 10th June, the bird team birded MMF. A total of 66 bird species were detected. Highlights of this count included all 6 resident species of woodpeckers, two long-distance grassland/fallow field specialists (Bobolink and Dickcissel), six species of migratory flycatchers, and eight species of long-distance migratory warblers. The most surprising find was a male singing Cerulean Warbler on territory; this species has declined by over 70% throughout its rangewide distribution during the last five decades and its stronghold in Indiana is restricted to the southern forested parts of the state. On 11th June, the team surveyed WRW along mowed pathways and trails. A total of 59 species of birds were recorded. Notable species included Osprey and Bald Eagle. A Rose-breasted Grosbeak was observed singing on territory; normally, this species breeds further north in the state.

More species (66) and more individuals (465) were observed at MMF than at WRW (59 species, 276 individuals). This discrepancy in number of species recorded and individuals counted between the two properties is likely a result of a difference in acreage rather than effort. In addition, MMF has a much larger contiguous block of mature forest with Bush Creek meandering its way into the Mississinewa River. Along Bush Creek and other areas of the property, several mature forest dependent species were detected and these species were largely absent at WRW, such as Yellow-billed Cuckoo (3 vs. 0), Yellow-throated Vireo (5 vs. 0), Red-eyed Vireo (18 vs. 3), Ovenbird (1 vs. 0), Kentucky Warbler (1 vs. 0), American Redstart (1 vs. 0), Cerulean Warbler (1 vs. 0), and Scarlet Tanager (2 vs. 0).

Forty-seven species were found at both properties consisting of many edge species or generalists such as Mourning Dove, Warbling Vireo,

House Wren, American Robin, Common Yellowthroat, Yellow-breasted Chat, Field Sparrow, and Indigo Bunting among others. Five species with the highest count were Red-winged Blackbird (62), Indigo Bunting (37), European Starling (37), Canada Goose (28), and Brown-headed Cowbird (25). European Starlings are an introduced commensal that have successfully colonized North America. The Brown-headed Cowbird, a known brood parasite, has also benefitted from human modification of the landscape, especially with the removal of forests for agriculture.

Butterflies.—Species diversity of butterflies was similar at both sites with 15 species at MMF and 19 species at WRW (22 total species from both sites). However, WRW had more individual butterflies detected (182) compared to MMF (101), likely due to greater sampling effort. Abundant species at both sites included Silver-spotted Skipper (*Epargyreus clarus*), Cabbage White (*Pieris rapae*), Summer Azure (*Celastrina neglecta*), and Red Admiral (*Vanessa atalanta*). It is notable that the date of the bioblitz was between or before the main flights of several skipper species (Belth 2013), which may explain why only three species of skipper were detected. A surprising absence was that of Pearl Crescents (*Phyciodes tharos*), which are often abundant and easily found during butterfly surveys.

The most unexpected find was an Eyed Brown (*Lethe eurydice eurydice*) at WWR (Fig. 6); it was several counties south of its expected range in Indiana (Belth 2013). One individual was found in an open seep dominated by *Carex stricta*, its larval host plant. The Eyed Brown is typically a northern species, so it is possible that this represents a remnant population, or simply that a small number have dispersed to Delaware County. This record indicates that other areas of *Carex stricta* in Indiana should be checked for this species in June and July.

Other notable species found during the butterfly survey were the White-M Hairstreak (*Parrhasius m-album*) at WRW and four Banded Hairstreaks (*Satyrium calanus*) at each location. The White-M Hairstreak is a canopy dwelling species, which is rarely observed closer to convenient observation level. Hairstreaks in general are often localized in distribution, so these sites may represent important local habitat for them. The Eyed Brown and both hairstreaks represent county records for each county in which they occurred. Other county

records include Zabulon Skipper (*Poanes zabulon*) in Randolph, Delaware Skipper (*Anatrytone logan*) and Hackberry Emperor (*Asterocampus celtis*) in Randolph, and Northern Pearly-eye (*Lethe anhedon*) in Delaware and Randolph counties. These likely represent lack of sampling rather than rarity, as these four species are not uncommon.

Odonates (dragonflies and damselflies).—A total of 28 species of odonates, comprised of 18 dragonflies and 10 damselflies, were detected during the bioblitz, with 20 species at each property. Numbers of individuals were similar at both locations, with 122 at MMF and 108 at WRW. Abundant species at both locations included Widow Skimmer (*Libellula luctuosa*), Twelve-spotted Skimmer (*Libellula pulchella*), Ebony Jewelwing (*Calopteryx maculata*), and Blue-tipped Dancer (*Argia tibialis*).

The diversity of aquatic habitats at both sites is a likely driver of the odonate diversity observed, as species composition was typical of standing and running waterways. The pond at the southern end of MMF was an excellent location for skimmer species (Libellulidae), as may be expected from a large, isolated, and shallow pond. Both sites have extensive running waterways which provide excellent habitat for the many damselflies identified during the bioblitz. However, many larger and interesting species were found in upland habitats, including Swamp Darner (*Epi-aeschna heros*), Handsome Clubtail (*Gomphus crassus*; Fig. 7), Illinois River Cruiser (*Macromia illinoensis*) on both sites; Arrowhead Spiketail (*Cordulegaster obliqua*) at MMF; and Ruby Meadowhawk (*Sympetrum rubicundulum*) and Spot-winged Glider (*Pantala hymenaea*) at WRW. Delaware and Randolph Counties are not well represented for odonate collection (see Curry 2001) so most species encountered represented county records, i.e., 14 Delaware County and 15 Randolph County records. Most of these were photographed, and records will be documented at the Odonata Central website (Abbott 2006–2017).

Fish.—A total of 47 species of fish were collected from the four sites sampled in WRW (one site on the West Fork White River) and MMF (one site on the Mississinewa River and two sites on Bush Creek). Fish diversity was slightly higher within MMF, with 42 species collected compared to 36 from WRW. Eleven species were unique to MMF, including Steel-color Shiner (*Cyprinella whipplei*), Western



Figure 11.—Channel Catfish (*Ictalurus punctatus*) collected from the West Fork White River, White River Woods. Drew Holloway with the Muncie Bureau of Water Quality is holding the fish. (Photo by Brant Fisher)

Creek Chubsucker (*Erimyzon claviformis*), Spotted Sucker (*Minytrema melanops*), Black Bullhead (*Ameiurus melas*), Tadpole Madtom (*Noturus gyrinus*), Brindled Madtom (*N. miurus*), Rainbow Trout (*Oncorhynchus mykiss*), Orangespotted Sunfish (*Lepomis humilis*), Least Darter (*Etheostoma microperca*), Slenderhead Darter (*Percina phoxocephala*), and Freshwater Drum (*Aplodinotus grunniens*). Western Creek Chubsucker, Spotted Sucker, Black Bullhead, and Tadpole Madtom do inhabit areas of the upper West Fork White River drainage, but with the limited aquatic habitat to sample in the WRW property, they were not encountered. Of the five species unique to WRW, i.e., River Chub (*Nocomis micropogon*), Silver Shiner (*Notropis photogenis*), Rosyface Shiner (*N. rubellus*), Mimic Shiner (*N. volucellus*), and Channel Catfish (*Ictalurus punctatus*), only the Channel Catfish (Fig. 11) would be possible from the MMF property; the other four minnow species are not known from the upper Mississinewa River drainage. Of the remaining 31 species found on both properties, 26 were found at least three of the four sites sampled and would be considered common inhabitants of central Indiana streams. No state listed fish species were collected from either property.

Freshwater mussels.—Evidence of 24 native species of freshwater mussels and one non-native mollusk (Asian Clam – *Corbicula fluminea*) was found from the five sites sampled in WRW (one site on the West Fork White River) and MMF (two sites on the Mississine-

wa River and two sites on Bush Creek). While fourteen native species of freshwater mussels were found live/fresh dead on both properties, Mucket (*Actinonaias ligamentina*), Spike (*Elliptio dilatata*), Wavyrayed Lampmussel (*Lampsilis fasciola*), and Rainbow (*Villosa iris*) were only found live in WRW. None of these four species are still found live anywhere in the upper Mississinewa River drainage. Live/fresh dead White Heelsplitter (*Lasmigona complanata*), Giant Floater (*Pyganodon grandis*), Mapleleaf (*Quadrula quadrula*) and Paper Pondshell (*Utterbackia imbecillis*) were only collected from the MMF property. Giant Floater and Paper Pondshell are known to be live in the upper West Fork White River drainage near the WRW property and could be found there in future surveys. Shell material of the federal and state endangered Northern Riffleshell (*Epioblasma torulosa rangiana*), Clubshell (*Pleurobema clava*), and Rayed Bean (*Villosa fabalis*) was found but none are still known live on either property. Two live individuals and additional fresh dead shell material of the Wavyrayed Lampmussel, a state species of special concern, were collected from the WRW property; only weathered shell material was found on the MMF property and it is likely not live there. Weathered shell material of two additional state species of special concern, Kidneyshell (*Ptychobranthus fasciolaris*) and Purple Lilliput (*Toxolasma lividum*), was found on both properties, but neither is likely still live. Overall, a relatively diverse freshwater mussel community, compared to other central Indiana streams, still persists on both the WRW and MMF properties, even though both have lost around a third of their historic diversity.

Herpetofauna.—Amphibians and reptiles were surveyed by a combination of methods. Terrestrial and wetland habitats were sampled by visual searches and sampling cover objects. Calling frogs were identified and wetlands were sampled by dip-nets for larvae. Turtles and amphibian larvae were also sampled by turtle traps and minnow traps in wetlands, ponds, and the river. Effort was evenly split between the two sites.

The herp team found a total of 53 herpes from 12 species including 25 reptiles representing 5 species and 28 amphibians representing 7 species. Two species (*Lithobates catesbeianus* and *Lithobates clamitans*) are listed by Minton (2001) as

present but had never been vouchered in Delaware County. Two species (*Acris blanchardi* and *Anaxyrus americanus*) are listed by Minton (2001) as present but had never been vouchered in Randolph County. Two species (*Graptemys geographica* and *Hyla versicolor*) represent new Randolph County records. *Acris blanchardi* is a species of special concern in Indiana and has declined greatly throughout the northern half of its geographic range. They were common at each wetland and pond surveyed at MMF. *Rana pipiens* is also a species of special concern. Although common, a northern watersnake (*Nerodia sipedon*; Fig. 8) was seen in the White River.

Voucher photos of *Graptemys geographica*, *Acris blanchardi*, *Hyla versicolor*, *Anaxyrus americanus*, *Lithobates catesbeianus*, and *Lithobates clamitans* are kept by Dr. Robert Brodman and Herp Mapper. A specimen of *Acris blanchardi* is deposited in the Indiana State Museum.

Small mammals.—Sixteen lines consisting of 50 snap-traps were set in WRW and maintained during the time period June 12–17, 2017. This work comprised 3400 trap nights and approximately 192 person-hours. Only three species of small mammals were taken in traps. Several mole burrows, chipmunks, raccoons, and a woodchuck were observed. In all, seven species of small mammal were reported. These numbers were lower than expected; mostly because of human interference. Four lines were run over, one line was flooded, one line was mowed, and most of the traps of one line were pulled out of the woods and deposited into the adjacent lane. We classed the habitats at WRW into four types, i.e., nine lines in grassy weedy fields, five lines along the edge of woods, one line in the woods, and one line in a marshy field.

The diversity with regard to species caught was low with only three species taken, i.e., white-footed mouse (*Peromyscus leucopus*), northern short-tailed shrew (*Blarina brevicauda*), and the meadow jumping mouse (*Zapus hudsonicus*). Species expected but not captured included the prairie deer mouse (*Peromyscus maniculatus bairdii*), meadow vole (*Microtus pennsylvanicus*), prairie vole (*Microtus ochrogaster*), and perhaps the masked shrew (*Sorex cinereus*). Species less likely to occur but possible are the least shrew (*Cryptotis parva*) and the bog lemming (*Synaptomys cooperi*).

Moths (Lepidoptera).—Moths were surveyed using lights (ultraviolet and mercury vapor

lights) and white sheets from the beetle team. Surveying took place on June 10th from 8:30 pm to midnight in a forested area at MMF. Voucher specimens were collected and will be housed in the Purdue Entomological Research Collection.

A total of 51 taxa of moths (50 identified to at least family level) were collected. Nine different families of moths were recorded, but Geometridae (geometer moths or inchworm moths) made up the bulk of the specimens present at the light sheets. Geometridae was the most diverse family recorded, having 15 of the 51 taxa observed. The second most abundant family present (in terms of individuals) was Erebidae, with the majority of the moths belonging to the subfamily Herminiinae (litter moths). A total of seven eretid species was recorded. The abundance of these two groups was expected, given that they are commonly found in forested areas. However, eretid moths in the genus *Catocala* were surprisingly absent, since they are a very diverse group with a preference for forested habitat. Other families found include Tortricidae (8 taxa), Limacodidae (3 species), Crambidae (6 taxa), Pyralidae (2 species), Saturniidae (1 species), Sphingidae (1 species), Notodontidae (1 species), and Noctuidae (5 species). There were two “micro” moth specimens that could not be identified to family level.

Mushrooms (fungi and associates).—Team Fungi went out Saturday, June 10th, and encountered 68 observations of 54 different species at two different sites, i.e., the woodlands to the mesic upland woods in the northwest corner of WRW and the woodland at MMF. These species ranged across 45 genera. There were few mushrooms growing from the ground at the time of year this event was held, but a fair number of lignicolous species were encountered. Of particular interest was *Rhodotus palmatus*, known as the netted rhodotus or wrinkled peach. It is one of the most stunningly beautiful mushrooms in North America, featuring a pinkish cap with a veined/ridged surface. It was observed at five locations across the two survey sites. In addition, an interesting *Pluteus* (genus of wood-loving, pink-spored mushrooms), named *P. americanus*, was found. It is one of the few *Pluteus* species known to contain psilocybin, a hallucinogenic chemical.

Another interesting specimen found during this survey was *Reticularia (Enteridium) lycoperdon*, a slime mold known as a “false puffball.” There is only one other record of this species from Indiana,

with no current collections in fungaria. Slime molds are no longer classified as true fungi, but we report them as they are generally only studied by mycologists. Another species of note is *Tyromyces galactinus*; there is only one other record of this species in fungaria, dating back to 1917 in Sullivan County. Many collections of *Tyromyces* are documented under the name *Tyromyces chioneus*, a common species in field guides. However, the DNA results indicate that *Tyromyces galactinus* is the most common member of the genus found in Indiana and that many, if not most collections of *T. chioneus*, are likely misidentified specimens of *T. galactinus* (the present specimens included). We will be publishing updated information about this species group in future years. A final interesting find was *Hohenbuehelia angustata*, a genus that is often misidentified as belonging to *Crepidotus* or *Pleurotus* (oyster mushrooms). Despite being somewhat common across the state (pers. observ.), there is only one other record of this species in fungaria dating back to 1925 from Turkey Run State Park.

Physical specimens were collected and dried for 39 of the observations at this event. These specimens are housed at Purdue University’s Kriebel Herbarium (PUL). All of the specimen records have been uploaded to MyCoPortal (www.mycportal.org), a consortium containing the records of North American fungaria. These records contain additional specimen information including PUL accession numbers. Color images for the species encountered at the bioblitz can be found on MyCoMap (www.mycomap.com). Lastly, 25 of the specimens from this event underwent DNA sequencing of the ITS region, and these DNA sequences and their GenBank accession numbers have been made publicly available through GenBank (www.ncbi.nlm.nih.gov/genbank). Several of these sequences represent the first time a DNA sequence for the species has been made publicly available. These include *Agrocybe acericola* (MG748577), *Gymnopus spongiosus* (MG748574), and *Mycena niveipes* (MG748570). A species name has not been finalized for the *Inocybe* (MG748575), but this record also represents the first time a sequence for the species has been made publicly available. Most of the other sequences that were generated represent the first publicly available DNA records for the species from Indiana.

Non-vascular plants (bryophyte).—The sampling of the bryophyte community on the bioblitz properties demonstrates a suite of

bryophytes suited to moist, enriched soils of temperate deciduous flatwoods. This Central Till Plains terrain has been scoured down, valleys filled, and the whole surface much smoothed over in a random mix of till. Along with wind-blown dust from pulverized stone and 10,000 years of humus from the decay of grasses, trees, and herbaceous vegetation, and with the help of bryophytes, nature has created this swath of nearly flat, fertile landscape which contains the WRW and MMF preserves. The specimens were collected in approximately three hours of field work followed by seven hours of microscopic study. The collection process was limited by thick cover by vascular plants, conditions that restricted access and visibility of ground-level bryophytes. Such a survey would ideally be conducted in early spring before tall foliage obscures the bryophytes. Nevertheless, a substantial number of species were obtained from trees, stumps, rotting logs and humus, many of which are indicative of moist, calcium enriched mesic flatwoods.

It is interesting to note that mosses collected from humus growing under the massive growth of vascular vegetation appeared healthy and robust even though only about 3% of available sunlight reaches the forest floor in some areas; and the moist, shaded substrates provide cooler habitats that bryophytes prefer. Although a few mosses access water and nutrients from the ground via primitive vascular systems (i.e., Polytrichaceae), only one of those acrocarps, *Atrichum undulatum*, was present, occupying more open areas of the moist forest floor.

Both preserves were comparable in species diversity and composed generally of mosses characteristic of shaded, moist, calcium enriched sites. A total of 30 species were identified, including 29 species of mosses and one species of leafy liverwort. Twenty-four species were identified from MMF, while 22 species were identified from WRW. Sixteen of the 30 total species occurred at both sites. No rare species or any species considered indicators of acid, nutrient deficient soils were encountered. Most notably in this particular survey were the beautiful *Plagiothecium* mosses appearing to grow in abundance. These glossy, yellow-green, calciphilous pleurocarps, also known as "silk mosses", were found frequently hugging the dark substrates of decaying logs. Also worth noting was a healthy specimen of *Anomodon attenuatus* growing on

an oxidized metal stake sunk into the ground, which begs the question, "What is a calciphile doing here?" Perhaps it only goes to show the remarkable ability of mosses to tolerate and adapt to substrates that would be impossible for vascular plants, maintaining their unique purpose evolved biochemically over millions of years. Certainly each species of moss is a variation on a theme, a unique creation designed for success in tiny niches in virtually every ecosystem. Therefore, knowing mosses adds depth and intimacy to our knowing the world.

Singing and non-singing insect.—The timing of the 2017 bioblitz was early in the singing insects' season, as most species do not mature until mid- to late-summer. The four species identified all are common and expected, i.e., spring trigs (*Anaxipha vernalis*) abundant at both sites, the non-native Roesel's katydid (*Roeseliana roeselii*) at WRW, and the green-striped grasshoppers (*Chortophaga viridifasciata*; Fig. 9) and protean shieldbacks (*Atlantiscus testaceus*) at MMF. There was an additional species of katydid singing at McVey that I was unable to see for identification. It had the pattern of a meadow katydid, with one or two quick ticks attached to the beginning of a buzz, but did not exactly match any species of my acquaintance. They may have been newly matured common meadow katydids, which had not fully developed their songs and were singing at a higher frequency than they will have when fully mature. The lack of spring field crickets, not only at the sites but in the area generally, was a surprising absence. Seven species of non-singing insects were observed.

Snail-killing flies (Diptera: Sciomyzidae).—All specimens were collected over the course of two days by use of a sweep net from the margin of a pond at the southern end of MMF, in full sunlight. As expected, no sciomyzids were found in vegetation adjacent to either the Mississinewa or White rivers, where the muddy banks had been scoured by spring floods. The mature woodlands in both areas undoubtedly contain *Euthycera flavescens* (Loew) and *Trypetoptera canadensis* (Macquart), the larvae of which prey on land snails. Both species are found throughout Indiana in deciduous forests. In North America, *E. flavescens* has been found feeding within the land snails *Mesodon inflectus* (Say), *Stenotrema hirsutum* (Say), and *Ventridens ligera* (Say), while *T. canadensis* is known to feed on small pulmonate land snails. Both

species of sciomyzids rarely are collected by use of a sweep net. They are most often captured in Malaise traps, which were not used in this study.

Sixty-eight snail-killing flies (Diptera: Sciomyzidae) of 11 species were recorded. Two species (*Ditaeniella parallela* and *Pherbellia nana nana*) are members of the sciomyzid tribe Sciomyzini, larvae of which live chiefly as parasitoids in exposed aquatic, hygrophilous, and terrestrial snails. The other nine species are members of the tribe Tetanocerini, the aquatic larvae of which are overt predators of aquatic and semi-aquatic snails in fens, marshes, pond margins, and even roadside ditches. New for Randolph County are *Dictya expansa*, *D. sabroskyi*, *D. stricta*, *Ditaeniella parallela*, *Limnia boscii* (Fig. 10), and *P. nana nana*, bringing to 19 the number of sciomyzid species known from Randolph County. All species are native. Surprisingly, when one considers the extensive expanses of tilled soil in Randolph County that is unsuitable habitat for sciomyzids, the county now ranks third in the state (after Tippecanoe and Marshall) for the greatest diversity of sciomyzid species.

In Indiana, nine of the species recorded are widespread, with *D. stricta* approaching its northern limit, whereas two species (*D. parallela* and *P. nana nana*) are far less common, being found mainly where falling water levels have stranded their snail hosts. All 11 species would be expected to occur in suitable habitat anywhere in Indiana. The two specimens of *S. fuscipennis* were of the southern form (*S. f. fuscipennis* Loew), which in Indiana generally is found from approximately the latitude of Indianapolis south; no individuals were of the northern form (*S. f. nobilis* Orth). These findings indicate a southern influence on the sciomyzid fauna in east-central Indiana. All specimens will be deposited in the U.S. National Museum of Natural History, Washington, DC.

Spiders.—During this bioblitz, the spider team employed a variety of methods to find and collect spiders. The most common collection method was sweep netting. This technique involved the use of a sweep net to collect spiders from low vegetation. A second technique employed was litter sifting. Litter sifting used a long canvas tube separated on the inside by metal screens (called a litter sifter). Leaf litter was put into the top of the litter sifter and the tube was held over a white sheet and shaken so that spiders that leave the leaf litter could

then be collected on the sheet below. Finally, hand collecting was used to capture spiders, especially at night when headlamps were used to find spiders by eye shine and then scooped up into vials. All specimens are housed at the University of Indianapolis except for new state records, which are held at Indiana State University.

The bioblitz was considered a success by the spider team. We expected to find ~ 72 species through one day and night of searching. However, after spending two weeks identifying spiders back in the lab post-bioblitz, we accumulated a tally of 81 species. Among the species found were many rare and infrequently collected species. Moreover, our collecting uncovered six spider species never recorded from the state. These notable species were *Emblyna hentzi* (meshweaver, Dictynidae), *Gladicosa bellamyi* (wolf spider, Lycosidae), *Pirata triens* (pirate wolf spider, Lycosidae), *Schizocosa mccooki* (wolf spider, Lycosidae), *Oxyopes scalaris* (western lynx spider, Oxyopidae), and *Xysticus fervidus* (ground crab spider, Thomisidae). For details, see the final report at <https://www.indianaacademyofscience.org/IAS/media/Documents/BioBlitzInfoandData/RTC-2017-Bioblitz-Final-Report.pdf>.

The spider species richness at both sites is higher than reported here. It's estimated that it takes over 3,000 spider specimens to accurately gauge the species richness of a habitat but only ~500 specimens were captured over our sampling period. However, as evidenced by the large number of new spider distribution records found through only 21 man-hours of collecting during this bioblitz, these areas may represent refuges for biodiversity in Eastern Indiana – an area where most of the land has been cleared for agriculture. WWR possesses habitats such as riparian woods, marshland, and temperate forest that are becoming rarer in this area and are therefore critically important for the conservation of a variety of animals. Although relatively young, MMF possesses high spider species richness. Our prediction is that, through time, spider species richness will increase as the leaf layer increases, the canopy closes, and the area recovers from its recent disturbances. As leaf layer increases, smaller arthropods such as collembola will increase in prevalence, providing ideal living conditions for litter-dwelling spiders such as small linyphiids, dictynids, lycosids, and gnaphosids. Moreover, a closed canopy combined with a thick leaf litter will help retain moisture close to the soil, preventing

the desiccation of small arthropods. The conservation of these two sites would be important in preserving arthropod biodiversity in Eastern Indiana.

Vascular plants.—It is clear from the results of the bioblitz that east-central Indiana supports a rich and diverse vascular plant flora. In summary 477 taxa (406 at MMF and 289 at WRW) were reported. Of the total, 218 taxa occurred at both sites, 71 taxa only occurred at WRW, and 187 taxa only occurred at MMF. The details of each site are presented separately here.

McVey Memorial Forest: The woodland at MMF was divided into two sections, i.e., the northern woods (all land north of CR 750 N) and the southern woods (all land between CR 700N and 750 N). A total of 406 species were observed at MMF. Of these 15 occurred only in the northern woodland, 142 occurred in both woodlands, and 249 species occurred only in the southern woodland. Of the 406 taxa, 312 (76.8%) were native and 94 (23.2%) were non-native. From the northern woodland, 157 taxa were reported of which 111 (70.7%) were native species and from the southern woodland, 388 taxa were reported of which 302 (77.8%) native species.

Among the 406 species were 24 potential Randolph County records. Most notable among these were *Callitriche terrestris*, *Elodea canadensis*, *Erythronium americanum*, *Monotropa uniflora*, *Najas flexilis*, *Potamogeton nodosus*, *Quercus palustris*, *Scutellaria nervosa*, *Silphium laciniatum*, and *Solidago rigida*. Lastly, two species, *Hydrastis canadensis* and *Viola pubescens*, are on the state watch list. No endangered, rare, or threatened species were encountered.

The native FQI and mean C for MMF were 62.9 and 3.6, respectively, while the total (native + non-native species) FQI and mean C were 55.1 and 2.7, respectively. The vascular plant taxa documented and the native FQI at MMF were typical of other floristic inventories of vegetation in east-central Indiana (see Ruch et al. 2014; Hubini et al. 2017). The native matrices suggest that MMF is of remnant natural quality and contains some noteworthy remnants of the natural heritage of the region (Swink & Wilhelm 1994; Rothrock & Homoya 2005). Although low for sites outside the Central Till Plain region, the native mean C for MMF is typical for sites within this region. See Hubini et al. (2017) for an explanation of

the lower native mean C values in the Central Till Plain region, especially east-central Indiana. Of the 406 species reported from MMF, 33 (8.1%) had C-values equal to or greater than seven ($C \geq 7$), include five $C = 10$ species, i.e., *Carex bromoides*, *Ranunculus hispidus* var. *caricetorum*, *Silphium laciniata*, *Taxodium distichum*, and *Thuja occidentalis*. However, the later three species were likely planted.

For all species (native + non-native), the FQI = 55.1 or 7.8 units lower than the FQI for native species alone. Likewise, for all species the mean C was 2.7 or 0.9 units lower than the mean C for native species alone. Rothrock & Homoya (2005) have suggested that natural quality of an area is compromised when non-native diversity lowers mean $C \geq 0.7$ units. Based on these numbers, it would appear that the non-native flora is having a negative impact on the native flora. However, based on visual observations and species distribution, the negative impact is not equal across all habitats. Non-native flora is negatively impacting the native flora along the roadside, in old fields, along drainage ditches, in tree plantations along SR 1, and in and around the man-made pond. However, within the older woodland, the impact is negligible. Problematic non-natives include *Alliaria petiolata*, *Bromus* spp., *Cirsium arvense*, *Conium maculatum*, *Festuca arundinacea* (= *Schedonorus arundinaceus*), *Hemerocallis fulva* (in patches), *Leucanthemum vulgare*, *Lonicera maackii*, *Melilotus officinalis*, *Phalaris arundinacea* (along the river), *Poa pratensis*, *Rosa multiflora*, *Setaria* spp., *Trifolium* spp., and *Vicia cracca*.

White River Woods: Figure 12 shows the plant team working along the White River. Of the 289 species observed at WRW, 220 (76.1%) were native and 69 (23.9%) were non-native. From the mature woods, 161 taxa were reported of which 129 (80.1) were native species, including several large tree species (Fig. 13); from the old fields, 172 taxa were reported of which 121 (70.3%) were native species; and from the floodplain woods, 173 taxa were reported of which 123 (71.1%) were native.

Among the 289 species reported, 22 were potential Delaware County records. Most notable among these were *Carex oligocarpa*, *Desmodium illinoense*, *Echinocystis lobata*, *Euphorbia obtusata*, *Heracleum maximum*, *Iris pseudacorus* (non-native), *Prenanthes crepidi-*



Figure 12.—Members of the plant team working the banks along the river at White River Woods. (Photo by John Taylor)

nea, *Robinia pseudoacacia* (surprisingly!), *Schoenoplectus acutus*, and *Vicia villosa*. In addition, *Euphorbia obtusata*, which was collected in an old field, is listed as state

endangered, and *Prenanthes crepidinea*, which was collected in the floodplain woods, is listed on the state watch list.

The native FQI and mean C for WRW were 46.3 and 3.1, respectively, while the total (native + non-native species) FQI and mean C were 40.4 and 2.6, respectively. The flora observed and the native FQI and mean C at WRW were typical of other floristic inventories in east-central Indiana (see Ruch et al. 2014; Hubini et al. 2017). Although these matrices represent observations and data collection for only one weekend, the numbers indicate that WRW is of nature preserve quality (Swink & Wilhelm 1994; Rothrock & Homoya 2005).

Of the 289 species reported from WRW, only 14 (4.8%) had $C \geq 7$. Although there were no species with C-values of 9 or 10, there were five $C = 8$ species, i.e., *Carex amphibola*, *C. oligocarpa*, *Carya laciniosa*, *Elymus trachycaulus*, and *Symplocarpus foetidus*.

For all species (native + non-native) at WRW, the FQI = 40.4 was ~ 6 units lower than the FQI for native species alone. Likewise, for all species the mean C was 2.4 or 0.7 units lower than the mean C for native species alone. As stated earlier, Rothrock & Homoya (2005) have suggested that natural quality of an area is compromised when non-native diversity lowers



Figure 13.—Stephanie Schuck from the plant team measuring the dbh of a large bur oak (*Quercus macrocarpa*) at White River Woods. The dbh was over 90 cm! (Photo by John Taylor)

mean $C \geq 0.7$ units. As described above, the negative impact is not equal across all habitats. Clearly, the non-native flora is negatively impacting the native flora along the roadside and in all the old fields. The negative impact of exotics is negligible in the interior of the woodlands, especially the older woodland in the northeast corner of the property. The non-native species presenting the greatest problem are *Bromus inermis*, *Cirsium arvense*, *Conium maculatum*, *Dipsacus fullonum*, *Elaeagnus umbellata*, *Festuca arundinacea*, *Galium mullugo*, *Iris pseudacorus*, *Lonicera maackii*, *Melilotus* spp., and *Vicia villosa*.

ACKNOWLEDGMENTS

Food and lodging for the participants was provided through the generous support of the Red-Tail Land Conservancy, Robert Cooper Audubon Society, and the Indiana Academy of Science. The bioblitz organizers express their sincere appreciation to the Oakwood Retreat Center for the use their equipment storage barn as the headquarters for the event. We thank the staff of the Red-Tail Land Conservancy for providing the sites and participating in the bioblitz. We express our sincere appreciation to Mathew Purtill for providing a summary geomorphological assessment of both sites and to James Martin and J. Ryan Duddleson for providing the cultural resources assessment of MMF. Lastly, we express our sincere thanks to the participants who made the event a success and to the team leaders for their valuable assistance in preparing the team reports.

LITERATURE CITED

Abbott, J.C. 2006–2017. OdonataCentral: An online resource for the distribution and identification of Odonata. Available at <http://www.odonatacentral.org>.

- Belth, J.E., 2013. Butterflies of Indiana –A Field Guide. Indiana University Press, Bloomington and Indianapolis, Indiana. 323 pp.
- Curry, J.R. 2001. Dragonflies of Indiana. Indiana Academy of Sciences, Indianapolis, Indiana. 303 pp.
- Homoya, M.A., D.B. Abrell, J.R. Aldrich & T.W. Post. 1985. The Natural Regions of Indiana. Proceedings of the Indiana Academy of Science 94: 245–268.
- Hubini, H.M.H., D.G. Ruch, M.E. Crecelius, J.F. Taylor, K.S. Badger & P.E. Rothrock. 2017. Floristic inventory of the Cooper Woods-Skinner Woods complex, Ball State University, Delaware County, Delaware. Proceedings of the Indiana Academy of Science 126:72–93.
- Merritt, R.W., K.W. Cummins & M.B. Berg (Eds.). 2008. An Introduction to the Aquatic Insects of North America. Kendall/Hunt Publishing Company, Dubuque, Iowa. xvi + 1158 pp.
- Red-Tail Biodiversity Survey Final Report. 2018. Indiana Academy of Science, Indianapolis, Indiana. At: <https://www.indianaacademyofscience.org/IAS/media/Documents/BioBlitzInfoandData/RTC-2017-Bioblitz-Final-Report.pdf>.
- Rothrock, P.E. & M.A. Homoya. 2005. An evaluation of Indiana's Floristic Quality Assessment. Proceedings of the Indiana Academy of Science 114:9–18.
- Ruch, D.G., K.S. Badger, J.E. Taylor, M.E. Smith & P.E. Rothrock. 2014. The vascular flora and vegetational communities of Coffman Woods Nature Preserve, Wayne County, Indiana. Proceedings of the Indiana Academy of Science 123:72–93.
- Swink, F. & G. Wilhelm. 1994. Plants of the Chicago Region, 4th edition. Indiana Academy of Science, Indianapolis, Indiana. 921 pp.
- Thorp, J.H. & A.P. Covich (Eds.). 2001. Ecology and Classification of North American Freshwater Invertebrates, second edition. Academic Press, San Diego, California. xvi + 1056 pp.

Manuscript received 1 May 2018, revised 5 June 2018.