A Survey of Bees (Hymenoptera: Apoidea) of the Indiana Dunes and Northwest Indiana, USA

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ABSTRACT: The Indiana Dunes, and nearby natural areas in northwest Indiana, are floristically rich Midwest U.S. locales with many habitat types. We surveyed bees along a habitat gradient ranging from grasslands to forests in these locales, collecting at least 175 bee species along this gradient plus 29 additional species in other nearby habitats. About 25% of all species were from the genus *Lasioglossum* and 12% of the species were associated with sandy soils. Several bumblebee (*Bombus*) species of conservation concern that should occur in this region were not collected during our surveys. Similarity of the northwest Indiana bee fauna to other published U.S. faunas decreased about 1.3% per 100 km distance from northwest Indiana. Thirty percent of bees netted from flowers were males. Males and females differed significantly in their frequency of occurrence on different plant species. For bees collected in bowl traps, the percentage captured in fluorescent yellow traps declined and in fluorescent blue traps increased from spring to late summer. Capture rates for different bee genera varied temporally, with about a quarter of the genera being captured most frequently in late spring and a quarter in late summer. Capture rates for most genera were higher in more open than in more closed canopy habitats. The maximum number of plant species on which a single bee species was captured plateaued at 24, on average. Forty-nine percent of bee species known to occur in Indiana were found at these northwest Indiana sites. Having this relatively high proportion of the total Indiana bee fauna is consistent with Indiana Dunes existing at a biogeographic crossroads where grassland and forest biomes meet in a landscape whose climate and soils are affected by proximity to Lake Michigan. The resulting habitat, plant, edaphic, and climatic diversity likely produces the diverse bee community documented.

KEY WORDS: Apoidea, bees, floral records, Indiana Dunes

The pioneering ecological studies by Cowles in the Indiana Dunes formally presented the concept of succession as a major force shaping plant communities (Cowles, 1899). Shelford (1907, 1913) soon thereafter explored whether tiger beetles (*Cicindela* spp.), fish, and other animal groups similarly exhibited successional patterns along the increasingly old dune ridges and ponds that are present as one moves inland from the current shoreline of Lake Michigan at the Indiana Dunes. From this work, Shelford concluded that distributions of tiger beetles and fish were largely determined by their physiologic tolerance to various abiotic and biotic factors, setting the framework for the modern concept of the niche. The Indiana Dunes historically represented an excellent locale for such studies because of the

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variety of habitats, ranging from grasslands to savannas to forests, present in a relatively small area, especially near the shore of Lake Michigan, and because these habitats were often arranged on the landscape in a manner that reflected their ecological age.

Habitat variety in this region also represented a microcosm of broader biogeographic trends due to northwest Indiana’s location in an ecological transition zone between the grasslands of central North America and forested landscapes to the east (Anderson, 1998). This variety influences the diversity and biogeographic affinities of plants in this area. Although only 6000 ha in area, Indiana Dunes National Lakeshore (INDU) is the largest natural area in the Indiana Dunes region, and is one of the most floristically rich U.S. national parks, with about 1140 native plant species, and about 1435 plant species total, including plant species with boreal to desert affinities co-occurring within the national park (Wilhelm, 1990; Pavlovic and Bowles, 1996). Today, due to development and changes in fire regimes, grassland and savanna cover in the Midwest is severely diminished (Auclair, 1976; Nuzzo, 1986; Hoekstra et al., 2005), although the variety of native habitats historically present in the region still can be found in several preserves, including Indiana Dunes National Lakeshore.

Understanding how animal communities relate to successional stages of plant communities in this region is important for providing guidance to land managers as they use fire to restore or maintain different successional stages (Grundel and Pavlovic, 2007a, b; Grundel and Pavlovic, 2008). Because plant pollination by bees is a keystone interaction between animal and plant communities, understanding the forces affecting bee distribution can be very important when considering restoration options. Towards that goal, we surveyed bees across a gradient of woody vegetation density, from open, nearly treeless grasslands to black oak (*Quercus velutina*) savannas to woodlands to scrublands to forests at INDU and nearby natural areas in northwest Indiana (Grundel et al., 2010). Here we document basic information from that survey by presenting an annotated checklist of the bees collected and describing some of the associations linking bees and plants. In addition to listing plant associations of bees, we document the bees’ phenology and habitat associations.

**Materials and Methods**

We surveyed bees in northwest Indiana at three locations, Indiana Dunes National Lakeshore (Lake, Porter, LaPorte Counties) (41° 38’ N, 87° 09’ W; n = 17 sampling sites; 6000 ha), Teft Savanna Nature Preserve and Jasper-Pulaski Fish and Wildlife Area (Jasper County) (41° 10’ N, 86° 58’ W; n = 7 sites; 3250 ha), and Hoosier Prairie Nature Preserve (Lake County) (41° 31’ N, 87° 27’ W; n = 1 site; 225 ha) (Grundel and Pavlovic, 2007a; Haney et al., 2008). Twenty-two of the 25 sites were on predominantly sandy soils (>80% sand content by weight). Sampling sites were classified as open (<20% canopy cover measured with a spherical densiometer), savanna (20–50%), woodland (50–90%), scrub (>1000 woody stems 2.5–10 cm diameter at breast height (dbh) ha⁻¹), or forest (>90% canopy cover and >300 woody stems >10 cm dbh ha⁻¹) (Grundel and Pavlovic, 2007a; Grundel et al., 2010). Five replicates of each habitat type were present in the 25 sampling sites, which were located from 0.8–80 km from the southern shore of Lake Michigan and
averaged 1.8 km ± 0.7 (SE) between nearest neighbor sites. All Indiana Dunes National Lakeshore sites were less than 2 km inland from the Lake Michigan shoreline, Hoosier Prairie was 13 km inland, and Tefft Savanna sites were about 80 km inland.

Northwest Indiana is located in a transition zone between the eastern deciduous forest and Great Plains prairie biomes (Transeau, 1935; Anderson, 1998). Remnant vegetation consists of mosaics of oak savannas and woodlands interspersed with swamps, wet meadows, prairie, marshes, and ponds (Cowles, 1899; Olson, 1958; Wilhelm, 1990). The 25 sites represent a grassland-to-forest gradient existing in a former oak savanna-woodland complex that has been modified by fire suppression and soil disruption (Cook and Jackson, 1978; Bacon et al., 1980; Henderson and Long, 1984; Wilcox et al., 2005).

The climate of the region is temperate humid continental with rainfall varying according to proximity to Lake Michigan (Changnon and Jones, 1972; Furr, 1981). Total precipitation is reported to increase from east to west across the study area, ranging from 917 to 1092 mm per year (Persinger, 1972; Furr, 1981, 1982; Smallwood and Osterholz, 1990). The mean annual temperature at INDU from 1952 to 2009 was 10.2°C.

Most INDU sites are located on Tolleston aged (approximately 4000 BP) corrugated sand dune plains or parabolic sand dunes dominated by black oak trees (*Quercus velutina*) with mean sand content, by weight, of 87 ± 3% (SE), based on soil samples taken across the bee survey sites (Chrzanowski and Thompson, 1992; Schoon, 2003). The one less sandy site was Mnoke Prairie, an open INDU site that was on the Lake Border Moraine (52 ± 20% sand). Hoosier Prairie is on low sand ridges of the Griffith spit of the Glenwood phase formed between 12–13K years ago (Chrzanowski and Thompson, 1992). Due to low topography and long topographic-moisture gradients, the soils at Hoosier Prairie are richer than on INDU’s dunes, averaging 77 ± 3% sand. Tefft Savanna is a complex of windblown parabolic dunes that formed 8000 years ago when the Kankakee Torrent, meltwaters from the receding Wisconsin glaciation, diminished in flow (Bretz, 1939; Willman and Frye, 1970; Futyma, 1985; Fenelon and Bobay, 1994). The parabolic dunes formed as sand was blown by prevailing west winds from the floodplain, up to three miles south of the Kankakee River. Mean sand content of the Tefft Savanna sites’ soils, 88 ± 1%, was similar to Indiana Dunes.

At each site, bees were surveyed along a single 270 m long transect by netting and by capturing in colored bowls (Roulston et al., 2007; Grundel et al., 2010). For bowl trapping at each site, we placed out nine each of 178 ml plastic bowls painted fluorescent blue, fluorescent yellow, or left as the original white. Bees were attracted to the bowls and drowned in soapy water filling the bowls. Along the transect, bowl triplets (one blue, one yellow, one white placed in a line perpendicular to the main transect line) were separated by 20 m, along the central 160 m of the overall transect. Within a triplet, bowls were separated by 5 m. For netting surveys, we slowly walked the 270 m transect line, examining nearby plants for bees and capturing any bees observed. We counted stems bearing flowers for each plant species observed within a 5 m radius of the center of each of the nine triplets of bowls, during each netting or bowl survey. At each site, bowl surveys were carried out approximately once every 25 days from 30 May to 17 September 2003 and from 14 April to 8 July 2004, for a total of seven surveys. Netting was carried out approximately once every 25 days.
from 14 April 2004 to 9 September 2004, again for seven cycles. The first three netting cycles were carried out concurrently with bowl surveys. Additional details on survey methods are available in Grundel et al. (2010).

In spring and summer 2010, we also netted and bowl-trapped bees at several additional sites at INDU but not as part of the same type of systematic survey employed in the main study. Sites for these additional surveys included both locations that were similar to the ones surveyed in the main study (Howes’ Prairie, a prairie/savanna) and other locations that were different (Heron Rookery, a floodplain forest, and Pinhook Bog, an acidic bog). In the bee checklist we present below, we list bee species and plant associations accumulated during this additional collecting. However, we do not quantify or analyze these observations in the same manner as we do observations based on bees collected in the main, systematic part of the study.

Using Sørenson similarity (McCune and Mefford, 2011), we calculated how similar bee faunas were between northwest Indiana and nine published bee faunas from across the country. Then we performed a linear regression analysis (SPSS, 2004) to determine how similarity among faunas changed as a function of distance between sites. Because classifications of bee species have changed through time, we attempted to adjust our taxonomic determinations to match those current when the comparison site study was undertaken, before calculating similarity.

Species richness and species density are two descriptors of species diversity (Gotelli and Colwell, 2001). Species richness is the total number of species present across a site and is best assessed when comparisons among sites are made at the same number of individuals collected at each site, since richness will increase as the number of individuals collected increases. Species density is the number of species per unit area. If we assume that collection methods, such as bowl traps, collect bees from within a certain radius of a bowl, then the number of bee species collected in that bowl represents the number of species collected over that area, a species density (Grundel et al., 2010; Grundel et al., 2011). When you take many samples across a site, the composition of the samples might be very similar to each other, in which case the number of species in a sample and across the site would be similar. If the species composition differs greatly from sample to sample within a site, the total species richness across the site would be greater than the number of species in a given sample. To examine how species richness and species density varied by month across the 25 sites, we calculated monthly rarefaction curves (Gotelli and Colwell, 2001; Colwell, 2009) based on the site by species abundance matrix for data collected within that month. Separate monthly rarefaction curves were produced for number of bee species collected versus number of samples and versus number of specimens collected. These April-September rarefaction curves were then compared, at a common number of individuals, for species richness, and at a common number of samples for species density (Grundel et al., 2010). Because the number of samples taken or individuals collected varies monthly, this procedure allows us to differentiate monthly differences in richness or density while controlling for the number of individuals or samples taken. Specifically, for species density, we determined the number of species estimated to be captured at a common number of samples taken per month (n = 10 samples). For species richness, we also adjusted by comparing rarefaction curves at a common number of individuals taken per month (n = 335 specimens). These two numbers, 10 samples and 335 specimens, represent
the lowest monthly totals for samples or specimens, thereby ensuring that we compared at the same level of bee sampling across all months.

We compared temporal patterns of bee genus captures by standardizing the number of bees captured from different genera. To do this, we first determined whether a particular genus was most often captured in bowl traps or by netting and then, for the more common method of capture, we summed the number of individuals of the genus captured per month across all sites. This sum was standardized by dividing by the number of collecting days for the month, with one day of collecting at a site equaling one collecting day. This yielded a per-day, per-site number of individuals captured, by netting or in bowl traps, for a genus in a month. We then further standardized the monthly totals by dividing by the maximum monthly value for that genus, resulting in a relative abundance ranging from 0 to 1.

Results are presented for genera for which we captured at least 25 individuals by bowl trapping or netting.

Taxonomy in the checklist below mainly follows Michener (2007), except for Panurginae where we follow suggestions of J. Ascher (personal communication). Taxonomic references used for bee names included keys by Chandler (1950), LaBerge (1961, 1980), McGinley (1986), Mitchell (1960, 1962), and Williams (2008). Recent revisions of eastern North American members of the genus *Lasioglossum* (Gibbs, 2010, in press) and of the genus *Ceratina* (Rehan and Sheffield, 2011) allowed us to separate morphologically similar, and previously unidentified, species in these two genera. Because current keys cannot reliably differentiate females of *Hylaeus affinis* and *H. modestus*, we combined observations of females of those two species into a single listing. Males of these two species are listed separately. Two entries, *Lasioglossum near admirandum* and *Stelis aff. grossa*, could not be definitively named at this time but are counted as species in the checklist. Museum collections at Indiana State University (Terre Haute, Indiana), Purdue University (West Lafayette, Indiana), and the Illinois Natural History Survey (Champaign-Urbana) were consulted to confirm species identifications within genera such as *Andrena*, *Sphecodes*, and *Nomada*, demonstrating the importance of historical collections.

Bees collected in this study are currently housed in the museum of Indiana Dunes National Lakeshore at 1100 N. Mineral Springs Road, Porter, IN 46304 (www.nps.gov/indu).

Results

Following is the checklist of bee species found at Indiana Dunes National Lakeshore, Hoosier Prairie Nature Preserve, and Tefft Savanna Nature Preserve / Jasper-Pulaski Fish and Wildlife Area during systematic collecting surveys at 25 sites. In the checklist, we also list bee species and plant associations accumulated during additional 2010 collections. Listings of bee species collected during 2010 additional surveys are quantified as are results from the 2003–2004 twenty-five site study but these quantities are not comparable since the sampling efforts are not the same. New plant associations observed in the additional collections are not quantified for the bees previously collected in the 25-site study but are merely listed.
Key to the checklist: (1) Genus (Subgenus) Species (2) Author (“(Extra)” indicates bee species collected only during additional 2010 surveys. Quantities of these bees are not comparable to quantities of bees collected from the systematic surveys of the 25 sites). (3) Sex: Number of females (♀), males (♂), (Q)ueens, or (Work)ers captured (queens were not determined for all species). (4) Habitat: Number of bees captured in (O)pen, (Sa)vanna, (W)oodland, (Sc)rub, and (F)orest habitats, X indicates bees collected during additional 2010 surveys. (5) Locale: How many bees of a species were collected at (I)ndiana Dunes National Lakeshore, (H)ooiser Prairie State Nature Preserve, or (T)efft Savanna Nature Preserve/ Jasper-Pulaski Fish and Wildlife Area. (6) Sand: Based on our observations and published records, whether this bee is strongly associated with sandy substrates. (7) Introduced: Whether this is a species introduced to North America. (8) Sociality: Eusocial/Subsocial/Solitary/Parasitic indicates sociality based on published information (Mitchell 1960, Giles and Ascher 2006, Michener 2007, Wolf and Ascher 2008) and personal observations. (9) Months: Months of captures: (Ap)ril (M)ay, (Jn) June, (Jl) July, (Au)gust, (S)eptember. (10) Capture Method: (N)etting, (B)lue bowl trap, (W)hite bowl trap, (Y)ellow bowl trap, (U)known bowl trap color – data on bowl color for 41 bowl trap captures were lost. (11) Floral Records: plant species from which this bee species was collected while on a flower. The sex of the individuals visiting the flowers is indicated next to each plant species. No determination was made as to whether the captured bee was collecting pollen or nectar on that plant species. (12) Additional Floral Records: plant species from which this bee species was collected while on a flower during additional 2010 surveys. Number of individuals recorded from these additional plant species is not listed. (13) Indiana Record: Based on examination of museum records and published lists for the state (Montgomery 1957, Jean 2010), whether this is the first recorded capture of this species in Indiana.

**ANDRENIDAE**

1. *Andrena (Andrena) mandibularis* Robertson, 1892 - (Extra) - Sex: 1 ♂; Habitat: 1 X; Locale: 1 I; Solitary; Months: 1 Ap; Capture Method: 1 W.

2. *Andrena (Callandrena s.l.) aliciae* Robertson, 1891 - Sex: 1 ♀; Habitat: 1 O; Locale: 1 T; Solitary; Months: 1 Au; Capture Method: 1 N; Floral Records: *Helianthus occidentalis* (1 ♀).

3. *A. (C.) asteris* Robertson, 1891 - Sex: 1 ♂; Habitat: 1 W; Locale: 1 I; Solitary; Months: 1 S; Capture Method: 1 N; Floral Records: *Solidago* spp. (1 ♀); Additional Floral Records: *Symphyotrichum ericoides*.

4. *A. (C.) helianthi* Robertson, 1891 - Sex: 1 ♀; Habitat: 1 O; Locale: 1 I; Solitary; Months: 1 Au; Capture Method: 1 N; Floral Records: *Liatris aspera* (1 ♀).

5. *Andrena (Cnemidandrena) canadensis* Dalla Torre, 1896 - Sex: 2 ♀, 1 ♂; Habitat: 2 Sa, 1 W; Locale: 3 T; Sand; Solitary; Months: 3 S; Capture Method: 3 N; Floral Records: *Solidago* spp. (2 ♀, 1 ♂); Additional Floral Records: *Symphyotrichum oolentangiense*.

6. *A. (C.) nubecula* Smith, 1853 - Sex: 1 ♂; Habitat: 1 O; Locale: 1 I; Solitary; Months: 1 Au; Capture Method: 1 N; Floral Records: *Solidago* spp. (1 ♂).
7. *A. (C.) runcinatae* Cockerell, 1902 - Sex: 1 ♀; Habitat: 1 O; Locale: 1 T; Solitary; Months: 1 S; Capture Method: 1 N; Floral Records: *Symphyotrichum* spp. (1 ♀).

8. *Andrena (Euandrena) geranii* Robertson, 1891 - (Extra) - Sex: 1 ♀, 3 ♂; Habitat: 4 X; Locale: 4 I; Solitary; Months: 3 Ap, 1 M; Capture Method: 1 N, 1 W, 1 Y, 1 B; Floral Records: *Krigia biflora* (1 ♂).

9. *A. (E.) polemonii* Robertson, 1891 - (Extra) - Sex: 1 ♂; Habitat: 1 X; Locale: 1 I; Solitary; Months: 1 S; Capture Method: 1 N; Floral Records: *Krigia biflora* (1 ♂).

10. *Andrena (Holandrena) cressonii* Robertson, 1891 - Sex: 4 ♂, 3 ♀; Habitat: 2 O, 2 Sa, 2 W, 1 Sc; Locale: 4 I, 1 H, 2 T; Solitary; Months: 4 Ap, 2 M, 1 Jn; Capture Method: 2 W, 3 Y, 1 B, 1 U; Additional Floral Records: *Arabis lyrata*, *Lupinus perennis*, *Packera aurea*, *Photinia melanocarpa*.

11. *Andrena (Iomelissa) violae* Robertson, 1891 - (Extra) - Sex: 1 ♀; Habitat: 1 X; Locale: 1 I; Solitary; Months: 1 M; Capture Method: 1 B.

12. *Andrena (Larandrena) miserabilis* Cresson, 1872 - Sex: 3 ♂; Habitat: 2 Sc, 1 F; Locale: 3 I; Solitary; Months: 2 Ap, 1 M; Capture Method: 2 W, 1 U; Additional Floral Records: *Photinia melanocarpa*.

13. *Andrena (Leucandrena) barbilabris* (Kirby, 1802) - Sex: 1 ♂, 1 ♀; Habitat: 2 F; Locale: 2 I; Solitary; Months: 2 Ap; Capture Method: 1 Y, 1 B.

14. *Andrena (Melandrena) carlini* Cockerell, 1901 - Sex: 3 ♂, 10 ♀; Habitat: 6 Sc, 7 F; Locale: 10 I, 3 T; Solitary; Months: 13 Ap; Capture Method: 6 W, 6 Y, 1 B; Additional Floral Records: *Photinia melanocarpa*, *Vaccinium corymbosum*.

15. *A. (M.) commoda* Smith, 1879 - Sex: 2 ♀; Habitat: 2 X; Locale: 2 I; Solitary; Months: 2 M; Capture Method: 1 W, 1 Y.

16. *A. (M.) illini* Bousman and LaBerge, 1979 - (Extra) - Sex: 1 ♀; Habitat: 1 X; Locale: 1 I; Solitary; Months: 1 M; Capture Method: 1 N; Floral Records: *Photinia melanocarpa* (1 ♀).

17. *A. (M.) pruni* Robertson, 1891 - (Extra) - Sex: 4 ♂, 10 ♀; Habitat: 14 X; Locale: 14 I; Solitary; Months: 14 Ap; Capture Method: 11 W, 1 Y, 2 B.

18. *A. (M.) vicina* Smith, 1853 - Sex: 8 ♂, 11 ♀; Habitat: 1 Sa, 2 W, 11 Sc, 5 F; Locale: 13 I, 6 T; Solitary; Months: 10 Ap, 9 M; Capture Method: 5 N, 2 W, 6 Y, 1 B, 5 U; Floral Records: *Vaccinium spp.* (3 ♂, 2 ♀); Additional Floral Records: *Gaylussacia baccata*, *Vaccinium corymbosum*.

19. *Andrena (Plastandrena) crataegi* Robertson, 1893 - (Extra) - Sex: 2 ♂; Habitat: 2 X; Locale: 2 I; Solitary; Months: 1 Ap, 1 M; Capture Method: 1 N, 1 B; Floral Records: *Photinia melanocarpa* (1 ♀).

20. *Andrena (Ptilandrena) distans* Provancher, 1888 - Sex: 1 ♀; Habitat: 1 Sc; Locale: 1 I; Solitary; Months: 1 M; Capture Method: 1 B.

21. *A. (P.) erigeniae* Robertson, 1891 - Sex: 11 ♂, 4 ♀; Habitat: 1 O, 7 Sa, 2 W, 1 Sc, 4 F; Locale: 3 I, 4 H, 8 T; Solitary; Months: 6 Ap, 9 M; Capture Method: 6 W, 4 Y, 5 B.

22. *Andrena (Scapteropsis) fenningeri* Viereck, 1922 - (Extra) - Sex: 1 ♀; Habitat: 1 X; Locale: 1 I; Solitary; Months: 1 M; Capture Method: 1 N; Floral Records: *Photinia melanocarpa* (1 ♀).

23. *A. (S.) imitatrix* Cresson, 1872 - Sex: 3 ♂, 1 ♀; Habitat: 1 O, 1 W, 1 Sc, 1 F; Locale: 2 I, 2 T; Solitary; Months: 3 Ap, 1 Jn; Capture Method: 1 N, 3 W; Floral Records: *Carex pensylvanica* (1 ♀); Additional Floral Records: *Photinia melanocarpa*. 
24. Andrena (Simandrena) nasonii Robertson, 1895 - Sex: 3 ♂, 3 ♀; Habitat: 4 O, 1 W, 1 F; Locale: 4 I, 2 T; Solitary; Months: 2 Ap, 2 M, 2 Jn; Capture Method: 3 W, 3 Y; Additional Floral Records: *Arabis lyrata, Photinia melanocarpa*.

25. Andrena (Trachandrena) ceanothi Viereck, 1917 - Sex: 12 ♂, 7 ♀; Habitat: 1 O, 5 Sa, 12 Sc, 1 F; Locale: 17 I, 2 T; Solitary; Months: 1 Ap, 15 M, 3 Jn; Capture Method: 1 N, 3 W, 7 Y, 2 B, 6 U; Floral Records: *Antennaria* spp. (1 ♂); Additional Floral Records: *Fragaria virginiana, Gaylussacia baccata, Lupinus perennis, Rubus hispidus, Zizia aurea*.

26. A. (T.) forbesii Robertson, 1891 - Sex: 1 ♂, 1 ♀; Habitat: 1 O, 1 Sc; Locale: 2 I; Solitary; Months: 2 Ap; Capture Method: 1 N, 1 Y; Floral Records: *Salix* spp. (1 ♂); Additional Floral Records: *Photinia melanocarpa*.

27. A. (T.) hippotes Robertson, 1895 - (Extra) - Sex: 1 ♂; Habitat: 1 X; Locale: 1 I; Solitary; Months: 1 M; Capture Method: 1 N; Floral Records: *Photinia melanocarpa* (1 ♂).

28. A. (T.) mariae Robertson, 1891 - Sex: 1 ♂; Habitat: 1 O; Locale: 1 I; Solitary; Months: 1 Ap; Capture Method: 1 N; Floral Records: *Salix* spp. (1 ♂).

29. A. (T.) rugosa Robertson, 1891 - (Extra) - Sex: 6 ♂, 2 ♀; Habitat: 8 X; Locale: 8 I; Solitary; Months: 8 Ap; Capture Method: 4 W, 2 Y, 2 B.

30. Andrena (Tylandrena) perplexa Smith, 1853 - (Extra) - Sex: 2 ♂; Habitat: 2 X; Locale: 2 I; Solitary; Months: 1 Ap, 1 M; Capture Method: 1 W, 1 Y.

31. Pseudopanurgus albitarsis (Cresson, 1872) - (Extra) - Sex: 1 ♂; Habitat: 1 X; Locale: 1 I; Solitary; Months: 1 Jl; Capture Method: 1 N; Floral Records: *Rudbeckia hirta* (1 ♂). Indiana record.

32. P. nebrascensis (Crawford, 1903) - Sex: 1 ♂; Habitat: 1 W; Locale: 1 T; Sand; Solitary; Months: 1 S; Capture Method: 1 N; Floral Records: *Solidago* spp. (1 ♂).

33. P. rugosus (Robertson, 1895) - Sex: 5 ♂; Habitat: 2 Sa, 2 W, 1 F; Locale: 5 T; Solitary; Months: 2 Jl, 2 Au, 1 S; Capture Method: 5 N; Floral Records: *Helianthus divaricatus* (4 ♂), *Solidago* spp. (1 ♂).

34. P. solidaginis (Robertson, 1893) - Sex: 1 ♂; Habitat: 1 O; Locale: 1 T; Solitary; Months: 1 S; Capture Method: 1 N; Floral Records: *Symphyotrichum* spp. (1 ♂). Indiana record.


37. P. (P.) halictoides Smith, 1853 - Sex: 1 ♂; Habitat: 1 O; Locale: 1 I; Sand; Solitary; Months: 1 Jl; Capture Method: 1 N; Floral Records: *Hypericum perforatum* (1 ♂).

38. P. (P.) maculigera Cockerell, 1896 - Sex: 1 ♂; Habitat: 1 Sa; Locale: 1 I; Sand; Solitary; Months: 1 Jn; Capture Method: 1 B. Indiana record.

39. P. (P.) octomaculata (Say, 1824) - Sex: 1 ♂; Habitat: 1 Sa; Locale: 1 I; Sand; Solitary; Months: 1 Au; Capture Method: 1 N; Floral Records: *Solidago* spp. (1 ♂).

APIDAE

41. *Anthophora* (*Clisodon*) *terminalis* Cresson, 1869 - Sex: 3 ♀, 2 ♂; Habitat: 1 O, 2 Sa, 1 Sc, 1 F; Locale: 5 I; Solitary; Months: 2 Jn, 1 Jl, 2 Au; Capture Method: 1 N, 1 W, 3 B; Floral Records: *Liatris aspera* (1 ♂); Additional Floral Records: *Lobelia siphilitica*.


44. *Bombus* (*Psithyrus*) *citrinus* (Smith, 1854) - Sex: 7 ♂; Habitat: 3 O, 1 Sa, 1 W, 2 F; Locale: 2 I, 1 H, 4 T; Parasitic; Months: 1 Jl, 6 Au; Capture Method: 7 N; Floral Records: *Doellingeria umbellata* (1 ♂), *Helianthus divaricatus* (2 ♂), *Liatris aspera* (2 ♂), *Monarda punctata* (1 ♂), *Solidago* spp. (1 ♂).


47. **B. (P.) vagans** Smith, 1854 - Sex: 3 ♀, 9 Work; Habitat: 1 O, 3 W, 5 Sc, 3 F; Locale: 10 I, 2 T; Eusocial; Months: 1 Ap, 1 Jn, 1 Jl, 8 Au, 1 S; Capture Method: 9 N, 1 W, 2 B; Floral Records: *Aureolaria pedicularia* (1 Q, 4 Work), *Liatris aspera* (1 Work), *Solidago spp.* (2 Work).

48. **Bombus (Thoracobombus) fervidus** (Fabricius, 1798) - Sex: 1 ♂, 1 Work; Habitat: 1 O, 1 Sa; Locale: 2 I; Eusocial; Months: 1 M, 1 Jl; Capture Method: 1 N, 1 Y; Floral Records: *Silphium terebinthinaceum* (1 Work); Additional Floral Records: *Liatris cylindracea.*

49. **Eucera (Synhalonia) hamata** (Bradley, 1942) - Sex: 1 ♀; Habitat: 1 O; Locale: 1 I; Solitary; Months: 1 Jn; Capture Method: 1 B.

50. **Melissodes (Eumelissodes) agilis** Cresson, 1878 - Sex: 1 ♂; Habitat: 1 Sa; Locale: 1 I; Solitary; Months: 1 J; Capture Method: 1 N; Floral Records: *Coreopsis palmata* (1 ♂).

51. **M. (E.) denticulata** Smith, 1854 - Sex: 3 ♀, 1 ♂; Habitat: 3 Sa, 1 W; Locale: 1 I, 3 T; Solitary; Months: 2 Au, 2 S; Capture Method: 4 N; Floral Records: *Helianthus divaricatus* (1 ♂), *Ionactis linearifolius* (1 ♂), *Symphyotrichum spp.* (1 ♂), *Vernonia gigantea* (1 ♂).

52. **M. (E.) druriella** (Kirby, 1802) - Sex: 1 ♀; Habitat: 1 Sc; Locale: 1 I; Solitary; Months: 1 Au; Capture Method: 1 N; Floral Records: *Helianthus divaricatus* (1 ♂).

53. **M. (E.) illata** Lovell & Cockerell, 1906 - Sex: 1 ♂; Habitat: 1 Sa; Locale: 1 I; Solitary; Months: 1 Jn; Capture Method: 1 N; Floral Records: *Rudbeckia hirta* (1 ♂).

54. **M. (E.) subillata** Cockerell, 1906 - Sex: 1 ♀; Habitat: 1 Sa; Locale: 1 I; Solitary; Months: 1 Jn; Capture Method: 1 Y; Additional Floral Records: *Rudbeckia hirta.*

55. **M. (E.) trinodis** Robertson, 1901 - Sex: 8 ♀, 3 ♂; Habitat: 3 O, 7 Sa, 1 Sc; Locale: 9 I, 2 H; Solitary; Months: 1 Jl, 8 Au, 2 S; Capture Method: 10 N, 1 B; Floral Records: *Coreopsis tripteris* (1 ♀), *Helianthus divaricatus* (6 ♀), *H. mollis* (1 ♂), *Silphium terebinthinaceum* (2 ♂); Additional Floral Records: *Helianthus occidentalis.*

56. **Melissodes (Melissodes) bimaculata** (Lepeletier, 1825) - Sex: 18 ♀, 5 ♂; Habitat: 3 O, 1 Sa, 16 W, 2 Sc, 1 F; Locale: 18 I, 1 H, 4 T; Solitary; Months:
16 Au, 7 S; Capture Method: 2 N, 4 W, 1 Y, 16 B; Floral Records: *Aureolaria pedicu- laria* (2 φ).

57. **Peponapis (Peponapis) pruinosa** (Say, 1837) - Sex: 2 φ; Habitat: 2 O; Locale: 1 I, 1 T; Solitary; Months: 2 Jl; Capture Method: 2 B.

58. **Epeolus lectoides** Robertson, 1901 - Sex: 7 φ, 1 2; Habitat: 2 O, 4 Sa, 6 W, 7 Sc; Locale: 8 I, 11 T; Parasitic; Months: 12 Jl, 6 Au, 1 S; Capture Method: 16 N, 3 W; Floral Records: *Asclepias tuberosa* (1 φ), *Coreopsis palmata* (1 φ), *Helianthus divaricatus* (3 φ), *Melilotus officinalis* (1 φ, 3 φ), *Rhus copallinum* (1 φ, 2 φ), *Solidago* spp. (2 φ, 2 φ).

59. **E. pusillus** Cresson, 1864 - Sex: 4 φ; Habitat: 3 O, 1 Sc; Locale: 1 I, 3 T; Parasitic; Months: 4 S; Capture Method: 1 N, 3 Y; Floral Records: *Solidago* spp. (1 φ).

60. **E. scutellaris** Say, 1824 - Sex: 3 φ; Habitat: 1 W, 2 Sc; Locale: 3 I; Parasitic; Months: 3 S; Capture Method: 1 N, 2 W, 1 Y; Floral Records: *Solidago* spp. (1 φ).

61. **Tripeolus helianthi** (Robertson, 1897) - Sex: 1 φ; Habitat: 1 O; Locale: 1 I; Parasitic; Months: 1 Au; Capture Method: 1 N; Floral Records: *Helianthus annuus* (1 φ).

62. **Nomada armatella** Cockerell, 1903 - Sex: 1 φ, 1 φ; Habitat: 2 F; Locale: 1 I, 1 T; Parasitic; Months: 2 Ap; Capture Method: 1 Y, 1 B.

63. **N. cressoni** Robertson, 1893 - Sex: 2 φ; Habitat: 2 F; Locale: 2 T; Parasitic; Months: 2 Ap; Capture Method: 1 W, 1 B.

64. **N. denticulata** Robertson, 1902 - (Extra) - Sex: 3 φ; Habitat: 3 X; Locale: 3 I; Parasitic; Months: 1 Ap, 2 M; Capture Method: 3 N; Floral Records: *Packera aurea* (2 φ), *Vaccinium corymbosum* (1 φ).

65. **N. fervida** Cresson, 1878 - Sex: 3 φ, 2 φ; Habitat: 5 O; Locale: 5 I; Parasitic; Months: 3 Jl, 1 Au, 1 S; Capture Method: 4 N, 1 Y; Floral Records: *Melilotus officinalis* (1 φ, 2 φ), *Solidago* spp. (1 φ); Additional Floral Records: *Coreopsis lanceolata*.

66. **N. imbricata** Smith, 1854 - Sex: 2 φ; Habitat: 2 O; Locale: 2 I; Parasitic; Months: 2 M; Capture Method: 1 N, 1 W.

67. **N. lepida** Cresson, 1863 - Sex: 4 φ; Habitat: 1 Sc, 3 F; Locale: 1 I, 3 T; Parasitic; Months: 3 Ap, 1 M; Capture Method: 2 W, 1 Y, 1 B; Additional Floral Records: *Coreopsis lanceolata*, *Fragaria virginiana*, *Krigia biflora*, *Packera aurea*.

68. **N. luteoloides** Robertson, 1895 - Sex: 1 φ; Habitat: 1 Sc; Locale: 1 I; Parasitic; Months: 1 M; Capture Method: 1 U.

69. **N. maculata** Cresson, 1863 - Sex: 3 φ, 9 φ; Habitat: 1 W, 3 Sc, 8 F; Locale: 5 I, 7 T; Parasitic; Months: 10 Ap, 2 M; Capture Method: 1 N, 3 W, 4 Y, 3 B, 1 U; Floral Records: *Vaccinium* spp. (1 φ); Additional Floral Records: *Arabis lyrata*, *Coreopsis lanceolata*.

70. **N. ovata** (Robertson, 1903) - Sex: 3 φ, 1 φ; Habitat: 1 O, 1 Sa, 1 W, 1 F; Locale: 2 I, 2 T; Parasitic; Months: 2 M, 2 Jn; Capture Method: 1 N, 3 Y; Floral Records: *Potentilla simplex* (1 φ).

71. **N. parva** Robertson, 1900 - Sex: 1 φ; Habitat: 1 Sa; Locale: 1 I; Parasitic; Months: 1 M; Capture Method: 1 Y.

72. **N. rubicunda** Olivier, 1811 - Sex: 1 φ; Habitat: 1 O; Locale: 1 I; Parasitic; Months: 1 Jn; Capture Method: 1 W.
73. *N. sayi* Robertson, 1893 - Sex: 2♀, 1♂; Habitat: 2 Sc, 1 F; Locale: 2 I, 1 T; Parasitic; Months: 1 Ap, 1 M, 1 Jn; Capture Method: 2 W, 1 B.

74. *N. vegana* Cockerell, 1903 - Sex: 2♀; Habitat: 2 O; Locale: 2 I; Parasitic; Months: 2 Jl; Capture Method: 2 N; Floral Records: *Euphorbia corollata* (1 ♀). Indiana record.


lanceolata, C. palmata, C. tripteris, Hieracium caespitosum, Packera aurea, Polygala polygama, Rudbeckia hirta, Solidago rugosa.

79. *Xylocopa (Xylocopoides) virginica* (Linnaeus, 1771) - (Extra) - Sex: 3 ♂, 4 ♀; Habitat: 7 X; Locale: 7 I; Subsocial; Months: 1 M, 2 Jn, 1 Jl, 2 Au, 1 S; Capture Method: 7 N; Floral Records: *Euphorbia corollata* (1 ♀), *Liatris cylindracea* (1 ♂), *L. spicata* (1 ♀), *Solidago speciosa* (1 ♂), *Tephrosia virginiana* (2 ♂), *Vaccinium corymbosum* (1 ♂).

**COLLETIDAE**

80. *Colletes americanus* Cresson, 1868 - Sex: 5 ♂; Habitat: 5 W; Locale: 4 I, 1 T; Solitary; Months: 5 S; Capture Method: 5 N; Floral Records: *Solidago spp.* (5 ♂).

81. *C. compactus* Cresson, 1868 - Sex: 3 ♂; Habitat: 3 Sc;Locale: 3 I; Solitary; Months: 3 S; Capture Method: 3 N; Floral Records: *Solidago spp.* (3 ♂).

82. *C. inaequalis* Say, 1837 - Sex: 26 ♂, 3 ♂; Habitat: 2 Sa, 50 Sc, 6 F; Locale: 53 I, 5 T; Solitary; Months: 56 Ap, 2 M; Capture Method: 14 W, 22 Y, 22 B; Additional Floral Records: *Vaccinium corymbosum*.

83. *C. mandibularis* Smith, 1853 - Sex: 1 ♀; Habitat: 1 O; Locale: 1 I; Sand; Solitary; Months: 1 Au; Capture Method: 1 N; Floral Records: *Hieracium scabrum* (1 ♀).

84. *C. nudus* Robertson, 1898 - Sex: 3 ♂; Habitat: 1 Sa, 1 W, 1 Sc; Locale: 2 I, 1 T; Solitary; Months: 2 Ji, 1 Au; Capture Method: 3 N; Floral Records: *Aureolaria pedicularia* (1 ♂), *Helianthus divaricatus* (1 ♂), *Rhus copallinum* (1 ♂).

85. *C. simulans* Cresson, 1868 - Sex: 2 ♂; Habitat: 1 Sa, 1 W; Locale: 1 I, 1 T; Solitary; Months: 1 Au, 1 S; Capture Method: 2 N; Floral Records: *Helianthus divaricatus* (1 ♂), *Solidago spp.* (1 ♂); Additional Floral Records: *Solidago speciosa*.

86. *C. thoracicus* Smith, 1853 (Extra) - Sex: 1 ♀; Habitat: 1 X; Locale: 1 I; Sand; Solitary; Months: 1 M; Capture Method: 1 N; Floral Records: *Lupinus perennis* (1 ♂).

87. *C. validus* Cresson, 1868 - Sex: 4 ♂; Habitat: 4 W; Locale: 4 T; Solitary; Months: 4 Ap; Capture Method: 4 N; Floral Records: *Vaccinium spp.* (3 ♂), *Viola pedata* (1 ♂); Additional Floral Records: *Gaylussacia baccata*.

88. *Hylaeus (Hylaeus) annulatus* (Linnaeus, 1758) - (Extra) - Sex: 1 ♀, 1 ♂; Habitat: 2 X; Locale: 2 I; Solitary; Months: 2 Ji; Capture Method: 2 N; Floral Records: *Saururus cernuus* (1 ♂, 1 ♀). Indiana record.

90. **H. (H.) saniculae** (Robertson, 1896) - Sex: 1 ♀; Habitat: 1 Sa; Locale: 1 H; Solitary; Months: 1 M; Capture Method: 1 N; Floral Records: *Erigeron annuus* (1 ♀).

91. **Hylaeus (Prospis) affinis** (Smith, 1853) – (Males only) Sex: 3 ♀; Habitat: 3 W; Locale: 3 I; Solitary; Months: 1 M, 2 Au; Capture Method: 2 N, 1 Y; Floral Records: *Helianthus divaricatus* (1 ♀), *Rhus copallinum* (1 ♀).

92. **H. (P.) modestus** Say, 1837 - (Males only) Sex: 21 ♀; Habitat: 5 O, 4 Sa, 5 W, 6 Sc, 1 F; Locale: 10 I, 11 T; Solitary; Months: 2 M, 1 Jn, 11 Jl, 7 Au; Capture Method: 18 N, 1 W, 1 Y, 1 B; Floral Records: *Erigeron strigosus* (1 ♀), *Melilotus officinalis* (3 ♀), *Monarda punctata* (1 ♀), *Rhus copallinum* (10 ♂), *Rubus allegheniensis* (1 ♂), *Solidago spp.* (2 ♂); Additional Floral Records: *Apocynum androsaemifolium*, *Eryngium yuccifolium*, *Euphorbia corollata*, *Spiraea alba*.


### HALICHTIDAE


96. *A. (P.) sumptuosa* (Smith, 1853) - Sex: 13 ♀, 1 ♂; Habitat: 7 O, 2 Sa, 4 W, 1 Sc; Locale: 12 I, 2 T; Sand; Solitary; Months: 3 Jn, 6 Jl, 5 Au; Capture Method: 10 N, 1 W, 1 Y, 2 B; Floral Records: *Asclepias tuberosa* (1 ♀), *Coreopsis tripteris* (1 ♀), *Erigeron strigosus* (1 ♀), *Monarda fistulosa* (1 ♀), *M. punctata* (3 ♀, 1 ♂), *Tephrosia virginiana* (2 ♀).

97. *Agapostemon* (Agapostemon) *sericeus* ( Förster, 1771) - Sex: 2 ♀; Habitat: 2 Sa; Locale: 2 I; Solitary; Months: 1 M, 1 S; Capture Method: 1 N, 1 B; Floral Records: *Phlox pilosa* (1 ♀); Additional Floral Records: *Coreopsis tripteris*, *Ionaictis linearifolius*, *Lythrum salicaria*, *Symphyotrichum dumosum*.


99. *A. (A.) texanus* Cresson, 1872 - Sex: 11 ♀; Habitat: 3 O, 6 W, 2 Sc; Locale: 11 I; Solitary; Months: 2 M, 7 Jn, 2 Jl; Capture Method: 4 W, 1 Y, 6 B.

100. *A. (A.) virescens* (Fabricius, 1775) - Sex: 35 ♀, 4 ♂; Habitat: 27 O, 6 Sa, 3 W, 2 Sc, 1 F; Locale: 36 I, 3 T; Solitary; Months: 1 M, 16 Jn, 17 Jl, 4 Au, 1 S; Capture Method: 5 N, 4 W, 20 Y, 10 B; Floral Records: *Liatris aspera* (1 ♂), *Solidago spp.* (2 ♀), *Symphyotrichum spp.* (1 ♂), *Tephrosia virginiana* (1 ♂).

101. *Halictus* (Nealicus) *parallelus* Say, 1837 - Sex: 1 ♀; Habitat: 1 O; Locale: 1 T; Eusocial; Months: 1 Jn; Capture Method: 1 B.

103. Halictus (Protohalictus) rubicundus (Christ, 1791) - Sex: 8 ♀; Habitat: 3 O, 2 Sa, 1 W, 2 Sc; Locale: 8 I; Eusocial; Months: 1 Ap, 1 M, 4 Jn, 1 Jl, 1 Au; Capture Method: 3 N, 2 W, 2 Y, 1 B; Floral Records: *Leucanthemum vulgare* (1 ♀), *Liatris aspera* (1 ♀), *Solidago spp.* (1 ♀).

104. Halictus (Seladonia) confusus Smith, 1853 - Sex: 4 ♀, 1 ♂; Habitat: 2 O, 2 Sa, 1 F; Locale: 4 I, 1 T; Eusocial; Months: 1 Ap, 3 Jn, 1 Au; Capture Method: 1 N, 2 W, 2 Y; Floral Records: *Solidago spp.* (1 ♀); Additional Floral Records: *Ionactis linariifolius*, *Lythrum salicaria*.

105. Lasioglossum (Dialictus) admirandum (Sandhouse, 1924) - Sex: 1 ♀; Habitat: 1 F; Locale: 1 I; Eusocial; Months: 1 Ap; Capture Method: 1 B.

106. L. (D.) near admirandum - Sex: 2 ♀; Habitat: 2 O; Locale: 2 I; Eusocial; Months: 2 Jn; Capture Method: 1 N, 1 B; Floral Records: *Trifolium hybridum* (1 ♀).

107. L. (D.) anomalum (Robertson, 1892) - Sex: 9 ♀, 1 ♂; Habitat: 7 O, 2 W, 1 F; Locale: 9 I, 1 T; Eusocial; Months: 4 M, 2 Jn, 4 Jl; Capture Method: 3 N, 3 W, 1 Y, 3 B; Floral Records: *Daucus carota* (1 ♀), *Erigeron annuus* (1 ♂), *Monarda fistulosa* (1 ♀).

108. L. (D.) atwoodi Gibbs, 2010 - Sex: 2 ♀; Habitat: 2 F; Locale: 2 I; Eusocial; Months: 2 Ap; Capture Method: 1 W, 1 Y. Indiana record.

109. L. (D.) bruneri (Crawford, 1902) - Sex: 21 ♀; Habitat: 1 O, 8 Sa, 6 W, 2 Sc, 4 F; Locale: 8 I, 13 T; Eusocial; Months: 2 Ap, 1 M, 1 Jn, 12 Jl, 2 Au, 3 S; Capture Method: 2 N, 10 W, 2 Y, 7 B; Floral Records: *Hieracium gronovii* (1 ♀), *Rhus copallinum* (1 ♀); Additional Floral Records: *Liatris cylindracea*, *Rubus hispidus*.

110. L. (D.) callidum (Sandhouse, 1924) - (Extra) - Sex: 7 ♀; Habitat: 7 X; Locale: 7 I; Eusocial; Months: 1 Ap, 1 M, 1 Jn, 2 Jl, 1 Au, 1 S; Capture Method: 4 N, 1 Y, 2 B; Floral Records: *Krigia biflora* (1 ♀), *Lupinus perennis* (1 ♀), *Pontederia cordata* (1 ♀), *Sagittaria graminea* (1 ♀).

111. L. (D.) cattellae (Ellis, 1913) - Sex: 5 ♀, 10 ♂; Habitat: 2 O, 11 Sa, 2 F; Locale: 15 I, Months: 1 Ap, 2 Jn, 1 Jl, 11 Au; Capture Method: 12 N, 1 W, 2 B; Floral Records: *Erigeron annuus* (1 ♂), *Solidago spp.* (2 ♂, 3 ♀); Additional Floral Records: *Solidago altissima*.

112. L. (D.) coeruleum (Robertson, 1893) - Sex: 39 ♀, 1 ♂; Habitat: 3 O, 10 Sa, 6 Sc, 21 F; Locale: 28 I, 12 T; Eusocial; Months: 8 Ap, 10 Jn, 15 Jl, 3 Au, 4 S;
Capture Method: 2 N, 17 W, 4 Y, 17 B; Floral Records: Salix spp. (1 φ), Solidago spp. (1 φ).

113. **L. (D.) cressonii** (Robertson, 1890) - Sex: 21 φ, 1 ♂; Habitat: 3 O, 7 Sa, 3 W, 7 Sc, 2 F; Locale: 15 I, 7 T; Eusocial; Months: 9 Jn, 9 Jl, 3 Au, 1 S; Capture Method: 4 N, 6 W, 4 Y, 8 B; Floral Records: Aureolaria pedicularia (1 φ), Rosa carolina (1 φ), Solidago spp. (1 φ, 1 ♂); Additional Floral Records: Apocynum androsaemifolium, Aquilegia canadensis, Arabis lyrata, Doellingeria umbellata, Solidago speciosa, Taraxacum officinale.

114. **L. (D.) ellisiae** (Sandhouse, 1924) - Sex: 9 φ, 1 ♂; Habitat: 7 O, 2 Sa, 1 W; Locale: 10 I; Eusocial; Months: 1 M, 3 Jn, 4 Jl, 1 Au, 1 S; Capture Method: 2 N, 6 W, 2 Y; Floral Records: Euphorbia corollata (1 φ), Monarda punctata (1 φ); Additional Floral Records: Eupatorium perfoliatum, Heterotheca subaxillaris.

115. **L. (D.) ephialtum** Gibbs, 2010 - Sex: 2 φ; Habitat: 1 O, 1 Sc; Locale: 2 I; Eusocial; Months: 1 M, 1 Jl; Capture Method: 1 B, 1 U. Indiana record.

116. **L. (D.) fattigi** (Mitchell, 1960) - Sex: 1 φ; Habitat: 1 F; Locale: 1 T; Eusocial; Months: 1 Jn; Capture Method: 1 W.

117. **L. (D.) floridanum** (Robertson, 1892) - Sex: 126 φ, 2 ♂; Habitat: 39 O, 13 Sa, 62 W, 14 F; Locale: 18 I, 110 T; Eusocial; Months: 44 Ap, 13 M, 25 Jn, 26 Jl, 20 Au; Capture Method: 8 N, 34 W, 51 Y, 35 B; Floral Records: Aureolaria pedicularia (4 φ), Coreopsis palmata (1 φ), Euphorbia corollata (1 φ), Helianthus divaricatus (1 φ), Lupinus perennis (1 φ). Indiana record.

118. **L. (D.) foveolatum** (Robertson, 1902) - Sex: 69 φ, 2 ♂; Habitat: 8 O, 20 Sa, 36 W, 7 Sc; Locale: 31 I, 40 T; Sand; Eusocial; Months: 1 Ap, 18 M, 22 Jn, 15 Jl, 11 Au, 4 S; Capture Method: 24 N, 20 W, 10 Y, 17 B; Floral Records: Aureolaria pedicularia (1 φ), Ceanothus americanus (1 φ, 1 ♂), Euphorbia corollata (1 φ), Hieracium canadense (1 φ), Krigia virginica (1 φ), Monarda punctata (1 φ), Rhus copallinum (9 φ, 1 ♂), Rosa carolina (1 φ), Solidago spp. (5 φ), Tephrosia virginiana (1 φ); Additional Floral Records: Monarda fistulosa, Solidago canadensis, Tradescantia ohiensis, Zizia aurea.

119. **L. (D.) foxii** (Robertson, 1895) - Sex: 1 φ; Habitat: 1 Sc; Locale: 1 I; Solitary; Months: 1 Ap; Capture Method: 1 B.

120. **L. (D.) illinoense** (Robertson, 1892) - Sex: 8 φ; Habitat: 2 O, 4 Sa, 2 Sc; Locale: 4 I, 1 H, 3 T; Eusocial; Months: 2 Ap, 3 M, 2 Jn, 1 Au; Capture Method: 1 N, 1 W, 1 Y, 5 B; Floral Records: Tradescantia ohiensis (1 φ).

121. **L. (D.) imitatum** (Smith, 1853) - Sex: 1 φ; Habitat: 1 Sc; Locale: 1 I; Eusocial; Months: 1 Jl; Capture Method: 1 Y; Additional Floral Records: Eryngium yuccifolium, Packera aurea.

122. **L. (D.) laevissimum** (Smith, 1853) - Sex: 3 φ; Habitat: 1 Sa, 1 Sc, 1 F; Locale: 3 I; Eusocial; Months: 2 M, 1 Jl; Capture Method: 3 Y; Additional Floral Records: Saururus cernuus.

123. **L. (D.) leucocomum** (Lovell, 1908) - Sex: 96 φ, 4 ♂; Habitat: 37 O, 12 Sa, 41 W, 6 Sc, 4 X; Locale: 70 I, 30 T; Eusocial; Months: 6 Ap, 7 M, 37 Jn, 34 Jl, 14 Au, 2 S; Capture Method: 4 N, 27 W, 36 Y, 32 B, 1 U; Floral Records: Arabis lyrata (1 φ), Aureolaria pedicularia (1 φ), Hypericum perforatum (1 φ), Rhus copallinum (1 φ); Additional Floral Records: Asclepias verticillata.
124. *L. (D.) lineatum* (Crawford, 1906) - Sex: 4 ♀; Habitat: 1 O, 1 Sc, 2 F; Locale: 4 I; Eusocial; Months: 2 Ap, 1 Jl, 1 S; Capture Method: 1 W, 2 Y, 1 B.

125. *L. (D.) macoupinense* (Robertson, 1895) - Sex: 28 ♀, 1 ♂; Habitat: 2 O, 2 W, 16 Sc, 9 F; Locale: 18 I, 11 T; Solitary; Months: 5 Ap, 1 M, 20 Jn, 1 Jl, 2 Au; Capture Method: 2 N, 9 W, 8 Y, 10 B; Floral Records: *Rhus copallinum* (1 ♀), *Solidago* spp. (1 ♂); Additional Floral Records: *Hieracium gronovii*, *Pontederia cordata*.

126. *L. (D.) michiganense* (Mitchell, 1960) - (Extra) - Sex: 1 ♂; Habitat: 1 X; Locale: 1 I; Parasitic; Months: 1 Au; Capture Method: 1 N; Floral Records: *Solidago* speciosa (1 ♀).

127. *L. (D.) mitchelli* Gibbs, 2010 - Sex: 45 ♀, 3 ♂; Habitat: 19 O, 5 Sa, 6 W, 13 Sc, 5 F; Locale: 46 I, 1 H, 1 T; Eusocial; Months: 5 Ap, 1 M, 20 Jn, 1 Jl, 2 Au; Capture Method: 5 N, 9 W, 8 Y, 10 B; Floral Records: *Asclepias tuberosa* (1 ♀), *Erigeron annuus* (1 ♂), *Trifolium hybridum* (1 ♀); Additional Floral Records: *Hieracium gronovii*, *Pontederia cordata*.

128. *L. (D.) oblongum* (Lovell, 1905) - Sex: 31 ♀, 2 ♂; Habitat: 9 Sa, 3 W, 5 Sc, 16 F; Locale: 28 I, 5 T; Eusocial; Months: 17 Ap, 4 M, 6 Jn, 2 Jl, 4 Au; Capture Method: 6 N, 10 W, 6 Y, 11 B; Floral Records: *Aureolaria pedicularia* (1 ♀), *Rubus hispidus* (1 ♂), *Solidago* spp. (1 ♂, 2 ♀), *Tephrosia virginiana* (1 ♀); Additional Floral Records: *Lupinus perennis*.

129. *L. (D.) obscurem* (Robertson, 1892) - Sex: 2 ♀, 1 ♂; Habitat: 1 Sa, 1 Sc, 1 F; Locale: 2 I, 1 T; Eusocial; Months: 2 Jn, 1 Au; Capture Method: 1 N, 1 Y, 1 B; Floral Records: *Solidago* spp. (1 ♂); Additional Floral Records: *Saururus cernuus*.


131. *L. (D.) perpunctatum* (Ellis, 1913) - (Extra) - Sex: 1 ♀; Habitat: 1 X; Locale: 1 I; Eusocial; Months: 1 Au; Capture Method: 1 N; Floral Records: *Liatris aspera* (1 ♀).

132. *L. (D.) pictum* (Crawford, 1902) - Sex: 16 ♀; Habitat: 15 O, 1 W; Locale: 16 I; Sand; Eusocial; Months: 3 M, 1 Jn, 8 Jl, 4 S; Capture Method: 2 N, 5 W, 7 Y, 2 B; Floral Records: *Hypericum perforatum* (1 ♀), *Oenothera biennis* (1 ♀).

fistulosa (1♀), M. punctata (1♀, 1♂), Oenothera biennis (7♀), Opuntia humifusa (1♀), Pedicularis lanceolata (1♀), Potentilla recta (1♀), Rubus hispidus (1♀), Salix spp. (1♀), Solidago spp. (1♀), Tradescantia ohiensis (2♀); Additional Floral Records: Arabis lyrata, Hieracium gronovii.

134. L. (D.) platyparium (Robertson, 1895) - Sex: 1♀; Habitat: 1 O; Locale: 1 I; Parasitic; Months: 1 Jn; Capture Method: 1 B; Additional Floral Records: Solidago rugosa.

135. L. (D.) smilacinae (Robertson, 1899) - Sex: 4♀; Habitat: 1 O, 1 Sa, 1 Sc, 1 F; Locale: 1 I, 1 H, 2 T; Eusocial; Months: 1 Ap, 1 Jn, 1 Jl, 1 S; Capture Method: 1 N, 1 W, 2 B; Floral Records: Solidago spp. (1♀).

136. L. (D.) subviridatum (Cockerell, 1938) - Sex: 109♀, 1♂; Habitat: 7 O, 23 Sa, 20 W, 7 Sc, 53 F; Locale: 49 I, 61 T; Eusocial; Months: 29 Ap, 33 Jn, 37 Jl, 9 Au, 2 S; Capture Method: 8 N, 33 W, 25 Y, 44 B; Floral Records: Asclepias tuberosa (1♀), Monarda fistulosa (1♀), Rhus copallinum (1♀), Rudbeckia hirta (1♀), Solidago spp. (2♀), Symphyotrichum spp. (1♀), Tradescantia ohiensis (1♀).

137. L. (D.) taylorae Gibbs, 2010 - Sex: 1♀; Habitat: 1 F; Locale: 1 T; Eusocial; Months: 1 Au; Capture Method: 1 W. Indiana record.

138. L. (D.) timothyi Gibbs, 2010 - Sex: 6♀; Habitat: 3 Sa, 1 W, 2 F; Locale: 6 T; Eusocial; Months: 1 Ap, 3 Jn, 2 Jl; Capture Method: 1 N, 1 W, 4 B; Floral Records: Tephrosia virginiana (1♀). Indiana record.

139. L. (D.) versans (Lovell, 1905) - Sex: 3♀; Habitat: 1 Sa, 1 Sc, 1 F; Eusocial; Months: 1 Ap, 1 M, 1 Jn; Capture Method: 2 Y, 1 B.

140. L. (D.) versatum (Robertson, 1902) - Sex: 18♀; Habitat: 9 O, 4 Sa, 4 W, 1 Sc; Locale: 12 I, 6 T; Eusocial; Months: 3 Ap, 4 M, 5 Jn, 3 Jl, 2 Au, 1 S; Capture Method: 4 N, 3 W, 3 Y, 8 B; Floral Records: Daucus carota (1♀), Salix spp. (2♀), Solidago spp. (1♀); Additional Floral Records: Krigia biflora, Spiraea alba.


142. L. (D.) viridatum (Lovell, 1905) - Sex: 1♀; Habitat: 1 W; Locale: 1 I; Eusocial; Months: 1 Jn; Capture Method: 1 Y.

143. L. (D.) weemsi Mitchell, 1960 - Sex: 2♀; Habitat: 1 O, 1 Sc; Locale: 2 I; Eusocial; Months: 1 Jl, 1 Au; Capture Method: 1 N, 1 Y; Floral Records: Helianthus divaricatus (1♀). Indiana record.

144. L. (D.) zephyrum (Smith, 1853) - Sex: 2♀, 1♂; Habitat: 1 O, 1 Sa, 1 Sc; Locale: 2 I, 1 T; Eusocial; Months: 2 Au, 1 S; Capture Method: 2 N, 1 W; Floral Records: Rhus copallinum (1♀), Solidago spp. (1♂).

Lasioglossum (Evylaeus) fedorense (Crawford, 1906) - Sex: 14♀; Habitat: 13 O, 1 W; Locale: 14 I; Sand; Months: 13 M, 1 Au; Capture Method: 4 W, 2 Y, 8 B. Indiana record.
146. *L. (E.) nelumbonis* (Robertson, 1890) - (Extra) - Sex: 3 ♀; Habitat: 3 X; Locale: 3 I; Solitary; Months: 3 M; Capture Method: 1 W, 2 B.
147. *L. (E.) swenki* (Crawford, 1906) - Sex: 15 ♀; Habitat: 15 O; Locale: 15 I; Sand; Months: 14 M, 1 Jn; Capture Method: 6 W, 4 Y, 5 B.
148. *Lasioglossum (Hemihalictus) lustrans* (Cockerell, 1897) - Sex: 7 ♀; Habitat: 1 Sa, 5 W, 1 Sc; Locale: 6 I, 1 T; Sand; Solitary; Months: 1 M, 6 Jn; Capture Method: 7 N; Floral Records: *Krigia biflora* (6 ♀), *K. virginica* (1 ♀); Additional Floral Records: *Hieracium gronovii*.
150. *L. (L.) coriaceum* (Smith, 1853) - Sex: 36 ♀, 4 ♂; Habitat: 13 O, 15 Sa, 4 W, 1 Sc; Locale: 21 I, 10 H, 9 T; Solitary; Months: 1 Ap, 9 M, 17 Jn, 2 Jl, 7 Au, 4 S; Capture Method: 4 N, 13 W, 7 Y, 16 B; Floral Records: *Coreopsis tripteris* (1 ♂), *Solidago spp.* (1 ♂); Additional Floral Records: *Hieracium caespitosum, Krigia biflora, Rudbeckia hirta*.
151. *L. (L.) forbesii* (Robertson, 1890) - Sex: 1 ♀; Habitat: 1 O; Locale: 1 I; Solitary; Months: 1 B.
152. *L. (L.) fuscipenne* (Smith, 1853) - Sex: 2 ♀, 1 ♂; Habitat: 1 Sa, 1 W, 1 F; Locale: 3 I; Solitary; Months: 2 Jn, 1 S; Capture Method: 3 N; Floral Records: *Aureolaria pedicularia* (1 ♀), *Coreopsis lanceolata* (1 ♀, 1 ♂), *Tradescantia occidentalis* (1 ♂), *Hieracium caespitosum, Krigia biflora, Rudbeckia hirta*.
153. *S. aroniae* Mitchell, 1960 - Sex: 1 ♀; Habitat: 1 Sa; Locale: 1 I; Parasitic; Months: 1 Jn; Capture Method: 1 B.
154. *S. banksii* Lovell, 1909 - Sex: 8 ♀, 4 ♂; Habitat: 5 O, 3 Sa, 4 W; Locale: 7 I, 5 T; Sand; Parasitic; Months: 1 M, 3 Jn, 6 Jl, 2 Au; Capture Method: 4 N, 5 W, 3 Y; Floral Records: *Asclepias verticillata* (1 ♀), *Monarda punctata* (1 ♂), *Rhus copallinum* (1 ♂), *Solidago spp.* (1 ♂).
161. *S. mandibularis* Robertson, 1893 - Sex: 2 ♀; Habitat: 1 Sa, 1 F; Locale: 1 H, 1 T; Parasitic; Months: 1 Au, 1 S; Capture Method: 1 W, 1 Y; Additional Floral Records: *Solidago altissima*, *S. speciosa*.

162. *S. pimpinellae* Robertson, 1900 - Sex: 5 ♀; Habitat: 1 O, 4 Sa; Locale: 3 I, 2 T; Parasitic; Months: 2 M, 3 Jn; Capture Method: 1 W, 4 Y; Additional Floral Records: *Coreopsis lanceolata*.

163. *S. ranunculi* Robertson, 1897 - Sex: 1 ♀, 1 ♂; Habitat: 1 W, 1 Sc; Locale: 2 I; Parasitic; Months: 1 M, 1 Jn; Capture Method: 1 W, 1 B.

164. *Dieunomia (Dieunomia) heteropoda* (Say, 1824) - Sex: 16 ♀; Habitat: 2 Sa, 14 W; Locale: 16 T; Solitary; Months: 9 Jl, 7 Au; Capture Method: 16 N; Floral Records: *Helianthus divaricatus* (15 ♀), *Solidago spp.* (1 ♀).

**MEGACHILIDAE**

165. *Anthidiellum (Loyolanthidium) notatum* (Latraille, 1809) - Sex: 2 ♀; Habitat: 1 O, 1 W; Locale: 2 T; Solitary; Months: 2 Jl; Capture Method: 2 N; Floral Records: *Helianthus divaricatus* (2 ♀).

166. *Anthidium (Anthidium) psoralae* Robertson, 1902 - Sex: 1 ♂; Habitat: 1 Sa; Locale: 1 T; Solitary; Months: 1 Jn; Capture Method: 1 N; Floral Records: *Tephrosia virginiana* (1 ♀).

167. *Dianthidium (Dianthidium) simile* (Cresson, 1864) - Sex: 1 ♀; Habitat: 1 W; Locale: 1 I; Sand; Solitary; Months: 1 Au; Capture Method: 1 W.

168. *Stelis (Heterostelis) aff. grossa* - Sex: 1 ♀; Habitat: 1 O; Locale: 1 I; Parasitic; Months: 1 Jn; Capture Method: 1 N; Floral Records: *Helianthus annuus* (1 ♀).

169. *Stelis (Stelis) lateralis* Cresson, 1864 - (Extra) - Sex: 1 ♂; Habitat: 1 X; Locale: 1 I; Parasitic; Months: 1 Jn; Capture Method: 1 N; Floral Records: *Arabis lyrata* (1 ♀).

170. *Trachusa (Heteranthidium) zebrata* (Cresson, 1872) - Sex: 1 ♀; Habitat: 1 Sa; Locale: 1 I; Sand; Solitary; Months: 1 Au; Capture Method: 1 N; Floral Records: *Helianthus divaricatus* (1 ♀). Indiana record.

171. *Coelioxys (Boreocoeiloxys) octodontata* Say, 1824 - (Extra) - Sex: 1 ♀; Habitat: 1 X; Locale: 1 I; Parasitic; Months: 1 Au; Capture Method: 1 N; Floral Records: *Brickellia eupatorioides* (1 ♀).

172. *C. (B.) porterae* Cockerell, 1900 - Sex: 1 ♂; Habitat: 1 Sc; Locale: 1 I; Parasitic; Months: 1 Jn; Capture Method: 1 B.

173. *C. (B.) sayi* Robertson, 1897 - Sex: 1 ♂; Habitat: 1 W; Locale: 1 I; Parasitic; Months: 1 Au; Capture Method: 1 N; Floral Records: *Aureolaria pedicularia* (1 ♀); Additional Floral Records: *Asclepias tuberosa*.

174. *Coelioxys (Coelioxys) immaculata* Cockerell, 1912 - (Extra) - Sex: 1 ♀; Habitat: 1 X; Locale: 1 I; Parasitic; Months: 1 Jn; Capture Method: 1 N; Floral Records: *Tephrosia virginiana* (1 ♀).

175. *Coelioxys (Cyrtoceiloxys) modesta* Smith, 1854 - Sex: 3 ♂; Habitat: 1 O, 2 W; Locale: 3 T; Parasitic; Months: 2 Jl, 1 Au; Capture Method: 3 N; Floral Records: *Helianthus divaricatus* (3 ♂); Additional Floral Records: *Lythrum salicaria*.

176. *Coelioxys (Synocoeiloxys) alternata* Say, 1837 - Sex: 4 ♀, 3 ♂; Habitat: 4 Sa, 3 W; Locale: 3 I, 4 T; Parasitic; Months: 4 Jl, 3 Au; Capture Method: 7 N;
Floral Records: *Coreopsis tripteris* (2 ♀), *Helianthus divaricatus* (1 ♀, 3 ♂), *Solidago* spp. (1 ♀); Additional Floral Records: *Rudbeckia hirta*.

177. *Megachile (Chelostomoides) campanulae* (Robertson, 1903) - Sex: 1 ♀, 6 ♂; Habitat: 2 O, 1 Sa, 1 W, 1 Sc, 2 F; Locale: 5 I, 2 T; Solitary; Months: 1 M, 2 Jl, 4 Au; Capture Method: 5 N, 1 W, 1 B; Floral Records: *Asclepias tuberosa* (1 ♂), *Coreopsis palmata* (1 ♂), *Coronilla varia* (1 ♂), *Helianthus divaricatus* (1 ♂), *Solidago* spp. (1 ♂); Additional Floral Records: *Campanula rotundifolia, Lespedeza capitata*.

178. *Megachile (Leptorachis) petulans* Cresson, 1878 - (Extra) - Sex: 4 ♀; Habitat: 4 X; Locale: 4 I; Solitary; Months: 1 Jn, 2 Jl, 1 Au; Capture Method: 4 N; Floral Records: *Eryngium yuccifolium* (2 ♂), *Helianthus divaricatus* (1 ♂), *Tradescantia ohiensis* (1 ♀).

179. *Megachile (Litomegachile) brevis* Say, 1837 - Sex: 2 ♀; Habitat: 2 O; Locale: 2 I; Solitary; Months: 1 Au, 1 S; Capture Method: 1 N, 1 B; Floral Records: *Liatris aspera* (1 ♀); Additional Floral Records: *Desmodium paniculatum*.


181. *M. (L.) texana* Cresson, 1878 - (Extra) - Sex: 2 ♀; Habitat: 2 X; Locale: 2 I; Solitary; Months: 1 Jn, 1 Au; Capture Method: 2 N; Floral Records: *Desmodium paniculatum* (1 ♀), *Tephrosia virginiana* (1 ♀).

182. *Megachile (Megachile) montivaga* Cresson, 1878 - Sex: 4 ♀; Habitat: 3 O, 1 Sa; Locale: 2 I, 2 T; Solitary; Months: 2 Jn, 2 Jl; Capture Method: 1 N, 1 W, 2 Y; Floral Records: *Aureolaria pedicularia* (1 ♀); Additional Floral Records: *Hypericum kalmianum, Liatris aspera, Oenothera fruticosa*.

183. *M. (M.) relativa* Cresson, 1878 - Sex: 1 ♀; Habitat: 1 Sa; Locale: 1 I; Solitary; Months: 1 Jl; Capture Method: 1 W; Additional Floral Records: *Oenothera fruticosa*.

184. *Megachile (Megachiloides) dakotensis* Mitchell, 1926 - Sex: 2 ♀; Habitat: 2 O; Locale: 2 I; Sand; Solitary; Months: 2 Jl; Capture Method: 2 Y; Additional Floral Records: *Monarda punctata*.

185. *Megachile (Sayapis) frugalis* Cresson, 1872 - (Extra) - Sex: 1 ♀; Habitat: 1 X; Locale: 1 I; Solitary; Months: 1 Jn; Capture Method: 1 N; Floral Records: *Asclepias tuberosa* (1 ♀).

186. *M. (S.) inimica* Cresson, 1872 - Sex: 5 ♀, 4 ♂; Habitat: 1 O, 3 Sa, 4 W, 1 Sc; Locale: 6 I, 3 T; Solitary; Months: 2 Jl, 7 Au; Capture Method: 9 N; Floral Records: *Helianthus divaricatus* (5 ♀, 3 ♂), *Vernonia gigantea* (1 ♀); Additional Floral Records: *Liatris aspera*.

187. *M. (S.) pugnata* Say, 1837 - Sex: 1 ♀; Habitat: 1 W; Locale: 1 I; Solitary; Months: 1 Jl; Capture Method: 1 N; Floral Records: *Helianthus divaricatus* (1 ♀); Additional Floral Records: *Coreopsis tripteris, Rudbeckia hirta*.
188. *Megachile (Xanthosarus) addenda* Cresson, 1878 - Sex: 9 ♀, 4 ♂; Habitat: 3 Sa, 9 W, 1 Sc; Locale: 10 I, 3 T; Solitary; Months: 8 Jn, 4 Jl, 1 Au; Capture Method: 3 N, 3 W, 5 Y, 2 B; Floral Records: *Campanula rotundifolia* (1 ♀), *Coronilla varia* (1 ♀), *Tephrosia virginiana* (1 ♀).

189. *M. (X.) gemula* Cresson, 1878 - Sex: 4 ♂; Habitat: 1 O, 3 Sa; Locale: 1 I; Solitary; Months: 1 Jn, 3 Au; Capture Method: 2 W, 1 Y, 1 B; Additional Floral Records: *Tephrosia virginiana*.

190. *M. (X.) mucida* Cresson, 1878 - Sex: 1 ♂; Habitat: 1 O; Locale: 1 I; Solitary; Months: 1 Jn; Capture Method: 1 Y.

191. *Chelostoma (Prochelostoma) philadelphi* (Robertson, 1891) - Sex: 1 ♂; Habitat: 1 Sa; Locale: 1 I; Solitary; Months: 1 M; Capture Method: 1 N; Floral Records: *Krigia biflora* (1 ♂).

192. *Heriades (Neotrypetes) carinatus* Cresson, 1864 - Sex: 1 ♀; Habitat: 1 W; Locale: 1 I; Solitary; Months: 1 Jl; Capture Method: 1 N; Floral Records: *Monarda fistulosa* (1 ♀); Additional Floral Records: *Apocynum androsaemifolium*, *Monarda punctata*.

193. *H. (N.) variolosus* (Cresson, 1872) - Sex: 10 ♀, 4 ♂; Habitat: 2 Sa, 6 W, 5 Sc, 1 F; Locale: 9 I, 5 T; Solitary; Months: 5 Jl, 5 Au, 4 S; Capture Method: 13 N, 1 W; Floral Records: *Hieracium gronovii* (1 ♀), *Melilotus officinalis* (1 ♂), *Solidago spp.* (7 ♀, 2 ♂), *Symphyotrichum spp.* (1 ♀).

194. *Hoplitis (Alcidamea) pilosifrons* (Cresson, 1864) - Sex: 10 ♂, 3 ♀; Habitat: 9 O, 3 Sa, 1 W; Locale: 10 I, 3 T; Solitary; Months: 3 M, 4 Jn, 6 Jl; Capture Method: 5 W, 3 Y, 5 B; Additional Floral Records: *Nuttallanthus canadensis*, *Pontederia cordata*.

195. *H. (A.) producta* (Cresson, 1864) - Sex: 5 ♂, 2 ♀; Habitat: 7 O, 7 Sa, 4 W, 8 Sc; Locale: 15 I, 11 T; Solitary; Months: 15 M, 8 Jn, 3 Jl; Capture Method: 12 W, 8 Y, 6 B; Additional Floral Records: *Arabis lyrata*, *Oenothera fruticosa*, *Rubus hispidus*.

196. *Osmia (Diceratosmia) conjuncta* Cresson, 1864 - (Extra) - Sex: 3 ♀; Habitat: 3 X; Locale: 3 I; Solitary; Months: 3 M; Capture Method: 3 B.

197. *Osmia (Helicosmia) georgica* Cresson, 1878 - Sex: 2 ♀; Habitat: 1 Sa, 1 W; Locale: 1 I, 1 T; Solitary; Months: 2 Jn; Capture Method: 2 W; Additional Floral Records: *Coreopsis lanceolata*, *Krigia biflora*.

198. *Osmia (Melanosmia) atriventris* Cresson, 1864 - Sex: 6 ♀, 18 ♂; Habitat: 8 O, 4 Sa, 1 W, 7 Sc, 4 F; Locale: 19 I, 5 T; Solitary; Months: 16 Ap, 6 M, 1 Jn, 1 Jl; Capture Method: 1 N, 12 W, 3 Y, 7 B, 1 U; Floral Records: *Viola pedata* (1 ♀).

199. *O. (M.) bucephala* Cresson, 1864 - Sex: 1 ♀; Habitat: 1 F; Locale: 1 T; Solitary; Months: 1 Ap; Capture Method: 1 B; Additional Floral Records: *Geranium maculatum*, *Krigia biflora*, *Lupinus perennis*, *Phlox pilosa*.

200. *O. (M.) distincta* Cresson, 1864 - Sex: 3 ♀, 1 ♂; Habitat: 1 O, 3 Sa; Locale: 4 T; Solitary; Months: 2 M, 2 Jn; Capture Method: 1 W, 2 Y, 1 B.

201. *O. (M.) michiganensis* Mitchell, 1962 - Sex: 15 ♂; Habitat: 14 O, 1 Sa; Locale: 15 I; Solitary; Months: 4 Ap, 7 Jn, 4 Jl; Capture Method: 3 W, 2 Y, 10 B.

202. *O. (M.) pumila* Cresson, 1864 - Sex: 33 ♂, 29 ♀; Habitat: 10 O, 6 Sa, 6 W, 16 Sc, 24 F; Locale: 44 I, 1 H, 17 T; Solitary; Months: 32 Ap, 18 M, 9 Jn, 3 Jl; Capture Method: 3 N, 27 W, 22 Y, 10 B; Floral Records: *Helianthus divaricatus* (1 ♀), *Lupinus perennis* (1 ♀), *Rubus allegheniensis* (1 ♀); Additional
Floral Records: 
Gaylussacia baccata, Krigia biflora, Oenothera fruticosa, Rubus hispidus, Tephrosia virginiana.

203. O. (M.) virga Sandhouse, 1939 - (Extra) - Sex: 1 ♀; Habitat: 1 X; Locale: 1 I; Solitary; Months: 1 M; Capture Method: 1 N; Floral Records: Gaylussacia baccata (1 ♀).

MELITTIDAE

204. Hesperapis carinata Stevens, 1919 - Sex: 2 ♂; Habitat: 1 O, 1 Sc; Locale: 2 I; Solitary; Months: 2 Au; Capture Method: 2 N; Floral Records: Coreopsis tripteris (1 ♂), Helianthus annuus (1 ♂). Indiana record.

Characteristics of the Northwest Indian Bee Fauna: Summary and Discussion of the Checklist

We identified 175 bee species along the woody vegetation gradient at the 25 collection sites plus 29 additional species during the additional 2010 surveys. The 204 bee species identified overall in this study are distributed among 36 genera and all 6 North American families, and represent about 49% of the Indiana bee flora documented in publications and museum records (Montgomery, 1957; Jean, 2010). The high percentage of the entire state’s fauna in a relatively small area may be due to the variety of habitats present in the Indiana Dunes region and across northwest Indiana, the high plant diversity of the region (Wilhelm, 1990; Pavlovic and Bowles, 1996), and the sandy soils that are used for nesting by many bee species.

We compared the similarity of the northwest Indiana bee fauna at the 25 sites to published bee faunas from (1) the Chicago region, including collection sites within the Indiana Dunes, from the 1930s (Pearson, 1933), (2) the New Jersey Pine Barrens, a sandy, barrens preserve (Winfree et al., 2007), (3) Michigan highbush blueberry (Vaccinium corymbosum L.) fields (Tuell et al., 2009), (4) Minnesota prairies (Reed, 1995), (5) an eastern New York forest (Giles and Ascher, 2006), (6) Nova Scotia (Sheffield et al., 2009), (7) Boulder, Colorado grasslands (Kearns and Oliveras, 2009), (8) Louisiana pine savannas (Bartholomew et al., 2006), and (9) the Florida Everglades (Pascarella et al., 1999) (Fig. 1). Similarities ranged from 60% (Chicago region) to 19% (Florida Everglades) and decreased about 1.3% per 100 km separation between sites. Of the bee species in our study with distribution information available on the Discover Life website as of July 2011 (Ascher and Pickering, 2011) (n = 200), 99% have additional capture records from the Midwest (including the states of Illinois, Indiana, Iowa, Kansas, Michigan, Minnesota, Missouri, Nebraska, North Dakota, South Dakota, Ohio and Wisconsin), 97% the Northeast, 84% the South, and 62% the West (west of the 100th meridian). Thus, the northwest Indiana bee fauna has fewer species that also occur in the western U.S than occur in the other regions of the U.S.

Bees found in northwest Indiana included species with a variety of geographic distributions (Ascher and Pickering, 2011). For example, Trachusa zebrata and Hesperapis carinata have been found mainly west of Indiana Dunes and ours are among the few records of these species in the eastern U.S. Andrena canadensis is generally a more northern species, near the southern edge of its range in Indiana. Lasioglossum floridanum, L. leucocomum, and L. pilosum are three morphologically similar species (Gibbs, 2010). Our collecting area may straddle geographical
boundaries of these species in that *L. floridanum* was collected mainly from our southernmost sites (Tefft Savanna/Jasper-Pulaski) south of the Kankakee River, *L. pilosum* nearly exclusively from our northernmost sites (Indiana Dunes), and *L. leucocomum* more evenly divided in our collections between the northern and southern sites. The Kankakee River is the approximate divide between the Northwestern Morainal and Grand Prairie Natural Regions of Indiana (Homoya, 1997), with the Grand Prairie representing an historic tallgrass prairie peninsula and the Northwestern Morainal being a biologically diverse lake plain along the southern shore of Lake Michigan (Post, 1997a, b). *Colletes thoracicus* is a more southern species near the northwest extent of its known range at INDU, perhaps occurring at Indiana Dunes due to the sandy soils. We found that at least 23 (11%) of the species in the checklist, and likely more, are strongly associated with sandy substrates. These sand associates included six *Perdita* and seven *Lasioglossum* species. It is likely that other species, such as other *Lasioglossum*, are sand associates but we currently do not have sufficient observations to confirm that notion.

Although the northwest Indiana bee fauna was most similar to Pearson’s (1933) Chicago area collections that included the Indiana Dunes, some significant differences may have arisen in the seventy years since Pearson’s surveys. One possible change that would be of considerable concern is the number of bumblebee species (*Bombus*) in our collection. We collected six *Bombus* species while Pearson collected at least twelve. Sixteen *Bombus* species are known for Illinois (Grixti *et al.*, 2009) and for northern Indiana (Jean, 2010). *Bombus* species not found in our
collection included three species, *affinis*, *fraternus*, and *pensylvanicus* that Grixti et al. (2009) found were present in fewer locations in Illinois today than in the early part of the twentieth century, and are, therefore, of special concern (Colla and Packer, 2008).

Although it is often assumed for bees that females are the chief pollinators of plants, male use of flowers is not well documented (Cane, 2002). In our 25 site surveys, we found 179 plant taxa (168 identified to species and 11 identified to genus) within 5 m of the center of the nine bowl triplets during bowl trapping and netting surveys. Of these, 146 plant species were present during netting surveys. We found bees on 84 of these 146 plant species (47%). Of the 1457 bees that we netted on flowers from these 84 plant species, 437 bees (30%) were males, and 1020 (70%) were females (including 6 queens and 226 workers). Chi-square analysis of the 2 × 84 table of sex by plant species indicated that the capture rates of males and females on the plants, overall, were independent of each other ($\chi^2 = 244$, d.f. = 82, $P < 0.001$), suggesting that males and females differed in the rates at which they visited different plant species. The largest deviations (highest adjusted standardized residuals in the chi-square analysis (SPSS, 2004)) from expected proportions of males and females captured on a given plant species included a relative overabundance of male bees on *Asclepias tuberosa* (butterfly milkweed), *Helianthus divaricatus* (woodland sunflower), and *Solidago* spp. (goldenrods) and a relative female overabundance on *Aureolaria pedicularia* (fernleaf false foxglove), *Oenothera biennis* (common evening primrose), and *Rubus hispidus* (bristly dewberry). A possible reason why males and females might differ in use of flowers is that males of social bee species are often in flight for a shorter portion of the season than are females. Therefore, flowers of some plant species might be available to females but not to males. In addition, females are seeking out pollen and nectar while males are mainly seeking out nectar, so male bees may seek flowers with large nectar rewards while females seek particular pollens in addition to nectar.

The frequency with which bees were captured in bowl traps of different colors exhibited a temporal pattern, with captures in yellow bowls declining, blue bowls increasing, and white bowls remaining steady as surveys progressed from spring to fall (Fig. 2). The proportion of bees captured in different color bowls differed significantly by habitat ($\chi^2 = 56$, d.f. = 8, $P < 0.001$) with the largest deviation from expected proportions (highest adjusted standardized residuals) being a higher rate of capture in yellow bowls in open habitats than expected by chance. Relative to females, male bees were more likely to be captured by netting (30% of netted individuals were males, $n = 1457$ captures) than in bowl traps (17% of bowl trapped individuals were males, $n = 3117$ captures) ($\chi^2 = 96$, d.f. = 1, $P < 0.001$). The percentage of collected individuals that were males was lowest in mid-season, June for netting, July for bowl trapping (Fig. 3).

Using published records (Mitchell, 1960; Giles and Ascher, 2006; Michener, 2007; Wolf and Ascher, 2008) to classify the life histories of the bees in this study, we estimate that about 22% of the bee species in our checklist were eusocial, 59% solitary or subsocial, and 19% parasitic. The percentage of bee species parasitic on other bee species, 19%, was similar to the 12–24% range reported from other eastern and Midwest U.S. sites by Bartholomew et al. (2006).

The number of bee species collected increased from April to June then remained at high levels before declining in September (Fig. 4). Species density, adjusted for
sample size differences among months, exhibited a similar pattern, peaking in June and declining through the rest of the summer. Species richness, adjusted to a common number of individuals taken per month, tended to be stable across most of the spring and summer, gradually rising to a peak in September. This suggests that the number of species found per unit area was highest early in the year (June) while the total number of species occurring across larger areas was highest later in the summer (September).

Differences in capture frequency in time are summarized for the 25 sites, by genus, in Fig. 5. Many genera could be classified as having adults predominantly captured early (Andrena, Ceratina, Colletes, Hoplitis, Nomada, Osmia) or late (Apis, Augochlora, Halictus, Megachile, Melissodes, Perdita) in the year, where early in northwest Indiana is April and May while late is August and September. Other genera exhibited a mid-season (June and July) peak (Agapostemon, Augochoropsis, Hylaeus), gradual decline throughout the year (Augochlorella, Lasioglossum, Sphecodes), and declines then increases (Bombus, Epeolus).

Although different species within a genus may exhibit different habitat affinities (Grundel et al., 2010), general habitat affinity patterns within this collection were observed by genus for the 25 sites (Fig. 6). Most genera generally declined in capture rate with increasing canopy cover, although several (Andrena, Augochlora, Colletes, Epeolus, Melissodes) peaked at intermediate or high canopy covers, and a few (Nomada, Osmia) were least frequently captured at intermediate canopy covers. The general decrease in capture rate with increasing canopy cover is consistent with the fact that flowering of ground level plants is mainly limited to the time prior to tree leaf out in high canopy sites (Grundel et al., 2010).

Including floral records from additional 2010 surveys, the most plant species on which a bee species was observed was 60 plant species by Augochlorella aurata. The
Fig. 4. Bee species collected, estimated species richness, and estimated species density in northwest Indiana, by month. Species collected represents all bee species collected in a given month regardless of sampling intensity, species richness is estimated number of bee species present per 335 individuals collected, and species density is estimated number of bee species present per 10 samples collected.
maximum number of plant species bee species were found on plateaued, on average, at about 24 plant species across the 25 sites (Fig. 7). Few bee species netted more than three times were captured on a single plant species. An exception was *Perdita gerhardi*, of which we captured 27 individuals, all from *Monarda punctata* (Lamiaceae). Although 55 bee species were observed on *Solidago* spp., the single plant species on which we observed the most bee species (36) across the 25 sites was woodland sunflower, *Helianthus divaricatus*. Again across the 25 sites, the average number of bee species observed per plant species (±standard deviation), for plants identified to species, was \(5.5 \pm 6.1\) (range 1–36) while the average number of plant species on which a given bee species was captured was \(4.3 \pm 5.8\) (range 1–35) for bees netted at least once from a plant species.

About half of the bee species captured were from four genera, *Lasioglossum* (\(n = 50\) or 25% of the 204 species in the checklist), *Andrena* (30 or 15%), *Megachile* (14 or 7%), and *Nomada* (13 or 6%). In comparison, about 22% of the recently described Wisconsin bee fauna were *Andrena* species and 15% *Lasioglossum* (Wolf and Ascher, 2008). Percentages similar to Wisconsin’s have been found for the overall Indiana bee fauna (Jean, 2010), suggesting either many more *Andrena* species are yet to be

Fig. 5. Relative capture rates of different bee genera by month (April (4) to September (9)) in northwest Indiana.
discovered in northwest Indiana or that northwest Indiana is a region particularly rich in *Lasioglossum* species. Recent taxonomic revisions for *Lasioglossum* mean we have identified *Lasioglossum* species that many past researchers overlooked or misidentified, adding to our species total for that genus (Gibbs, 2010, in press).

When comparing the bee species list for northwest Indiana to historic lists, researchers should consider such recent changes in bee species taxonomy, including (1) recent revision of the genus *Ceratina* (Apidae) (Rehan and Sheffield, 2011) that allowed us to separate *Ceratina* specimens into three species, *calcarata*, *dupla*, and *mikmaqi* that in the past might have been lumped as *C. calcarata/dupla*. (2) Several *Lasioglossum* species that have recently been named (*L. atwoodi*, *L. ephialtum*, *L. mitchelli*, *L. taylorae*, and *L. timothyi*) (Gibbs, 2010). These new species have most assuredly been mixed with other species in past surveys and museum records. (3) We suspect that some species in our list, such as *Lasioglossum subviridatum*, include specimens from more than one species. *Lasioglossum near admirandum* is similar, but distinct, from *L. admirandum* and remains to be classified. (4) Several species have undergone recent name changes including (a) *Lasioglossum foveolatum* (Robertson, fig. 6. Distribution of bee genera specimens among northwest Indiana habitats (Habitat 1 = Open, 2 = Savanna, 3 = Woodland, 4 = Scrubland, 5 = Forest).
1902) for which females have historically been referred to as *L. supraclypeatum* (Mitchell, 1960); (b) *L. versatum* in our checklist is synonymous with *L. rohweri* used in previous studies. Mitchell (1960) and subsequent authors commonly used *versatum* to refer to a species with wide front trochanters; now known as *L. callidum*; (c) In the past, many *L. mitchelli*, an eastern US species with a complete acarinarium and light tegulae, were incorrectly identified as *L. admirandum* (Gibbs, 2010); (d) *L. floridanum*, *leucocomum*, and *pilosum* in the past may all have been identified as *L. pilosum* (Gibbs, 2010); (e) The list includes a *Stelis* specimen we refer to as *Stelis (Heterostelis) aff. grossa*. It is the largest *Stelis* yet recorded from Indiana and resembles *Stelis grossa*, a species known from the southeastern U.S.

The bee fauna of northwest Indiana, in summary, seems shaped by the confluence of habitats that characterize the central location of Indiana in the U.S. and North America. Together with the climate-moderating influence of Lake Michigan, this makes northwest Indiana a region of ecological transition in biogeographic perspective. Along with the sandy substrates of the dune landscape, this ecological transition is associated with a moderately rich and often substrate dependent bee fauna.

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