

Baseline wild bee surveys in Michigan Lakeplain Prairie and Prairie Fen natural communities



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Cover: Hill Creek Fen, August 2021. Photo by Logan Rowe.

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Abstract

Michigan's Lakeplain Prairie and Prairie Fen natural communities contain refugia for many at-risk species of insects, including species that are federally and state listed. Wild bees are a group of insects that are crucial for maintaining robust plant-pollinator communities. Numerous species of bees are presumed to be in decline. However, baseline community surveys are lacking but are needed to document the status of species occupying these natural communities. In 2021, Michigan Natural Features Inventory completed baseline wild bee surveys in Lakeplain Prairie (Lakeplain Wet-mesic Prairie and Lakeplain Wet Prairie) and Prairie Fens in Michigan using a combination of aerial netting and bowl trapping. A total of 1118 wild bees, representing 104 unique species, were collected during 2021 surveys, including new state records for *Dufourea marginata* and *Sphecodes nigricorpus*. The baseline inventory of wild bees in 2021 provide valuable information on species presence and floral resources used by the wild bee communities at these sites. Continued management of Lakeplain Prairie and Prairie Fen natural communities should take into consideration wild bee communities and strive to ensure populations maintain stable numbers. Additional baseline surveys are needed to document the wild bee communities of other natural communities in Michigan and would benefit the long-term conservation of species at risk of population decline.

Introduction

Lakeplain Prairie and Prairie Fen habitats serve as refuge for numerous at-risk wildlife species, including threatened and endangered species and multiple rare insect species (Cohen et al. 2015). With many insect species known to be in decline, these habitats remain critical in protecting extant populations against environmental pressures from anthropogenic disturbances, invasive species, and climate change, among other sources of pressure. As such, research that examines species persistence in occupied habitats is crucial to supporting long-term population viability and robust community structure, and to develop actions to mitigate the effects of species loss. Furthermore, with many pollinator species continuing to decline, having current pollinator population and community data is vital to facilitating proactive habitat and species management.

Wild bees (Hymenoptera: Anthophila) are a diverse group of pollinators that provide essential pollination services vital to the stability of global plant-pollinator communities (Potts et al 2010). Many species of bees are presumed to be in decline, likely as a result of synergistic properties from multiple environmental pressures experienced by a species (Potts et al. 2010, Winfree et al. 2010, Koh et al. 2016). In response, state and federal government agencies have taken initiative to mitigate species loss through various governmental policies, increased funding to promote healthy wild bee populations, and in some cases, providing legal protection for species of greatest conservation concern (i.e., listing under the Endangered Species Act) (United States 1983, Taylor et al. 2005). These decisions, in part, are informed by contemporary knowledge regarding species long-term population viability and geographic occupancy trends, specific habitat requirements, and life-history traits, which are supported by robust collection records and data sets for species of interest. However, in many parts of the United States, the necessary information to make inferences on a species' conservation status are lacking (Winfree 2010, Woodard et al. 2020, Fischer et al. 2021). This is particularly evident for rare species, primarily due to inadequate population level data to inform conservation decision making practices.



Figure 1. View of the Blazing Star Lakeplain Wet-mesic Prairie survey location on August 31st, 2021.

Michigan contains approximately 465 unique species of wild bees, which vary considerably in their abundance and distribution across the state. Gibbs et al. 2017 provides invaluable information on each species' occurrence, geographic distribution, and life history (when available). This rich data set can inform ongoing conservation planning and future analyses on trends in wild bee populations but can be improved upon by the collection of additional information and data regarding species occurrence and population persistence and habitat associations. It has been suggested that robust wild bee monitoring initiatives, that are standardized across space and time, are needed to meet the criteria necessary for making determinations on a species' conservation status. Furthermore, monitoring frameworks should target understudied, yet highly valuable ecosystems that may contain refugia for rare species or otherwise contain plant-pollinator communities buffered against the effects of increased environmental pressures. Currently, wild bee surveys in high-quality natural communities are lacking in Michigan yet are needed to acquire a baseline understanding of species occupancy and diversity, and to provide a basis for future conservation efforts that target species of greatest conservation need in these habitats.

In 2021, Michigan Natural Features Inventory (MNFI) partnered with United States Fish and Wildlife Service (USFWS) and the Great Lakes Restoration Initiative (GLRI) Pollinator Task Force to complete standardized wild bee community surveys two high-quality natural community types in Michigan known to harbor numerous rare pollinator species: Lakeplain Prairies and Prairie Fens. Surveys consisted of standardized meander wild bee surveys and bowl traps. The objectives of this project were to 1) develop a baseline dataset of wild bee species richness and abundance in Michigan Prairie Fen and Lakeplain Prairie habitats, 2) to characterize the flowering plant communities used by foraging wild bees in these natural community types, and 3) to identify any rare wild bee species that occupy Lakeplain Prairies and Prairie Fens in Michigan.



Figure 2. View of the Brandt Road Prairie Fen on September 1st, 2021.

Methods

Lakeplain Prairie and Prairie Fen survey locations were selected by referring to the Michigan Natural Heritage Database (Figure 1, Figure 2). Element Occurrences (EOs) for these high-quality natural communities were extracted from the database and assessed using the EO rank value (overall quality of the EO based on an assessment of estimated the ecological integrity of the natural community) (MNFI 2021). A total of five Lakeplain Prairie and five Prairie Fen EOs were selected for wild bee surveys. However, after initial site visits, and due to poor site quality at one Lakeplain Prairie location, one Lakeplain Prairie survey site was excluded and replaced by a sixth Prairie Fen site (Figure 4, Table 1).



Figure 3. Michigan Natural Features Inventory technician, Molly Fava, completing aerial surveys for wild bees at Geiger to Haist Road Lakeplain Wet-mesic Prairie on August 30th, 2021.

Wild bee meander surveys with aerial net collections

Standardized meander surveys were conducted between 7/27/2021 and 7/29/2021 and again between 08/30/2021 and 09/02/2021. At each site, 1-2 surveyors walked the flowering habitat for a total of 2 person hours collecting any wild bees encountered (Figure 3). Bees were generally collected during floral visits. However, some specimens were collected during flight. When possible, the flowering host was recorded. Collected specimen were stored in small plastic vials with the following information: site, date of collection, floral host, and name of collector.

Bowl trap collections

Bowl traps were placed at each survey site in late July for a total of 48 hours and collected from each site between 7/27/2022 and 7/30/2022. Bowls were placed again in late August and collected between 08/31/2022 and 09/02/2022. At each site, an array of 5 traps was placed within the general meander survey area. Each bowl trap set-up consisted of 3 plastic deli cups on a single PVC pole approximately 3 feet above ground level, or at the height of the local vegetation (Figure 5). A random selection of colors was used on each trap and included the colors blue, yellow, white, green, orange, or red. Each cup was filled halfway with soapy water to minimize the chance that a bee could escape once collected.



Figure 4. Map of Lakeplain Prairie (Lakeplain Wet-mesic Prairie and Lakeplain Wet Prairie) and Prairie Fen survey locations in 2021.

Specimen identifications

All specimens collected during surveys in 2021 were identified to the lowest possible taxonomic classification by Dr. Zachary Portman at the University of Minnesota.

Table 1. Each wild bee survey location in 2021 including Element Occurrence rank and the dates of first and second survey events.

Community Type	Site Name	X cor.	Y cor.	EO Rank	Aerial Survey		Bowl Trap Survey	
					First Survey	Second Survey	First Survey	Second Survey
Lakeplain Wet-mesic Prairie	Blazing Star Prairie	42.6534	-82.5187	NR	07/28/2021	09/01/2021	07/30/2021	09/02/2021
Lakeplain Wet-mesic Prairie	Geiger to Haist Roads	43.7955	-83.4131	C	07/27/2021	08/30/2021	07/29/2021	09/01/2021
Lakeplain Wet-mesic Prairie	King Road Prairie	42.1520	-83.2733	B	07/28/2021	08/31/2021	07/30/2021	08/31/2021
Lakeplain Wet Prairie	King to Dickerson Roads	43.6098	-83.6354	CD	07/27/2021	08/30/2021	07/27/2021	08/30/2021
Prairie Fen	Brandt Road Fen	42.8528	-83.4683	BC	07/29/2021	09/03/2021	07/30/2021	09/03/2021
Prairie Fen	Eaton Road Fen	42.7569	-83.5436	AB	07/30/2021	09/03/2021	07/28/2021	09/03/2021
Prairie Fen	Hill Creek Fen	42.6654	-85.4542	BC	07/27/2021	08/31/2021	07/27/2021	08/31/2021
Prairie Fen	Liberty Fen	42.0917	-84.4553	AB	07/26/2021	09/01/2021	07/26/2021	09/01/2021
Prairie Fen	Lime Lake	42.2493	-85.8299	B	07/26/2021	08/30/2021	07/29/2021	09/02/2021
Prairie Fen	Sarrett Nature Center	42.1611	-86.3796	C	07/27/2021	08/30/2021	07/29/2021	09/02/2021



Figure 5. (Right) Standard bowl trap set-up used during 2021 bowl trap surveys. (Left) Example of collected specimen in a single cup during bowl trap surveys.

Results

In 2021, we collected a total of 1118 wild bees during meander surveys. Lakeplain Prairie samples included 513 bees (64.13 bees per survey) while Prairie Fen samples included 605 bees (50.42 bees per survey). A total of 159 bees were collected in bee bowls, including 75 bees from Lakeplain Prairie sites (12.5 bees per survey) and 85 bees from Prairie Fens sites (10.5 bees per survey) (Table 2). A total of 104 unique bee species were observed during meander surveys. Lakeplain Prairie meander surveys produced 71 bee species while Prairie Fen meander surveys produced 75 bee species. Both natural community types had unique bee species found only within that natural community (34 unique bee species found at Lakeplain Prairie sites and 30 unique bee species found at Prairie Fen sites). The natural community types shared 40 bee species during meander surveys. Only two species were collected from bowl trap samples that were not also represented in meander surveys: *Lasioglossum anomalum* and *Lasioglossum bruneri* (Table 3).

Wild bees were collected from at least 40 different plant species blooming in Lakeplain Prairie or Prairie Fen habitats in 2021. The plant species which had the greatest number of visits included *Dasiphora fruticosa* (Shrubby cinquefoil; 153 individual bees collected), *Lythrum salicaria* (Purple loosestrife; 121 individual bees collected) and *Vernonia fasciculata* (Smooth ironweed; 71 individual bees collected). A total of 124 individual bees were collected from unidentified species of *Solidago* (Goldenrod) (Table 4). In Lakeplain Prairie, the most frequently visited plant species included *Vernonia fasciculata* (Smooth ironweed; 71 individual bees collected), *Lythrum salicaria* (Purple loosestrife; 70 individual bees collected), *Liatris spicata* (38 individual bees collected), *Pycnanthemum virginianum* (Mountain mint; 37 individual bees collected), and *Daucus carota* (Wild carrot; 24 individual bees collected). In Prairie fen, the most frequently visited plant species included *Eutrochium purpureum* (Joe-pye weed; 57 individual bees collected), *Lythrum salicaria* (Purple loosestrife; 51 individual bees collected), *Rudbeckia hirta* (Black-eyed Susan; 31 individual bees collected), *Liatris spicata* (27 individual bees collected), and *Spiraea alba* (White meadowsweet; 27 individual bees collected).

Full descriptions of rare and noteworthy wild bee specimen collected from Lakeplain Prairie and Prairie fen sites are included in the companion report titled *Report on the Identification of Bees for the Great Lakes Restorative Initiative*, produced by Zachary Portman and Daniel Cariveau (Portman and Cariveau, 2022). The Lakeplain Prairie and Prairie Fen sites surveyed in 2021 contained multiple rare and/or declining native bee species of interest. Two new state records for wild bees were collected from the Blazing Star Prairie in Algonac State Park: *Dufourea marginata* and *Sphecodes nigriscopus*. *Dufourea marginata* is a rare specialist of *Helianthus* sp. that was collected from *Helianthus giganteus*, while *S. nigriscopus* is an extremely rare cleptoparasite that was collected from *Pycnanthemum virginianum*. Additionally, a single *Bombus pensylvanicus* (G3G4, State Special Concern) was collected from *Centaurea stoebe* at King Road Prairie, a Lakeplain Wet-mesic Prairie site. This species has experienced an approximate 98% decline in Michigan (Wood et al. 2019), despite being once common across the state, particularly in southern Michigan (Husband et al. 1980).

Table 2. Wild bees collected during aerial surveys at Michigan Lakeplain Prairie and Prairie Fen sites in 2021.

Aerial Surveys		Lakeplain Prairie				Prairie Fen					
						</					

Aerial Surveys		Lakeplain Prairie		Prairie Fen								
Family	Full Name	Blazing Star Prairie	Geiger to Haist Roads	King Road Prairie	King to Dickerson Roads	Brandt Rd Fen	Eaton Road Fen	Hill Creek Fen	Liberty Fen	Lime Lake	Sarett Nature Center	Total
Andrenidae	<i>Pseudopanurgus (Pterosarus) andrenoides</i> (Smith, 1853)	2	6	3								11
Andrenidae	<i>Pseudopanurgus (Pterosarus) compositarum</i> (Robertson, 1893)	1		1								2
Apidae	<i>Anthophora (Clisodon) terminalis</i> Cresson, 1869				2		1			1	1	5
Apidae	<i>Anthophora (Melea) bomboides</i> Kirby, 1838									1	1	2
Apidae	<i>Apis (Apis) mellifera</i> Linnaeus, 1758	2	2	3	1	3	1	1	1	3	1	18
Apidae	<i>Bombus (Cullumanobombus) griseocollis</i> (De Geer, 1773)	3		1		1	1	4	2	1	1	14
Apidae	<i>Bombus (Cullumanobombus) rufocinctus</i> Cresson, 1863	1										1
Apidae	<i>Bombus (Psithyrus) citrinus</i> (Smith, 1854)	1			5	3						9
Apidae	<i>Bombus (Pyrobombus) bimaculatus</i> Cresson, 1863	1						5			1	7
Apidae	<i>Bombus (Pyrobombus) impatiens</i> Cresson, 1863	17	14	11	11	12	88	9	4	11	9	186
Apidae	<i>Bombus (Pyrobombus) vagans</i> Smith, 1854		2		3	1		1		2	1	10
Apidae	<i>Bombus (Thoracobombus) fervidus</i> (Fabricius, 1798)		1	3			2					6
Apidae	<i>Bombus (Thoracobombus) pensylvanicus</i> (De Geer, 1773)			1								1
Apidae	<i>Ceratina (Zadontomerus) calcarata</i> Robertson, 1900	5	8	9	4		1	1	6	7	5	46
Apidae	<i>Ceratina (Zadontomerus) dupla</i> Say, 1837		12	3		1	10	7	2	9	15	59

Aerial Surveys		Lakeplain Prairie				Prairie Fen						
Family	Full Name	Blazing Star Prairie	Geiger to Haist Roads	King Road Prairie	King to Dickerson Roads	Brandt Rd Fen	Eaton Road Fen	Hill Creek Fen	Liberty Fen	Lime Lake	Sarett Nature Center	Total
Apidae	<i>Ceratina (Zadontomerus) mikmaqi</i> Rehan and Sheffield, 2011	1	18	3		3	3	1	1	2	5	37
Apidae	<i>Ceratina (Zadontomerus) strenua</i> Smith, 1879	1	2	18	1	2				2	2	28
Apidae	<i>Epeolus scutellaris</i> Say, 1824		1									1
Apidae	<i>Melissodes (Eumelissodes) agilis</i> Cresson, 1878		1				1					2
Apidae	<i>Melissodes (Eumelissodes) denticulatus</i> Smith, 1854	21	1	3								25
Apidae	<i>Melissodes (Eumelissodes) druriellus</i> (Kirby, 1802)	2	4				5					11
Apidae	<i>Melissodes (Eumelissodes) illatus</i> Lovell and Cockerell, 1906		1	1			1		1			4
Apidae	<i>Melissodes (Eumelissodes) subillatus</i> LaBerge, 1961			1								1
Apidae	<i>Melissodes (Eumelissodes) trinodis</i> Robertson, 1901		2									2
Apidae	<i>Melissodes (Heliomelissodes) desponsus</i> Smith, 1854						1					1
Apidae	<i>Triepeolus michiganensis</i> Mitchell, 1962			1								1
Apidae	<i>Xylocopa (Xylocopoides) virginica</i> (Linnaeus, 1771)	1		11		2	2	2		1		19
Colletidae	<i>Colletes nudus</i> Robertson, 1898			1					1			2
Colletidae	<i>Colletes simulans</i> Cresson, 1868		2				1					3
Colletidae	<i>Hylaeus (Hylaeus) annulatus</i> (Linnaeus, 1758)				2	5		1	2	1		11
Colletidae	<i>Hylaeus (Hylaeus) mesillae</i> group morphospecies		1	8	2	5					1	17

Aerial Surveys		Lakeplain Prairie				Prairie Fen						
Family	Full Name	Blazing Star Prairie	Geiger to Haist Roads	King Road Prairie	King to Dickerson Roads	Brandt Rd Fen	Eaton Road Fen	Hill Creek Fen	Liberty Fen	Lime Lake	Sarett Nature Center	Total
Colletidae	<i>Hylaeus (Prosopis) affinis</i> (Smith, 1853)	3	2	1		6	3	4	1			20
Colletidae	<i>Hylaeus (Prosopis) modestus</i> group morphospecies	24	7	1	7	11	5	3	4	10	2	74
Colletidae	<i>Hylaeus (Prosopis) nelumbonis</i> (Robertson, 1890)		1									1
Halictidae	<i>Agapostemon (Agapostemon) sericeus</i> (Forster, 1771)		6		18	2		2	3	3		34
Halictidae	<i>Agapostemon (Agapostemon) splendens</i> (Lepeletier, 1841)		1									1
Halictidae	<i>Augochlora (Augochlora) pura</i> (Say, 1837)	47		3	11	3	1	7	20	1	5	98
Halictidae	<i>Augochlorella aurata</i> (Smith, 1853)		18	2	4	2	7	2		3	2	40
Halictidae	<i>Dufourea harveyi</i> (Cockerell, 1906)						6	9	8			23
Halictidae	<i>Dufourea marginata</i> (Cresson, 1878)	1										1
Halictidae	<i>Halictus (Nealictus) parallelus</i> Say, 1837									2		2
Halictidae	<i>Halictus (Odontalictus) ligatus</i> Say, 1837		1	3			7	4	4	4	1	24
Halictidae	<i>Halictus (Protohalictus) rubicundus</i> (Christ, 1791)	1		1	1	1			2			6
Halictidae	<i>Halictus (Seladonia) confusus</i> Smith, 1853	4	2	3	6	8	8	2	9			42
Halictidae	<i>Lasioglossum (Dialictus) admirandum</i> (Sandhouse, 1924)			1			1	2				4
Halictidae	<i>Lasioglossum (Dialictus) atwoodi</i> Gibbs, 2010										5	5
Halictidae	<i>Lasioglossum (Dialictus) cattellae</i> (Ellis, 1913)									1	1	2
Halictidae	<i>Lasioglossum (Dialictus) cressonii</i> (Robertson, 1890)							1				1

Aerial Surveys		Lakeplain Prairie		Prairie Fen								
Family	Full Name	Blazing Star Prairie	Geiger to Haist Roads	King Road Prairie	King to Dickerson Roads	Brandt Rd Fen	Eaton Road Fen	Hill Creek Fen	Liberty Fen	Lime Lake	Sarett Nature Center	Total
Halictidae	<i>Lasioglossum (Dialictus) heterognathus</i> (Mitchell, 1960)					2						2
Halictidae	<i>Lasioglossum (Dialictus) hitchensi</i> Gibbs, 2012	4										4
Halictidae	<i>Lasioglossum (Dialictus) imitatum</i> (Smith, 1853)					1					2	3
Halictidae	<i>Lasioglossum (Dialictus) laevissimum</i> (Smith, 1853)	2										2
Halictidae	<i>Lasioglossum (Dialictus) leucocomus</i> (Lovell, 1908)	1							1			2
Halictidae	<i>Lasioglossum (Dialictus) lineatum</i> (Crawford, 1906)	7				2	3			1	3	16
Halictidae	<i>Lasioglossum (Dialictus) oblongum</i> (Lovell, 1905)				1				1			2
Halictidae	<i>Lasioglossum (Dialictus) oceanicum</i> (Cockerell, 1916)		3									3
Halictidae	<i>Lasioglossum (Dialictus) pilosum</i> (Smith, 1853)	9										9
Halictidae	<i>Lasioglossum (Dialictus) planatum</i> (Lovell, 1905)					2						2
Halictidae	<i>Lasioglossum (Dialictus) subviridatum</i> (Cockerell, 1938)					1						1
Halictidae	<i>Lasioglossum (Dialictus) taylorae</i> Gibbs, 2010								3			3
Halictidae	<i>Lasioglossum (Dialictus) versatum</i> (Robertson, 1902)		1			4	7	1	1			14
Halictidae	<i>Lasioglossum (Dialictus) viridatum</i> (Lovell, 1905)			1	1	3		5				10
Halictidae	<i>Lasioglossum (Hemihalictus) nelumbonis</i> (Robertson, 1890)										3	3

Aerial Surveys		Lakeplain Prairie		Prairie Fen									
Family	Full Name	Blazing Star Prairie	Geiger to Haist Roads	King Road Prairie	King to Dickerson Roads	Brandt Rd Fen	Eaton Road Fen	Hill Creek Fen	Liberty Fen	Lime Lake	Sarett Nature Center	Total	
Halictidae	<i>Lasioglossum (Hemihalictus) pectorale</i> (Smith, 1853)			1								1	
Halictidae	<i>Lasioglossum (Leuchalictus) leucozonium</i> (Schrank, 1781)		3		1				2	1	1	8	
Halictidae	<i>Lasioglossum (Leuchalictus) zonulum</i> (Smith, 1848)				5							5	
Halictidae	<i>Sphecodes dichrous</i> Smith, 1853								1			1	
Halictidae	<i>Sphecodes heraclei</i> Robertson, 1897			1								1	
Halictidae	<i>Sphecodes mandibularis</i> Cresson, 1872					1						1	
Halictidae	<i>Sphecodes nigricorpus</i> Mitchell, 1956	1										1	
Megachilidae	<i>Coelioxys (Boreocoelioxys) porterae</i> Cockerell, 1900					1						1	
Megachilidae	<i>Coelioxys (Boreocoelioxys) sayi</i> Robertson, 1897		2						1			3	
Megachilidae	<i>Coelioxys (Cyrtocoelioxys) modestus</i> Smith, 1854									1		1	
Megachilidae	<i>Coelioxys (Synocoelioxys) alternatus</i> Say, 1837									1	2	3	
Megachilidae	<i>Heriades (Neotrypetes) carinata</i> Cresson, 1864	2	1		2	1			2	1		9	
Megachilidae	<i>Heriades (Neotrypetes) leavitti</i> Crawford, 1913				2							2	
Megachilidae	<i>Hoplitis (Alcidamea) producta</i> (Cresson, 1864)						1					1	
Megachilidae	<i>Hoplitis (Alcidamea) spoliata</i> (Provancher, 1888)						1					1	
Megachilidae	<i>Megachile (Callomegachile) sculpturalis</i> Smith, 1853				1							1	

Aerial Surveys		Lakeplain Prairie		Prairie Fen								
Family	Full Name	Blazing Star Prairie	Geiger to Haist Roads	King Road Prairie	King to Dickerson Roads	Brandt Rd Fen	Eaton Road Fen	Hill Creek Fen	Liberty Fen	Lime Lake	Sarett Nature Center	Total
Megachilidae	<i>Megachile (Chelostomoides) rugifrons</i> (Smith, 1854)			1								1
Megachilidae	<i>Megachile (Eutricharaea) rotundata</i> (Fabricius, 1787)					1						1
Megachilidae	<i>Megachile (Litomegachile) brevis</i> Say, 1837			1								1
Megachilidae	<i>Megachile (Litomegachile) mendica</i> Cresson, 1878	6	1	6	1					1	3	18
Megachilidae	<i>Megachile (Megachile) centuncularis</i> (Linnaeus, 1758)	1										1
Megachilidae	<i>Megachile (Megachile) inermis</i> Provancher, 1888					1						1
Megachilidae	<i>Megachile (Megachile) inimica</i> Provancher, 1888	1										1
Megachilidae	<i>Megachile (Megachile) relativa</i> Cresson, 1878						2					2
Megachilidae	<i>Megachile (Sayapis) pugnata</i> Say, 1837									1		1
Megachilidae	<i>Megachile (Xanthosarus) latimanus</i> Say, 1823			2	1				1			4
Megachilidae	<i>Stelis (Dolichostelis) louisae</i> Cockerell, 1911	1	1									2
Melittidae	<i>Macropis (Macropis) nuda</i> (Provancher, 1882)				1							1
Total		173	135	106	99	98	175	86	92	76	78	1118

Table 3. Wild bees collected during bowl trap surveys at Michigan Lakeplain Prairie and Prairie Fen sites in 2021.

Bowl Trap Surveys		Lakeplain Prairie				Prairie Fen						
Family	Full Name	Blazing Star Prairie	Geiger to Haist Roads	King Road Prairie	King to Dickerson Roads	Brandt Rd Fen	Eaton Road Fen	Hill Creek Fen	Liberty Fen	Lime Lake	Sarett Nature Center	Total
Andrenidae	<i>Andrena (Cnemidandrena) hirticincta</i> Provancher, 1888	1										1
Apidae	<i>Anthophora (Melea) bomboides</i> Kirby, 1838										1	1
Apidae	<i>Apis (Apis) mellifera</i> Linnaeus, 1758		1				12					13
Apidae	<i>Bombus (Cullumanobombus) rufocinctus</i> Cresson, 1863	1										1
Apidae	<i>Bombus (Psithyrus) citrinus</i> (Smith, 1854)	2										2
Apidae	<i>Bombus (Pyrobombus) bimaculatus</i> Cresson, 1863					1						1
Apidae	<i>Bombus (Pyrobombus) impatiens</i> Cresson, 1863		1		3		1					5
Apidae	<i>Bombus (Thoracobombus) fervidus</i> (Fabricius, 1798)			1								1
Apidae	<i>Ceratina (Zadontomerus) calcarata</i> Robertson, 1900	1	1							4		6
Apidae	<i>Ceratina (Zadontomerus) dupla</i> Say, 1837		2				1			6	7	16
Apidae	<i>Ceratina (Zadontomerus) mikmaqi</i> Rehan and Sheffield, 2011		7	1				2		1	8	19
Apidae	<i>Ceratina (Zadontomerus) strenua</i> Smith, 1879	4										4
Apidae	<i>Xylocopa (Xylocopoides) virginica</i> (Linnaeus, 1771)				1							1
Colletidae	<i>Hylaeus (Hylaeus) annulatus</i> (Linnaeus, 1758)								1			1
Colletidae	<i>Hylaeus (Hylaeus) mesillae</i> group morphospecies			1					1			2
Colletidae	<i>Hylaeus (Prosopis) affinis</i> (Smith, 1853)		1									1
Colletidae	<i>Hylaeus (Prosopis) modestus</i> group morphospecies	4										4

Bowl Trap Surveys		Lakeplain Prairie		Prairie Fen							

Table 4. Floral resource associations for wild bees collected at Lakeplain Prairie and Prairie Fen sites in 2021.

Associated Floral Resources		Lakeplain Prairie				Prairie Fen					

Associated Floral Resources		Lakeplain Prairie		Prairie Fen							
</											

Associated Floral Resources		Lakeplain Prairie				Prairie Fen						
Plant Species	Common Name	Blazing Star Prairie	Geiger to Haist Roads	King Road Prairie	King to Dickerson Roads	Brandt Rd Fen	Eaton Road Fen	Hill Creek Fen	Liberty Fen	Lime Lake	Sarett Nature Center	Total
<i>Coreopsis tripteris</i>	Tall coreopsis	1										1
<i>Desmodium sp.</i>	Tick-trefoil						1					1
<i>Eupatorium perfoliatum</i>	Common boneset									1		1
<i>Lactuca canadensis</i>	Canada lettuce						1					1
<i>Solidago ohioensis</i>	Ohio goldenrod				1							1
<i>Plant species not identified/ flying</i>		45	27	18	13	9	21	9	11	19	24	196
Grand Total		211	156	122	106	106	110	93	101	94	100	1199

Discussion

In 2021, MNFI completed baseline wild bee inventories in Lakeplain Prairie and Prairie Fen natural communities, providing data on wild bee species composition, floral resource use, and the occurrence of rare species in these critically important natural communities of Michigan. These surveys provide baseline data on 104 unique bee species utilizing Lakeplain Prairie and Prairie Fen habitats during 2021 survey efforts. A notable result from this project highlights that while many bee species are shared between natural community types, the potential for these natural communities to have unique wild bee assemblages is high. Future survey work in these habitats should parse out natural community associations for wild bees of conservation interest, which will further inform targeted conservation efforts. The provided data suggests that Lakeplain Prairie and Prairie Fen habitats contain diverse native bee assemblages which may be indicative of habitat quality. Furthermore, the occurrence of multiple rare species using these habitats suggests that they may act as refuges for increasingly rare species of bees. Therefore, Lakeplain Prairie and Prairie Fen natural communities within the state should be regularly managed to maintain system integrity. Considering that new state records were identified during these single season surveys, additional survey work in high-quality natural communities of Michigan is warranted and would benefit the goals of the GLRI Pollinator Task Force.



Figure 6. Survey location at Eaton Road Prairie Fen showing bowl trap set-up during the second round of bowl trap surveys.

Observed floral associations provide information regarding the flowering resources that are used by bees during the summer months in Lakeplain Prairie and Prairie Fen habitats. The results demonstrate that a wide array of flowering plant species are regularly used by bees, and include both native and non-native plants. However, to improve overall habitat quality, management actions should be implemented to improve native plant species abundance and persistence to maintain integrity of the natural system. Notably, both state records collected during 2021 surveys were collected from native plant species at the Blazing Star Lakeplain Wet-mesic Prairie in Algonac State Park. It is imperative that agencies focused on pollinator conservation work directly with land managers to implement habitat management and conservation strategies that benefit the natural community system and include the implementation of naturally occurring processes which helped maintain these systems for countless years before human integration. Specific guidance for habitat management within Lakeplain Prairie and Prairie Fen systems is provided in the Appendix. General management practices include a mix of invasive species control through targeted herbicide application, mechanical removal of invasive species, burning programs, and stabilizing hydrological processes. All of which will benefit these systems and aide in the maintenance of natural community integrity.



Figure 7. (Right) *Bombus fervidus* visiting Canada thistle at Eaton Road Prairie Fen. (Left) *Bombus citrinus* visiting joe-pye weed at Sarett Nature Center Prairie Fen.

As the GLRI Pollinator Task Force continues to prioritize the conservation of diverse wild bee community assemblages and populations of priority bee species, it is important that regularly conducted bee surveys are implemented to better understand community structure and the persistence of rare species in occupied habitats. There are many unknowns when it comes to wild bee habitat associations, population level trends of rare species, and best management practices to support species of concern. Baseline inventories such as this provide a valuable

starting point for identifying species population patterns, developing management actions, and planning the future of conservation in high quality habitat. Furthermore, there is evidence that high quality natural communities may provide refugia for some of the rarest bee species in Michigan, yet surveys to identify the species associated with these habitats are severely lacking. Considering that these natural communities are known to provide habitat for other rare insect species, a better understanding of resident wild bee community could help improve management actions that benefit multiple species of greatest concern in Michigan.



Figure 8. View of the Blazing Star Lakeplain Wet-mesic Prairie in Algonac State Park on August 31st, 2021.

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Appendix

Habitat recommendations for Lakeplain Prairie and Prairie Fen natural communities in Michigan

Lakeplain Wet Prairie

Since the 1800s, there has been extensive loss and degradation of lakeplain wet prairies due to conversion to agriculture, residential and industrial development, alterations of groundwater hydrology, and fire suppression. It is estimated that less than 1% of the original community remains. Therefore, protection and restoration of existing prairie remnants is a top conservation priority.

Threats to remaining sites include hydrologic alteration, nutrient enrichment, siltation, fire suppression, shrub and tree encroachment, and destruction of upland buffers. Fire suppression and hydrologic alterations such as ditching and tiling promote shrub and tree invasion, which results in reduced cover of graminoids and the fine-fuels needed to carry a fire. Invasive plants are favored by nutrient enrichment, fire suppression, and hydrologic alteration. Invasive species that threaten the diversity and community structure of lakeplain wet prairie include glossy buckthorn (*Frangula alnus*), multiflora rose (*Rosa multiflora*), autumn olive (*Elaeagnus umbellata*), reed (*Phragmites australis* subsp. *australis*), reed canary grass (*Phalaris arundinacea*), narrow-leaved cat-tail (*Typha angustifolia*), hybrid cat-tail (*Typha xglauca*), and purple loosestrife (*Lythrum salicaria*). Prescribed fire, in conjunction with cutting and/or herbiciding of invasive species, can be used to maintain biodiversity of lowland grasslands. Some sites may require hydrologic restoration and efforts to restrict nutrient and sediment inputs. In addition, restoration of upland natural communities bordering lakeplain wet prairie occurrences should be conducted to improve hydrology and provide refugia for flood-intolerant species during periods of high water.

Lakeplain Wet-Mesic Prairie

Since European settlement, there has been extensive loss and degradation of lakeplain wet-mesic prairies due to conversion to agriculture, residential and industrial development, alterations of groundwater hydrology, and fire suppression. It is estimated that less than 1% of the original community remains. Therefore, protection and restoration of existing prairie remnants is a top conservation priority.

Threats to remaining sites include hydrologic alteration, nutrient enrichment, siltation, fire suppression, tree and shrub encroachment, and destruction of upland buffers. Fire suppression and hydrologic alterations such as ditching and drain tiling promote shrub and tree invasion, which reduces graminoid cover and the fine fuels capable of carrying a fire. Invasive plants are favored by nutrient enrichment, fire suppression, and hydrologic alteration. Invasive species that threaten the diversity and community structure in lakeplain wet-mesic prairie include glossy buckthorn (*Frangula alnus*), common buckthorn (*Rhamnus cathartica*), multiflora rose (*Rosa multiflora*), autumn olive (*Elaeagnus umbellata*), reed (*Phragmites australis* subsp. *australis*), reed canary grass (*Phalaris arundinacea*), narrow-leaved cat-tail (*Typha angustifolia*), hybrid cat-tail (*Typha xglauca*), and purple loosestrife (*Lythrum salicaria*). Prescribed fire, in conjunction with cutting and/or herbiciding of invasive species, should be considered to maintain the biodiversity of

lowland grasslands. Some sites may require hydrologic restoration and efforts to restrict nutrient and sediment inputs. In addition, restoration of upland natural communities bordering lakeplain wet-mesic prairie occurrences should be conducted to improve hydrology and provide refugia for flood-intolerant species during periods of high water.

Prairie Fen

Land use planning to protect groundwater reserves in areas surrounding prairie fens is critical to maintaining the natural community. Drainage ditches can interrupt groundwater flow through fens, reducing water levels and facilitating rapid establishment and growth of shrubs and trees. Nutrient additions from leaking septic tanks, drain fields, or agricultural runoff can contribute to dominance by invasive species such as reed (*Phragmites australis* subsp. *australis*), reed canary grass (*Phalaris arundinacea*), and narrow-leaved cat-tail (*Typha angustifolia*).

Today, most prairie fens are significantly reduced in size as a result of shrub and tree establishment. In addition, the surrounding uplands have also changed from open, oak savanna or woodland, to closed-canopy forest. Historically, the principal natural process that maintained the open structure of these upland and wetland communities was fire. Thus, reintroducing fire through prescription burning of prairie fens and adjacent upland oak forests is a critical management need. Because of the small and fragmented condition of many of our remaining prairie fens, use of prescribed fire as a management tool should include setting aside significant portions of fen to remain unburned in any given year to help lessen impacts to fire-sensitive species. Streams, rivers, lakes, and wet lines created by hoses can serve as fire breaks for establishing unburned refugia within a prairie fen.

In addition to prescribed fire, reducing the density of trees and shrubs also typically requires the use of herbicides, which can be applied to the recently cut stumps of woody plants. Cutting woody plants without applying herbicides is typically ineffective at reducing shrub and tree density because the plants resprout and grow rapidly from well developed root stocks.

Invasive species that reduce diversity and alter community structure in prairie fen include reed, reed canary grass, narrow-leaved cat-tail, hybrid cat-tail (*Typha xglauca*), purple loosestrife (*Lythrum salicaria*), glossy buckthorn (*Frangula alnus*), common buckthorn (*Rhamnus cathartica*), multiflora rose (*Rosa multiflora*), and autumn olive (*Elaeagnus umbellata*). Glossy buckthorn, an invasive shrub, has become especially widespread and well established in prairie fens, where it has formed dense monocultures, replacing formerly species-rich open fen. Invasive species can spread rapidly and outcompete native plants for nutrients, light, and space. Reducing well established populations of invasive plants typically requires long-term commitments by managers to repeatedly apply control treatments, over multiple years, and carryout sustained monitoring efforts. The use of herbicides in controlling invasive species can be very effective, while cultural treatments such as pulling, mowing, and cutting by themselves generally have poor results.