Bumble Bee Community Surveys at National Lakeshores and National Wildlife Refuges in Michigan

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We collectively acknowledge that Michigan State University occupies the ancestral, traditional, and contemporary Lands of the Anishinaabeg – Three Fires Confederacy of Ojibwe, Odawa, and Potawatomi peoples. In particular, the University resides on Land ceded in the 1819 Treaty of Saginaw. We recognize, support, and advocate for the sovereignty of Michigan's twelve federally recognized Indian nations, for historic Indigenous communities in Michigan, for Indigenous individuals and communities who live here now, and for those who were forcibly removed from their Homelands. By offering this Land Acknowledgement, we affirm Indigenous sovereignty and will work to hold Michigan State University more accountable to the needs of American Indian and Indigenous peoples.

Cover: *Bombus terricola* foraging from *Asclepias syriaca* at Sleeping Bear Dunes National Lakeshore. Photo by Logan Rowe.

EXECUTIVE SUMMARY

Michigan Natural Features Inventory (MNFI) received funding from the United States Fish and Wildlife Service (USFWS) through the Great Lakes Restoration Initiative (GLRI) Pollinator Task Force (Cooperative Agreement No. F24AC00208) to complete bumble bee community surveys at conservation focal areas identified by USFWS and NPS in Michigan. Funding was provided to determine site level bumble bee community composition, species richness, and any extant populations of state listed bumble bee species. Bumble bee community surveys were conducted alongside standardized habitat assessments to evaluate the quality of floral resources. This report details the methods and results of 2024-2025 bumble bee and habitat surveys at a total of six National Lakeshores and National Wildlife Refuges in Michigan and provides details on habitat management needs at the locations visited during this effort.

We used a modified version of the USFWS RPBB protocols for unoccupied zones (USFWS Survey Protocols for the Rusty-Patched Bumble Bee Version 2.2) to complete bumble bee community surveys. Surveys were 1.5-person hour, meander-based, and completed twice per year at each survey site between June and August. We prioritized areas with high densities of floral resources where bumble bees were most likely to be present. We limited specimen collections to representative samples for confirmation in a laboratory setting.

Between 2024-2025, a total of 48 sites were surveyed across six management areas including Detroit River International Wildlife Refuge, Pictured Rocks National Lakeshore, Sleeping Bear Dunes National Lakeshore, Seney National Wildlife Refuge, Shiawassee National Wildlife Refuge, and multiple locations along the North Country Trail in Michigan. A total of 4,296 bumble bees were documented, with the most common observations being *Bombus ternarius* (tri-colored bumble bee; n=1401) and *B. impatiens* (common eastern bumble bee; n=1354). Multiple state-listed bumble bee species were observed including *B. auricomus* (black and gold bumble bee; special concern; n=13), *B. fervidus* (golden northern bumble bee; special concern; n=21); *B. pensylvanicus* (American bumble bee; state endangered; n=4), *B. sandersoni* (Sanderson's bumble bee; special concern; n=3) and *B. terricola* (yellow-banded bumble bee; special concern; n=26).

The bumble bee community surveys completed at National Lakeshores and National Wildlife Refuges in Michigan increase our knowledge of species distributions, relative abundance, floral resource use, and provide information that directly informs habitat conservation. Importantly, these surveys highlight the importance of federally protected landscapes for supporting populations of Michigan's rare bumble bee species. Future survey work should target locations at National Lakeshores and National Wildlife Refuges where rare species are present and further describe local population status and habitat use, ultimately informing conservation or habitat management needs in these important landscapes.

ACKNOWLEDGEMENTS

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INTRODUCTION

Bumble bees are an integral component of Michigan's native ecosystems, contributing substantially to the reproduction of wild plants and the integrity of natural communities across the state's conservation lands. Recent declines in several species, including those listed at the state or federal level, underscore the need for continued monitoring in landscapes managed for biodiversity conservation. These declines can be attributed to multiple stressors, including increased use of pesticides (particularly neonicotinoids), increased pathogen/parasite prevalence, and loss of historical occupied habitat (Potts et al. 2010, Evans et al. 2023). While the most well-known bumble bee species in decline in the Midwest is *Bombus affinis* (rusty-patched bumble bee), many other species of bumble bees are in decline or may need conservation assistance (Wood et al. 2019, Rowe et al. 2019). Ongoing documentation of declines have led to the creation of several initiatives to preserve bumble bee populations across all levels of government, as well as community science and research collaboratives coalescing to monitor bumble bee populations at the local, regional, and national scale (Woodard et al. 2020, Miller et al. 2025).

In Michigan, six species of bumble bees are tracked within the Natural Heritage Database (NHD), two of which are listed as state endangered (*B. affinis* and *B. pensylvanicus*, American bumble bee) (Table 1). *Bombus affinis*, which historically occurred throughout the lower peninsula of Michigan, has not been documented in the state since 1999, when a single occurrence was documented in Monroe County. Despite a previously estimated decline of 98%, *B. pensylvanicus* has now been documented in 16 counties in Michigan since 2018 (Miller et al. 2025), suggesting that remnant populations of rare species do exist in the state and lack adequate survey effort. Similarly, recently constructed habitat suitability models for Michigan's bumble bee species of conservation concern suggest significant potential for species documentation in previously under-surveyed or unsurvyed regions of the state (Rowe et al. 2023, Earl et al. 2025). Importantly, these previous efforts by researchers in Michigan highlight the need for continuing species documentation efforts and monitoring of at-risk populations once discovered.

The Federal government owns and manages approximately 3.6 million acres of land in Michigan. While much of this land is managed by the U.S. Forest Service (UFS), a significant proportion is managed by the U.S. Fish and Wildlife Service (USFWS) and the National Park Service (NPS). National Lakeshores and National Wildlife Refuges are management areas managed by the NPS and USFWS, respectively. These federally owned lands in Michigan contain numerous habitats consisting of foraging and nesting resources suitable for bumble bees, such as open dunes, wetland complexes, and a variety of grassland and prairie habitats. Many habitats within the National Lakeshore and National Wildlife Refuge areas of Michigan remain under-surveyed, particularly for important pollinators such as bumble bees. Identifying populations of at-risk bumble bee species could lead to improved management and directed conservation of these species and the habitats they occupy.

In 2024-2025, Michigan Natural Features Inventory (MNFI) conducted surveys at 6 USFWS and NPS management areas in Michigan: Detroit River International Wildlife Refuge (DRIWR), Pictured Rocks National Lakeshore (PIRO), Seney National Wildlife Refuge (SeNWR), Shiawassee National Wildlife Refuge (ShNWR), Sleeping Bear Dunes National Lakeshore (SLBE), and multiple locations along the North Country Trail (NCT) (Figure 1, Table 2). Each survey effort included a bumble bee community and habitat survey using standardized methodologies. The primary objectives of this project were to 1) assess bumble bee communities and species presence at NPS and USFWS management areas, 2) document occurrences of rare bumble bee species, and 3) assess the quality of habitat for bumble bees to inform future conservation and habitat management actions. Importantly, these surveys represent a baseline of knowledge on bumble bee communities and associated habitats at National Lakeshores and National Wildlife Refuges for which future work can be directed.

Bumble bee survey from Augusta Prairie along the North Country Trail on June 24th, 2025. Photo by Izzy Wejrowski.

Table 1. Listed bumble bee species in Michigan that are tracked within the Natural Heritage Database. NatureServe conservation ranks at the global and subnational level are shown.

Species Name	Common Name	State Listing Status	Global/State Ranks
B. affinis	Rusty-patched bumble bee	Endangered (Federally Endangered)	G2/SH
B. auricomus	Black and gold bumble bee	Special Concern	G5/S2
B. fervidus	Golden northern bumble bee	Special Concern	G3G4/S3
B. pensylvanicus	American bumble bee	State Endangered	G3G4/S1
B. sandersoni	Sanderson's bumble bee	Special Concern	G5/S2S3
B. terricola	Yellow-banded bumble bee	Special Concern	G3G4/S2S3

METHODS

Site Selection and Field Surveys

We worked with the USFWS and NPS staff from individual National Lakeshores and National Wildlife Refuges to identify potential bumble bee survey areas within each priority area. Final survey sites were selected based on multiple criteria: 1) quality of foraging habitat, 2) potential to document state-listed bumble bee species, 3) ongoing habitat management, and 4) bolstering pollinator datasets collected by the USFWS. We aimed for at least 7 survey sites at each USFWS or NPS location but did include opportunistic surveys when possible. A single site at PIRO was surveyed in both the NCT and PIRO survey efforts. In total 48 sites were surveyed across the 6 priority areas (Table 3).

Bumble bee community and associated habitat surveys followed protocols developed previously by MNFI (Rowe et al. 2023, Earl et al. 2025). Each bumble bee community survey consisted of a 1.5-person hour meander-based effort to document bumble bees and floral resources used, recording visual observations of bumble bee and plant species. If a bumble bee species could not easily be determined visually that specimen was collected for identification and processing in the lab. Surveys at each site were conducted twice per year, once in late June/early July, and again in August, to document the entire bumble bee community over the course of a single field season.

Table 2. Priority areas identified for bumble bee surveys, with year surveyed and number of sites surveyed by Michigan Natural Features Inventory staff at each priority area.

Managing Agency	Priority Area	Year Surveyed	Target Listed Bumble Bee Species
USFWS	Detroit River International Wildlife Refuge	2024	*Bombus auricomus, B. pensylvanicus, B. fervidus*
USFWS	Seney National Wildlife Refuge	2025	*B. terricola, B. sandersoni*
USFWS	Shiawassee National Wildlife Refuge	2025	*B. auricomus, B. pensylvanicus, B. fervidus*
NPS	North Country Trail	2025	*B. auricomus, B. pensylvanicus, B. fervidus, B. sandersoni,*
NPS	Pictured Rocks National Lakeshore	2024	*B. terricola, B. sandersoni*
NPS	Sleeping Bear National Lakeshore	2024	*B. terricola, B. sandersoni*

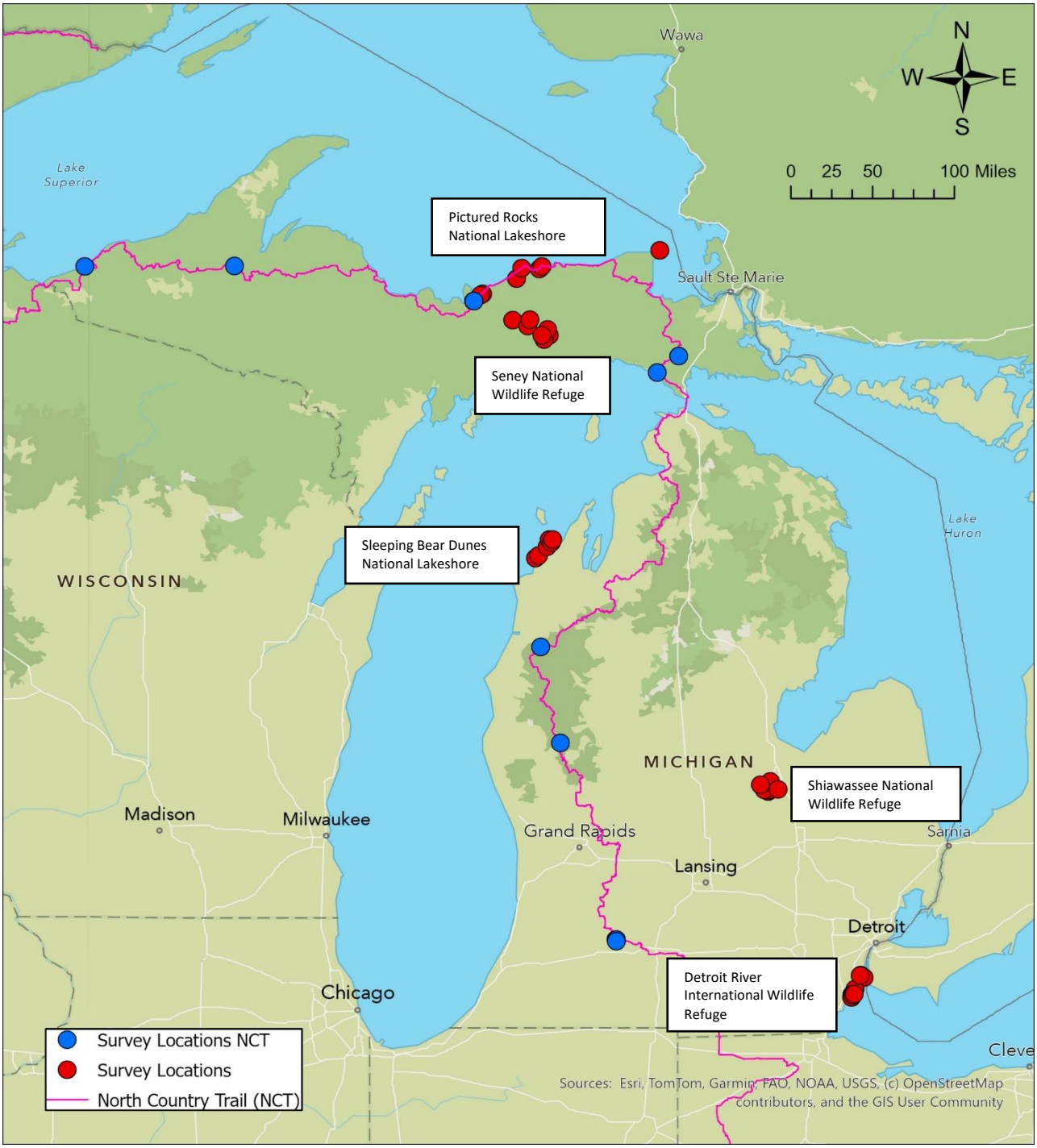


Figure 1. Bumble bee and habitat survey locations at National Lakeshores and National Wildlife Refuges in Michigan. Blue dots represent survey locations along the North Country Trail in Michigan.

Each bumble bee survey was accompanied by a habitat assessment following protocols developed by the Xerces Society for Invertebrate Conservation (Xerces 2017). These assessments incorporate 5 main sections to evaluate the suitability of a site for RPBB (Section 1: Regional and Landscape Features, Section 2: Site Features, Section 3: Foraging Habitat, Section 4: Nesting and Overwintering Habitat, Section 5: Pesticide and Management Practices). Since we were unable to accurately describe a survey site's history of pesticide and management practices, we left this section blank. Maximum scores for each section based on the criteria set in sections 1-4 each are as follows: Section 1: 20; Section 2: 35; Section 3: 40; and section 4: 35; for a maximum score of up to 130 points.

Data Summary

For each National Lakeshore and National Wildlife Refuge priority area, we provide a summary of state-listed bumble bee species documented and a full visualization of the bumble bee-plant species foraging network (package: bipartite, v2.23; Dormann et al., 2009). In addition, we summarized habitats using standardized assessment forms. ArcGIS Survey123 was used to record all bumble bees, associated floral data, and floral resources at site during field surveys. Observations of at-risk bumble bees were added into Michigan's Natural Heritage Database.

Bombus terricola (left) and *B. ternarius* (right) collected from Pictured Rocks National Lakeshore during surveys in 2024. Photo by Nicolette Sexton.

Table 3. National Lakeshore and National Wildlife Refuge survey site locations prioritized for bumble bee and habitat surveys in 2024-2025. Latitude and longitude information for each location is provided in WGS 84.

Site	Site ID	Longitude	Latitude
Detroit River International Wildlife Refuge			
	Site 1	[redacted]	[redacted]
	Site 2	[redacted]	[redacted]
	Site 3	[redacted]	[redacted]
	Site 4	[redacted]	[redacted]
	Site 5	[redacted]	[redacted]
	Site 6	[redacted]	[redacted]
	Site 7	[redacted]	[redacted]
	Site 8	[redacted]	[redacted]
	Site 9	[redacted]	[redacted]
Pictured Rocks National Lakeshore			
	Site 1	[redacted]	[redacted]
	Site 2	[redacted]	[redacted]
	Site 3	[redacted]	[redacted]
	Site 4	[redacted]	[redacted]
	Site 5	[redacted]	[redacted]
	Site 6	[redacted]	[redacted]
	Site 7	[redacted]	[redacted]
Sleeping Bear Dunes National Lakeshore			
	Site 1	[redacted]	[redacted]
	Site 2	[redacted]	[redacted]
	Site 3	[redacted]	[redacted]
	Site 4	[redacted]	[redacted]
	Site 5	[redacted]	[redacted]
	Site 6	[redacted]	[redacted]
	Site 7	[redacted]	[redacted]
Seney National Wildlife Refuge			
	Site 1	[redacted]	[redacted]
	Site 2	[redacted]	[redacted]
	Site 3	[redacted]	[redacted]
	Site 4	[redacted]	[redacted]
	Site 5	[redacted]	[redacted]
	Site 6	[redacted]	[redacted]
	Site 7	[redacted]	[redacted]

Site	Site ID	Longitude	Latitude
Seney National Wildlife Refuge	Whitefish Point	[redacted]	[redacted]
Shiawassee National Wildlife Refuge			
	Site 1	[redacted]	[redacted]
	Site 2	[redacted]	[redacted]
	Site 3	[redacted]	[redacted]
	Site 4	[redacted]	[redacted]
	Site 5	[redacted]	[redacted]
	Site 6	[redacted]	[redacted]
	Site 7	[redacted]	[redacted]
North Country Trail			
	Black River Harbor	[redacted]	[redacted]
	Prickett Dam	[redacted]	[redacted]
	Sand Point	[redacted]	[redacted]
	East Lake	[redacted]	[redacted]
	Brevoort Lake	[redacted]	[redacted]
	High Bridge	[redacted]	[redacted]
	Loda Lake Wildflower Sanctuary	[redacted]	[redacted]
	North Augusta Prairie	[redacted]	[redacted]
	Middle Augusta Prairie	[redacted]	[redacted]
	South Augusta Prairie	[redacted]	[redacted]

Michigan Natural Features Inventory technician surveying for bumble bees at a Sleeping Bear Dunes National Lakeshore survey site dominated by milkweed (*Asclepias syriacia*). Photo by Logan Rowe.

RESULTS

Overall Summary

In 2024-2025, we completed two rounds of bumble bee and community surveys at 48 sites with six National Lakeshore and National Wildlife Refuge priority areas. A total of 4,296 bumble bee observations were made. The most observed bumble bee species were *B. ternarius* (tri-colored bumble bee) and *B. impatiens* (common eastern bumble bee) with 1401 and 1,354 individuals observed respectively. We did not observe any occurrences of the rusty-patched bumble bee. However, multiple observations of at-risk bumble bees were documented across the surveyed priority survey areas (Table 4). A full summary of state-listed bumble bees found during 2024-2025 surveys at National Lakeshore and National Wildlife Refuge sites is located in Table 5.

Table 4. Number of state-listed bumble bee species documented at National Lakeshore and National Wildlife Refuge priority areas during 2024-2025 bumble bee community surveys performed by Michigan Natural Features Inventory.

Priority Area	*B. auricomus*	*B. fervidus*	*B. pensylvanicus*	*B. sandersoni*	*B. terricola*
Detroit River International Wildlife Refuge	1	14	3	-	-
Pictured Rocks National Lakeshore	-	-	-	3	4
Seney National Wildlife Refuge	-	-	-	-	4
Shiawassee National Wildlife Refuge	8	6	-	-	-
Sleeping Bear National Lakeshore	2	-	1	-	11
North Country Trail	-	-	-	-	-
NCT-Black River Harbor	-	-	-	-	4
NCT-Brevoort Lake	-	-	-	-	2
NCT-East Lake	-	-	-	-	1
NCT-Middle Augusta Prairie	1	1	-	-	-
NCT-South Augusta Prairie	1	-	-	-	-
Totals	**13**	**21**	**4**	**3**	**26**

Table 5. State-listed bumble bee occurrences documented at National Lakeshore and National Wildlife Refuge sites during 2024-2025 surveys. Survey round and flower associations are provided.

National Lakeshore/ National Wildlife Refuge	Site ID	Survey Round	Bumble Bee Species	Flower Association
2024 Surveys				
Detroit International Wildlife Refuge	Site 1	1	*B. auricomus*	*Echinacea purpurea*
Detroit International Wildlife Refuge	Site 1	1	*B. fervidus*	*Cirsium arvense*
Detroit International Wildlife Refuge	Site 1	1	*B. fervidus*	*Cirsium arvense*
Detroit International Wildlife Refuge	Site 1	1	*B. fervidus*	*Trifolium pratense*
Detroit International Wildlife Refuge	Site 1	1	*B. fervidus*	*Vicia villosa*
Detroit International Wildlife Refuge	Site 1	2	*B. fervidus*	*Lotus corniculatus*
Detroit International Wildlife Refuge	Site 1	2	*B. fervidus*	*Lotus corniculatus*
Detroit International Wildlife Refuge	Site 1	2	*B. fervidus*	*Lotus corniculatus*
Detroit International Wildlife Refuge	Site 1	2	*B. fervidus*	*Monarda fistulosa*
Detroit International Wildlife Refuge	Site 1	2	*B. fervidus*	*Monarda fistulosa*
Detroit International Wildlife Refuge	Site 1	2	*B. fervidus*	*Monarda fistulosa*
Detroit International Wildlife Refuge	Site 1	2	*B. fervidus*	*Monarda fistulosa*
Detroit International Wildlife Refuge	Site 1	2	*B. fervidus*	*Centaurea stoebe*
Detroit International Wildlife Refuge	Site 2	1	*B. fervidus*	*Penstemon digitalis*
Detroit International Wildlife Refuge	Site 4	1	*B. fervidus*	Unknown
Detroit International Wildlife Refuge	Site 4	1	*B. pensylvanicus*	*Penstemon digitalis*
Detroit International Wildlife Refuge	Site 4	2	*B. pensylvanicus*	*Dipsacus laciniatus*
Detroit International Wildlife Refuge	Site 4	2	*B. pensylvanicus*	*Dipsacus laciniatus*
Pictured Rocks National Lakeshore	Site 2	2	*B. terricola*	*Centaurea stoebe*
Pictured Rocks National Lakeshore	Site 2	2	*B. terricola*	Flying
Pictured Rocks National Lakeshore	Site 2	2	*B. terricola*	*Solidago* spp.
Pictured Rocks National Lakeshore	Site 3	2	*B. sandersoni*	*Eutrochium purpureum*
Pictured Rocks National Lakeshore	Site 5	2	*B. sandersoni*	*Eutrochium purpureum*
Pictured Rocks National Lakeshore	Site 6	2	*B. terricola*	*Centaurea stoebe*
Sleeping Bear Dunes National Lakeshore	Site 1	1	*B. auricomus*	*Vicia villosa*
Sleeping Bear Dunes National Lakeshore	Site 1	1	*B. pensylvanicus*	*Vicia villosa*
Sleeping Bear Dunes National Lakeshore	Site3	1	*B. terricola*	*Asclepias syriaca*

National Lakeshore/ National Wildlife Refuge	Site ID	Survey Round	Bumble Bee Species	Flower Association
Sleeping Bear Dunes National Lakeshore	Site 4	1	*B. auricomus*	*Vicia villosa*
Sleeping Bear Dunes National Lakeshore	Site 4	1	*B. terricola*	*Vicia villosa*
Sleeping Bear Dunes National Lakeshore	Site 4	1	*B. terricola*	*Vicia villosa*
Sleeping Bear Dunes National Lakeshore	Site 4	1	*B. terricola*	*Vicia villosa*
Sleeping Bear Dunes National Lakeshore	Site 4	1	*B. terricola*	*Vicia villosa*
Sleeping Bear Dunes National Lakeshore	Site 5	1	*B. terricola*	*Asclepias syriaca*
Sleeping Bear Dunes National Lakeshore	Site 5	1	*B. terricola*	*Asclepias syriaca*
Sleeping Bear Dunes National Lakeshore	Site 5	2	*B. terricola*	*Solidago* spp.
Sleeping Bear Dunes National Lakeshore	Site 6	1	*B. terricola*	*Asclepias syriaca*
2025 Surveys				
North Country Trail	Black River Harbor	2	*B. terricola*	*Centaurea stoebe*
North Country Trail	Black River Harbor	2	*B. terricola*	*Daucus carota*
North Country Trail	Black River Harbor	2	*B. terricola*	*Daucus carota*
North Country Trail	Brevoort Lake	2	*B. terricola*	*Centaurea stoebe*
North Country Trail	Brevoort Lake	2	*B. terricola*	*Centaurea stoebe*
North Country Trail	East Lake	2	*B. terricola*	*Daucus carota*
North Country Trail	Middle Augusta Prairie	2	*B. auricomus*	*Monarda fistulosa*
North Country Trail	Middle Augusta Prairie	2	*B. fervidus*	*Monarda fistulosa*
North Country Trail	South Augusta Prairie	2	*B. auricomus*	*Heliopsis helianthoides*
Seney National Wildlife Refuge	Site 1	1	*B. terricola*	*Lotus corniculatus*
Seney National Wildlife Refuge	Site 2	2	*B. terricola*	*Leonurus cardiaca*
Seney National Wildlife Refuge	Site 6	2	*B. terricola*	*Centaurea stoebe*
Seney National Wildlife Refuge	Site 6	2	*B. terricola*	*Solidago* spp.
Shiawassee National Wildlife Refuge	Site 1	2	*B. auricomus*	*Monarda fistulosa*
Shiawassee National Wildlife Refuge	Site 1	2	*B. auricomus*	*Trifolium pratense*
Shiawassee National Wildlife Refuge	Site 6	2	*B. fervidus*	*Lotus corniculatus*
Shiawassee National Wildlife Refuge	Site 4	1	*B. fervidus*	*Lotus corniculatus*
Shiawassee National Wildlife Refuge	Site 4	1	*B. fervidus*	*Trifolium pratense*
Shiawassee National Wildlife Refuge	Site 4	2	*B. fervidus*	*Securigera varia*
Shiawassee National Wildlife Refuge	Site 4	2	*B. fervidus*	*Trifolium pratense*

Detroit River International Wildlife Refuge

A total of 217 bumble bees were observed during 2024 surveys (Figure 2). *Bombus griseocollis* (brown-belted bumble bee) was the most frequently documented species (98 observations), followed by *B. impatiens* (common eastern bumble bee). State-listed bumble bee species were documented at Sites 1, 2, and 4. Three observations of *B. pensylvanicus* (American bumble bee) were made at Site 4 (Table 7). Sites 2, 4, and 5 had the highest pollinator habitat scores (Table 7).

Table 6. Summary of the bumble bees documented at each survey site in Detroit River National Wildlife Refuge in 2024.

Site ID	*B. auricomus*	*B. bimaculatus*	*B. fervidus*	*B. griseocollis*	*B. impatiens*	*B. pensylvanicus*	Total
Site 1	1	13	12	52	32	-	**110**
Site 2	-	10	1	23	12	-	**46**
Site 3	-	1	-	9	14	-	**24**
Site 4	-	2	1	1	8	3	**15**
Site 5	-	-	-	10	1	-	**11**
Site 6	-	-	-	-	-	-	**0**
Site 7*	-	-	-	-	4	-	**4**
Site 8*	-	-	-	3	3	-	**6**
Site 9*	-	-	-	-	1	-	**1**
Total	**1**	**26**	**14**	**98**	**75**	**3**	**217**

* Only surveyed during round 2 of bumble bee surveys.

State special concern *Bombus fervidus* (Golden northern bumble bee) foraging from thistle at Detroit River International Wildlife Refuge. Photo by Logan Rowe.

Table 7. Pollinator habitat scores for each site surveyed at Detroit River International Wildlife Refuge in 2024. Pollinator habitat assessments were not completed during round 1 of bumble bee surveys.

	Section 1 Score		Section 2 Score		Section 3 Score		Section 4 Score		Total Score	
Site ID	Visit 1	Visit 2	Visit 1	Visit 2	Visit 1	Visit 2	Visit 1	Visit 2	Visit 1	Visit 2
Site 1	-	6	-	19	-	18	-	12	-	55
Site 2	-	13	-	11	-	17	-	25	-	66
Site 3	-	13	-	10	-	12	-	20	-	55
Site 4	-	6	-	20	-	20	-	18	-	64
Site 5	-	6	-	18	-	24	-	27	-	75
Site 6	-	13	-	12	-	8	-	22	-	55
Site 7*	-	3	-	6	-	9	-	8	-	26
Site 8*	-	3	-	14	-	11	-	8	-	35
Site 9*	-	7	-	10	-	16	-	8	-	41

* Only surveyed during round 2 of bumble bee surveys.

Veronicastrum virginicum (Culvers root) in bloom during the first round of surveys at Detroit River International Wildlife Refuge. Photo by Logan Rowe.

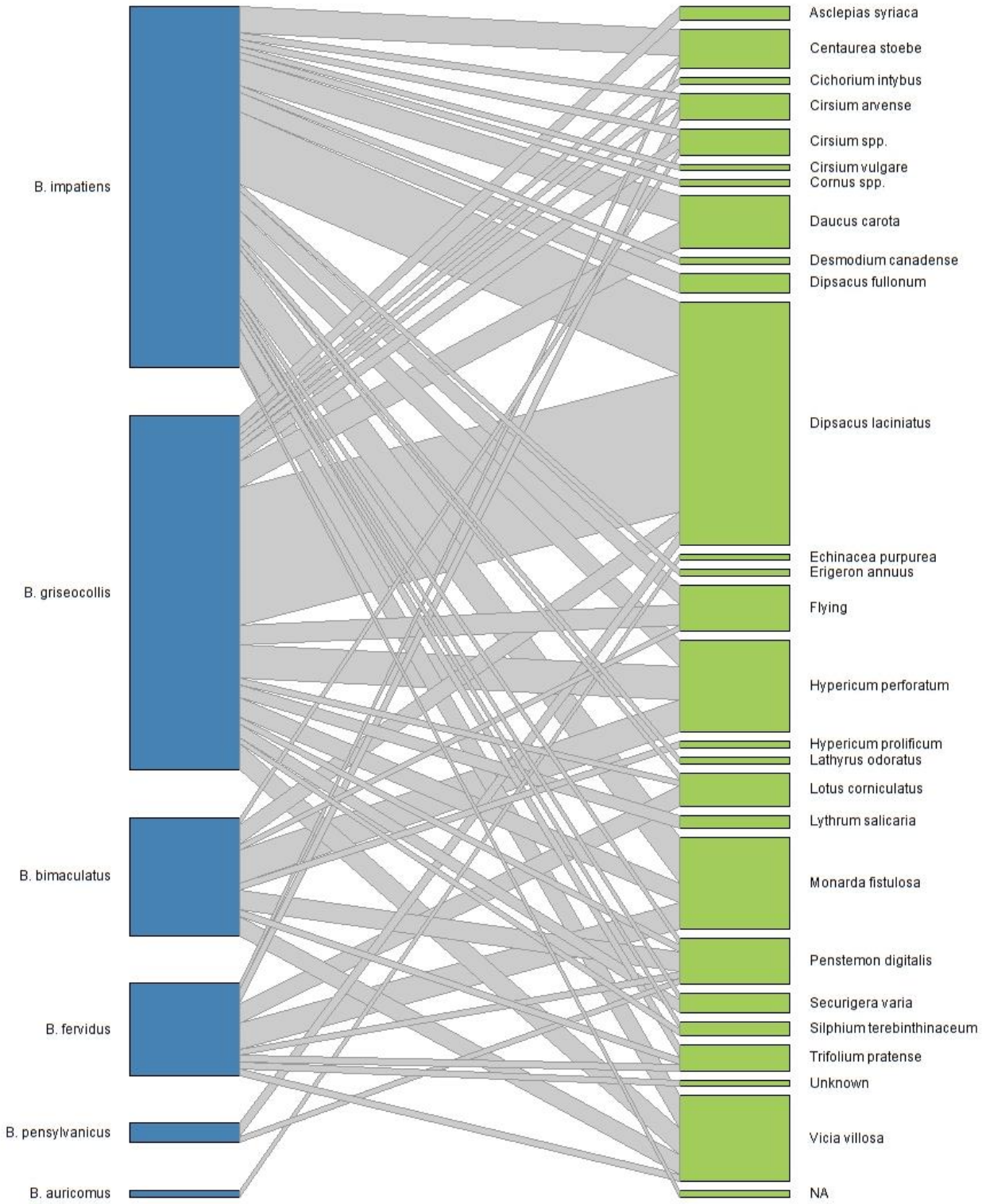


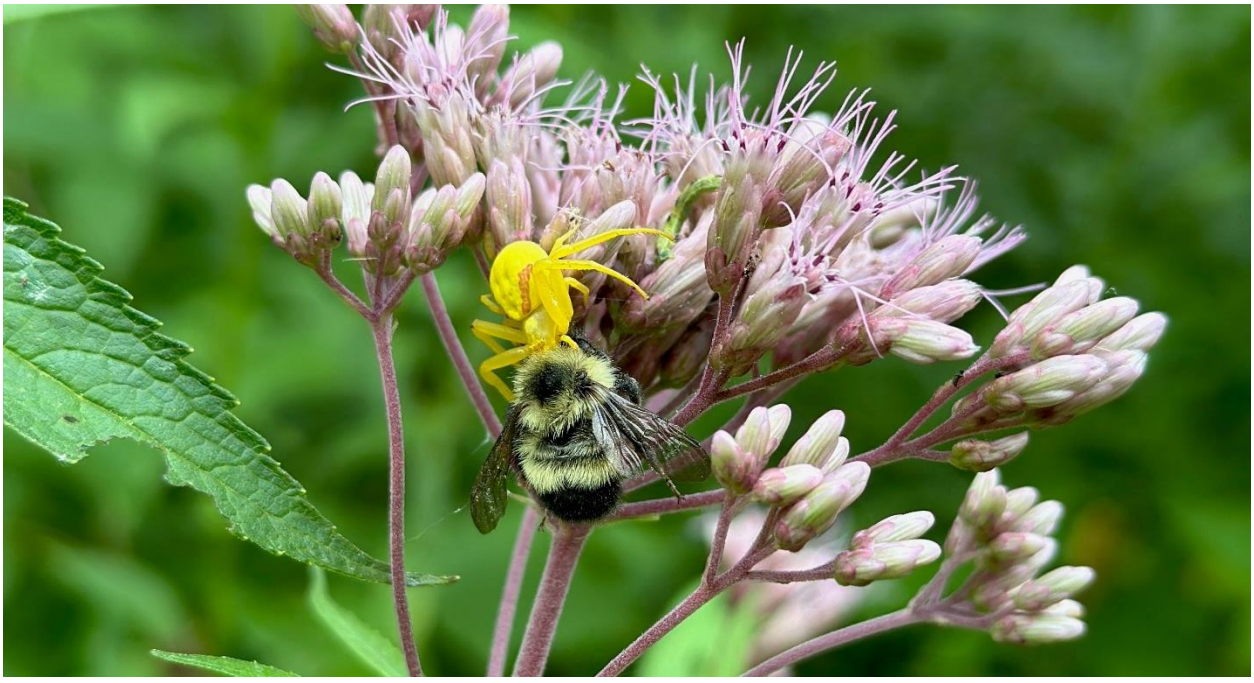
Figure 2. Visualization of the bumble bee plant visitation network recorded during surveys at Detroit River International Wildlife Refuge in 2024.

Pictured Rocks National Lakeshore

A total of 307 bumble bees were observed during 2024 surveys (Figure 3). *Bombus vagans* (half-black bumble bee) was the most frequently documented species (196 observations), followed by B. ternarius (68 observations). State-listed bumble bee species were documented at Sites 2, 3, 5, and 6. Three observations of B. terricola (yellow-banded bumble bee) were made at Site 2 (Table 8). Sites 1, 2, and 6 had the highest pollinator habitat assessment scores (Table 9).

Table 8. Summary of the bumble bees documented at each survey site in Pictured Rocks National Lakeshore in 2024.

Site ID	*B. borealis*	*B. griseocollis*	*B. impatiens*	*B. perplexus*	*B. sandersoni*	*B. ternarius*	*B. terricola*	*B. vagans*	Total
Site 1	3	-	2	-	-	10	-	28	**43**
Site 2	3	1	-	-	-	1	3	20	**28**
Site 3	1	-	2	5	1	17	-	52	**78**
Site 4	-	-	-	-	-	1	-	4	**5**
Site 5	-	-	3	11	2	4	-	74	**94**
Site 6	-	-	-	-	-	23	1	-	**24**
Site 7	-	-	-	5	-	12	-	18	**35**
Total	**7**	**1**	**7**	**21**	**3**	**68**	**4**	**196**	**307**



Bombus vagans (half-black bumble bee) foraging on Joe-pye weed (and being eaten by a crab spider) at Pictured Rocks National Lakeshore. Photo by Nicolette Sexton.

Table 9. Pollinator habitat scores for each site surveyed at Pictured Rocks National Lakeshore in 2024.

	Section 1 Score		Section 2 Score		Section 3 Score		Section 4 Score		Total Score	
Site ID	Visit 1	Visit 2	Visit 1	Visit 2	Visit 1	Visit 2	Visit 1	Visit 2	Visit 1	Visit 2
Site 1	17	10	23	28	21	25	27	27	88	90
Site 2	12	13	20	17	25	25	26	29	83	84
Site 3	13	17	17	22	22	25	22	25	74	89
Site 4	7	3	6	6	9	7	12	15	34	31
Site 5	13	13	20	19	24	20	25	25	82	77
Site 6	13	13	26	28	20	22	23	24	82	87
Site 7	12	10	20	14	17	25	17	18	66	67

Bumble bee survey habitat at Pictured Rocks National Lakeshore during the second round of surveys. Photo by Nicolette Sexton.

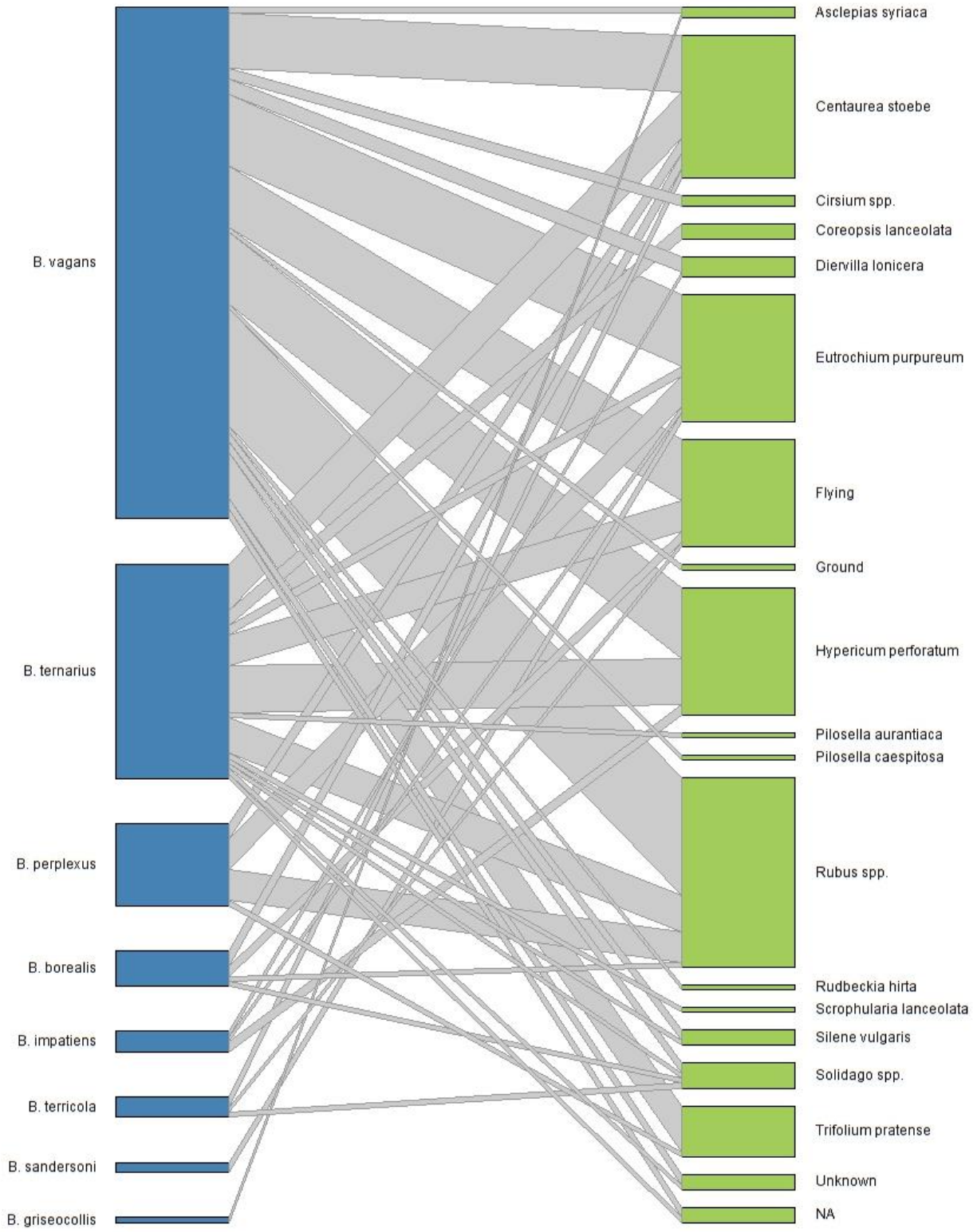


Figure 3. Visualization of the bumble bee plant visitation network recorded during surveys at Pictured Rocks National Lakeshore in 2024.

Sleeping Bear Dunes National Lakeshore

A total of 245 bumble bees were observed during surveys in 2024 (Figure 4). *Bombus griseocollis* was the most frequently documented species (119 observations), followed by *B. impatiens* (40 observations). State-listed bumble bee species were documented at Sites 1, 3, 4, 5, and 6. The state endangered *B. pensylvanicus* was documented at Site 1 (Table 10). This observation represents a new county record and the furthest north this species has been documented in Michigan. Sites 4, 6, and 7 had the highest pollinator habitat assessment scores (Table 11).

Table 10. Summary of the bumble bees documented at each survey site in Sleeping Bear Dunes National Lakeshore in 2024.

Site ID	*B. auricomus*	*B. bimaculatus*	*B. borealis*	*B. citrinus*	*B. griseocollis*	*B. impatiens*	*B. pensylvanicus*	*B. perplexus*	*B. ternarius*	*B. terricola*	*B. vagans*	Total
Site 1	1	11	1	1	2	4	1	-	-	-	9	**30**
Site 2	-	7	-	1	16	3	-	-	-	-	1	**28**
Site 3	-	4	-	2	63	2	-	1	-	1	2	**75**
Site 4	1	8	8	-	3	12	-	-	3	6	1	**42**
Site 5	-	-	1	1	22	7	-	1	6	3	3	**44**
Site 6	-	-	-	-	12	7	-	-	-	1	-	**20**
Site 7	-	-	-	-	1	5	-	-	-	-	-	**6**
Total	**2**	**30**	**10**	**5**	**119**	**40**	**1**	**2**	**9**	**11**	**16**	**245**

Bombus perplexus (perplexing bumble bee) foraging from milkweed during the first round of surveys at Sleeping Bear Dunes National Lakeshore. Photo by Logan Rowe.

Table 11. Pollinator habitat scores for each site surveyed at Sleeping Bear Dunes National Lakeshore in 2024.

	Section 1 Score		Section 2 Score		Section 3 Score		Section 4 Score		Total Score	
Site ID	Visit 1	Visit 2	Visit 1	Visit 2	Visit 1	Visit 2	Visit 1	Visit 2	Visit 1	Visit 2
Site 1	17	17	20	17	22	18	19	19	78	71
Site 2	17	17	15	15	24	22	19	19	75	73
Site 3	14	14	10	10	24	22	19	19	67	65
Site 4	17	17	23	24	29	22	22	22	91	85
Site 5	14	14	15	15	18	22	19	21	66	72
Site 6	17	17	20	17	24	22	22	21	83	77
Site 7	17	17	20	17	24	22	22	22	83	78

Survey habitat at Sleeping Bear Dunes National Lakeshore during the second round of bumble bee surveys. Photo by Logan Rowe.

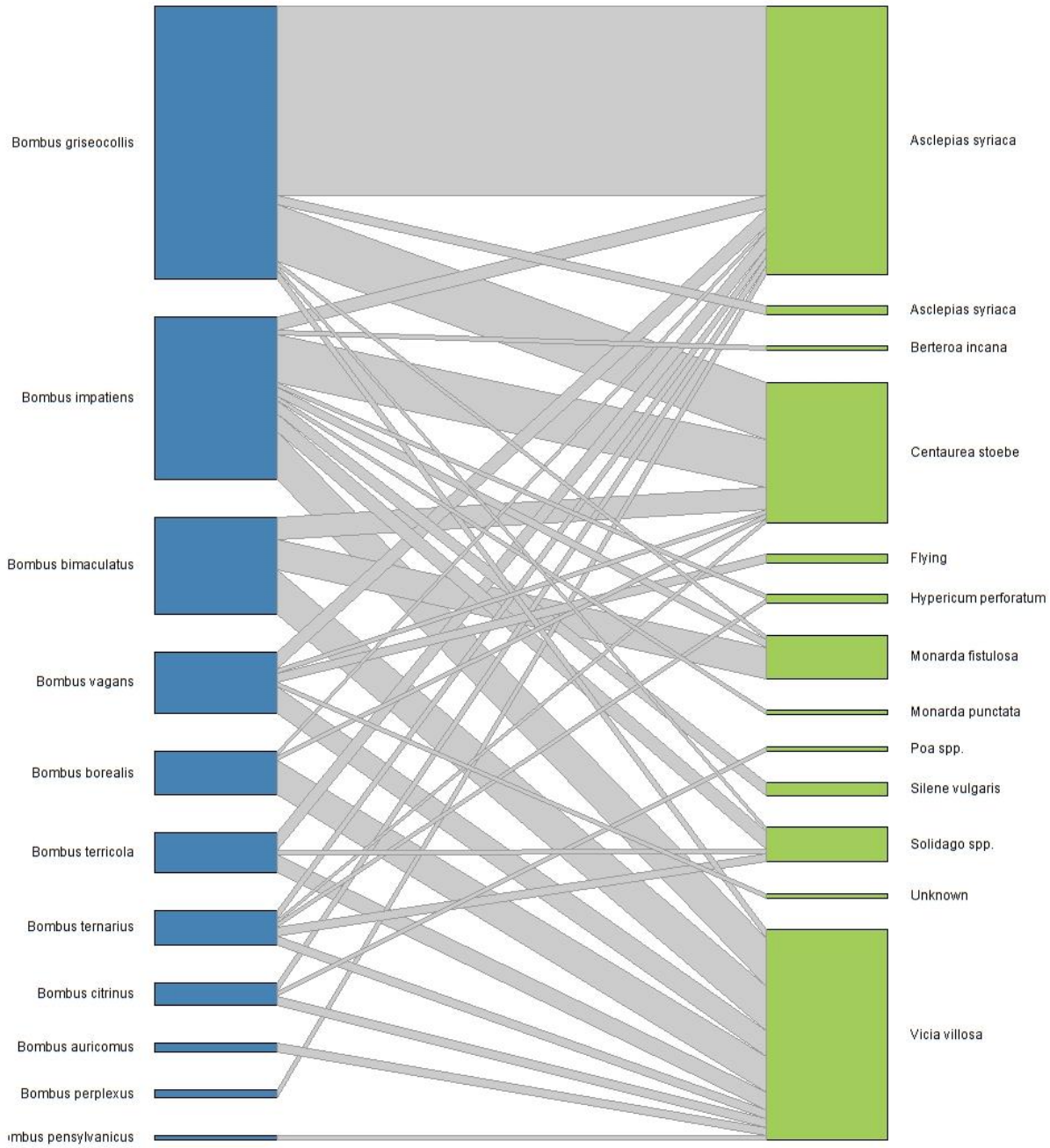


Figure 4. Visualization of the bumble bee plant visitation network recorded during surveys at Sleeping Bear Dunes National Lakeshore in 2024.

North Country Trail

A total of 1575 bumble bees were observed during surveys along the North Country Trail in 2025. *Bombus impatiens* was the more frequently documented species (885 observations), followed by *B. bimaculatus* (219 observations). State-listed bumble bee species were documented at Middle Augusta Prairie, Black River Harbor, Brevoort Lake, and East Lake (Table 12). Loda Lake, Augusta Prairie Middle, and Augusta Prairie North had the highest pollinator habitat assessment scores (Table 13).

Table 12. Summary of the bumble bees documented at each survey site along the North Country Trail in 2025.

Site ID	*B. auricomus*	*B. bimaculatus*	*B. borealis*	*B. citrinus*	*B. fervidus*	*B. flavidus*	*B. griseocollis*	*B. impatiens*	*B. perplexus*	*B. ternarius*	*B. terricola*	*B. vagans*	*B.vagans/sandersoni*	Total
Black River Harbor	-	34	-	-	-	1	14	19	22	23	4	43	1	**161**
Brevoort Lake	-	1	-	-	-	-	5	4	2	73	2	4	-	**91**
East Lake	-	4	1	3	-	-	6	13	3	48	1	11	-	**90**
High Bridge	-	6	-	-	-	-	12	52	3	-	-	3	-	**76**
Loda Lake Wildflower Sanctuary	-	52	-	4	-	-	10	14	-	1	-	3	-	**84**
Middle Augusta Prairie	1	46	-	-	1	-	38	263	-	-	-	5	-	**354**
North Augusta Prairie	-	40	-	-	-	-	34	228	1	-	-	3	-	**306**
Prickett Dam	-	-	-	-	-	-	1	11	-	1	-	15	-	**28**
Sand Point	-	4	-	-	-	3	2	7	-	10	-	11	-	**37**
South Augusta Prairie	1	32	-	3	-	-	30	274	6	-	-	2	-	**348**
Total	**2**	**219**	**1**	**10**	**1**	**4**	**152**	**885**	**37**	**156**	**7**	**100**	**1**	**1575**

Table 13. Pollinator habitat scores for each site surveyed along the North Country Trail in 2025.

	Section 1 Score		Section 2 Score		Section 3 Score		Section 4 Score		Total Score	
Site ID	Visit 1	Visit 2	Visit 1	Visit 2	Visit 1	Visit 2	Visit 1	Visit 2	Visit 1	Visit 2
Black River Harbor	17	13	6	16	20	14	22	25	65	68
Breevort Lake	17	13	15	10	15	20	25	30	72	73
East Lake	20	13	0	10	25	13	27	28	72	64
High Bridge Access	17	17	6	16	12	20	23	24	58	77
Loda Lake	20	17	15	15	17	22	21	27	73	81
Middle Augusta Prairie	17	-	10	-	23	-	30	-	80	-
North Augusta Prairie	17	-	10	-	25	-	28	-	80	-
Prickett Lake Dam	20	17	6	16	12	19	24	27	62	79
Sand Point	17	17	6	16	13	17	28	26	64	76
South Augusta Prairie	14	13	6	5	22	18	23	30	65	66

Seney National Wildlife Refuge

A total of 1680 bumble bees were observed during surveys at Seney National Wildlife Refuge in 2025 (Figure 5). *Bombus ternarius* was the most frequently documented bumble bee species (1168 observations), followed by *B. vagans* (169 observations). State-listed bumble bee species were documented at site six (*Bombus terricola*, n =2) (Table 14). Sites 2, 5, and 7 had the highest pollinator habitat assessment scores (Table 15).

Table 14. Summary of the bumble bees documented at each survey site in Seney National Wildlife Refuge in 2025.

Site ID	*B. bimaculatus*	*B. borealis*	*B. citrinus*	*B. flavidus*	*B. griseocollis*	*B. impatiens*	*B. perplexus*	*B. ternarius*	*B. terricola*	*B. vagans*	Total
Site 1	-	1	-	-	8	25	-	49	1	26	**110**
Site 2	6	1	-	-	37	3	-	478	1	10	**536**
Site 3	-	-	-	-	2	-	-	46	-	26	**74**
Site 4	1	-	-	-	60	10	-	149	-	26	**246**
Site 5	-	-	-	-	14	1	-	51	-	11	**77**
Site 6	6	-	-	3	33	95	1	127	2	57	**324**
Site 7	4	-	-	3	5	19	-	251	-	7	**289**
Whitefish Point	-	-	1	-	-	-	-	17	-	6	**24**
Total	**17**	**2**	**1**	**6**	**159**	**153**	**1**	**1168**	**4**	**169**	**1680**

Bombus ternarius collected during bumble bee survey at Seney National Wildlife Refuge in 2025. Photo by Nicolette Sexton.

Table 15. Pollinator habitat scores for each site surveyed in Seney National Wildlife Refuge in 2025.

	Section 1 Score		Section 2 Score		Section 3 Score		Section 4 Score		Total Score	
Site ID	Visit 1	Visit 2	Visit 1	Visit 2	Visit 1	Visit 2	Visit 1	Visit 2	Visit 1	Visit 2
Site 1	10	13	15	15	16	24	28	32	64	84
Site 2	10	13	15	10	16	28	26	34	67	85
Site 3	10	13	8	7	18	27	25	30	61	77
Site 4	17	13	8	8	21	22	21	25	67	68
Site 5	10	13	16	15	18	20	32	32	76	80
Site 6	13	13	8	8	22	24	26	22	69	67
Site 7	13	13	7	18	22	25	26	34	68	90
Whitefish Point	14	13	6	5	22	18	23	30	65	66

Bumble bee foraging habitat surveyed at Seney National Wildlife Refuge in 2025. Photo by Nicolette Sexton.

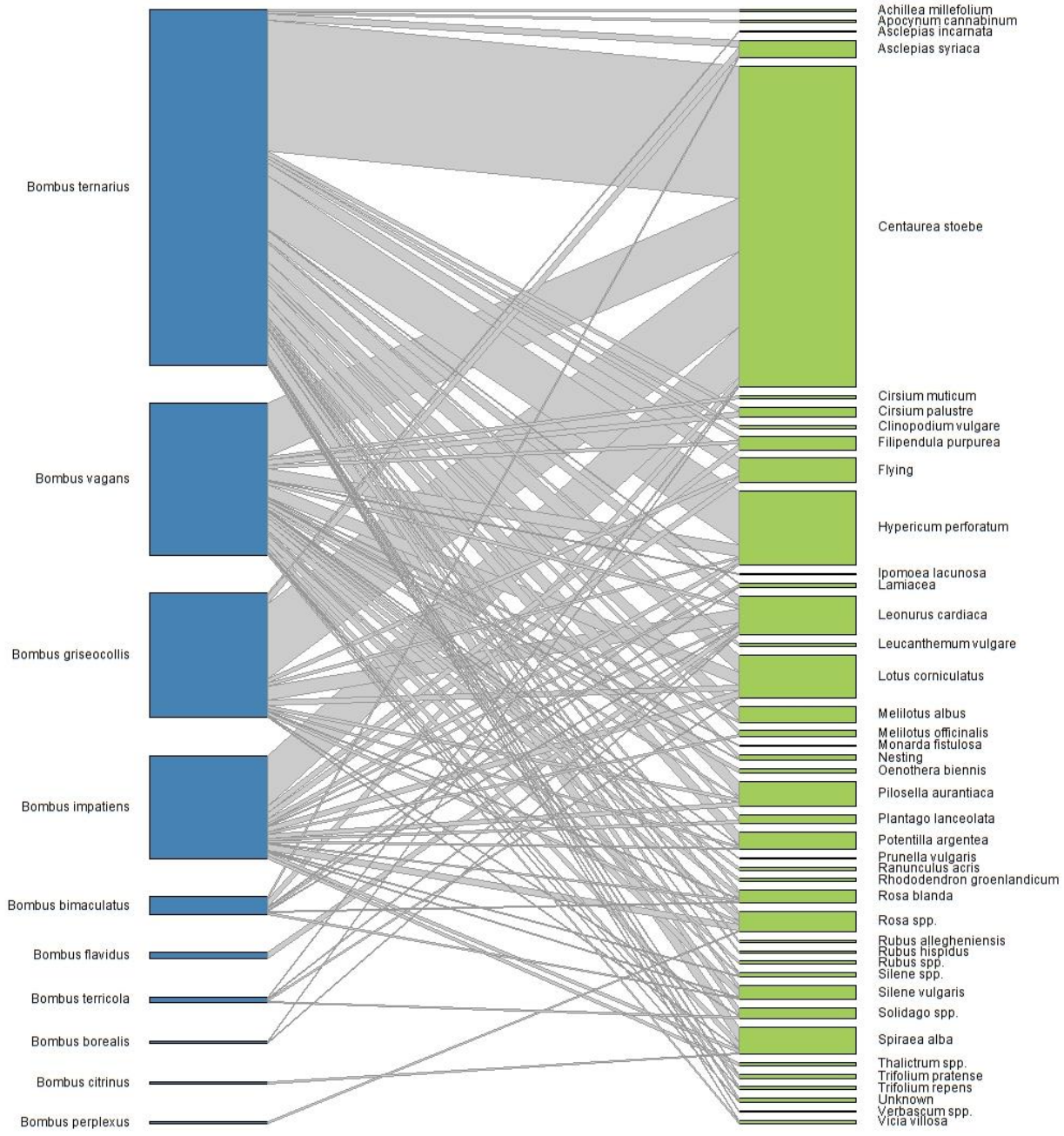


Figure 5. Visualization of the bumble bee plant visitation network recorded during surveys at Seney National Wildlife Refuge in 2025.

Shiawassee National Wildlife Refuge

A total of 272 bumble bees were observed during 2025 surveys at Shiawassee National Wildlife Refuge (Figure 6). *Bombus impatiens* was the most frequently documented species (194 observations), followed by *B. griseocollis* (57 observations). State-listed species were documented at Sites 1, 4, and 6 (Table 16). *Bombus fervidus* was documented at Sites 4 and 6. A single *B. pensylvanicus* was documented during initial site checks at site 4 but was not represented in the survey data. Pollinator habitat assessment scores were highest at sites 1, 5, and 7 (Table 17).

Table 16. Summary of the bumble bees documented at each survey site in Shiawassee National Wildlife Refuge in 2025.

Site ID	*B. auricomus*	*B. bimaculatus*	*B. fervidus*	*B. griseocollis*	*B. impatiens*	*B. vagans*	Total
Site 1	8	2	-	10	51	-	71
Site 2	-	1	-	-	9	-	10
Site 3	-	-	-	13	6	-	19
Site 4	-	1	4	5	50	-	60
Site 5	-	-	-	18	13	2	33
Site 6	-	1	2	3	41	-	47
Site 7	-	-	-	8	24	-	32
Total	**8**	**5**	**6**	**57**	**194**	**2**	**272**

Bombus pensylvanicus observed foraging from autumn olive during an initial site visit to Site 4. Photo by Olivia Franklin.

Table 17. Pollinator habitat scores for each site surveyed in Shiawassee National Wildlife Refuge in 2025.

	Section 1 Score		Section 2 Score		Section 3 Score		Section 4 Score		Total Score	
Site ID	Visit 1	Visit 2	Visit 1	Visit 2	Visit 1	Visit 2	Visit 1	Visit 2	Visit 1	Visit 2
Site 1	13	13	7	1	4	14	25	4	49	32
Site 2	13	13	7	1	4	4	25	8	49	26
Site 3	13	13	0	0	12	10	20	12	45	35
Site 4	13	10	0	1	4	4	30	15	47	29
Site 5	13	13	0	0	4	4	30	19	47	36
Site 6	13	13	5	0	6	8	12	10	36	31
Site 7	13	13	0	0	6	8	30	25	49	46

Bumble bee foraging habitat surveyed at Shiawassee National Wildlife Refuge during the second round of surveys in 2025. Photo by Logan Rowe.

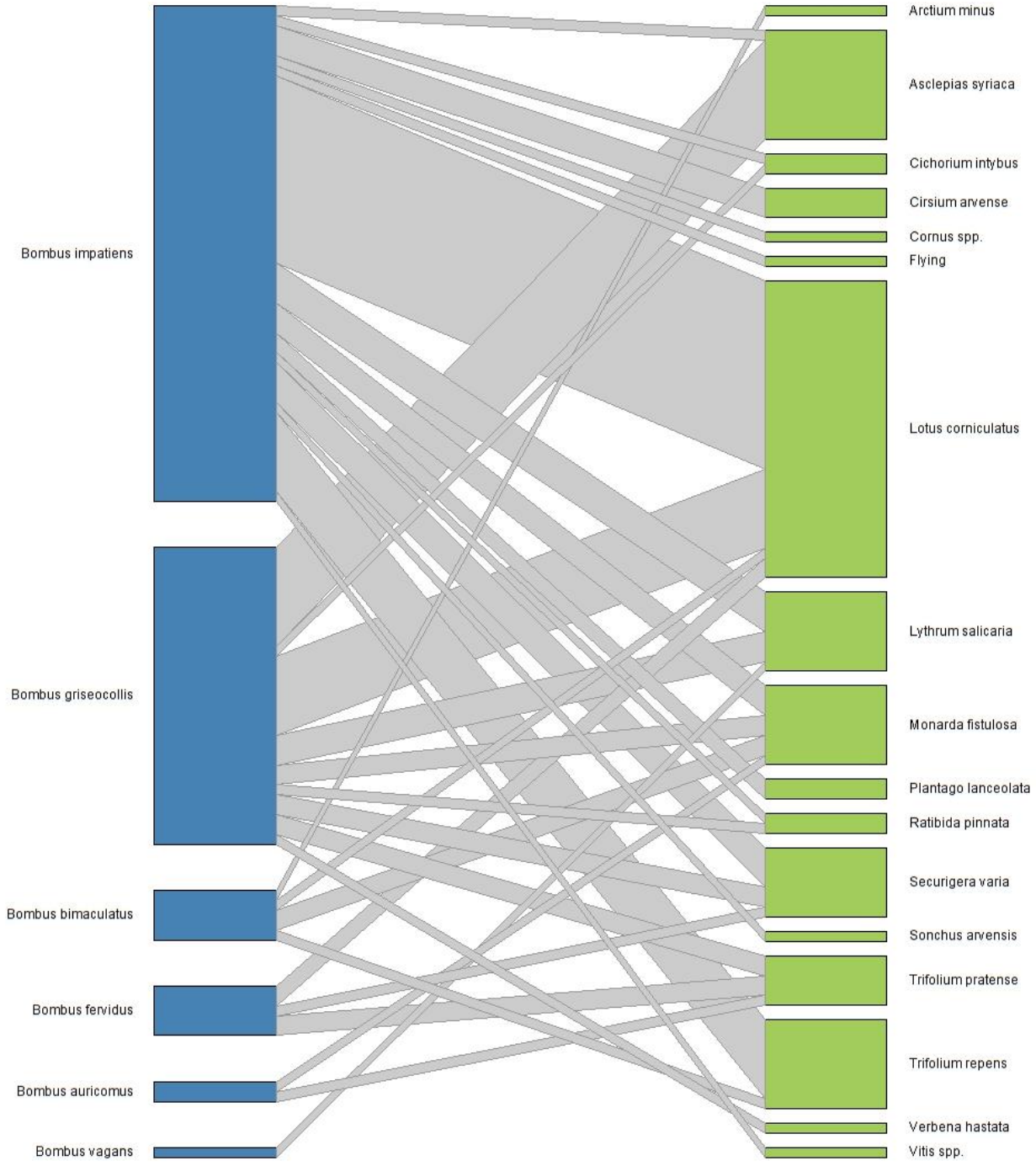


Figure 6. Visualization of the bumble bee plant visitation network recorded during surveys at Shiawassee National Wildlife Refuge in 2025.

DISCUSSION

The bumble bee surveys completed in 2024 and 2025 provide a detailed snapshot of bumble bee occupancy, species richness, and habitat quality within some of Michigan's most ecologically significant federal lands. New records of state-listed species were documented across the state and within each National Lakeshore or National Wildlife Refuge surveyed, demonstrating the importance these protected landscapes have in supporting populations of bumble bees.

Across all sites, a total of 4,296 individual bumble bees representing a broad suite of species were observed, with community composition varying by region, habitat type, and floral resource availability. Several widespread and disturbance-tolerant species, particularly *B. impatiens*, *B. bimaculatus*, and *B. griseocollis*, were abundant across both Lower Peninsula and Upper Peninsula NPS and USFWS management areas, consistent with their known tolerance for fragmented and human-influenced landscapes (Novotny et al. 2021). In contrast, multiple at-risk species had regional distributions and lower abundances, reflecting both their rarity and the increasing importance of targeted monitoring and management.

Five state-listed species were documented across Michigan: *B. auricomus*, *B. fervidus*, *B. pensylvanicus*, *B. sandersoni*, and *B. terricola*. Their distributions were mostly consistent with past statewide surveys (Rowe et al. 2023), yet the clustering of occurrences within specific survey areas emphasizes the conservation value of these federal lands. *Bombus pensylvanicus*, a state-endangered species, was detected at Detroit River IWR and Sleeping Bear Dunes NL, including a particularly noteworthy observation at Site 1 at Sleeping Bear Dunes. This detection represents a new county record and extends the known northern range of the species within Michigan. Such observations strongly suggest the persistence of small, previously undocumented populations, particularly in landscapes with abundant late-season forbs and open, grass-dominated vegetation structure. Upper Peninsula sites, particularly Pictured Rocks NL, Seney NWR, and North Country Trail (Black River Harbor, Brevoort Lake, East Lake), supported the majority of *B. terricola* detections. This finding is consistent with historical patterns showing that *B. terricola* persists at higher rates in northern Michigan, although at significantly reduced abundance compared to pre-decline baselines (Colla et al. 2012). Repeated documentation of these species at multiple sites indicates that federal lands continue to serve as important refugia despite broader regional declines documented in the Great Lakes region.

Variability in habitat assessment scores was documented across sites, but several consistent patterns emerged. First, sites with high floral richness, structurally diverse vegetation, and persistent bloom across the growing season scored highest for foraging habitat and generally supported the greatest bumble bee abundance and species richness. Second, many sites in both NPS and USFWS management areas exhibited strong late-season floral resources, particularly, *Solidago* spp., *Monarda fistulosa*, *Eutrochium purpureum*, and *Asclepias syriaca*. Which are plants in Michigan that are regularly used by both common and listed bumble bee species (Rowe et al. 2023, Earl et al. 2025). Finally, sites with lower scores often reflected

increased canopy cover, early successional vegetation lacking mid/late-season bloom, or dominance of non-native forbs. Notably, several detections of listed species occurred at sites where floral resources were partially dominated by invasive species (*Centaurea stoebe*, *Vicia villosa*, *Lotus corniculatus*). This pattern underscores both the adaptability of some species and the need for management strategies that reduce invasive cover while bolstering native nectar sources. Across all agencies, habitat assessments illustrate that ongoing management, prescribed fire, invasive removal, grassland restoration, and strategic mowing, continues to strongly influence habitat quality for pollinators.

The results from bumble bee community and habitat surveys highlight several opportunities to increase the conservation value of NPS and USFWS lands for bumble bee populations. Habitats where state listed bumble bee species were documented should be prioritized for 1) habitat maintenance and possible expansion through invasive species management and incorporating additional native foraging resources and 2) supplementary pollinator surveys to improve understanding of local populations. For sites in the Upper Peninsula, adjacent forest understory should also be maintained to boost spring flowering species, such as *Claytonia* sp. and *Dicentra cucullaria*, which are known to be preferred resources for spring foraging queen bumble bees. Sites in the Southern Peninsula should prioritize open-habitat restoration and improving the connectivity between prairie/grassland patches.

The surveys completed in 2024 and 2025 represent a small fraction of occupiable lands in the NPS and USFWS management areas. Therefore, additional targeted surveys are warranted in within the National Lakeshore and National Wildlife Refuges to further describe resident bumble bee populations and habitat use. These surveys lacked spring efforts focused on queen bumble bee resource use, which would provide useful insights into spring floral and nesting resource availability. The population of *B. pensylvanicus* in Sleeping Bear Dunes is represented by a single individual documented in 2024 and the full extent of the population is currently unknown. Additional surveys throughout Sleeping Bear Dunes NL would improve this species representation within the broader National Lakeshore.

By establishing a strong baseline of community composition, habitat quality, and species occurrences, these surveys lay the groundwork for long-term monitoring and adaptive management across Michigan's National Lakeshores and National Wildlife Refuges. Continued collaboration among MNFI, NPS, USFWS, and regional partners will be essential to building on this foundation and ensuring that conservation actions remain responsive, effective, and grounded in data-driven understanding of pollinator needs across Michigan's protected landscapes. As future survey efforts expand in geographic scope and seasonal coverage, the collective knowledge gained through this project will continue to refine priorities, inform restoration strategies, and strengthen the capacity of federal land managers to support resilient bumble bee populations well into the future.

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