Bumble Bee Community and Habitat Surveys in Indiana, Michigan, and Ohio

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Cover: An American bumble bee (*Bombus pensylvanicus*) foraging on wild white indigo (*Baptisia alba*). Photo by Nicolette Sexton.

EXECUTIVE SUMMARY

Michigan Natural Features Inventory (MNFI) received funding from the United States Fish and Wildlife Service (USFWS, Grant No. F22AC01443) through the Great Lakes Restoration Initiative (GLRI) to support rusty-patched bumble bee (*Bombus affinis*; RPBB) recovery goals. Funding was provided to support three primary project objectives: 1) conduct bumble bee community surveys at 60 sites across Indiana, Michigan, and Ohio where RPBB may occur, 2) complete habitat assessments at each survey location to complement bumble bee community surveys, and 3) construct habitat suitability models for two bumble bee species of conservation concern. This report details the methods and results of 2023-2025 bumble bee and habitat surveys in Indiana, Michigan, and Ohio, and provides details on habitat management needs and future warranted surveys at locations visited during this effort.

We used a modified version of USFWS RPBB protocols for unoccupied zones (USFWS Survey Protocols for the Rusty Patched Bumble Bee Version 2.2) to complete bumble bee community surveys and to determine the presence of RPBB at 60+ locations across Indiana, Michigan and Ohio. Surveys were one-person hour, meander-based, and completed twice per year at each site between June and August. We prioritized areas with high densities of floral resources where bumble bees were most likely to be foraging. If bumble bees could not be identified in the field, specimens were collected and identified in a laboratory setting. In addition to bumble bee community surveys, we completed RPBB habitat assessments after each survey round to better quantify suitability for bumble bees beyond foraging resources (Xerces 2017). Upon completion of field-based surveys, habitat suitability models were constructed for RPBB and American bumble bee (*B. pensylvanicus*) to provide a regional perspective of habitat suitability for these species.

Between 2023-2025, a total of 9728 bumble bee observations were made across 74 different sites, including 28 sites in Indiana, 24 in Michigan, and 22 in Ohio. The most frequently observed species of bumble bee was the common eastern bumble bee (*Bombus impatiens,* n=4636), followed by brown-belted bumble bee (*Bombus griseocollis*, n=2570), and two-spotted bumble bee (*Bombus bimaculatus*, n=1748). No occurrences of RPBBs were recorded, but we documented several occurrences of other rare or declining bumble bee species in each state. This included the American bumble bee (*B. pensylvanicus)* at 16 sites in Indiana (n=81), one site in Michigan (n=1), and 5 sites in Ohio (n=12). Wild bergamot (*Monarda fistulosa*) was the most frequently visited plant species during bumble bee surveys, representing 46.8% of all foraging observations made between 2023-2025.

The bumble bee community surveys completed in Indiana, Michigan, and Ohio increase our knowledge of species distribution, relative abundance, floral resource use, and provide a baseline for identifying potential habitats for rare or declining bumble bee species. Furthermore, these surveys support the RPBB recovery plan by addressing multiple recovery actions for this species within Conservation Unit 3 for the RPBB. While no RPBB were located during these efforts, future survey work can prioritize high quality habitats capable of supporting RPBB and other rare or declining bumble bees.

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INTRODUCTION

Bumble bees (Hymenoptera: Apidae: *Bombus*) are one of the most important pollinators in natural and planted flowering plant communities. Large population declines of several bumble bee species have been documented over the last 50 years (Colla et al. 2012, Jacobson et al. 2018). For some species, these declines have been rapid, and multiple possible causes have been identified including habitat loss, pesticides, parasites and pathogens, and changing weather patterns (Janousek et al. 2023). One species of bumble bee that has shown particularly sharp population decline across its historic range is the rusty-patched bumble bee (*Bombus affinis*; RPBB) which has had an estimated relative population decline of 92-95% and currently occupies about 1% of its historical distribution (Cameron et al. 2011, USFWS 2021). This steep decline in RPBB abundance and distribution led the United States Fish and Wildlife Service (USFWS) to issue and emergency listing to add the species to the US Endangered Species list (USFWS 2017).

The post-listing Recovery Plan for RPBB, developed by the USFWS, seeks to conserve populations across the species' current and historic range while working to expand its distribution (USFWS 2021). The plan outlines a series of Recovery Actions designed to stabilize populations and ultimately achieve the goal of delisting RPBB from the U.S. Endangered Species list. Among these, Recovery Action 4 emphasizes the need to assess population and habitat status and track long-term trends through systematic monitoring and surveys, while Recovery Action 5 focuses on managing, protecting, and enhancing habitats critical to the species' survival.

Indiana, Michigan, and Ohio make up Conservation Unit 3 of the RPBB Recovery Plan. Within this unit, populations of RPBB have not been recorded in Indiana since 2016, in Michigan since 1999, and in Ohio since 2002. To achieve the recovery goals established for RPBB, comprehensive bumble bee community and habitat surveys are needed to clarify the species' status in the Conservation Unit. These efforts are especially critical given that even though RPBB has not been observed in Conservation Unit 3 for nearly a decade, potentially suitable habitat remains. Focused monitoring could reveal whether small, remnant populations persist undetected, and when conducted in tandem with habitat assessments, may help determine opportunities for restoration or future reintroduction efforts. More broadly, such surveys would provide essential data to guide conservation strategies and evaluate progress toward recovery benchmarks. Conducting targeted surveys for RPBB also creates opportunities to document other bumble bee species currently occupying habitats historically used by RPBB. Through community survey efforts, we can document species that may be rare or state listed. These include the American bumble bee (*Bombus pensylvanicus*; ABB), which is listed as State Endangered in Michigan and State Rare in Indiana. These surveys help pinpoint locations and habitats that support rare or potentially declining species, providing valuable information to guide conservation and habitat management efforts.

From 2023-2025, the Michigan Natural Features Inventory conducted surveys in Indiana, Michigan, and Ohio to: 1) document bumble bee communities in this portion of the RPBB

historic range (Conservation Unit 3), 2) gather floral resource use and habitat data associated with resident bumble bee communities and species of conservation concern, and 3) collect baseline data for incorporation into habitat suitability models for RPBB and ABB. These surveys expand upon previous MNFI research that surveyed for RPBB populations and provided habitat suitability models for RPBB, ABB, and yellow banded bumble bee (*Bombus terricola*) in Michigan (Rowe et al 2023).

Bumble bee survey habitat located at Adams Lake Prairie State Nature Preserve in Ohio. Managed by the Ohio Department of Natural Resources. Photo Credit: Logan Rowe

METHODS

Site Selection

During the fall of 2022, an initial list of survey sites was developed with a target of at least 20 survey sites in each of Indiana, Michigan, and Ohio. Survey sites were selected based on the documentation of historic RPBB occurrence, availability of abundant floral resources for forage, research accessibility, history of/ongoing habitat management, and level of protection (i.e. currently managed by state-level or local conservation agency). Seventy-two sites were identified as potential survey sites with 28 in Indiana, 22 in Michigan, and 22 in Ohio (Figures 1-3; Table 1). Sites largely consisted of managed conservation areas including state nature preserves, state parks, and conservation properties held by land conservancies. In the fall of 2023, and again in 2024, sites were re-evaluated based on floral resource abundance and local bumble bee communities observed during surveys. A small number of sites were removed each year and when possible, replaced with new locations based on similar criteria as above.

Foraging habitat at Fisher Oak Savanna Nature Preserve Managed by NICHES Land Trust. Photo credit: Nicolette Sexton
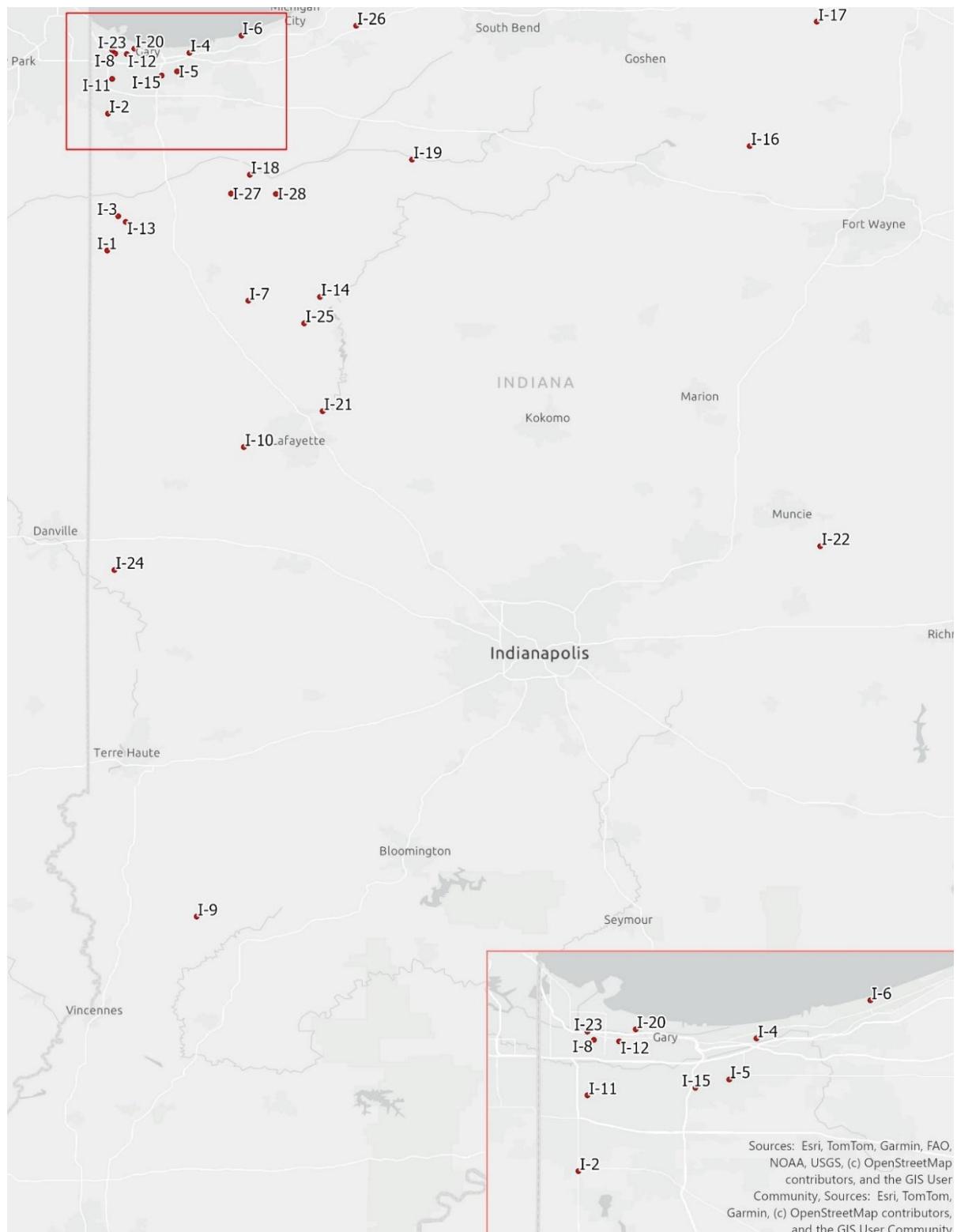
Figure 1. Map of sites surveyed by Michigan Natural Features Inventory in Indiana from 2023-2025. Includes insert map of sites in the Gary region. Sites are labelled with a site code that corresponds to Table 1.
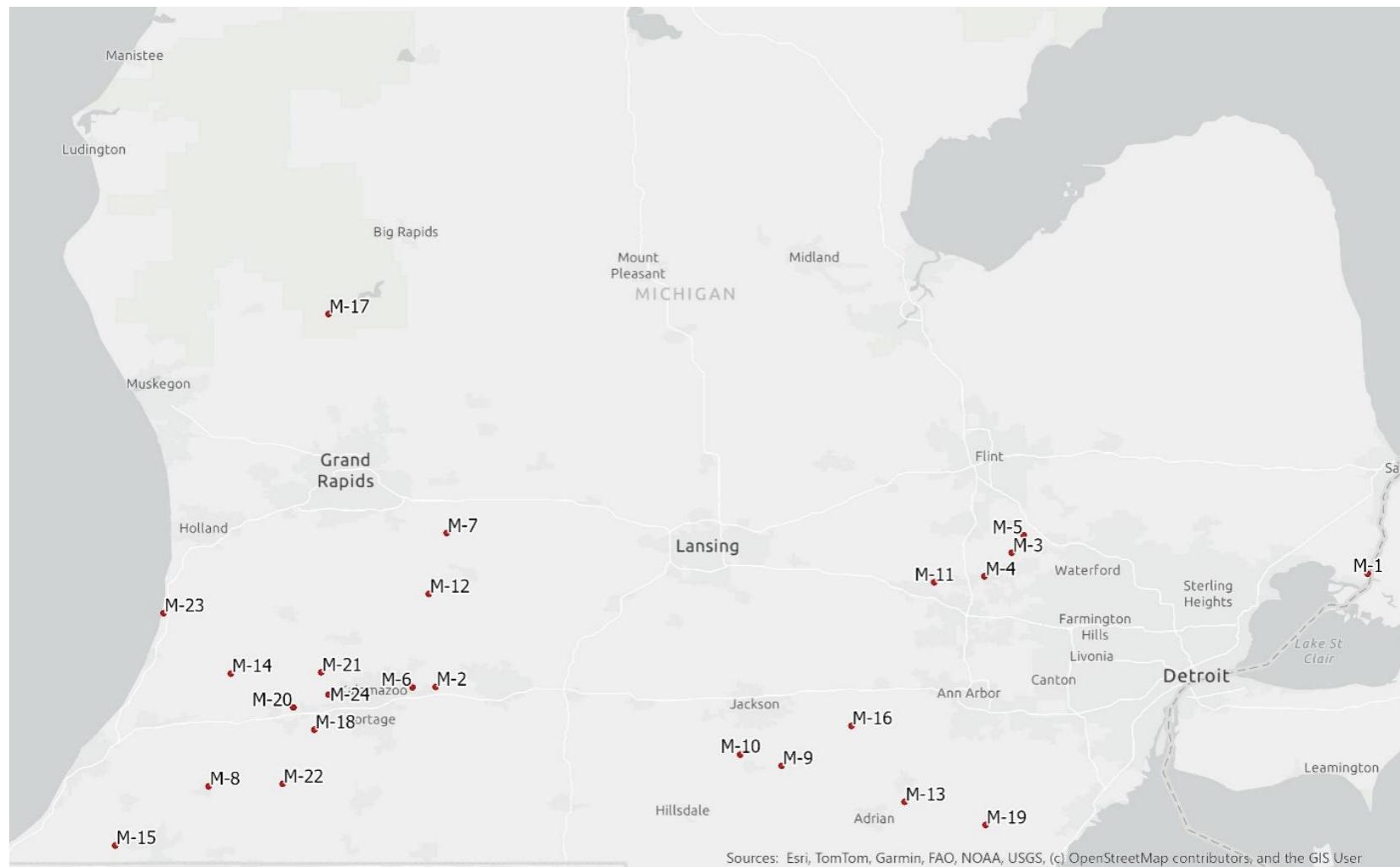
Figure 2. Map of sites surveyed by Michigan Natural Features Inventory in Michigan from 2023-2025. Sites are labelled with a site code that corresponds to Table 1.
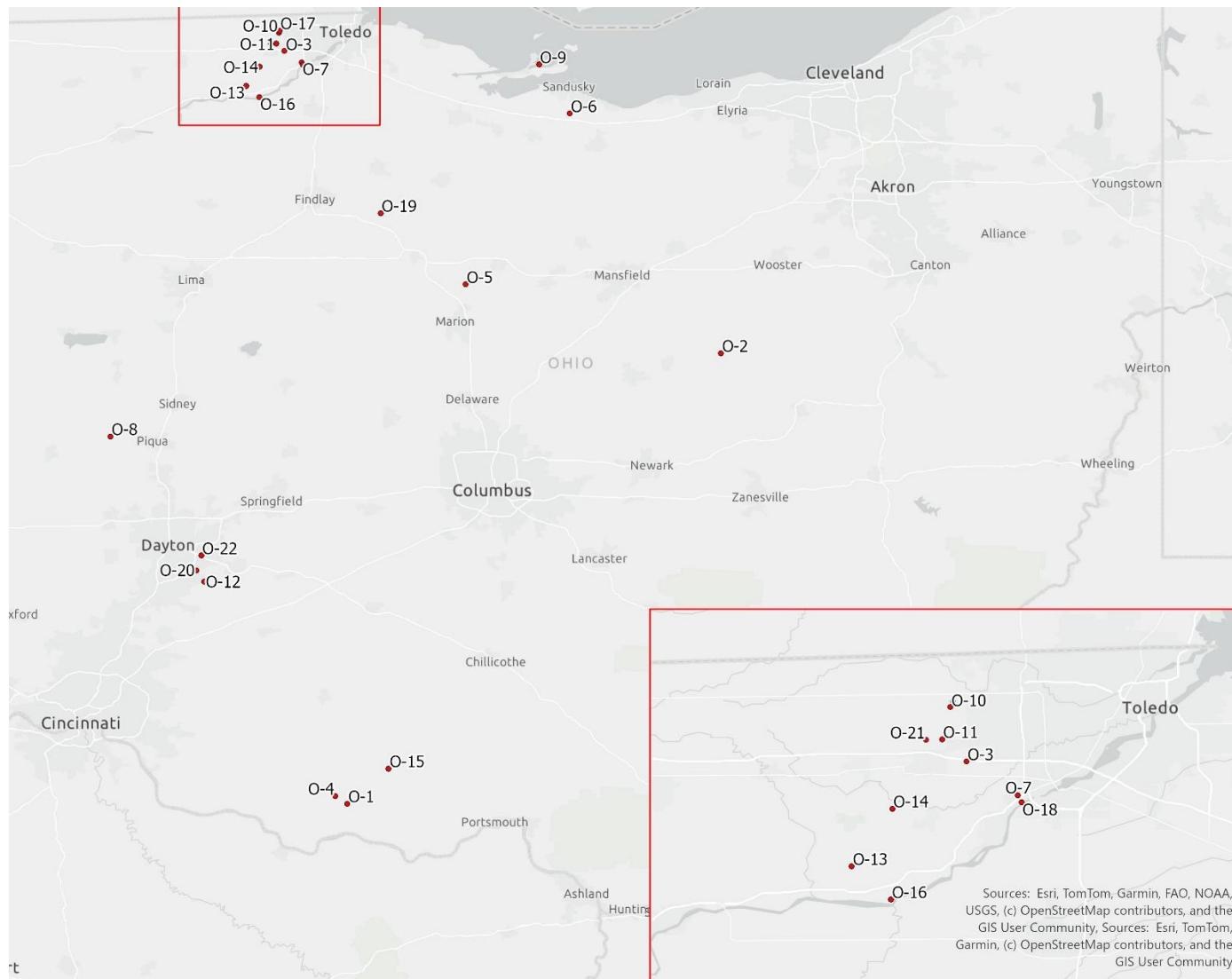
Figure 3. Map of sites surveyed by Michigan Natural Features Inventory in Ohio from 2023-2025. Includes map insert of sites in the Toledo region. Sites are labelled with a site code that corresponds to Table 1.

Table 1. Sites where bumble bee and habitat surveys were conducted by Michigan Natural Features Inventory from 2023-2025. The central latitude and longitude (WGS 84) are provided for each site in addition to site codes that correspond to labels in Figures 1-3.

Site	State	Site ID	Latitude	Longitude
Barnes Nature Preserve	IN	I-1		
Biesecker Prairie Nature Preserve	IN	I-2		
Conrad Savanna Nature Preserve	IN	I-3		
Coulter Nature Preserve	IN	I-4		
Cressmoor Prairie Nature Preserve	IN	I-5		
Dunes Prairie Nature Preserve	IN	I-6		
Fisher Oak Savanna Nature Preserve	IN	I-7		
Gibson Woods Nature Preserve	IN	I-8		
Goose Pond Fish and Wildlife Area	IN	I-9		
Granville Sand Barrens Nature Preserve	IN	I-10		
Hoosier Prairie Nature Preserve	IN	I-11		
Ivanhoe Dune and Swale Nature Preserve	IN	I-12		
Kankakee Sands Preserve	IN	I-13		
Lowe Prairie	IN	I-14		
McCloskey's Burr Oak Savanna Nature Preserve	IN	I-15		
Merry Lea Nature Preserve	IN	I-16		
Mongoquinong Nature Preserve	IN	I-17		
NIPSCO Savanna	IN	I-18		
Ober Savanna Nature Preserve	IN	I-19		
Pine Station Nature Preserve	IN	I-20		
Prophetstown Fen State Park	IN	I-21		
Red-tail Nature Preserve	IN	I-22		
Seidner Dune and Swale Nature Preserve	IN	I-23		
Smith Cemetery Nature Preserve	IN	I-24		
Spinn Prairie Nature Preserve	IN	I-25		
Springfield Fen Nature Preserve	IN	I-26		
Stoutsburg Savanna Nature Preserve	IN	I-27		
Tefft Savanna Nature Preserve	IN	I-28		
Algonac State Park Blazing Star Prairie	MI	M-1		
Augusta Floodplain	MI	M-2		
Big Valley Nature Sanctuary	MI	M-3		
Bullard Lake Fen Plant Preserve	MI	M-4		
Calla C. Burr Memorial Nature Sanctuary	MI	M-5		
Chipman Nature Preserve	MI	M-6		
Dolan Nature Preserve	MI	M-7		
Dowagiac Fen Nature Sanctuary	MI	M-8		
Goose Creek Grasslands	MI	M-9		
Grand River Fen Preserve	MI	M-10		
H.E. Hardy Memorial Nature Sanctuary	MI	M-11		
Hidden Pond Preserve	MI	M-12		
Ives Road Fen	MI	M-13		

Site	State	Site ID	Latitude	Longitude
Jeptha Lake Fen	MI	M-14		
McCoy's Creek Trail	MI	M-15		
Nan Weston Nature Preserve at Sharon Hollow	MI	M-16		
Newaygo Prairie	MI	M-17		
Paw Paw Prairie Fen	MI	M-18		
Petersburg State Game Area	MI	M-19		
Portman Nature Preserve	MI	M-20		
Sand Creek Preserve	MI	M-21		
Tamarack Swamp Preserve	MI	M-22		
Wau-Ke-Na, William Erby Smith Preserve	MI	M-23		
Wolf Tree Nature Trails	MI	M-24		
Adams Lake Prairie State Nature Preserve	OH	O-1		
Brinkhaven Oak Barrens State Nature Preserve	OH	O-2		
Campbell State Nature Preserve	OH	O-3		
Chaparral Prairie State Nature Preserve	OH	O-4		
Daughmer Prairie Savanna State Nature Preserve	OH	O-5		
Erie Sand Barrens	OH	O-6		
Fallen Timbers Battlefield	OH	O-7		
Goode Prairie State Nature Preserve	OH	O-8		
Great Egret Marsh Preserve	OH	O-9		
Irwin Prairie State Nature Preserve	OH	O-10		
Kitty Todd State Nature Preserve	OH	O-11		
Morris Reserve	OH	O-12		
Muck Farm	OH	O-13		
Oak Openings Metropark	OH	O-14		
Plum Run Prairie State Natural Area	OH	O-15		
Providence Metropark	OH	O-16		
Secor Metropark	OH	O-17		
Side Cut Metropark	OH	O-18		
Springville Marsh State Nature Preserve	OH	O-19		
Sweet Arrow Reserve	OH	O-20		
TNC - Mancy Wilkins Tract	OH	O-21		
Zimmerman Prairie State Natural Area	OH	O-22		

Bumble Bee Community Surveys

We used a modified version of USFWS RPBB survey protocol for unoccupied zones (USFWS 2019) to complete bumble bee community surveys at each survey location between 2023-2025. During each survey year, sites were surveyed twice, once in early summer (June) and again in late summer (July/early August), to capture changes in bumble bee communities or floral resources (Table 2). Early summer surveys largely targeted queen and early worker floral

resource use, while late summer surveys focused more heavily on documenting workers. Surveys consisted of a 1 person-hour meander bumble bee community survey. Surveyors walked meander paths through potential habitat, focusing survey efforts in areas with high concentrations of floral resources and ensuring multiple flowering species were targeted. Non-lethal techniques were generally used. However, in the event a bumble bee could not be identified to species in the field it was collected and identified later in a laboratory setting. For potentially rare or declining bumble bee species, a voucher specimen was generally collected to confirm identification. The primary purpose of this methodology was to document the relative abundance of each bumble bee species encountered and to determine the floral resources utilized at different time periods of colony development. For each bumble bee occurrence, we recorded the site, date, species (if known), GPS location, behavior (flying, foraging, perched) and floral resource association. In some instances, we were unable to identify the plant species association, and so we recorded the lowest taxonomic level with high certainty. We used ArcGIS Survey123 to record all bumble bees and associated data during field surveys. All bumble bee community surveys were conducted on days that had no rain, when temperatures above 15° C (60° F), and when winds were ≤ 25 kph (15 mph).

Surveyors collect bumble bee data from Hoosier Prairie Nature Preserve. Photo credit: Logan Rowe

Table 2. Survey date ranges for 2023-2025 bumble bee and habitat surveys in Indiana, Michigan and Ohio.

	Round 1 Survey Dates	Round 2 Survey Dates	Number of Sites Surveyed
Indiana			
2023	6/15-6/24	7/24-7/28	28
2024	6/11-6/14	7/22-7/25	24
2025	6/9-6/16	7/21-7/29	22
Michigan			
2023	6/9-6/16	7/31-8/3	22
2024	6/14-6/19	7/16-7/22	20
2025	6/12-6/17	7/21-8/1	20
Ohio			
2023	6/19-6/22	7/24-7/28	22
2024	6/11-6/14	7/22-7/26	21
2025	6/9-6/12	7/22-7/24	19

Habitat Assessments

At each site and within each survey round, we collected information to complete a RPBB habitat assessment using the Xerces RPBB Habitat Assessment Form for Natural Areas and Rangelands (Jordan et al. 2014). 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 site's history of pesticide and management practices, we left this section blank. In addition, since we did not survey the sites in fall, we omitted section 3d where the available flowering plants in fall were counted. Based on the criteria set in sections 1-4 and the omission of section 3d, each site received a score on a scale of 1-120 points during each round to describe the overall habitat quality and suitability for rare bumble bees. The maximum scores for each section are as follows: regional features (20); site features (35); foraging habitat (40); and nesting and overwintering habitat (30).

Data Summary and Analysis

We summarized bumble bee occurrences at each site for each round of each year surveyed. We also compared overall and average bumble bee abundance and species richness at each state for each survey round by year to determine if there were any differences between average bumble bee abundance and species richness. In addition, we summarized floral resources used by bumble bees and identified the most frequent floral resources used by rare or declining bumble bee species. Survey sites for each state were also ranked by bumble bee habitat suitability by taking and comparing the score between both visits to a site for each year based on the completed Xerces habitat assessments. We also compared the average score of habitat assessments at sites where RPBB and ABB were present to sites where they were absent to determine if score of these sites were significantly different from other sites surveyed.

Habitat Suitability Modelling

Species distribution modeling, here referred to as habitat suitability modeling (HSM), quantifies the relationship between the distribution of a species and environmental factors to predict the species potential habitat in environmental space. For declining or potentially declining species such as RPBB and ABB, HSM allows for a way to visualize suitable habitats to be protected across the landscape where these species may occur. For the RPBB HSM, we used a HSM training process using a set of environmental variables and applying the model to a different geographic extent using the same environmental variables. The training extent of Illinois, Minnesota, and Wisconsin was projected to the geographic extent of Indiana, Michigan, and Ohio to create the final HSM for RPBB across these six states.

Since no contemporary records for RPBB exist in Indiana, Michigan, or Ohio, we used records from other states with RPBB occurrences to inform the model for this species. Rusty-patched

bumble bee occurrence records (observed 2012-2022) were obtained from Illinois, Minnesota, and Wisconsin through a NatureServe data request submitted in Spring 2023. Using natural heritage quality data sources ensures that the occurrence data has been vetted prior to use in models. Locations were spatially thinned to a minimum distance of 1 km to avoid potential spatial autocorrelation, resulting in a total of 389 occurrences (153 from Illinois, 102 from Minnesota, and 134 from Wisconsin).

For the ABB model, current occurrence records were compiled from ABB observations through the bumble bee community surveys described in this report and other MNFI studies (n = 135) and iNaturalist database (724). Records collected from iNaturalist only included records that met the following five criteria: research grade, open geoprivacy, not captive or introduced, observed within last 10 years, positional accuracy <= 100 meters. Like the RPBB NatureServe data, ABB observations were spatially thinned to a minimum distance of 1 km to avoid potential spatial autocorrelation. Six iNaturalist Michigan observations were located > 1 km from the thinned MNFI occurrences. None of the iNaturalist Indiana or Ohio ABB observations were within 1 km of the MNFI occurrences, but many were still spatially clustered, so the R script "thin.max.r" (Warren 2024) was used to spatially rarify the point dataset. The size of the dataset was reduced to 350 points, while still maximizing the distance between points (1.48 km). The thinned MNFI and iNaturalist occurrence data were merged to create the model presence point dataset of 404 occurrences (122 from Indiana, 249 from Ohio, and 33 from Michigan).

A HSM for RPBB was created for Illinois, Minnesota, and Wisconsin (model training area) using the maximum entropy algorithm (Maxent ver. 3.4.4k), a presence-only modeling method (Phillips et al. 2006). Maxent requires approximately 10,000 pseudo-absence or background locations. The selection of background locations in presence-background HSMs can affect model estimates (e.g., Phillips et al. 2009) and inflate model evaluation statistics (e.g., Rodda et al. 2011). Models using either background locations or pseudo-absence locations can suffer from sampling bias (geographic and/or environmental) if the background or pseudo-absence locations do not mimic sampling bias in the presence data. A targeted background approach was used in our modelling, where contemporary *Bombus* species occurrence data were extracted from iNaturalist (research grade, positional accuracy <= 1 km) and buffered by two kilometers (Elith and Leathwick 2007, Philips et al. 2009). Background points (n=10,000, minimum distance 500 meters) were randomly created within the buffered area (Figure 4).

At first, the same background point generation method used in the RPBB model was used for ABB. However, once testing the environmental variables, they showed little influence on the model output. This led us to suspect that the common *Bombus* species, from which the background points were created, occupied very similar habitat as AMBB. Instead, iNaturalist data was queried using the following criteria: insect species, research grade, 2025 observation date, open geoprivacy, and positional accuracy less than 1 km. Within the model extent 189,306 insect observations met the criteria. The point selection was then buffered by 2 kilometers and from this extent, 10,000 random points (minimum distance 500 meters) were created to create the final background point dataset (Figure 5).
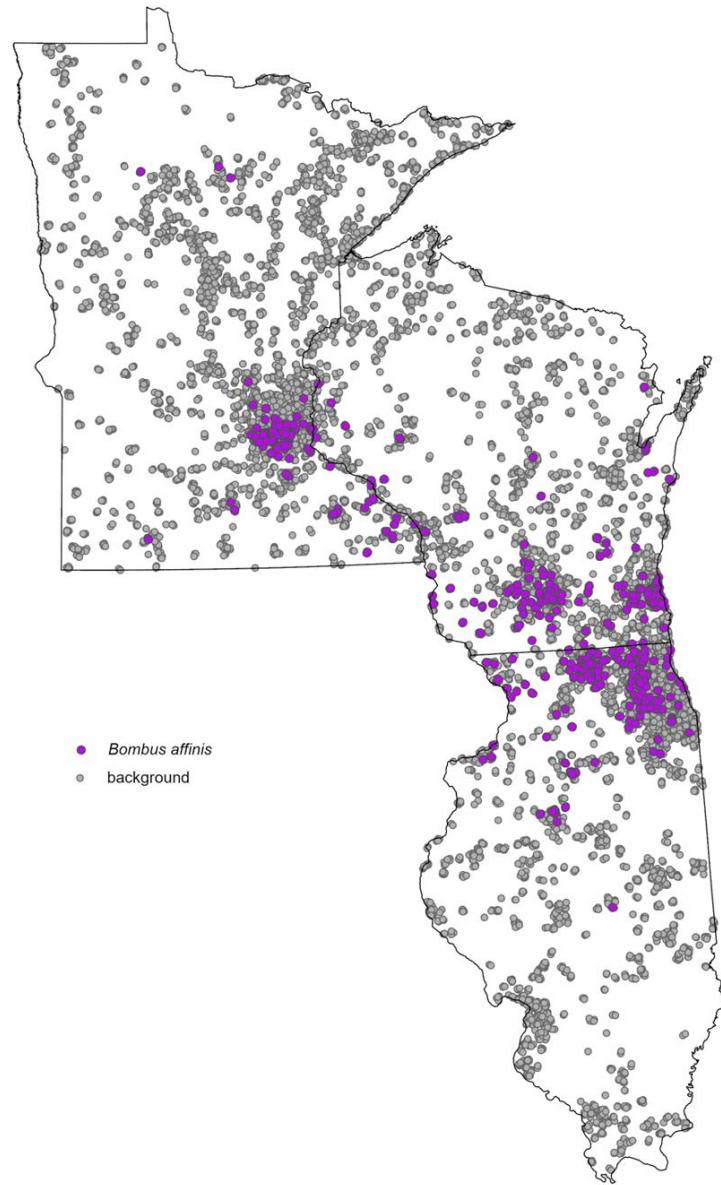
Figure 4. Map of rusty-patched bumble bee observations and background bumble bee observations used to fit habitat suitability model for rusty-patched bumble bee.
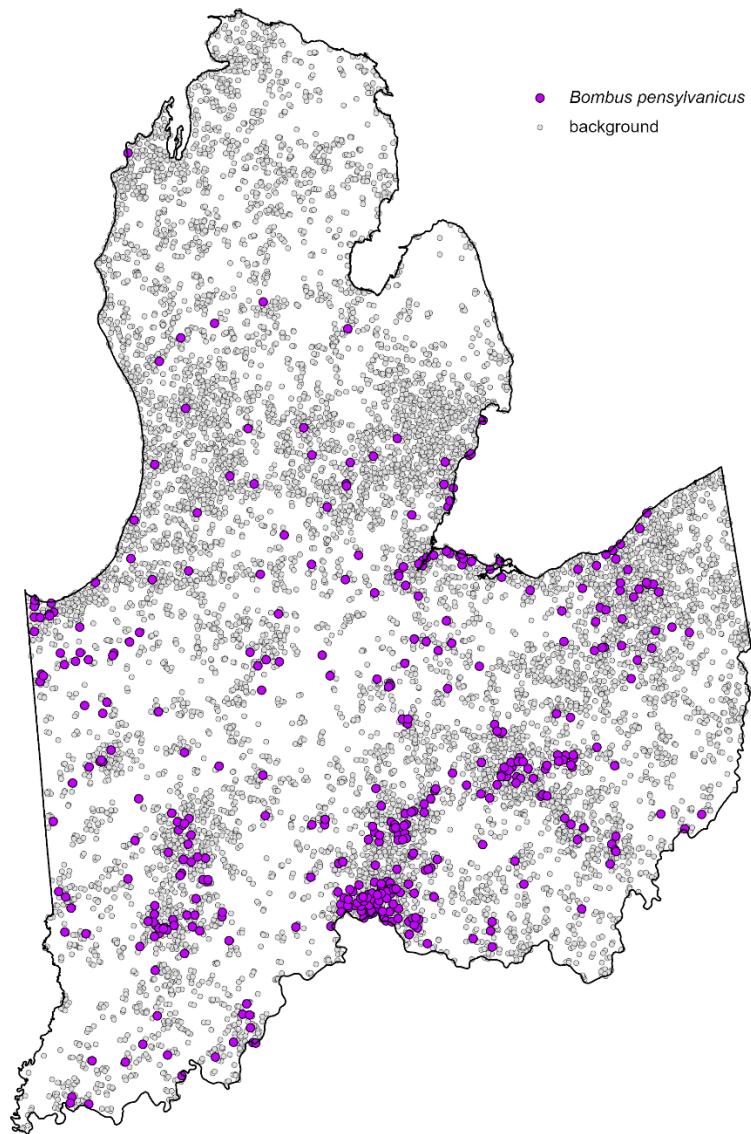
Figure 5. Map of American bumble bee observations and background insect observations used to fit habitat suitability model for American bumble bee.

For both HSM's, environmental variables were selected based on their potential relevance to RPBB and ABB habitat from available spatial datasets with uniform coverage of the model training area and projected extents. The National Land Cover Database provides nation-wide data on land cover at 30-meter resolution and would provide a suitable fit for this model (USGS 2024). The highest landcover for the entire model extent (Il, IN, MI, MN, OH, and WI) was cultivated crops followed by deciduous forest and woody wetlands (Table 3). Individual land cover classes or groups of classes were extracted from the NLCD, and continuous variables

were created by calculating the percent cover at neighborhood scales of 100-, 300- and 900-meter radii.

Table 3. Percent coverage of the 15 National Landcover Database landcovers in the habitat suitability modeling area for rusty-patched and American bumble bees.

Land Cover Class	Percent Area
Cultivated Crops	38%
Deciduous Forest	19%
Woody Wetlands	12%
Pasture/Hay	8%
Emergent Herbaceous Wetlands	3%
Developed, Open Space	5%
Open Water	3%
Developed, Low Intensity	4%
Mixed Forest	3%
Evergreen Forest	2%
Developed, Medium Intensity	1%
Grassland/Herbaceous	1%
Shrub/Scrub	1%
Developed, High Intensity	0.5%
Barren Land	0.3%

Bioclimatic variables are derived from monthly temperature and rainfall data to create biologically meaningful variables that are often used in ecological modeling techniques. Bioclimatic temperature variables have been important covariates in other bee SDMs (Naeem et al. 2024; Tronstad et al. 2025). We selected four temperature-related bioclimatic variables to include in modeling for each species HSM: annual mean temperature, temperature seasonality, maximum temperature of warmest month, and mean temperature of coldest quarter (Table 4).

Table 4. Names and descriptions of bioclimatic variables used in bumble bee habitat suitability modelling.

Name	Title	Resolution (meters)	Unit	Description
BIO1	Annual Mean Temperature	1024	°C	The mean of all the monthly mean temperatures. Each monthly mean temperature is the mean of that month's maximum and minimum temperature.
BIO4	Temperature Seasonality (standard deviation *100)	1024	%	The temperature Coefficient of Variation (C of V) is the standard deviation of the monthly mean temperatures expressed as a percentage of the mean of those temperatures (i.e. the annual mean).
BIO5	Max Temperature of Warmest Month	1024	°C	The highest temperature of any monthly maximum temperature.
BIO9	Mean Temperature of Driest Quarter	1024	°C	The driest quarter of the year is determined (to the nearest month), and the mean temperature of this period is calculated.

After model fitting, single variable models were run to assess individual variable importance. To address multi-collinearity in environmental variables, which can adversely affect model outcomes, a correlation matrix of the environmental variables was created. Highly correlated variables (+/- 0.7), were removed, retaining the variable of highest importance in the single variable model. Iterative models, run with 10-fold cross-validation training and test sets, were used to identify the most important combination of environmental variables while avoiding model over-fitting and complexity. This is particularly important for a model that will be projected like the RPBB HSM. Finally, the goodness of fit for final fitted models needed to be addressed. We used area under curve (AUC) for model evaluation, expressed on a 0-1 scale with 0.5 representing a model that is no better than random (Fielding and Bell 1997).

Field of wild bergamot (*Monarda fistulosa*) at Lowe Prairie Nature Preserve. Photo Credit: David Cuthrell

RESULTS

Bumble Bee Community Surveys

From 2023-2025, we completed 379 surveys across 74 sites (Indiana 28, Michigan 24, and Ohio 22) and observed a total of 9728 bumble bees comprised of at least nine different species. A table of the complete survey results (year, site, survey round) is available in Appendix A. Michigan had the highest single season count of bumble bees with 1618 bumble bees being observed in the second round of surveys in 2023, as well as the site with the highest single abundance of bumble bees during a survey (H.E. Hardy during Round 2 in 2023; n =275 bees) (Figure 6, Appendix A). We generally observed lower average numbers of bumble bees during the first survey round each year compared to the second survey round. Species richness was also higher on average during the second round of surveys (Round 1: n=2.3 species; Round 2: n=3.5 species) and this trend was consistent for each state and in each year (Figure 7). The most frequently observed bumble bee was the common eastern bumble bee (*Bombus impatiens*) with 4636 total observations, followed by the brown-belted bumble bee (*Bombus griseocollis*; n=2570) and then the two-spotted bumble bee (*Bombus bimaculatus*; n=1748) (Table 5). The common eastern bumble bee was also the most frequently observed bee in each state, however the brown-belted bumble bee was much more frequently observed in Indiana and Ohio than in Michigan (Table 5, Figure 8). No observations of RPBB were recorded. Several new occurrences of species listed at the state level were found in both Michigan and Indiana, as well as populations of ABB in Ohio (Table 6).

Black and gold bumble bee (*Bombus auricomus*) (left) and yellow bumble bee (*B. fervidus*) (right) observed during bumble bee surveys in Ohio. Photo Credits: (L): Logan Rowe; (R): Nicolette Sexton
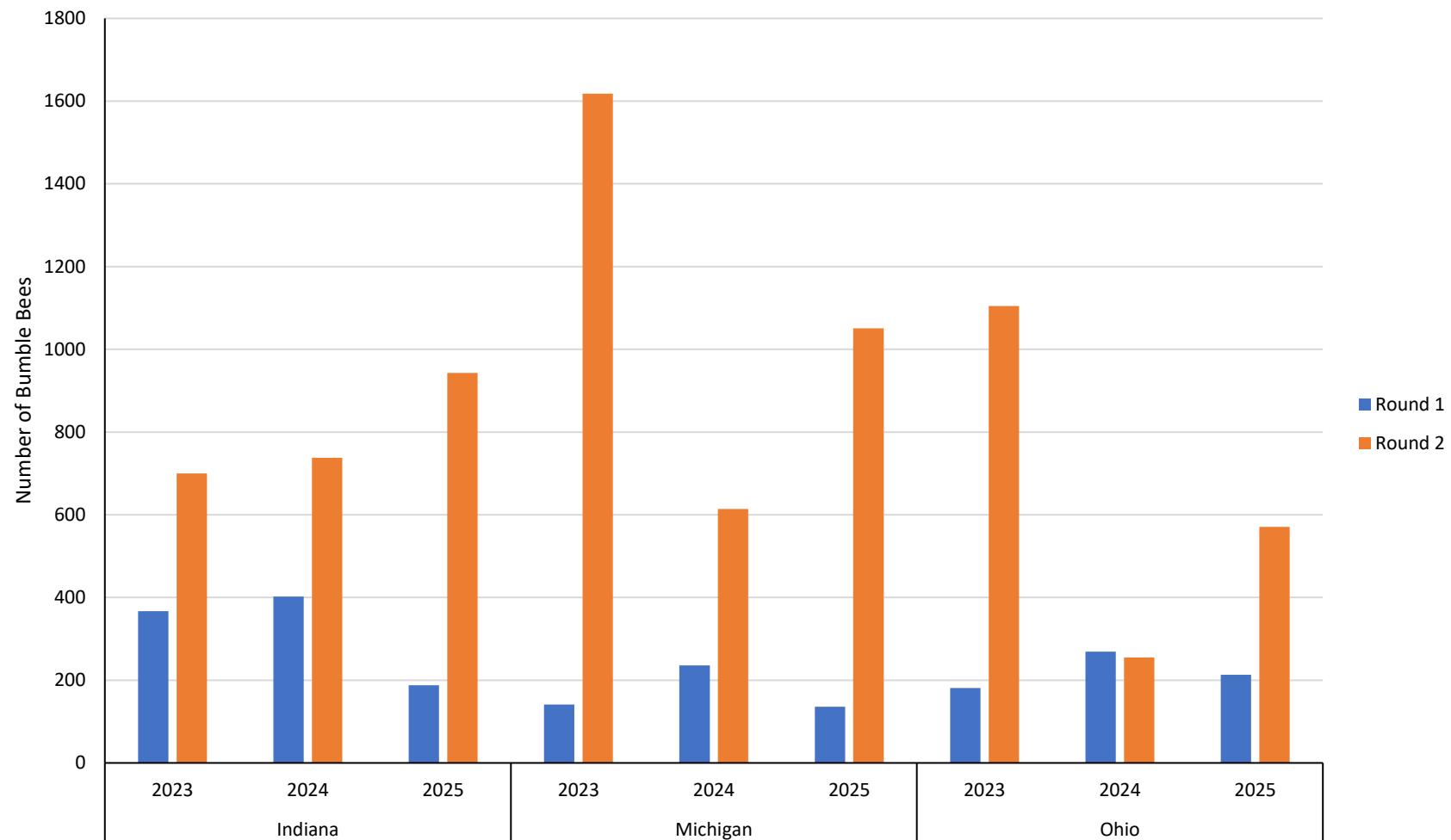
Figure 6. Total number of bumble bees observed in Indiana, Michigan, and Ohio from 2023-2025 during round 1 and round 2 of surveys.
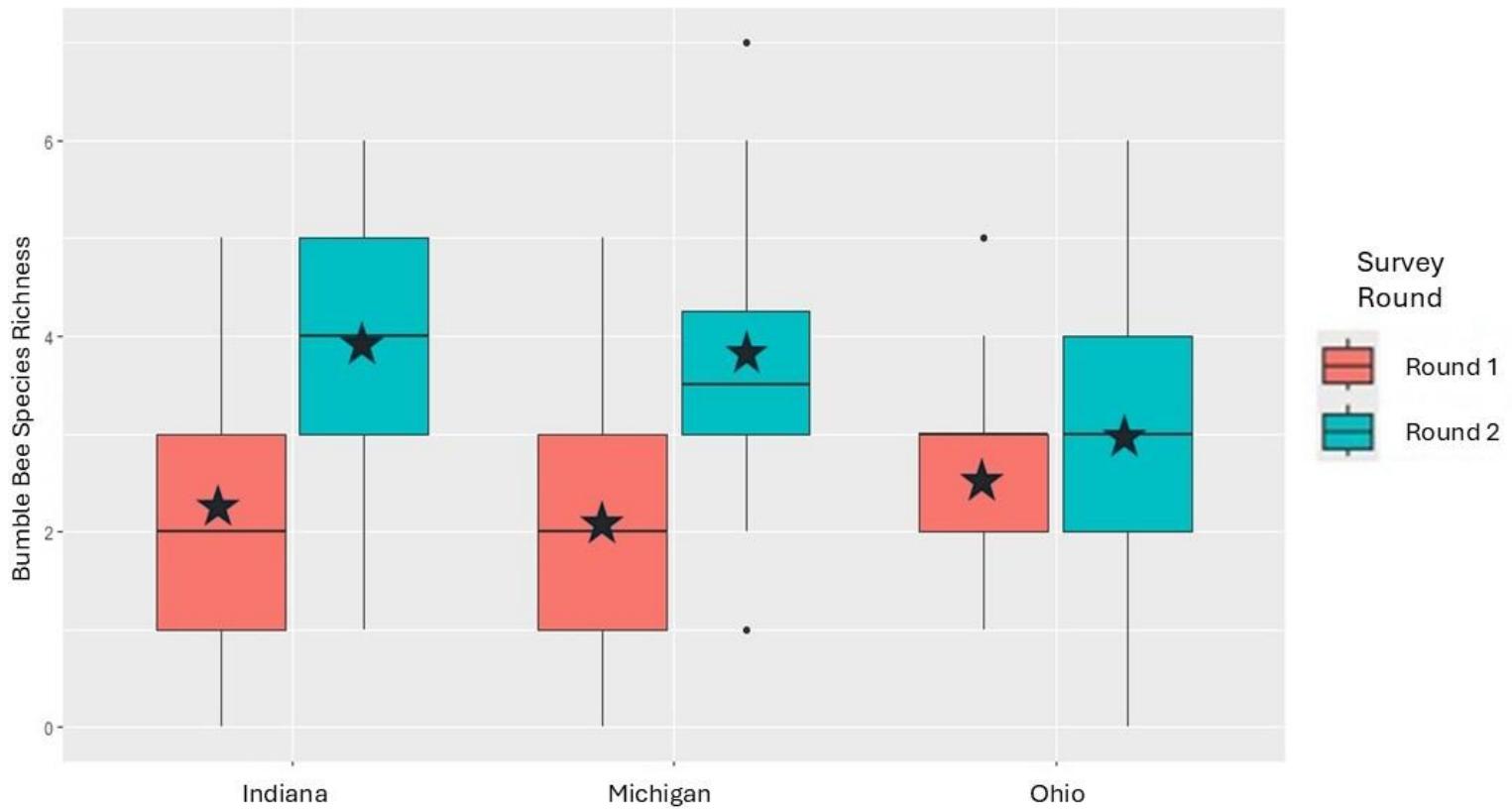
Figure 7. Box and whisker plot showing inter-quartile ranges of bumble bee species richness at survey sites in Indiana, Michigan, and Ohio during surveys from 2023-2025. Average species richness is displayed as a star.

Table 5. Counts of bumble bees observed by species each year in Indian, Michigan, and Ohio during 2023-2025 surveys.

	Bombus auricomus[+]	*Bombus bimaculatus*	*Bombus citrinus*	*Bombus fervidus*[+]	*Bombus griseocollis*	*Bombus impatiens*	*Bombus pensylvanicus*[++]	*Bombus perplexus*	*Bombus vagans*[+++]	Unknown	Grand Total
Indiana											
2023	33	102	13	44	426	409	25		8	7	1067
2024	40	220	12	45	343	439	19		9	13	1140
2025	35	299	16	30	384	321	37		4	5	1131
Indiana Total	**108**	**621**	**41**	**119**	**1153**	**1169**	**81**		**21**	**25**	**3338**
Michigan											
2023	41	167	8	21	145	1347		1	21	8	1759
2024	9	174	9	12	126	497	1		7	15	850
2025	4	360	2	9	181	578			18	35	1187
Michigan Total	**54**	**701**	**19**	**42**	**452**	**2422**	**1**	**1**	**46**	**58**	**3796**
Ohio											
2023	11	144	33	12	498	570	7	3	3	5	1286
2024	2	81	1	6	258	146	4		3	23	524
2025	7	201	6	15	209	329	1			16	784
Ohio Total	**20**	**426**	**40**	**33**	**965**	**1045**	**12**	**3**	**6**	**44**	**2594**
Grand Total	**182**	**1748**	**100**	**194**	**2570**	**4636**	**94**	**4**	**73**	**127**	**9728**

+Special Concern in Michigan; ++State Rare in Indiana, State Endangered in Michigan; +++ State Threatened in Indiana.
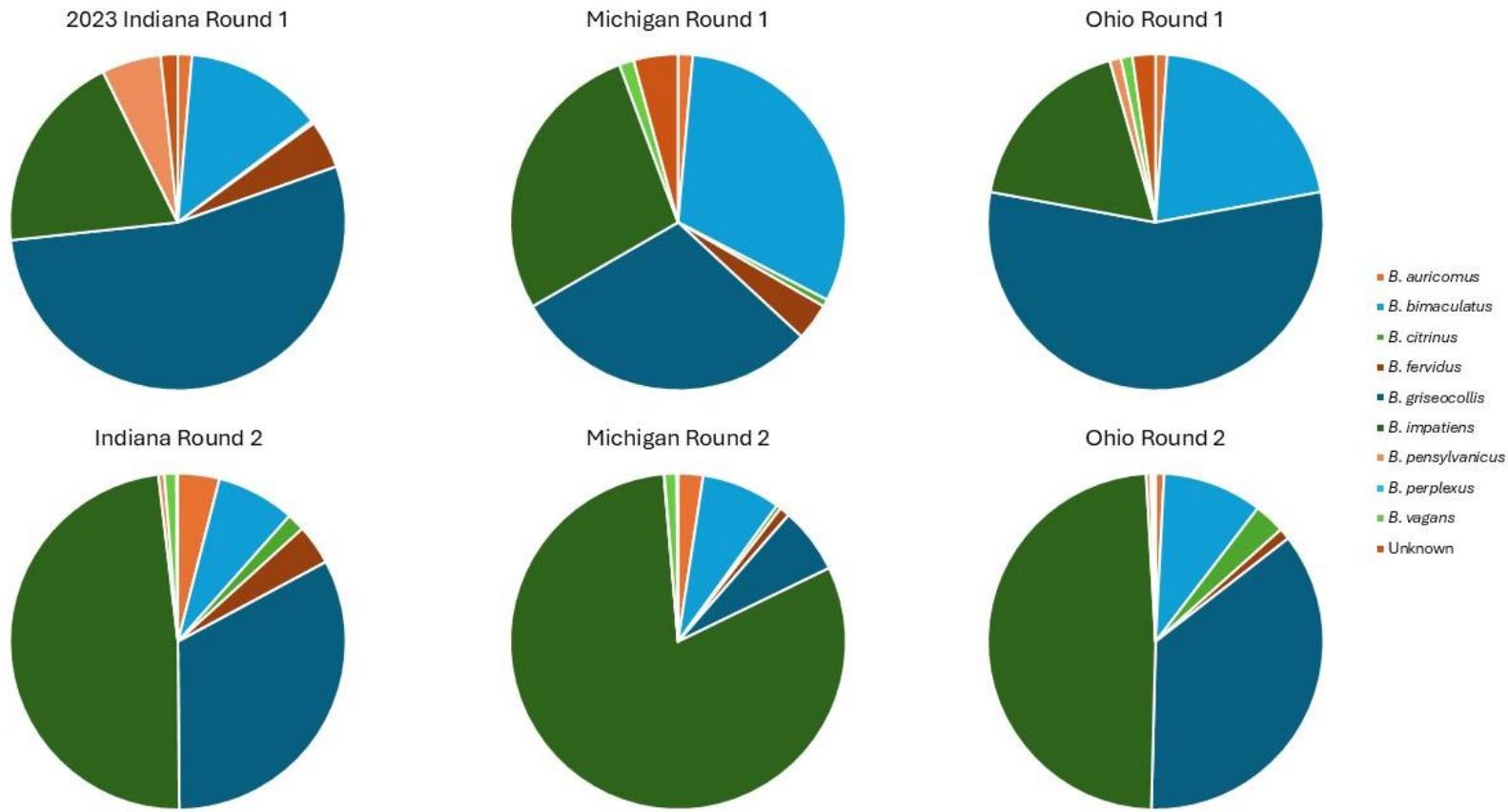
Figure 8. Pie charts showing survey round 1 and round 2 bumble bee species composition in Indiana, Michigan, and Ohio during surveys from 2023-2025.

Table 6. Count of state-listed bumble bees observed during bumble bee surveys from 2023-2025 in Indiana, Michigan, and Ohio. A "-" notes that the bumble bee species is not listed or otherwise tracked in that state.

	B. auricomus				*B. fervidus*				*B. pensylvanicus*				*B. vagans*			
	2023	2024	2025	Total	2023	2024	2025	Total	2023	2024	2025	Total	2023	2024	2025	Total
Indiana																
Barnes Nature Preserve	-	-	-	-	-	-	-	-	0	0	0	0	2	0	0	2
Biesecker Prairie Nature Preserve	-	-	-	-	-	-	-	-	1	0	0	1	0	0	0	0
Conrad Savanna Nature Preserve	-	-	-	-	-	-	-	-	17	0	4	21	0	0	0	0
Cressmoor Prairie Nature Preserve	-	-	-	-	-	-	-	-	0	0	1	1	0	0	0	0
Fisher Oak Savanna Nature Preserve	-	-	-	-	-	-	-	-	1	2	1	4	0	0	1	1
Granville Sand Barrens Nature Preserve	-	-	-	-	-	-	-	-	0	3	0	3	0	0	0	0
Hoosier Prairie Nature Preserve	-	-	-	-	-	-	-	-	0	4	0	4	0	0	0	0
Kankakee Sands Nature Preserve	-	-	-	-	-	-	-	-	0	2	5	7	0	0	0	0
Lowe Prairie	-	-	-	-	-	-	-	-	1	4	1	6	0	0	0	0

	B. auricomus				B. fervidus				B. pensylvanicus				B. vagans			
	2023	2024	2025	Total	2023	2024	2025	Total	2023	2024	2025	Total	2023	2024	2025	Total
McCloskey's Burr Oak Savanna Nature Preserve	-	-	-	-	-	-	-	-	0	0	2	2	0	0	0	0
Merry Lea Nature Preserve	-	-	-	-	-	-	-	-	0	0	0	0	1	2	0	3
Mongoquinong Nature Preserve	-	-	-	-	-	-	-	-	0	0	0	0	1	2	3	6
NIPSCO Savanna	-	-	-	-	-	-	-	-	1	0	2	3	0	0	0	0
Ober Savanna Nature Preserve	-	-	-	-	-	-	-	-	0	1	0	1	0	0	0	0
Prophetstown Fen Nature Preserve	-	-	-	-	-	-	-	-	0	2	19	21	0	0	0	0
Smith Cemetery Nature Preserve	-	-	-	-	-	-	-	-	0	1	0	1	0	0	0	0
Spinn Prairie Nature Preserve	-	-	-	-	-	-	-	-	3	0	0	3	0	0	0	0
Stoutsburg Savanna Nature Preserve	-	-	-	-	-	-	-	-	1	0	0	1	0	0	0	0
Tefft Savanna Nature Preserve	-	-	-	-	-	-	-	-	0	0	2	2	4	5	0	9
Michigan																
Augusta Floodplain Forest	9	2	4	15	3	1	2	6	0	0	0	0	-	-	-	-

	B. auricomus				B. fervidus				B. pensylvanicus				B. vagans			
	2023	2024	2025	Total	2023	2024	2025	Total	2023	2024	2025	Total	2023	2024	2025	Total
Big Valley Nature Sanctuary	0	0	0	0	4	1	0	5	0	0	0	0	-	-	-	-
Calla C Burr Memorial Nature Sanctuary	0	0	0	0	0	0	2	2	0	0	0	0	-	-	-	-
Chipman Nature Preserve	1	0	0	1	1	2	0	3	0	0	0	0	-	-	-	-
Dowagiac Woods Nature Sanctuary	0	0	0	0	0	1	0	1	0	0	0	0	-	-	-	-
Grand River Fen	0	1	0	1	0	1	0	1	0	1	0	1	-	-	-	-
Hidden Pond Preserve	1	0	0	1	5	2	1	8	0	0	0	0	-	-	-	-
Ives Road Fen	7	0	0	7	1	1	1	3	0	0	0	0	-	-	-	-
Jeptha Lake Fen	0	0	0	0	0	1	0	1	0	0	0	0	-	-	-	-
Newaygo Prairie	0	0	0	0	1	0	0	1	0	0	0	0	-	-	-	-
Paw Paw Prairie Preserve	0	0	0	0	4	0	1	5	0	0	0	0	-	-	-	-
Portman Nature Preserve	1	0	0	1	0	0	0	0	0	0	0	0	-	-	-	-
Sand Creek Preserve	2	0	0	2	0	2	2	4	0	0	0	0	-	-	-	-
Tamarack Swamp Preserve	18	5	0	23	1	0	0	1	0	0	0	0	-	-	-	-

	B. auricomus				B. fervidus				B. pensylvanicus				B. vagans			
	2023	2024	2025	Total	2023	2024	2025	Total	2023	2024	2025	Total	2023	2024	2025	Total
Wau-Ke-Na, William Erby Smith Preserve	0	0	0	0	1	0	0	1	0	0	0	0	-	-	-	-
Wolf Tree Nature Trails	2	1	0	3	0	0	0	0	0	0	0	0	-	-	-	-
Ohio*																
Chaparral Prairie	-	-	-	-	-	-	-	-	0	2	1	3	-	-	-	-
Oak Openings Preserve Metropark	-	-	-	-	-	-	-	-	0	1	0	1	-	-	-	-
Plum Run Prairie State Natural Area	-	-	-	-	-	-	-	-	1	0	0	1	-	-	-	-
Springville Marsh State Nature Preserve	-	-	-	-	-	-	-	-	5	1	0	6	-	-	-	-
Zimmerman Prairie State Natural Area	-	-	-	-	-	-	-	-	1	0	0	1	-	-	-	-

*No bumble bee species are listed or otherwise tracked in Ohio beyond RPBB, ABB observations are included as a focal species of this report.

A full summary of floral resources used by bumble bees during each survey is provided in Appendix B. The most frequently visited flowering plant in all states across all surveys was wild bergamot (*Monarda fistulosa*; n=4559). While this species was occasionally present in the first round of surveys each year, it was much more frequently visited during the second round of surveys (Figure 9; Appendix B). During the first round of surveys the most frequently visited floral resource was fox-glove beardtongue (*Penstemon digitalis*; n=413). However, in Ohio it was less visited during the first round of surveys than common milkweed (*Asclepias syriaca*) (Appendix B). For rare or declining bumble bees in Michigan, 63% of observations were made on wild bergamot (n=62), including the single observation of ABB in Michigan during these surveys (Table 7). In Indiana, state listed bumble bees utilized wild white indigo (*Baptisa alba*) and wild bergamot to a large degree (n= 38 and n=36 respectively) with these observations making up 77% of listed bumble bee observations in Indiana.
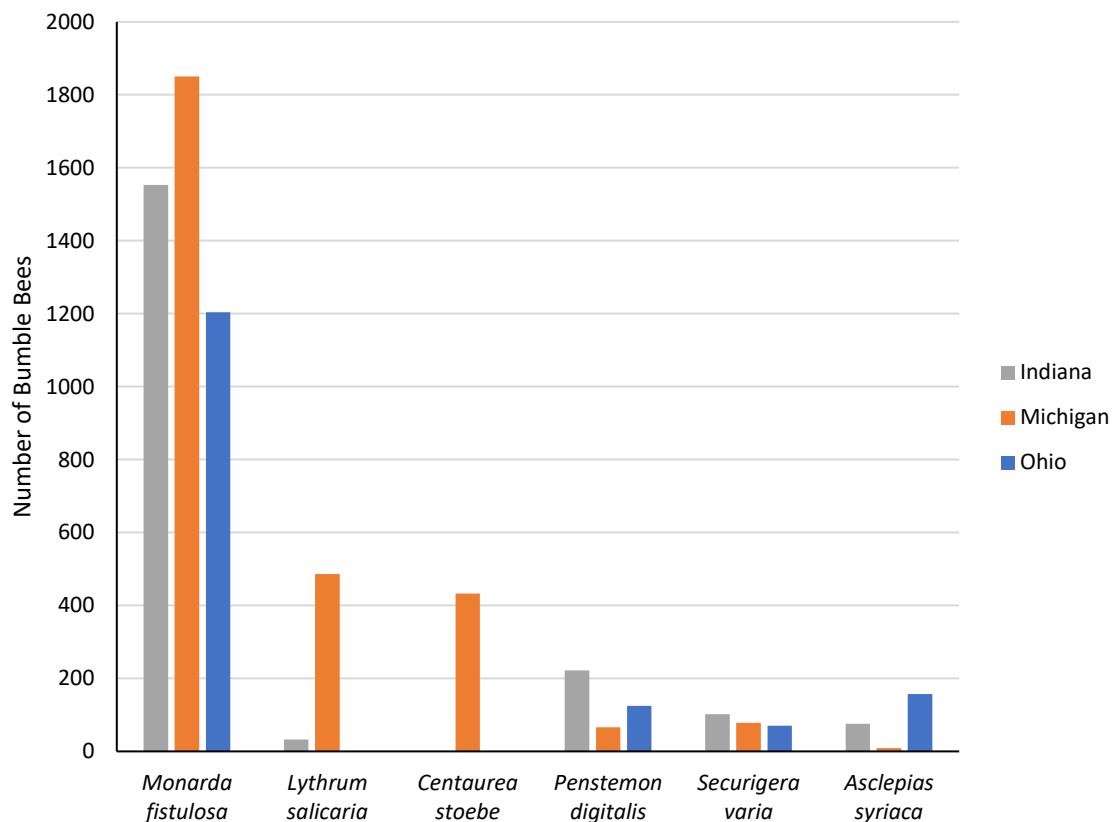
Figure 9. Counts of bumble bee observations on the six most visited floral resources during bumble bee surveys in Indiana, Michigan, and Ohio from 2023-2025.

Table 7. Total counts of rare and/or declining bumble bees in Indiana, Michigan, and Ohio based on floral association during 2023-2025 surveys.

	Baptisia alba	Centaurea stoebe	Cirsium muticum	Convolvulus spp.	Coreopsis lanceolata	Desmodium paniculatum	Eryngium yuccifolium	Heliopsis helianthoides	Lathyrus odoratus	Liatris spicata	Lobularia maritima	Lythrum salicaria	Monarda fistulosa	Opuntia humifusa	Penstemon digitalis	Poa spp.	Rubus spp.	Securigera varia	Senna hebecarpa	Silphium spp.	Trifolium pratense	Veronicastrum virginicum	Vicia villosa
Indiana																							
B. pensylvanicus	36	0	0	4	3	0	2	0	0	0	0	0	24	0	3	0	0	0	1	1	2	0	0
B. vagans	2	0	0	0	0	1	0	0	0	0	0	0	12	0	1	0	0	0	0	0	1	0	0
Michigan																							
B. auricomus	0	0	0	0	0	0	0	2	1	0	0	0	46	0	0	1	1	1	0	0	0	1	0
B. fervidus	2	3	1	0	0	0	0	0	0	1	1	1	15	0	2	0	0	4	0	0	1	0	11
B. pensylvanicus	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0
Ohio																							
B. pensylvanicus	3	0	0	0	0	0	0	0	0	0	0	0	1	1	0	0	1	0	0	1	4	0	0

A field containing dense growth of multiple floral resources including wild bergamot (*Monarda fistulosa*) at Smith Cemetery Nature Preserve. Photo credit: Dan Earl

Habitat Assessments

During 2023-2025 habitat surveys, sites in Indiana had the highest average site suitability with a total score of 67.06 (Table 8). The full list of each site's habitat assessment scores by year and survey round is provided in Appendix C. There were no strong differences in the average of each state's site suitability scores between years or between the first and second round of surveys each year, though the average total site suitability score tended to be higher during the second visits (Figure 10). Sites where ABB was present had a higher average habitat assessment score compared to sites where they were not documented, particularly in Michigan and Ohio (Table 9, Michigan score based on single site). Of the ten highest scoring surveys, eight were during second round of surveys; five were in Indiana, three in Michigan, and two in Ohio. One site in Michigan (Grand River Fen) was one of highest scoring sites in two different years. Five of the highest ranking 10 sites have known occurrences of ABB (Table 10).

Table 8. Average Xerces Habitat Assessment scores in Indiana, Michigan, and Ohio from 2023-2025.

State	Average of Regional Features	Average of Site Features	Average of Foraging Habitat	Average of Nest and Overwintering Habitat	Total
Indiana	13.96	19.93	10.39	16.68	67.06
Michigan	13.36	19.14	11.32	17.19	64.19
Ohio	13.72	18.56	11.29	15.30	61.52
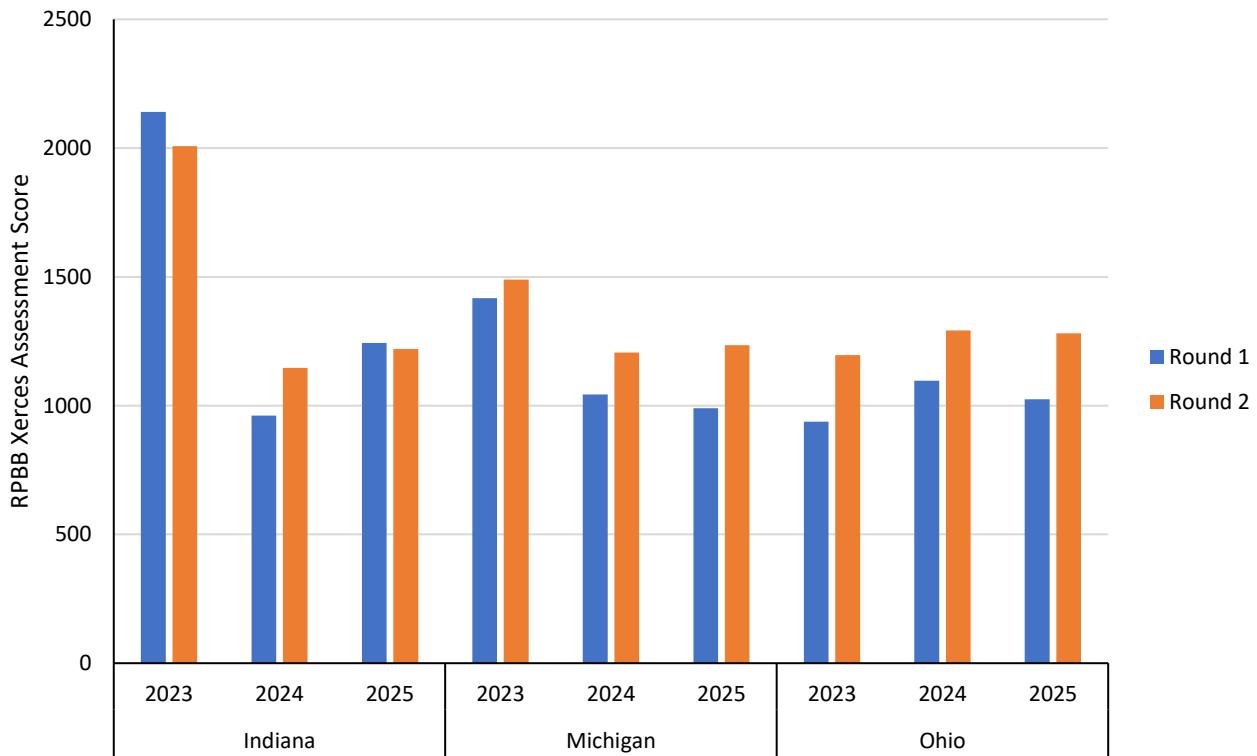
Figure 10. Average total rusty-patched bumble bee habitat suitability scores for Indiana, Michigan, and Ohio during round 1 and round 2 surveys from 2023-2025.

Table 9. Average habitat assessment scores at sites where American bumble bee was present and absent in Indiana, Michigan, and Ohio.

	American Bumble Bee Absent	American Bumble Bee Present
Indiana	63.69	68.51 (n=16)
Michigan	63.20	86 (n=1)
Ohio	60.87	63.46 (n=5)
Overall	62.45	68.07

Table 10. Site and attribute features of the ten highest ranking sites from habitat assessments using the Xerces Habitat Assessment form during 2023-2025 surveys.

Site Name	State	American Bumble Bee Present?	Year	Survey Round	Regional Features Total	Site Features Total	Foraging Habitat Total	Nest and Overwintering Habitat Total
Campbell State Nature Preserve	Ohio	Absent	2024	Round 2	17	29	23	25
Grand River Fen	Michigan	Present	2023	Round 2	17	30	23	24
Stoutsburg Savanna Nature Preserve	Indiana	Present	2023	Round 2	17	25	23	28
Cressmoor Prairie Nature Preserve	Indiana	Present	2023	Round 1	20	25	17	29
Grand River Fen	Michigan	Present	2025	Round 2	17	25	23	26
Dunes Prairie Nature Preserve	Indiana	Absent	2023	Round 1	20	25	16	29
Goose Pond Fish and Wildlife Area	Indiana	Absent	2023	Round 1	20	25	18	27
Prophetstown Fen	Indiana	Present	2025	Round 2	20	24	25	21
Bullard Lake Fen Plant Preserve	Michigan	Absent	2023	Round 2	17	34	13	25
Oak Openings Metropark	Ohio	Present	2024	Round 2	20	20	23	26

Foraging habitat at Grand River Fen Preserve one of the highest scoring sites on Xerces Habitat assessments completed during surveys. Photo Credit: Dan Earl.

Habitat Suitability Modeling

The final HSM for RPBB included two environmental variables: annual mean temperature (BIO1; % contribution = 0.71), and percent of open land cover within a 100-meter radius (% contribution = 0.29). Open land cover consisted of the NLCD land covers "developed, low intensity", "developed, open space", "grassland/herbaceous", and "pasture/hay". Annual mean temperature was found to have a unimodal relationship with and over 50% predicted occupancy for RPBB occurring in areas with a mean annual temperature from 7.1-10.2 C (Figure 11). Percentage of open landcover increased the predicted suitability for RPBB rapidly until reaching maximum suitability around 70% open landcover within 100m of the observation (Figure 11). The AUC for the RPBB HSM was 0.82. Once the model evaluation was trained and evaluation completed, the HSM was projected to Indiana, Michigan, and Ohio to determine where on the landscape RPBB would be most likely occur (Figure 12). The final HSM for ABB included the environmental variables annual mean temperature (BIO1; % contribution = 47.2), temperature seasonality (BIO4; % contribution = 10.5), and open land cover consisting of the same NLCD land classes of the RPBB model within a 100-meter radius (% contribution = 42.3) and the model AUC was 0.81 (Figures 13-14).
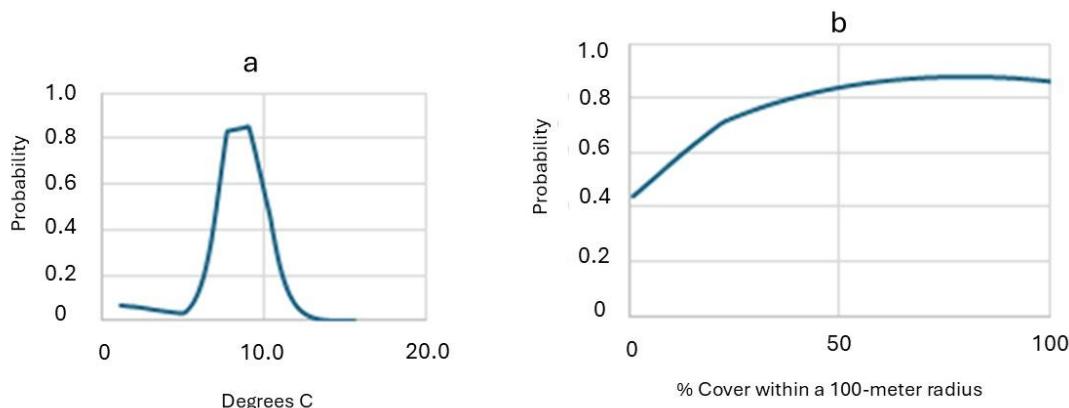
Figure 11. Variable response curves for variables included in rusty-patched bumble bee habitat suitability model. a: influence of annual mean temperature; b: influence of % open landcover within 100-m radius.

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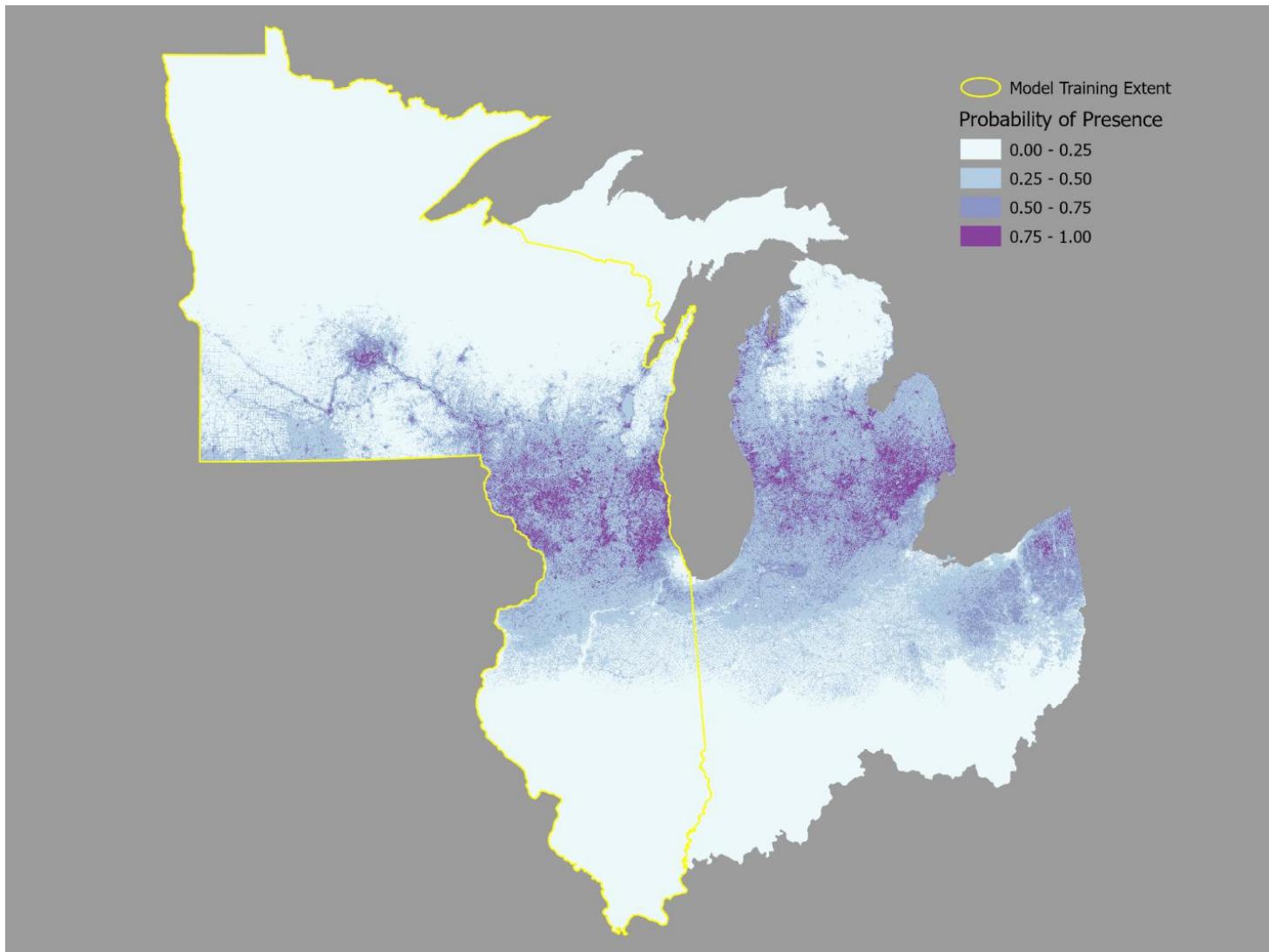
Figure 12. Visualization of results for habitat suitability model for Conservation Area 3 of rusty-patched bumble bee trained on observations from Illinois, Minnesota, and Wisconsin.
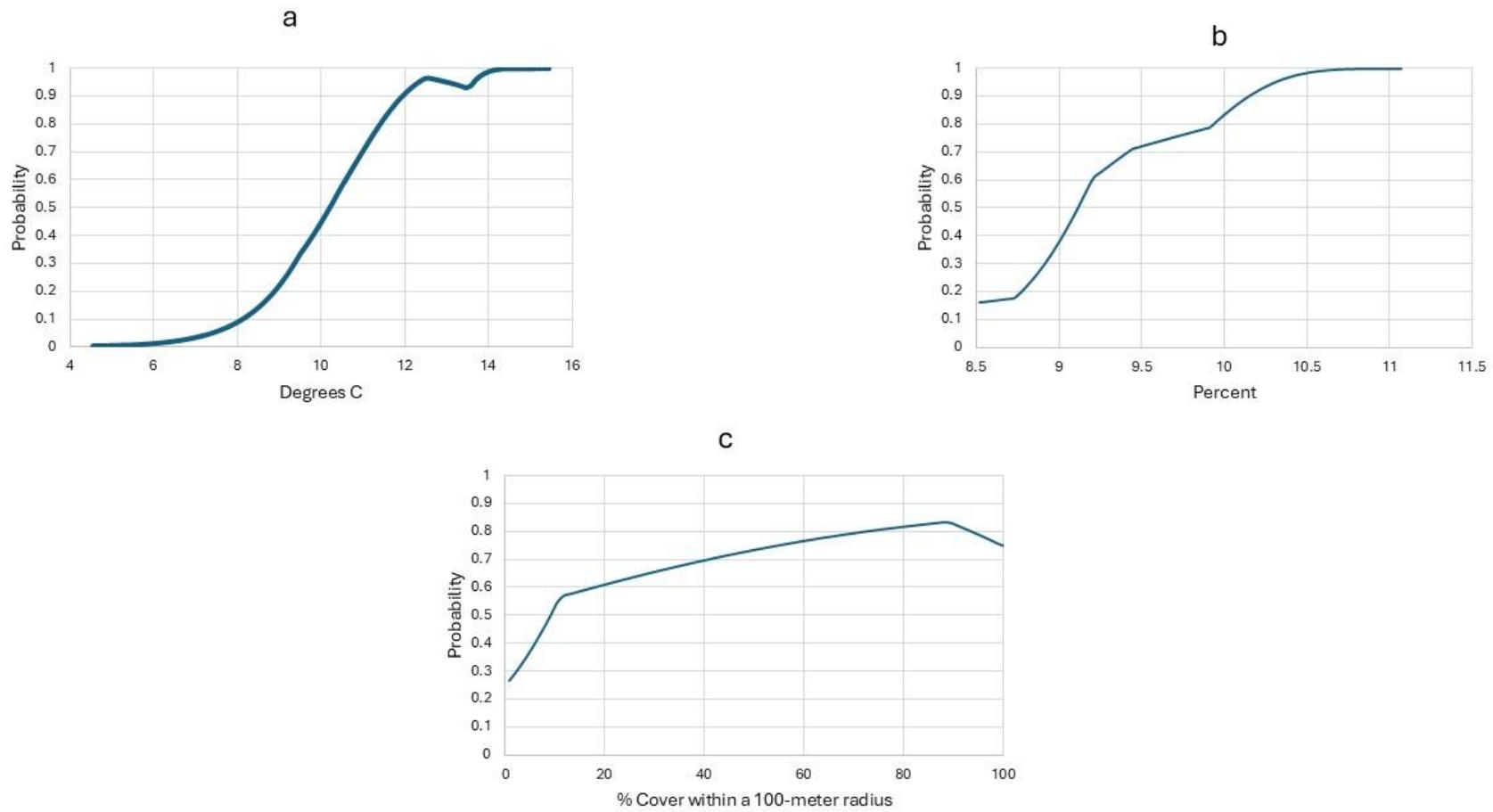
Figure 13. Variable response curves for variables included in American bumble bee habitat suitability model. a: influence of annual mean temperature; b: temperature seasonality; c: influence of % open landcover within 100-m radius.
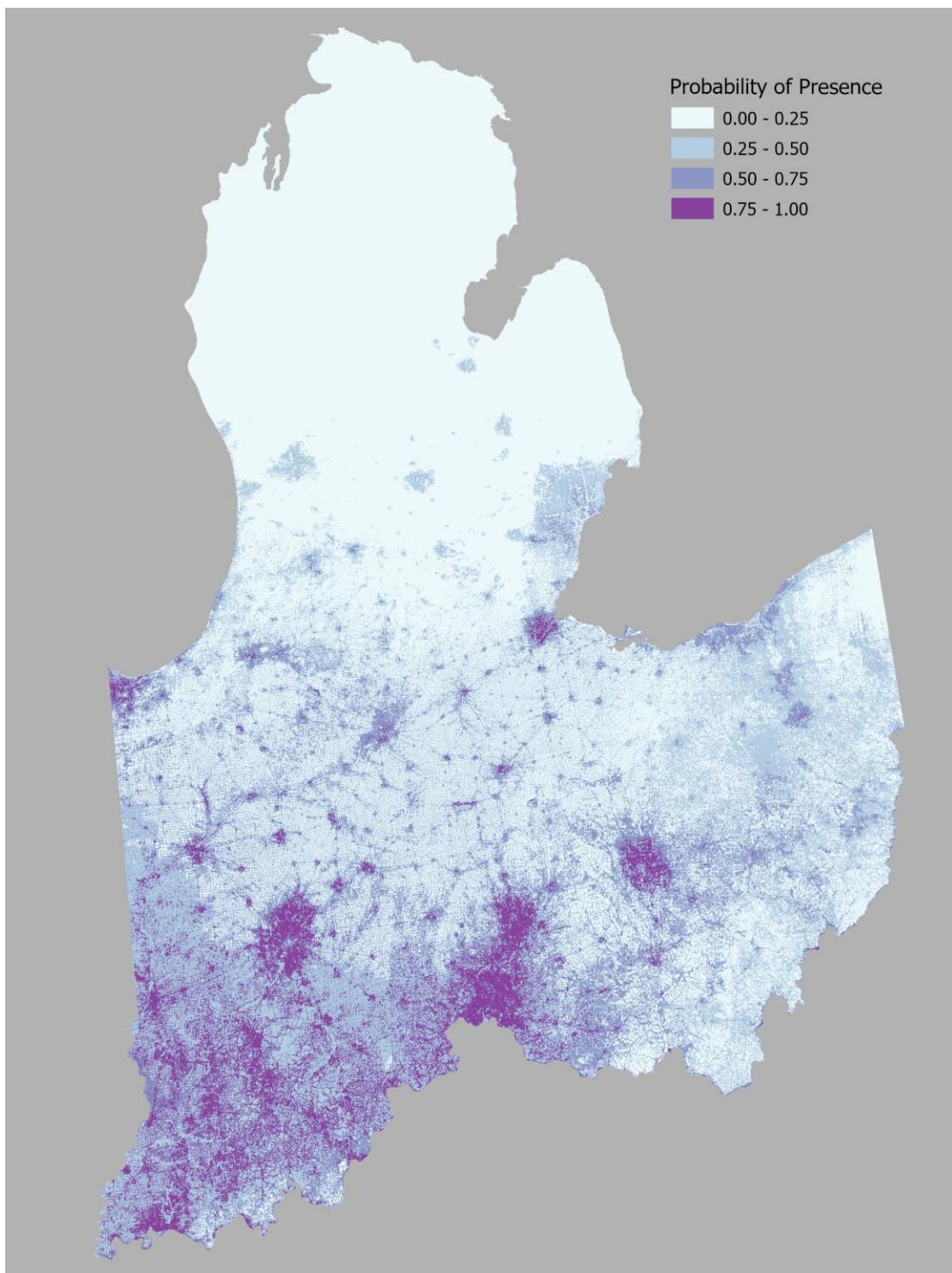
Figure 14. Visualization of results for habitat suitability model for American bumble bee in Indiana, Michigan and Ohio.

DISCUSSION

From 2023-2025 MNFI conducted 379 bumble bee community surveys across Indiana, Michigan, and Ohio at 74 different sites. While these surveys did not detect any populations of RPBB, they documented several rare or declining bumble bee species in each state, including ABB (n =94 across all states), yellow bumble bee (*Bombus fervidus*) (n=42 in MI) and black and gold bumble bee (*Bombus auricomus*) (n=54 in MI) in Michigan, and half black bumble bee in Indiana (n=21 in IN). Ohio doesn't currently have any state-listed species other than RPBB, but ABB did occur at 5 sites (n = 24). In general, bumble bee communities in this study were dominated by common eastern bumble bee, two-spotted bumble bee, and brown-belted bumble bee, which is consistent with previous work in the region (Strange and Tripodi 2018, Rowe et al. 2023).

Across all states and years, bumble bee abundance and species richness were consistently higher during the second survey round (late summer) compared to the first (early summer), with mean richness increasing from 2.3 to 3.5 species per survey and total counts of bumble bee individuals nearly doubling in most cases. This pattern reflects seasonal colony dynamics; early surveys primarily captured queens and initial workers, whereas later surveys coincided with peak worker activity and broader floral availability. Community composition also shifted markedly between rounds. Early-season communities were dominated by species such as two-spotted bumble bee and brown-belted bumble bee, while late-season surveys showed a strong increase in common eastern bumble bee and greater representation of rare or declining species, including ABB. However, early season detections of rare species provide valuable insights into important floral resources for the initial stages of colony development. These findings underscore the importance of multi-round surveys for accurately characterizing bumble bee communities and detecting species of conservation concern.

During bumble bee community surveys, we found that wild bergamot was by far the most common floral association for bumble bees, including rare or declining bumble bee species. However, floral resource use differed markedly between survey rounds, reflecting bloom dynamics and species-specific preferences. Native species including foxglove beardtongue, wild white indigo, and common milkweed were a preferred early summer forage. By late season, floral associations shifted strongly toward wild bergamot, which accounted for nearly half of all foraging observations and was also the dominant resource in many of the habitats surveyed. In Michigan, where invasive plants such as spotted knapweed (*Centaurea stoebe*) and purple loosestrife (*Lythrum salicaria*) were more prevalent, these species became frequent forage for common bees and occasionally for rare species. In contrast, Indiana and Ohio preserves generally supported more intact native plant communities, reinforcing the value of habitat management that promotes diverse native floral resources while limiting invasives. Controlling invasives gradually and supplementing habitats with native plant species is critical to avoid sudden forage loss and maintain continuity for bumble bee colonies, particularly those of conservation concern.

The Xerces habitat assessments we conducted allowed for identifying areas with high potential suitable habitat for bumble bees across the region. The highest average scores were at sites in Indiana (67.06), followed by Michigan (64.19) and Ohio (61.52). In this study sites with ABB presence tended to score higher, especially in Michigan (86 vs. 63.2) and Indiana (68.51 vs. 63.69), highlighting the relationship between habitat quality and documentation of rare species. In Michigan, Grand River Fen ranked among the highest scoring surveys in 2023 (Round 2) and 2025 (Round 2), illustrating both the importance of late season assessments and potential within-year and year-to-year variability in habitat conditions. We suspect that the variability in scores at sites between years reflects changes in environmental conditions, such as early season temperature or prolonged drought. Therefore, while these assessments provide a snapshot of the habitat at the time of our surveys, completing them multiple times a year and across years for a site informs a better understanding of site quality over time, which may be particularly important for the presence of rare species.

Habitat suitability models (HSM) for RPBB and ABB found that suitable habitat for these species may be driven by multiple variables. For RPBB predicted suitability was found to increase with annual mean temperature to a maximum predicted suitability at 9° C, after that point predicted suitability decreases rapidly. American bumble bee similarly had predicted suitability increasing with average mean temperature and seasonal temperature variation but predicted habitat suitability did not drop with increased temperature past a certain point. These findings are similar to other research that shows bumble bee community compositions are likely to change with changes in temperature trends (Hemberger and Williams 2024).

These suitability models may be used in tandem with the on-site habitat assessments to provide management recommendation goals for sites surveyed and guide future RPBB conservation. Our models found that open landscapes have higher predicted suitability for RPBB and ABB, and as such these areas should be conserved when possible. However, to best support RPBB and other rare bumble bees an individual site needs to be properly managed in ways that be most beneficial to bumble bee communities and promote habitats for bumble bees year-round. The findings from our surveys support and habitat assessments allow us to recommend several guidelines to best support bumble bee populations.

The results from our 2023-2025 bumble bee and habitat surveys can inform habitat management at sites supporting bumble bee communities and improve the quality of sites with potential for rare species. In general, management of these habitats should focus on providing continuous forage, controlling invasive species, enhancing nesting and overwintering resources, and improving landscape connectivity. Sites need a diverse array of native flowering plants that bloom from early spring through late fall to support colony development (Xerces 2017; USFWS 2021). Where gaps exist, managers should supplement with local-genotype plantings, including species such as foxglove beardtongue and wild white indigo in spring; wild bergamot, common milkweed, and rattlesnake master (*Eryngium yuccifolium*) in mid-summer; and goldenrods (*Solidago spp.*), blazing stars (*Liatris spp.*), and meadowsweets (*Spiraea spp.*) in late summer and fall (Rowe et al. 2023). Invasive species such as spotted knapweed and purple loosestrife while used by bumble bees, can displace native flora and reduce habitat resilience (Baskett et

al. 2011). Their removal should be gradual or paired with immediate replacement by native species to avoid sudden forage loss. Nesting and overwintering habitat is equally critical. Managers should retain leaf litter, coarse woody debris, and areas of grass and thatch, especially plants with hollow stems, to provide suitable sites for queens (USFWS 2021). Finally, conservation efforts should extend beyond individual sites to the landscape scale by ensuring high-quality habitats are within bumble bee flight range (approximately 2km) to each other and connected by intermediate forage patches such as pollinator gardens or roadside plantings. This connectivity reduces stress on dispersing queens and workers and supports recolonization potential for rare species, including the rusty patched bumble bee (Mola and Williams 2025).

While no RPBB populations were observed during surveys, we believe that continued monitoring of bumble bee populations in Michigan and across this region will provide key insights to bumble bee conservation. By identifying high quality bumble bee habitats in these historic regions of RPBB occurrence, we can understand the pathways of potential RPBB reintroduction and help guide management to improve and connect habitats. Furthermore, we have found that bumble bee species, particularly rare or declining species, may not be observed in each survey at a site and as such repeat surveys, especially in high quality sites, are warranted. Our surveys completed at these sites have created a baseline of bumble bee community compositions at these sites, and future conservation work may expand upon our findings to conserve or study these bumble bee populations. Rigorous scientific surveys may also be supplemented by observations made by community scientists, as apparent in our habitat suitability model for ABB. Community science observations can help fill in the temporal and spatial gaps left by researchers and inform conservation actions, such as floral resource and habitat needs, and timing of habitat management implementation. Community science observations help bridge temporal and spatial gaps in research, providing critical insights for conservation actions such as identifying floral resource and habitat needs, determining optimal timing for habitat management, and assessing site occupancy and corridor connectivity.

Long-term recovery of the RPBB will require cooperation across state lines and between multiple agencies. Additional research is needed to identify and characterize the attributes of high-quality habitats that can support RPBB and other at-risk species, including factors such as floral diversity, nesting resources, and landscape connectivity. A primary goal of the Recovery Plan is to increase RPBB populations across the broader landscape, which cannot be achieved without ensuring that suitable habitats exist throughout the species' historical range. This includes restoring and managing native plant communities, reducing invasive species, and creating a network of connected habitats that provide continuous forage and overwintering resources. By integrating habitat assessments, species distribution models, and targeted management actions, conservation partners can work toward stabilizing pollinator communities and re-establishing RPBB populations in Conservation Unit 3 and beyond.

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APPENDIX A: FULL COUNTS OF BUMBLE BEE SPECIES OBSERVED AT EACH SITE SURVEY ROUND DURING MNFI BUMBLE BEE SURVEYS FROM 2023-2025

Bombus species	*auricomus*	*bimaculatus*	*citrinus*	*fervidus*	*griseocollis*	*impatiens*	*pensylvanicus*	*perplexus*	*vagans*	Unknown	Grand Total
Indiana Total	108	621	41	119	1153	1169	81		21	25	3338
Barnes Nature Preserve	1				33	10			2		46
2023	1				33	10			2		46
Round 1					20	7					27
Round 2	1				13	3			2		19
Biesecker Prairie Nature Preserve	2	35		4	42	73	1				157
2023	1	11		2	9	28	1				52
Round 2	1	11		2	9	28	1				52
2024		1		1	4	15					21
Round 1		1									1
Round 2				1	4	15					20
2025	1	23		1	29	30					84
Round 1		1									1
Round 2	1	22		1	29	30					83
Conrad Savanna Nature Preserve	12	7		3	65	67	21				175
2023	8	2		1	54	14	17				96
Round 1	5			1	45		17				68
Round 2	3	2			9	14					28

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Bombus species	*auricomus*	*bimaculatus*	*citrinus*	*fervidus*	*griseocollis*	*impatiens*	*pensylvanicus*	*perplexus*	*vagans*	Unknown	Grand Total
2024	1	1		1	4	33					40
Round 1		1			2	29					32
Round 2	1			1	2	4					8
2025	3	4		1	7	20	4				39
Round 1	1										1
Round 2	2	4		1	7	20	4				38
Coulter Nature Preserve					4	16					20
2023					3	13					16
Round 1						2					2
Round 2					3	11					14
2024					1	3					4
Round 1					1	1					2
Round 2						2					2
Cressmoor Prairie Nature Preserve	1	80	1	8	47	69	1			1	208
2023		13	1	1	28	26					69
Round 1		11				2					13
Round 2		2	1	1	28	24					56
2024		27		2	3	5				1	38
Round 1		24		1		1					26
Round 2		3		1	3	4				1	12

Bombus species	auricomus	bimaculatus	citrinus	fervidus	griseocollis	impatiens	pensylvanicus	perplexus	vagans	Unknown	Grand Total
2025	1	40		5	16	38	1				101
Round 1		36		3	1		1				41
Round 2	1	4		2	15	38					60
Dunes Prairie Nature Preserve		9				1					10
2023		9				1					10
Round 2		9				1					10
Fisher Oak Savanna Nature Preserve		8		7	18	16	4		1		54
2023		1		4	2	9	1				17
Round 2		1		4	2	9	1				17
2024		5		3	6	5	2				21
Round 1		5		3		1	2				11
Round 2					6	4					10
2025		2			10	2	1		1		16
Round 1		2			1				1		4
Round 2					9	2	1				12
Gibson Woods Nature Preserve		75		11	17	59				2	164
2023		7		4	7	16				1	35
Round 2		7		4	7	16				1	35
2024		46		3	1	18				1	69

Bombus species	*auricomus*	*bimaculatus*	*citrinus*	*fervidus*	*griseocollis*	*impatiens*	*pensylvanicus*	*perplexus*	*vagans*	Unknown	Grand Total
Round 1		21			1	3					25
Round 2		25		3		15				1	44
2025		22		4	9	25					60
Round 1						1					1
Round 2		22		4	9	24					59
Goose Pond Fish and Wildlife Area		5			8	4					17
2023		5			8	4					17
Round 1		5			7	4					16
Round 2					1						1
Granville Sand Barrens Nature Preserve	32	17		8	56	55	3				171
2023	3	3			24	28					58
Round 2	3	3			24	28					58
2024	13	10		4	18	19	3				67
Round 1	8	2		3	1		2				16
Round 2	5	8		1	17	19	1				51
2025	16	4		4	14	8					46
Round 1	2	3		3	6	2					16
Round 2	14	1		1	8	6					30
Hoosier Prairie Nature Preserve	9	26		4	86	71	4				200

Bombus species	auricomus	bimaculatus	citrinus	fervidus	griseocollis	impatiens	pensylvanicus	perplexus	vagans	Unknown	Grand Total
2023	3	1		2	28	22					56
Round 2	3	1		2	28	22					56
2024		9			29	19	4				61
Round 1		7					4				11
Round 2		2			29	19					50
2025	6	16		2	29	30					83
Round 1						4					4
Round 2	6	16		2	29	26					79
Ivanhoe Dune and Swale Nature Preserve	1	17		1	27	29				1	76
2023		5		1	10	13				1	30
Round 1					2	2				1	5
Round 2		5		1	8	11					25
2024		7			15	15					37
Round 1		2				2					4
Round 2		5			15	13					33
2025	1	5			2	1					9
Round 1		1			2						3
Round 2	1	4				1					6
Kankakee Sands Nature Preserve	6	12		1	39	85	7			5	155
2023	3	1			19	10				4	37

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Bombus species	auricomus	bimaculatus	citrinus	fervidus	griseocollis	impatiens	pensylvanicus	perplexus	vagans	Unknown	Grand Total
Round 1					11					4	15
Round 2	3	1			8	10					22
2024	2	7		1	13	50	2				75
Round 1		6			6	10					22
Round 2	2	1		1	7	40	2				53
2025	1	4			7	25	5			1	43
Round 1					1	4					5
Round 2	1	4			6	21	5			1	38
Lowe Prairie	2	41		6	78	94	6			5	232
2023	2	1		1	9	29	1				43
Round 1				1	1		1				3
Round 2	2	1			8	29					40
2024		9		5	13	43	4			4	78
Round 1		9		3	2		1			3	18
Round 2				2	11	43	3			1	60
2025		31			56	22	1			1	111
Round 1		11			4	10				1	26
Round 2		20			52	12	1				85
McCloskey's Burr Oak Savanna Nature Preserve		36	1	9	23	57	2				128
2023		11	1	1	12	38					63

Bombus species	*auricomus*	*bimaculatus*	*citrinus*	*fervidus*	*griseocollis*	*impatiens*	*pensylvanicus*	*perplexus*	*vagans*	Unknown	Grand Total
Round 1		6			1						7
Round 2		5	1	1	11	38					56
2024		14		3	11	13					41
Round 1		11		1	1						13
Round 2		3		2	10	13					28
2025		11		5		6	2				24
Round 1		5		3			2				10
Round 2		6		2		6					14
Merry Lea Nature Preserve		45	1		58	37			3		144
2023			1		9	5			1		16
Round 1					1						1
Round 2			1		8	5			1		15
2024		8			12	18			2		40
Round 1		4									4
Round 2		4			12	18			2		36
2025		37			37	14					88
Round 1		9				1					10
Round 2		28			37	13					78
Mongoquinong Nature Preserve		45	14		25	38			6	5	133
2023		19	3		4	17			1		44
Round 1		17				15					32

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Bombus species	auricomus	bimaculatus	citrinus	fervidus	griseocollis	impatiens	pensylvanicus	perplexus	vagans	Unknown	Grand Total
Round 2		2	3		4	2			1		12
2024		1	6		2	4			2	5	20
Round 1			2			1				3	6
Round 2		1	4		2	3			2	2	14
2025		25	5		19	17			3		69
Round 1		5									5
Round 2		20	5		19	17			3		64
NIPSCO Savanna	4	5	7	1	27	24	3				71
2023	2	2	4	1	8	14	1				32
Round 1		2		1							3
Round 2	2		4		8	14	1				29
2024	2	2			12	6					22
Round 1		2									2
Round 2	2				12	6					20
2025		1	3		7	4	2				17
Round 1						1					1
Round 2		1	3		7	3	2				16
Ober Savanna Nature Preserve		41	5	12	51	22	1			1	133
2024		16		11	36	12	1			1	77
Round 1		11		8	16	9				1	45
Round 2		5		3	20	3	1				32

Bombus species	*auricomus*	*bimaculatus*	*citrinus*	*fervidus*	*griseocollis*	*impatiens*	*pensylvanicus*	*perplexus*	*vagans*	Unknown	Grand Total
2025		25	5	1	15	10					56
Round 1		8				5					13
Round 2		17	5	1	15	5					43
Pine Station Nature Preserve	1	5			16	41				1	64
2023	1	1			13	11				1	27
Round 1										1	1
Round 2	1	1			13	11					26
2024		4			3	30					37
Round 1					2	2					4
Round 2		4			1	28					33
Prophetstown Fen Nature Preserve	29	34		17	93	60	21			2	256
2023	6			9	18						33
Round 1				6	11						17
Round 2	6			3	7						16
2024	20	17		5	68	23	2				135
Round 1	4	15		2	44	3					68
Round 2	16	2		3	24	20	2				67
2025	3	17		3	7	37	19			2	88
Round 1	1	7		1	1		10				20
Round 2	2	10		2	6	37	9			2	68

Bombus species	auricomus	bimaculatus	citrinus	fervidus	griseocollis	impatiens	pensylvanicus	perplexus	vagans	Unknown	Grand Total
Red-tail Nature Preserve		4			5	1					10
2023		4			5	1					10
Round 1		4									4
Round 2					5	1					6
Seidner Dune and Swale Nature Preserve	5	36		11	34	74					160
2023				5	5	22					32
Round 1						2					2
Round 2				5	5	20					30
2024	2	23		3	15	48					91
Round 1		15		1	10	6					32
Round 2	2	8		2	5	42					59
2025	3	13		3	14	4					37
Round 1		2									2
Round 2	3	11		3	14	4					35
Smith Cemetery Nature Preserve		14		1	141	112	1			1	270
2023					84	57					141
Round 1					84	33					117
Round 2						24					24
2024		5		1	40	37	1			1	85

Bombus species	auricomus	bimaculatus	citrinus	fervidus	griseocollis	impatiens	pensylvanicus	perplexus	vagans	Unknown	Grand Total
Round 1		3		1	32	4				1	41
Round 2		2			8	33	1				44
2025		9			17	18					44
Round 1		3			17	2					22
Round 2		6				16					22
Spinn Prairie Nature Preserve		6		9	88	7	3			1	114
2023		3		8	10	2	3				26
Round 1		3		8	9	2	3				25
Round 2					1						1
2024				1	3						4
Round 1					2						2
Round 2				1	1						2
2025		3			75	5				1	84
Round 1										1	1
Round 2		3			75	5					83
Springfield Fen Nature Preserve		2	1		11	15					29
2023		2	1		11	15					29
Round 1					4						4
Round 2		2	1		7	15					25

Bombus species	*auricomus*	*bimaculatus*	*citrinus*	*fervidus*	*griseocollis*	*impatiens*	*pensylvanicus*	*perplexus*	*vagans*	Unknown	Grand Total
Stoutsburg Savanna Nature Preserve	3	9	4	5	38	23	1				83
2023	3	1		3	6	2	1				16
Round 1		1			1	1					3
Round 2	3			3	5	1	1				13
2024		8	1	1	31	21					62
Round 1					5	9					14
Round 2		8	1	1	26	12					48
2025			3	1	1						5
Round 2			3	1	1						5
Tefft Savanna Nature Preserve		7	7	1	23	9	2		9		58
2023			2	1	7	2			4		16
Round 1			1			1					2
Round 2			1	1	7	1			4		14
2024			5		3	2			5		15
Round 1			2						1		3
Round 2			3		3	2			4		12
2025		7			13	5	2				27
Round 1					2						2
Round 2		7			11	5	2				25
Michigan Total	54	701	19	42	452	2422	1	1	46	58	3796

Bombus species	auricomus	bimaculatus	citrinus	fervidus	griseocollis	impatiens	pensylvanicus	perplexus	vagans	Unknown	Grand Total
Algonac State Park Blazing Star Prairie		7			5	19				2	33
2025		7			5	19				2	33
Round 1										2	2
Round 2		7			5	19					31
Augusta Floodplain Forest	15	82	1	6	28	164				4	300
2023	9	13		3	3	39					67
Round 1					1						1
Round 2	9	13		3	2	39					66
2024	2	12		1	5	79				2	101
Round 1		9		1	1	1					12
Round 2	2	3			4	78				2	89
2025	4	57	1	2	20	46				2	132
Round 1		41		2		5					48
Round 2	4	16	1		20	41				2	84
Big Valley Nature Sanctuary		49		5	34	239			5	1	333
2023		3		4	16	146			1		170
Round 1		1		4	5						10
Round 2		2			11	146			1		160

Bombus species	auricomus	bimaculatus	citrinus	fervidus	griseocollis	impatiens	pensylvanicus	perplexus	vagans	Unknown	Grand Total
2024		9		1	3	42			1		56
Round 1						8					8
Round 2		9		1	3	34			1		48
2025		37			15	51			3	1	107
Round 1		1			1					1	3
Round 2		36			14	51			3	0	104
Bullard Lake Fen Plant Preserve		2			2	39					43
2023		1			2	8					11
Round 1		1			1						2
Round 2					1	8					9
2024						1					1
Round 2						1					1
2025		1				30					31
Round 1		1				1					2
Round 2						29					29
Calla C. Burr Memorial Nature Sanctuary		54		2	11	72				3	142
2023		2			2	49					53
Round 2		2			2	49					53
2024		6			1	5				3	15

Bombus species	auricomus	bimaculatus	citrinus	fervidus	griseocollis	impatiens	pensylvanicus	perplexus	vagans	Unknown	Grand Total
Round 1						1					1
Round 2		6			1	4				3	14
2025		46		2	8	18					74
Round 1		3									3
Round 2		43		2	8	18					71
Chipman Nature Preserve	1	11		3	17	21			2	3	58
2023	1	5		1	15	18			2		42
Round 1		1			2						3
Round 2	1	4		1	13	18			2		39
2024		2		2	1	3				2	10
Round 1										2	2
Round 2		2		2	1	3					8
2025		4			1					1	6
Round 1		4			1					1	6
Dolan Nature Sanctuary		24	1		6	95			4	4	134
2023		5			2	30			2		39
Round 2		5			2	30			2		39
2024		11			1	31				1	44
Round 2		11			1	31				1	44
2025		8	1		3	34			2	3	51
Round 1		1				2				2	5

Bombus species	auricomus	bimaculatus	citrinus	fervidus	griseocollis	impatiens	pensylvanicus	perplexus	vagans	Unknown	Grand Total
Round 2		7	1		3	32			2	1	46
Dowagiac Woods Nature Sanctuary		9		1	11	20				2	43
2023		8			6	16				2	32
Round 1		2			3	4				2	11
Round 2		6			3	12					21
2024				1	4	3					8
Round 1						1					1
Round 2				1	3	3					7
2025		1			1	1					3
Round 2		1			1	1					3
Goose Creek Grasslands		5			22	213					240
2023						116					116
Round 2						116					116
2024		2			16	27					45
Round 1		2			14	4					20
Round 2					2	23					25
2025		3			6	70					79
Round 1		1			3	1					5
Round 2		2			3	69					74

Bombus species	auricomus	bimaculatus	citrinus	fervidus	griseocollis	impatiens	pensylvanicus	perplexus	vagans	Unknown	Grand Total
Grand River Fen Preserve	1	26		1	63	328	1			1	421
2023		3			21	175					199
Round 1					1	2					3
Round 2		3			20	173					196
2024	1	4		1	16	105	1			1	129
Round 1		4			4	1				1	10
Round 2	1			1	12	104	1				119
2025		19			26	48					93
Round 1		2			2	8					12
Round 2		17			24	40					81
H.E. Hardy Memorial Nature Sanctuary		10	1		5	317				3	336
2023		9	1		1	267				1	279
Round 1					1	2				1	4
Round 2		9	1			265					275
2024		1			3	18					22
Round 1		1			1	3					5
Round 2					2	15					17
2025					1	32				2	35
Round 1						1				2	3

Bombus species	auricomus	bimaculatus	citrinus	fervidus	griseocollis	impatiens	pensylvanicus	perplexus	vagans	Unknown	Grand Total
Round 2					1	31					32
Hidden Pond Preserve	1	101	2	8	58	299			3	25	497
2023	1	5		5	15	100					126
Round 1		3			11	3					17
Round 2	1	2		5	4	97					109
2024		35	2	2	23	94				3	159
Round 1		35	1	1	6	78					121
Round 2			1	1	17	16				3	38
2025		61		1	20	105			3	22	212
Round 1						6				1	7
Round 2		61		1	20	99			3	21	205
Ives Road Fen	7	15		3	38	99			3	2	167
2023	7	7		1	15	90			3	2	125
Round 1	1	2			1	7				2	13
Round 2	6	5		1	14	83			3		112
2024		3		1	10	4					18
Round 1		1			1	4					6
Round 2		2		1	9						12
2025		5		1	13	5					24
Round 1				1							1
Round 2		5			13	5					23

Bombus species	auricomus	bimaculatus	citrinus	fervidus	griseocollis	impatiens	pensylvanicus	perplexus	vagans	Unknown	Grand Total
Jeptha Lake Fen		12	4	1	9	13			2		41
2023					1	1					2
Round 1					1						1
Round 2						1					1
2024		12	4	1	8	12			2		39
Round 1		3			1						4
Round 2		9	4	1	7	12			2		35
McCoy's Creek Trail		7			19	31			6		63
2023		3			5	21			2		31
Round 1		2			3	12					17
Round 2		1			2	9			2		14
2024		4			14	10			4		32
Round 2		4			14	10			4		32
Nan Weston Nature Preserve at Sharon Hollow			1			12					13
2023			1			12					13
Round 2			1			12					13
Newaygo Prairie		10		1	7	45					63
2023		10		1	7	45					63
Round 1		6			3	6					15

Bombus species	auricomus	bimaculatus	citrinus	fervidus	griseocollis	impatiens	pensylvanicus	perplexus	vagans	Unknown	Grand Total
Round 2		4		1	4	39					48
Paw Paw Prairie Preserve		39	7	5	12	69			6	1	139
2023		21	5	4	4	30			6	1	71
Round 1			1	1		1			1		4
Round 2		21	4	3	4	29			5	1	67
2024		3	2		1	27					33
Round 1			1			6					7
Round 2		3	1		1	21					26
2025		15		1	7	12					35
Round 1		1		1	2						4
Round 2		14			5	12					31
Petersburg State Game Area						1					1
2025						1					1
Round 2						1					1
Portman Nature Preserve	1	33			36	100			12		182
2023	1	16			8	67			2		94
Round 1		2				1					3
Round 2	1	14			8	66			2		91
2024		8			7	4					19
Round 2		8			7	4					19

Bombus species	*auricomus*	*bimaculatus*	*citrinus*	*fervidus*	*griseocollis*	*impatiens*	*pensylvanicus*	*perplexus*	*vagans*	Unknown	Grand Total
2025		9			21	29			10		69
Round 2		9			21	29			10		69
Sand Creek Preserve	2	85		4	35	85				2	213
2023	2	17			7	39					65
Round 1		10			3						13
Round 2	2	7			4	39					52
2024		26		2	9	3					40
Round 1		25		1	3						29
Round 2		1		1	6	3					11
2025		42		2	19	43				2	108
Round 1		26		1	1					2	30
Round 2		16		1	18	43					78
Tamarack Swamp Preserve	23	32	1	1	17	89			2	2	167
2023	18	5		1	11	54			2	1	92
Round 1	1	1			3				1	1	7
Round 2	17	4		1	8	54			1		85
2024	5	7	1		1	24				1	39
Round 1	2					1					3
Round 2	3	7	1		1	23				1	36
2025		20			5	11					36
Round 1		2									2

Bombus species	auricomus	bimaculatus	citrinus	fervidus	griseocollis	impatiens	pensylvanicus	perplexus	vagans	Unknown	Grand Total
Round 2		18			5	11					34
Wau-Ke-Na, William Erby Smith Preserve		20		1	3	7				2	33
2023		5		1	3	4					13
Round 1		3			3	1					7
Round 2		2		1		3					6
2024		15				3				2	20
Round 1		1								1	2
Round 2		14				3				1	18
Wolf Tree Nature Trails	3	68	1		14	45		1	1	1	134
2023	2	29	1		1	20		1	1	1	56
Round 1		10									10
Round 2	2	19	1		1	20		1	1	1	46
2024	1	14			3	2					20
Round 1	1	3			1						5
Round 2		11			2	2					15
2025		25			10	23					58
Round 1		3									3
Round 2		22			10	23					55
Ohio Total	20	426	40	33	965	1045	12	3	6	44	2594

Bombus species	auricomus	bimaculatus	citrinus	fervidus	griseocollis	impatiens	pensylvanicus	perplexus	vagans	Unknown	Grand Total
Adams Lake Prairie State Nature Preserve	2	5			7	10				3	27
2023		4			6	5				1	16
Round 1		4									4
Round 2					6	5				1	12
2025	2	1			1	5				2	11
Round 1	2	1				1				1	5
Round 2					1	4				1	6
Brinkhaven Oak Barrens State Nature Preserve		1				47				5	53
2023						46					46
Round 2						46					46
2024		1				1				5	7
Round 1		1				1				4	6
Round 2										1	1
Campbell State Nature Preserve		7	2		7	23					39
2023		1	2		4	12					19
Round 2		1	2		4	12					19
2024		1				4					5
Round 2		1				4					5
2025		5			3	7					15

Bombus species	auricomus	bimaculatus	citrinus	fervidus	griseocollis	impatiens	pensylvanicus	perplexus	vagans	Unknown	Grand Total
Round 1		3			1	3					7
Round 2		2			2	4					8
Chaparral Prairie State Nature Preserve		4			130	16	3			3	156
2023		1			64	11					76
Round 1		1			43	7					51
Round 2					21	4					25
2024		3			55	1	2			1	62
Round 1		3			47		2				52
Round 2					8	1				1	10
2025					11	4	1			2	18
Round 1					3	1	1			2	7
Round 2					8	3					11
Daughmer Prairie Savanna State Nature Preserve		3			10	13				2	28
2023		2			9	12					23
Round 1						1					1
Round 2		2			9	11					22
2024						1				1	2
Round 2						1				1	2
2025		1			1					1	3

Bombus species	auricomus	bimaculatus	citrinus	fervidus	griseocollis	impatiens	pensylvanicus	perplexus	vagans	Unknown	Grand Total
Round 1					1					1	2
Round 2		1									1
Erie Sand Barrens State Nature Preserve		26	2	1	32	42				9	112
2023		13	2		12	8					35
Round 2		13	2		12	8					35
2024		7		1	13	30				5	56
Round 1		7			1	1				2	11
Round 2				1	12	29				3	45
2025		6			7	4				4	21
Round 1		1				1				3	5
Round 2		5			7	3				1	16
Fallen Timbers Battlefield	4	4			2	22					32
2023	3	4			2	10					19
Round 2	3	4			2	10					19
2024	1					12					13
Round 1						1					1
Round 2	1					11					12
Goode Prairie State Nature Preserve		7	1	2	75	26			1	2	114
2023		5		2	43	19			1	1	71

Bombus species	auricomus	bimaculatus	citrinus	fervidus	griseocollis	impatiens	pensylvanicus	perplexus	vagans	Unknown	Grand Total
Round 1		2			18	2				1	23
Round 2		3		2	25	17			1		48
2024					23						23
Round 2					23						23
2025		2	1		9	7				1	20
Round 1		2								1	3
Round 2			1		9	7					17
Great Egret Marsh Preserve	1	13			53	7					74
2023	1	13			53	7					74
Round 1	1	1			21						23
Round 2		12			32	7					51
Irwin Prairie State Nature Preserve		25	11	1	77	51					165
2023		9	7		62	45					123
Round 1		3				3					6
Round 2		6	7		62	42					117
2025		16	4	1	15	6					42
Round 1		8				4					12
Round 2		8	4	1	15	2					30
Kitty Todd – Mancy Wilkins Tract		8			11	17					36

Bombus species	auricomus	bimaculatus	citrinus	fervidus	griseocollis	impatiens	pensylvanicus	perplexus	vagans	Unknown	Grand Total
2023					1						1
Round 1					1						1
2024		1			2	3					6
Round 1		1				1					2
Round 2					2	2					4
2025		7			8	14					29
Round 1		2				7					9
Round 2		5			8	7					20
Kitty Todd Nature Preserve		49	1	9	110	91					260
2023		9	1		56	19					85
Round 2		9	1		56	19					85
2024		5			21	13					39
Round 1		5			10	8					23
Round 2					11	5					16
2025		35		9	33	59					136
Round 1		1		1		1					3
Round 2		34		8	33	58					133
Morris Reserve	1	20		7	162	185				1	376
2023		8		4	61	98					171
Round 2		8		4	61	98					171
2024		1			54	8				1	64

Bombus species	auricomus	bimaculatus	citrinus	fervidus	griseocollis	impatiens	pensylvanicus	perplexus	vagans	Unknown	Grand Total
Round 1					45						45
Round 2		1			9	8				1	19
2025	1	11		3	47	79					141
Round 1		9			37	2					48
Round 2	1	2		3	10	77					93
Muck Farm		7	1		32	15			1		56
2023		2			1						3
Round 1		2			1						3
2024			1		24	7			1		33
Round 1						2					2
Round 2			1		24	5			1		31
2025		5			7	8					20
Round 2		5			7	8					20
Oak Openings Preserve Metropark		21		1	44	122	1	2	1		192
2023		11			23	78		2			114
Round 2		11			23	78		2			114
2024		1	1		6	25	1		1		35
Round 1					5	2	1				8
Round 2		1	1		1	23			1		27
2025		9			15	19					43
Round 1		1			2	5					8

Bombus species	auricomus	bimaculatus	citrinus	fervidus	griseocollis	impatiens	pensylvanicus	perplexus	vagans	Unknown	Grand Total
Round 2		8			13	14					35
Plum Run Prairie State Natural Area		10		1	18	28	1		1	7	66
2023		3		1	4	26	1		1		36
Round 1		1			2	3	1		1		8
Round 2		2		1	2	23					28
2024		6			11					4	21
Round 1		6			8					1	15
Round 2					3					3	6
2025		1			3	2				3	9
Round 1		1				2				2	5
Round 2					3					1	4
Providence Metropark		24	1		5	38		1			69
2023		6	1			3		1			11
Round 2		6	1			3		1			11
2024					3	1					4
Round 1					2	1					3
Round 2					1						1
2025		18			2	34					54
Round 2		18			2	34					54
Secor Metropark	2	49	17	1	61	46				1	177

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Bombus species	auricomus	bimaculatus	citrinus	fervidus	griseocollis	impatiens	pensylvanicus	perplexus	vagans	Unknown	Grand Total
2023	1	21	16		42	33				1	114
Round 1		4			3	1				1	9
Round 2	1	17	16		39	32					105
2024					2						2
Round 2					2						2
2025	1	28	1	1	17	13					61
Round 1	1	18		1	1	8					29
Round 2		10	1		16	5					32
Side Cut Metropark	8	24			19	66				1	118
2023	4	18			10	46				1	79
Round 1		15			7	5				1	28
Round 2	4	3			3	41					51
2024	1	3			3	7					14
Round 1		3			2	1					6
Round 2	1				1	6					8
2025	3	3			6	13					25
Round 1						3					3
Round 2	3	3			6	10					22
Springville Marsh State Nature Preserve	1	22		1	41	31	6			2	104
2023	1	8			14	19	5				47

Bombus species	auricomus	bimaculatus	citrinus	fervidus	griseocollis	impatiens	pensylvanicus	perplexus	vagans	Unknown	Grand Total
Round 1	1	3			4		1				9
Round 2		5			10	19	4				38
2024		11		1	20	9	1				42
Round 1		8			16	6					30
Round 2		3		1	4	3	1				12
2025		3			7	3				2	15
Round 1		2									2
Round 2		1			7	3				2	13
Sweet Arrow Reserve	1	90	4	6	49	123			1	5	279
2023	1	4	4	2	28	55					94
Round 2	1	4	4	2	28	55					94
2024		37		3	16	20			1	4	81
Round 1		37		2	9	3			1	2	54
Round 2				1	7	17				2	27
2025		49		1	5	48				1	104
Round 1		48		1		6				1	56
Round 2		1			5	42					48
Zimmerman Prairie State Natural Area		7		3	20	26	1		1	3	61
2023		2		3	3	18	1		1	1	29
Round 1		2			1	10			1	1	15

Bombus species	auricomus	bimaculatus	citrinus	fervidus	griseocollis	impatiens	pensylvanicus	perplexus	vagans	Unknown	Grand Total
Round 2				3	2	8	1				14
2024		4			5	4				2	15
Round 1		4			5	2					11
Round 2						2				2	4
2025		1			12	4					17
Round 1		1			8						9
Round 2					4	4					8
Grand Total	182	1748	100	194	2570	4636	94	4	73	127	9728

APPENDIX B: FULL COUNTS OF BUMBLE BEE OBSERVATIONS ON FLORAL RESOURCES BY STATE AND SURVEY ROUND

	Indiana		Michigan		Ohio		Total
	Round 1	Round 2	Round 1	Round 2	Round 1	Round 2	
Achillea millefolium	1		1				2
Agrimonia parviflora		2					2
Allium canadense				1			1
Allium cernuum		10		8		1	19
Amorpha canescens	12			1			13
Apocynum cannabinum	1		19		9		29
Asclepias incarnata		6		1		6	13
Asclepias syriaca	67	9	4	5	152	5	242
Asclepias tuberosa	1	2	1	5	14	1	24
Asparagus officinalis			2				2
Baptisia alba	146	38	18	1	12		215
Baptisia tinctoria						62	62
Berteroa incana			19				19
Blephilia ciliata	2				5		7
Calystegia sepium						1	1
Campanula americana						2	2
Carduus nutans	2						2
Ceanothus americanus	117	23					140
Centaurea stoebe				433			433
Cephalanthus occidentalis		3				3	6
Chamaecrista fasciculata				25		4	29
Cirsium arvense	3		4	2	6		15
Cirsium muticum				2			2
Cirsium spp.				1			1
Cirsium vulgare			2	3			5

	Indiana		Michigan		Ohio		Total
	Round 1	Round 2	Round 1	Round 2	Round 1	Round 2	
Convolvulus spp.		16					16
Coreopsis lanceolata	5	4	1		7		17
Cornus sericea	1		5		2		8
Cornus spp.	1		1		1		3
Dalea purpurea		31		1			32
Dasiphora fruticosa			1	7	3		11
Dasistoma macrophylla						2	2
Daucus carota		1		7			8
Desmodium canadense		1		4			5
Desmodium illinoense		1					1
Desmodium paniculatum		2					2
Desmodium spp.		3				3	6
Digitalis purpurea			1				1
Dipsacus fullonum						28	28
Dipsacus lacinatus						8	8
Dipsacus spp.						54	54
Echinacea paradoxa		4		9			13
Echinacea purpurea	45	4		13		14	76
Erigeron annuus						1	1
Eryngium yuccifolium		227				1	228
Eutrochium maculatum				12		3	15
Eutrochium purpureum		1		20		1	22
Filipendula ulmaria						1	1
Flying	42	37	29	40	23	19	190
Frangula alnus			2				2
Ground	3	1	3	6			13
Helianthus divaricatus				7		1	8

	Indiana		Michigan		Ohio		Total
	Round 1	Round 2	Round 1	Round 2	Round 1	Round 2	
Helianthus mollis						3	3
Helianthus spp.		1					1
Heliopsis helianthoides			4	2	3		9
Hypericum perforatum	5	14		30	13	3	65
Hypericum prolificum		5				88	93
Iris versicolor	5						5
Krigia biflora					1		1
Lamium spp.						4	4
Lathyrus odoratus			2				2
Leonurus cardiaca	1		100				101
Leucanthemum vulgare			2	1			3
Liatris aspera				1			1
Liatris punctata		4					4
Liatris spicata		6		4		98	108
Liatris spp.		1		1		16	18
Linaria vulgarius		2					2
Lobelia spicata					2		2
Lobularia maritima				1			1
Lonicera japonica					3		3
Lotus corniculatus	12			1	9		22
Lupinus perennis	3		2		1		6
Lupinus spp.					1		1
Lythrum alatum		3				1	4
Lythrum salicaria		33		486	1		520
Melilotus albus		1		29	1	7	38
Melilotus officinalis					16	6	22
Monarda fistulosa	3	1550	1	1801		1204	4559

	Indiana		Michigan		Ohio		Total
	Round 1	Round 2	Round 1	Round 2	Round 1	Round 2	
Monarda punctata		2		10		35	47
Opuntia cespitosa	14						14
Opuntia humifusa					4		4
Orbexilum pedunculatum					1		1
Origanum vulgare				3			3
Penstemon digitalis	222		66		125		413
Penstemon hirsutus					1		1
Penstemon spp.					2		2
Perched	1	4		1			6
Phlox pilosa	2						2
Picea abies			5				5
Poa spp.				1			1
Podophyllum peltatum	1						1
Pontederia cordata				8			8
Prunella vulgaris				3		5	8
Pycnanthemum incanum						12	12
Pycnanthemum spp.		2					2
Pycnanthemum tenuifolium	1					1	2
Pycnanthemum virginianum		35		52		41	128
Quercus spp.		1					1
Ratibida pinnata		12		24		93	129
Rhus copallinum						4	4
Rosa blanda	1						1
Rosa carolina					5		5
Rosa multiflora			1		1		2
Rosa palustris			5		2		7
Rosa setigera	1		1		24		26

	Indiana		Michigan		Ohio		Total
	Round 1	Round 2	Round 1	Round 2	Round 1	Round 2	
Rosa spp.	24		2		21		47
Rubus allegheniensis					1		1
Rubus idaeus					1		1
Rubus occidentalis			4				4
Rubus spp.	34	2	28		3		67
Rudbeckia hirta		1	1	1			3
Rumex spp.					1		1
Securigera varia	79	23	17	54	64	6	243
Senna hebecarpa		3		1			4
Silene latifolia				1			1
Silene vulgaris			1				1
Silphium integrifolium		1		2			3
Silphium laciniatum		3				1	4
Silphium perfoliatum		5					5
Silphium spp.		14		7			21
Silphium terebinthinaceum		8		13		4	25
Solanum carolinense	7	5		54		1	67
Solanum dulcamara	1	2					3
Solanum spp.					1		1
Solidago juncea				1			1
Solidago spp.				4			4
Spiraea alba		30		5		15	50
Teucrium canadense		1					1
Toxicodendron vernix			2				2
Tradescantia ohiensis	16		10		2		28
Tradescantia virginiana	1		28	13	1		43
Trifolium arvense			5				5

	Indiana		Michigan		Ohio		Total
	Round 1	Round 2	Round 1	Round 2	Round 1	Round 2	
Trifolium campestre					3		3
Trifolium hybridum					1		1
Trifolium pratense	37	4	4	1	91	38	175
Trifolium repens	4	2	13	1	18	2	40
Triosteum spp.					1		1
Unknown	1	1			1	4	7
Verbascum blattaria					1		1
Verbascum spp.		1					1
Verbena hastata		40		2			42
Verbena spp.		6		12		3	21
Verbena stricta		2				8	10
Verbesina spp.					1		1
Vernonia spp.		2					2
Veronia gigantea				1			1
Veronicastrum virginicum		123		36		7	166
Vicia spp.					1		1
Vicia villosa	32		96	1			129
Grand Total	**957**	**2381**	**513**	**3283**	**663**	**1931**	**9728**

APPENDIX C: FULL RESULTS OF XERCES HABITAT ASSESSMENTS COMPLETED FOR EACH SURVEY FROM 2023-2025

	2023		2024		2025	
	Round 1	**Round 2**	**Round 1**	**Round 2**	**Round 1**	**Round 2**
Indiana						
Barnes Nature Preserve	72	59				
Biesecker Prairie Nature Preserve	83	84	59	61	68	66
Conrad Savanna Nature Preserve	88	75	65	69	64	60
Coulter Nature Preserve	82	71	10			
Cressmoor Prairie Nature Preserve	91	79	59	65	63	75
Dunes Prairie Nature Preserve	90	71				
Fisher Oak Savanna Nature Preserve	72	77	63	76	46	48
Gibson Woods Nature Preserve	57	86			68	10
Goose Pond Fish and Wildlife Area	90	80				
Granville Sand Barrens Nature Preserve	64	79	64	74	67	76
Hoosier Prairie Nature Preserve	66	74	61	70	50	65
Ivanhoe Dune and Swale Nature Preserve	66	68	10		62	48
Kankakee Sands	80	77		64	73	
Lowe Prairie	73	79	53	64	54	60
McCloskey's Burr Oak Savanna Nature Preserve	85	79	67	72	69	67
Merry Lea Nature Preserve	82	84	42	45		65
Mongoquinong Nature Preserve	70	55	43	70	32	58
NIPSCO Savanna	67	64	70	73	72	49

	2023		2024		2025	
	Round 1	**Round 2**	**Round 1**	**Round 2**	**Round 1**	**Round 2**
Ober Savanna Nature Preserve	72		60	71	62	45
Pine Station Nature Preserve	78	73				
Prophetstown Fen	74	56	61	70	63	90
Red-tail Nature Preserve	71	73				
Seidner Dune and Swale Nature Preserve	78	75			68	73
Smith Cemetery Nature Preserve	81	87	56	68	59	64
Spinn Prairie Nature Preserve	86	74	60	67	56	68
Springfield Fen Nature Preserve	65	84				
Stoutsburg Savanna Nature Preserve	84	93			71	62
Tefft Savanna Nature Preserve	74	51	58	67	76	71
Michigan						
Algonac State Park Blazing Star Prairie					52	68
Augusta Floodplain	74	80	85	56	74	65
Big Valley Nature Sanctuary	59	88		78	52	67
Bullard Lake Fen Plant Preserve	55	89	78	41	45	64
Calla C Burr Memorial Nature Sanctuary	65			61	47	72
Chipman Nature Preserve	77	80	72	49	56	
Dolan Nature Sanctuary	57	76	43	43	47	69
Dowagiac Woods Nature Sanctuary	59	62	49	51	41	52
Goose Creek Grasslands	72	72	65	59	63	63
Grand River Fen	78	94	81	86		91
H.E. Hardy Memorial Nature Sanctuary	47	70		40	50	73
Hidden Pond Preserve	80	80	55	47	47	64

	2023		2024		2025	
	Round 1	**Round 2**	**Round 1**	**Round 2**	**Round 1**	**Round 2**
Ives Road Fen	76	76	71	71	49	67
Jeptha Lake Fen	79	45	55	59		
McCoy's Creek Trail	48	55	55	50		
Nan Weston Nature Preserve at Sharon Hollow	59	66				
Newaygo Prairie	52	72				
Paw Paw Prairie Fen	79	74	74	75	66	74
Petersburg State Game Area					62	81
Portman Nature Preserve	55	54		71	60	46
Sand Creek Preserve	70	70	66	70	54	56
Tamarack Swamp Preserve	49	80	80	78	71	88
Wau-Ke-Na, William Erby Smith Preserve	73	37	41	43		
Wolf Tree Nature Trails	55	69	74	78	54	75
Ohio						
Adams Lake Prairie State Nature Preserve	56	74		41	51	59
Brinkhaven Oak Barrens State Nature Preserve		60	38	38		
Campbell State Nature Preserve		69	67	94	58	80
Chaparral Prairie State Nature Preserve	74	76		85	69	68
Daughmer Prairie Savanna State Nature Preserve	52	70	63	69	57	54
Erie Sand Barrens State Nature Preserve		60	54	41	43	54
Fallen Timbers Battlefield			61	38		
Goode Prairie State Nature Preserve	68	83	46	80	51	50

	2023		2024		2025	
	Round 1	**Round 2**	**Round 1**	**Round 2**	**Round 1**	**Round 2**
Great Egret Marsh Preserve	68	73				
Irwin Prairie State Nature Preserve	72	68	71	74	63	81
Kitty Todd State Nature Preserve	53	72	68	63	58	70
Mancy Wilkins Tract	58		79	85	64	77
Morris Reserve		75	55	61	64	73
Muck Farm	40		37	55	34	74
Oak Openings Metropark	42		70	89	70	87
Plum Run Prairie State Natural Area	72	69	76	46	63	56
Providence Metropark	35	68	50	57	47	68
Secor Metropark	43	70	65	68	60	80
Side Cut Metropark	66		30	62	31	64
Springville Marsh State Nature Preserve	77	59	76	36	38	64
Sweet Arrow Reserve		78	55	61	60	70
Zimmerman Prairie State Natural Area	62	72	36	49	44	52