

2025 Status of Karner Blue Butterfly on State Lands in Michigan

Interim Report (Year 1 of 3-year sampling frame)



Prepared By:

Ashley A. Cole-Wick, Eric C. Branch, Courtney N. Ross.

Michigan Natural Features Inventory, Michigan State University Extension, P.O. Box 13036,
Lansing, MI 48901-3036. Report No. 2025-24.

Prepared For:

Michigan Department of Natural Resources

October 6, 2025

Introduction

The Michigan Department of Natural Resources (MDNR) provided funding to the Michigan Natural Features Inventory (MNFI) to conduct occupancy-based surveys for the Karner blue butterfly (*Plebejus samuelis*) at Allegan, Flat River, and Muskegon State Game Areas in 2025, as well as nearby conservation lands when time and resources allowed. Surveys were designed to address multiple goals: 1) determine occupancy status of habitat patches to inform regulatory and management decisions; 2) track population status to evaluate progress toward recovery plan goals; and 3) evaluate the response to management actions.

Our survey methods align with those from previous years to allow for comparison across time to assess population trends (Monfils and Cuthrell 2015, 2018; Monfils et al. 2021; Cole-Wick et al. 2023; Cole-Wick et al. 2024). In 2024 and 2025 we made improvements upon existing methods to allow us to collect data to provide to MDNR land managers, such as nectar resource use and ant mound abundance. Upon completion, the current three-year project will provide an in-depth report comparing trends in all data between 2015 and 2027.

Methods

We generated maps of the 2025 survey sites with ArcGIS Pro and Field Maps and uploaded them to smart devices (i.e., tablet computers, smartphones) to assist surveyors as they navigated among and within sites. In addition to navigating through the sites using Field Maps, surveyors recorded their tracks to document which areas were surveyed. In the field, surveyors collected habitat and butterfly occurrence data in a Survey 123 form customized for this project. The occupancy-based survey method we have used for Karner blue since 2015 requires two visits to each site during the second flight (late June – late July). We limited surveys to periods when the temperature was above 15° C (60° F), there was no rain, winds $\leq$ 25 km/h (15 mph), and between 9 AM and 6 PM.

We conducted modified Pollard-Yates (Pollard and Yates 1993) surveys in which we followed a series of transects paralleling the outer boundary of the survey site polygon. The first transect began 5 m inward from the outer edge of the patch, with one surveyor slowly walking along the first transect until the entire periphery of the site was surveyed. A second transect was located 10 m inward from the first transect and was surveyed in the same manner. Additional transects were added until the entire patch of suitable habitat was surveyed. At large sites, two or more people conducted the survey together, with transects spaced 10 m apart.

Observers looked for and counted Karner blues within an area 5 m to either side of the transect, 5 m forward along the transect, and 5 m above the transect (10 m x 5 m x 5 m, rectangular survey area). Surveyors walked at a steady, slow speed of approximately 35 m/min. If butterflies flew ahead of an observer, they were ignored if the surveyor was certain the individual was already counted. To facilitate an accurate count of the Karner blue and understand their distributions within and among sites, we collected geospatial information for each butterfly. We collected GPS coordinates in the Survey123 form for each Karner blue observed.

We recorded sex (male, female, unknown), wing wear (a scale from 1 to 5), and activity (perched, flying, nectaring, copulating) of each adult Karner blue. We recorded all other butterfly species detected during surveys on a checklist (present/absent) for each site.

We identified environmental and habitat characteristics at each site by collecting information on variables that may influence Karner blue detection and occupancy. At the start and end of a survey, we recorded the temperature (°C), percent relative humidity, cloud cover (expressed as the % of sky occluded), and maximum wind speed (km/h). Surveyors collected general information about potential threats to Karner blue and their habitats, such as shrub encroachment or damaged habitat, and ranked the relative

abundance of sundial lupine (*Lupinus perennis*), nectar sources, and invasive plant species. We used the DAFOR (Dominant, Abundant, Frequent, Occasional, Rare) scale to rank the relative abundance of lupine, nectar sources, and invasive species as dominant, abundant, frequent, occasional, or rare. We also recorded the total number of active and inactive ant mounds observed at each site.



Results

In 2025 we completed Karner blue surveys in July. We used a newly developed survey panel in which we survey a select number of polygons every year and survey the remaining sites once every three years. We completed 71 surveys at 35 sites on state lands, with all sites having at least two visits. Eleven of these sites were scheduled to be surveyed in 2025 only (Year 1 of the panel), while 22 sites are scheduled to be surveyed annually. We also surveyed two additional sites not originally included in this year's sample frame that were requested by Don Poppe (MDNR). Beyond state lands, we completed an additional 10 surveys at seven partner properties of high conservation priority (one site in Kent County, four in Newaygo County, and two at the Muskegon Resource Recovery Center, adjacent to Muskegon State Game Area). Spatial results can be viewed on the [DNR GIS Portal](#) by MDNR staff.

We detected Karner blues at 24 (57%) of the 42 sites surveyed and recorded 3,709 individuals across all site visits. Our maximum season count across all 42 sites was 2,435 individuals, which we calculated by summing the highest single visit count for each site. (Table 1). The highest single visit count at a site was recorded at the Karner Blue Nature Sanctuary (P009), owned and managed by the Michigan Nature Association, with 708 individuals detected during the first survey.

For the 35 sites located on state lands (i.e., located within one of the three state game areas), we detected Karner blues at 20 (57%) sites and recorded a maximum count of 1,690 individuals, with Allegan State Game Area accounting for 87% of this total (Table 1). Of these 20 occupied sites, 45% (9) had maximum counts of fewer than 10 individuals (Table 2), and three sites, A001DS, A059, and A073, accounted for 60% of the maximum season count. We have created Table 2 to assist MDNR staff in prioritizing restoration activities.

Table 1. The number of sites located within state and private lands where we conducted surveys in 2025, with corresponding values of maximum abundance (sum of highest single visit count from each site), naïve occupancy (proportion of sites occupied), and raw density (number of Karner blues per hectare surveyed) of Karner blues for each.

	Sites Surveyed	Max Abundance	Naïve Occupancy	Raw Density
Allegan State Game Area	29	1,471	0.55	5.29
Flat River State Game Area	1	146	1.00	42.94
Muskegon State Game Area	5	73	0.60	1.67
Private	7	745	0.57	8.62
Total	42	2,435	---	---

Table 2. A summary of Karner blue populations, potential threats, ant activity, resource availability, and potentially limiting factors for all sites surveyed on state lands at Allegan (sites beginning with A), Flat River (sites beginning with F), and Muskegon (sites beginning with M) State Game Areas (SGA). Max abundance is the highest number of Karner blues observed during a single visit. Potential threats were noted by surveyors for each site while walking transects. Site-level DAFOR ranks for Pennsylvania sedge, invasive plant species, nectar sources, and lupine were converted to numeric values (0-5, 0 = absent, 5 = Dominant), and the scores represent the sum of these values averaged across visits. Active ant mound density represents the maximum number of ant mounds recorded on a single visit divided by site area in hectares (ant mounds per hectare). Potentially limiting factors were determined based upon nectar score, active ant mound density, and lupine score according to the following criteria: Average nectar score < 10, Active Ant Mound Density < 5, Average Lupine Score < 3.

Site	Max Abundance	Potential Threats	Avg. Penn Sedge Score	Avg. Invasive Score	Avg. Nectar Score	Active Ant Mound Density	Avg. Lupine Score	Limiting Factor(s)
A001	0	Shrub encroachment, ORV damage, Equestrian damage	3	0.5	3.5	0.8	1	Nectar, Ants, Lupine
A001DS	304	Shrub encroachment, ORV damage, Equestrian damage, Dumping	3.5	2.5	7.5	6.6	2.5	Nectar, Lupine
A002	0	Shrub encroachment, ORV damage, Equestrian damage	1	0	0	1.1	0	Nectar, Ants, Lupine
A002DS	98	Shrub encroachment, ORV damage, Equestrian damage	3.5	2	14.5	2.9	2	Ants, Lupine
A003	0	Shrub encroachment, ORV damage, Equestrian damage	3.5	1	6	8.5	1	Nectar, Lupine
A007	0	Shrub encroachment, ORV damage	2.5	1	4	0.8	0.5	Nectar, Ants, Lupine
A019	0	Shrub encroachment, ORV damage	2	0.5	5.5	23.6	3.5	Nectar
A021	0	Shrub encroachment, ORV damage, Human development	4	0	5	9.7	3.5	Nectar
A037	18	Shrub encroachment, ORV damage	5	0	4	37.6	4	Nectar
A046	57	Shrub encroachment, ORV damage, Equestrian damage	4	4	16.5	12.5	4	
A049	1	Shrub encroachment, ORV damage, Equestrian damage	4	0.5	3.5	6.6	0.5	Nectar, Lupine
A051	6	Shrub encroachment	4	0	2	10.0	1.5	Nectar, Lupine
A055	1	Shrub encroachment	3	0	0.5	3.9	1.5	Nectar, Ants, Lupine
A059	326	Shrub encroachment, ORV damage, Equestrian damage	4	2	9	8.0	2.5	Nectar, Lupine
A060	4	Shrub encroachment	4	0	2	12.3	4	Nectar
A068	3	Shrub encroachment, ORV damage	5	4.5	16	0.1	3	Ants
A073	389	Shrub encroachment, ORV damage	4.5	3.5	16	5.0	3	
A075	0	Shrub encroachment	4	0.5	1	5.5	1	Nectar, Lupine

A082	0	Shrub encroachment, ORV damage, Equestrian damage	4	1.5	11.5	2.3	3.5	Ants
A086	8	Shrub encroachment, ORV damage, Equestrian damage	4.5	1.5	12	2.2	2	Ants, Lupine
A088	0	Shrub encroachment, ORV damage, Equestrian damage	3	1.5	12.5	4.6	1.5	Ants, Lupine
A094	9	Shrub encroachment, ORV damage	2	2.5	10	10.9	2	Lupine
A108	80	Shrub encroachment, ORV damage	4	3.5	14	11.3	3	
A129	0	Shrub encroachment, ORV damage, Equestrian damage	3	3.5	14.5	1.4	2	Ants, Lupine
A201	0	Shrub encroachment, ORV damage	4	0.5	7	31.0	2	Nectar, Lupine
A203	0	Shrub encroachment, ORV damage	3.5	0.5	11.5	1.2	2	Ants, Lupine
A207	1	Shrub encroachment, ORV damage	3	2	12	1.1	2	Ants, Lupine
A208	166	Shrub encroachment, ORV damage, Equestrian damage	4	2.5	5	12.5	3.5	Nectar
A307	0	Shrub encroachment, ORV damage, Equestrian damage	3	0	4.5	2.3	0.5	Nectar, Ants, Lupine
F003DS	146	Shrub encroachment	1	2	15	4.3	2	Ants, Lupine
M100	37	Shrub encroachment, ORV damage	2.5	4	16	0.2	1.5	Ants, Lupine
M101	2	Shrub encroachment, ORV damage	3	1.3	11.3	0.0	1	Ants, Lupine
M105	0	Shrub encroachment, ORV damage, Mountain bikes	3.5	1	9	0.7	1	Nectar, Ants, Lupine
M106	0	Shrub encroachment, ORV damage	1.5	0	6	0.8	1	Nectar, Ants, Lupine
P007_Gamez*	34	Shrub encroachment, ORV damage	2	1	13.5	1.0	1.5	Ants, Lupine

* = We included privately owned P007_Gamez along with the Muskegon sites due to proximity to Muskegon SGA.

Nectar Resource Use

In 2025 we collected data on Karner blue nectar resource choice. We recorded 325 observations of 918 Karner blues nectaring on 23 plant species. Butterfly-weed (*Asclepias tuberosa*), spotted knapweed, and goats-rue (*Tephrosia virginiana*) were visited by the greatest number of individuals (Table 3). A single observation often included more than one butterfly on the same plant or small group of plants, thus the discrepancy between the number of observations and number of nectaring butterflies.

Table 3. The total number of Karner blues observed visiting each nectar source.

Common Name	Scientific Name	Total No. of Nectaring Karner Blues
Butterfly-weed	<i>Asclepias tuberosa</i>	385
Spotted knapweed	<i>Centaurea stoebe</i>	185
Goats-rue	<i>Tephrosia virginiana</i>	124
Horse mint	<i>Monarda punctata</i>	80
Hoary alyssum	<i>Berteroa incana</i>	66
White sweet-clover	<i>Melilotus alba</i>	21
Spreading dogbane	<i>Apocynum androsaemifolium</i>	10
Flowering spurge	<i>Euphorbia corollata</i>	9
Black-eyed susan	<i>Rudbeckia hirta</i>	8
Common St. John's-wort	<i>Hypericum perforatum</i>	7
Whorled milkweed	<i>Asclepias verticillata</i>	7
Fleabane spp.	<i>Erigeron spp.</i>	5
Wild-bergamot	<i>Monarda fistulosa</i>	1
Sand coreopsis	<i>Coreopsis lanceolata</i>	1
Deptford pink	<i>Dianthus armeria</i>	1
Woodland sunflower	<i>Helianthus divaricatus</i>	1
Common milkweed	<i>Asclepias syriaca</i>	1
Common spiderwort	<i>Tradescantia ohiensis</i>	1
Green milkweed	<i>Asclepias viridiflora</i>	1
Long-spiked evening-primrose	<i>Oenothera rhombipetala</i>	1
New Jersey tea	<i>Ceanothus americanus</i>	1
Northern dewberry	<i>Rubus flagellaris</i>	1
Wild carrot	<i>Daucus carota</i>	1
	Total	918

We collected DAFOR ranks of relative abundance for 15 of the 23 plant species visited by Karner blues, and site-level DAFOR ranks for each of these plants were converted to numeric values (1-5) and summed across all sites surveyed to provide a measure of relative availability. Spotted knapweed, common St. John's-wort (*Hypericum perforatum*), and

fleabane (*Erigeron spp.*) were the most abundant, while common spiderwort (*Tradescantia ohiensis*), white sweet-clover (*Melilotus alba*), and common milkweed (*Asclepias syriaca*) were the least abundant of the nectar sources visited by Karner blues.

Despite being only the fifth most abundant nectar source, butterfly-weed was visited by over twice as many individuals as any other plant species (Figure 1). Finally, one should note that nectar resource use fluctuates from year-to-year with phenology, for instance, in 2025 the Karner blue flight aligned with the blooms of goats-rue (*Tephrosia virginiana*) but in previous years the plant was not yet in full bloom when the butterfly's second generation was flying. Conversely, in other years we observed Karner blues using cylindrical blazing star (*Liatris cylindracea*), but this year the plant bloom did not coincide with the Karner blue peak flight.

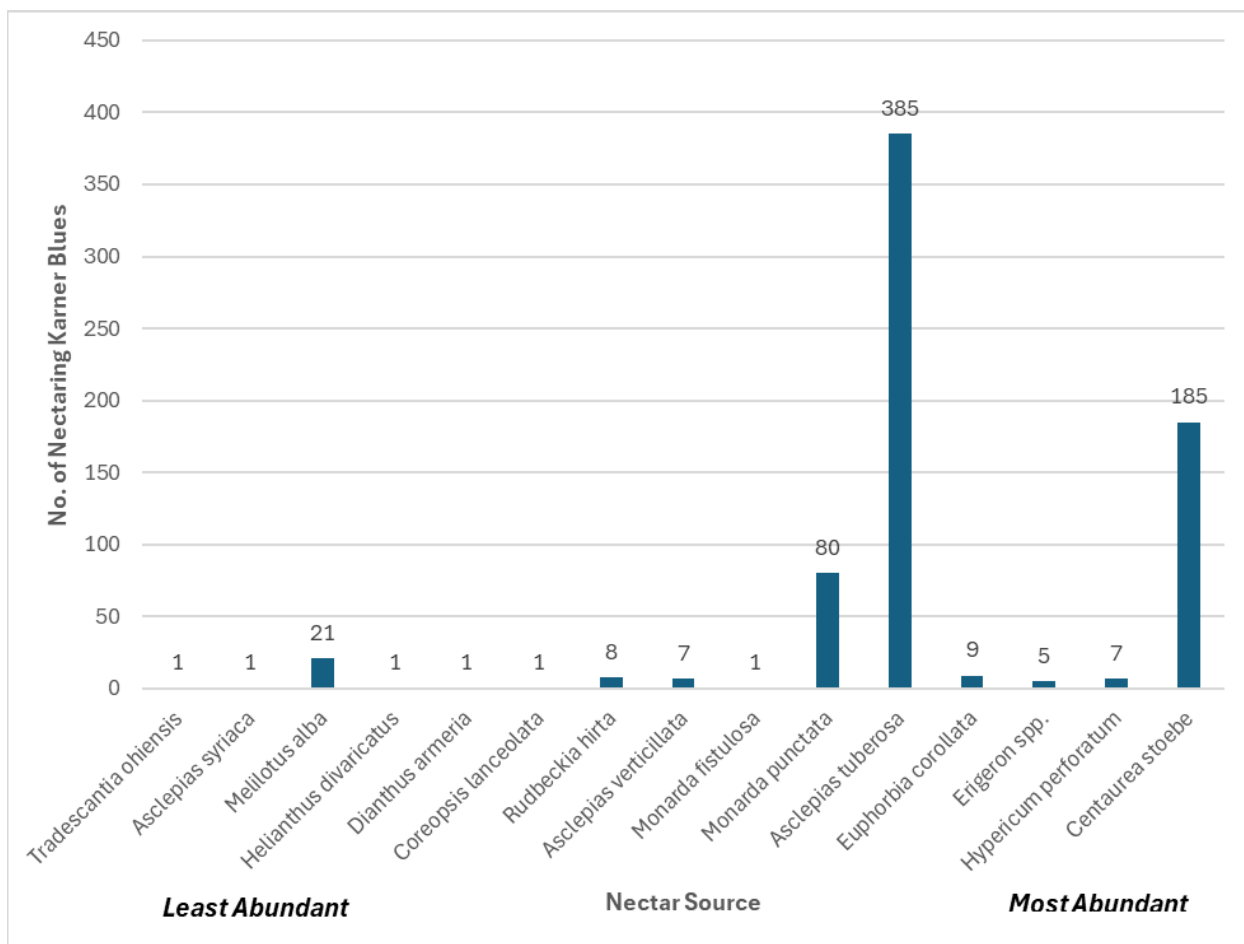


Figure 1. Nectar source utilization in relation to availability for the 15 nectar sources with corresponding relative abundance data. Nectar sources displayed in increasing order of relative abundance.

Management Recommendations for MDNR State Game Areas (SGAs)

Allegan SGA

Allegan Barrens (126th Avenue Barrens, A207) is one of the largest survey polygons and in 2025 we documented one Karner blue, the first observation recorded in this area since 1998 (Figure 2, MNFI 2025). We are uncertain if Karner blues have a sustaining population at this site, or if they are slowly colonizing it from other areas, most likely the latter. This site also contains a population of the State Threatened frosted elfin butterfly (*Callophrys irus*), which also feeds on sundial lupine. Regardless of Karner blue population status at this site, it is valuable to a variety of plants and animals and is an important high-quality natural community.

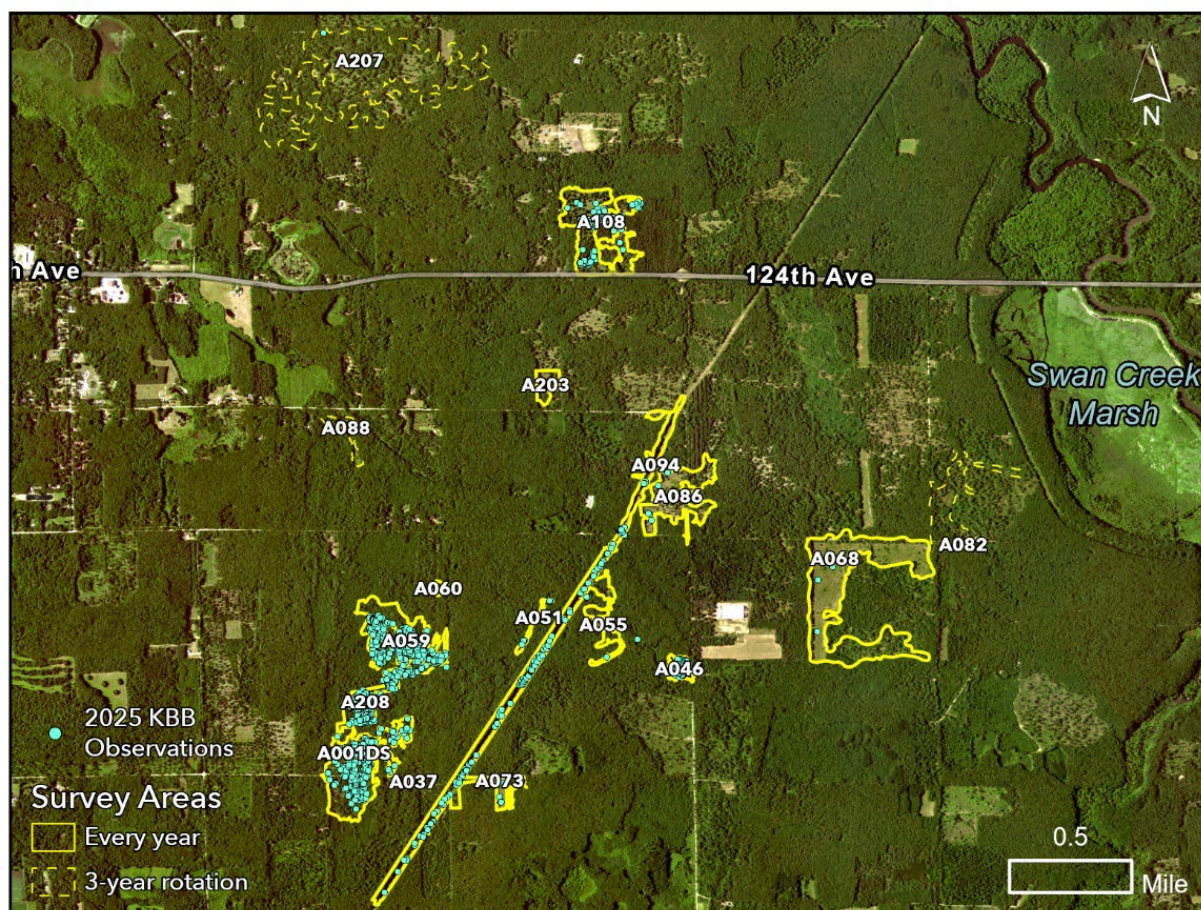


Figure 2. Allegan SGA Karner blue survey sites in the central portion of the site.

122nd Avenue Barrens (A068) has good overall habitat with frequent lupine (Table 2) but low Karner blue abundance, with a maximum count of three butterflies in 2025. For the last two years we have observed that the most limiting factor for Karner blues at this site may be *Formica* ant abundance.

Recent land management at the sites adjacent to the pipeline (A073) has been incrementally successful in reducing canopy and shrub cover but work remains to improve these sites and continue to connect them to larger populations. Continuing to reduce canopy and increase forbs at A086, A049, A051, and A055 will help maintain a metapopulation. Connecting the pipeline (A073) and to these smaller sites will provide a benefit to Karner blues. A082, located adjacent to A068, is a candidate for more prescribed fire and shrub removal, specifically in the west portion of the polygon where lupine is most abundant and a Karner blue was last seen in 2023 (0 observed in 2024 and 2025).

Muskegon SGA

The Fitzgerald Barrens (Figure 3, M101) at Muskegon State Game Area has undergone notable ecological improvement, a testament to the work of the MDNR staff. The newly established corridor canopy cover is a valuable enhancement. To further support biodiversity and pollinator health, the addition of more nectar-producing plant species is recommended. We recommend butterfly-weed (*Asclepias tuberosa*) and whorled milkweed (*A. verticillata*), as their bloom time overlaps with the second generation Karner blue flight.

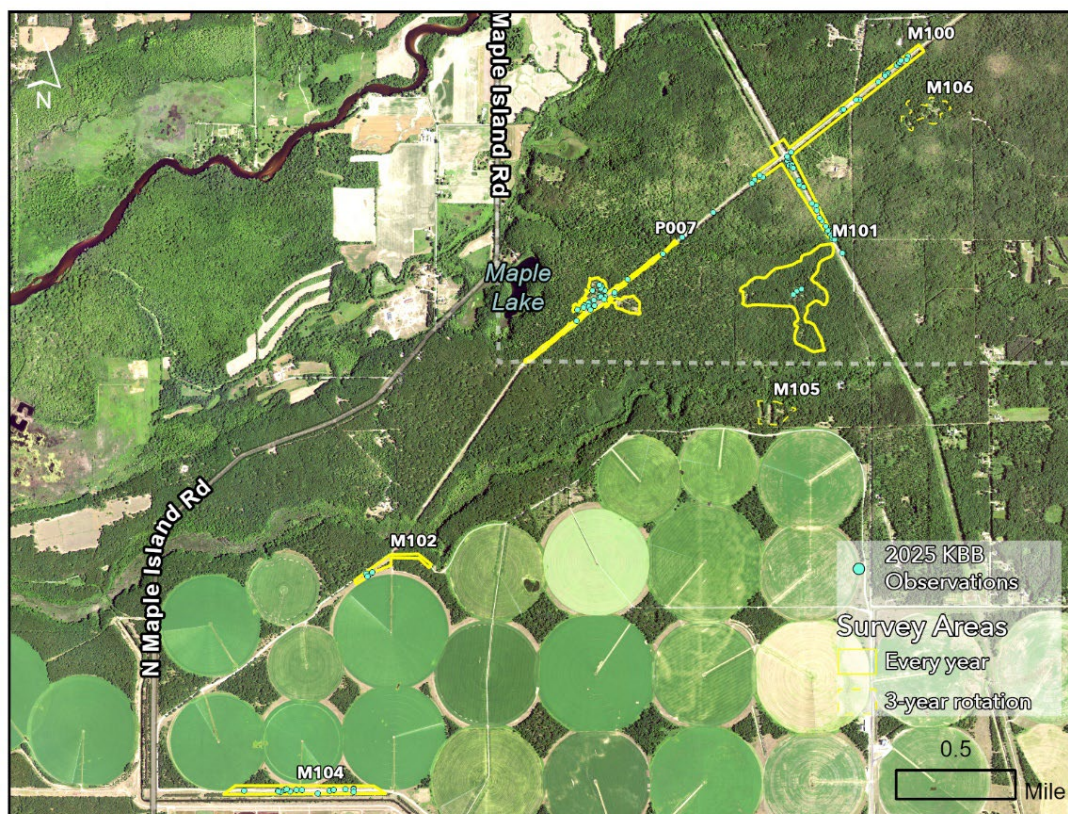


Figure 3. Muskegon SGA Karner blue survey sites.

Flat River SGA

The Ramney Road population (Figure 4, F003DS) of Karner blues has been positively responding to MDNR land management with prescribed fire and management north of the powerline right-of-way. The success of recent management is clear in the numbers, most notable is the massive increase in nectar resources (Table 2) despite its diminutive size. In 2025 we observed 146 Karner blues (max count) compared to 55 (max count) in 2024 – a 165% increase in observations at F003DS. In 2025 we found a total of 53 Karner blues in a new area northwest of the main population and created a new survey polygon for 2026 surveys (F004, Figure 4). Restoration successes like this provide immensely valuable habitat for the Karner blue and many other species. We recommend continuing to expand these sites as barrens indicator species are expressed after prescribed burns.



Figure 4. Flat River SGA Karner blue survey sites, including a new survey polygon (F004) created for 2026 surveys to include newly restored habitat.

MNFI Goals for 2026

Conduct Karner blue surveys.

In 2026 we will survey the year-two panel of the three-year sampling scheme and add new site (F004) to the panel. We will maintain open communication with MDNR land managers to ensure we are adding sites to the panel to assist with habitat management reporting. In addition, we made significant improvements to the Survey123 form in preparation for 2026. Updates listed below:

- Updated invasive species, threats, nectar resources, and ant mounds to a single point collection layer to help pinpoint management actions at each site.
- Butterfly observation categories have warnings if the total count listed was not met or exceeded to minimize error and streamline QC process.
- Additional fields included to increase details collected on survey effort.
- An autocomplete or drop-down option is now available for all plant species text fields instead of manual text entry to streamline QC process.
- The form is now in a grid format which condenses the fields for a cleaner view.

Ant translocation.

We identified active ant mounds as the most limiting Karner blue habitat requirement at the Muskegon SGA restorations, specifically Fitzgerald Barrens (M101) and Comstock Barrens (M106). We selected one site at Allegan SGA (A068) where ants are a limiting factor for extant Karner blue populations (Table 2). We would follow an ant translocation protocol provided by Dr. Ann Fraser, who has studied *Formica* ants and myrmecophilous butterflies, including the silvery blue (*Glaucopsyche lygdamus*) (e.g., Fraser et al. 2001).

Identify suitable reintroduction sites.

In partnership with the Michigan Karner Blue Working Group, we are identifying a prioritized list of potential reintroduction sites for the Karner blue in western Michigan. In 2025 the John Ball Zoo and Michigan State University collected Karner blues from Allegan SGA (Horseman's Campground, A001DS) and reared them in their facility in Grand Rapids, MI. Upon a successful pilot study, plans are underway to select both a collection site and a reintroduction site as early as 2026. Plans will be communicated to the MDNR to invite input and involvement.

References

- Cole-Wick, A.A., E.C. Branch, and M.J. Monfils. 2023. Results of Karner blue butterfly surveys on State Lands in Michigan. Michigan Natural Features Inventory, Report No. 2023-20, Lansing, MI.
- Cole-Wick, A.A., E.C. Branch, and M.J. Monfils. 2024. Status of the Karner Blue Butterfly on State Lands in Michigan. Michigan Natural Features Inventory Document No. 2024-23, Lansing, MI.
- Fraser, A., A.H. Axen, and N.E. Pierce. 2001. Assessing the quality of different ant species as partners of a myrmecophilous butterfly. *Oecologia* 129(3): 452-460.
- Michigan Natural Feature Inventory. 2025. Natural Heritage Database. Lansing, MI.
- Monfils, M.J., and D.L. Cuthrell. 2015. Development and implementation of an occupancy survey for Karner blue butterflies. Michigan Natural Features Inventory, Report No. 2015-15, Lansing, USA.
- Monfils, M.J., and D.L. Cuthrell. 2018. Evaluation of Karner blue butterfly occupancy and relationships to management on state lands in Michigan. Michigan Natural Features Inventory, Report No. 2018-21, Lansing, USA.
- Monfils, M.J., L.M. Rowe, A.A. Cole-Wick, and D.L. Cuthrell. 2021. Monitoring butterfly species of greatest conservation need in Michigan grasslands and savannas. Michigan Natural Features Inventory, Report No. 2021-10, Lansing, MI.
- Pollard, E., and T.J. Yates. 1993. Monitoring butterflies for ecology and conservation. Chapman and Hall, London, Great Britain.