

# Rare borer moth surveys (Noctuidae: *Papaipema*) at Shiawassee Basin Preserve Springfield Township, Oakland County, MI



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Prepared For:  
Springfield Charter Township

12/30/2022

MNFI Report No. 2022-35

Suggested Citation:

D.L. Cuthrell, Rowe, L.M., and M.A. Sanders. 2022. Rare borer moth surveys (Noctuidae: *Papaipema*) at Shiawassee Basin Preserve, Springfield Township, Oakland County, Michigan. Prepared for Springfield Charter Township. Michigan Natural Features Inventory, Report No. 2022-35, Lansing, MI. 11pp + appendices.

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Cover: Long Lake East blacklight station near prairie dock and blazing star, Shiawassee Basin Preserve, Oakland County, Michigan, September 2022 (photo by D. Cuthrell).

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# Introduction

The Prairie fen within the Springfield Township known as the Shiawassee Basin Preserve, is one of the largest, most diverse, and high-quality fens in Michigan. It contains habitat for several rare species (both plants and animals) including the federally endangered Poweshiek skipperling (*Oarisma poweshiek*) and is one of six populations in the world of the critically rare Lake Huron Leafhopper (*Flexamia huroni*). Because of its high-quality prairie habitat, high flowering forb diversity, and the presence of other rare insects, the preserve likely contains two other rare moth species in the Noctuid genus *Papaipema*, including the Silphium borer moth (*Papaipema silphii*; SBM), and the Blazing-star borer moth (*Papaipema beeriana*; BSBM).

The Silphium Borer Moth (Lepidoptera: Noctuidae), is currently listed by the state of Michigan as threatened, with a total of 12 recorded sites in Michigan, with the last confirmed observation of this species in the state in 1996 from Washtenaw County (MNFI Biotics Conservation Database 2022, Figure 1). The species is considered rare range-wide and is a Michigan, as well as Regional, Species of Conservation Concern. This moth produces a single brood per year, with the adults appearing in late summer/early fall. There is a general lack of understanding of the life history, distribution, relative abundance, and the potential effects on populations from climate change and pesticides for the SBM.

The SBM is one of the largest *Papaipema* species in Michigan with a wingspan of 40-50 mm (1.6-2.0 in.) (Bird 1915). The SBM is brownish-black with a dusting of white scales on the dorsal forewings (Figure 1). It can easily be confused with the two sunflower borers, *Papaipema necopina* and *P. maritima*, as well as the plain form of the BSBM.



**Figure 1.** Silphium Borer Moth adult on dried leaf of larval hostplant Prairie dock Washtenaw County, Michigan 1996 (photo by D. Cuthrell).

When fresh, the SBM has a distinctive purplish cast and a large tuft of hair-like scales on the thorax (Cuthrell 2000). Many species of *Papaipema* are difficult to identify but most can be sorted into species groups (Rings et al. 1992). These species groups can then be sent to

experts for positive identification. A series (5 to 10 individuals from the same location) of specimens are easier to work with because of the large amount of individual variation. In addition, many field-collected specimens can be quite worn (many of the scales missing) giving the specimen a lighter appearance than normal or eliminating many of the scale characteristics important for identification. The larvae bore in the root of their food plant, prairie dock (*Silphium terebinthenaceum*) and perhaps other *Silphium* species. Signs of feeding are a few brown or yellow leaves, a wilted flower stalk, and large amounts of brown frass around the base of the plant (Hessel 1954).

The BSBM (*Papaipema beeriana*) is currently listed as state Special Concern, with a total of 30 known sites in Michigan, 15 of which are classified as either good or fair viability (MNFI Biotics Conservation Database 2022). The species is currently a focal species in the Michigan Wildlife Action Plan (WAP) (Derosier et al. 2015). It is considered rare and/or local range-wide, always in close association with its primary larval food plants, blazing-stars (*Liatris* spp.). This moth produces a single brood per year, with the adults appearing in late summer/early fall. There is a general lack of understanding of the BSBM life history, distribution, relative abundance, and the potential effects on populations from climate change and pesticides. Many records for this moth



Figure 2. Blazing star Borer Moth **a)** adult perched in field near light, **b)** adult unspotted form in field, **c)** spotted form in collection, **d)** unspotted form in collection, **e)** unspotted form on sheet in field. (Photos by D. Cuthrell).

date from 50-100 years ago and come from areas that are now completely urbanized or replaced with large-scale row crop agriculture (Bess 2005, Cuthrell 1999).

The BSBM has a wingspan of 31-36 mm (1.2-1.5 in). It has two color forms, both spotted and unspotted (**Figure 2**). The unspotted form has forewings which are dull brownish, frosted with whitish scale-bases, and with scattered white scales; markings practically absent or very faint (Forbes 1954). The hind wings are a paler and more uniform gray. The spotted form has forewings similar to the unspotted form with the exception of white spots (Forbes 1954).

Two goals were listed for the BSBM in the WAP including 1) Determine statewide distribution and relative abundance, and 2) Manage three extant BSBM sites. In addition, several conservation actions were identified in the Michigan WAP including 1) Conduct habitat management for BSBM to include its larval host plant, 2) Incorporate habitat needs of BSBM into land management plans, 3) Determine if herbicides and pesticides are impacting populations, and 4) Determine effects of habitat management, and develop best management practices for BSBM.

Surveys were conducted at the Shiawassee Basin Preserve during late summer of 2022, by the Michigan Natural Features Inventory (MNFI). MNFI completed field surveys for rare *Papaipema* moths using standardized blacklighting techniques. This information will be used during planning for future land management within the project areas, and to serve as a baseline to allow for the assessment of long-term population trends. Data on any rare species occurrences were documented and entered into MNFI's Natural Heritage Database. This final report details our survey methodology, results, and management recommendations.



## Methods

During 2022, standardized blacklight surveys were conducted at three sites in the Springfield Township, Shiawassee Basin Preserve on September 21, 2022. Survey sites were selected based on known hostplant records and in conjunction with areas prioritized for habitat management by Springfield Township. A total of three separate survey locations were selected for blacklight surveys, Long Lake East, Long Lake Middle, and Long Lake West (**Figure 3**). During each survey, we collected data on *Papaipema* species abundance and richness at each site, along with associated weather and moon data on the hour and recorded this information on MNFI *Papaipema* moth survey forms (Appendix A). Surveys were conducted from 8pm to 12am at each site.

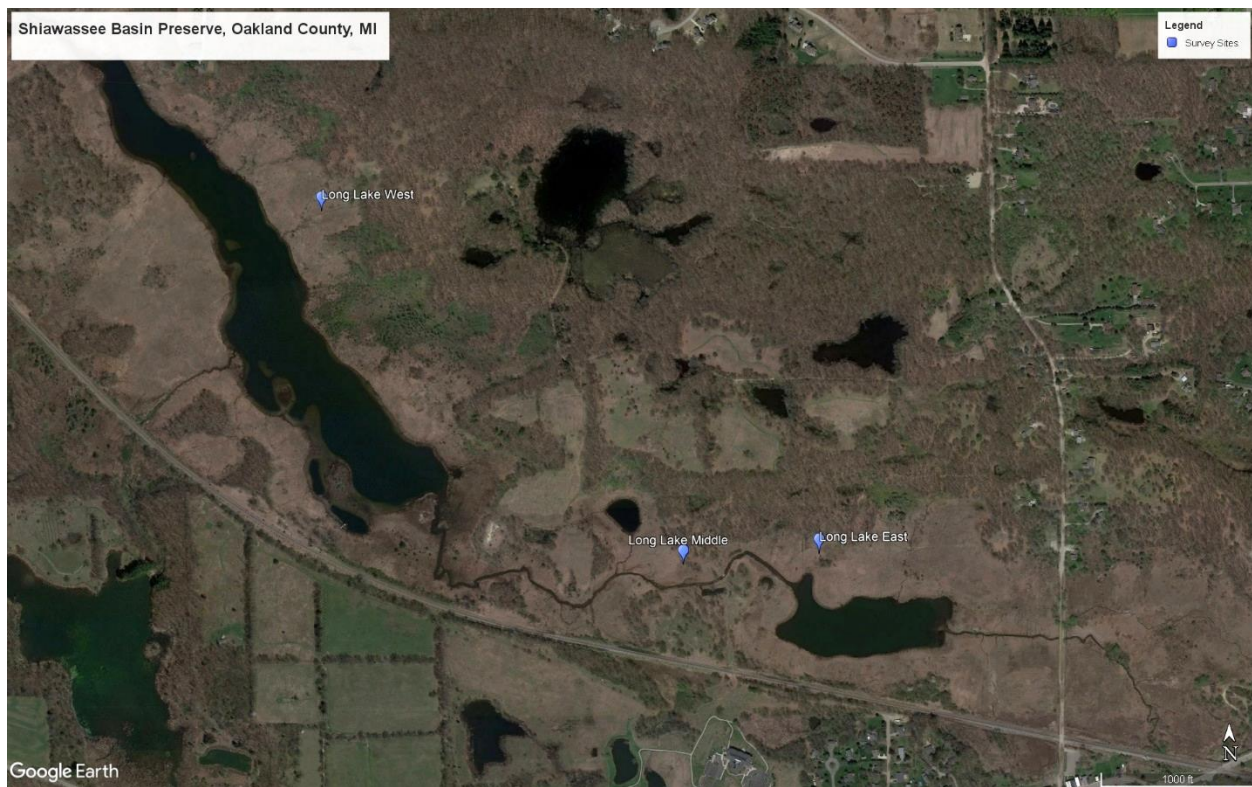


Figure 3. Location of black light stations, Shiawassee Basin Preserve, September 21, 2022.

The survey technique of blacklighting consisted of standard mercury-vapor and UV lights powered by either a portable gas generator (Honda EX1000) or a portable power station (Jackery Explorer 1000). A large white sheet was used as a collecting surface (**report cover and Figure 4**). This frame was placed in a central location amongst larval host plants and as close to the plants as possible and included plants on all sides to maximize the likelihood of collecting adults.



Figure 4. Typical blacklight station in the field at Long Lake Middle (42.7564 -83.5504) within Springfield Township, Shiawassee Basin Preserve, September 2022 (photo by L. Rowe)



# Results

Across all three sites (Long Lake East, Long Lake Middle, and Long Lake West) a total of 63 moths in the genus *Papaipema* were collected as part of these surveys. Long Lake East contained the majority of the specimens at 49, followed by Long Lake Middle (9 specimens) and Long Lake West recorded 5 *Papaipema* moths. A total of 10 different species were recorded (**Table 1**), including one of the target species, the BSBM (*Papaipema beeriana*). No SBMs (*P. silphii*) were detected as part of these surveys. Weather metrics are presented below with start temperature at 69.8 degrees Fahrenheit and ending temperature cooling to 63.8 degrees Fahrenheit (**Table 2**). Little other changes were noted with the exception of the % cloud cover decreasing from 95% to 50%.

**Table 1.** Summary of *Papaipema* collected at Springfield Township, Shiawassee Basin Preserve, September 21, 2022.

Survey Site	GPS Coordinates	<i>P. activorens</i>	<i>P. beeriana</i>	<i>P. birdii</i>	<i>P. cataphracta</i>	<i>P. eupatorii</i>	<i>P. impecuinosa</i>	<i>P. inquaesita</i>	<i>P. nepheleptena</i>	<i>P. rigida</i>	<i>P. unimoda</i>	TOTALS
Springfield – Long Lake East	42.7566 -83.5471	2	1	1	1	15	11	3	2	4	9	49
Springfield – Long Lake Middle	42.7564 -83.5504		1					3		5		9
Springfield – Long Lake West	42.7627 -83.5592		4			1						5

**Table 2.** Weather Metrics collected at Springfield Township, Shiawassee Basin Preserve, September 21, 2022.

<b>Start 8:00pm</b>	Temperature	69.8 F
	Relative Humidity	62.7%
	Average Wind Speed	2.6 mph
	% Cloud Cover	95%
	Precipitation	0
	Moon Visibility	0
	Barometric Pressure	28.84
<b>End 12:00am</b>	Temperature	63.8 F
	Relative Humidity	64%
	Average Wind Speed	2 mph
	% Cloud Cover	50%
	Precipitation	0
	Moon Visibility	0
	Barometric Pressure	28.86

## Discussion and Management Recommendations

Based on over two decades of blacklighting at several sites throughout southern Michigan by the lead author, the diversity of *Papaipema* in the fen (10 species total) at Shiawassee Basin Preserve is a good representation of what is to be expected in this habitat. Weather conditions were also appropriate for *Papaipema* surveys but not ideal, as the temperatures were above seasonal norms and not within the 50–55-degree F range, which appears to be most productive for *Papaipema* attraction (Cuthrell and Rowe, unpublished data).

The absence of the SBM could be because of the small number of prairie dock plants (less than 25) at the site. It is possible that with additional surveys, the species could be detected, but a large population is not likely to occur on the preserve or the SBM would have been detected in 2022. The larger prairie dock population southeast of the Shiawassee Basin Preserve on Oakland County property should also be surveyed for SBMs. If a population occurs there, then a reintroduction of SBM to the Shiawassee Basin Preserve could be possible. Of course, additional prescribed fires (to maintain appropriate habitat and stimulate flowering) and the supplemental seeding (or planting of plugs) of prairie dock on the preserve should be considered to increase the likelihood of any reintroductions being successful.

As for the BSBM, it was the only species that was collected from all three sites, which makes sense because all three sites contained sufficient amounts of flowering *Liatris spicata* or *L. scariosa* to support a population. It is likely that a large population of the moth occurs on the preserve and with additional surveys BSBM be found at other locations south of Long Lake in areas containing *Liatris*. Additional surveys for the BSBM are recommended during 2023 and could potentially increase the understood boundaries of the extant population at the site. MNFI has additional funding as part of a Michigan DNR funded project, and with Springfield Township approval, we would like to complete another round of blacklight surveys in mid-late September 2023.

The BSBM preferred Michigan host plant, marsh blazing-star (*Liatris spicata*) occurs in the more mesic of sites, including moist sandy plains, wet lakeplain prairies, marly roadsides and prairie fens and only rarely in drier oak, or jack pine savanna (Reznicek et al. 2021). The other species of blazing-stars which have been utilized by BSBM in Michigan (Cuthrell unpublished data) include both the rough blazing-star (*Liatris aspera*) and the northern blazing-star (*Liatris scariosa*) both of which can occur in the natural communities: mesic Lakeplain prairie, dry sand prairie, savannas, and barrens. At known sites associated prairie plants typically include big bluestem (*Andropogon gerardii*), Indian grass (*Sorghastrum nutans*), common mountain mint (*Pycnanthemum virginianum*), tall coreopsis (*Coreopsis tripteris*), Ohio goldenrod (*Solidago ohioensis*), Culver's root (*Veronicastrum virginicum*), and switch grass (*Panicum virgatum*). All these natural communities listed above would have been in a landscape with varying degrees of wildfires and are in communities that today are actively maintained by prescribed fire. For a much more in-depth discussion on prairie fens including descriptions of landscape and vegetation communities, management and conservation, and research needs, we refer you to Spieles et al. 1999 (link: [Prairie Fen \(msu.edu\)](https://www.msu.edu/prairie-fen)).

Almost all major researchers of the genus have commented on the fire sensitivity of *Papaipema* eggs and Decker (1930) highly recommends use of fire to control the stalk borer, *Papaipema nebris*, a known pest of corn. Land managers should always assume high mortality of BSBM eggs in fall, winter, or spring burn units. To protect *Papaipema* populations, retaining an adequate amount of the foodplant is required. No BSBM site should ever be entirely burned in a

single year. Foodplants spread over a large area, or in several discrete patches, reduce the risk from predators and parasitoids as compared to a comparable number of plants in a single dense patch. It is also important to monitor where, within a site the moths occur, to allow for properly configured prescribed fire units. All known sites of BSBM on managed lands should be monitored periodically and over the long term (5-15 years or more) to adequately ascertain true population trends.

Keep in mind that distribution of the BSBM population among the various burn units will likely vary from year to year, so current information is needed. Generally, decisions will be made on adult observations from the previous growing season, since this is the best approximation on the distribution of BSBM eggs within a site. To preserve the rarer *Papaipema* populations, Schweitzer (1999) recommends protecting an adequate amount of the foodplant by dividing their habitat into smaller burn units. These smaller units, once they reach maintenance levels, can be burned in rotation with 3-5 years between burns of a single unit, and adjacent units should not be burned in consecutive years.

Finally, the fact that the BSBM occurs within the Long Lake Fen portion of Shiawassee Basin Preserve (at no less than three separate locations) attests to the wise and prudent use of prescribed fire and other habitat management efforts ongoing by Springfield Township land stewards. Continue to consider this important group of invertebrates in any future land management activities.



## Acknowledgements

This project was supported through a service agreement with Springfield Township, Oakland County, Michigan. We especially thank Michael Losey, Springfield Township Natural Resources Manager, for helping with administering the contract and helping shuttle MNFI staff and sampling gear to field locations. We thank MNFI staff Dan Earl and Summer Eckhardt for helping with blacklight surveys and data collection. Dr. Brian Klatt, Ashley Adkins, Sarah Carter, Kraig Korroch (MNFI) and Deb Richardson (MSUE) provided important administrative and technical support for the project.

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## Appendix

Appendix 1. MNFI Papaipema Moth Survey Form – see below

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[illegible]

# Michigan Natural Features Inventory Papaipema Moth Survey Form

## Instructions

- 1) **Survey Site:** the name of the specific location (e.g. Brandt Rd fen)
- 2) **Managed Area:** the name of the state game area, rec area, or nature preserve (e.g. Holly SRA)
- 3) Please write times using the **24 hr clock**
- 4) Please use **decimal degrees** or **degrees/minutes/seconds**
- 5) Check the box to indicate what **units** were used for the **temperature** and **wind speed** data.
- 6) **Cloud cover** should be estimated to the nearest 10%.
- 7) **Precipitation level:** **0** = none **T** = trace **1** = light **2** = moderate **3** = heavy
- 8) **Moon visibility:** **0** = not visible at all - obscured by clouds, other features, or below the horizon  
**1** = partially obscured by clouds or other features (e.g. trees, buildings)  
**2** = completely visible
- 9) **Barometric pressure:** The barometric pressure may be recorded at the same time as other env. data, if possible, but at a minimum it should be looked up later for either the beginning or end of the overall sampling period and noted whether the pressure was rising, stable, or falling.
- 10) You may begin the survey at any time but begin the "2nd hour" interval when the next full hour starts (e.g. you begin the 1st hour at 20:30 but the "2nd hour" begins at 21:00 and every hour thereafter is on the hour). Next to each hour designation write in the start time of that period. **Note that the first and last 1 hour periods may be partial hours so be sure to record the start and end times.**
- 11) You may place a small tick or question mark in the appropriate box when a known or suspect moth is collected or observed (e.g. a possible silphim borer is collected during the "3rd hour" so a "?" is marked under P. silphii next to "3rd hour"). Specimens collected within the same 1 hour period may be kept in the same kill jar and transferred later to reclosable storage bags with a slip indicating date, location, sampling period/time, and collector(s). Specimens will be ID'd later in the lab and the total number of each species will be written in the appropriate sampling hour row/column.

**Papaipema spp. in Michigan** in order by Hodges Number (special concern, threatened, or endangered are in bold):

<b>(SC)</b> <i>cerina</i> (Grt., 1874)	<i>lysimachiae</i> Bird, 1914	<i>appassionata</i> (Harv., 1876)	<b>(SC)</b> <i>aweme</i> (Lyman, 1908)
<i>cataphracta</i> (Grt., 1864)	<i>pterisii</i> Bird, 1907	<i>furcata</i> (Sm., 1899)	<i>cerussata</i> (Grt., 1864)
<i>aerata</i> (Lyman, 1901)	<b>(SC)</b> <i>speciosissima</i> (G. & R., 1868)	<i>nebris</i> (Gn., 1852)	<b>(SC)</b> <i>sciata</i> Bird, 1908
<i>arctivorens</i> Hamp., 1910	<i>inquaesita</i> (G. & R., 1868)	<i>necopina</i> (Grt., 1876)	<i>limpida</i> (Gn., 1852)
<i>harrisii</i> (Grt., 1881)	<i>rutila</i> (Gn., 1852)	<b>(T)</b> <i>silphii</i> Bird, 1915	<b>(SC)</b> <i>beeriana</i> Bird, 1923
<i>impecuniosa</i> (Grt., 1881)	<i>baptisiae</i> (Bird, 1902)	<b>(SC)</b> <i>maritima</i> Bird, 1909	<i>unimoda</i> (Sm., 1894)
<i>verona</i> (Sm., 1899)	nr. <i>Birdi</i> (Dyar, 1908)	<i>eupatorii</i> (Lyman, 1905)	
<i>astuta</i> Bird, 1907	<i>nepheleptena</i> (Dyar, 1908)	<i>nelita</i> (Stkr., 1898)	
<i>leucostigma</i> (Harr., 1841)	<i>circumlucens</i> (Sm., 1899)	<i>rigida</i> (Grt., 1877)	

## Michigan Natural Features Inventory Papaipema Moth Survey Form