

# Blazing-star borer moth (*Papaipema beeriana*) surveys in the Lakeplain Oak Openings Region of Southeastern Michigan



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Cover: Black light surveys at Teal Road West in Petersburg State Game Area, Monroe County, MI. (Logan Rowe) Inset: photo of *Papaipema beeriana* resting on leaf (David Cuthrell).

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## Abstract

During 2020 and 2021, Michigan Natural Features Inventory partnered with The Nature Conservancy to address population level needs of the Blazing-star Borer Moth (BSBM) in the Oak Openings region. Through targeted blacklight surveys and a mark and recapture study, Michigan Natural Features Inventory completed surveys for BSBM at nine locations in southern Michigan in both 2020 and 2021. All sites surveyed had BSBM in 2020, while BSBM was only documented at five sites in 2021. The mark and recapture study provides the first field derived estimate for *Papaipema* borer moth dispersal. It is recommended that BSBM blacklight surveys continue in areas with extant populations in order to regularly monitor populations and continue with efforts to identify and protect new populations. Finally, habitat management is discussed, which will be key to the conservation of BSBM and other rare species in the Oak Openings region.

## Introduction

The Blazing-star Borer Moth (*Papaipema beeriana*; BSBM) 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 2018). The species is currently a focal species for Prairies & Savannas in the Michigan Wildlife Action Plan (WAP) (Derosier et al. 2015). It is considered rare and 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 life history, distribution, relative abundance, and the potential effects on populations from climate change and pesticides for the BSBM. Many records for this moth 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).

The BSBM has a wing-span of 31-36 mm (1.2-1.5 in). It has two color forms, both spotted and unspotted (Figure 1). 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, *lacinariae* Bird, has forewings similar to the unspotted form with the exception of white spots (Forbes 1954).



Figure 1. *Papaipema beeriana* (Lepidoptera: Noctuidae) **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. (all photos by D. Cuthrell)

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.

With these conservation factors in mind, MNFI worked collaboratively to develop the current research and stewardship proposal with our partners from The Nature Conservancy, Oak Openings Region. The objectives of this research project were to: 1) assess presence absence/relative abundance of BSBM at a minimum of 8 sites for both 2020 and 2021 using night-time backlighting, 2) conduct one round of daytime, meander surveys for butterflies and native bees on a minimum of 8 restoration sites, and 3) provide information on movement and dispersal capabilities of BSBM through the use of mark and recapture surveys. This report addresses objectives 1 and 3 only. Objective 2 was started in 2021 and will be completed by further work in 2022 during next year's phase 2 research.

## Methods

### *Papaipema* blacklight surveys

During 2020-2021, standardized blacklight surveys were conducted at sites in the Oak Openings Region of southeast Michigan during the month of September. Survey sites were selected based on known BSBM records within the MNFI Biotics Conservation Database (MNFI 2020) and in conjunction with areas prioritized for habitat management by The Nature Conservancy. A total of 9 separate survey locations were selected for BSBM surveys (Table 1, Figure 2). During each survey event in 2020 and 2021, 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 data forms (Appendix A).

Moth surveys utilized the technique of backlighting, which consisted of standard mercury-vapor and UV lights powered by a portable generator. A large white sheet was used as a collecting surface (report cover). This frame was placed in a central location with larval host plants on all sides to maximize the likelihood of collecting adults.

Table 1. Blazing-star borer moth (BSBM) site name, date of survey, start and end time, and Latitude and Longitude for study sites located in southeast Michigan.

**2020**

<b>County</b>	<b>Site Name</b>	<b>Date</b>	<b>Survey Start</b>	<b>Survey End</b>	<b>Lat</b>	<b>Long</b>
Wayne	ITC East	09/21/2020	7:30pm	12:00am	42.1063300	-83.4548000
Monroe	LuLu Road SW	06/16/2020	8:00pm	12:00am	41.8995300	-83.6859000
Monroe	Teal Road East	09/15/2020	8:00pm	12:00am	41.8793800	-83.6941300
Monroe	Teal Road SW	09/23/2020	7:40pm	10:30pm	41.8745400	-83.6945100
Monroe	LuLu Road SE	09/16/2020	8:00pm	12:00am	41.8794050	-83.6843375
Wayne	King Road South	09/22/2020	7:45pm	12:00am	42.1519030	-83.2748732
Monroe	Teal Road West	09/15/2020	8:00pm	12:00am	41.8782644	-83.6971558
Wayne	Sibley Road West Prairie	09/22/2021	7:40pm	12:00am	42.1394300	-83.2907400
Wayne	Arkona Road North	09/21/2020	7:45pm	12:00am	42.1027467	-83.4675909

**2021**

<b>County</b>	<b>Site Name</b>	<b>Date</b>	<b>Survey Start</b>	<b>Survey End</b>	<b>Lat</b>	<b>Long</b>
Wayne	ITC East	09/20/2021	8:00pm	12:30am	42.1063900	-83.4548100
Monroe	LuLu Road SW	09/16/2021	8:00pm	12:00am	41.8795500	-83.6859900
Monroe	Teal Road East	09/15/2021	8:00pm	12:00am	41.8793400	-83.6942000
Monroe	Teal Road SW	09/28/2021	7:35pm	12:00am	41.8745400	-83.6945100
Monroe	LuLu Road SE	09/16/2021	8:00pm	12:00am	41.8797093	-83.6844881
Wayne	King Road South	09/27/2021	8:00pm	12:00am	42.1518410	-83.2753690
Monroe	Teal Road West	09/15/2021	8:00pm	12:00am	41.8780842	-83.6973302
Wayne	Sibley Road West Prairie	09/27/2021	7:45pm	12:30am	42.1394300	-83.2907400
Wayne	Arkona Road North	09/20/2021	8:00pm	12:00am	42.1025560	-83.4672690

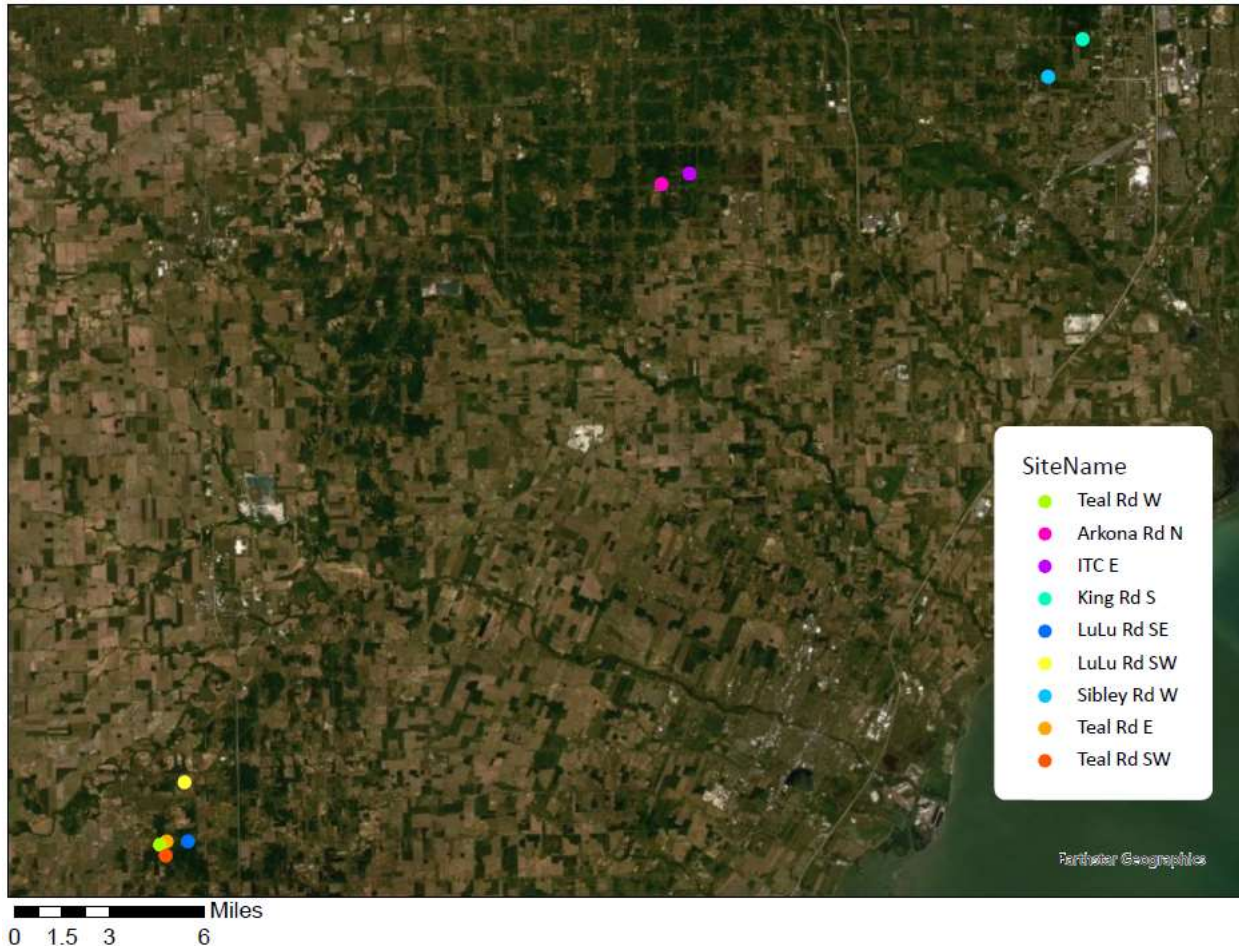


Figure 2. Southeast Michigan survey locations for *Papaipema beeriana* in 2020 and 2021.

### Mark and recapture study

In addition to community-based surveys, MNFI conducted a mark and recapture study during 2020-2021 to determine the proportion of *Papaipema* spp. released that would return to blacklight set up from 25, 50, 100, and 200ft distances. This study was conducted simultaneously with community-based surveys, and used three colors of florescent powder (blue, yellow, red) (Figure 3). When a *Papaipema* moth first flew into the blacklight sheet, it was captured, placed in a marking vial for approximately 25 seconds, and released at either 25, 50, 100, or 200 ft away from blacklight set up. In 2020, the distances 50, 100, and 200ft were prioritized, but release distance was reduced to 25, 50, and 100ft due to zero captures at 200ft.





Figure 3. Marked Blazing-star borer moth released from 25ft at Teal Rd East that was recaptured at the blacklight set-up. Blue, yellow, and red florescent powders used to conduct mark and recapture study in 2020-2021 (inset).



Figure 4. Example of blacklight set-up used for *Papaipema* surveys in a lakeplain oak-opening in Wayne County, Mi.

## Results

### Papaipema blacklight surveys

A total of 152 and 60 *Papaipema* moths were documented during blacklight surveys in lakeplain oak-openings in 2020 and 2021, respectively. In 2020, 49 BSBM occurrences were recorded, and each survey site had at least 1 BSBM. In 2021, a total of 11 BSBM occurrences were recorded, and no BSB were documented at Arkona Rd North, ITC East, LuLu Road SE, and Sibley Road West Prairie (Table 2).

Table 2. *Papaipema* borer moths observed during blacklight surveys in 2020 and 2021 in lakeplain oak-openings in southeastern Michigan.

2020	Species													
	<i>P. baptisiae</i>	<i>P. beeriana</i>	<i>P. birdi</i>	<i>P. cataphracta</i>	<i>P. cerusata</i>	<i>P. furcata</i>	<i>P. impecuniosa</i>	<i>P. inquaesita</i>	<i>P. pterisii</i>	<i>P. rigida</i>	<i>P. sciata</i>	<i>P. speciosissima</i>	<i>P. unimoda</i>	Grand Total
Arkona Road North	1	5	0	0	0	1	0	3	2	0	0	0	0	12
ITC East	2	2	0	3	0	5	0	2	1	0	0	0	1	16
King Road South	0	1	0	0	0	0	0	5	0	0	0	2	0	8
LuLu Road SE	0	5	0	0	1	0	0	4	7	0	0	0	0	17
LuLu Road SW	1	2	1	0	0	1	0	5	6	0	0	0	0	16
Sibley Road West Prairie	0	9	9	0	2	1	1	4	0	0	0	0	0	26
Teal Road East	2	7	0	0	0	1	0	5	4	1	1	0	0	21
Teal Road SW	1	11	1	0	0	0	0	0	6	1	0	0	0	20
Teal Road West	1	7	0	0	1	0	0	3	4	0	0	0	0	16
<b>Grand Total</b>	<b>8</b>	<b>49</b>	<b>11</b>	<b>3</b>	<b>4</b>	<b>9</b>	<b>1</b>	<b>31</b>	<b>30</b>	<b>2</b>	<b>1</b>	<b>2</b>	<b>1</b>	<b>152</b>

2021	Species											Grand Total	
	<i>P. activorens</i>	<i>P. baptisiae</i>	<i>P. beeriana</i>	<i>P. birdi</i>	<i>P. cataphracta</i>	<i>P. cerusata</i>	<i>P. furcata</i>	<i>P. impecuniosa</i>	<i>P. inquaesita</i>	<i>P. necopina</i>	<i>P. pterisii</i>		<i>P. sciata</i>
Arkona Road North	0	0	0	0	0	0	0	0	0	0	1	0	1
ITC East	0	0	0	0	4	0	0	0	3	0	0	0	7
King Road South	0	1	1	0	2	0	0	0	0	0	0	0	4
LuLu Road SE	2	0	0	0	0	0	0	0	4	0	0	0	6
LuLu Road SW	0	0	2	0	0	0	0	0	2	0	0	0	4
Sibley Road West Prairie	0	0	0	3	0	1	0	1	1	0	0	0	6
Teal Road East	4	0	6	0	0	0	0	0	5	1	7	0	23
Teal Road SW	0	0	1	0	0	0	0	0	0	0	0	0	1
Teal Road West	1	0	1	0	0	0	1	0	1	0	2	2	8
<b>Grand Total</b>	<b>7</b>	<b>1</b>	<b>11</b>	<b>3</b>	<b>6</b>	<b>1</b>	<b>1</b>	<b>1</b>	<b>16</b>	<b>1</b>	<b>10</b>	<b>2</b>	<b>60</b>

## Mark and recapture study

A total of 69 *Papaipema* borer moths were used for this study in 2020-2021 (Table 3.a). Seventeen of these moths were *P. ptersii*, 16 were *P. inquaesita*, and 14 were *P. beeriana* (Table 3.b). The proportion of moths that returned to the blacklight sheet was greatest at a release distance of 25 ft, with a sharp decline in returns at 50 and 100 ft, and no returns at 200 ft (Figure 5).

Table 3.a) The total number of *Papaipema* borer moths released and recaptured from 25, 50, 100, and 200ft in 2020 and 2021. 2.b) The number of *Papaipema* borer moths of each species released and recaptured in 2021 and 2021.

a.				b.			
<u>Released</u>							
Distance (ft)	2020	2021	Total	<u>Recapture status</u>			
				Species	no	yes	Total
25	6	11	17	<i>P. activorens</i>	3	1	4
50	17	8	25	<i>P. baptisae</i>	0	1	1
100	13	7	20	<i>P. beeriana</i>	14	3	17
200	7	0	7	<i>P. cataphracta</i>	1	1	2
<b>Total</b>	<b>43</b>	<b>26</b>	<b>69</b>	<i>P. cerussata</i>	2	0	2
				<i>P. furcata</i>	0	1	1
				<i>P. inquaesita</i>	16	4	20
				<i>P. ptersii</i>	17	3	20
				<i>P. rigida</i>	1	0	1
				<i>P. rutila</i>	0	1	1
				<b>Total</b>	<b>54</b>	<b>15</b>	<b>69</b>

<u>Recaptured</u>			
Distance (ft)	2020	2021	Total
25	3	5	8
50	5	1	6
100	1	0	1
200	0	0	0
<b>Total</b>	<b>9</b>	<b>6</b>	<b>15</b>

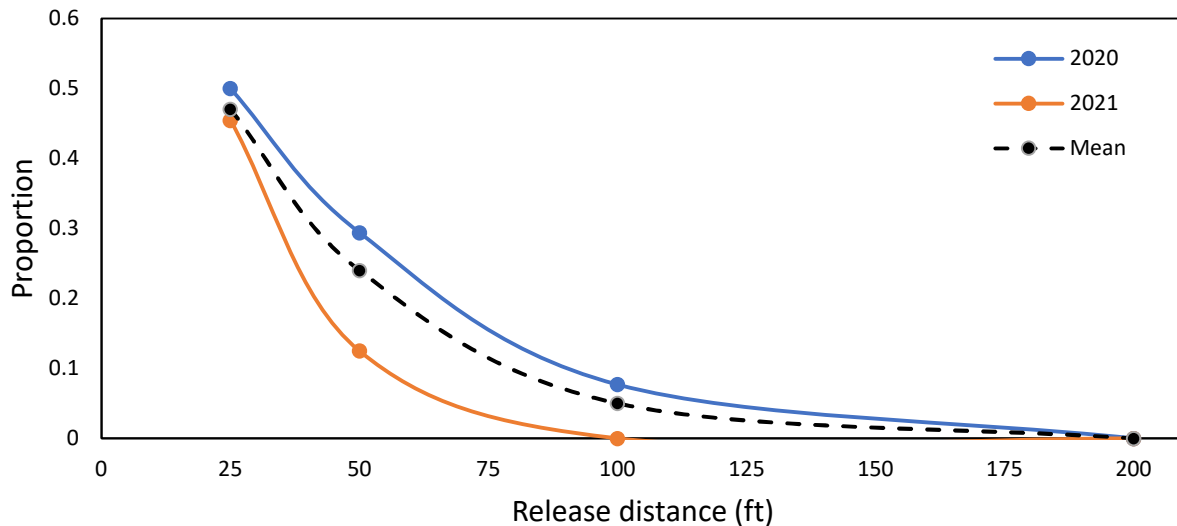


Figure 5. Proportion of *Papaipema* species returning to blacklight sheet after release from 25, 50, 100 and 200 ft distances in 2020 and 2021.

## Discussion

This project successfully confirmed occupancy of BSBM at 8 locations (i.e. element occurrence (EO) records in the MNFI Biotics Conservation database) and we discovered one new location (Sibley Road West Prairie). In addition, we located two other pockets of occupied BSBM habitat within Petersburg State Game Area (Teal Road East and Teal Road SW) (Table 4). Furthermore, we updated the EO for the state special concern Culver’s root borer moth (*Papaipema sciata*) from the Petersburg State Game Area, locating 1 adult at Teal Road East site in 2020 and 2 adults at the Teal Road West site in 2021, as well as the state special concern Regal fern borer moth (*Papaipema speciosissima*) from the King Rd south site.

Table 4. Sites with *Papaipema beeriana*, associated MNFI Biotics EO data including first and last observations and a site and EO rank (AB = excellent or good estimated viability BC = Good or fair estimated viability CD = Fair or poor estimated viability and BD = Good, fair, or poor estimated viability).

Site Name	MNFI Biotics	First Obs	Last Obs	EO Rank
Arkona Road North	EOID 20089	09/14/2014	09/20/2021	BD
ITC East	EOID 22145	09/15/2012	09/21/2020	CD
King Road South	EOID 20090	09/12/2014	09/27/2021	BC
Sibley Road West Prairie	EOID 23892	09/22/2020	09/22/2020	BC
LuLu Road SE	EOID 12949	09/23/1968	09/16/2020	AB
LuLu Road SW	EOID 12949	09/23/1968	09/15/2021	AB
Teal Road East	EOID 12949	09/15/2020	09/15/2021	AB
Teal Road West	EOID 12949	09/10/2013	09/15/2021	AB
Teal Road SW	EOID 12949	09/23/2020	09/28/2021	AB

In 2020, blacklight surveys documented BSBM at each of the 9 survey locations, while in 2021, only 5 sites produced BSBM during these surveys. This decline in the number of sites where BSBM was detected needs to be evaluated with caution, since the overall numbers for all *Papaipema* moths was down in 2021 compared to 2020. Insect populations can fluctuate greatly from year to year and therefore, without long-term data sets, it’s difficult to determine overall population trends. Furthermore, the 2021 season had unusually high night-time low temperatures when compared to 2020, which could also have had an impact on adult *Papaipema* moth flight activity. Even common species of *Papaipema* (i.e., *inquaesita*, *ptersii*) numbers were markedly lower in 2021. Only future years of blacklight surveys will ascertain site-level population trends. We recommend blacklight surveys of regular intervals to continue monitoring the status of the populations in the oak-openings region.

It’s understood that populations of the BSBM can be difficult to detect at many sites due to their lack of mobility, short adult life cycle, and unpredictable weather conditions during their typical flight times. For some Michigan sites, we have only detected presence of BSBM after multiple attempts of black lighting,

likely due to a smaller population size and decreased mobility. For these reasons, it is necessary for BSBM surveys to: 1) target the best time of year (when adults are most abundant); 2) target places within each site where there is an abundance/density of larval foodplants; 3) conduct surveys in weather conditions when the moths are expected to be most active; and 4) be repeated sufficient times to ensure that BSBM is not overlooked.

There's much to gain by incorporating under-utilized survey methodologies for a local and uncommon species like BSBM. In this project we incorporated a mark and recapture study to better understand *Papaipema* mobility within a habitat, which we propose has implications for understanding BSBM dispersal. Blazing-star borer moth dispersal abilities have been estimated in the literature and range from 0.5-5 miles (Bess 2005), but no efforts (to our knowledge) have tried to determine actual distances BSBM can disperse in a night of flight activity and over the course of their adult lifetime. We offer the first mark-recapture data set for *Papaipema* moths aimed specifically to address this question. From our results we have extrapolated the estimated distance a BSBM could possibly travel over the course of its adulthood. The results from the average time for the 25 ft distance and 100 ft distance bins are included below to arrive at a hypothetical total dispersal distance by an adult BSBM:

**25 feet in 15 minutes** = 100 ft/hr. and during six-hour night flight period = 600 ft/night x 10 nights of adult flight activity = 6,000 ft or 1.13 miles (1.82km).

**100 feet in 38 minutes** = 158 ft/hr. and during a six-hour night flight period = 948 ft/night x 10 nights of adult flight activity = 9,480 ft = 1.8 miles (2.88km).

For comparison, the recommended separation distance according to the Natural Heritage Methodology between prairie *Papaipema* EOs is 2 km (for unsuitable habitat between EOs) and 5 km (with suitable habitat in between). We feel that our BSBM dispersal estimates are in-line with both the NatureServe and Bess dispersal distance estimates.

## Management implications

The BSBM occurs with its larval host plant, blazing-star (*Liatris* spp.). The BSBM preferred host plant, marsh blazing-star (*Liatris spicata*) occurs in the more mesic of sites, including moist sandy plains, wet lakeplain prairies, marly roadsides and fields 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 dry sand prairie remnants, 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*).

Almost all major workers on the genus have commented on the fire sensitivity of *Papaipema* eggs and Decker (1930) highly recommends use of fire to control the pest species *P. nebris*. 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 and to divide habitat into smaller burn units is recommended. 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. Most, if not all, of these parasitoids are native species, and in many instances they do not need to be controlled. 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.



Figure 6. On the left Lu Lu Road SW – 2014 after widespread mowing of lakeplain prairie habitat. On the right, Lu Lu Road SW - 2020 after a lapse in management at the same location.

Ongoing restoration of lakeplain prairie habitat within these 9 sites should continue and need to be incorporated into site management plans. The rapid succession of habitat to woody vegetation following management will need to be set back every few years. We can see from Figure 4 that in only 5-10 years a site can become severely overgrown, especially if the site contains non-native aggressive species such as common buckthorn, autumn olive, honeysuckle or phragmites. However, even native woody species such as dogwoods and willows can crowd out native prairie forbs, thus it is recommended that all sites (and habitat patches within sites) with BSBM should be monitored for encroachment. Mowing and prescribed fire are the best methods for helping set back woody plant succession. For a very detailed report on prairie restoration concepts for Petersburg State Game Area, including a good background on the historical landscape context, natural community descriptions, and very detailed management considerations, we refer you to the following document: [2018-04 Prairie Restoration concepts for Petersburg State Game Area, JML Jan 2018.pdf](#) (Lincoln, 2018).

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.

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Appendix A

## Michigan Natural Features Inventory Papaipema Moth Survey Form

Survey Site:	Date ____ - ____ - ____	Managed Area:
Surveyors:	overall start time :	
	overall end time :	
GPS coordinates of blacklight setup		Waypoint or file name:

Start time of the period	Scientific Name												Environmental Data						
	temperature [C] [F]	relative humidity - %	wind speed - max [km/h] [mph]	wind speed - avg [km/h] [mph]	cloud cover - %	precipitation level	moon visibility	barometric pressure [kPa] [inHg]											
<b>1st hour</b> :																			
<b>2nd hour</b> :																			
<b>3rd hour</b> :																			
<b>4th hour</b> :																			
<b>5th hour</b> :																			
<b>6th hour</b> :																			
<b>7th hour</b> :																			
<b>TOTALS</b>																			

Dominant Plant Species	Notes/Comments/Diagrams

## 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 1hour 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)	