Rare Insect Surveys and Pollinator Plot Design at Camp Grayling, Michigan

Prepared By:

David Cuthrell, Logan Rowe, and Courtney Ross
Michigan Natural Features Inventory
Michigan State University Extension
P.O. Box 30444
Lansing, MI 48909-7944

Prepared For:

Matt Kleitch and Cullen Haesler
Camp Grayling Maneuver Training Center, Environmental Office
Building 100A, Grayling, MI 49739

12/30/2021

MNFI Report No. 2021-32

Suggested Citation:

Cuthrell, D.L., L.M. Rowe, and C. Ross. 2021. Camp Grayling Rare Insect Surveys and Pollinator Plots. Michigan Natural Features Inventory, Report No. 2021-32, Lansing, MI. 21 pp. + appendix

Cover: Dry sand prairie vegetation in Polygon 23 which is habitat for Dusted skipper (inset). Photos by David Cuthrell

Contents

List of Tables

List of Figures

Executive Summary

Military installations, such as The Camp Grayling Joint Maneuver Training Center (CGJMTC), serve as refuges for numerous at-risk wildlife species, including threatened and endangered species and multiple rare insect species. With many insect species continuing to decline, having current information on the status of insect species of conservation concern is vital to facilitating proactive habitat and species management and minimizing possible conflicts between conservation measures and military training activities. The Michigan Natural Features Inventory (MNFI) partnered with the Department of Military and Veterans Affairs (DMVA) to gather baseline population data on at-risk insect species currently occupying habitats at CGJMTC, and to develop a site-specific seed mix to be used in ongoing insect conservation efforts at CGJMTC.

The MNFI worked with DMVA to plan and implement rare insect surveys at Camp Grayling, focusing on insect species of greatest conservation need (SGCN) found in sand prairie or pine barrens habitat: Dusted skipper (*Atrytonopsis hianna*, Army species at risk, state special concern), Cobweb skipper (*Hesperia metea*, state special concern), Blazing star borer moth (*Papaipema beeriana*, state special concern), and Secretive locust (*Appalachia arcana*, Army species at risk, state special concern). Secretive locust is endemic to Michigan with most occurrences isolated in the Grayling Outwash Plains ecoregion of the state. In addition, MNFI assisted the DMVA in planning for pollinator plots within the Cantonment area of Camp Grayling by identifying sites for potential pollinator enhancement plots and developing a site-specific native seed mix for use in pollinator plots.

In 2021, MNFI completed transect based meander surveys in 37 polygons for Dusted and Cobweb skippers, and 14 polygons for Secretive locust. Through these surveys, we recorded 460 observations of Dusted skipper, 45 observations of Cobweb skipper, and 133 observations of Secretive locust. All species occurrence and population data has been incorporated into MNFI's Natural Heritage Database.

In this report, we provide an overview of insect survey methodology and results, site-specific seeding recommendations to support species of high conservation concern, and additional recommendations for conserving populations of target species in occupied habitats. The surveys conducted in 2021 provide a baseline species occurrence dataset, necessary for evaluating trends in insect distributions and relative abundances as surveys are implemented in the future.

Introduction

Camp Grayling Joint Maneuver Training Center (CGJMTC) is an approximately 147,000-acre military installation used for military training that consists of a mosaic of lands owned by the Michigan Department of Military and Veterans Affairs (DMVA) and Michigan Department of Natural Resources (DNR). The facility provides a variety of habitats for both endemic and imperiled insects, including Dusted skipper (*Atrytonopsis hianna*, Army species at risk, state special concern), Cobweb skipper (*Hesperia metea*, state special concern), Blazing star borer moth (*Papaipema beeriana*, state special concern), and Secretive locust (*Appalachia arcana*, Army species at risk, state special concern, Michigan endemic). Within CGJMTC, rare insect species rely heavily on Pine barrens (G3- Vulnerable, S2- Imperiled), as well as other natural communities such as: Bog (G3G4, S4- Apparently secure) and Dry sand prairie (G3, S2). As more species become a conservation concern, it is increasingly important for land managers at military facilities to document the species that currently exist on their lands and, through proactive management, avoid potential conflicts between conservation measures and military training. Baseline surveys are a critical first step in making informed management decisions. When collected repeatedly over multiple years, population data can inform population changes while simultaneously helping installations meet regulatory requirements.

Camp Grayling populations of Dusted and Cobweb skippers and Secretive locust are believed to be large, and therefore extremely important to the overall global health of these species. Furthermore, secretive locust is endemic to Michigan with most occurrences isolated in the Grayling Outwash Plains ecoregion, amplifying the critical role Camp Grayling has in Secretive locust conservation. However, population demographics in the area and trends for these species aren't fully understood, limiting conservation effectiveness in habitats with extant populations. Therefore, it is first necessary to identify stable populations and high-quality habitats to prioritize conservation efforts and to build a baseline for future survey work and population assessments.

The Michigan Natural Features Inventory (MNFI), a program of Michigan State University Extension (MSUE), worked with the DMVA to design an insect survey program to gather information on insect species of high conservation concern. The program will provide baseline data on at-risk species using CGJMTC lands and a mechanism to monitor changes in relative abundance and distributions over time. The primary objectives of this project were to 1) gather baseline data on the size and demographics of the rare insect populations within (and adjacent to) CGJMTC, 2) Identify potential areas on the base for pollinator plots, and 3) develop a native seed mix along with recommendations for incorporating managed pollinator habitat into CGJMTC. Ultimately, these data will be incorporated into the CGJMTC Integrated Natural Resources Management Plan (INRMP) and used to provide guidelines for species management. In this report, we describe the rare insect surveys and methods used, the methods for identifying potential pollinator demonstration plots, and summarize the results of the 2021 surveys.

Figure 1. Pine barrens (top) and bog (bottom) habitats and associated rare insect species Dusted skipper (top left), Cobweb skipper (top right), and Secretive locust (bottom left) found at Camp Grayling in 2021.

Methods

Site selection for rare species surveys

Existing Element Occurrence (EO) records in the Natural Heritage Database were extracted as .kmz files and examined in Google Earth Pro (Earth v. 7.3.4). Using the best available aerial imagery, we compared EO boundaries with adjacent landscapes within CGJMTC to identify potential habitats containing populations of target insect species: Dusted skipper, Cobweb skipper, Blazing star borer moth, and Secretive locust. In a few instances, survey locations were direct extensions of existing EOs, while other locations were newly identified and not connected to existing EOs. For the skippers and borer moth, we focused our selection on landscapes identified as 'pine barrens', 'oak pine barrens', or 'dry sand prairie'. For Secretive locust, we focused selection on landscapes identified as 'bog' and 'pine barrens'. All potential survey locations were assessed by MNFI species experts to determine the final survey locations for each target species. Using the 'create polygon' tool in Google Earth Pro, we created polygons for final survey sites for each species and exported the spatial data as a .kmz file. Due to the overlap in habitat use, Cobweb and Dusted skipper polygons were the same for both species. Using this methodology, we identified a total of 43 potential survey polygons (31 on CGJMTC and 12 on adjacent MDNR state forest lands) for Dusted and Cobweb skipper, and 25 potential survey polygons (21 on CGJMT and 4 on adjacent state forest lands) for Secretive locust.

Imperiled butterfly meander surveys

Surveys for Cobweb and Dusted skipper were completed between May 24th and June 10th, 2021. To survey for these species, we conducted visual meander surveys through suitable areas of each survey polygon containing both species larval hostplant (bluestem grasses, *Andropogon* sp.). Meander surveys consisted of 1-2 people walking along equally spaced transects (~5m) throughout the polygon and recording any occurrence of target species using a handheld GPS device. As much as possible, we limited surveys to periods when the temperature was above 15° C (60° F), there was no rain, and when winds were ≤ 25 km/h (15 mph). If temperatures were 15 - 21° C (60 - 70° F), surveys were only conducted when cloud cover was ≤ 50% of the sky. There was no cloud cover restriction if the temperature was above 21° C (70° F).

Rare grasshopper meander surveys

Surveys for Secretive locust were completed between August 18th and September 9th, 2021. To survey for this species, we conducted visual meander surveys through suitable areas of each survey polygon, which were generally classified as 'bog' or 'pine barrens'. Rather than walking transects, meander surveys for Secretive locust consisted of scanning the bases of jack pine (*Pinus banksiana*) above the vegetation line, which is usually dominated by leatherleaf (*Chamaedaphne calyculata*) and/or black huckleberry (*Gaylussacia baccata*). Using binoculars, surveyors would start at the base of jack pine and slowly scan upwards until the entire base of tree was thoroughly surveyed. Because adults use the thermoregulatory behavior of sunbathing on the trunks of suitable trees, we focused our surveys on the sunny side of each surveyed tree. In addition to presence/absence data, we collected additional data on individual sex, height about vegetation line (inches), species of tree the individual was observed on, and the species of dominant vegetation below individual occurrence. As much as possible, we limited surveys to periods when the temperature was above 15° C (60° F), there was no rain, skies were mostly clear, and when winds were ≤ 25 km/h (15 mph).

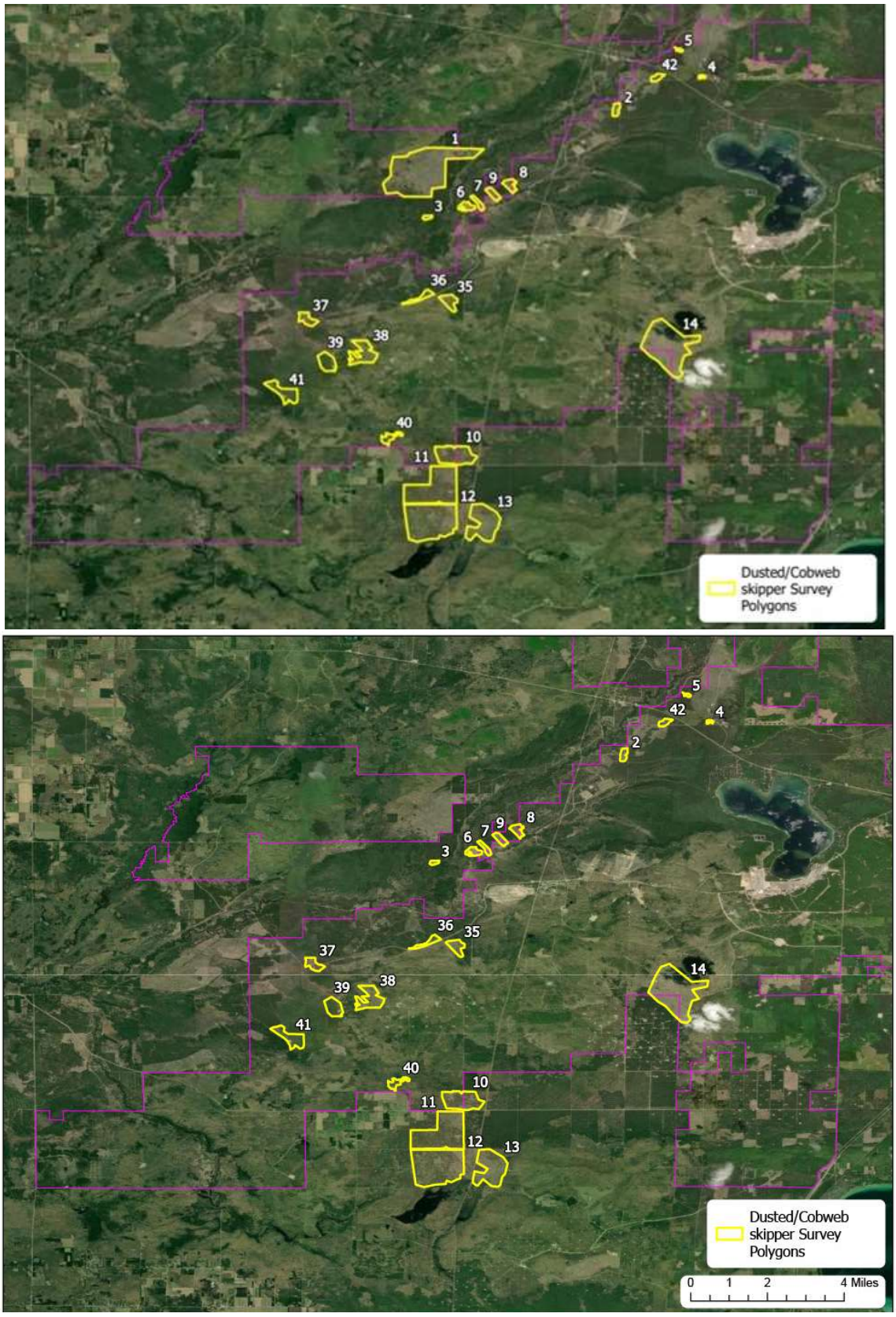

Figure 2. Survey polygons for Dusted and Cobweb skipper in the north (top) and south (bottom) sections of Camp Grayling. Camp boundaries are shown in purple.

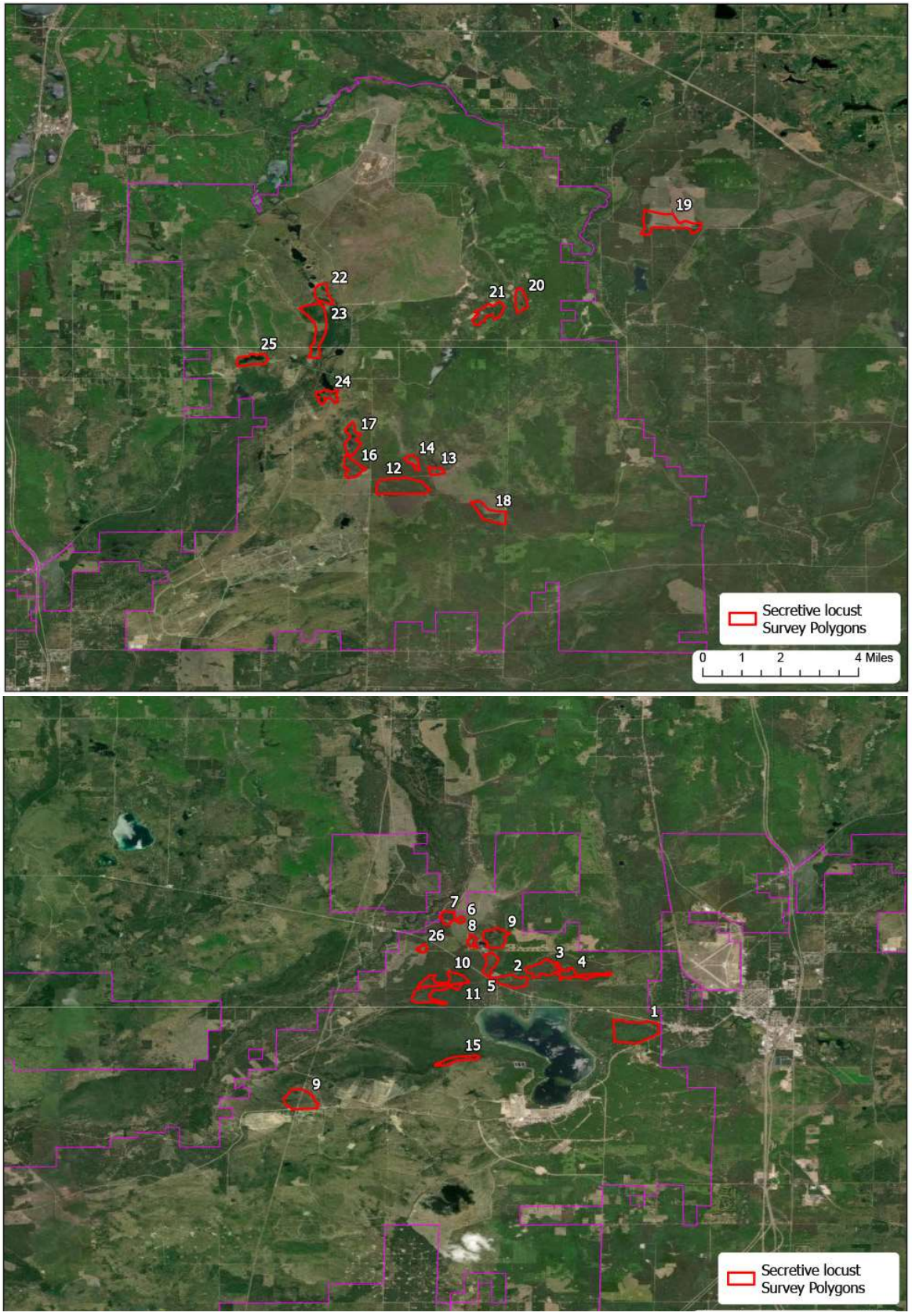

Figure 3. Survey polygons for Secretive locust in the north (top) and south (bottom) sections of Camp Grayling. Camp boundaries are shown in purple.

Blazing star borer moth surveys

Surveys for Blazing star borer moth were conducted within Camp Grayling on the night of September 8th, 2021. Two standardized blacklight survey stations were set-up approximately 100m from each other to assess the *Papaipema beeriana* population at a single location with adequate host plant (Blazing star, *Liatris aspera*) (station 1: 44.6847, -84.8368; station 2: 44.6854, -84.8362). Each station consisted of standard mercury-vapor and UV lights powered by a portable generator. A large white sheet was used as a collecting surface. This frame was placed in a central location with larval host plants on all sides to maximize the likelihood of collecting adults. We collected data on *Papaipema* species abundance and richness at this site, along with associated weather and moon data on the hour and recorded this information on data forms (Appendix B).

Figure 4. Example of blacklight set-up used for Blazing star borer moth surveys in Camp Grayling, Crawford County, MI.

Pollinator plot study

In addition to rare insect surveys, MNFI conducted an assessment of the cantonment area at CGJMTC to identify locations for pollinator demonstration plots and vegetation enhancements using a tailored pollinator supportive seed mix. On May 27th, 2021, MNFI scientists conducted a vehicle survey of the entire cantonment area to locate vacant, or otherwise unused plots of land capable of supporting pollinator habitat. Site selection prioritized the following metrics: currently unoccupied, limited anthropogenic disturbance, limited invasive pressure, and ease of access.

Once plots were identified, a native wildflower and grass seed mix was designed to provide forage resources for the pollinator community, with a focus on including specific plant species that support at-

risk pollinators (Dusted and Cobweb skipper, bumble bees). We used the Xerces Society for Invertebrate Conservation seed mix design and calculator tool to develop a site-specific seed mix for the identified locations within the cantonment area at CGJMTC (Xerces, 2020).

Data contribution to the Natural Heritage Database

Rare species occurrence data from Camp Grayling was added to Michigan's Natural Heritage Database in October 2021. Independent species occurrences, or occurrence clusters of the same species were added to the database as source features (SF). Depending on the proximity of SFs to adjacent SFs of the same species, naturally occurring populations occupying the landscapes at Camp Grayling were described in the database as element occurrences (EO). Each species was assessed independently, creating species specific spatial datasets for Dusted skippers, Cobweb skippers, Blazing star borer moths, and Secretive locusts.

Results

Imperiled butterfly meander surveys

We surveyed a total of 37 polygons at Camp Grayling (and vicinity) for Dusted and Cobweb skippers in 2021. Of those, we identified 21 polygons with occurrences of Dusted skipper (57% of polygons) and 9 polygons with occurrences of Cobweb skipper (24% of polygons).

Dusted skipper

A total of 460 observations of Dusted skippers were recorded during surveys at Camp Grayling (and vicinity) in 2021. Of these observations, 236 occurred on the base, 216 occurred off of the base, and 5 observations were made in polygons that intersect base boundary lines. In occupied polygons, our surveys produced an average of 22 Dusted skippers per polygon. However, the number of Dusted skippers per occupied polygon ranged from 1 skipper (polygons 10, 25, and 34) to 135 skippers (Polygon 1). In addition, we located a single population of Dusted skipper within the cantonment area of CGJMTC (SF 68212). In total, we identified 22 new source features representing Dusted skipper populations associated with 10 element occurrences within or near Camp Grayling (Table 1).

Table 1. Each Camp Grayling survey location for Dusted skipper is shown with associated survey date, occurrences, and heritage database updates for source features and element occurrences. Polygons that are within CGJMTC are highlighted with an *. Polygons that are partially on CGJMTC are highlighted with **.

Polygon ID	Survey Site Name	Survey Date(s)	# of Dusted Skipper Observed	Source Feature ID(s)	Element Occurrence ID(s)
1*	Riverview Road SE	5/29/2021, 6/7/2021, 6/10/2021	135	SF 68188, 68757	EO 14528
2*	Arrowhead Camp Road SE	05/29/2021	0	No targets found	NA
3	Yellow Tree Road	05/29/2021	0	No targets found	NA
4*	Howes Lake SW	06/01/2021	0	No targets found	NA
5*	Manistee River Road	06/02/2021	4	SF 61055	EO 14532

Polygon ID	Survey Site Name	Survey Date(s)	# of Dusted Skipper Observed	Source Feature ID(s)	Element Occurrence ID(s)
6	Portage Creek Road	06/07/2021	0	No targets found	NA
7**	Portage Creek SW	06/07/2021	5	SF 68214	EO 14528
8**	Portage Creek NE	06/07/2021	0	No targets found	NA
9*	Portage Creek Central	06/07/2021	5	SF 68215	EO 14528
10*	Maple Road	05/25/2021 06/02/2021	1	SF 68172	EO 920
11	Fletcher Road	05/25/2021	6	SF 68173	EO 920
12	Grass Lake	05/25/2021, 06/02/2021	12	SF 68174	EO 920
13	Spike Horn Road	06/01/2021	39	SF 68175	EO 920
15	Old 27 south	05/23/2021	0	No targets found	NA
16	Spy Trail	05/30/2021, 05/31/21, 09/09/2021	102	SF 68189	EO 8718
17	Northland Drive	05/30/2021	23	SF 68208	EO 8718
18*	N Thendara Road South	06/02/2021, 06/03/2021	7	SF 68178, 68184	EO 14529
19*	Frog Lakes West	06/02/2021, 06/03/2021	5	SF 68179	EO 14529
20*	E Karen Lake Road	06/02/2021	0	No targets found	NA
21*	Section 22	06/02/2021	0	No targets found	NA
22*	Bucks East-West Truck Trail	06/02/2021	37	SF 68177	EO 24423
23*	W Jones Lake Road	06/02/2021, 06/03/2021	26	SF 68180, 68186	EO 14529
24*	N Wakely Bridge Road	05/28/2021	0	No targets found	NA
25*	Mastej Drive	05/30/2021	1	SF 68209	EO 14529
26*	County Road 612	05/30/2021	5	SF 68210	EO 14529
27*	Grayling HS Trail	06/08/2021	0	No targets found	NA
28	Old 27 north	05/23/2021	0	No targets found	NA
29*	The Ford Road East	06/08/2021	3	SF 68187	EO 24424
30*	The Ford Road West	06/08/2021	0	No targets found	NA
31*	Oates Road	06/02/2021	0	No targets found	NA
32	Highlander Trail	06/02/2021, 06/04/2021	33	SF 68181	EO 206
33	N Big Creek Road	06/04/2021	0	No targets found	NA

Polygon ID	Survey Site Name	Survey Date(s)	# of Dusted Skipper Observed	Source Feature ID(s)	Element Occurrence ID(s)
34	May Lake Road Barrens	05/29/2021	1	SF 13964	EO 8718
40*	Beach Road	05/23/2021, 05/31/2021	6	SF 68211	EO 920
41*	W Township Road SE	05/24/2021	0	No targets found	NA
42*	Arrowhead Road	06/02/2021	3	SF 68213	EO 14532
43*	Wakely Bridge Road	06/02/2021	0	No targets found	EO 14526^
main base*	S Access Road	06/02/2021	1	SF68212	EO 24428

* - on CGJMTC, **-partially on CGJMTC ^ - previously documented EO

Cobweb skipper

A total of 45 observations of Cobweb skippers were recorded during surveys at Camp Grayling (and vicinity) in 2021; of these observations, 42 occurred within CGJMTC, 3 occurred off of the base, and 0 observations were made in polygons that intersect base boundary lines. In occupied polygons, our surveys produced an average of 5 Cobweb skippers per polygon. The number of cobweb skippers per occupied polygon ranged from 1 skipper to 23 skippers. We identified 8 new source features representing Cobweb skipper populations associated with 3 element occurrences at Camp Grayling (Table 2).

Table 2. Each Camp Grayling survey location for Cobweb skipper is shown with associated survey date, occurrences, and heritage database updates for source features and element occurrences. Polygons that are within CGJMTC are highlighted with an *. Polygons that are partially on CGJMTC are highlighted with **.

Polygon ID	Survey Site Name	Survey Date(s)	# of Cobweb Skipper Observed	Source Feature ID(s)	Element Occurrence ID(s)
1*	Riverview Road SE	05/29/2021, 06/07/2021, 06/10/2021	23	SF 68220, 68756	EO 24429
2*	Arrowhead Camp Road SE	05/29/2021	0	No targets found	NA
3	Yellow Tree Road	05/29/2021	0	No targets found	NA
4*	Howes Lake SW	06/01/2021	0	No targets found	NA
5*	Manistee River Road	06/02/2021	2	SF 68221	EO 24179
6	Portage Creek Road	06/07/2021	0	No targets found	NA
7**	Portage Creek SW	06/07/2021	0	No targets found	NA
8**	Portage Creek NE	06/07/2021	0	No targets found	NA
9*	Portage Creek Central	06/07/2021	0	No targets found	NA
10*	Maple Road	05/25/2021, 06/02/2021	4	SF 68183	EO 23702

Polygon ID	Survey Site Name	Survey Date(s)	# of Cobweb Skipper Observed	Source Feature ID(s)	Element Occurrence ID(s)
11	Fletcher Road	05/25/2021	2	SF 68182	EO 23702
12	Grass Lake	05/25/2021, 06/02/2021	1	SF 64905	EO 23702
13	Spike Horn Road	06/01/2021	0	No targets found	NA
15	Spy Trail	05/30/2021, 05/31/2021, 09/09/2021	0	No targets found	NA
16	Northland Drive	05/30/2021	0	No targets found	NA
17	N Thendara Road South	06/02/2021, 06/03/2021	0	No targets found	NA
18*	Frog Lakes West	06/02/2021, 06/03/2021	1	SF 68216	SF 24179
19*	E Karen Lake Road	06/02/2021	0	No targets found	NA
20*	Section 22	06/02/2021	0	No targets found	NA
21*	Bucks East-West Truck Trail	06/02/2021	10	SF 68217, 68222	SF 24179
22*	W Jones Lake Road	06/02/2021, 06/03/2021	1	SF 68185	EO 24179
23*	N Wakely Bridge Road	05/28/2021	0	No targets found	NA
24*	Mastej Drive	05/30/2021	0	No targets found	NA
25*	County Road 612	05/30/2021	0	No targets found	NA
26*	Grayling HS Trail	06/08/2021	0	No targets found	NA
27*	Old 27 north	05/23/2021	0	No targets found	NA
28	The Ford Road East	06/08/2021	0	No targets found	NA
29*	The Ford Road West	06/08/2021	0	No targets found	NA
30*	Oates Road	06/02/2021	0	No targets found	NA
31*	Highlander Trail	06/02/2021, 06/04/2021	0	No targets found	NA
32	N Big Creek Road	06/04/2021	0	No targets found	NA
33	May Lake Road Barrens	05/29/2021	0	No targets found	NA
34	Beach Road	05/23/2021, 05/31/2021	1	SF 68755	EO 23702
40*	W Township Road SE	05/24/2021	0	No targets found	NA
41*	Arrowhead Road	06/02/2021	0	No targets found	NA

Polygon ID	Survey Site Name	Survey Date(s)	# of Cobweb Skipper Observed	Source Feature ID(s)	Element Occurrence ID(s)
42*	Wakely Bridge Road	06/02/2021	0	No targets found	NA
43*	S Access Road	06/02/2021	0	No targets found	NA
* - on CGJMTC, **-partially on CGJMTC					

Rare grasshopper meander surveys

We surveyed a total of 14 polygons on the base at Camp Grayling for secretive locust in 2021. Of those, we identified 11 polygons with a total of 133 verified observations of Secretive locust (79% of polygons). The number of secretive locusts per occupied polygon ranged from 1 to 77 Secretive locusts. In total, we identified a total of 30 source features, representing 7 separate element occurrences. (Table 3).

Table 3. Each Camp Grayling survey location for Secretive locust is shown with associated survey date, occurrences, and heritage database updates for source features and element occurrences.

Polygon ID	Survey Date(s)	# of Secretive Locust Observed	Source Feature ID(s)	Element Occurrence ID(s)
2	08/18/2021, 08/23/2021	10	SF 68233, 68234, 68235, 68236, 68237, 68238, 68239, 68240, 68241, 68242	EO 7357
3	09/09/2021	15	SF 68255, 68256, 68257, 68258, 68259, 68260, 68261, 68758	EO 7641
4	09/06/2021	77	SF 68262	EO 7641
5	08/24/2021	1	SF 68759	EO 12654
6	08/23/2021	0	SF 12671	EO 11655
7	08/23/2021	3	SF 68244, 68245, 68246	EO 11655
8	08/23/2021	1	SF 68243	EO 12654
9	08/24/2021	1	SF 68760	EO 12654
10	09/09/2021	15	SF 68250,8244, 68251, 68252, 668254, 68761 - 68767	EO 24432
11	09/09/2021	0	No targets found	NA
18	09/08/2021	6	SF 68247, 68248, 68768, 68769, 68770, 68771	EO 9373
20	09/08/2021	0	No targets found	NA

21	09/08/2021	0	No targets found	NA
26	09/09/2021	4	SF 68249, 68772, 68773	EO 24432

Blazing star borer moth surveys

A total of 10 person hours of blacklighting were conducted on the evening of September 8, 2021. We did not locate any Blazing star borer moths during 2021 surveys on CGJMTC, nor did we locate any non-target moths in the genus *Papaipema*. However, provided the extant populations of *Liatris* spp. at Camp Grayling, we mapped out 18 locations in the study area, 13 of which are within the CGJMTC, and 5 nearby, on adjacent state forest lands (Table 4).

Table 4. *Liatris aspera* locations observed and recorded during rare insect surveys at Camp Grayling. Locations marked with * are outside the CGJMTC on state forest land.

General Location	**X**	**Y**	**Number of *Liatris* stems**
Secretive Locust Polygon 18	44.737000	-84.532402	10+
Polygon 43	44.773720	-84.522329	10
Polygon 22	44.736608	-84.531658	30
Polygon 22	44.737098	-84.532080	5
Polygon 22	44.740900	-84.533390	5
North of Howes Lake	44.693053	-84.816933	25
Polygon 42	44.684960	-84.836586	20
Polygon 1	44.645566	-84.926145	5
Polygon 1	44.656908	-84.925532	5
Polygon 40	44.551799	-84.932811	5
Polygon 40	44.549798	-84.937637	25
Polygon 40	44.548674	-84.939188	20
Polygon 40	44.548406	-84.938512	8
Polygon 12 *	44.525077	-84.910865	15
North of Polygon 13 *	44.532927	-84.904436	5
Polygon 16 *	44.774723	-84.727124	40
Polygon 16 *	44.780344	-84.727938	5
Polygon 16 *	44.777863	-84.728150	3

Pollinator plots

We identified 8 locations within the cantonment area of CGJMTC that are suitable for pollinator habitat enhancement seeding projects (Figure 3). Based on the site conditions at Camp Grayling, we suggest utilizing a sandy mix, comprised of approximately 45% forbs and 55% native grasses, which includes the hostplants of Dusted and Cobweb skipper (little bluestem, *Schizachyrium scoparius*) and Blazing star borer moth (northern blazing star, *Liatris scariosa*) (Table 5). The mix also contains a mixture of nectar and pollen sources to feed a broad range of pollinators, including monarch butterflies and multiple state special concern bumble bee species that have statewide distributions that include Camp Grayling (American bumble bee, *Bombus pensylvanicus*; Yellow-banded bumble bee, *Bombus terricola*).

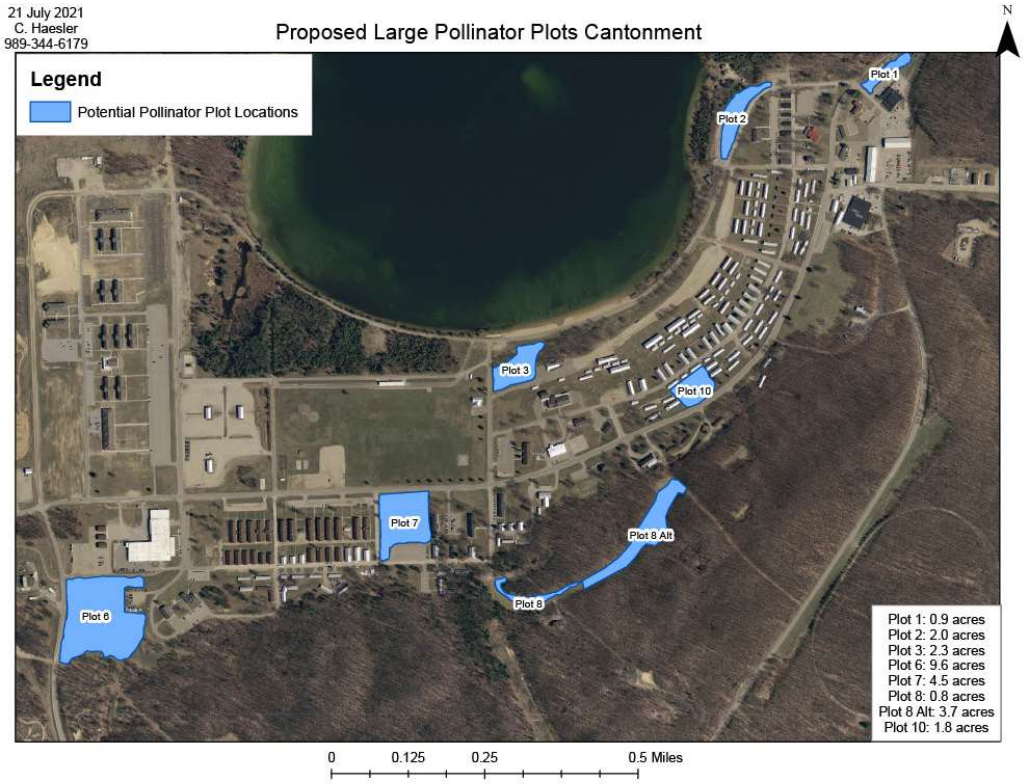

Figure 5. Potential locations for pollinator seed mix at Camp Grayling.

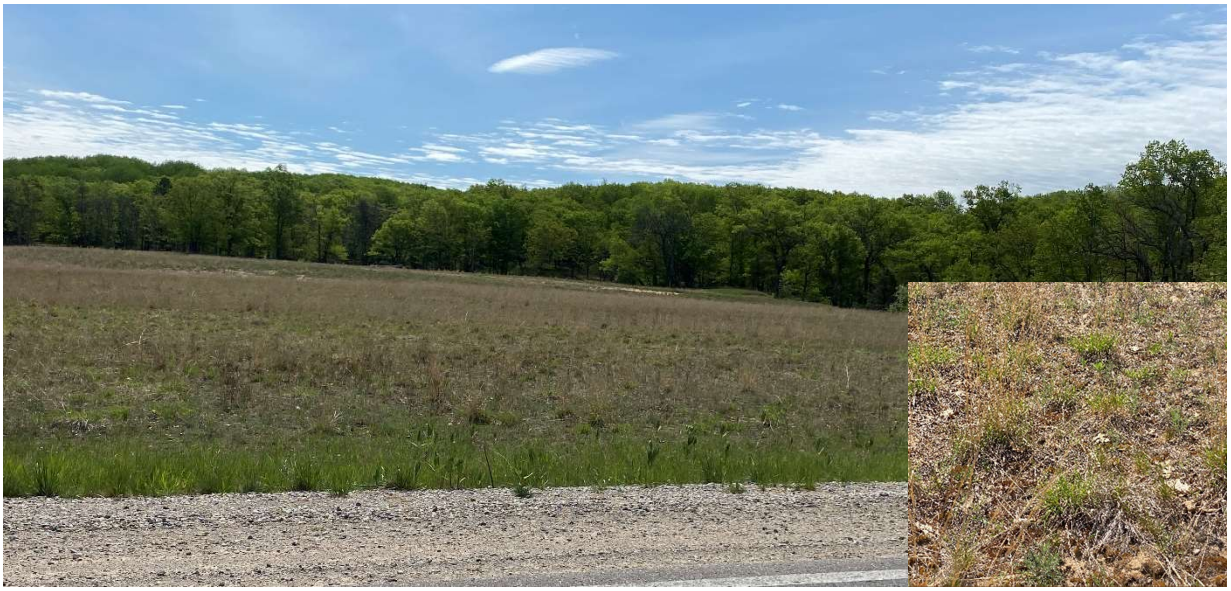

Figure 6. Pollinator plot 6 seen from the road and primary vegetation (insert). Area is dominated by little bluestem and documentation of Dusted skipper confirmed.

Table 5. Pollinator plot mix developed for Camp Grayling. All prices are provided per ounce and are from Michigan Wildflower Farm. Species marked with an "*" are from Cardno Native Plant Nursery.

Camp Grayling Pollinator Mix

Botanical Name	Common Name	PLS Ounces/Acre	Price/Ounce	Total Cost
Permanent Grasses:				
Andropogon gerardii	Big Bluestem	3	$3.00	$9.00
Elymus canadensis	Canada Wild Rye	14	$4.00	$56.00
Schizachyrium scoparium	Little Bluestem	34	$3.00	$102.00
Sorghastrum nutans	Indian Grass	12	$3.00	$36.00
	Total	**63**		$203.00
Forbs:				
Achillea millefolium	Common Yarrow	4	$15.00	$60.00
Coreopsis lanceolata	Sand Coreopsis	5	$12.00	$60.00
Coreopsis tripteris	Tall Coreopsis	2	$25.00	$50.00
Lespedeza capitata	Round-Headed Bush Clover	3	$20.00	$60.00
Liatris scariosa	Northern Blazing Star	5	$48.00	$240.00
Monarda fistulosa	Wild Bergamot	3	$25.00	$75.00
Monarda punctata	Spotted beebalm	4	$35.00	$140.00
Pycnanthemum virginianum	Common Mountain Mint	2	$78.00	$156.00
Rudbeckia hirta	Black-Eyed Susan	4	$7.50	$30.00
Solidago nemoralis	Old-Field Goldenrod	1	$50.00	$50.00
Solidago speciosa	Showy Goldenrod	2	$30.00	$60.00
Symphyotrichum laeve	Smooth Blue Aster	4	$35.00	$140.00
Symphyotrichum pilosum	Frost aster	3	$30.00	$90.00
Verbena stricta	Hoary vervain	2	$15.00	$30.00
Veronicastrum virginicum	Culver's Root	1	$65.00	$65.00
	Total	**45**		$1,306.00

Mix Statistics

Native Component	PLS lbs./Acre	% of Native Mix	Cost
Forbs	2.8125	41.67%	$203.00
Grasses	3.9375	58.33%	$1,306.00
Total	6.75	100.00%	$1,509.00

The species list and associated budget provided in Table 5 was created using current (2021) price/ounce information provided by regional seed providers, Michigan Wildflower Farm (MWF), and is priced on a

per acre basis. Individual species seed prices may vary if purchasing bulk seed in quantities larger than 1lb. For species where seed is unavailable through MWF, we used price/ounce costs from Cardno Native Plant Nursery. The estimated cost of seed for each identified polygon is shown in Table 6. We recommend purchasing seeds directly from native seed suppliers or collecting native seed from populations of target plant species within or around the base to ensure local adaptability.

Table 6. Estimated cost of the developed seed mix for each pollinator plot identified in the cantonment area of Camp Grayling.

Pollinator Plot ID	Acres	Cost
1	0.9	$1,358.10
2	2	$3,018.00
3	2.3	$3,470.70
6	9.6	$14,486.40
7	4.5	$6,790.50
8	0.8	$1,207.20
8 Alt	3.7	$5,583.30
10	1.8	$2,716.20

Discussion

In 2021, we implemented baseline surveys for state listed insects in the CGJMTC, focusing our efforts on Dusted and Cobweb skippers, Secretive locust, and Blazing star borer moth. We successfully surveyed 37 polygons for Dusted and Cobweb skippers, 14 polygons for Secretive locust, and a single location for Blazing star borer moth. Our efforts resulted in the identification of 22 new source features for Dusted skipper, 8 SFs for Cobweb skipper, and 30 SFs for Secretive locust, expanding on our previously limited knowledge of occupancy of these species in, and adjacent to, the CGJMTC. By identifying habitats with extant populations of these species, we are now able to work with CGJMTC to effectively plan conservation and habitat management strategies to support these populations and their habitats.

The survey protocols used were effective at identifying polygons with extant populations of species targets, however, future survey efforts should consider a more robust survey protocol capable of capturing species occurrence data necessary for deriving population estimates for each SF or EO. We recommend that the next round of Dusted and Cobweb surveys utilize a Pollard walk (1977) approach. This approach would be quite simple to implement in the polygons surveyed in 2021. Transect routes are established as appropriate for each identified polygon and extend directly through ideal habitat. While walking each transect, surveyors record skippers observed within a 5-meter band on both sides of the transect, recording observations visually, or using binoculars when needed. This standardized approach to each occupied habitat is needed to provide robust population estimates over time, which can inform long-term species trends in population and site occupancy in the CGJMTC.

Relatively little is known about Secretive locust life history, ecology, and population status in Michigan. Therefore, it is crucial that research efforts continue to build on the baseline data we provide in order to effectively support and manage for populations of this species in the CGJMTC. Future work should

continue monitoring populations of Secretive locust in the Grayling Outwash Plains ecoregion and identify life history traits that can aide in population management. We recommend that a better understanding of oviposition location and/or substrate, host plant use for forage and mating, and microhabitat characteristics of occurrence locations are needed to better plan and implement management practices. Developing research to address these gaps in knowledge, combined with continued population monitoring of Secretive locust, provide the greatest likelihood of effectively supporting this species in Camp Grayling.

To assist with general pollinator conservation measures in the cantonment area of Camp Grayling, we developed a seed mix that considers both abiotic factors (soil type, climate, etc.) and specific resource needs of state listed pollinators found in the CGJMTC. We recommend that the DMVA staff hire a contractor (or utilize existing maintenance staff) to prep the selected plots of land to 1) remove invasive or weedy species prior to seeding, 2) prepare the areas for seed, and 3) broadcast the seed evenly across the entire plot area. Plot 6 is an ideal location to first implement this pollinator mix because of an extant population of Dusted skipper.

Habitat recommendations

Imperiled skippers

Historically, dry sand prairies and pine barrens were maintained in an open condition because of frequent fires, droughty soils, and by frequent growing-season frosts (Cohen et. al 2020). These are the predominate habitat types in which we find Dusted and Cobweb skippers in CGJMTC. Fire frequency of these habitats depended on a variety of factors such as type and volume of fuel, topography, and natural firebreaks. In addition to creating and maintaining the open conditions of dry sand prairies, frequent fires also help preserve species diversity by promoting seed germination and seedling establishment, creating microsites for small species, increasing the availability of plant nutrients, and bolstering flowering and seed set, all of which are important to providing the larval (bluestems) and adult (various forbs) food sources for both the Dusted and Cobweb skippers.

The excessively drained, sandy soils of dry sand prairie/pine barrens act to perpetuate open conditions by limiting tree establishment, especially during periodic droughts. Growing-season frosts, which also limit tree establishment are particularly common in the CGJMTC. In this region, dry sand prairie frequently occurs along with pine barrens in lower elevation, flat outwash plains known as frost pockets (Cohen et al. 2020).

Managing dry sand prairie/pine barrens requires frequent prescribed burning to maintain open canopy, promote high levels of grass and forb diversity, deter woody vegetation and invasive plants, and limits the success of overstory dominants. In addition to prescribed fire, brush cutting accompanied by stump application of herbicide is often an important component of prairie restoration. To reduce the impacts of management on fire-intolerant species it is important to consider a rotating schedule of prescribed burns in which adjacent management units are burned in alternate years. Alternating burn units provides refugia for fire-intolerant insect species (such as Dusted and Cobweb skippers and Blazing star borer moth) that are then able to recolonize the burned areas. In addition, many restoration sites may require the reintroduction of appropriate native species and genotypes as small, isolated prairie remnants are subject to reduced gene flow.

In addition, within the CGJMTC, almost all sites contain non-native invasive plant species. Controlling invasive species is a critical step in restoring and managing dry sand prairie. By outcompeting native species, invasives alter vegetation structure, reduce species diversity, and disrupt ecological processes (Cohen et al. 2020). Additional invasive species within CGJMTC that threaten the diversity and community structure of dry sand prairie include spotted knapweed (*Centaurea stoebe*), common St. John's-wort (*Hypericum perforatum*), leafy spurge (*Euphorbia virgata*), and hoary alyssum (*Berteroa incana*).

Single species management for Kirtland's warbler over the past decade and the widespread furrowing and planting of jack pines has led to the destruction or degradation of habitat for a host of rare species including skipper habitat (see photo below). Invasive species such as spotted knapweed and leafy spurge use roads and other disturbances to inhabit more pristine natural habitats, and the planting of pines leads to trees shading out native grasses and forbs.

Figure 7. View of a portion of survey Polygon 1 where jack pines have been planted for Kirtland's warbler managment, potentially degrading imperiled skipper and rare plant habitats.

When feasible, prescribe fire management for dry sand prairie/pine barrens should encompass other adjacent fire-dependent upland and wetland communities such as dry northern forest, dry-mesic northern forest, bog, poor fen intermittent wetland, northern fen, and northern wet meadow. Where rare insect species are a management concern, burning strategies should allow for ample refugia to

facilitate effect post-burn recolonization. Degraded barrens that have long been deprived of fire and have converted to closed canopy forest may require mechanical thinning or girdling prior to implementation of prescribed fire. And finally consider a paradigm shift to simultaneously manage for pine barrens and Kirtland's warbler at the landscape scale.

Secretive locust

The habitat requirements for Secretive locust are a bit more challenging because so little is known about the life history and oviposition habit of the species. We do know that adults occupy habitat ranging from the dry end including the edges of dry sand prairie, pine barrens, dry northern forest; to the wet end of the continuum including northern wet prairies, intermittent wetlands, and bogs (Rabe et al. 1996). The locust also could be affected by development, road construction, and logging at occupied sites. Uncut buffer areas around bogs/ wetlands may be necessary to protect oviposition sites. Because habitat needs are unclear, the maintenance of a mosaic of suitable upland and wetland habitats in their natural state is prudent until further research more clearly defines specific habitat requirements.

The Secretive locust is best known from bogs where leatherleaf (*Chamaedaphne calyculata*) and Labrador tea (*Ledum groenlandicum*) typically occur in dense stands underlain by deep, hummocky sphagmum (see photo below). These bogs often are surrounded by stands of jack pine (*Pinus banksiana*) and some tamarack (*Larix larcina*) which may encroach along the margins of the bog. The primary

Figure 8. Typical Secretive locust habitat on the wet end of the spectrum (Bog) in Camp Grayling, this from Survey Polygon 3.

Figure 9. Typical Secretive locust habitat on the dry end of the spectrum (Pine Barrens) in Camp Grayling, this from Survey Polygon 26, Arrowhead Road.

mechanism for preserving bogs is to maintain their hydrology. Reducing access to peatland systems will help decrease detrimental impacts caused by off-road vehicles. Minimizing impacts to hydrologic regimes can be accomplished by avoiding surface water inputs from drainage ditches, agricultural fields, road construction, and logging in the adjacent uplands, and maintaining native vegetation types in the uplands around the community. In forested landscapes, establishing no-cut buffers around bogs and avoiding road construction and complete canopy removal in stands immediately adjacent to wetlands can help protect the hydrologic regime. In fire-prone landscapes, where shrub and tree encroachment threatens to convert open wetlands to shrub-dominated systems or forested swamps, prescribed fire or selective cutting can be employed to maintain open conditions. Ideally, prescribed fires conducted in adjacent fire-dependent upland communities would be allowed to carry into open wetlands such as bogs when safety permits.

Acknowledgements

Funding for this project was provided by the Michigan Department of Military and Veterans Affairs (DMVA). Cullen Haesler and Matt Kleitch (DMVA) helped with project design, provided logistical support, assisted us with access to sites, reviewed earlier versions of this report, and provided overall grant administration. We appreciate the assistance from the folks at Camp Grayling Range Control for gaining access to the installation to conduct the insect surveys.

We thank Nicki Bailey (MNFI Insect Technician) for assistance with skipper surveys. Brian Klatt, Ashley Adkins, Sarah Carter (MNFI) and Deb Richardson (MSUE) provided administrative support for the project.

Literature Cited

Bess, J. 2005. Conservation Assessment for Beer's Blazingstar Borer (*Papaipema beeriana* Bird). Report submitted to USDA Forest Service, Eastern Region, 3 October 2005. 33pp. + appendices.

Cohen, J.G., M.A. Kost, B.S. Slaughter, D.A. Albert, J.M. Lincoln, A.P. Kortenhoven, C.M. Wilton, H.D. Enander, and K.M. Korroch. 2020. Michigan Natural Community Classification [web application]. Michigan Natural Features Inventory, Michigan State University Extension, Lansing, Michigan. Available https://mnfi.anr.msu.edu/communities/classification. (Accessed: December 22, 2021).

Cuthrell, D. 2013. Rare Insects (leafhoppers, spittlebugs, butterflies, and *Papaipema* moths) of the Lakeplain Oak Openings Region, Michigan, and Ohio. Michigan Natural Features Inventory Report Number 2013-19. Michigan Natural Features Inventory, Michigan State University Extension, East Lansing, MI.

Pollard, E. 1977. A method for assessing changes in the abundance of butterflies. Biological Conservation 12(2): 115-134.

Rabe, M.L., J.T. Legge, and D.A. Hyde. 1996. Special animal abstract for *Appalachia arcana* (secretive locust). Michigan Natural Features Inventory, Lansing, MI. 2pp.

Reznicek, A. A, E. G. Voss, & B. S. Walters. February 2011. *MICHIGAN FLORA ONLINE*. University of Michigan. Web. October 30, 2021. https://michiganflora.net/genus.aspx?id=Liatris.

Stein, B.A., C. Scott, and N. Benton. 2008. Federal lands and endangered species: the role of military and other federal lands in sustaining biodiversity. BioScience 58:339-347.

Appendix A

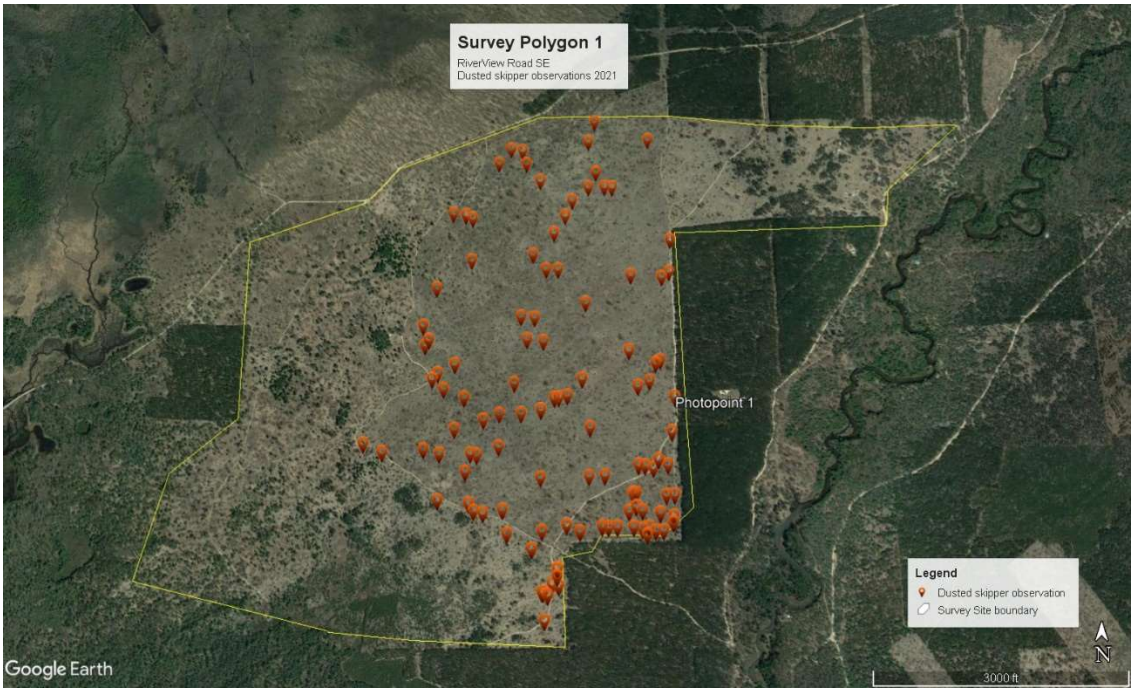

Figure A10. Survey Polygon 1 viewing off to southwest showing sand cherry that needs to be controlled by mechanical mowing and application of herbicide to stumps followed up with prescribed fire to promote bluestem grasses and forb diversity.

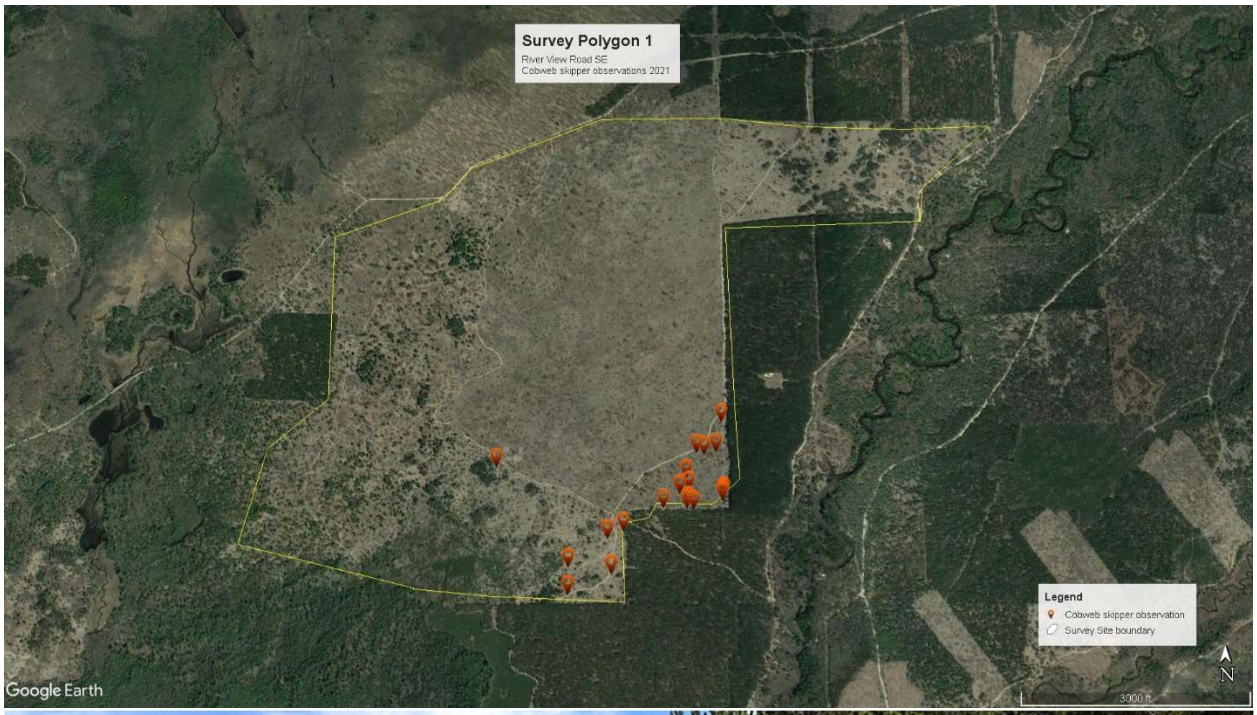

Figure A11. Survey Polygon 1 facing northwest. Location where two Cobweb skippers were seen during surveys. Notice low growing vegetation during the early growing season, with exposed sandy soil and dominance of little bluestem grasses (larval foodplant for Cobweb

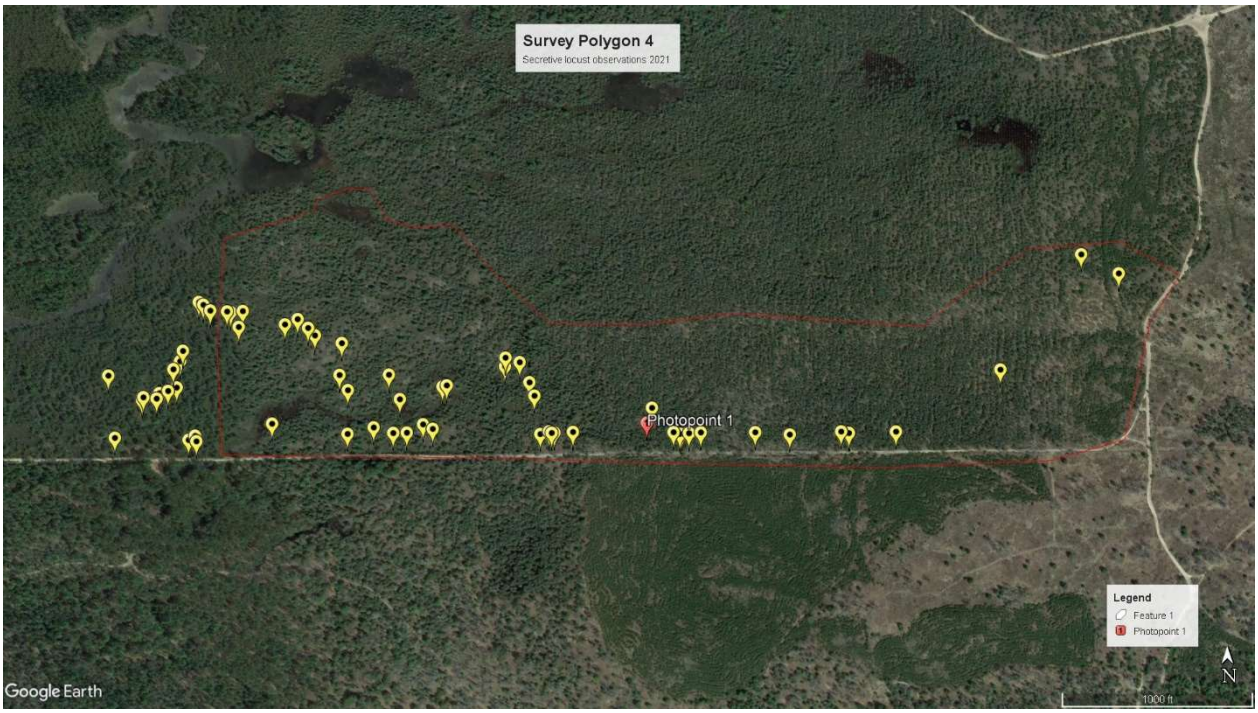

Figure A12. Survey Polygon 4 showing typical habitat within the survey polygon which contained Secretive locust adults, both males and females.

Appendix B: Papaipema survey form

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:

	Scientific Name																Environmental Data							
Start time of the period																TOTALS	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]
1st hour :																								
2nd hour :																								
3rd hour :																								
4th hour :																								
5th hour :																								
6th hour :																								
7th hour :																								
TOTALS																								

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 Michgan in order by Hodges Number (special concern, threatened, or endangered are in bold):

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