

Natural communities and rare species in invasive Phragmites treatment zones in Saginaw Bay coastal and Quanicassee Riverine wetlands



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We collectively acknowledge that Michigan State University occupies the ancestral, traditional, and contemporary Lands of the Anishinaabeg – Three Fires Confederacy of Ojibwe, Odawa, and Potawatomi peoples. In particular, the University resides on Land ceded in the 1819 Treaty of Saginaw. We recognize, support, and advocate for the sovereignty of Michigan’s twelve federally recognized Indian nations, for historic Indigenous communities in Michigan, for Indigenous individuals and communities who live here now, and for those who were forcibly removed from their Homelands. By offering this Land Acknowledgement, we affirm Indigenous sovereignty and will work to hold Michigan State University more accountable to the needs of American Indian and Indigenous peoples.

Cover: Lakeplain wet prairie with tuberous Indian plantain (*Arnoglossum plantagineum*) blooming in the foreground and Phragmites (*Phragmites australis*) looming in the background. Photo by Danielle Smith on August 1, 2023.

EXECUTIVE SUMMARY

Saginaw Bay is highly valued for recreational pursuits such as fishing, waterfowl hunting and kayaking. Over the last decade highly invasive, non-native *Phragmites australis* subspecies *australis* has expanded throughout Saginaw Bay at a debilitating rate, impacting fish spawning areas, nesting bird habitat, lake access, and obscuring the view of the Bay itself. Given the sensitivity and uniqueness of the area, invasive management plans must also account for the remanent natural communities and rare plant and animal species that persist near the invaded areas. MNFI surveyed three natural community, six rare plant, and three rare animal occurrences documented in zones marked for treatment in the fall of 2023. Surveys were conducted between June 19 and September 19, 2023, according to the best detection timing and methods for the species. Of the occurrences, we failed to find three of the plant occurrences. Two the natural community occurrences, both west of Quanicassee River, were degraded to invasive species encroachment and higher than past water levels. The invasive species encroachment in the third natural community was restricted mostly to the borders and many rare plant and animal species occupied the area. All rare animal species were present in 2023 surveys.

Six Treatment Zones contained species or habitat that warrants greater precision than aerial herbicide spraying for invasive *Phragmites*: [REDACTED]. Mapped natural community and rare plant areas should be treated by burning in phases, hand-wicking, or backpack spraying depending on the nearness and density of the invasive *Phragmites* to those mapped populations. Aerial spraying in these zones should provide enough of a buffer to prevent drift into the mapped communities and rare species areas. Thirteen Treatment Zones contained habitat for rare animal species that adjustment in treatment timings are recommended to avoid times when the species is using the area. Treatment zones [REDACTED] should be treated when the rare animal is overwintering from late-October to April to minimize non-target effects on the species. Treatment Zones [REDACTED] have been recently occupied by breeding marsh birds, so treatment that disrupts the structure of the area (e.g., burning, mowing) should not be conducted in the spring during the breeding season.

ACKNOWLEDGEMENTS

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TABLE OF CONTENTS

EXECUTIVE SUMMARY i

ACKNOWLEDGEMENTS ii

TABLE OF CONTENTS iii

LIST OF TABLES v

LIST OF FIGURES vi

INTRODUCTION 1

METHODS 2

 Study Area 2

 Previously Documented EOs 2

 Field Survey 3

 Natural communities 3

 Rare plants 4

 Rare animals 4

RESULTS 7

 Natural communities 7

 Lakeplain Wet Prairie 7

 Lakeplain Wet-mesic Prairie 13

 Rare plants 15

 Prairie Fringed Orchid 15

 Cooper’s Milk Vetch 16

 White Lady Slipper 16

 Tall Green Milkweed 17

 Tuberous Indian Plantain 18

 Rare animals 19

 Borer moths (*Papaipema* spp.) 19

 Blanding’s turtle 19

DISCUSSION 21

 Summary 22

 Treatment Zone ■ 23

 Treatment Zone ■ 26

 Treatment Zone ■ 28

Treatment Zone [REDACTED]	30
Treatment Zone [REDACTED]	33
Treatment Zone [REDACTED]	36
Treatment Zones [REDACTED]	38
LITERATURE CITED	39
APPENDIX A: Definitions and NatureServe Terminology	42
APPENDIX B: Natural Communities of Michigan in Report.....	44
Great Lakes marsh.....	45
Lakeplain wet prairie.....	46
Lakeplain wet-mesic prairie	47
APPENDIX C: Invasive species observations.....	48

LIST OF TABLES

Table 1. List of EOs of natural communities, animals, and plants previously documented in treatment zones 3

Table 2. Visited species EOs 7

Table 3. Results of blacklighting surveys for borer moths 19

Table 4. Base information for the 11 captures of Blanding’s turtles at [REDACTED] [REDACTED] 20

LIST OF FIGURES

Figure 1. Map of proposed treatment zones in Saginaw Bay, Michigan, USA..... 1

Figure 2. Boundaries of Albert’s Ecoregion subsections in Southern Lower Michigan Ecoregion section in Treatment Zones..... 2

Figure 3. Lakeplain wet prairie..... 13

Figure 4. Rare plant species observed during surveys..... 17

Figure 5. Rare animal species observed during surveys..... 20

Figure 6. Map of Treatment Zone █..... 24

Figure 7. Detailed map of EOs in southern portion of Treatment Zone █..... 25

Figure 8. Map of EO ID 364 in Treatment Zone █..... 27

Figure 9. Map of lakeplain wet prairie (EO ID 12438) in Treatment Zone █..... 29

Figure 10. Map of Treatment Zone 20 and part of Treatment Zone █..... 31

Figure 11. Detailed map of EOs in southern portion of Treatment Zone █..... 32

Figure 12. Map of Treatment Zone █..... 34

Figure 13. Detailed map of EOs in eastern portion of Treatment Zone █..... 35

Figure 14. Map of EOs in Treatment Zone █..... 37

INTRODUCTION

The North American Great Lakes is one of the world's largest freshwater ecosystems. Michigan has approximately 35% of the 15,131 km (9,402 mi) of Great Lakes coastline and the entirety of Michigan drains into the Great Lakes Basin. The Saginaw Bay watershed drains nearly 22,500 km² (8,700 mi²) of land, rivers, and lakes into Lake Huron. Saginaw Bay coast alone hosts a rich array of ecosystems that provide critical habitat for native plant and animal species, some of which are globally imperiled or declining (e.g., federally endangered eastern prairie-fringed orchid). Saginaw Bay is also highly valued for recreational pursuits such as fishing, waterfowl hunting and kayaking. Whitehead and Groothuis (2005) estimated the annual recreational value of the Bay's coastal marshes alone at approximately \$16 million. Over the last decade, however, highly invasive, non-native *Phragmites australis* subspecies *australis* (henceforth invasive Phragmites) has expanded throughout Saginaw Bay at a debilitating rate, impacting fish spawning areas, nesting bird habitat, lake access, and obscuring the view of the Bay itself (Bourgeau-Chavez et al. 2013, Mazerolle et al. 2014, Dinehart et al. 2022).

Since 2010, numerous efforts have been made to control invasive Phragmites in Saginaw Bay. Given the sensitivity and uniqueness of the area, invasive management plans must also account for the remanent natural communities and rare plant and animal species that persist near the invaded areas. The most recent Phragmites treatment and monitoring effort has included provisions to update the status on known occurrences of rare species and communities in proposed treatment zones. Experts will recommend adjustments to treatment methods to protect these remaining communities and species.

The purpose of this project is restore over 6,000 acres of Saginaw Bay shoreline adjacent to previous treatment efforts and reduce degradation of remanent natural communities and rare species habitats. To best protect remanent natural communities and rare species, known occurrences should undergo recent survey to understand possible non-target effects. Adjustments to invasive treatments in timing, method, or application could reduce negative effects on these occurrences.

METHODS

Study Area

The surveys focused on documented natural communities and rare species in Michigan, USA within proposed treatment zones (Figure 1). The treatment zones include ecoregion section VI Southern Lower Michigan subsections of Saginaw Bay Lake Plain and Sandusky Lake Plain (Figure 2; Albert 1995). The elevation in this ecoregion ranges from 174 to 265 m (572 to 870 ft). Like the rest of Michigan, the ecoregion's geology is glacially influenced (Albert 1998a, Albert 1998b). Lake Huron strongly influences the climate in the coastal regions of this area contributing to longer and warmer growing season than adjacent sections. The climate makes the coastal areas suitable for commercial row crops and is the most heavily farmed section in Michigan, having converted nearly all the original tallgrass and wet prairies to farmland (Albert 1995).

Previously Documented EOs

Michigan Natural Features Inventory (MNFI) manages the Michigan Natural Heritage Database. This database houses records and documentation of Michigan's high quality and/or rare natural communities and federal- and state-listed plant and animal species. Each record of a natural community or species is called an element occurrence (EO; APPENDIX A: Definitions and NatureServe Terminology). Contained in each record is spatial information, directions, EO description, survey dates, surveyors, documentation related to the EO (e.g., report, herbarium specimen, report form), any additional data, and a ranking based on its quality, size, landscape context, and viability of the species population or community (Faber-Langendoen et al., 2008). We queried this database to locate EOs of communities and species that intersected with the zones proposed for Phragmites treatment (Table 1; MNFI 2023).

Surveys were conducted in previously documented natural communities and rare species locations in [REDACTED] (Table 1). Results of the surveys were documented and/or updated in the Michigan Natural Heritage Database. Natural community types surveyed for this project are described in more detail in APPENDIX B: Natural Communities of Michigan in Report.

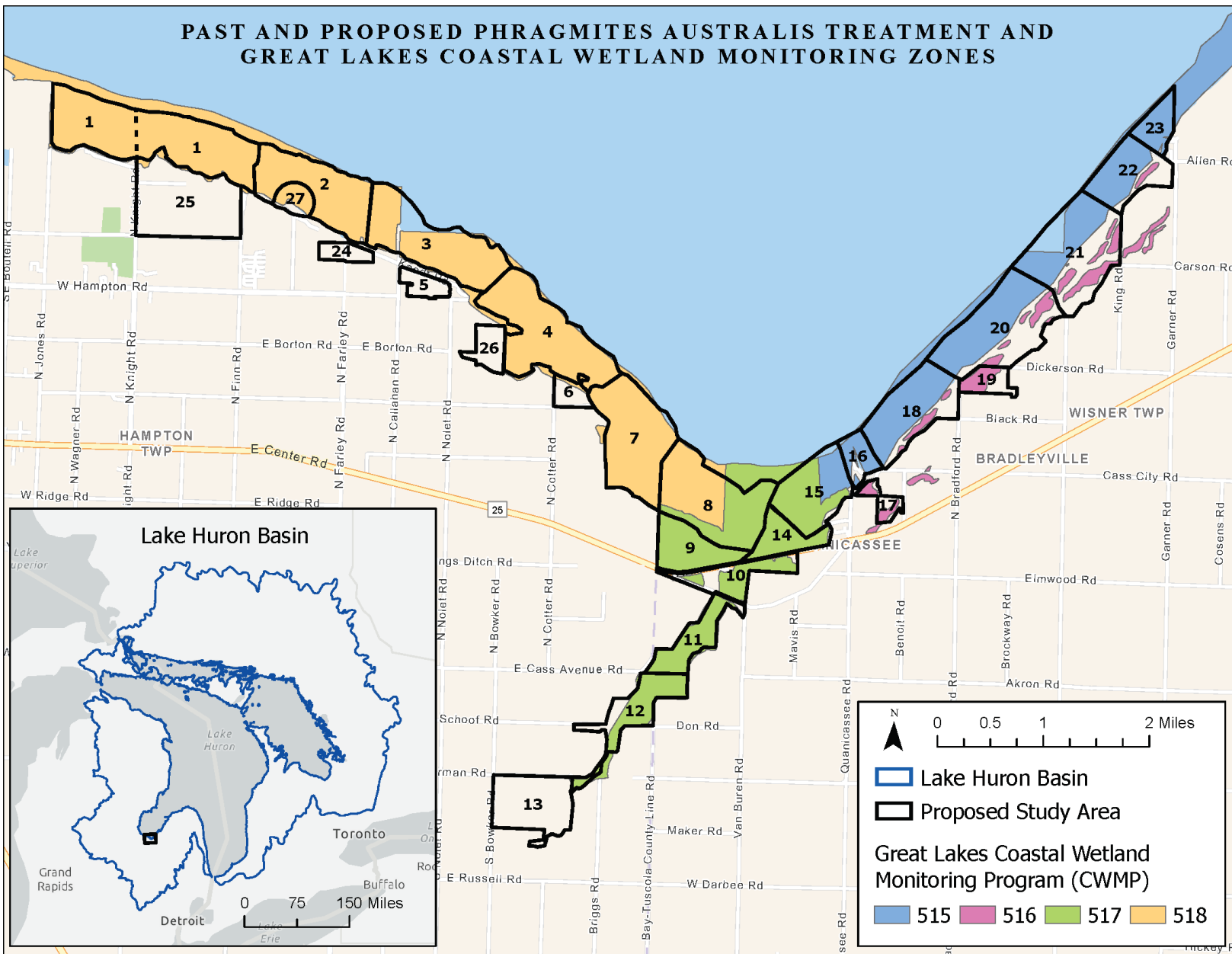


Figure 1. Map of proposed treatment zones in Saginaw Bay, Michigan, USA. The colors and numbered polygons in the legend refer to identifiers used by ongoing Environmental Protection Agency’s Great Lakes Coastal Wetland Monitoring Program. Map inset shows the Lake Huron watershed including Saginaw Bay. Map from Hergott et al. 2022.

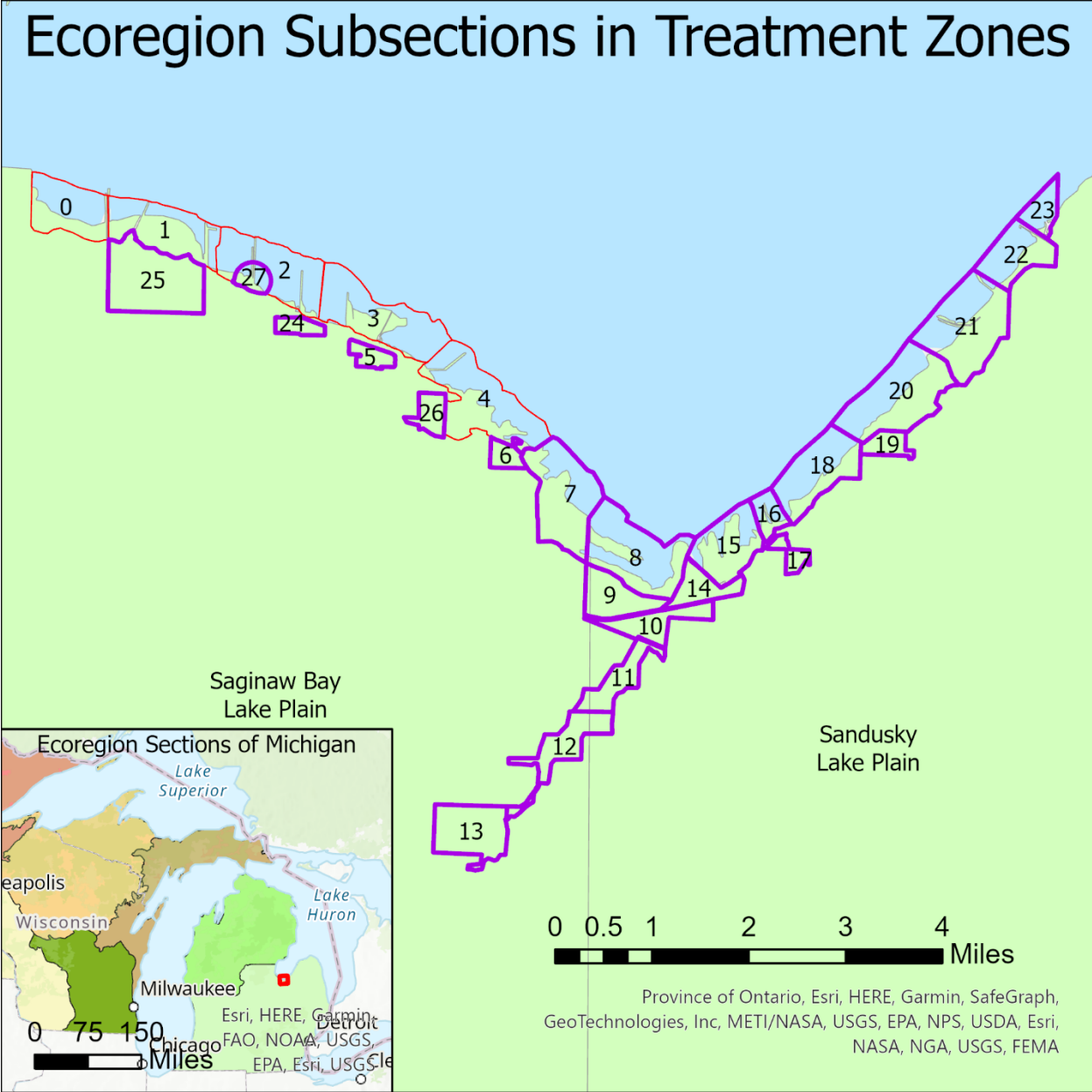


Figure 2. Boundaries of Albert’s Ecoregion subsections in Southern Lower Michigan Ecoregion section in Treatment Zones. Purple outlined zones are proposed for treatment. Red, thin lined zones were treated prior to 2023. Inset displays Albert’s Ecoregion sections in Michigan (Albert 1995).

Table 1. List of EOs of natural communities, animals, and plants previously documented in treatment zones. Status refers to a federal, global, or state rank of species rarity (see APPENDIX A: Definitions and NatureServe Terminology). Year last obs. refers to the last documentation of species observation or community survey of occurrences prior to 2023 surveys. Rank is a qualitative ranking of the quality, size, and landscape of the features (See APPENDIX A: Definitions and NatureServe Terminology). EO ID is a unique identifier for each feature in the Michigan Natural Heritage Database (MNFI 2023). Zone refers to the number Treatment Zone where the record is found. A treatment zone is listed as “NA” if EO is extirpated (X) or the geographic uncertainty of the location prevents precise placement.

Natural Feature	Common Name	Status	Year Last Obs.	Rank	EO ID	Zone
<i>Arnoglossum plantagineum</i>	Prairie Indian-plantain	SC	2015	CD	12163	
<i>Asclepias hirtella</i>	Tall green milkweed	T	1993	A	11460	
<i>Astragalus neglectus</i>	Cooper’s milk vetch	SC	1979	E	50	
<i>Cypripedium candidum</i>	White lady-slipper	T	1994	BC	2521	
<i>Galearis spectabilis</i>	Showy orchis	T	1893	H	3115	
<i>Platanthera leucophaea</i>	Eastern prairie-fringed orchid	LE, E	2016	C	364	
<i>Platanthera leucophaea</i>	Eastern prairie-fringed orchid	LE, E	1990	D	2999	
<i>Platanthera leucophaea</i>	Eastern prairie-fringed orchid	LE, E	1980	X	4604	
<i>Papaipema berriana</i>	Blazing star borer moth	T	2018	E	22146	
<i>Papaipema berriana</i>	Blazing star borer moth	T	2018	E	22147	
<i>Emydoidea blandingii</i>	Blanding’s turtle	SC	2012	BC	13398	
<i>Botaurus lentiginosus</i>	American bittern	SC	2007	E	13453	
<i>Cistothorus palustris</i>	Marsh wren	SC	2007	BC	13452	
<i>Cistothorus palustris</i>	Marsh wren	SC	1993	H	21759	
<i>Gallinula galeata</i>	Common gallinule	T	2019	E	21758	
<i>Haliaeetus leucocephalus</i>	Bald eagle	SC	2019	E	12977	
<i>Sterna forsteri</i>	Forster’s tern	SC	1998	CD	13502	
Great Lakes marsh		G2/S3	2015	B	11243	
Lakeplain wet prairie		G2/S1	2015	D	358	
Lakeplain wet prairie		G2/S1	2015	CD	12438	
Lakeplain wet-mesic prairie		G2?/S1	1994	CD	10525	

Field Survey

Natural communities

Lakeplain wet and lakeplain wet-mesic prairie natural communities were revisited. A documented natural community is reviewed on three components: 1) size, 2) landscape context, and 3) quality (Faber-Langendoen et al., 2008). Give the rare state and global ranks of Lakeplain wet and lakeplain wet-mesic prairies, the thresholds for each of these components is low. The revisit surveys consisted of a qualitative meander survey ensuring adequate observation of

representative features (e.g., riverbank, tributaries, stand interior, stand boundaries) and any stand variations as determined by aerial imagery interpretation (e.g., canopy coverage, species composition, crown size, tree density, disturbances). Dominant plant species were noted, invasive plant species documented, soil profiles were described, and current or new threats were noted. The location and density of invasive Phragmites was also noted by itself and in relation to other rare species.

The Great Lakes marsh (EO ID 11243) was not revisited on foot due to the invasive Phragmites infestation level and safety concerns. Previous reports and visits to other Great Lakes marsh in the area decreased the likelihood that rare species would be found in the areas that would be treated for invasive Phragmites.

Rare plants

Documented rare plant EOs were visited if their rank was not considered historical (H) or extirpated (X). The best time for detectability for each species was determined. During that time, meander surveys were conducted in suitable habitat within the documented areas. When an individual was found, notes were taken about the individual's location and condition. More intense meanders were conducted near the located individual. For each polygon for the EO on accessible land, the following information was collected: location, presence, count (estimate or actual), percent flowering, percent fruiting, condition, habitat, and threats.

If no individuals were found at the conclusion of the meander through the polygon, the species in that area was considered "failed to find" (F). The EO requires a F result from several deliberate species surveys throughout all polygons of the population to change the rank of an EO to F. The species possible cryptic appearance (e.g., orchids can be hard to detect) and the most recently observed date are taken into consideration for these determinations.

Rare animals

Blazing star borer moth

Areas of previously documented blazing star borer and lakeplain prairie EOs were surveyed for concentrations of host plants of four State Threatened or State Special Concern borer moth species: blazing star borer (*Papaipema beeriana*), Culvers root borer (*Papaipema sciata*), Silphium borer moth (*Papaipema silphia*), and regal fern borer (*Papaipema speciosissima*). Points where MNFI zoologists deemed to have enough of a concentration of host plants and access for the equipment needed (e.g., dry area for generator), blacklight surveys were conducted when adult moths would be flying. Adults flight time stretch from mid-September to the first week of October. Blazing star borer moths overwinter as eggs on their larval host plant.

Surveys for blazing star borer moth were conducted using a standardized backlight protocol utilized by MNFI staff. At these identified points: to attract and collect moths, a standard set-up of a 250W-mercury bulb and UV bulb were set up powered by a portable generator. Behind these lights a 2m x 2m standing metal frame supporting a white sheet was set up as the collection point. Any moths that appeared to be a borer moth (i.e., *Papaipema* spp.) that were observed on the sheet were collected and identified to species in a laboratory setting the day after surveys. For each moth collected during surveys, the time of collection and field estimated species was recorded on data collection forms.

Surveys were conducted from slightly before sunset (roughly between 7:30-8:00 PM) until at least midnight when moth species are most active. Ideal survey conditions were on cloudy, humid nights with minimal moon or star visibility. At the start, end, and at the top of each hour during the survey weather conditions were recorded including temperature, relative humidity, barometric pressure, maximum windspeed, average windspeed, cloud cover, precipitation level, and moon visibility.

Blanding's Turtle

Surveys for the Blanding's turtle (*Emydoidea blandingii*, State Special Concern) were conducted at [REDACTED] using a modified version of the trapping rapid assessment (TRA) survey protocol developed by the Northeast Blanding's Turtle Work Group (American Turtle Observatory 2017). The TRA surveys consisted of identifying and mapping one to four reference points separated by 800 – 1,600 m (0.5 - 1 mi) within a site or focus area and delimiting a circular plot with a 400 m (0.25 mi) radius around each reference point. Reference points were centered on areas with high suitability for Blanding's turtle habitat (i.e., high potential use wetlands). Within each reference plot, up to 10 medium or large collapsible minnow traps (Promar TR-502 36" L x 12" W or TR-503 24" L x 24" W with dual 5" entrances) and/or hoop traps (2.5 ft diameter, 1.5-inch mesh) were deployed for three to five consecutive nights for each trapping survey. Traps were placed ideally 80 m apart and at least 20 m apart in different directions from the reference point. Traps were placed in suitable wetlands based on the following placement criteria: 1) in deep (≥ 0.3 m, $<$ trap diameter) channels between vegetation, sedges, shrubs, logs, debris; 2) at the edge of thick vegetation; 3) surrounded by good cover and relatively deep water; 4) proximal to basking sites; 5) at sites with good solar exposure; and 6) if possible, out of direct sight to minimize disturbance to traps. Traps were placed to ensure turtles had enough headroom to get to the water surface to breathe and were secured with tall (> 1.2 m) stakes. Traps were baited with fish (e.g., canned sardines in soybean oil or trout in a small plastic container with holes) and fish oil to encourage turtles to come into trap. Each trap was flagged, and the location of and habitat around each trap were recorded. Traps were checked daily, and all animals captured in the traps were recorded and released. Traps were placed back in the same location, and rebaited if necessary. On the last day of the trapping period, traps were removed along with any other materials used to secure or mark the trap. All data were recorded using Survey123 and Field Maps on a mobile device.

When a Blanding's turtle was captured either in a trap or incidentally during the trapping surveys, it was processed, marked, and photographed. The following data were recorded: 1) turtle shell morphometrics (carapace and plastron length, width, and/or height); 2) weight or mass; 3) age class (i.e., adult, juvenile/subadult, hatchling) and number of annuli (growth rings on the scutes) visible; 4) wear class of the plastral scutes on the underside of the turtle (i.e., not worn/ $< 10\%$ wear, partly worn/ $< 50\%$ wear, mostly worn/ $50-90\%$ wear, or worn/ $> 90\%$ wear); 5) sex or gender; 6) reproductive status of adult females to determine if they were gravid; 7) presence of any injuries and general health or condition of the turtle; and 8) any scute or shell morphology or other deformities or abnormalities. Turtles were individually marked with a unique notch code by using a metal file to place small triangular notches along the outer margins of select scutes of the carapace (top shell) following a standard notch code system. A blood sample also was collected, when possible, from the subcarapacial vein or sinus under the midline of the carapace dorsal to the neck. Turtles were released at their capture site after processing was completed. Individuals of other turtle species that were captured during the TRA surveys were

recorded, marked using notching (except for large snapping turtles), and photographed when possible. All data and photographs were recorded in the field using a Survey123 data form on a mobile device.

Birds

Several species of marsh and water birds were identified as using the area for breeding habitat in the past: American bittern (EO ID 13453), marsh wren (EO ID 13452), common gallinule (EO ID 21758), and Forster's tern (EO ID 13502). Due to the proposed timing of the treatment occurring outside of the marsh bird breeding period, budgeting, and staff availability, no marsh bird breeding surveys were conducted.

The bald eagle nest was identified during the previous invasive Phragmites treatment. The Saginaw Bay Cisma is coordinating work with the appropriate entities to mitigate any non-target damage for the bald eagle.

RESULTS

Twelve previously documented and extant EOs consisting of 27 polygons were surveyed between June 19 and September 19, 2023, in the Treatment Zones. These polygons were components three natural community, six rare plant species, and three rare animal EOs. Three plant species and three animal species were found in their documented EOs while three plants were not (Table 2).

Sixty-six locations, density, and area estimates of invasive species were recorded incidentally while surveying natural community and rare plant EOs. They will be submitted to Midwest Invasive Species Information Network (MISIN; APPENDIX C: Invasive species observations, Table C - 1).

Table 2. Visited species EOs. EOID is a unique identifier for each EO in the Michigan Natural Heritage Database.

Scientific Name	Common Name	EO ID	Results
<i>Arnoglossum plantagineum</i>	Prairie Indian-plantain	12163	Present
<i>Asclepias hirtella</i>	Tall green milkweed	11460	Present
<i>Astragalus neglectus</i>	Cooper's milk vetch	50	Failed to Find
<i>Cypripedium candidum</i>	White lady-slipper	2521	Present
<i>Platanthera leucophaea</i>	Eastern prairie-fringed orchid	364	Failed to Find
<i>Platanthera leucophaea</i>	Eastern prairie-fringed orchid	2999	Failed to Find
<i>Papaipema berriana</i>	Blazing star borer moth	22146	Present
<i>Papaipema berriana</i>	Blazing star borer moth	22147	Present
<i>Emydoidea blandingii</i>	Blanding's turtle	13398	Present

Natural communities

Lakeplain Wet Prairie

EO ID 358

Summary: This EO consists of five polygons: denoted as Polygons A-E from east to west and north to south. All the polygons were very similar in landscape context and vegetative species composition. Polygons A-D were summarized together due to their proximity to each other (near [REDACTED]) while Polygon E is fragmented near [REDACTED]. This EO is visually evident in the landscape as clear graminoid-dominated openings within *Phragmites* monoculture. Two vascular plant EOs overlap EO ID 358: [REDACTED]

[REDACTED] Each species EO will be detailed in their own sections below. The health and integrity of this EO is dependent on invasive *Phragmites* treatments in the surrounding landscape. Lakeplain wet prairies are fire-adapted communities.

Polygons A, B, C, and D

Size: 3.3 acres

Surveyed: 7/25/2023

Location: [REDACTED]

Access: [REDACTED]

Description: The most high quality habitat is restricted to the southern 75% of all four polygons, although the overall vegetative community more closely resembles Great Lakes emergent marsh instead of lakeplain wet prairie currently. The northern 25% was inundated at the time of the survey and dominated by Phragmites and European frog's-bit (*Hydrocharis morsus-renae*). The southern boundaries of these polygons are threatened both by Phragmites and encroachment from woody species. Dominant species included Canada blue-joint grass (*Calamagrostis canadensis*), sedges (*Carex* spp.), bald spike-rush (*Eleocharis erythropoda*), rush species (*Juncus* spp.), northern water-plantain (*Alisma triviale*), and common arrowhead (*Sagittaria latifolia*). Very few lakeplain wet prairie species were present.

Rare Plants: [REDACTED]

Rare Animals: [REDACTED]

Polygon E

Size: 0.8 acres

Surveyed: 8/1/2023

Location: [REDACTED]

Access: [REDACTED]

Description: Virtually identical to Polygons A-D.

Rare Plants: [REDACTED]

Rare Animals: [REDACTED]

EO ID 12438

Summary: This EO is extensive and consists of nine, fragmented polygons labeled Polygon A-I from east to west and north to south. [REDACTED]

[REDACTED] The total size of the EO is 26.1 acres. Several other vascular plant EOs overlap EO ID 12438, [REDACTED]

[REDACTED] Each species EO will be detailed in their own sections below. All three plant species were found within this EO, specifically in Polygons C and H. The health and integrity of this EO is dependent on careful spot treatment of invasive Phragmites within the polygon boundaries accompanied by more aggressive treatments in the surrounding landscape. Lakeplain wet prairies are fire-adapted communities.

Polygon A

Size: 3.2 acres

Surveyed: 6/19/2023

Location: [REDACTED]

Access: [REDACTED]

Description: Polygon A is highly invaded by Phragmites with layers of thatch developing. The soils and vegetation were representative of a lakeplain wet prairie, although conditions were dryer than usual in June. Other invasive species were scattered in the polygon with glossy buckthorn (*Frangula alnus*) and reed canary grass (*Phalaris arundinacea*) in the northwest and glossy buckthorn mostly near the polygon edges and roadside. Deer browsing was evident. Shrubs composed much of the cover and may dominate the polygon once Phragmites is removed via other methods besides prescribed fire. Dominant species (other than Phragmites) included shrubby cinquefoil (*Dasiphora fruticosa*), sand cherry (*Prunus pumila*), Ohio goldenrod (*Solidago ohioensis*), dogwoods (*Cornus* spp.), northern bog aster (*Symphotrichum boreale*), sedges, meadowsweet (*Spiraea alba*), and Canada blue-joint grass.

Rare Plants: [REDACTED]

Rare Animals: [REDACTED]

Polygon B

Size: 2.3

Surveyed: 6/19/2023

Location: [REDACTED]

Access: [REDACTED]

Description: The soils and vegetation are representative of a lakeplain wet prairie, although conditions were dryer than usual in June. There was a significant population of marsh blazing star (*Liatris spicata*) in the northern half of the polygon. Phragmites was sparse and only formed patches in the west and south. Glossy buckthorn and common buckthorn were scattered throughout the polygon. Narrow-leaved cattail was only present in ditches near the road. There were signs of shrub treatment – possibly bulldozing or brush mowing – in the southern half of the polygon. Much of the herbaceous and graminoid vegetation was disturbed where this treatment occurred. [REDACTED]

Dominant species included marsh blazing star, Ohio goldenrod, meadowsweet, Canada blue-joint grass, sedges, northern bog aster, common mountain mint (*Pycnanthemum virginianum*), grass-leaved goldenrod (*Euthamia graminifolia*), and switch grass (*Panicum virgatum*).

Rare Plants: [REDACTED]

Rare Animals: [REDACTED]

Polygon C

Size: 5.9 acres

Surveyed: 6/29/2023

Location: [REDACTED]

Access: [REDACTED]

Description: Polygon C is nestled between beach ridges dominated by oaks (*Quercus* spp.), black cherry (*Prunus serotina*), and common buckthorn. There was a dramatic transition from invasives and shrubs to open lakeplain wet prairie along the western border. Phragmites was invading from the east and west. Glossy buckthorn was encroaching from edges and sparsely scattered throughout the polygon. [REDACTED]

Dominant species included graminoids like Canada blue-joint grass, cordgrass (*Spartina pectinata*), woolly sedge (*Carex pellita*) as well as other sedges. Other dominant species included shrubby cinquefoil, Kalm's St. John's-wort (*Hypericum kalmianum*), dogwoods, and hawthorn (*Crataegus* sp.), Ohio goldenrod, and northern bog aster.

Rare Plants: [REDACTED]

Rare Animals: [REDACTED]

Polygons D and E

Size: 1.1 acres

Surveyed: 6/29/2023,

Location: [REDACTED]

Access: [REDACTED]

Description: Polygons D and E similar in their small size, proximity, landscape context, and species composition. The northern portion of both polygons consist of and are surrounded by a shrubby swamp consisting of buttonbush (*Cephalanthus occidentalis*), willow species (*Salix* spp.), dogwood, Phragmites, and cattail (*Typha* spp.) There is a definite border where sedges and lakeplain wet prairie species become more dominant, which is closer to the ridge line. Marsh blazing star was found in both polygons, but it was browsed in Polygon D. Dominant species in the remnants included wiregrass sedge (*Carex lasiocarpa*), tussock sedge (*Carex stricta*), Canada blue-joint grass, shrubby cinquefoil, purple loosestrife, and northern bog aster.

Rare Plants: [REDACTED]

Rare Animals: [REDACTED]

Polygons F and G

Size: 0.7 acres

Surveyed: 8/1/2023

Location: [REDACTED]

Access: [REDACTED]

Description: Polygons F and G were similar in their small size, proximity, landscape context, and species composition. They were also both similar to Polygons E and G, i.e., most of the northern portion of both polygons were dominated by Phragmites and cattail with the remaining lakeplain wet prairie restricted to the southern border near the forested ridgeline. Dominant species in the prairie remnant included wiregrass sedge, Canada blue-joint grass, grass-leaved goldenrod, Kalm's St. John's-wort, dogwoods, northern bog aster, Joe-pye-weed (*Eutrochium maculatum*), and twig-rush (*Cladium mariscoides*).

Rare Plants: [REDACTED]

Rare Animals: [REDACTED]

Polygon H

Size: 12.9

Surveyed: 6/19/2023 and 8/1/2023

Location: [REDACTED]

Access: [REDACTED]

Description: This polygon is separated into a northern and southern section by a privately owned parcel. The private property was not surveyed. The southern half of the polygon is dominated by graminoids including Phragmites, cattail, Canada blue-joint grass, and Sartwell's sedge (*Carex sartwellii*). [REDACTED]

[REDACTED] The northern half is far more diverse than the southern section and dominated by Canada blue-joint grass, shrubby cinquefoil, Kalm's St. John's-wort, and sedges. [REDACTED]

Rare Plants: [REDACTED]

Rare Animals: [REDACTED]

Polygon I

Size: 3.4

Surveyed: 8/1/2023

Location: [REDACTED]

Access: [REDACTED]

Description: The eastern half of this polygon is located on private property and could not be surveyed. The western border is forested with the two dominant tree species consisting of green ash (*Fraxinus pennsylvanica*) and black willow (*Salix nigra*). Native Phragmites (*Phragmites australis* subsp. *americanus*) was present but mixed with nonnative Phragmites. Dominant species included Canada blue-joint grass, sedges, and shrubby cinquefoil. The Phragmites and cattail were restricted to the western border near the forest and were separated from the higher quality lakeplain wet prairie vegetation by a ditch.

Rare Plants: [REDACTED]

Rare Animals: [REDACTED]



Figure 3. Lakeplain wet prairie (EO ID 12438; polygon I). [REDACTED] and shubby cinquefoil (*Dasiphora fruticosa*) are blooming in the foreground on August 1, 2023. Photograph by Danielle Smith.

Lakeplain Wet-mesic Prairie

EO ID 10525

Size: 2.1 acres

Surveyed: 8/16/2023

Location: [REDACTED]

Access: [REDACTED]

Description: EO 10525 has drastically reduced in size due to the encroachment of invasive and woody species. Approximately 75% of the polygon is dominated by Phragmites, glossy buckthorn, and dogwood. The only portion that remains lakeplain wet-mesic prairie is restricted

to the northeastern corner of the polygon. The prairie remnant is dominated by late goldenrod (*Solidago gigantea*), cordgrass, and big bluestem.

Rare Plants: [REDACTED]

Rare Animals: [REDACTED]

Rare plants

Prairie Fringed Orchid

EO ID 2999

Size: 24.0 acres

Surveyed: 7/25/2023 and 8/16/2023

Location: [REDACTED]

Access: [REDACTED]

Description: This EO consists of four polygons denoted as Polygons f, g, h, and i from east to west and north to south. Polygons f, g, and h [REDACTED] [REDACTED] The northern half of Polygon i could not be surveyed because it overlaps with private property. The only part of Polygon i with suitable habitat was along the southern border along the tree line. North of this border is inundated and dominated by Phragmites and European frog's-bit. No prairie fringed orchid was found at the time of the survey.

Survey results: Failed to find.

Other Invasives: See notes for [REDACTED]

EO ID 364

Size: 16.5 acres

Surveyed: 7/26/2023

Location: [REDACTED]

Access: [REDACTED]

Description: A [REDACTED] that is heavily dominated by invasives. Some patches exhibited higher native species diversity than others. Dominant species included Phragmites, purple loosestrife, glossy buckthorn, Canada blue-joint grass, tussock sedge, and shrubby cinquefoil. Canada thistle (*Cirsium arvense*) was locally abundant. No prairie fringed orchid was found at the time of the survey, although plants were found in 2016.

Survey results: Failed to find.

Other invasive species: Cattail, glossy buckthorn, purple loosestrife, and Canada thistle.

Cooper's Milk Vetch

EO ID 50

Size: 8.0 acres

Surveyed: 7/25/2023

Location: [REDACTED]

Access: [REDACTED]

Description: This EO consists of two polygons denoted as Polygon d and Polygon e from east to west and north to south. Polygon e mostly consists of forested habitat that does not require Phragmites treatments. Both polygons overlap [REDACTED] No Cooper's milk vetch was found at the time of the survey.

Survey results: Failed to find.

Other invasive species: See notes for [REDACTED]

White Lady Slipper

EO ID 2521

Size: 27.9 acres

Surveyed: 6/29/2023

Location: [REDACTED]

Access: [REDACTED]

Description: This EO consists of two polygons designated as Polygon a and Polygon c. Polygon a is the larger of the two and intersects [REDACTED] Polygon c is south of Polygon a and is contained within [REDACTED] Most of the middle section of Polygon a consists of glossy and common buckthorn thickets and dense patches of Phragmites. The northern half of Polygon c could not be accessed because it crossed private property. White lady slipper was only found in Polygon a.

Survey results:

Plant count: 8

Percent flowering: 0

Percent fruiting: 0

Condition: Fair

Habitat: Growing in [REDACTED] with shrubby cinquefoil, marsh blazing star, Ohio goldenrod, Kalm's St. John's-wort, sedges, star grass, tall green milkweed, and small yellow flax (*Linum medium*)

Threats: Disrupted fire regime, encroaching invasive species

Tall Green Milkweed

EO ID 11460

Size: 5120 acres

Surveyed: 6/29/2023

Location: [REDACTED]

Access: [REDACTED]

Description: This EO consists of two Polygons denoted Polygon 1 and 2 from east to west and north to south. Tall green milkweed was only found in Polygon 1 in the northern half of [REDACTED]

Survey results:

Plant count: 33

Percent flowering: 0

Percent fruiting: 64

Condition: Good

Habitat: Found in [REDACTED] with shrubby cinquefoil, marsh blazing star, Ohio goldenrod, Kalm's St. John's-wort, sedges, white lady-slipper, and small yellow flax

Threats: Disrupted fire regime and encroaching invasive species



Figure 4. Rare plant species observed during surveys. Left: New patch of State Threatened tall green milkweed budding (EO ID 11460). Right: State Special Concern tuberous Indian plantain blooming (EO ID 12163). Photographs by Rachel Hackett.

Tuberous Indian Plantain

EO ID 12163

Size: 0.6 acres

Surveyed: 6/29/2023 and 8/1/2023

Location: [REDACTED]

Access: [REDACTED]

Description: This EO overlaps the northeastern corner of [REDACTED]. Dominant species included Canada blue-joint grass, shrubby cinquefoil, Kalm's St. John's-wort, and sedges. The population of tuberous Indian plantain appeared healthy in June (Figure 4) but leaves exhibited signs of heavy insect predation in August.

Survey results:

Plant Count: 210

Percent flowering: 3

Percent fruiting: 50

Condition: Good

Habitat: Growing in [REDACTED] with marsh blazing star, shrubby cinquefoil, grass-leaved goldenrod, Ohio goldenrod, Kalm's St. John's-wort, sedges, Phragmites, glossy buckthorn, big bluestem (*Andropogon gerardii*), switch grass (*Panicum virgatum*), Torrey's rush (*Juncus torreyi*), and winged loosestrife (*Lythrum alatum*)

Threats: Disrupted fire regime, encroaching invasive species

Rare animals

Borer moths (Papaipema spp.)

Surveyed: 9/12/2023 – 9/14/2023

Location: [REDACTED]

Access: [REDACTED]

Survey results: Three areas were surveyed from for borer moths (Figure 5): documented blazing star borer moth EO ID 22146, EO ID 22147, and [REDACTED] (Table 3). [REDACTED] was not surveyed for borer moths given the low density of the host plants, particularly *Liatrix* spp. and the difficulty of access for survey equipment.

Table 3. Results of blacklighting surveys for borer moths in invasive Phragmites treatment areas. EO ID is a unique identifier for each feature in the Michigan Natural Heritage Database (MNFI 2023).

Site Name	EO ID	Date	Results
[REDACTED]	22146	2023-09-13	<ul style="list-style-type: none">Collected 2 adult blazing star borer mothsCollected adult non-listed sunflower borer moth (<i>P. rigida</i>)
[REDACTED]	22147	2023-09-12	<ul style="list-style-type: none">Collected 1 adult blazing star borer moth
[REDACTED]	[REDACTED]	2023-09-14	<ul style="list-style-type: none">Collected 0 adult blazing star borer mothsCollected 2 adult non-listed brick-red borer moth (<i>P. marginidens</i>)

Blanding's turtle

Surveyed: 8/1/2023 – 8/4/2023; 8/14/2023 – 8/19/2023

Location: [REDACTED]

Survey results: TRA surveys for Blanding's turtles were conducted at [REDACTED] between August 1 and August 4, 2023. Traps were deployed at [REDACTED] for a second deployment between August 14 and August 19, 2023. At [REDACTED] 10 traps were deployed in one reference plot for a total of 30 trap nights. These traps were placed in an emergent wetland dominated by European frog-bit, duckweed (*Lemna* spp.), Phragmites, narrow-leaved cattails, and submergent algae. At [REDACTED], during the August 1-4 trapping period, 29 traps were deployed in three reference plots for a total of 87 trap nights. During the August 14-19 trapping period, 20 traps were deployed for 5 nights but 4 trap nights were lost due to trap malfunction, disturbance, and/or removal due to predators (e.g., raccoons) and/or other turtles (e.g., snapping turtles tearing holes in traps), which resulted in a total of 96 trap nights for this trapping period. Traps at [REDACTED] were placed in emergent wetlands dominated by Phragmites, European frog-bit, and water lilies and ditches along roads with duckweed, Phragmites, cottonwood (*Populus deltoides*), common buckthorn, cattail, purple loosestrife, and willows growing in or adjacent to the ditch.

Across the two TRA deployments at [REDACTED], there were 11 total captures of nine different individuals (seven adults and two juveniles) in two of the three reference plots: [REDACTED] (Table 4, Figure 5). Both juveniles were recaptured once on a separate date in a different trap location in the same plot. These captures over the two TRA survey periods at [REDACTED] resulted in overall Blanding's turtle capture rates of 0.06 turtle per trap night (i.e., 11 Blanding's turtles captured over 183 trap nights) and 16.6 trap nights per Blanding's turtle (i.e., 183 trap nights divided by 11 Blanding's turtles).

No Blanding's turtles were captured during the TRA surveys at [REDACTED] in 2023.

Table 4. Base information for the 11 captures of Blanding's turtles at Fish Point State Game Area. Notch code is a unique code marked on the individual before release.

Plot	Date	Notch Code	Age Class	Sex	Capture Type
[REDACTED]	(2) 2023-08-02	2075	Adult	Male	Initial
[REDACTED]	(2) 2023-08-03	2084	Juvenile	Undetermined	Initial
[REDACTED]	(2) 2023-08-03	2085	Juvenile	Undetermined	Initial
[REDACTED]	(2) 2023-08-04	2091	Adult	Male	Initial
[REDACTED]	(2) 2023-08-04	2092	Adult	Female	Initial
[REDACTED]	(2) 2023-08-04	2084	Juvenile	Undetermined	Recapture
[REDACTED]	(2) 2023-08-04	2085	Juvenile	Undetermined	Recapture
[REDACTED]	(2) 2023-08-15	2206	Adult	Female	Initial
[REDACTED]	(2) 2023-08-17	2093	Adult	Female	Initial
[REDACTED]	(3) 2023-08-02	2074	Adult	Female	Initial
[REDACTED]	(3) 2023-08-03	2083	Adult	Male	Initial



Figure 5. Rare animal species observed during surveys. Left: Marsh blazing star borer captured blacklighting on September 13, 2023. Photograph by Dan Earl. Right: Juvenile Blanding's turtle recaptured on August 4, 2023. Photograph by Abigail Allen and Justin Florkowski.

DISCUSSION

Five rare plant species were documented in the invasive *Phragmites* treatment zones. We failed to find two species throughout their documented polygons. Natural communities and rare plant species in [REDACTED] were seriously invaded. In [REDACTED], natural communities and rare species were more diverse and much of the invasive *Phragmites* invasion was restricted to the margins.

State threatened blazing star borer moths were captured in low numbers in [REDACTED] but that is not unusual. They have a low detection rate overall, and other factors may contribute to low detection during a survey period (e.g., variable weather, mistiming of local adult emergence). Finding multiple individuals in several different locations is considered a relatively good sign for their populations, especially in a low count year like 2023. Of the 23 locations in Michigan that were surveyed for borer moths, only 5 locations reported presence, 2 of those in the invasive *Phragmites* treatment zones.

To preserve blazing star borer moth, protection of their larval host plant is key. It is recommended that herbicide not be sprayed aerially near dense populations of blazing star plants (*Liatris* spp.) in [REDACTED], regardless if detection was made at that exact point. There were a few points marked as higher density blazing star plants that were not practical for surveys for other logistical reasons that may house populations of the blazing star borer moth. For invasive *Phragmites* treatment near blazing star plant populations, use as precise application of herbicide as possible to minimize non-target effects.

Prescribed burn as a treatment would best to avoid burning the entire blazing star plant population during the same growing season. Leaving a portion of the blazing star plant population offers refugia for the blazing star borer moth while it overwinters as eggs on their host plant.

State Special Concern Blanding's turtles utilized two areas surveyed with TRA in [REDACTED]. This species has declined throughout its range in recent years. It is currently undergoing a rangewide species status assessment to determine if it warrants listing under the federal Endangered Species Act due to its long-lived nature (over 50-75 years), delayed sexual maturity (14-20 years), and low annual reproductive capacity, high adult and juvenile survival is required to maintain stable populations of this species (Congdon et al. 1993). To avoid non-target effects on Blanding's turtles during invasive *Phragmites* treatment, it is best to treat in these zones after the turtles move to their overwintering sites and enter their winter dormancy. In Michigan, they move to overwintering sites in late-September and October and enter dormancy in late-October to November. Blanding's turtles will emerge from their winter dormancy in the substrate of inundated wetlands in April. Blanding's turtles also have potential to occur in lakeplain prairies. Using precise applications of herbicide for invasive *Phragmites* treatment and leaving some refugia during prescribed burns as recommended for the blazing star borer moth also would benefit the Blanding's turtle. Burning during the inactive season (November-March) or when turtles would be less likely to occur in or move through [REDACTED] (e.g., late July – mid-September).

Several species of marsh and water birds were documented as using several Treatment Zones for breeding habitat in the past (Table 1): American bittern [REDACTED], marsh wren [REDACTED], common gallinule [REDACTED], and Forster's tern [REDACTED]. Since invasive

Phragmites treatment is to occur long after breeding season, it was determined that no adaptations to treatment needed to be made on the account of these occurrences. Broadscale treatment in the spring that drastically and suddenly change the structure of the area such as burning or mowing is not recommended in these areas.

Summary

Six Treatment Zones contained species or habitat that warrants greater precision than aerial herbicide spraying for invasive Phragmites: [REDACTED]. These zones are discussed in more details below. Mapped natural community and rare plant areas should be treated by burning in phases, hand-wicking, or backpack spraying depending on the nearness and density of the invasive Phragmites to those mapped populations. Aerial spraying in these zones should provide enough of a buffer to prevent drift into the mapped communities and rare species areas.

Thirteen Treatment Zones contained habitat for rare animal species that adjustment in treatment timing are recommended to avoid times when the species is using the area. [REDACTED]

[REDACTED] are occupied by Blanding's turtle and should be treated when the turtle is overwintering from late-October to April to minimize non-target effects on the species.

[REDACTED] have been recently occupied by breeding marsh birds, so treatment that disrupts the structure of the area (e.g., burning, mowing) should not be conducted in the spring during the breeding season. These zones are discussed in more details below.

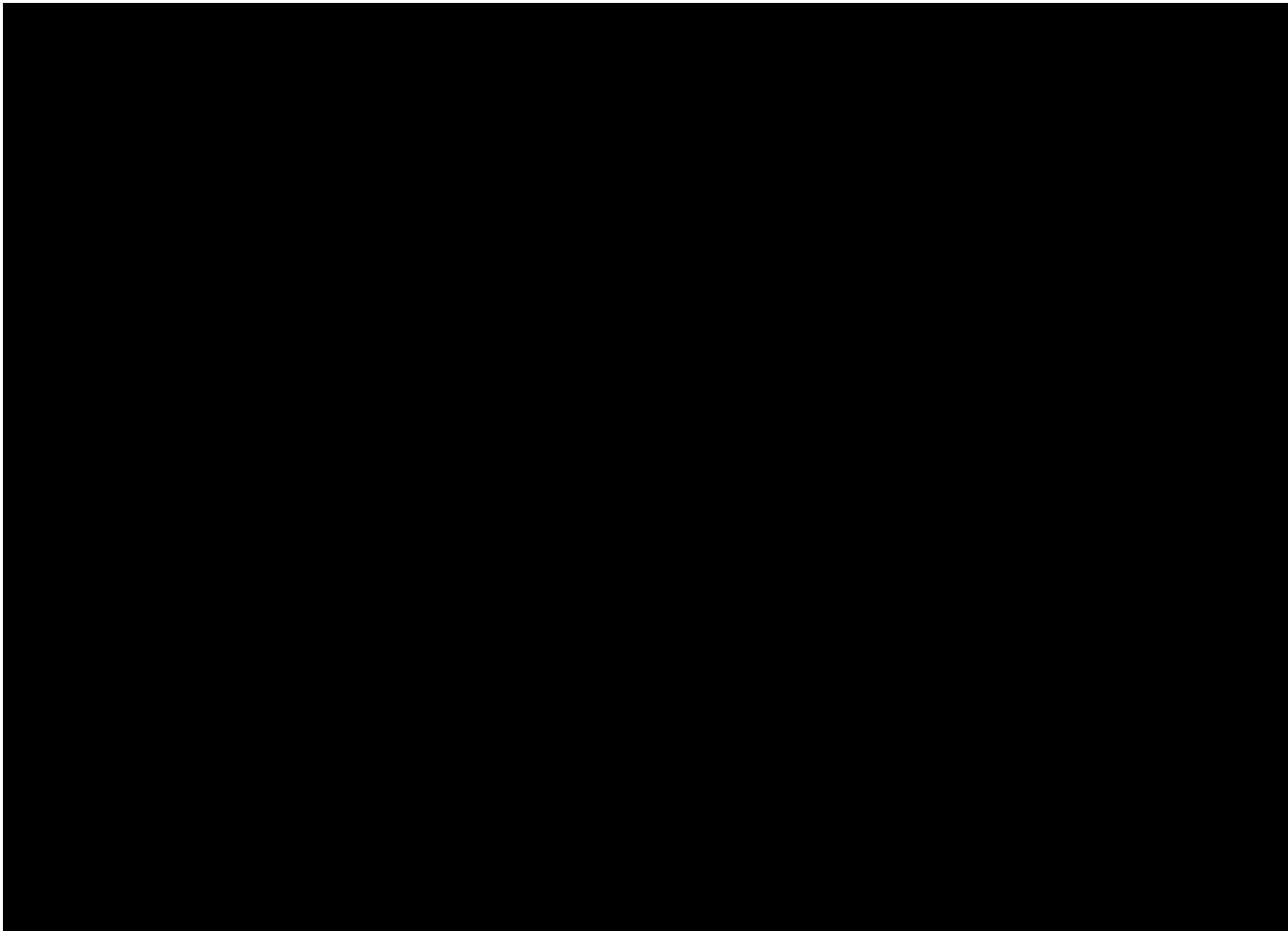


Figure 6. Map of Treatment Zone [redacted] Treatment zones outlined in red indicated invasive Phragmites treatments prior to 2023 but may need follow-up treatments. Yellow outlined Treatment Zones are slated for future treatment. Orange outlines are boundaries of EOs. Inset map shows the location of the Treatment Zone within Saginaw Bay.



Figure 7. Detailed map of EOs in southern portion of Treatment Zone EO ID 358, Treatment zones outlined in red indicated invasive Phragmites treatments prior to 2023 but may need follow-up treatments. Yellow outlined Treatment Zones are slated for future treatment. EO boundaries are orange with dashed blue lines for communities and dashed green lines for plants. Inset map shows the location within Saginaw Bay.

Treatment Zone [REDACTED]

Treatment Sensitivity: High in select areas, low throughout

[REDACTED] This area is a mix of private [REDACTED] and State lands, [REDACTED]. Dense invasive Phragmites stretches from the owned parcels into Saginaw Bay approximately 500 m (1640 ft).

There are two rare species EOs that intersect or are contained in this zone: Federally Endangered prairie fringed orchid (EO ID 364) and State Special Concern Blanding's turtle (EO ID 13398). Although we failed to find prairie fringed orchid in the area on July 26, 2023, prairie fringed orchid was observed in the area as recently as 2016. The area also contain sparsely scattered marsh blazing star, the host plant to the State Threatened blazing star borer moth. Given the nearby extant presence of the blazing star borer moth (EO ID 22146) and its recent low numbers, preservation of the marsh blazing start habitat may be crucial to the blazing star borer moth's survival in Michigan.

Given Treatment Zone [REDACTED] proximity to suitable, connected habitat to where Blanding's turtles were captured and the traveling extent of Blanding's turtle, the [REDACTED] is considered occupied in Treatment Zone [REDACTED]

Phragmites Management Recommendations: Given the presence of Blanding's turtles throughout the zone, invasive Phragmites treatment such as aerial herbicide spraying, backpack herbicide spraying, or burning should occur only when the turtles are overwintering from late-October to April. The potential for breeding marsh bird habitat in the spring limits broadscale treatment affecting the structure of the area (e.g., prescribed burn, mowing) to late-summer, fall, and winter.

Prescribed fire is recommended in the prairie fringed orchid area. If a burn plan is implemented, at least two-thirds of the marsh blazing star population should be left untreated during a season to provide potential refugia for borer moths. If prescribed fire is unfeasible, use herbicide with caution. Hand wick single stems of Phragmites near [REDACTED] as this is close to where the original population of prairie fringed orchid was found. Hand wick stems near marsh blazing star as well. Otherwise, treat large patches with backpack sprayers. Invasive Phragmites located outside the EO boundaries can be treated with more aggressive herbicide application methods as long as the community within the polygon remains unaffected by drift.

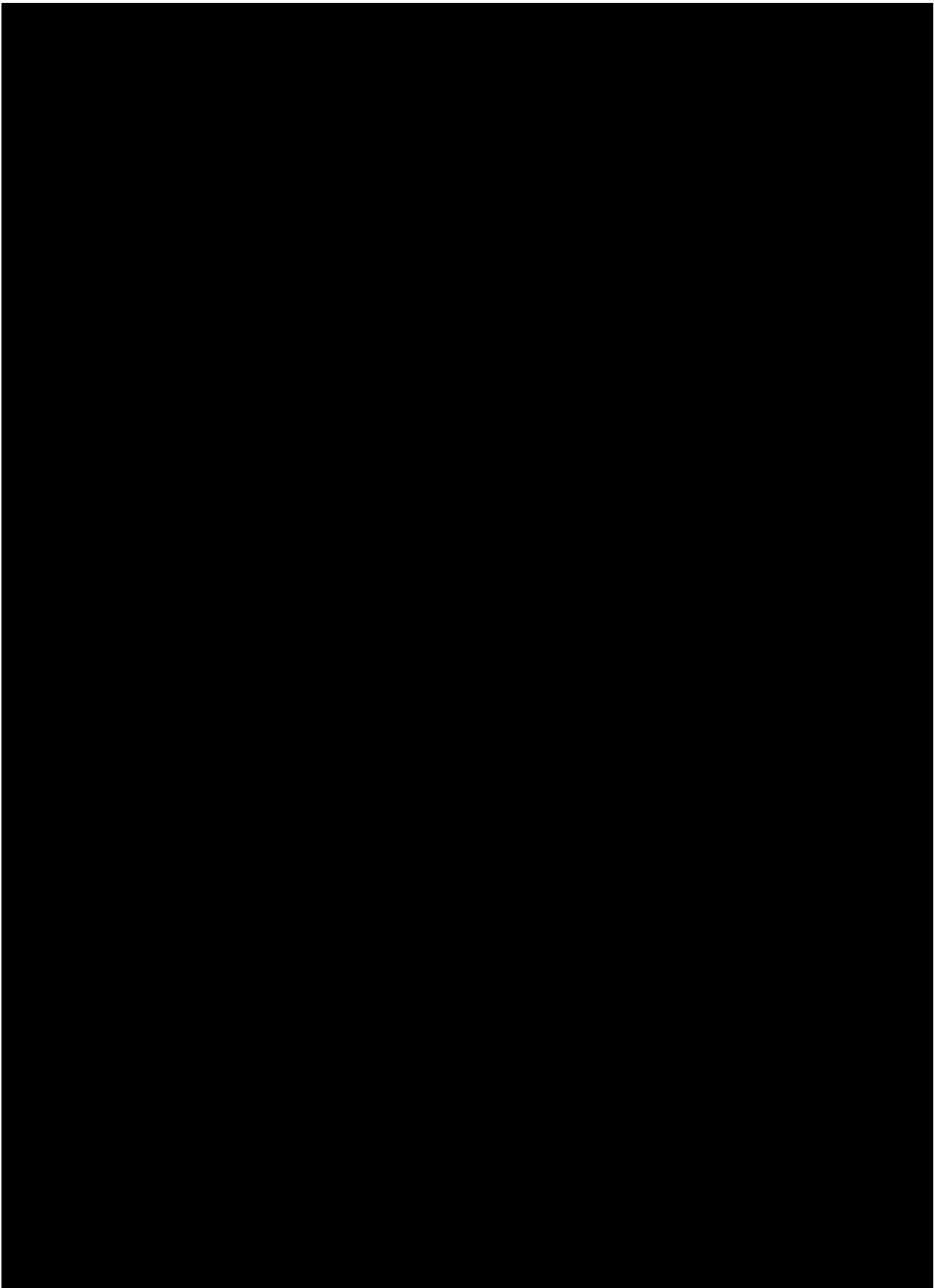


Figure 8. Map of EO ID 364 in Treatment Zone ■ Yellow outlined Treatment Zones are slated for future treatment. Pink outline with dashed green lines represents boundaries of the EO. Inset map shows the location within Saginaw Bay.

Treatment Zone [REDACTED]

Treatment Sensitivity: High in select area

[REDACTED]
[REDACTED] This zone is a mix east to west of State lands ([REDACTED]), [REDACTED] Township lands, and private lands.

There are two EOs that intersect or are contained in this zone: lakeplain wet prairie natural community (EO ID 12348) and State Special Concern Blanding's turtle (EO ID 13398). The lakeplain wet prairie is a quality remnant community with a diverse assemblage of sensitive plant species. It contained dense marsh blazing star, the host plant to the State Threatened blazing star borer moth. Given the nearby extant presence of the blazing star borer moth (EO ID 22146) and its recent low numbers, preservation of the marsh blazing star habitat may be crucial to the blazing star borer moth's survival in Michigan.

Two captures of individual Blanding's turtles occurred on the border of Treatment Zone [REDACTED]. Given the trap location and traveling extent of Blanding's turtle, Treatment Zone [REDACTED] is considered occupied.

Phragmites Management Recommendations: Given the presence of Blanding's turtles throughout the zone, invasive Phragmites treatment such as aerial herbicide spraying, backpack herbicide spraying, or burning should occur only when the turtles are overwintering from late-October to April.

Prescribed fire is recommended in the lakeplain wet prairie area. If a burn plan is implemented, at least two-thirds of the area should be left untreated during a season to provide potential refugia for blazing star borer moths. If prescribed fire is unfeasible, use herbicide with caution. Hand wick single stems of Phragmites near areas of dense marsh blazing star. Otherwise, treat large patches with backpack sprayers. Invasive Phragmites located outside the EO boundaries can be treated with more aggressive herbicide application methods as long as the community within the polygon remains unaffected by drift.

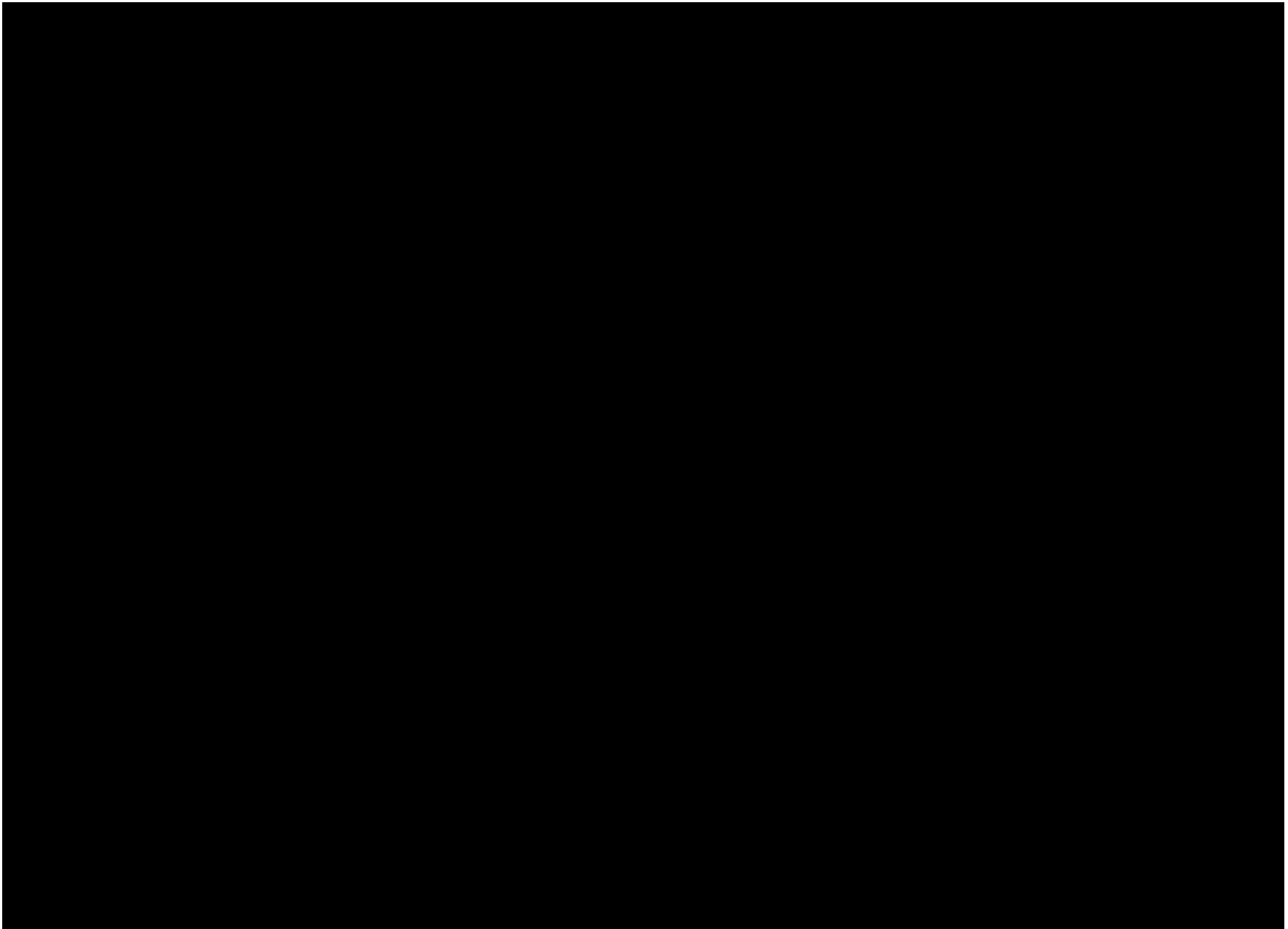


Figure 9. Map of lakeplain wet prairie (EO ID 12438) in Treatment Zone [redacted]. Pink outline with blue dashed line represents the natural community EO. Inset map shows the location of the Treatment Zone within Saginaw Bay.

Treatment Zone [REDACTED]

Treatment Sensitivity: High sensitivity in some areas, low throughout

[REDACTED]

[REDACTED] This zone is a mix State lands ([REDACTED]) and private lands.

There are six EOs across eight polygons that intersect or are contained in this zone (Figure 11): lakeplain wet prairie natural community (EO ID 12348; polygons F,G,H), State Threatened tall green milkweed (EO ID 11460), State Special Concern tuberous Indian plantain (EO ID 12163), State Threatened white lady-slipper (EO ID 2521), State Threatened blazing star borer moth (EO ID 22146) and State Special Concern Blanding's turtle (EO ID 13398). The lakeplain wet prairie is a quality remnant community with a diverse assemblage of sensitive plant species including the three rare plant species EOs mentioned above. The lakeplain wet prairie also contained dense marsh blazing star, the host plant to the State Threatened blazing star borer moth. Blazing star borer moth was present in the lakeplain wet prairie during the 2023 blacklight surveys. Given the borer moth's presence and its recent low numbers, preservation of the marsh blazing star habitat may be crucial to the blazing star borer moth's survival in Michigan.

All eleven captures of Blanding's turtles occurred on the border of Treatment Zone [REDACTED]. Given the trap locations and traveling extent of Blanding's turtle, Treatment Zone [REDACTED] is considered occupied.

Phragmites Management Recommendations: Given the presence of Blanding's turtles throughout the zone, invasive Phragmites treatment such as aerial herbicide spraying, backpack herbicide spraying, or burning should occur only when the turtles are overwintering from late-October to April. The potential for breeding marsh bird habitat in the spring limits broadscale treatment affecting the structure of the area (e.g., prescribed burn, mowing) to late-summer, fall, and winter.

Prescribed fire is recommended in the lakeplain wet prairie area. If a burn plan is implemented, at least two-thirds of the area should be left untreated during a season to provide potential refugia for blazing star borer moths. If prescribed fire is unfeasible, use herbicide with caution. Hand wick single stems of Phragmites near mapped rare species EOs and dense marsh blazing star. Otherwise, treat large patches with backpack sprayers. Invasive Phragmites located outside the EO boundaries can be treated with more aggressive herbicide application methods as long as the community within the polygon remains unaffected by drift.

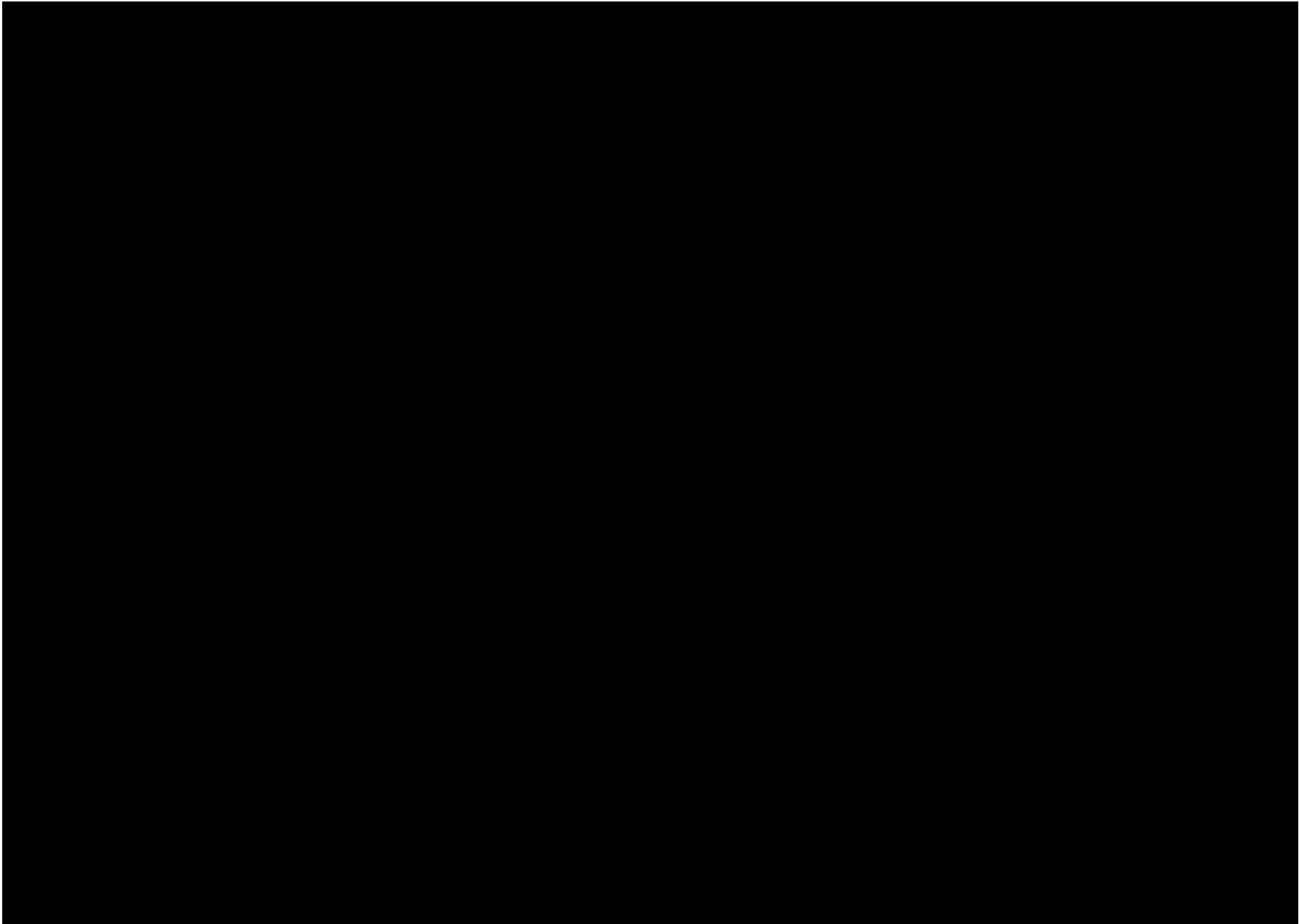


Figure 10. Map of Treatment Zone [redacted] and part of Treatment Zone [redacted] Inset map shows the location of the Treatment Zone within Saginaw Bay.

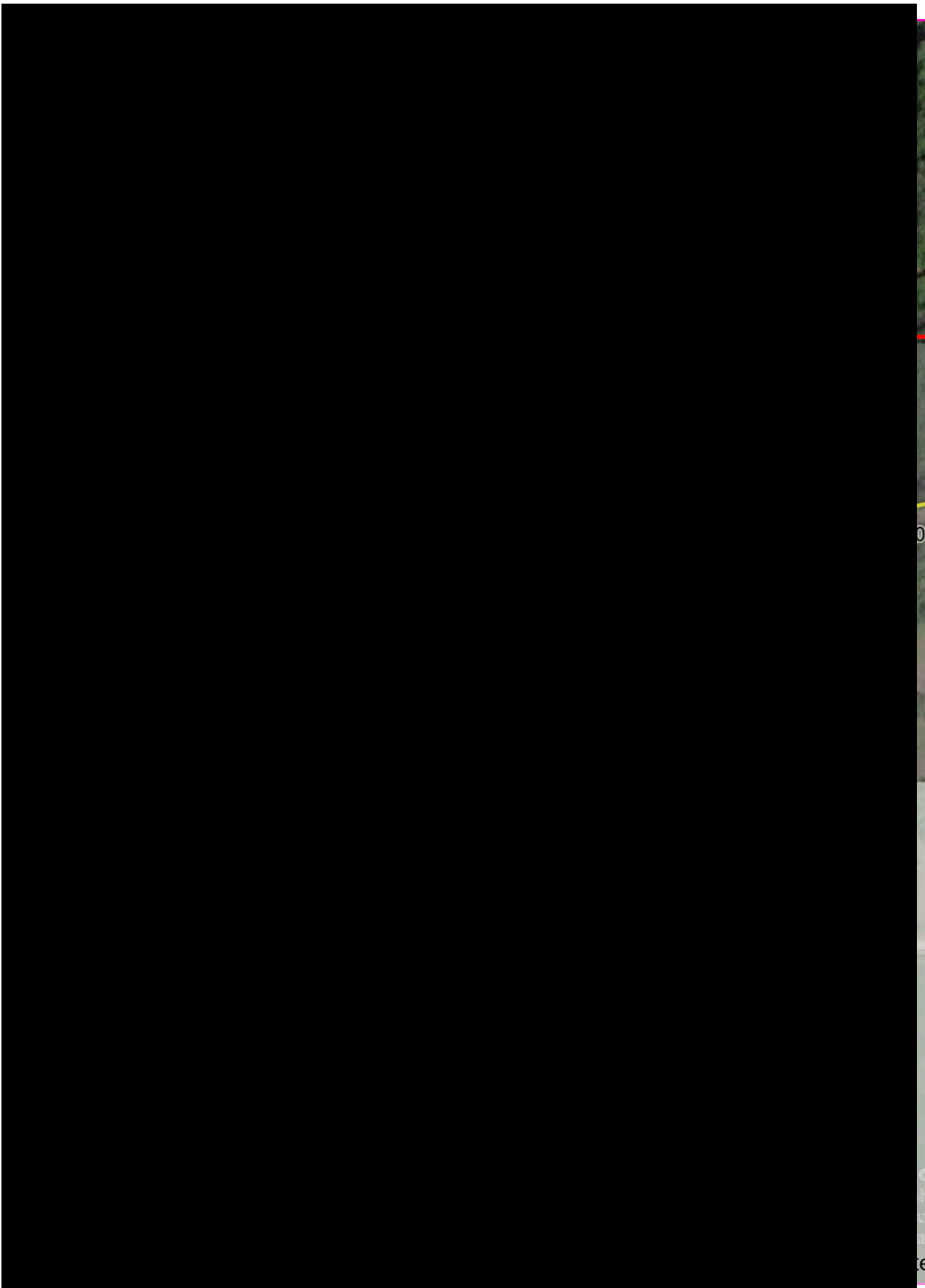


Figure 11. Detailed map of EOs in southern portion of Treatment Zone [redacted]: EO ID 12438, EO ID 11460, EO ID 12163, EO ID 2521, and EO ID 22146. Inset map shows the location of the Treatment Zone within Saginaw Bay.

Treatment Zone [REDACTED]

Treatment Sensitivity: High in some areas

[REDACTED]

[REDACTED] This zone is a mix State lands ([REDACTED]) and private lands.

There are five EOs across ten polygons that intersect or are contained in this zone (Figure 13): lakeplain wet prairie natural community (EO ID 12348; polygons A, B, C, D, E), State Threatened tall green milkweed (EO ID 11460), State Threatened white lady-slipper (EO ID 2521), State Threatened blazing star borer moth (EO ID 22146) and State Special Concern Blanding's turtle (EO ID 13398). The lakeplain wet prairie is a quality remnant community with a diverse assemblage of sensitive plant species including the two rare plant species EOs mentioned above. The lakeplain wet prairie also contained dense marsh blazing star, the host plant to the State Threatened blazing star borer moth. Blazing star borer moth was present in the lakeplain wet prairie during the 2023 blacklight surveys. Given the borer moth's presence and its recent low numbers, preservation of the marsh blazing star habitat may be crucial to the blazing star borer moth's survival in Michigan.

Nine captures of Blanding's turtles occurred on the border of Treatment Zone [REDACTED]. Given the trap locations and traveling extent of Blanding's turtle, Treatment Zone [REDACTED] is considered occupied.

Phragmites Management Recommendations: Given the presence of Blanding's turtles throughout the zone, invasive Phragmites treatment such as aerial herbicide spraying, backpack herbicide spraying, or burning should occur only when the turtles are overwintering from late-October to April.

Prescribed fire is recommended in the lakeplain wet prairie area. If a burn plan is implemented, at least two-thirds of the area should be left untreated during a season to provide potential refugia for blazing star borer moths. If prescribed fire is unfeasible, use herbicide with caution. Hand wick single stems of Phragmites near mapped rare species EOs and dense marsh blazing star. Otherwise, treat large patches with backpack sprayers. Invasive Phragmites located outside the EO boundaries can be treated with more aggressive herbicide application methods as long as the community within the polygon remains unaffected by drift.

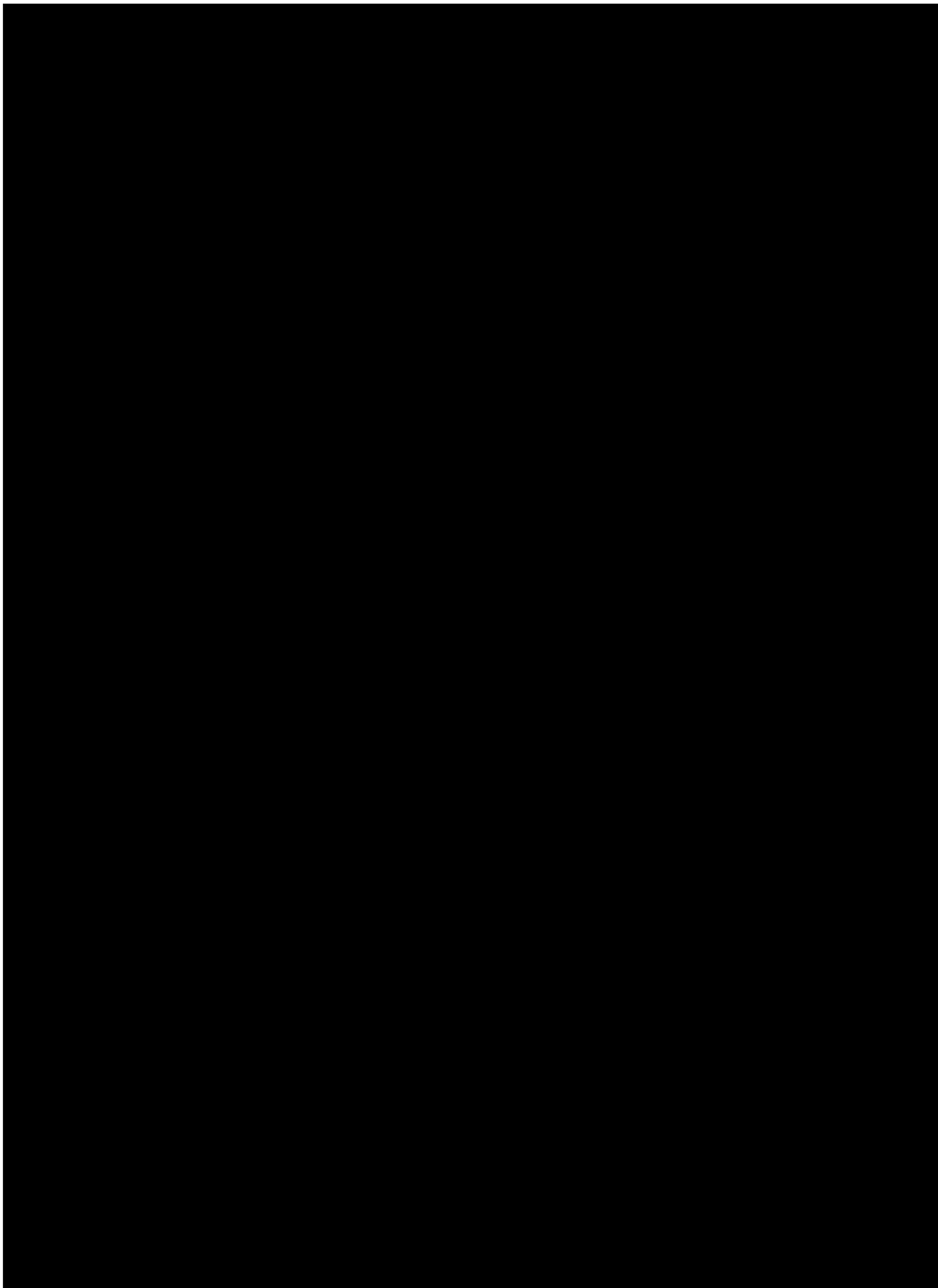


Figure 12. Map of Treatment Zone 1. Inset map shows the location of the Treatment Zone within Saginaw Bay.

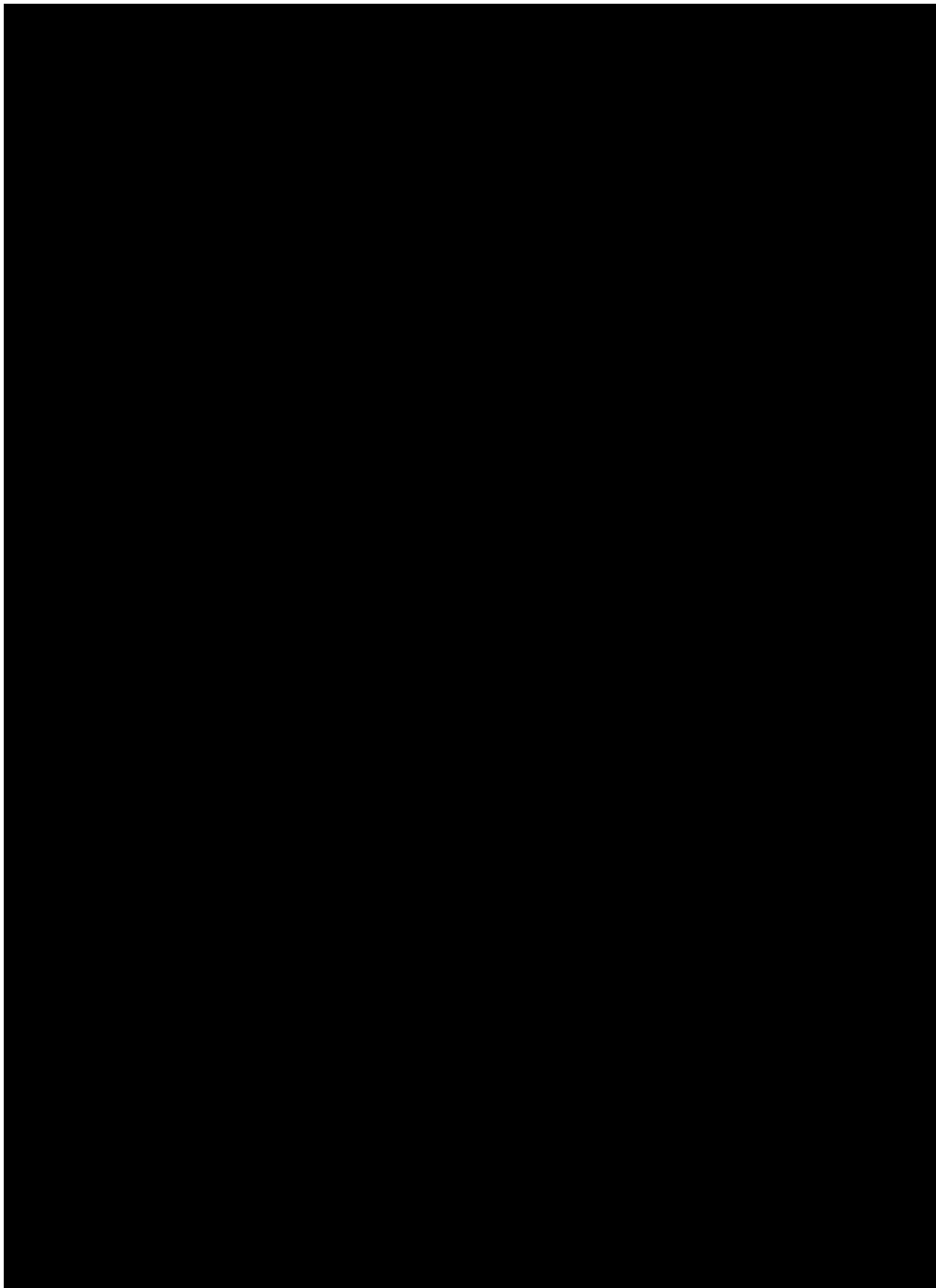


Figure 13. Detailed map of EOs in eastern portion of Treatment Zone [redacted]: EO ID 12438, EO ID 11460, and EO ID 2521. Inset map shows the location of the Treatment Zone within Saginaw Bay.

Treatment Zone [REDACTED]

Treatment Sensitivity: Low in some areas

[REDACTED] This zone is a mix State lands ([REDACTED]) and private lands.

There is one natural community EO within this zone: lakeplain wet-mesic prairie (EO ID 10525). The lakeplain wet-mesic prairie also contained dense marsh blazing star, the host plant to the State Threatened blazing star borer moth. Blazing star borer moth was present in the lakeplain wet prairie during the 2023 blacklight surveys. Although no blazing star borer moths were observed during the blacklight survey, the dense marsh blazing star population and the remaining diverse plant assemblage is worth protecting from non-target treatment damage.

Phragmites Management Recommendations: Prescribed fire is recommended in the lakeplain wet-mesic prairie area. If prescribed fire is unfeasible, use herbicide with caution. Hand wick single stems of Phragmites near dense marsh blazing star. Otherwise, treat large patches with backpack sprayers. Invasive Phragmites located outside the EO boundaries can be treated with more aggressive herbicide application methods as long as the community within the polygon remains unaffected by drift.

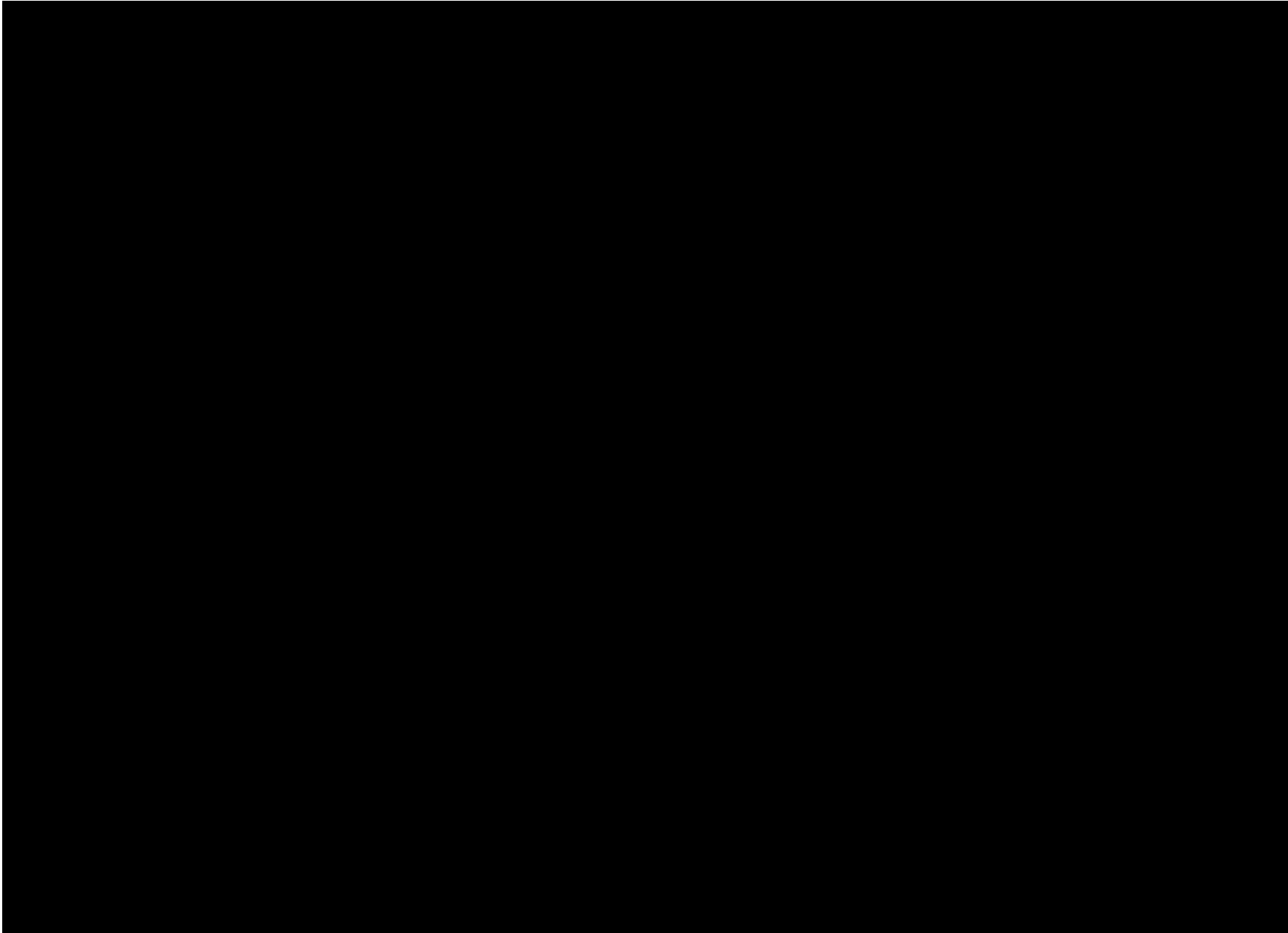


Figure 14. Map of EOs in Treatment Zone [redacted]; EO ID 10525. Inset map shows the location of the Treatment Zone within Saginaw Bay.

Treatment Zones [REDACTED]

[REDACTED]
[REDACTED] Zones [REDACTED] have had recent invasive Phragmites treatment.

Treatment Sensitivity: Low

These areas contain extant EOs of rare marsh bird species and Blanding’s turtles [REDACTED]. No Blanding’s turtles were captured in [REDACTED]. No other extant rare species or natural communities have been documented in these zones.

Phragmites Management Recommendations: The planned fall treatment for invasive Phragmites would not likely affect these species since the timing is well beyond their dependence on the area for breeding. We will advise if any spring treatments are anticipated, surveys for these marsh bird species should be budgeted and conducted. If these species are present, broadscale treatments that will significantly affect the habitat (e.g., prescribed burn, mowing) should not be conducted during the breeding period (i.e., spring).

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APPENDIX A: DEFINITIONS AND NATURESERVE TERMINOLOGY

This appendix contains definitions of terms used in the conservation community including NatureServe and Natural Heritage Program terminology and descriptions for global, state, and element occurrence ranks. Global and state ranks are assigned at a species- or natural community-level. Element occurrence ranks are assigned at a population- or stand-level.

Table A - 1. Additional definitions of terms and abbreviations used in report. Table modified from Cole-Wick et al. 2021.

Term	Description
Element Occurrence (EO)	A record of a listed species or natural community in a Natural Heritage Database that can contribute to the survival or persistence of that element
Natural Community	An assemblage of interacting plants, animals, and other organisms that repeatedly occur under similar environmental conditions across the landscape and is predominantly structured by natural processes rather than modern anthropogenic disturbances, such as timber harvest, alterations to hydrology, and fire suppression. Historically, indigenous peoples were an integral part of Michigan's natural communities with many natural community types being maintained by native management practices such as prescribed fire.
Natural Heritage Database	A repository of records documenting location, status, and characteristics of rare plant populations, animal populations, and natural communities in a designated region

Table A - 2. Explanation of status ranks for plant and animal species. Species with these ranks are tracked in state Natural Heritage Database.

Status	Description	Explanation
E	State endangered	State populations of species are considered endangered: in danger of extinction within the State of Michigan. The species has State protections under the Endangered Species Act of the State of Michigan (Part 365 of PA451, 1994 Michigan Natural Resources and Environmental Protection Act).
T	State threatened	State populations of species are considered threatened: likely to become endangered in the foreseeable future within the State of Michigan.. The species has State protections under the Endangered Species Act of the State of Michigan (Part 365 of PA451, 1994 Michigan Natural Resources and Environmental Protection Act).
SC	State special concern	State populations of species are declining but the species does not have State protections under the Endangered Species Act of the State of Michigan (Part 365 of PA451, 1994 Michigan Natural Resources and Environmental Protection Act). Protection of State special concern amphibian and reptiles are found under Michigan Department of Natural Resources Director's Order No. FO-224-13.
LE	Federally endangered	Populations of this species are considered endangered: in danger of extinction throughout all or a significant portion of its range in the USA. The species has protections under the federal Endangered Species Act of 1973..
LT	Federally threatened	Populations of this species are considered threatened: likely to become endangered within the foreseeable future. The species has protections under the federal Endangered Species Act of 1973.

Table A - 3. Explanation of state and global status ranks for natural communities. Abridged table developed by NatureServe (2021a).

Status	Description	Explanation
S1	Critically Imperiled	At very high risk of extirpation in the jurisdiction due to very restricted range, very few populations or occurrences, very steep declines, severe threats, or other factors.
S2	Imperiled	At high risk of extirpation in the jurisdiction due to restricted range, few populations or occurrences, steep declines, severe threats, or other factors.
S3	Vulnerable	At moderate risk of extirpation in the jurisdiction due to a fairly restricted range, relatively few populations or occurrences, recent and widespread declines, threats, or other factors.
S4	Apparently secure	At a fairly low risk of extirpation in the jurisdiction due to an extensive range and/or many populations or occurrences, but with possible cause for some concern as a result of local recent declines, threats, or other factors.
S5	Secure	At very low or no risk of extirpation in the jurisdiction due to a very extensive range, abundant populations or occurrences, with little to no concern from declines or threats.
G1	Critically Imperiled	At very high risk of extinction or elimination due to very restricted range, very few populations or occurrences, very steep declines, very severe threats, or other factors.
G2	Imperiled	At high risk of extinction or elimination due to restricted range, few populations or occurrences, steep declines, severe threats, or other factors.
G3	Vulnerable	At moderate risk of extinction or elimination due to a fairly restricted range, relatively few populations or occurrences, recent and widespread declines, threats, or other factors.
G4	Apparently secure	At fairly low risk of extinction or elimination due to an extensive range and/or many populations or occurrences, but with possible cause for some concern as a result of local recent declines, threats, or other factors.
G5	Secure	At very low risk of extinction or elimination due to a very extensive range, abundant populations or occurrences, and little to no concern from declines or threats.
GU	Unrankable	Currently unrankable due to lack of information or due to substantially conflicting information about status or trends. NOTE: Whenever possible (when the range of uncertainty is three consecutive ranks or less), a range rank (e.g., G2G3) should be used to delineate the limits (range) of uncertainty.

APPENDIX B: NATURAL COMMUNITIES OF MICHIGAN IN REPORT

This appendix contains abbreviated descriptions and information about the Michigan natural communities encountered for this project. Community overviews are described in Kost et al. (2007), Cohen et al. (2014), and individual community abstracts cited (e.g., Albert and Kost, 1998a). Ecoregion community maps are taken from Albert et al. 2008.

Table B - 1. List of Michigan natural communities encountered during this project. Global and State Rank refers to the global and subnational rarity of each community (See APPENDIX A: Definitions and NatureServe Terminology).

Natural Community	Global Rank	State Rank	Page
Great Lakes marsh	G2	S3	45
Lakeplain wet prairie	G2	S1	46
Lakeplain wet-mesic prairie	G2?	S1	47

Great Lakes marsh

G2 S3

Overview: Great Lakes marsh is an herbaceous wetland community occurring statewide along the shoreline of the Great Lakes and their major connecting rivers. Vegetational patterns are strongly influenced by water level fluctuations and type of coastal feature, but generally include the following: a deep marsh with submerged plants; an emergent marsh of mostly narrow-leaved species; and a sedge-dominated wet meadow that is inundated by storms. Great Lakes marsh provides important habitat for migrating and breeding waterfowl, shore-birds, spawning fish, and medium-sized mammals.

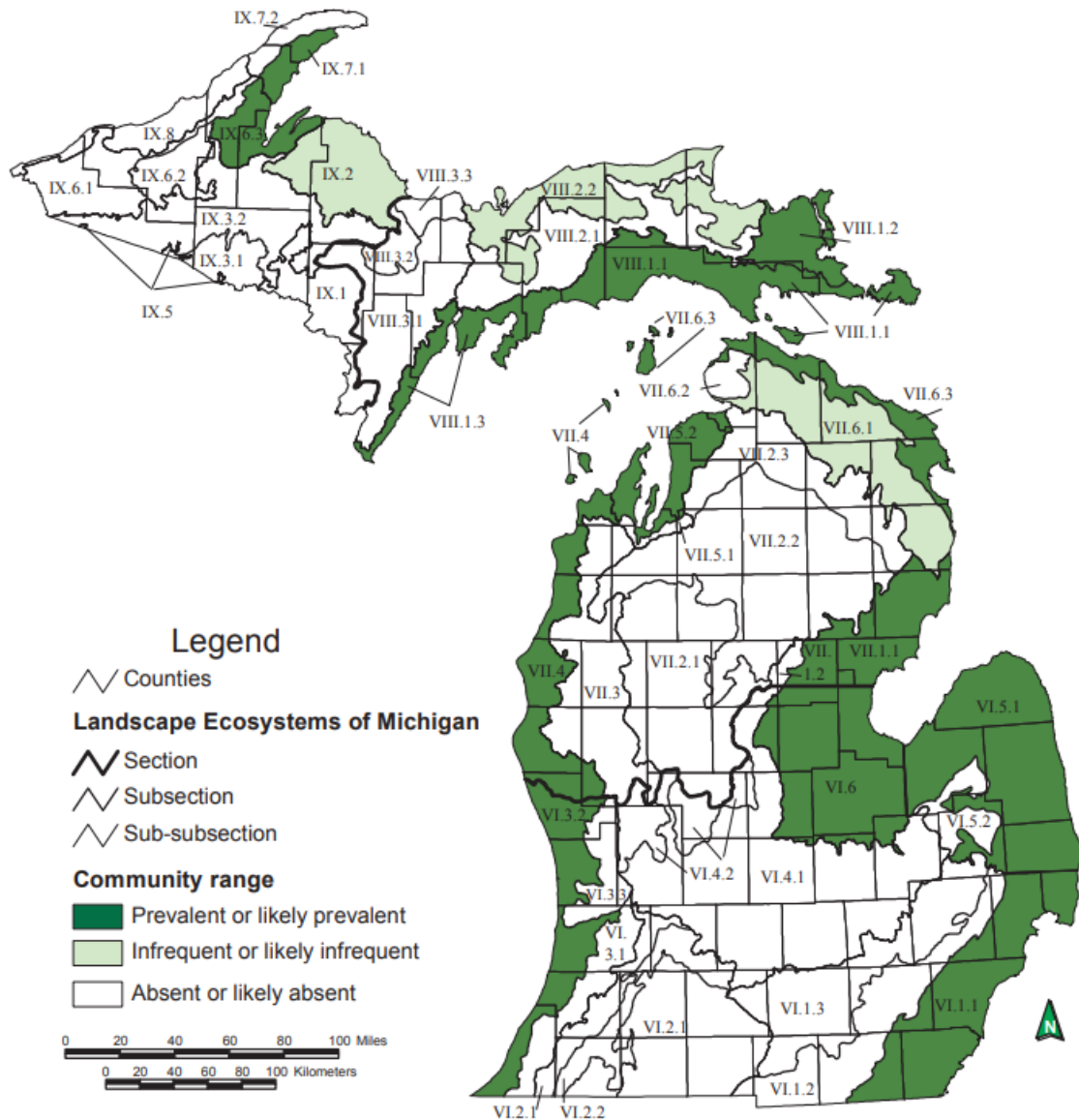


Figure C - 1. Ecoregional map of Michigan (Albert 1995) depicting distribution of Great Lakes marsh (Albert et al. 2008).

Lakeplain wet prairie

G2 S1

Overview: Lakeplain wet prairies occur on level, seasonally inundated glacial lakeplains near the Great Lakes shoreline. It is a native lowland grassland developed on slightly acidic to moderately alkaline sands, sandy loams, or silty clays. It is influenced by seasonal flooding, Great Lakes water levels, beaver, and fire. It is dominated by grasses, sedges, rushes, and a diversity of forbs. Lakeplain wet prairie and wet-mesic prairie are differentiated vegetatively by dominant plant species and differences in seasonal hydrology. It is nearly extirpated from Michigan due to changes in land use, shrubby encroachment, and invasive species.

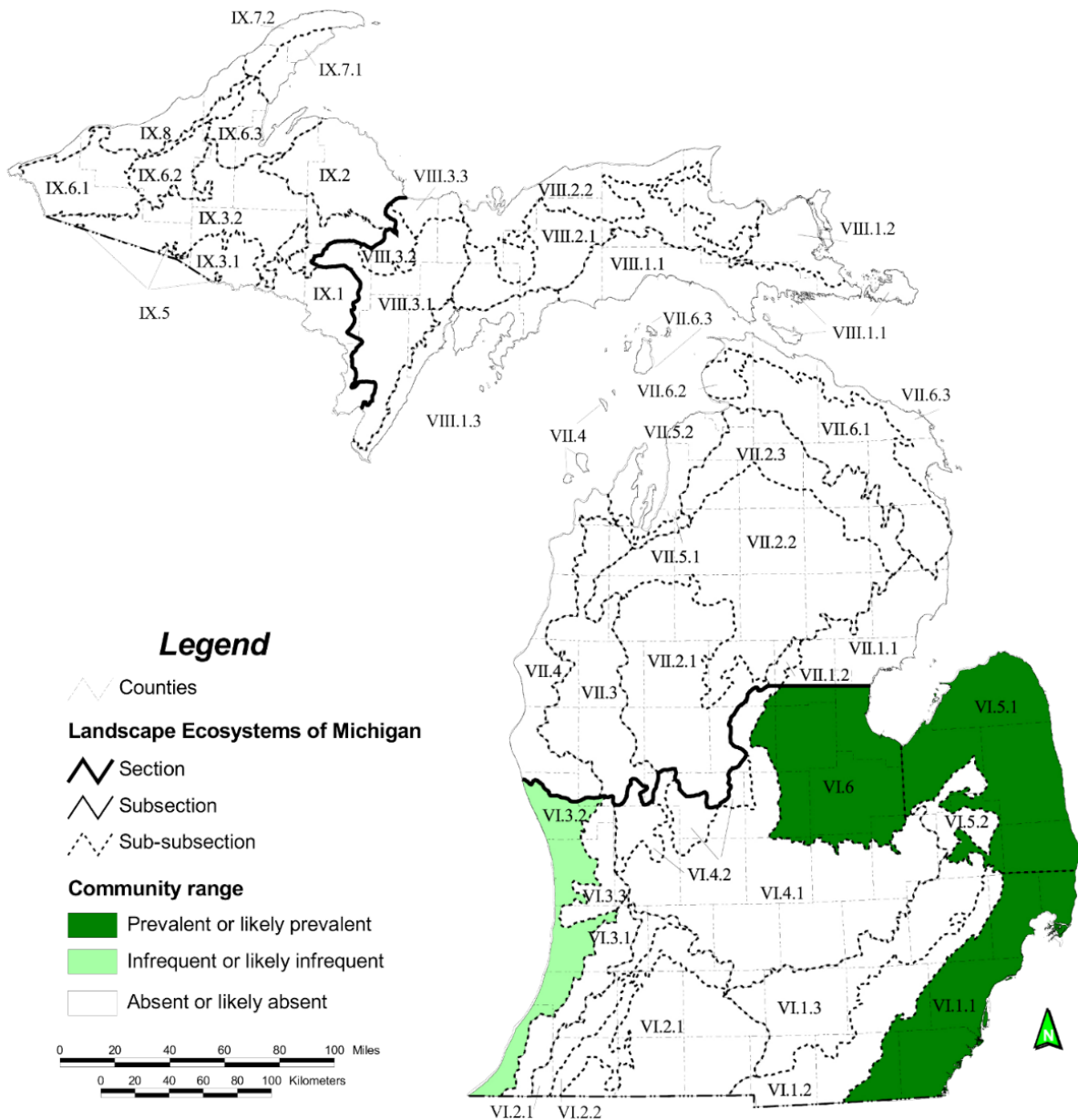


Figure B - 1. Ecoregional map of Michigan (Albert 1995) depicting historical distribution of lakeplain wet prairie (Albert et al. 2008).

Lakeplain wet-mesic prairie

G2? S1

Overview: Lakeplain wet prairies occur on level, seasonally inundated glacial lakeplains near the Great Lakes shoreline. It is a native lowland grassland developed on slightly acidic to moderately alkaline sands, sandy loams, or silty clays. It is influenced by seasonal flooding, Great Lakes water levels, beaver, and fire. It is dominated by prairie grasses, sedges, and a diversity of forbs. Lakeplain wet prairie and wet-mesic prairie are differentiated vegetatively by dominant plant species and differences in seasonal hydrology. It is nearly extirpated from Michigan due to changes in land use, shrubby encroachment, and invasive species.

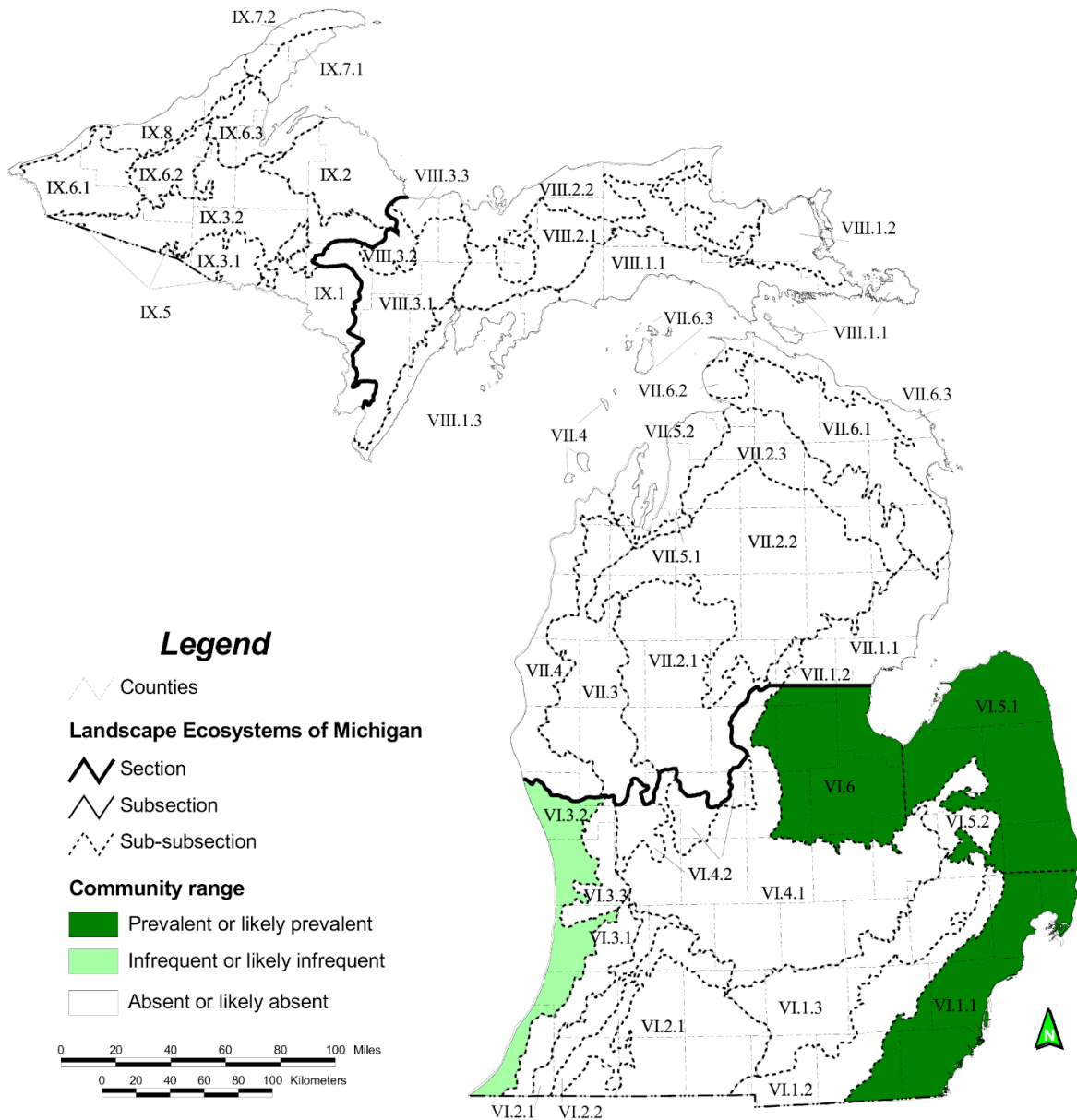


Figure B - 2. Ecoregional map of Michigan (Albert 1995) depicting historical distribution of lakeplain wet-mesic prairie (Albert et al. 2008).

APPENDIX C: INVASIVE SPECIES OBSERVATIONS

During rare plant and natural community surveys, problematic invasive species observations were recorded to be submitted in bulk to the Midwest Invasive Species Information Network (MISIN).

Table C - 1. Observations of problematic invasive species during 2023 surveys. MISIN area categorization is used: 1 – individual/few/several, 2 – < 1,000 ft², 3 – 1,000 ft² to 0.5 acre, 4 – 0.5 acre c - 1 to 1 acre, 5 - > 1 acre. MISIN density categorization is used: 1 – sparse, 2 – patchy, 3 – dense, 4 – monoculture. Coordinates were rounded to five decimal places for display in table.

Species	EO ID/ Polygon	Latitude (DD)	Longitude (DD)	Area	Density	Notes
Autumn olive (<i>Elaeagnus umbellata</i>)	[REDACTED]	[REDACTED]	[REDACTED]	1	1	
Autumn olive	[REDACTED]	[REDACTED]	[REDACTED]	1	1	
Autumn olive	[REDACTED]	[REDACTED]	[REDACTED]	1	1	
Bull thistle (<i>Cirsium vulgare</i>)	[REDACTED]	[REDACTED]	[REDACTED]	4	1	
Bull thistle	[REDACTED]	[REDACTED]	[REDACTED]	1	1	
Bull thistle	[REDACTED]	[REDACTED]	[REDACTED]	1	0	
Bull thistle	[REDACTED]	[REDACTED]	[REDACTED]	1	0	
Canada thistle (<i>Cirsium arvense</i>)	[REDACTED]	[REDACTED]	[REDACTED]	1	1	
Canada thistle	[REDACTED]	[REDACTED]	[REDACTED]	1	1	
Canada thistle	[REDACTED]	[REDACTED]	[REDACTED]	5	2	
Canada thistle	[REDACTED]	[REDACTED]	[REDACTED]	3	2	
Canary reed grass (<i>Phalaris arundinacea</i>)	[REDACTED]	[REDACTED]	[REDACTED]	2	1	
Canary reed grass	[REDACTED]	[REDACTED]	[REDACTED]	5	2	
Canary reed grass	[REDACTED]	[REDACTED]	[REDACTED]	5	1	
				5	3	This point represents the southernmost extent of cut buckthorn
Common buckthorn (<i>Rhamnus cathartica</i>)	[REDACTED]	[REDACTED]	[REDACTED]	5	2	[REDACTED]
Common buckthorn	[REDACTED]	[REDACTED]	[REDACTED]	2	1	
Common buckthorn	[REDACTED]	[REDACTED]	[REDACTED]	2	1	
Crown-vetch (<i>Securigera varia</i>)	[REDACTED]	[REDACTED]	[REDACTED]	2	2	

Species	EO ID/ Polygon	Latitude (DD)	Longitude (DD)	Area	Density	Notes
European frog-bit (<i>Hydrocharis morsus-ranae</i>)	[REDACTED]	[REDACTED]	[REDACTED]	3	2	
European frog-bit	[REDACTED]	[REDACTED]	[REDACTED]	4	2	
Glossy buckthorn (<i>Frangula alnus</i>)	[REDACTED]	[REDACTED]	[REDACTED]	5	3	
Glossy buckthorn	[REDACTED]	[REDACTED]	[REDACTED]	2	2	
Glossy buckthorn	[REDACTED]	[REDACTED]	[REDACTED]	5	2	[REDACTED]
Glossy buckthorn	[REDACTED]	[REDACTED]	[REDACTED]	5	1	
Glossy buckthorn	[REDACTED]	[REDACTED]	[REDACTED]	5	2	
Glossy buckthorn	[REDACTED]	[REDACTED]	[REDACTED]	5	2	
Glossy buckthorn	[REDACTED]	[REDACTED]	[REDACTED]	1	1	
Glossy buckthorn	[REDACTED]	[REDACTED]	[REDACTED]	5	2	
Glossy buckthorn	[REDACTED]	[REDACTED]	[REDACTED]	3	2	
Hybrid cat-tail (<i>Typha xglauca</i>)	[REDACTED]	[REDACTED]	[REDACTED]	3	3	
Invasive Phragmites (<i>Phragmites australis</i> ssp. <i>australis</i>)	[REDACTED]	[REDACTED]	[REDACTED]	4	2	
Invasive Phragmites	[REDACTED]	[REDACTED]	[REDACTED]	5	3	
Invasive Phragmites	[REDACTED]	[REDACTED]	[REDACTED]	5	3	
Invasive Phragmites	[REDACTED]	[REDACTED]	[REDACTED]	3	2	
Invasive Phragmites	[REDACTED]	[REDACTED]	[REDACTED]	2	2	
Invasive Phragmites	[REDACTED]	[REDACTED]	[REDACTED]	5	3	
Invasive Phragmites	[REDACTED]	[REDACTED]	[REDACTED]	5	3	
Invasive Phragmites	[REDACTED]	[REDACTED]	[REDACTED]	3	3	
Invasive Phragmites	[REDACTED]	[REDACTED]	[REDACTED]	3	3	
Invasive Phragmites	[REDACTED]	[REDACTED]	[REDACTED]	3	2	
Invasive Phragmites	[REDACTED]	[REDACTED]	[REDACTED]	5	3	There is a lot of dead Phragmites toward the bay
Invasive Phragmites	[REDACTED]	[REDACTED]	[REDACTED]	2	1	
Invasive Phragmites	[REDACTED]	[REDACTED]	[REDACTED]	3	2	

Species	EO ID/ Polygon	Latitude (DD)	Longitude (DD)	Area	Density	Notes
Invasive Phragmites				4	3	
Invasive Phragmites				5	2	
Moneywort (<i>Lysimachia nummularia</i>)				2	2	
Narrow-leaved cat-tail (<i>Typha angustifolia</i>)				4	3	
Narrow-leaved cat-tail				5	3	
Narrow-leaved cat-tail				5	3	
Narrow-leaved cat-tail				5	3	
Narrow-leaved cat-tail				3	3	
Narrow-leaved cat-tail				5	2	
Narrow-leaved cat-tail				4	2	
Narrow-leaved cat-tail				3	1	
Narrow-leaved cat-tail				2	1	
Narrow-leaved cat-tail				5	2	
Purple loosestrife (<i>Lythrum salicaria</i>)				4	3	
Purple loosestrife				3	2	
Purple loosestrife				5	2	
Purple loosestrife				1	1	
Purple loosestrife				5	2	
Purple loosestrife				3	2	
Purple loosestrife				3	2	
Purple loosestrife				5	2	
Purple loosestrife				5	2	