Summary of Natural Community Surveys for the Parks and Recreation Division

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Cover Photo: Prison Camp Dry Northern Forest, Tahquamenon Falls State Park. Photo by Jesse M. Lincoln.

ACKNOWLEDGMENTS

We thank the Michigan Department of Natural Resources (DNR) Parks and Recreation Division (PRD) for funding this effort to survey for high-quality natural communities in Michigan's State Parks and Recreation Areas. Special thanks are due to PRD's Ray Fahlsing and Glenn Palmgren for overseeing this project. Glenn was instrumental in the development of the workplan and the Threat Assessment Form. This report relies on data collected by many present and former Michigan Natural Features Inventory (MNFI) field scientists, especially: Joshua Cohen, Jesse Lincoln, Aaron Kortenhoven, Bradford Slaughter, Phyllis Higman, Patrick Comer, Dennis Albert, and Harvey Ballard. Editorial support and insightful comments were provided by Jesse Lincoln and Aaron Kortenhoven. Finally, we thank the following MNFI colleagues: Kraig Korroch and Rebecca Rogers assisted with database management; Helen Enander offered technological and map production support; and Sue Ridge, Nancy Toben, Yu Man Lee, and Brian Klatt provided administrative support.

Jesse Lincoln surveying Thompson's Harbor Great Lakes marsh, Thompson's Harbor State Park. Photo by Joshua G. Cohen.

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INTRODUCTION

The Michigan Department of Natural Resources (DNR), Parks and Recreation Division (PRD) is responsible for managing Michigan's State Parks, Recreation Areas, Boating Access Sites, Harbors, Scenic Sites, State Forest Campgrounds, and Pathways. Part of PRD's stated mission is to "acquire, protect, and preserve the natural, historic, and cultural features of Michigan's unique resources." Within the division, the Stewardship Unit is charged with preserving, protecting, and restoring the natural and cultural features. Preservation and restoration of the natural communities within State Parks and Recreation Areas, along with their constituent plants and animals, are core parts of the mission. The PRD is in the process of writing and updating management plans for State Parks and Recreation Areas. In these plans, the land is zoned for various levels of protection and use based on the location and type of its natural and cultural features.

A baseline inventory of rare natural communities was conducted by Michigan Natural Features Inventory (MNFI) in State Parks and Recreation Areas in the late 1990s to early 2000s. However, this initial inventory effort did not include comprehensive boundary mapping, detailed condition assessments, threat assessments, or surveys of common natural communities. To inform the PRD management planning process and the overall protection, preservation, and restoration of natural communities throughout Michigan's State Parks and Recreation Areas, up-to-date information is needed on the boundaries, condition, landscape context, and current threats to the ecological integrity of natural communities. From 2009 to 2012, Michigan Natural Features Inventory (MNFI) conducted a multi-year survey and assessment on state park and recreation area lands of known natural community element occurrences.

In 2013, surveys for new natural communities were conducted in many of the larger parks (i.e., Porcupine Mountains Wilderness State Park and Craig Lake State Parks) and in recently acquired lands including Lime Island State Recreation Area, Menominee River State Recreation Area, Belle Isle State Park, and Rockport State Park. In addition surveys were conducted on current state forest land along the Keweenaw Point in the Baraga State Forest Management Unit that will likely be transferred to PRD ownership. In 2014, MNFI staff and PRD staff identified the need for additional natural community surveys in the following State Parks: Duck Lake State Park, Fisherman's Island State Park, Ludington State Park, Palms Book State Park, Negwegon State Park, Tawas Point State Park, Tahquamenon Falls State Park, Thompson's Harbor State Park, and Wilderness State Park. Surveys within these state parks were conducted during the 2015 field season, targeted rare natural community types (Element Ranking of S1, S2, or S3), and were focused on those natural communities or potential natural communities with high estimated ecological viability (Element Occurrence Ranks A or B). Element occurrence updates were focused on expanding acreage of existing natural community element occurrences.

A natural community is defined as an assemblage of interacting plants, animals, and other organisms that repeatedly occurs under similar environmental conditions across the landscape and is predominantly structured by natural processes rather than modern anthropogenic disturbances. Protecting and managing representative natural communities is critical to biodiversity conservation, since native organisms are best adapted to environmental and biotic forces with which they have survived and evolved over the millennia (Kost et al. 2007, Cohen et al. 2014).

During the summer of 2015, MNFI scientists documented 12 new high-quality natural communities on State Park and Recreation Area lands and also updated eight known high-quality community element occurrences. According to MNFI's natural community classification, there are 77 natural community types in Michigan (Kost et al. 2007, Cohen et al. 2014). Thirteen different natural community types are represented in the 20 element occurrences surveyed (Table 1). No new natural community element occurrences were found at Fisherman's Island State Park. Surveys assessed the current ranking, classification, and delineation of element occurrences and detailed the vegetative structure and composition, ecological boundaries, landscape and abiotic context, threats, management needs, and restoration opportunities.

The primary goal of this survey effort is to provide resource managers and planners with standardized, baseline information on each natural community element occurrence. This baseline information is critical for facilitating site-level decisions about biodiversity stewardship, prioritizing protection, management and restoration, monitoring the success of management and restoration, and informing landscape-level biodiversity planning efforts. This report summarizes the findings of MNFI's 2015 ecological surveys.

METHODS

Field Surveys

The 20 high-quality natural communities were surveyed in eight different State Parks (Table 1) including the following: Duck Lake State Park (1 element occurrence or EO), Ludington State Park (2 EOs), Palms Book State Park (4 EOs), Negwegon State Park (1 EO), Tawas Point State Park (2 EOs), Tahquamenon Falls State Park (5 EOs), Thompson's Harbor State Park (4 EOs), and Wilderness State Park (1 EO). Each natural community was evaluated employing Natural Heritage and MNFI methodology, which considers three factors to assess a natural community's ecological integrity or quality: size, landscape context, and condition (Faber-Langendoen et al. 2008). If a site meets defined requirements for these three criteria (MNFI 1988) it is categorized as a high-quality example of that specific natural community type, entered into MNFI's database as an element occurrence, and given a rank based on the consideration of its size, landscape context, and condition. Ecological field surveys were conducted during the growing season to evaluate the condition and classification of the sites. To assess natural community size and landscape context, a combination of field surveys, aerial photographic interpretation, and Geographic Information System (GIS) analysis was employed. Typically, a minimum of a half day was dedicated to each site, depending on the size and complexity of the site. For sites that occur on multiple ownerships, surveys were restricted to PRD portions of the occurrences unless permission was granted to access other ownerships.

For each site visited, an Ecological Community Field Survey Form (Appendix 1) and a Threat Assessment Form (Appendix 2) were completed. The Threat Assessment Form allows for the scoring of each observed threat in terms of severity, scope, and reversibility. For the purposes of this form, severity was defined as the level of damage to the site caused by the threat, scope was defined as the geographic extent of impact of the threat, and reversibility was defined as the probability of controlling the threat and reversing the damage.

The ecological field surveys typically involved:

a) compiling comprehensive plant species lists and noting dominant and representative species

b) describing site-specific structural attributes and ecological processes

c) measuring tree diameter at breast height (DBH) of representative canopy trees and aging canopy dominants (where appropriate)

d) analyzing soils and hydrology

e) noting current and historical anthropogenic disturbances

f) evaluating potential threats (using the Threat Assessment Form, each observed threat was ranked in terms of its severity, scope, and reversibility, and scores for these categories were summed to generate an overall threat score)

g) ground-truthing aerial photographic interpretation using GPS (Garmin and HP iPAQ units were utilized)

h) taking digital photos and GPS points at significant locations

i) surveying adjacent lands when possible to assess landscape context

j) evaluating the natural community classification and mapped ecological boundaries

k) assigning or updating element occurrence ranks

l) noting management needs and restoration opportunities or evaluating past and current restoration activities and noting additional management needs and restoration opportunities

Following completion of the field surveys, the collected data were analyzed and transcribed to update or create element occurrence records in MNFI's statewide biodiversity conservation database (MNFI 2016). Natural community boundaries were mapped or re-mapped. Information from these surveys and prior surveys, if available, was used to produce threat assessments and management recommendations for each natural community occurrence, which appear within the following Results section.

RESULTS

The 20 occurrences of high-quality natural communities were surveyed during the 2015 field season. As noted above, the 20 sites surveyed were within eight different State Parks (see above and Table 1). A total of thirteen different natural communities were visited including: dry northern forest (1 EO), dry-mesic northern forest (2 EOs), emergent marsh (2 EOs), Great Lakes marsh (3 EOs), limestone cobble shore (1 EO), limestone bedrock glade (1 EO), northern fen (1 EO), northern wet meadow (1 EO), open dunes (2 EOs), poor fen (2 EOs), rich conifer swamp (2 EOs), submergent marsh (1 EO), and wooded dune and swale complex (1 EO). Table 1 lists the visited sites, their element occurrence ranks, and their previous element occurrence ranks if applicable.

The following site summaries contain a detailed discussion for each of these 20 natural communities organized alphabetically by community type and then by element occurrence. The beginning of each grouping of communities contains an overview of the natural community type, which was adapted from MNFI's natural community classification (Kost et al. 2007, Cohen et al. 2014). In addition, an ecoregional distribution map is provided for each natural community type (Albert et al. 2008). For each site summary, the following information is provided:

a) site name
b) natural community type
c) global and state rank (see Appendix 3 for ranking criteria)
d) current element occurrence rank
e) size
f) locational information
g) digital photograph
h) aerial photograph with mapped natural community boundaries
i) threat assessment
j) management recommendations

Tahqua Trail Fen poor fen, Tahquamenon Falls State Park. Photo by Joshua G. Cohen.

Table 1. Summary of Natural Community Surveys (* indicates element occurrences that were updated. Where applicable, old element occurrence rankings provided in parantheses).

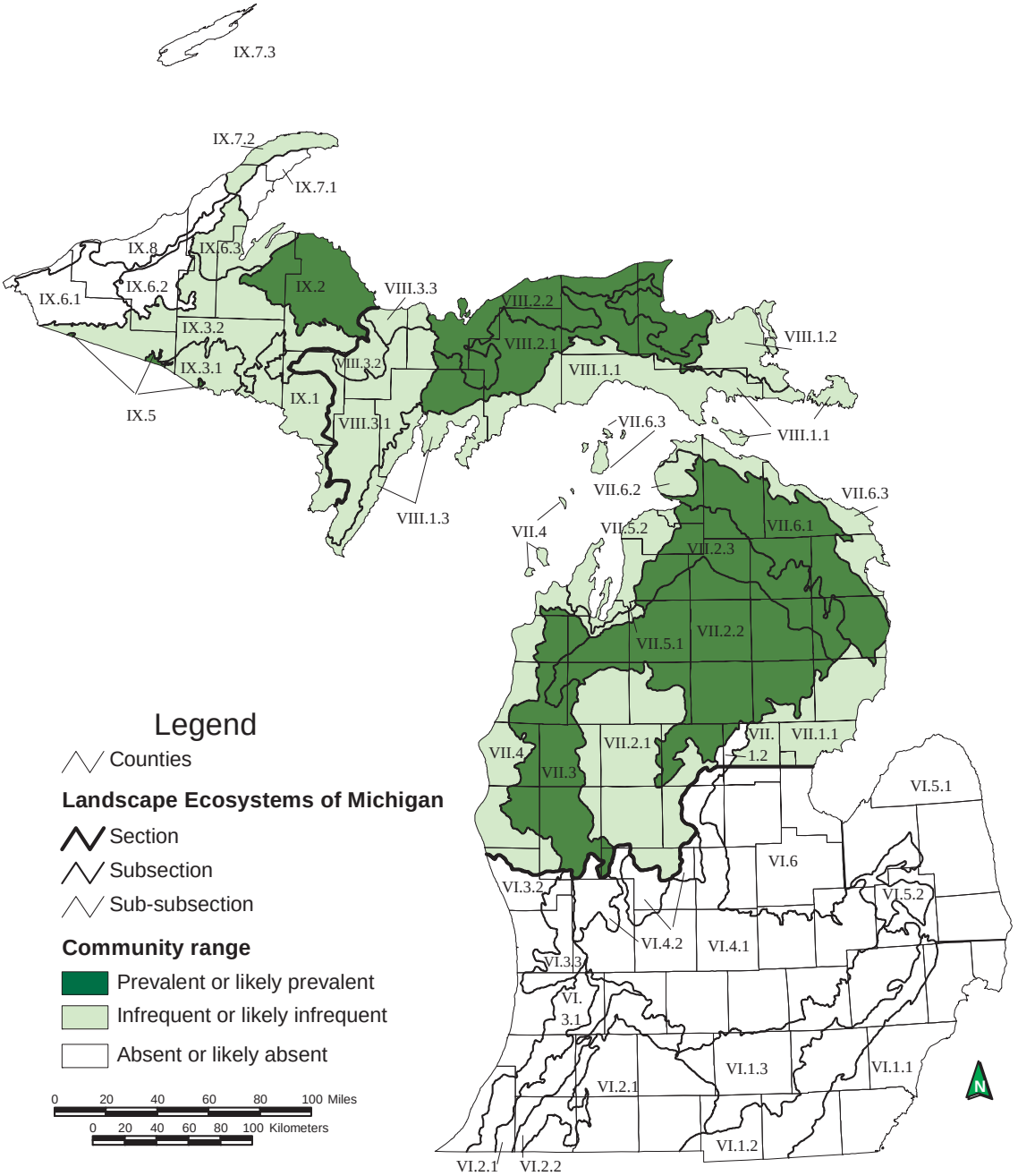
Community Type	EO ID	County	Site Name	Management Area	EO Rank	Surveyor
Dry Northern Forest*	17913	Chippewa	Prison Camp Dry Northern Forest	Tahquamenon Falls State Park	A (AB)	J. Cohen & J. Lincoln
Dry-Mesic Northern Forest	20625	Chippewa	Lynch Creek Forest	Tahquamenon Falls State Park	B	J. Cohen & J. Lincoln
Dry-Mesic Northern Forest*	17923	Chippewa	Prison Camp Pine Ridges	Tahquamenon Falls State Park	AB (AB)	J. Cohen & J. Lincoln
Emergent Marsh	20459	Mason	Hamlin Lake Marsh	Ludington State Park	B	J. Cohen
Emergent Marsh	20627	Schoolcraft	Indian Lake Marsh	Palms Book State Park	AB	J. Cohen & P. Badra
Great Lakes Marsh	20476	Chippewa	Mouth of the Tahquamennon River	Tahquamenon Falls State Park	B	J. Cohen & P. Badra
Great Lakes Marsh	20469	Iosco	Sandy Hook Marsh	Tawas Point State Park	C	J. Cohen & P. Badra
Great Lakes Marsh*	17340	Presque Isle	Thompson's Harbor	Thompson's Harbor State Park	B (B)	J. Cohen & J. Lincoln
Limestone Cobble Shore*	10477	Presque Isle	Thompson's Harbor	Thompson's Harbor State Park	AB (AB)	J. Cohen & J. Lincoln
Limestone Bedrock Glade*	9418	Presque Isle	Thompson's Harbor	Thompson's Harbor State Park	B (B)	J. Cohen & J. Lincoln
Northern Fen*	17341	Presque Isle	Thompson's Harbor	Thompson's Harbor State Park	AB (AB)	J. Cohen & J. Lincoln
Northern Wet Meadow	20628	Schoolcraft	Indian Lake Meadow	Palms Book State Park	AB	J. Cohen & P. Badra
Open Dunes	20461	Muskegon	Duck Lake Dunes	Duck Lake State Park	C	J. Cohen
Open Dunes	20483	Iosco	Tawas Dunes	Tawas Point State Park	C	J. Cohen & P. Badra
Poor Fen	20629	Schoolcraft	Indian Lake Fen	Palms Book State Park	B	J. Cohen & P. Badra
Poor Fen*	17871	Chippewa	Tahqua Trail Fen	Tahquamenon Falls State Park	B (B)	J. Cohen & A. Kortenhoven
Rich Conifer Swamp	20626	Schoolcraft	Big Spring Swamp	Palms Book State Park	BC	J. Cohen & J. Lincoln
Rich Conifer Swamp	20445	Emmet	Waugoshance Swamp	Wilderness State Park	B	J. Cohen & A. Kortenhoven
Submergent Marsh	20460	Mason	Hamlin Lake Marsh	Ludington State Park	B	J. Cohen
Wooded Dune and Swale Complex*	409	Alpena and Alcona	Negwegon Dune and Swale	Negwegon State Park	B (B)	J. Cohen & A. Kortenhoven

Prison Camp Pine Ridges dry-mesic northern forest adjacent to Sheephead Lake, Tahquamenon Falls State Park. Photo by Jesse M. Lincoln.

DRY NORTHERN FOREST

Overview

Dry northern forest is a pine or pine-hardwood forest found throughout the Upper Peninsula and northern Lower Peninsula. The community occurs primarily on sandy glacial outwash plains and lakeplains, and also commonly on upland sand ridges within peatlands on poorly drained glacial outwash plains or lakeplains. Dry northern forest develops on excessively drained, extremely to very strongly acidic sands with low nutrient content. Historically, dry northern forest dominated by jack pine (*Pinus banksiana*) typically originated in the wake of catastrophic fire. Frequent low-intensity ground fires maintained red pine (*P. resinosa*) systems by removing competing hardwoods. In addition to fire, natural processes that influence species composition and community structure include windthrow, insect outbreaks, and severe growing-season frosts (Kost et al. 2007, Cohen et al. 2014).



Map 1. Distribution of dry northern forest in Michigan (Albert et al. 2008).

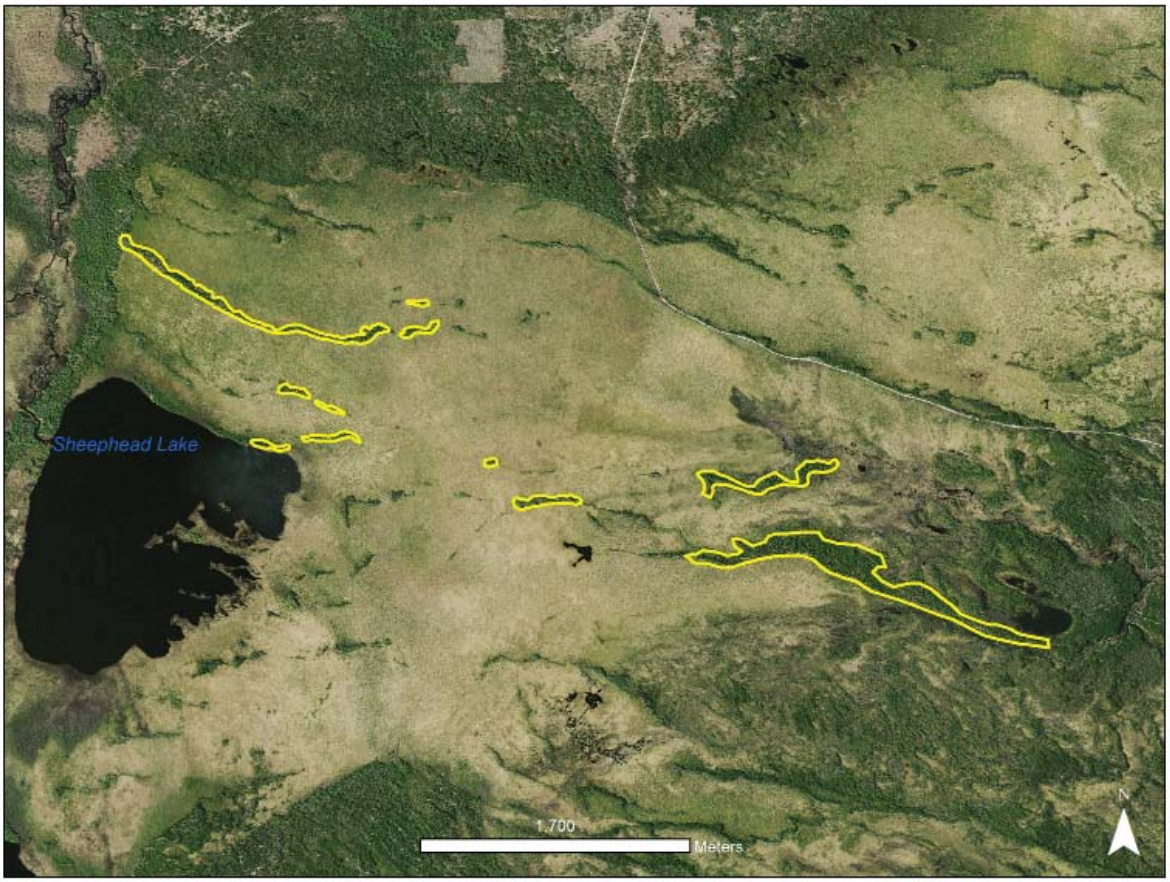
1. Prison Camp Dry Northern Forest
Natural Community Type: Dry Northern Forest
Rank: G3? S3, likely vulnerable globally and vulnerable within the state
Element Occurrence Rank: A
Size: 123 acres
Location: Tahquamenon Falls State Park
Element Occurrence Identification Number: 17913 (EO Update)

Threats: Species composition and structure driven by natural processes. No anthropogenic disturbances or non-native plants were noted during the course of the survey.

Management Recommendations: The primary management recommendation is to allow natural processes to operate unhindered (i.e., allow wildfires to burn). If fire suppression prevents wildfires within the next four decades, prescribed fire could be considered to promote pine regeneration. In the event of a wildfire or if prescribed fire is implemented, establishment of new fire lines should be avoided and existing fire breaks (i.e., roads and wetlands) should be used. New fire breaks could allow for non-native species encroachment.

Prison Camp Dry Northern Forest, Tahquamenon Falls State Park. The 79.5 cm red pine in the center of the picture was cored and estimated to be over 379 years old. Photo by Joshua G. Cohen.

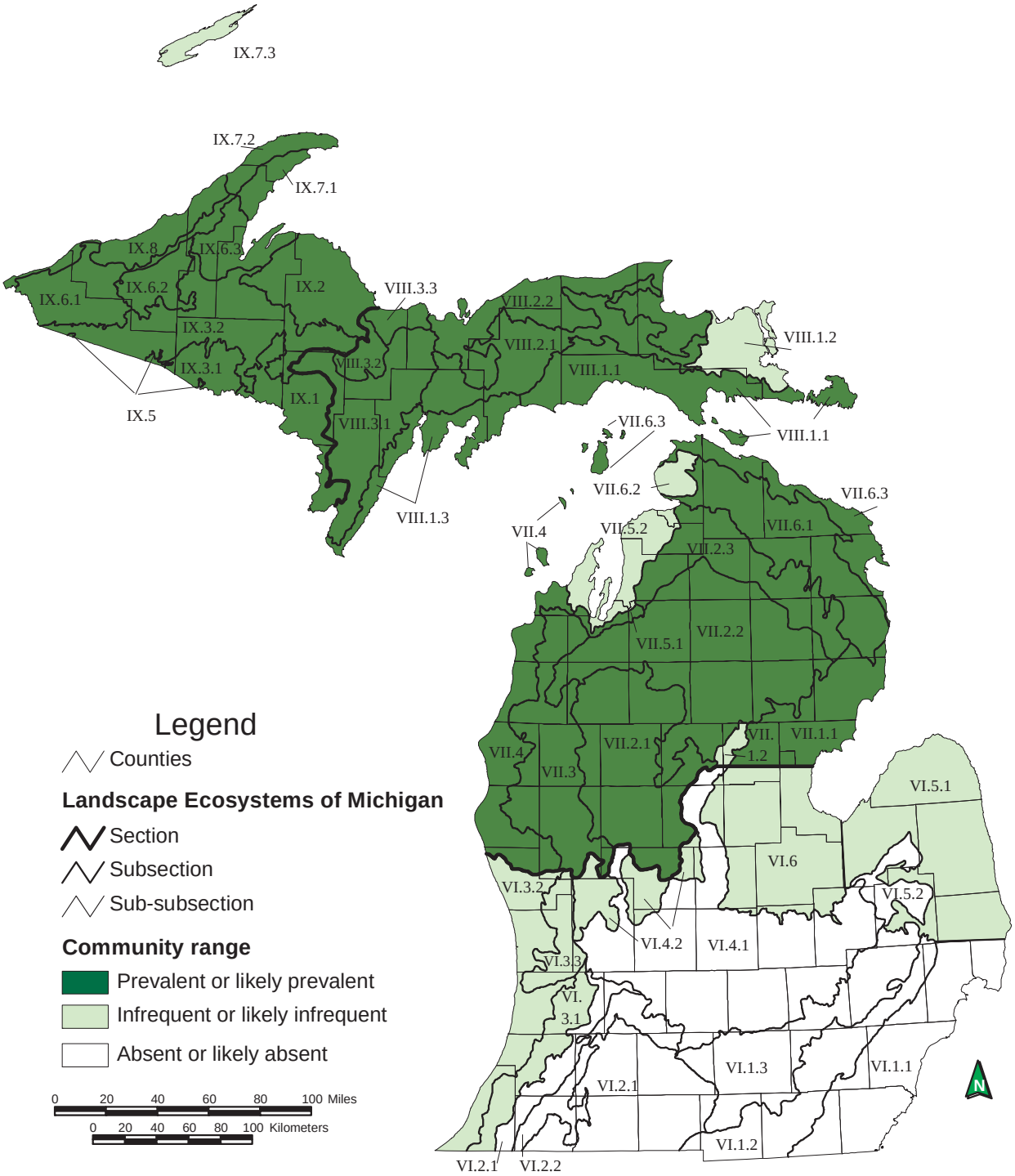
Prison Camp Dry Northern Forest, Tahquamenon Falls State Park. Photo by Joshua G. Cohen.



1998 aerial photograph of Prison Camp Dry Northern Forest.

DRY-MESIC NORTHERN FOREST

Overview: Dry-mesic northern forest is a pine or pine-hardwood forest found throughout the Upper Peninsula and northern Lower Peninsula. The community occurs principally on sandy glacial outwash plains, sandy glacial lakeplains, and less often on inland dune ridges, coarse-textured moraines, and thin glacial drift over bedrock. Dry-mesic northern forest develops on extremely to very strongly acidic sands or loamy sands. Dry-mesic northern forest historically originated in the wake of catastrophic fire and was maintained by frequent low-intensity ground fires. Natural processes that influence species composition and community structure include fire, windthrow, and insect outbreaks (Kost et al. 2007, Cohen et al. 2014).



Map 2. Distribution of dry-mesic northern forest in Michigan (Albert et al. 2008).

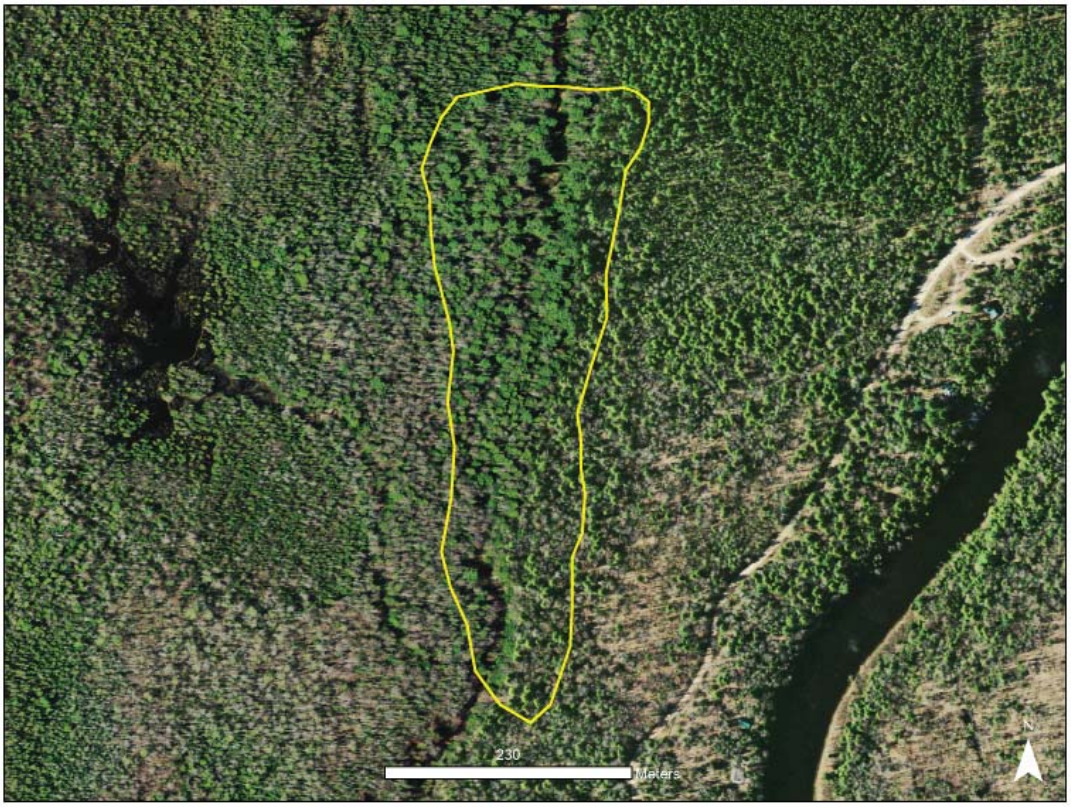
2. Lynch Creek Forest
Natural Community Type: Dry-mesic Northern Forest
Rank: G4 S3, apparently secure globally and vulnerable within the state
Element Occurrence Rank: B
Size: 19 acres
Location: Tahquamenon Falls State Park
Element Occurrence Identification Number: 20625 (New EO)

Threats: Species composition and vegetative structure are patterned by natural processes. No current threats were observed during the course of the survey. Scattered cut stumps occur within the forest.

Management Recommendations: The main management recommendations are to allow natural processes to operate unhindered and to retain an intact buffer of natural communities surrounding the dry-mesic northern forest.

Lynch Creek Forest dry-mesic northern forest, Tahquamenon Falls State Park. Photo by Joshua G. Cohen.

Lynch Creek Forest dry-mesic northern forest, Tahquamenon Falls State Park. Photo by Joshua G. Cohen.

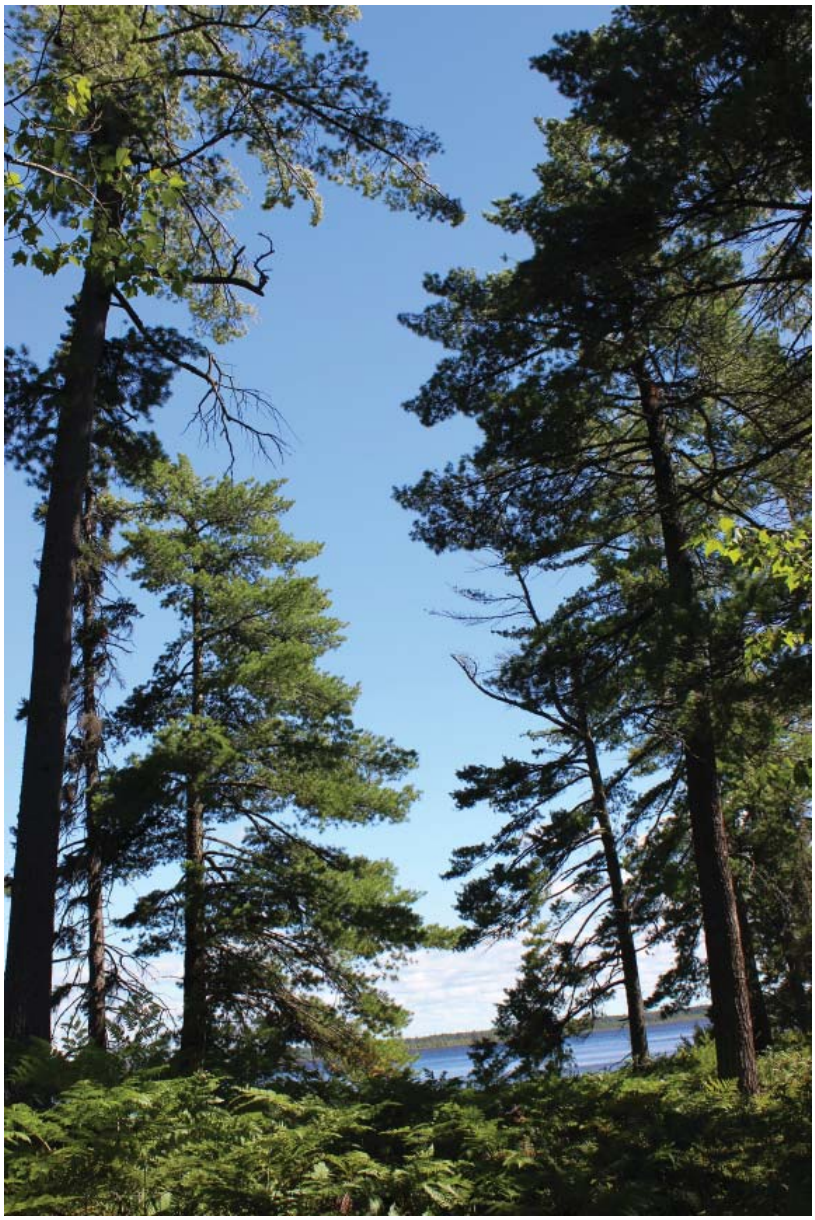


1998 aerial photograph of Lynch Creek Forest dry-mesic northern forest.

3. **Prison Camp Pine Ridges**
Natural Community Type: Dry-mesic Northern Forest
Rank: G4 S3, apparently secure globally and vulnerable within the state
Element Occurrence Rank: AB
Size: 321 acres
Location: Tahquamenon Falls State Park
Element Occurrence Identification Number: 17923 (EO Update)

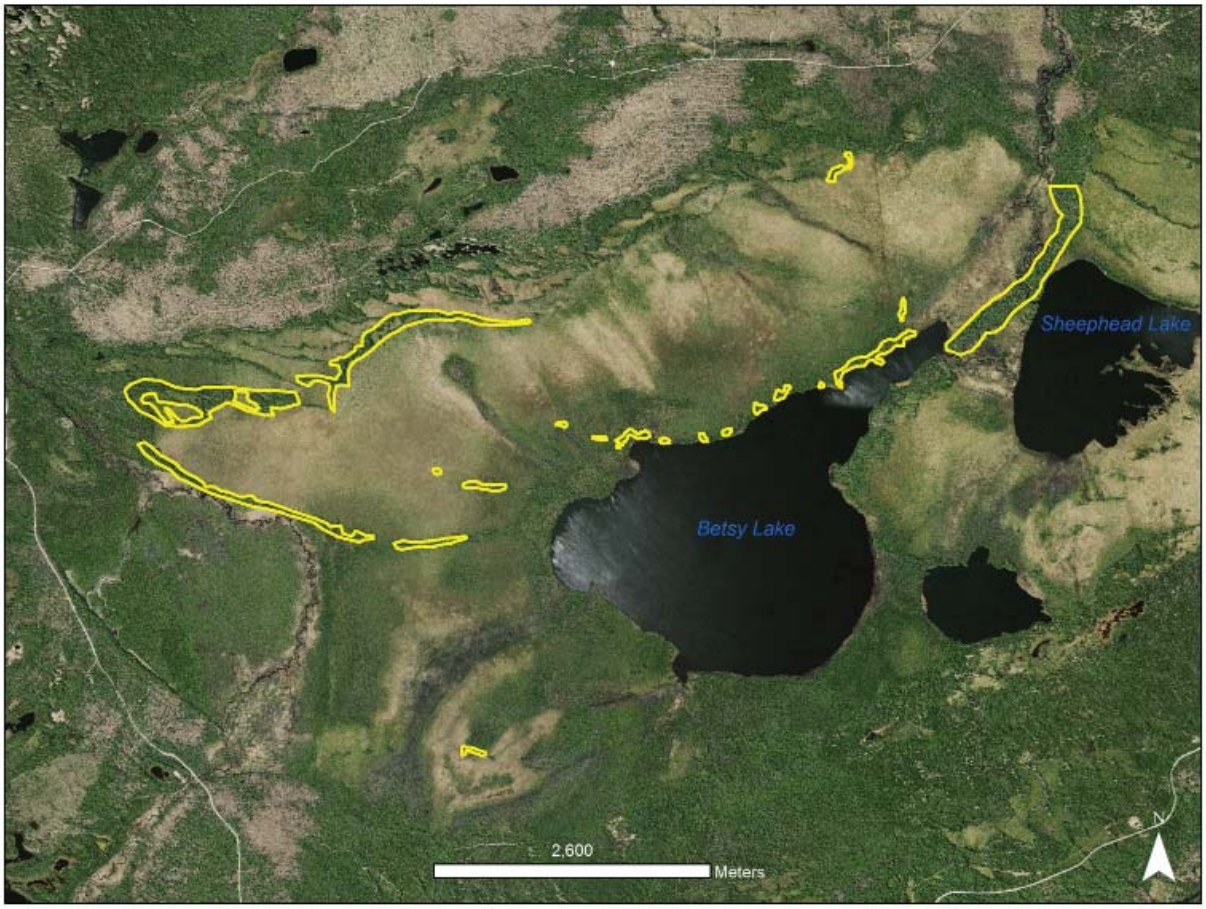
Threats: Species composition and vegetative structure are patterned by natural processes. No current threats were observed during the course of the survey. Some old off-road vehicle trails occur along some of the dune ridges. Areas that burned in 2010 were impacted by fire suppression activity. Off-road vehicle trails occur on burned ridges and many scorched canopy trees were felled, likely as a safety precaution.

Management Recommendations: The primary management recommendation is to allow natural processes to operate unhindered (i.e., permit wildfires to burn through this site and the surrounding wetlands). In the event of future wildfire or if prescribed fire is implemented, establishment of new fire lines should be avoided and existing fire breaks (i.e., roads and wetlands) should be used. Wildfires should be allowed to burn within natural areas. Old off-road vehicle trails and fire breaks should be closed.



Prison Camp Pine Ridges dry-mesic northern forest, Tahquamenon Falls State Park. Photo by Jesse M. Lincoln.

Prison Camp Pine Ridges dry-mesic northern forest, Tahquamenon Falls State Park. Photo by Joshua G. Cohen.



1998 aerial photograph of Prison Camp Pine Ridges, dry-mesic northern forest.

EMERGENT MARSH

Overview: Emergent marsh is a shallow-water wetland that occurs along the shores of lakes and streams throughout Michigan. Water depth of 15 cm (6 in) or more is usually present throughout the growing season. The community develops on all types of mineral soil and bedrock, sometimes covered by loosely consolidated, acidic to alkaline organic deposits of variable depth. Natural processes that influence species composition and community structure include fluctuating water levels, seasonal flooding, and flooding by beaver. Vegetation is comprised of narrow- and broad-leaved graminoids (i.e., grass-like plants) and herbs that extend above the water surface (i.e., emergent plants), as well as floating-leaved plants (Kost et al. 2007, Cohen et al. 2014).

Map 3. Distribution of emergent marsh in Michigan (Albert et al. 2008).

4. **Hamlin Lake Marsh**
Natural Community Type: Emergent Marsh
Rank: GU S4, globally unrankable and secure within the state
Element Occurrence Rank: B
Size: 32 acres
Location: Ludington State Park
Element Occurrence Identification Number: 20459 (New EO)

Threats: The species composition and structure of this emergent marsh is influenced by natural processes and the marsh is buffered by adjacent uplands and wetlands. The invasive narrow-leaved cat-tail (*Typha angustifolia*) is locally dominant within the marsh.

Management Recommendations: The main management recommendations are to allow natural processes to operate unhindered, retain an intact buffer of natural communities surrounding the wetland to minimize the threat of hydrological alteration, and control and monitor for invasive species.

Hamlin Lake Marsh emergent marsh, Ludington State Park. Photo by Joshua G. Cohen.

Hamlin Lake Marsh emergent marsh, Ludington State Park. Photo by Joshua G. Cohen.

1998 aerial photograph of Hamlin Lake Marsh emergent marsh.

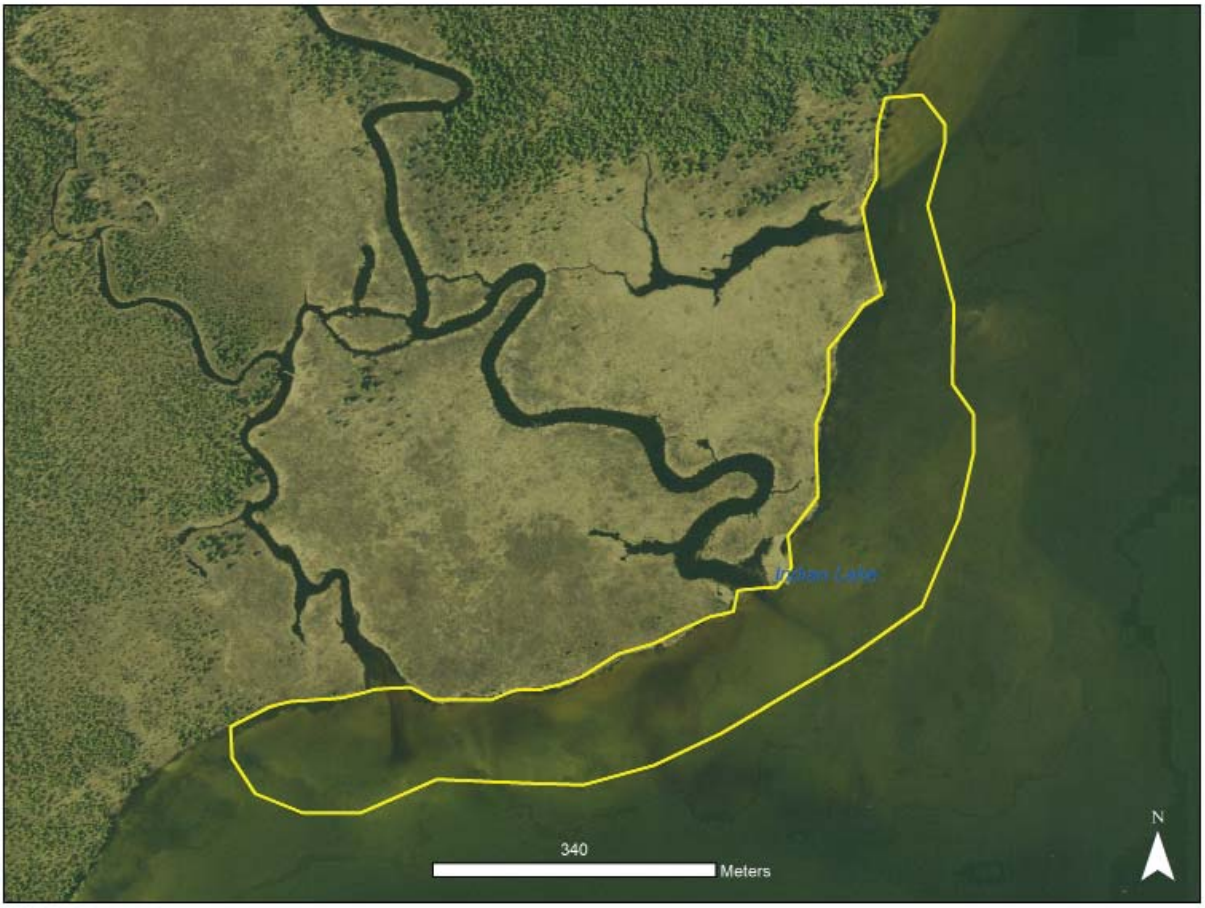
5. **Indian Lake Marsh**
Natural Community Type: Emergent Marsh
Rank: GU S4, globally unrankable and secure within the state
Element Occurrence Rank: AB
Size: 43 acres
Location: Palms Book State Park
Element Occurrence Identification Number: 20627 (New EO)

Threats: The species composition and structure of this emergent marsh is influenced by natural processes and the marsh is buffered by adjacent wetlands. No invasive species were noted during the course of the survey.

Management Recommendations: The main management recommendations are to allow natural processes to operate unhindered, retain an intact buffer of natural communities surrounding the wetland to minimize the threat of hydrological alteration, and monitor for invasive species.

Indian Lake Marsh emergent marsh, Palms Book State Park. Photo by Joshua G. Cohen.

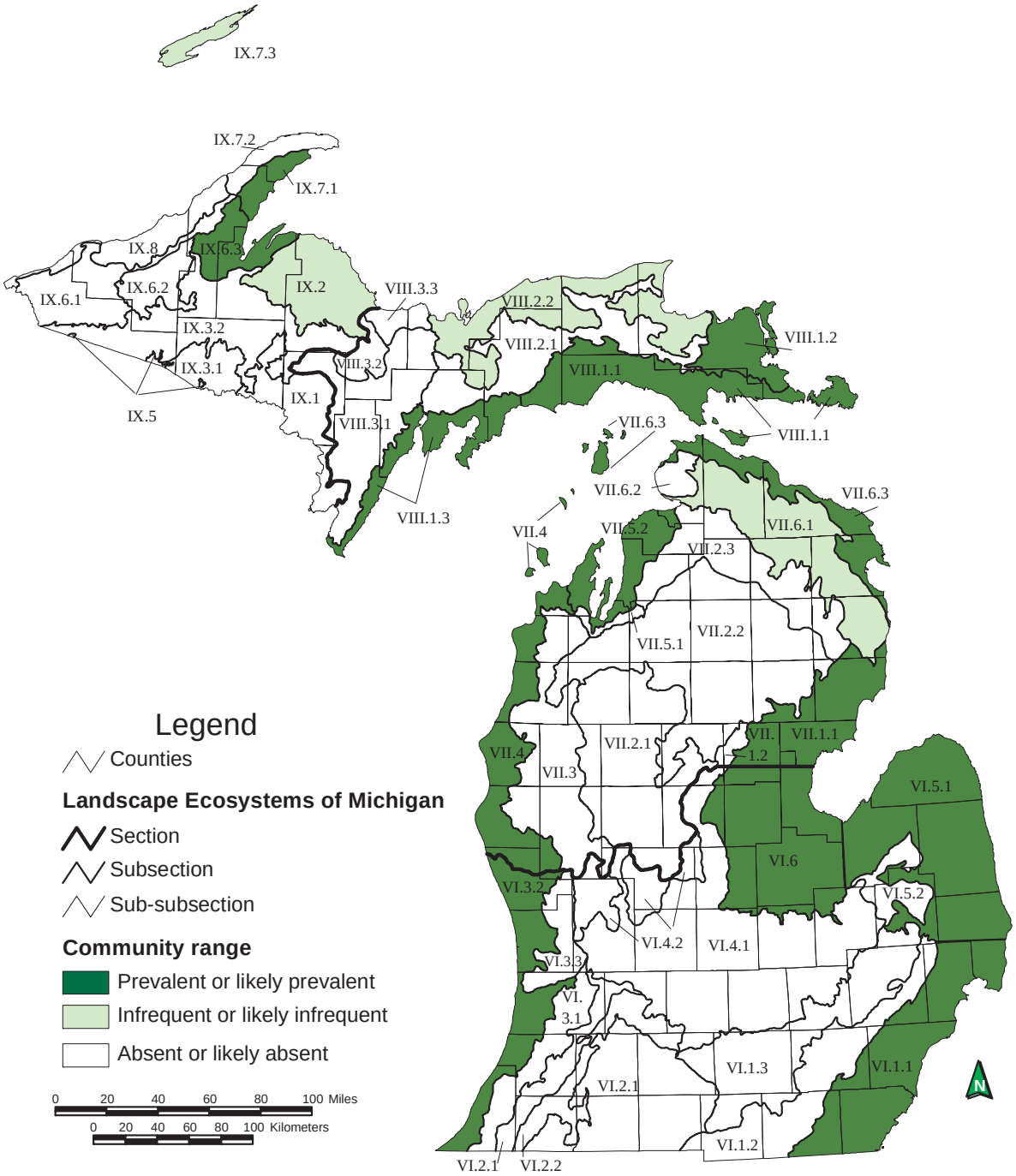
Indian Lake Marsh emergent marsh, Palms Book State Park. Photo by Joshua G. Cohen.



1998 aerial photograph of Indian Lake Marsh emergent marsh.

GREAT LAKES MARSH

Overview: Great Lakes marsh is an herbaceous wetland community occurring statewide along shorelines of the Great Lakes and their major connecting rivers. Great Lakes marsh can be found in association with open, protected, and sand-spit embayments; within dune and swale complexes, tombolos, and barrier-beach lagoons; in buried river mouths and river deltas; and in bays and channels within the connecting rivers. The community develops on all types of mineral soil and occasionally on bedrock, sometimes covered by loosely consolidated, acidic to alkaline organic deposits of variable depth. Vegetation patterns and diversity are strongly influenced by water-level fluctuations and the local configurations of shoreline. Vegetation zones generally include a deep marsh with floating-leaved and submergent plants; an emergent marsh of mostly narrow-leaved species such as bulrushes; and a sedge-dominated wet meadow that can be inundated by storms (Kost et al. 2007, Cohen et al. 2014).



Map 4. Distribution of Great Lakes marsh in Michigan (Albert et al. 2008).

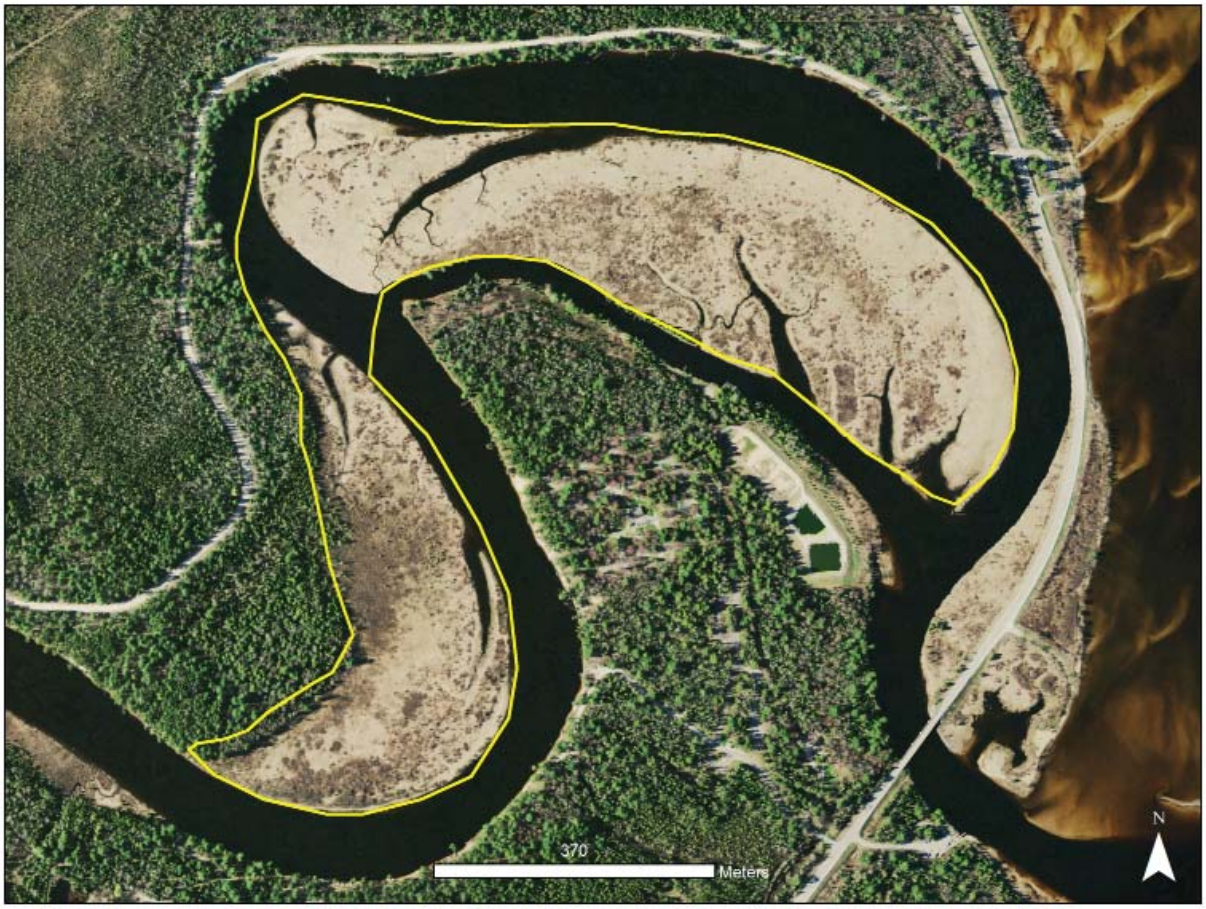
6. **Mouth of the Tahquamenon River**
Natural Community Type: Great Lakes Marsh
Rank: G2 S3, globally imperiled and vulnerable within the state
Element Occurrence Rank: B
Size: 100 acres
Location: Tahquamenon Falls State Park
Element Occurrence Identification Number: 20476 (New EO)

Threats: Species composition and zonation of the marsh are patterned primarily by natural processes. Michigan highway M-123 occurs to the east of the marsh and may partially interrupt the connectivity of the marsh to Whitefish Bay. Localized areas of emergent marsh are dominated by narrow-leaved cat-tail (*Typha angustifolia*) in the eastern portion of the marsh. A fair amount of boat traffic along the Tahquamenon River passes through this marsh.

Management Recommendations: The primary management recommendations are to allow natural processes to operate unhindered, control the narrow-leaved cat-tail population, and maintain a natural community buffer surrounding the marsh to prevent the increase of the weedy seed source and protect the hydrologic regime. Monitoring should be implemented following efforts to control invasive species.

Mouth of the Tahquamenon River Great Lakes marsh, Tahquamenon Falls State Park. Photo by Joshua G. Cohen.

Mouth of the Tahquamenon River Great Lakes marsh, Tahquamenon Falls State Park. Photo by Joshua G. Cohen.



1998 aerial photograph of the Mouth of the Tahquamenon River Great Lakes marsh.

7. Sandy Hook Marsh
Natural Community Type: Great Lakes Marsh
Rank: G2 S3, globally imperiled and vulnerable within the state
Element Occurrence Rank: C
Size: 15 acres
Location: Tawas Point State Park
Element Occurrence Identification Number: 20469 (New EO)

Threats: Species composition and zonation of the marsh are patterned primarily by natural processes but are locally influenced by invasive species. The invasives reed (*Phragmites australis* subsp. *australis*) and narrow-leaved cat-tail (*Typha angustifolia*) are locally dominant, especially in areas of deeper water (>50 cm). In addition purple loosestrife (*Lythrum salicaria*) occurs locally.

Management Recommendations: The primary management recommendations are to allow natural processes to operate unhindered, control invasive plants, and maintain a natural community buffer surrounding the shoreline to prevent the increase of the weedy seed source and protect the hydrologic regime. Monitoring should be implemented following efforts to control invasive species.

Sandy Hook Marsh Great Lakes marsh, Tawas Point State Park. Photo by Joshua G. Cohen.

Sandy Hook Marsh Great Lakes marsh, Tawas Point State Park. Photo by Joshua G. Cohen.

1998 aerial photograph of the Sandy Hook Marsh Great Lakes marsh.

8. Thompson's Harbor
Natural Community Type: Great Lakes Marsh
Rank: G2 S3, globally imperiled and vulnerable within the state
Element Occurrence Rank: B
Size: 55 acres
Location: Thompson's Harbor State Park
Element Occurrence Identification Number: 17340 (EO Update)

Threats: Species composition and zonation of the marsh are patterned primarily by natural processes. Hybrid cat-tail (*Typha* x*glauca*) occurs locally within the marsh.

Management Recommendations: The primary management recommendations are to allow natural processes to operate unhindered, control the hybrid cat-tail population, and maintain a natural community buffer surrounding the marsh to prevent the increase of the weedy seed source and protect the hydrologic regime. Monitoring should be implemented following efforts to control invasive species.

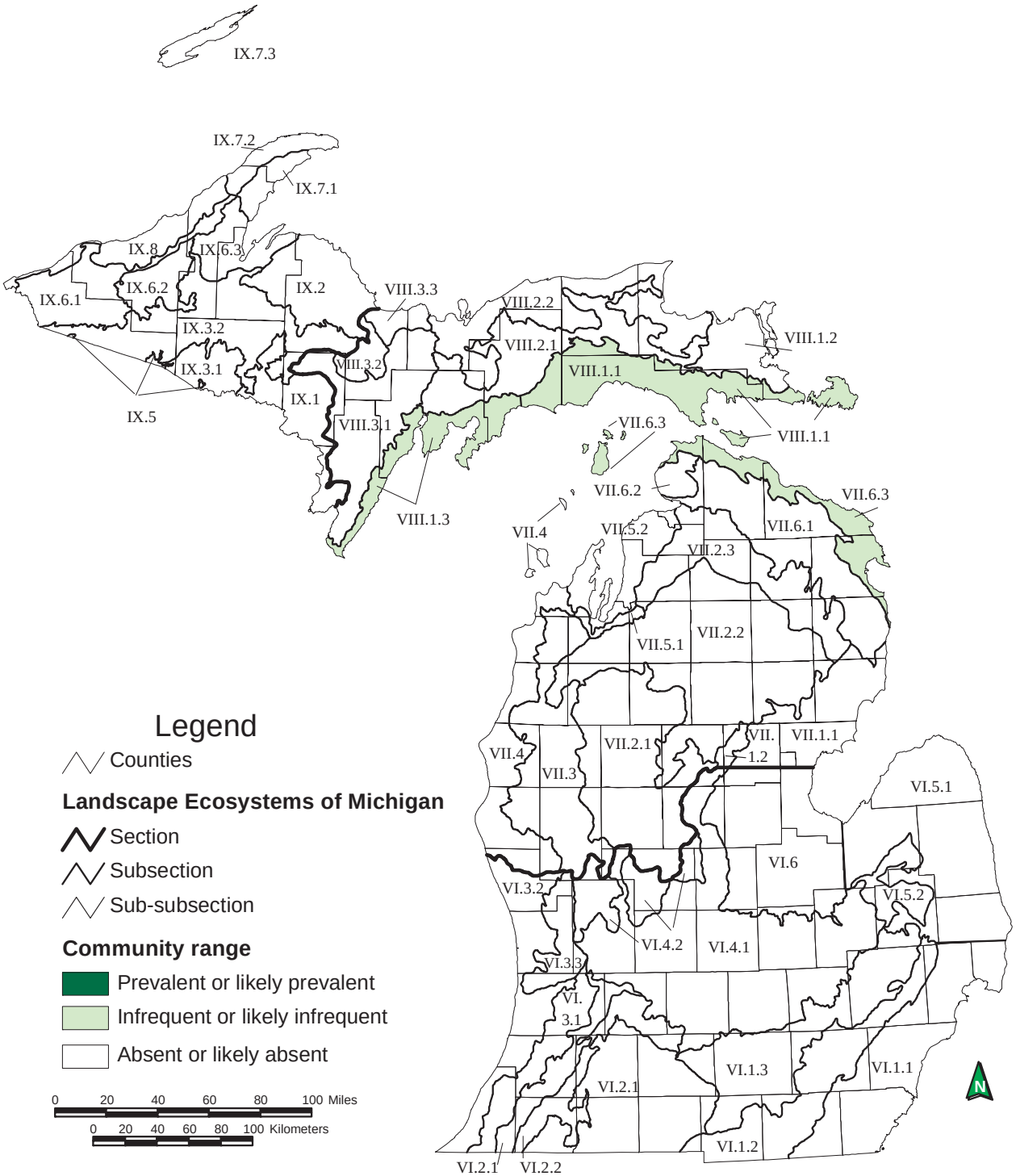
Thompson's Harbor Great Lakes marsh, Thompson's Harbor State Park. Photo by Joshua G. Cohen.

Thompson's Harbor Great Lakes marsh, Thompson's Harbor State Park. Photo by Jesse M. Lincoln.

1998 aerial photograph of the Thompson's Harbor Great Lakes marsh.

LIMESTONE BEDROCK GLADE

Overview: Limestone bedrock glade is a savanna or open woodland community dominated by herbs, graminoids, and scattered clumps of shrubs and stunted trees that typically occurs on flat expanses of calcareous bedrock (limestone or dolomite) near the shorelines of Lake Huron and Lake Michigan in the Upper Peninsula and near the Lake Huron shoreline in northern Lower Michigan. The calcareous bedrock is covered by a thin veneer of mildly to moderately alkaline loamy sand or sandy loam. Areas of exposed bedrock are common. Natural processes that influence species composition and community structure include extreme fluctuations in soil moisture ranging from inundation in spring to drought in summer, windthrow, and occasional fires (Kost et al. 2007, Cohen et al. 2014).



Map 5. Distribution of limestone bedrock glade in Michigan (Albert et al. 2008).

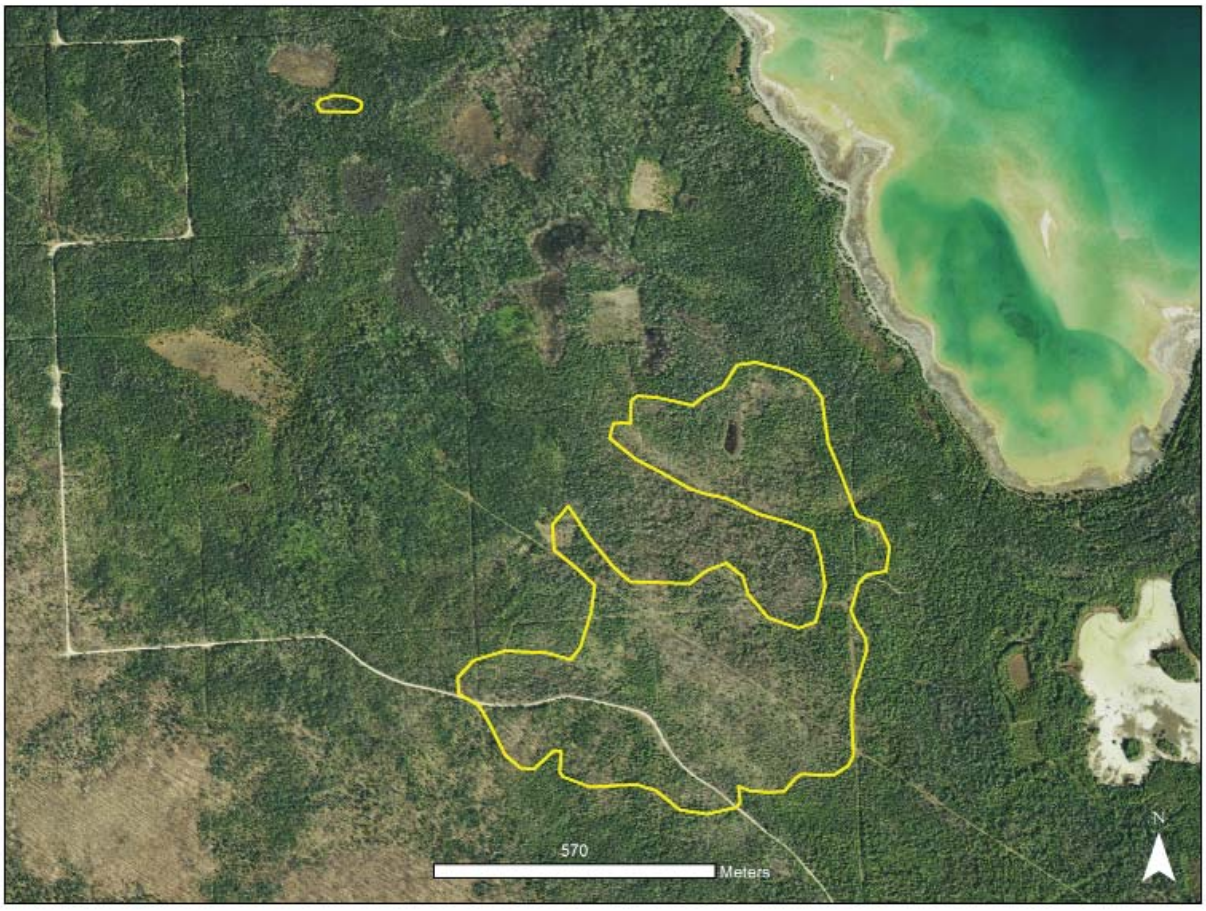
10. Thompson's Harbor Observatory
Natural Community Type: Limestone Bedrock Glade
Rank: G2G4 S2, imperiled to secure globally and imperiled within the state
Element Occurrence Rank: B
Size: 98 acres
Location: Thompson's Harbor State Park
Element Occurrence Identification Number: 9418 (EO Update)

Threats: Numerous roads and trails cross the site and act as pathways for invasive species. Invasives concentrated along road and trail margins include common St. John's-wort (*Hypericum perforatum*), ox-eye daisy (*Chrysanthemum leucanthemum*), and spotted knapweed (*Centaurea stoebe*). Ox-eye daisy, lawn prunella (*Prunella vulgaris*), and common hemp nettle (*Galeopsis tetrahit*) occur throughout the glade but do not appear to threaten species composition or vegetative structure. Deer herbivory is evident but mild. Fire suppression may be a threat, but little is known about fire as a natural disturbance factor of limestone bedrock glades.

Management Recommendations: The main management recommendations are to allow natural processes to operate unhindered (i.e., let wildfires burn), to control populations of non-native species (especially spotted knapweed and common St. John's-wort), and to maintain a forested buffer surrounding the glade to prevent the increase of the weedy seed source. Monitoring should be implemented for non-native plant populations and to gauge the impact of deer herbivory. Increasing the amount of late-successional habitat in the adjacent landscape will help reduce deer browse pressure. Reducing deer densities in the general landscape is also recommended.

Thompson's Harbor Observatory limestone bedrock glade, Thompson's Harbor State Park. Photo by Joshua G. Cohen.

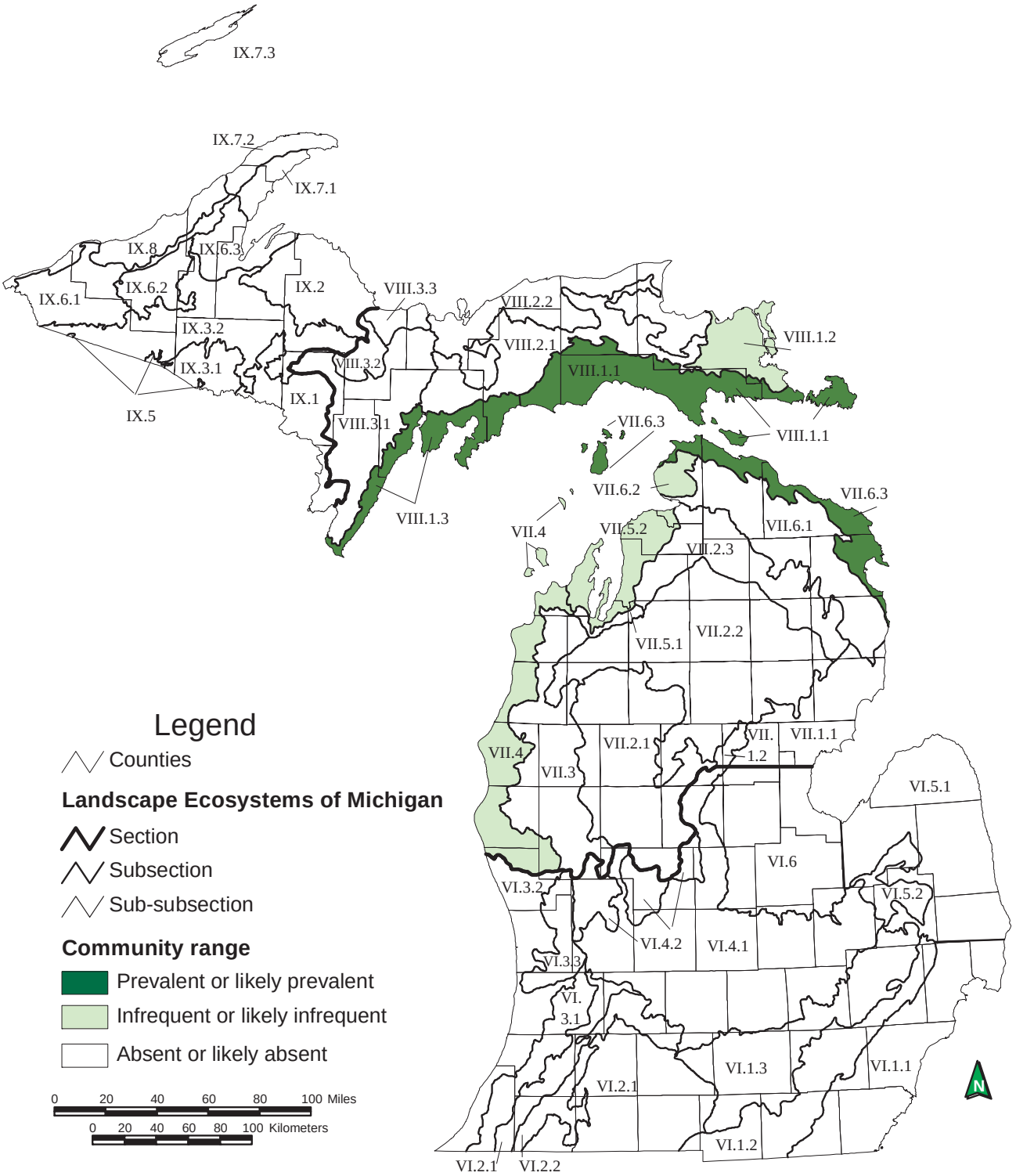
Thompson's Harbor Observatory limestone bedrock glade, Thompson's Harbor State Park. Photo by Joshua G. Cohen.



1998 aerial photograph of the Thompson's Harbor Observatory limestone bedrock glade.

LIMESTONE COBBLE SHORE

Overview: Limestone cobble shore is a sparsely vegetated community of scattered herbs, graminoids, shrubs, saplings, and stunted trees growing between limestone or dolomite cobbles along the shorelines of Lake Michigan and Lake Huron in the Upper Peninsula and northern Lower Peninsula. The community expands and contracts in size in accordance with periodic changes in Great Lakes water levels. Plants typically root in alkaline sands and gravel that accumulate between the cobbles, or in shallow organic sediments that accumulate in protected inner portions of the shore. Vegetation is typically sparse because cobbles cover most of the surface, soil development is limited, and storm waves prevent the establishment of a persistent plant community (Kost et al. 2007, Cohen et al. 2014).



Map 6. Distribution of limestone cobble shore in Michigan (Albert et al. 2008).

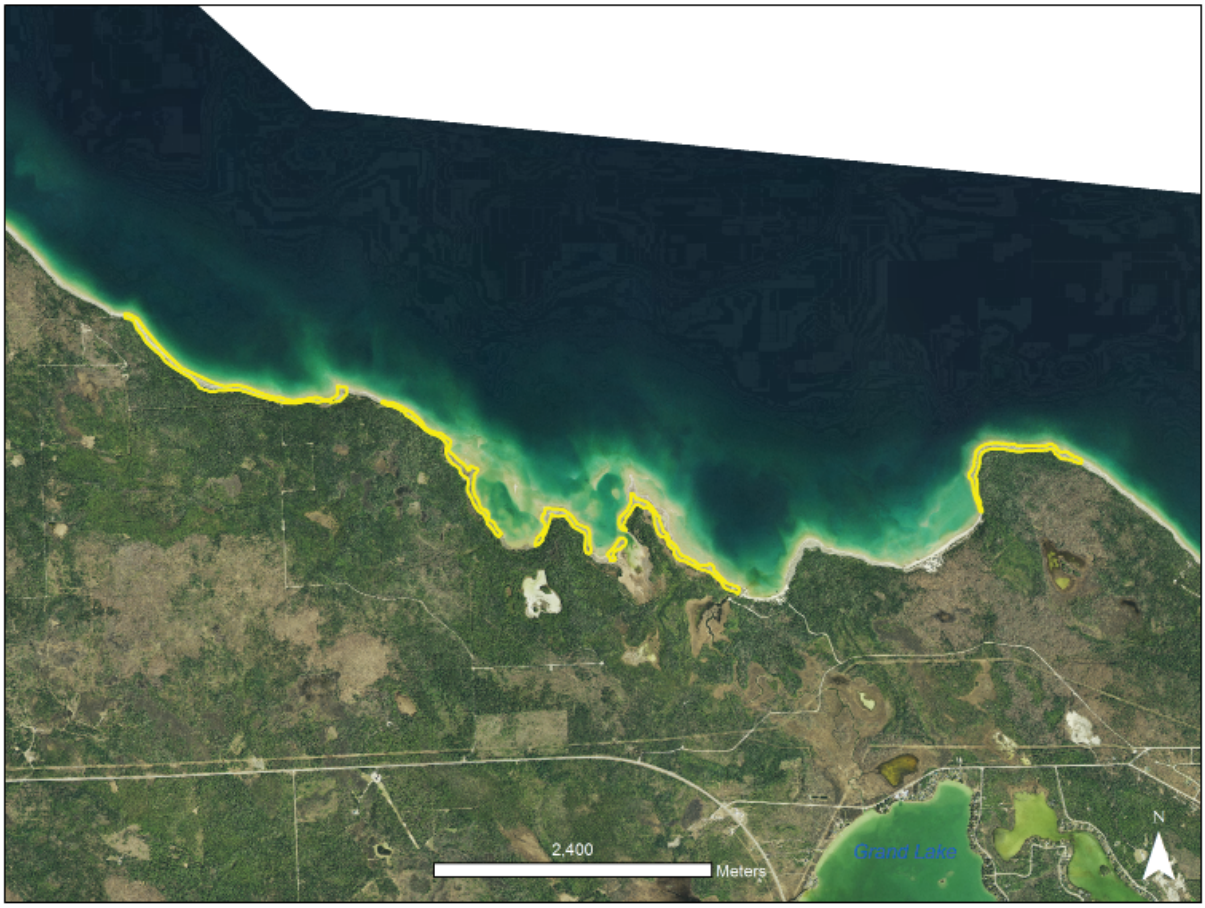
10. Thompson's Harbor
Natural Community Type: Limestone Cobble Shore
Rank: G2G3 S3, imperiled to vulnerable globally and vulnerable within the state
Element Occurrence Rank: AB
Size: 85 acres
Location: Thompson's Harbor State Park
Element Occurrence Identification Number: 10477 (EO Update)

Threats: The species composition and zonation of the limestone cobble shore are patterned by natural processes. Threats include off-road vehicle activity and invasive plants. The shoreline is characterized by localized infestations of non-native weeds, especially in sand and gravel beach inclusions. Non-native plant species found in these areas include common St. John's-wort (*Hypericum perforatum*), spotted knapweed (*Centaurea stoebe*), Canada bluegrass (*Poa compressa*), reed canary grass (*Phalaris arundinacea*), and wild carrot (*Daucus carota*). The most significant non-native threat to the site is posed by Siberian elm (*Ulmus pumila*), which is concentrated along the upland margin of the limestone cobble shore. Approximately 20 trees were observed ranging in DBH from 5 to 8 cm. Spread of non-native species may be facilitated by off-road vehicle traffic, which was noted along the upper margin of the shoreline.

Management Recommendations: The primary management needs are to eliminate off-road vehicle activity along the shoreline, control the invasive plant species, and maintain a natural community buffer surrounding the shoreline to prevent the increase of the weedy seed source. Eliminating off-road traffic along the shoreline will help reduce the disturbance to the substrate and soils and will help reduce the spread of non-native species. The clusters of Siberian elm should be removed through cutting and herbicide treatment. Monitoring should be implemented to evaluate efforts to control invasive species and off-road vehicle activity.

Thompson's Harbor limestone cobble shore, Thompson's Harbor State Park. Photo by Joshua G. Cohen.

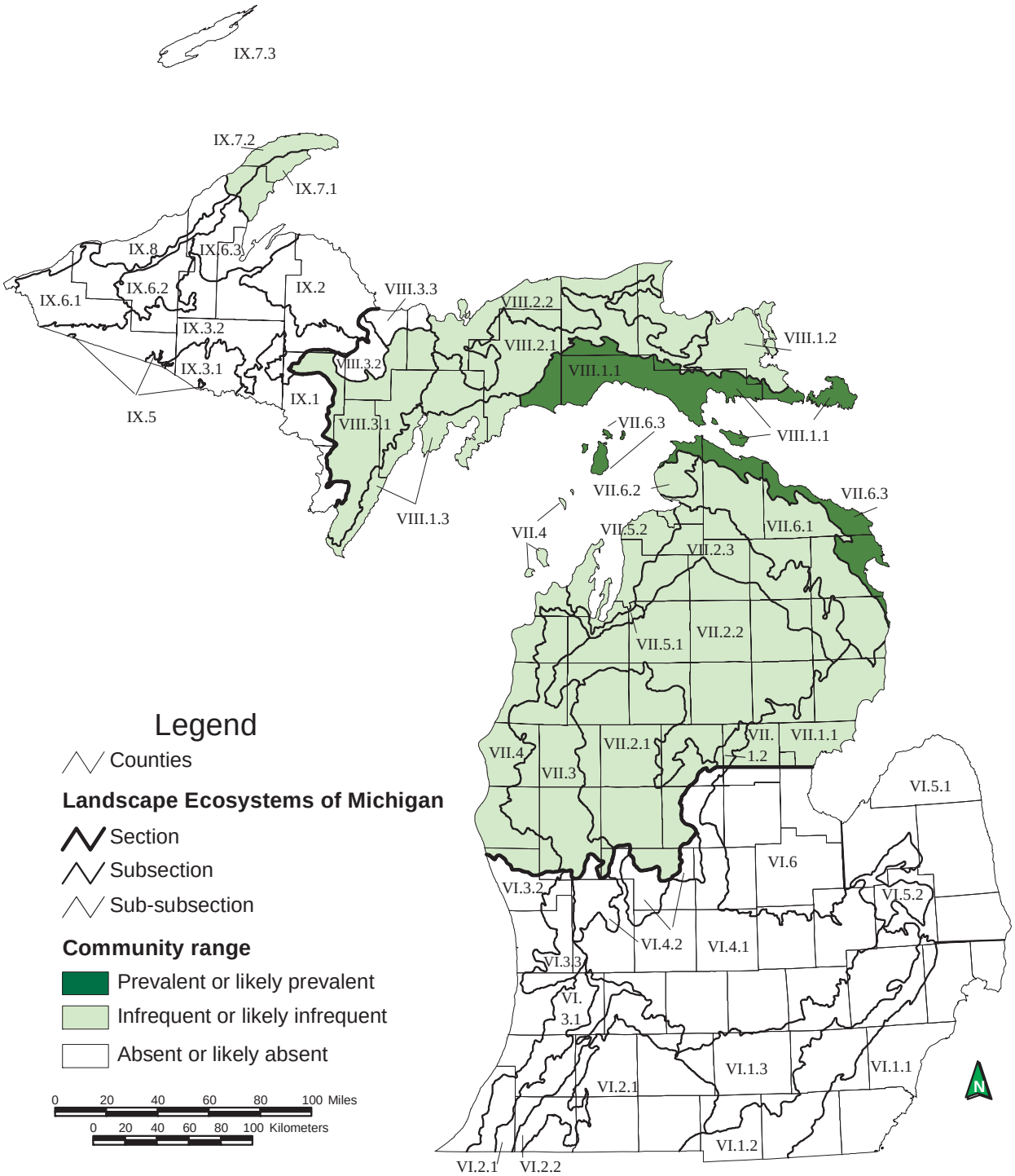
Thompson’s Harbor limestone cobble shore, Thompson’s Harbor State Park. Photo by Joshua G. Cohen.



1998 aerial photograph of Thompson’s Harbor limestone cobble shore.

NORTHERN FEN

Overview: Northern fen is a groundwater-influenced wetland community dominated by graminoids, forbs, shrubs, and stunted conifers. The community occurs on circumneutral to moderately alkaline peat and marl in the Upper and northern Lower Peninsulas. Although primarily found where calcareous bedrock underlies a thin mantle of glacial drift within glacial lakeplains, northern fen may also occur on glacial outwash plains and in kettle depressions on pitted outwash plains and moraines. Northern fen is often associated with headwater streams and cold, calcareous, groundwater-fed springs. Natural processes that influence species composition and community structure include calcareous groundwater seepage and lateral flow, flooding by beaver, and occasional fires. Variation in the flow rate and volume of groundwater moving through the community results in distinct vegetation zones, some of which support a diversity of calciphilic plants (Kost et al. 2007, Cohen et al. 2014).



Map 7. Distribution of northern fen in Michigan (Albert et al. 2008).

11. Thompson's Harbor
Natural Community Type: Northern Fen
Rank: G3G5 S3, vulnerable to secure globally and vulnerable within the state
Element Occurrence Rank: AB
Size: 92 acres
Location: Thompson's Harbor State Park
Element Occurrence Identification Number: 17341 (EO Update)

Threats: Threats are limited to localized anthropogenic disturbance. No invasive plant species were noted during the course of the survey. Invasives may become established near the foot trail that passes by one of the fen polygons since there is localized anthropogenic disturbance emanating from the trail. A powerline intersects one of the fen polygons and a lone off-road vehicle track was observed coming off of the powerline into the fen. Deer browse may be impacting species composition and structure.

Management Recommendations: The main management recommendations are to allow natural processes to operate unhindered, eliminate illegal off-road vehicle activity, and to reduce deer densities in the surrounding landscape to dampen deer browse pressure. Deer densities could be reduced through direct measures and also by reducing early-successional habitat in the surrounding landscape. Monitoring deer densities and deer herbivory will allow for the assessment of whether deer herbivory impacts species composition and structure. Establishing no cut buffers around the northern fen polygons can help protect the hydrologic regime. Invasive species occurring in adjacent areas should be controlled and these control efforts should be monitored.

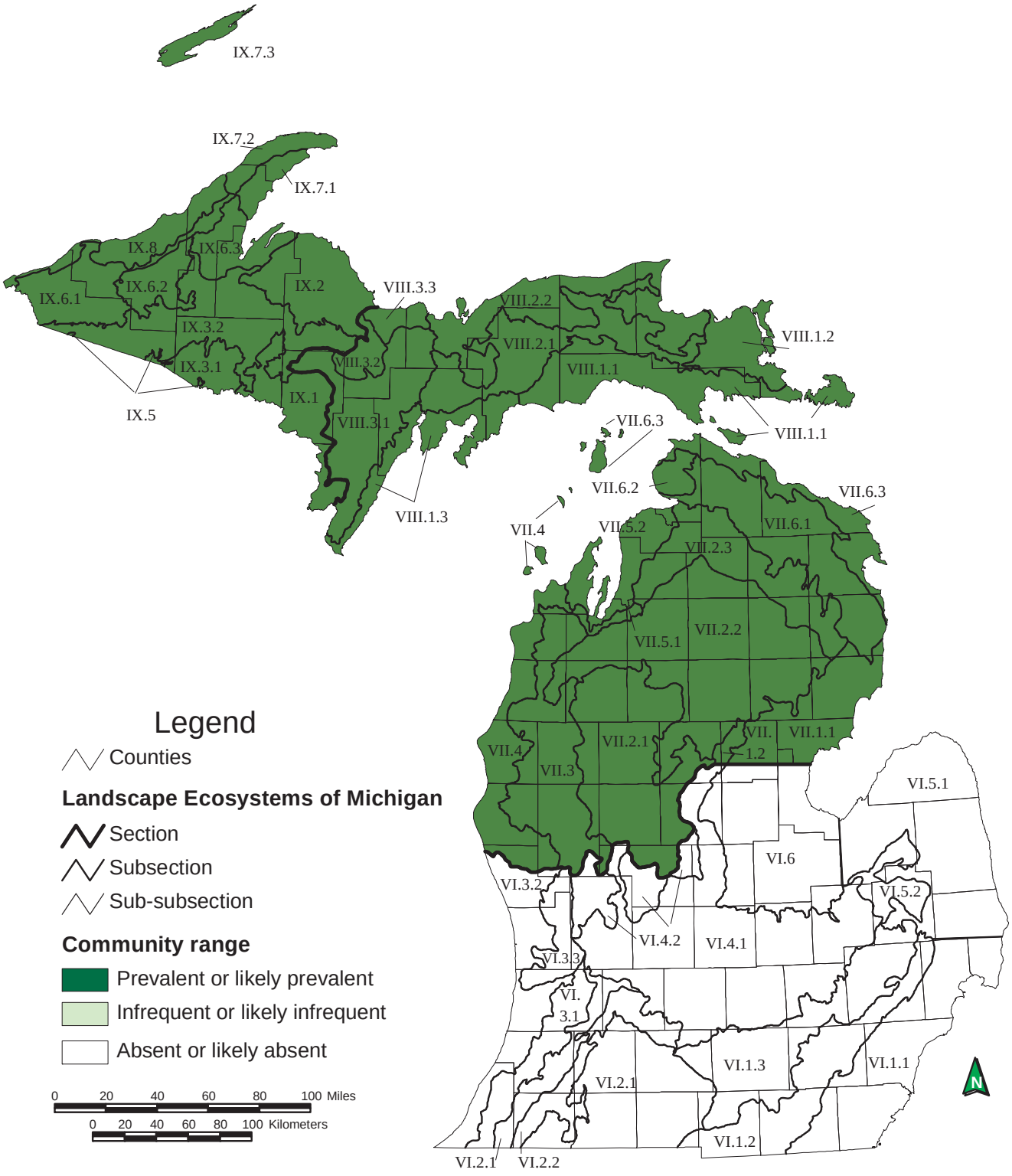
Thompson's Harbor northern fen, Thompson's Harbor State Park. Photo by Joshua G. Cohen.

Thompson’s Harbor northern fen, Thompson’s Harbor State Park. Photo by Joshua G. Cohen.

1998 aerial photograph of Thompson’s Harbor northern fen.

NORTHERN WET MEADOW

Overview: Northern wet meadow is a groundwater-influenced, sedge- and grass-dominated wetland that occurs in the Upper Peninsula and northern Lower Peninsula. Northern wet meadow typically borders streams but is also found on pond and lake margins and above beaver dams. The community typically develops on strongly acidic to circumneutral sapric peat but can also occur on saturated mineral soils. Natural processes that influence species composition and community structure include seasonal flooding, flooding by beaver, and fire (Kost et al. 2007, Cohen et al. 2015).



Map 8. Distribution of northern wet meadow in Michigan (Albert et al. 2008).

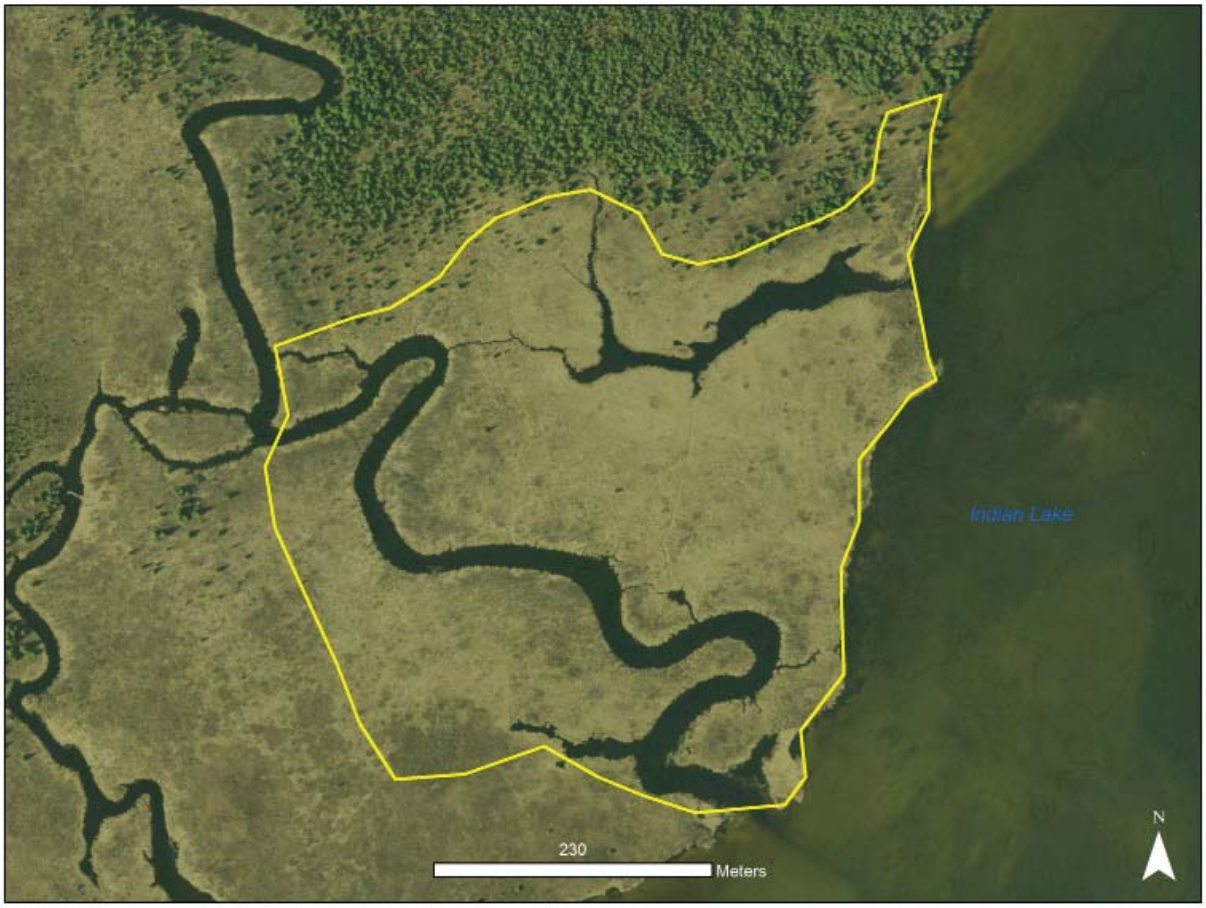
12. Indian Lake Meadow
Natural Community Type: Northern Wet Meadow
Rank: G4G5 S3, apparently secure globally and vulnerable within the state
Element Occurrence Rank: AB
Size: 52 acres
Location: Palms Book State Park
Element Occurrence Identification Number: 20628 (New EO)

Threats: No anthropogenic disturbances or non-native plants were noted during the course of the survey. The species composition and structure of the northern wet meadow are driven by natural processes.

Management Recommendations: The main management recommendations are to allow natural processes to operate unhindered and to retain an intact buffer of natural communities surrounding the wetland to minimize the threat of hydrological alteration.

Indian Lake Meadow northern wet meadow, Palms Book State Park. Photo by Joshua G. Cohen.

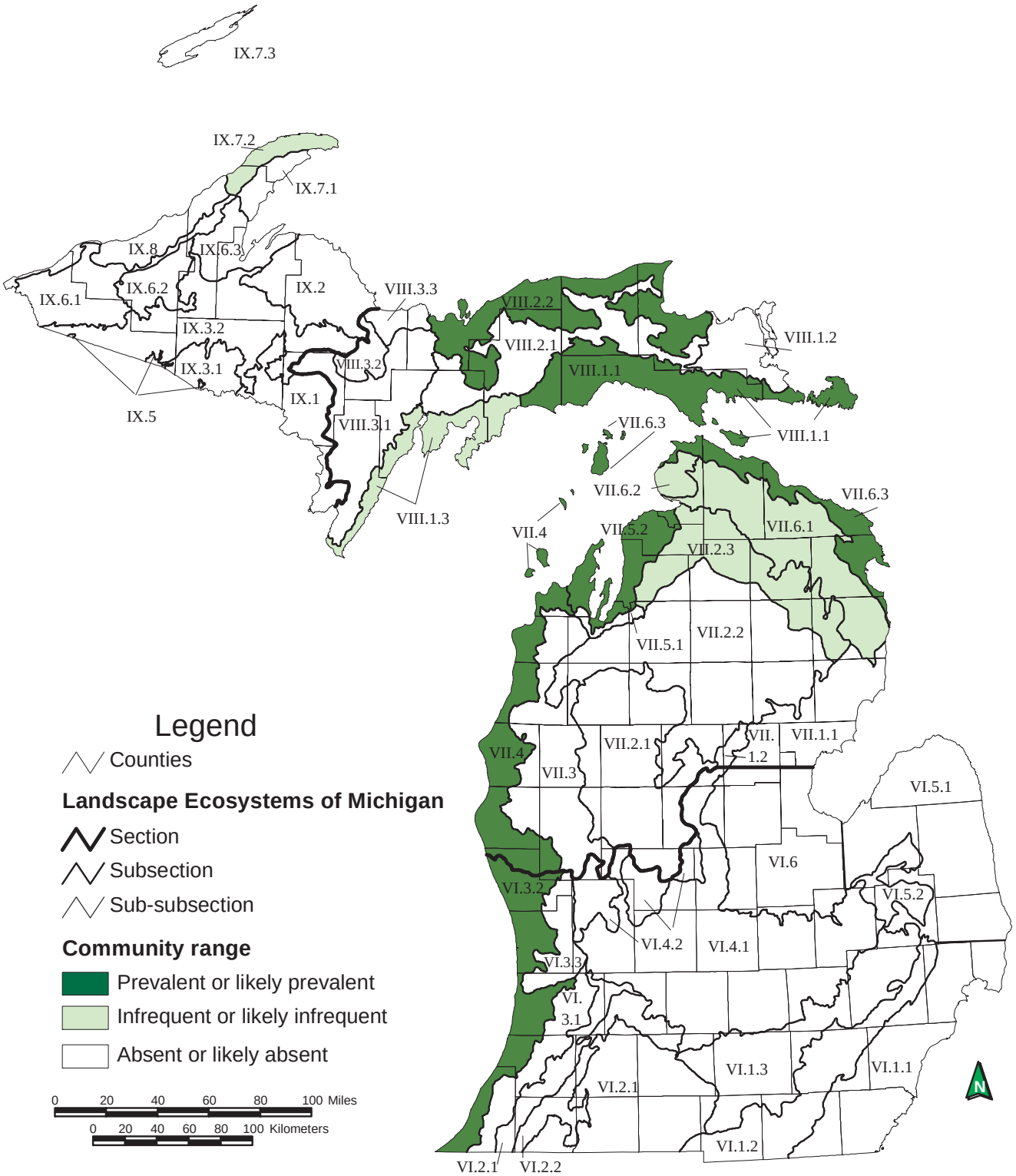
Indian Lake Meadow northern wet meadow, Palms Book State Park. Photo by Joshua G. Cohen.



1998 aerial photograph of Indian Lake Meadow northern wet meadow.

OPEN DUNES

Overview: Open dunes is a grass- and shrub-dominated community located on wind-deposited sand formations near the shorelines of the Great Lakes. The greatest concentration of open dunes occurs along the eastern and northern shorelines of Lake Michigan, with the largest dunes along the eastern shoreline due to strong prevailing southwest winds. Open dunes develop on circumneutral to slightly alkaline sands. Blowouts, sand burial and abrasion, excessively well-drained and droughty soils, desiccating winds, and occasional fires maintain open conditions (Kost et al. 2007, Cohen et al. 2014).



Map 9. Distribution of open dunes in Michigan (Albert et al. 2008).

13. Duck Lake Dunes
Natural Community Type: Open Dunes
Rank: G3 S3, vulnerable throughout range
Element Occurrence Rank: C
Size: 19 acres
Location: Duck Lake State Park
Element Occurrence Identification Number: 20461 (New EO)

Threats: Species composition and structure are driven by natural processes but have been profoundly impacted by invasive species. Threats include invasive plants and foot traffic and erosion. Locally common invasives in the open dunes include black locust (*Robinia pseudoacacia*), Japanese barberry (*Berberis thunbergii*), Canada bluegrass (*Poa compressa*), and spotted knapweed (*Centaurea stoebe*). Black locust is mostly shrub or sapling size but there are some scattered small tree-sized individuals. Foot trails occur throughout the dunes and areas of localized erosion occur along the upper margins of the dunes. The southern portion of the dunes is more degraded from foot traffic and areas of the dunes here are de-vegetated from foot traffic to and from the adjacent beach.

Management Recommendations: The primary management recommendations are to allow natural processes to operate unhindered and to eliminate clusters of non-native plants in the dune complex. It is important to monitor for invasive species following such control efforts. Foot traffic on the dunes could be reduced by educating park users about the fragile nature of open dunes.

Duck Lake Dunes open dunes, Duck Lake State Park. Photo by Joshua G. Cohen.

Duck Lake Dunes open dunes, Duck Lake State Park. Photo by Joshua G. Cohen.

1998 aerial photograph of Duck Lake Dunes open dunes.

14. Tawas Dunes
Natural Community Type: Open Dunes
Rank: G3 S3, vulnerable throughout range
Element Occurrence Rank: C
Size: 18 acres
Location: Tawas Point State Park
Element Occurrence Identification Number: 20483 (New EO)

Threats: Species composition and structure are driven by natural processes but have been impacted by invasive plants and foot traffic and erosion. Spotted knapweed (*Centaurea stoebe*) occurs locally in the open dunes and reed (*Phragmites australis* subsp. *australis*) is locally dominant in the adjacent interdunal wetland but could potentially spread into the adjacent open dunes.

Management Recommendations: The primary management recommendations are to allow natural processes to operate unhindered and to continue eliminating clusters of non-native plants in the dune complex. It is important to monitor for invasive species following such control efforts. Foot traffic on the dunes could be reduced by educating park users about the fragile nature of open dunes.

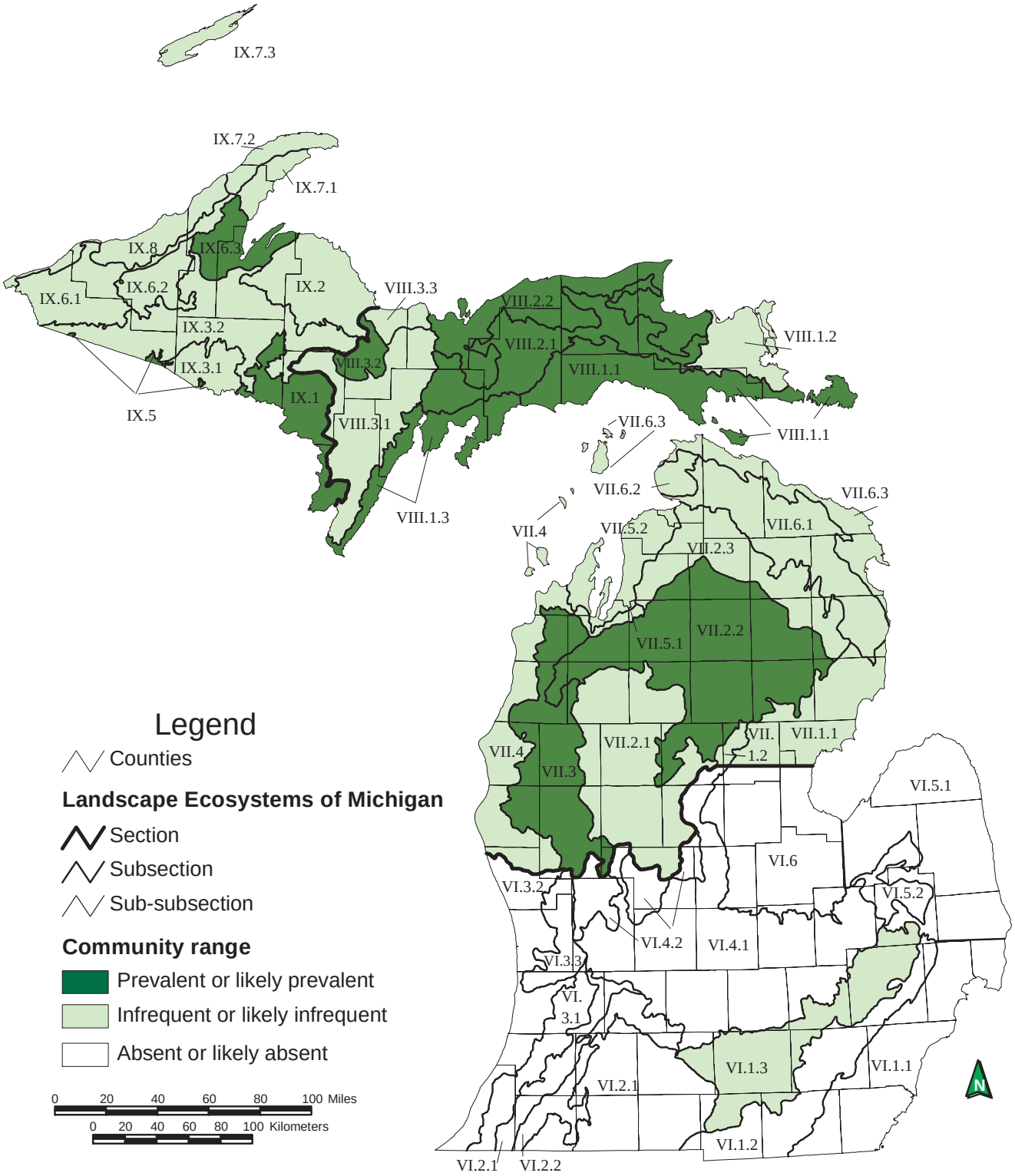
Tawas Dunes open dunes, Tawas Point State Park. Photo by Joshua G. Cohen.

Tawas Dunes open dunes, Tawas Point State Park. Photo by Joshua G. Cohen.

1998 aerial photograph of Tawas Dunes open dunes.

POOR FEN

Overview: Poor fen is a wetland dominated by sedges, shrubs, and stunted conifers, and moderately influenced by groundwater. The community occurs within kettle depressions in outwash plains and moraines, and in mild depressions on glacial outwash plains and glacial lakeplain primarily in the Upper Peninsula and northern Lower Peninsula and rarely in the southern Lower Peninsula. Poor fen typically develops on slightly acidic to strongly acidic peat. Natural processes that influence species composition and community structure include groundwater seepage and lateral flow, peat accumulation, flooding by beaver, insect outbreaks, and occasional fires (Kost et al. 2007, Cohen et al. 2014).



Map 10. Distribution of poor fen in Michigan (Albert et al. 2008).

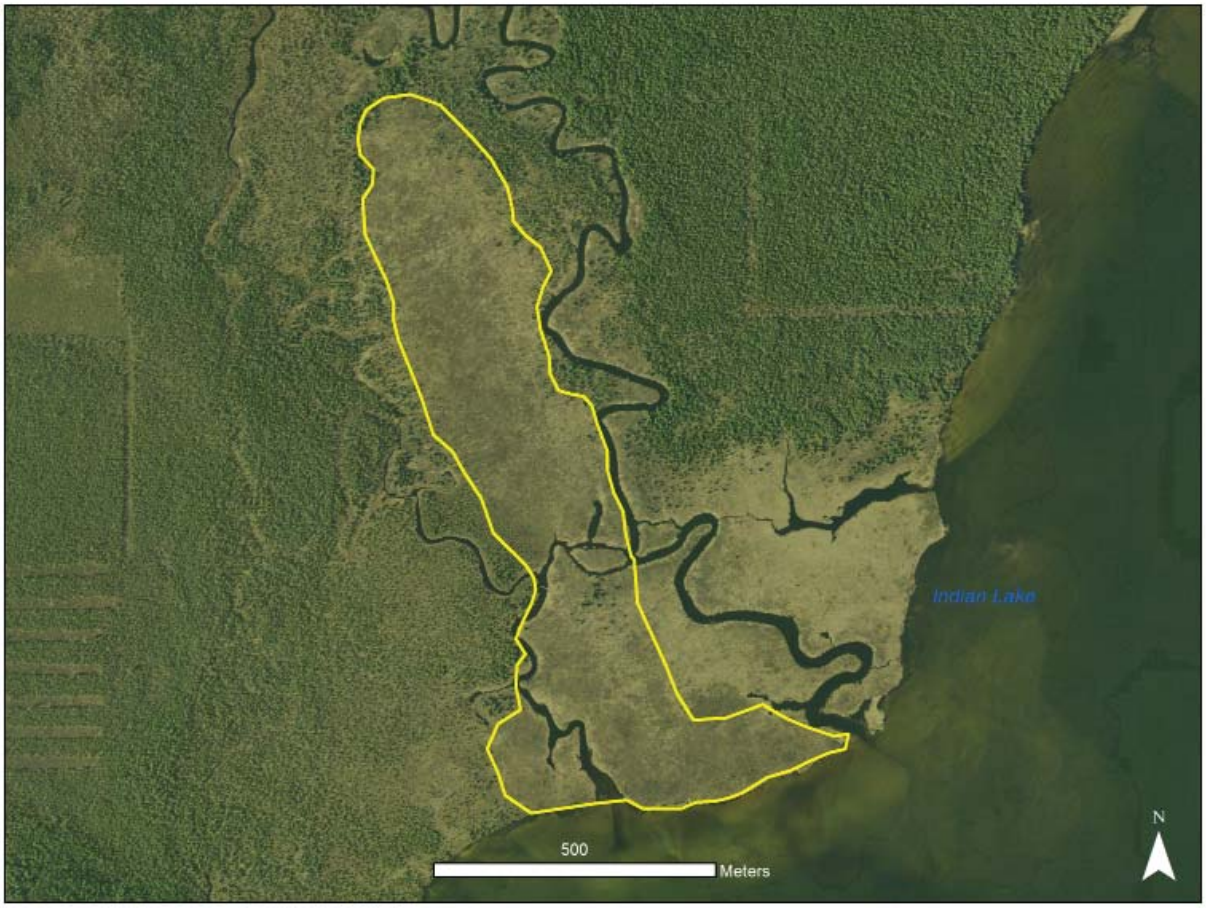
15 Indian Lake Fen
Natural Community Type: Poor Fen
Rank: G3G5 S3, vulnerable to secure globally and vulnerable within the state
Element Occurrence Rank: B
Size: 87 acres
Location: Palms Book State Park
Element Occurrence Identification Number: 20629 (New EO)

Threats: The species composition and vegetative structure of the poor fen are influenced by natural processes. No threats were noted during the course of the survey. Fire suppression throughout the general landscape may have altered the fire regime of the poor fen.

Management Recommendations: The main management recommendations are to allow natural processes to operate unhindered and to retain an intact buffer of natural communities surrounding the wetland to minimize the threat of hydrological alteration. In the event of a wildfire, establishment of new fire lines should be avoided and existing fire breaks (i.e., trails, roads, and wetlands) should be used.

Indian Lake Fen poor fen, Palms Book State Park. Photo by Joshua G. Cohen.

Indian Lake Fen poor fen, Palms Book State Park. Photo by Joshua G. Cohen.



1998 aerial photograph of Indian Lake Fen poor fen.

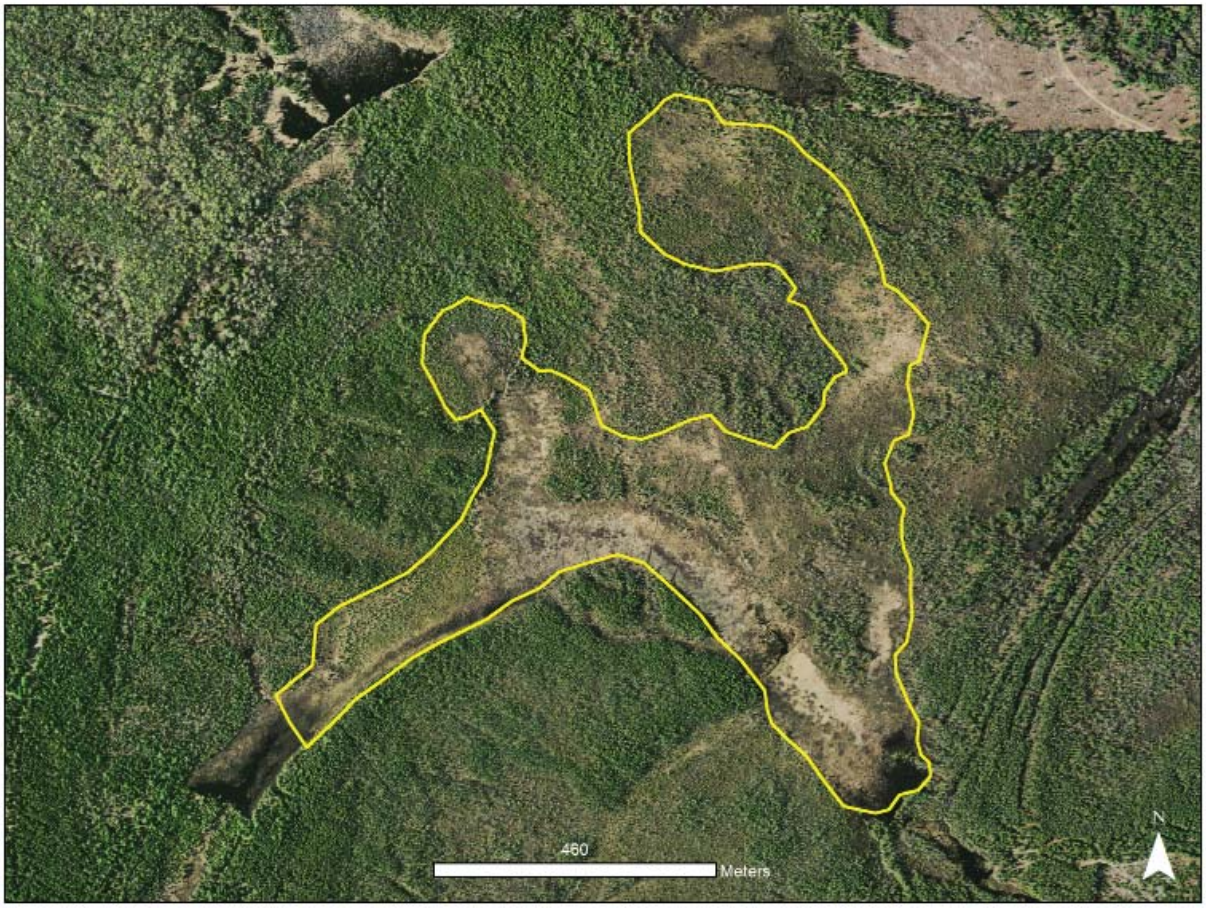
16. Tahqua Trail Fen
Natural Community Type: Poor Fen
Rank: G3G5 S3, vulnerable to secure globally and vulnerable within the state
Element Occurrence Rank: B
Size: 115 acres
Location: Tahquamenon Falls State Park
Element Occurrence Identification Number: 17871 (EO Update)

Threats: The species composition and vegetative structure of the poor fen are influenced by natural processes. No threats were noted during the course of the survey. Fire suppression throughout the general landscape may have altered the fire regime of the poor fen.

Management Recommendations: The main management recommendations are to allow natural processes to operate unhindered and to retain an intact buffer of natural communities surrounding the wetland to minimize the threat of hydrological alteration. In the event of a wildfire, establishment of new fire lines should be avoided and existing fire breaks (i.e., trails, roads, and wetlands) should be used.

Tahqua Trail Fen poor fen, Tahquamenon Falls State Park. Photo by Joshua G. Cohen.

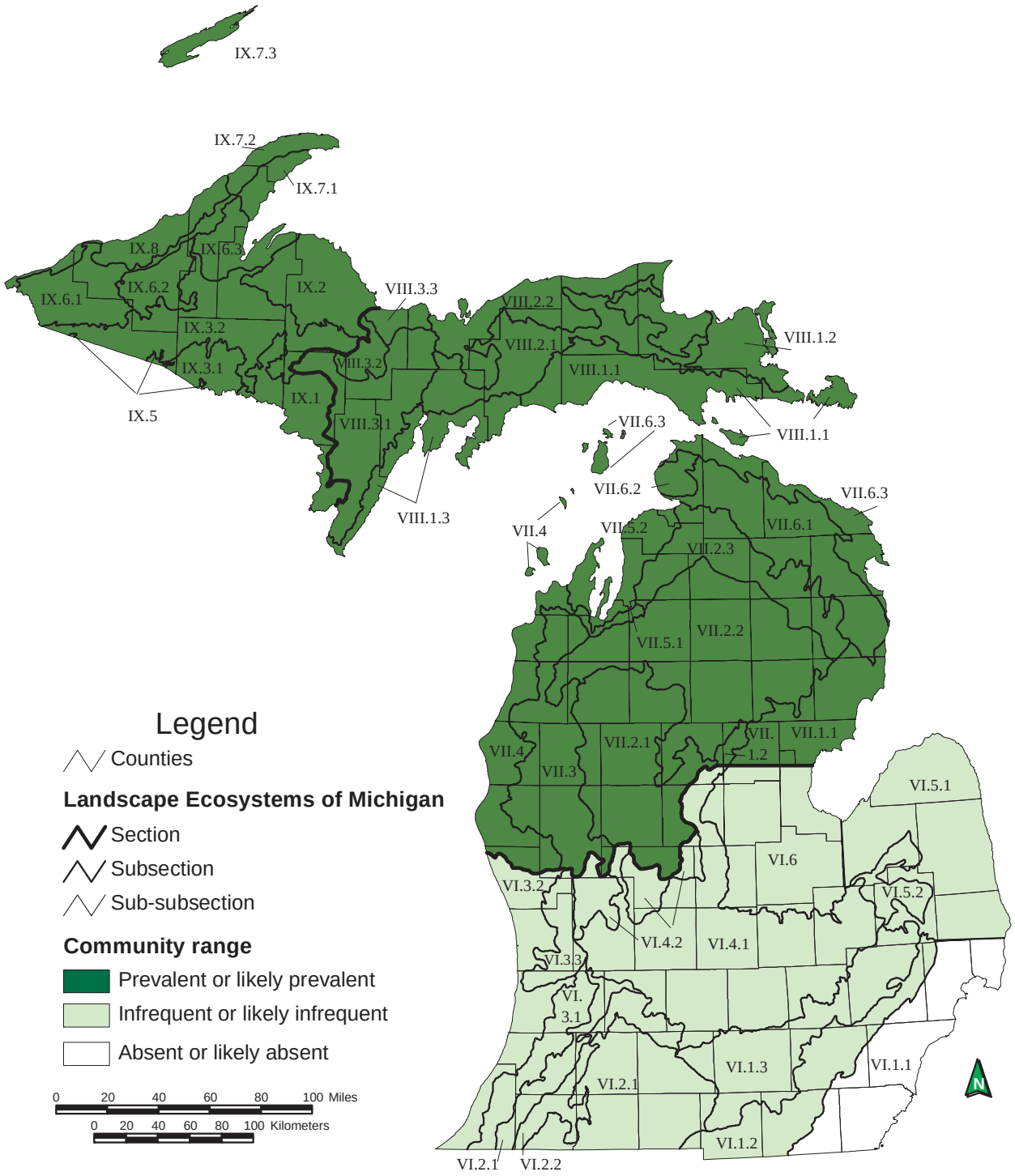
Tahqua Trail Fen poor fen, Tahquamenon Falls State Park. Photo by Joshua G. Cohen.



1998 aerial photograph of Tahqua Trail Fen poor fen.

RICH CONIFER SWAMP

Overview: Rich conifer swamp is a diverse groundwater-influenced, forested wetland dominated by northern white-cedar (*Thuja occidentalis*) that occurs primarily in the Upper Peninsula and northern Lower Peninsula. The community is found in outwash channels and in depressions on outwash plains, lakeplains, and moraines. Rich conifer swamp typically develops on saturated, circumneutral to moderately alkaline peats that may be acidic near the surface where sphagnum mosses are locally prevalent. The community is often associated with headwater streams and cold, calcareous, groundwater-fed springs. Natural processes that influence species composition and community structure include groundwater seepage, seasonal water-level fluctuations, windthrow, flooding by beaver, sphagnum hummock and hollow development, and infrequent fires (Kost et al. 2007, Cohen et al. 2014).



Map 11. Distribution of rich conifer swamp in Michigan (Albert et al. 2008).

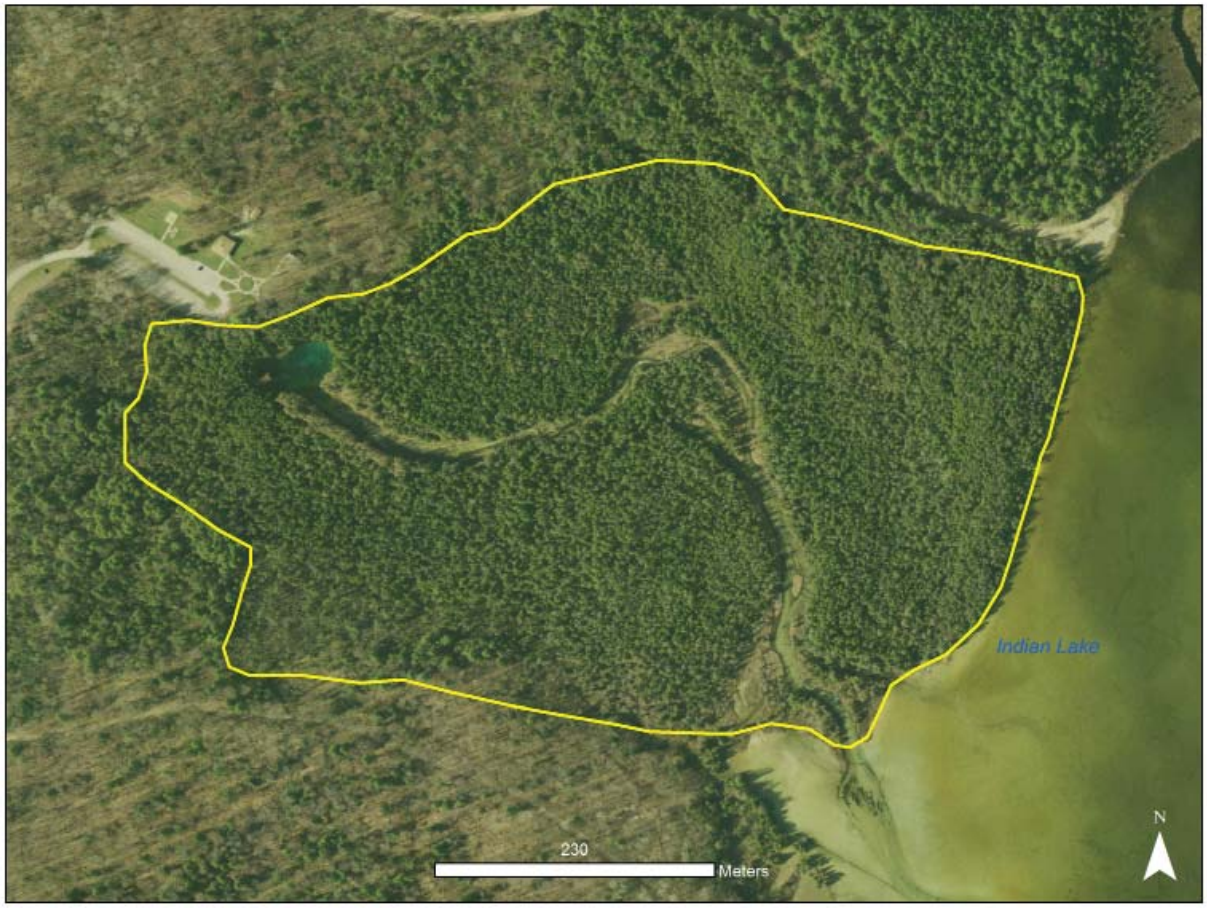
17. Big Spring Swamp
Natural Community Type: Rich Conifer Swamp
Rank: G4 S3, apparently secure globally and vulnerable within the state
Element Occurrence Rank: BC
Size: 65 acres
Location: Palms Book State Park
Element Occurrence Identification Number: 20626 (New EO)

Threats: Deer browse pressure is high and has impacted the species composition and vegetative structure of the rich conifer swamp. Deer trails and browse were noted throughout the swamp and cut stumps are concentrated along the stream and lake margins. Deer browse was noted on balsam fir (*Abies balsamea*) suggesting that deer browse pressure is heavy within this swamp since this is not a preferred browse species for deer. Portions of the swamp, especially near the lake margin, appear to be utilized by yarding deer in the winter.

Management Recommendations: The main management recommendations are to allow natural processes to operate unhindered, retain an intact buffer of natural communities surrounding the wetland to minimize the threat of hydrological alteration, reduce local deer populations, and monitor deer browse pressure.

Big Spring Swamp rich conifer swamp, Palms Book State Park. Photo by Joshua G. Cohen.

Big Spring Swamp rich conifer swamp, Palms Book State Park. Photo by Joshua G. Cohen.



1998 aerial photograph of Big Spring Swamp rich conifer swamp.

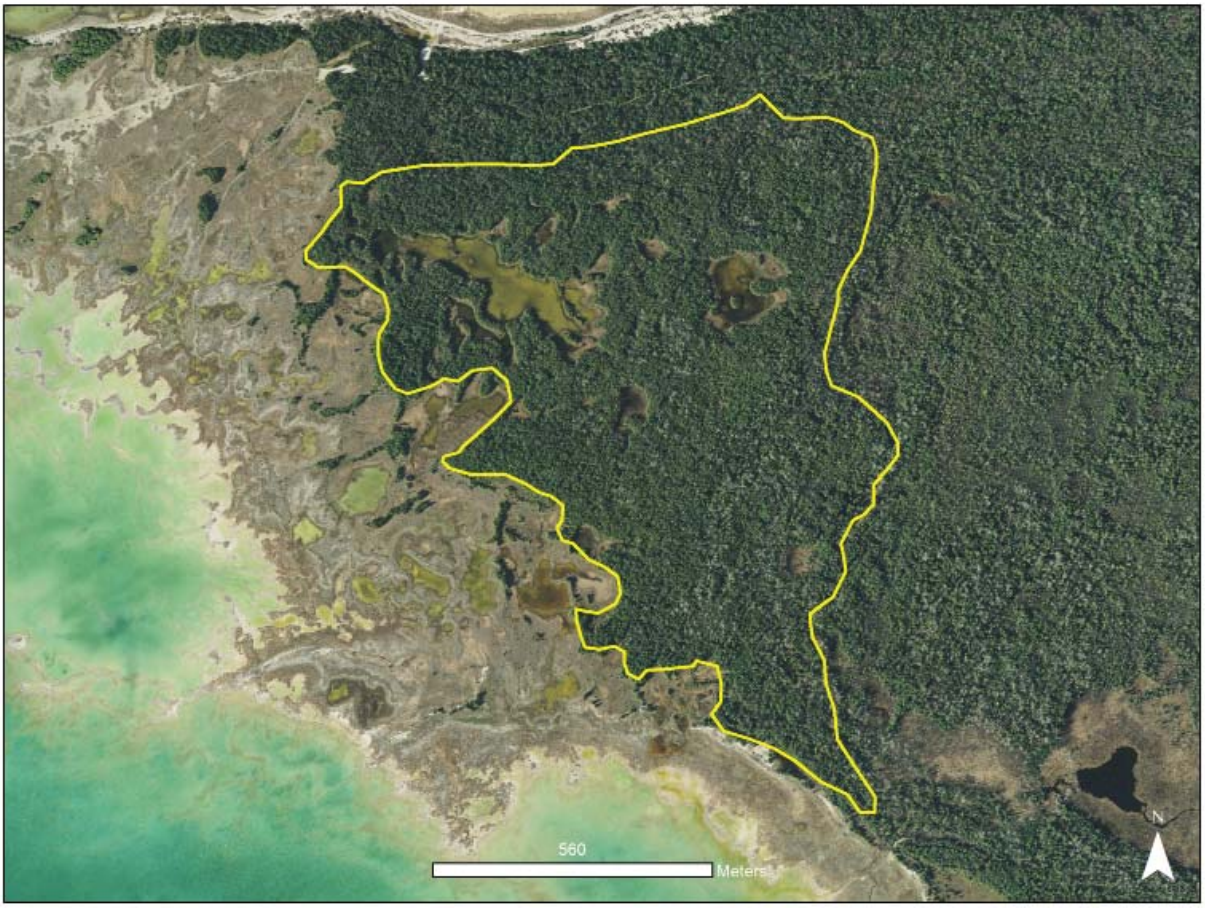
18. Waugoshance Swamp
Natural Community Type: Rich Conifer Swamp
Rank: G4 S3, apparently secure globally and vulnerable within the state
Element Occurrence Rank: B
Size: 215 acres
Location: Wilderness State Park
Element Occurrence Identification Number: 20445 (New EO)

Threats: Deer browse pressure is high and has impacted the species composition and vegetative structure of the rich conifer swamp. Deer trails and browse were noted throughout the swamp.

Management Recommendations: The main management recommendations are to allow natural processes to operate unhindered, retain an intact buffer of natural communities surrounding the wetland to minimize the threat of hydrological alteration, reduce local deer populations, and monitor deer browse pressure.

Waugoshance Swamp rich conifer swamp, Wilderness State Park. Photo by Joshua G. Cohen.

Waugoshance Swamp rich conifer swamp, Wilderness State Park. Photo by Joshua G. Cohen.



1998 aerial photograph of Waugoshance Swamp rich conifer swamp.

SUBMERGENT MARSH

Overview: Submergent marsh is an herbaceous plant community that occurs in deep to sometimes shallow water in lakes and streams throughout Michigan. Soils are characterized by loosely consolidated, acidic to alkaline organic deposits of variable depth that accumulate over all types of mineral soil and bedrock. Natural processes that influence species composition and community structure include fluctuating water levels, storm waves, currents, and flooding by beaver. Vegetation is comprised of both rooted and non-rooted plants that occur completely beneath the water surface (i.e., submergent plants), rooted floating-leaved plants, and non-rooted floating plants (Kost et al. 2007, Cohen et al. 2014).

Map 12. Distribution of submergent marsh in Michigan (Albert et al. 2008).

19. Hamlin Lake Marsh
Natural Community Type: Submergent Marsh
Rank: GU S4, globally unrankable and secure within the state
Element Occurrence Rank: B
Size: 29 acres
Location: Ludington State Park
Element Occurrence Identification Number: 20460 (New EO)

Threats: The species composition and structure of this emergent marsh is influenced by natural processes and the marsh is buffered by adjacent uplands and wetlands. The invasive narrow-leaved cat-tail (*Typha angustifolia*) is locally dominant within the adjacent emergent marsh.

Management Recommendations: The main management recommendations are to allow natural processes to operate unhindered, retain an intact buffer of natural communities surrounding the wetland to minimize the threat of hydrological alteration, and monitor for invasive species.

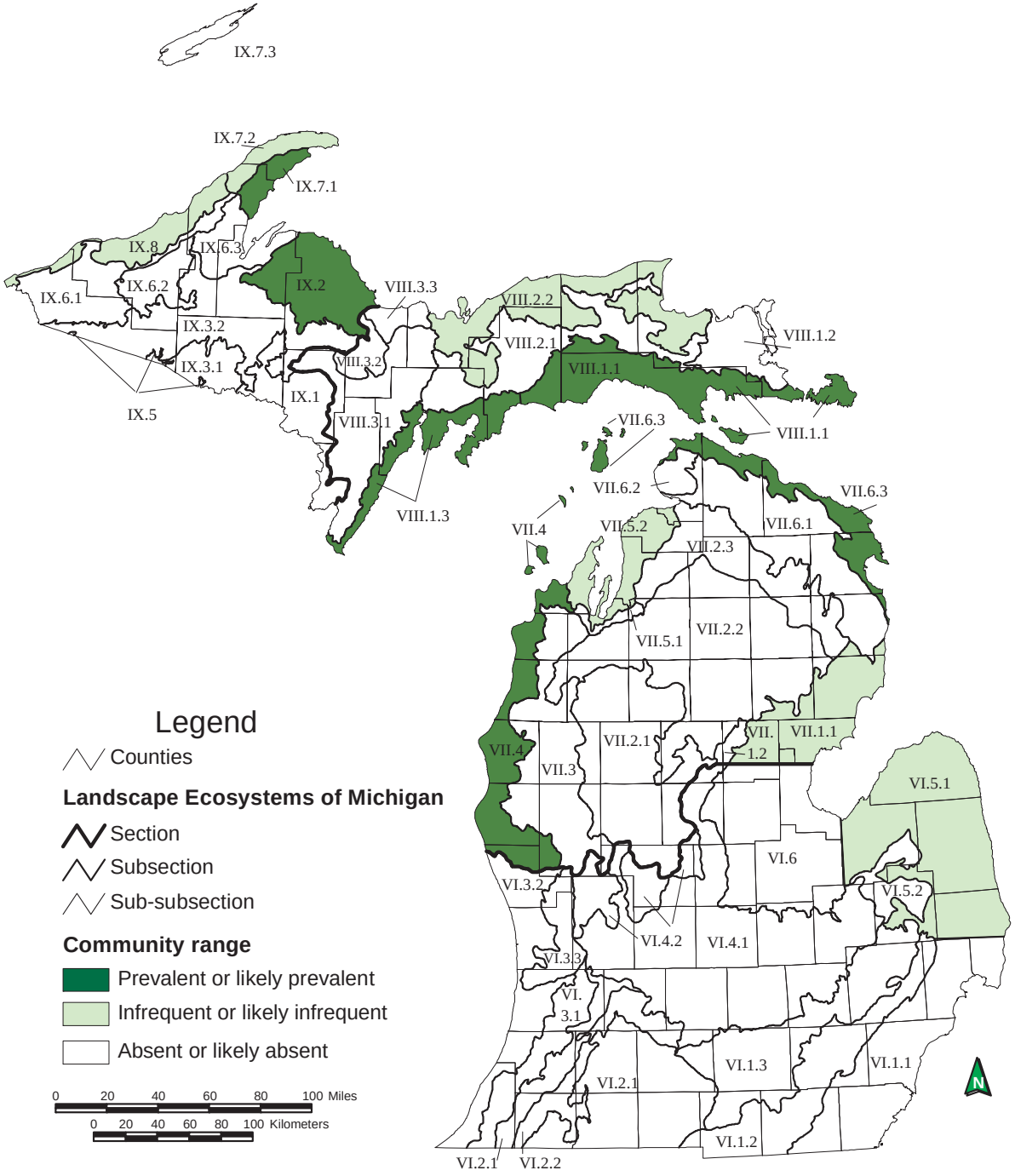
Hamlin Lake Marsh submergent marsh, Ludington State Park. Photo by Joshua G. Cohen.

Hamlin Lake Marsh submergent marsh, Ludington State Park. Photo by Joshua G. Cohen.

1998 aerial photograph of Hamlin Lake Marsh submergent marsh.

WOODED DUNE AND SWALE COMPLEX

Overview: Wooded dune and swale complex consists of a series of parallel wetland swales and upland beach ridges (dunes) found in coastal embayments and on large sand spits along the shorelines of the Great Lakes. The community occurs primarily in the Upper and northern Lower Peninsulas and the Thumb region. Wooded dune and swale complex develops on a variety of lacustrine soils, ranging from calcareous sands on the foredunes to shallow to deep acidic peat or alkaline marl in the swales. Natural processes that influence species composition and community structure include insect outbreaks, surface water and groundwater flow regimes, windthrow, flooding by beaver, and infrequent fires. Wooded dune and swale complexes formed as a result of receding Great Lakes water levels in combination with post-glacial uplift that created a series of parallel, arcuate sand ridges and swales. The upland dune ridges are often dominated by pines (*Pinus* spp.), but a diversity of upland trees can be dominant. The swales support a variety of herbaceous or forested wetland types, with open wetlands more common near the shoreline and forested wetlands more prevalent farther from the lake (Kost et al. 2007, Cohen et al. 2014).



Map 13. Distribution of wooded dune and swale complex in Michigan (Albert et al. 2008).

20. Negwegon Dune and Swale
Natural Community Type: Wooded Dune and Swale Complex
Rank: G3 S3, vulnerable throughout range
Element Occurrence Rank: B
Size: 1,783 acres
Location: Negwegon State Park
Element Occurrence Identification Number: 409

Threats: Historically, forested portions of the occurrence were apparently dominated by northern white-cedar (*Thuja occidentalis*) and other conifers. The region was heavily logged in the late 1800s and was impacted by subsequent slash fires; evidence of fires was noted on charred cut stumps within the occurrence. Current cover is dominated by early-successional hardwoods (aspen and birch), with conifers concentrated on beach ridges near Lake Huron. White pine (*Pinus strobus*) and balsam fir (*Abies balsamea*) regeneration is patchy. Deer browse appears to be reducing and locally eliminating woody regeneration on beach ridges, resulting in a patchy, occasionally open canopy with a patchy to absent shrub layer. The construction of the railbed and roads through the occurrence have locally disrupted hydrology. Several invasive plants of concern were noted in generally low levels. Glossy buckthorn (*Rhamnus frangula*) was occasional, mostly as seedlings or small saplings, in wetland areas. Although it has not yet had an appreciable negative impact on the site, it will be difficult to control due to its widespread distribution in relatively inaccessible areas. Hybrid cat-tail (*Typha* x*glauca*) occurred in patches along the railroad. Reed canary grass (*Phalaris arundinacea*) and reed (*Phragmites australis* subsp. *australis*) were noted as locally common in the open swales. Reed and narrow-leaved cat-tail (*Typha angustifolia*) also occur locally along wet areas of shoreline. Areas of low foredune are locally infested with spotted knapweed (*Centaurea stoebe*).

Management Recommendations: Management recommendations for this site include allowing natural processes to operate unhindered by avoiding salvage logging in areas of windthrow and allowing wildfires to burn, control of invasive species, reducing local deer densities, and monitoring of invasive species and deer browse pressure. In addition, pursuit of acquisition of adjacent private lands or discussion of compatible management with private landowners is recommended.

Negwegon Dune and Swale wooded dune and swale complex, Negwegon State Park. Photo by Joshua G. Cohen.

Negwegon Dune and Swale wooded dune and swale complex, Negwegon State Park. Photo by Joshua G. Cohen.

1998 aerial photograph of Negwegon Dune and Swale wooded dune and swale complex.

DISCUSSION

This report provides site-based assessments of 20 natural community element occurrences on PRD lands. Threats, management needs, and restoration opportunities specific to each individual site have been discussed. The baseline information presented in the current report provides resource managers with an ecological foundation for prescribing site-level biodiversity stewardship, monitoring these management activities, and implementing landscape-level biodiversity planning to prioritize management efforts. In addition to this survey effort, a much needed future step is the development of a framework for prioritizing stewardship efforts across all high-quality natural community element occurrences on PRD lands. This process should involve assessing the conservation significance of each site from both an ecoregional and statewide perspective and evaluating the severity of threats across sites. This analysis should be conducted using an ecological hierarchical framework, such as Albert's (1995) Regional Landscape Ecosystems of Michigan, Minnesota, and Wisconsin. Understanding how each site relates to other examples of the same natural community and how rare that community is within an ecological region will help facilitate difficult decisions regarding the distribution of finite stewardship resources.

Big Spring Swamp rich conifer swamp occurs adjacent to the Big Spring and the creek that drains from the Big Spring into Indian Lake, Palms Book State Park. Photo by Joshua G. Cohen.

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Indian Lake Fen poor fen, Palms Book State Park. Photo by Joshua G. Cohen.

Michigan Natural Features Inventory

Ecological Community Field Survey Form

MICHIGAN STATE UNIVERSITY EXTENSION

SURVEY INFORMATION

Survey date: _____ Time: from _____ to _____ Sourcecode: _____

Surveyors (principal surveyor first, include first & last name):

_____

Weather conditions: _____

Revisit needed? ☐ Yes ☐ No Why? ☐ Complete community survey ☐ Rare species survey ☐ Invasive plant survey ☐ Monitoring

FILING

Survey site: _____ Site name: _____

IDENTIFICATION (Identify community if known positively, or provide closest alliance/association if not known)

Community Name: _____ Overall Rank: _____ EOID: _____ EO #: _____

If classification problems, explain:

Photo/slide taken? ☐ Yes ☐ No Where has photo been deposited? _____

If associated plot, list project name, and reference #:

_____

LOCATIONAL INFORMATION

Township/Range/Section: _____ County: _____

DIRECTIONS: Provide detailed directions to the observation (rather than the survey site). Include landmarks, roads, towns, distances, compass directions.

Landowner type: ☐ Public ☐ Private ☐ Other: _____

Landowner Contact Information: _____

Notes: _____

Was a GPS used? ☐ Yes ☐ No Type of unit: _____ Unit number: _____

Waypoint name/#: _____ File name: _____

Latitude: _____ Longitude: _____

Feature Information (mandatory): _____ Source feature: ☐ Single Source EO ☐ Multiple Source EO

SIZE - Measure of the area of the Element at the observed location.

Observed area (unit): ☐ Acres ☐ Hectares Type of measurement: ☐ Precise ☐ Estimate

Basis for estimate: _____

SIZE RANK (comments): _____

CONFIDENCE EXTENT

Indicate whether there is confidence that the observed area represents the full extent of the community element at that location.
(Y = confidence that the full extent is known; N = confidence that the full extent is not known; ? = uncertainty whether full extent is known)

☐ Yes ☐ No ☐ ? _____

LANDSCAPE CONTEXT - An integrated measure of the quality of biotic and abiotic factors, structures and processes surrounding the observed area, and the degree to which they may affect the continued existence of the Element at that location. Component of landscape context for communities are: 1) landscape structure and extent, 2) condition of the surrounding landscape (i.e., community development/maturity, species composition and biological structure, ecological processes, and abiotic physical/chemical factors.) Factors to consider include integrity/fragmentation, stability/old growth, richness/distribution of species, presence of invasive species, presence of invasive species, degree of disturbance, changes to ecological processes, stability of substrate, and water quality.

SURROUNDING LAND USE AND LAND COVER:

Percent natural cover: ☐ >90% ☐ >75% ☐ >50% ☐ >25% ☐ <25% Road density: ☐ HIgh ☐ Medium ☐ Low

Check all that apply

Dominant land use:

- ☐ Natural cover
- ☐ Managed timber/forest
- ☐ Agriculture
- ☐ Mining
- ☐ Urban/suburban
- ☐ Other: _____

Dominant land cover:

- ☐ Upland forest
- ☐ Savanna/grassland
- ☐ Forested wetland
- ☐ Non-forested wetland
- ☐ Agriculture
- ☐ Urban
- ☐ Other: _____

1. Comment on the relative integrity/fragmentation of the surrounding landscape

2. List native plant communities in surrounding landscape

3. Comment on invasive plants present in surrounding area and describe resulting impacts

List disturbances (either natural or caused by humans) and ecological processes (e.g., hydrologic and fire regimes) in surrounding area

- ☐ Logging
- ☐ Grazing/browsing
- ☐ Agriculture
- ☐ Soil erosion
- ☐ Mining
- ☐ Dumping
- ☐ Trails/roads
- ☐ ORV/vehicular disturbance
- ☐ Hydrologic alteration (drainage, ditches, blocked culverts, etc.)
- ☐ Fire supression
- ☐ Other: _____
- ☐ Plant disease: _____
- ☐ Insect damage: _____
- ☐ Exotic animal activity: _____
- ☐ Herbivore impact (e.g., deer): _____
- ☐ Invasive plants: _____
- ☐ Wild fire
- ☐ Prescribed fire
- ☐ Windthrow
- ☐ Ice storm
- ☐ Ice scour
- ☐ Desiccation
- ☐ Flooding
- ☐ Beaver flooding
- ☐ Beaver chewed trees
- ☐ Other: _____

LANDSCAPE RANK (comments)**:**

CONDITION: ABIOTIC DATA

Geology

Igneous Rocks

- ☐ Granitic (Granite, Schyolite, Syenite, Trachyte)
- ☐ Dioritic (Diorite, Dacite, Andesite)
- ☐ Gabbroic (Gabbro, Basalt, Pyroxenite, Peridotite, Diabase, Traprock)
- ☐ Rhyolite
- ☐ Other: _____

Metamorphic Rocks

- ☐ Felsic Gneiss and Schist (Granitic)
- ☐ Mafic Gneiss and Schist
- ☐ Slate
- ☐ Quartzite
- ☐ Other: _____

Sedimentary Rocks

- ☐ Volcanic Conglomerates
- ☐ Breccias
- ☐ Sandstone
- ☐ Siltstone (calcareous or noncalcareous)
- ☐ Limestone and Dolomite
- ☐ Gypsum
- ☐ Shale
- ☐ Other: _____

Landform

Glacial

- ☐ Lake plain
- ☐ End or lateral moraine
- ☐ Ground moraine (till plain)

Ice Contact Feature

- ☐ Drumlin
- ☐ Esker
- ☐ Kame
- ☐ Kettle
- ☐ Lake bed
- ☐ Outwash channel

Outwash

- ☐ Outwash channel
- ☐ Outwash plain
- ☐ Pitted outwash
- ☐ Other: _____

River/Lakeshore

- ☐ Shoreline
- ☐ Sand dune
- ☐ Barrier dune
- ☐ Spit
- ☐ Offshore bar
- ☐ Riverine estuary
- ☐ Delta
- ☐ Stream bed
- ☐ Stream terrace
- ☐ Alluvial fan
- ☐ Alluvial flat
- ☐ Alluvial terrace
- ☐ Dike
- ☐ Other: _____

Aeolian

- ☐ Dunes
- ☐ Aeolian sand flats
- ☐ Other: _____

Other

- ☐ Cliff
- ☐ Ledge
- ☐ Lakeshore bedrock outcrop
- ☐ Ridgetop bedrock outcrop
- ☐ Inland level-to-sloping bedrock outcrop
- ☐ Ravine
- ☐ Seep
- ☐ Slide
- ☐ Talus
- ☐ Other: _____

Organic Soil Deposits:

Core One: GPS Point _____

	Depth	pH
☐ Fibirc Peat:		
☐ Hemic Peat:		
☐ Sapric Peat (muck):		
☐ Marl (depth):		
☐ Other (describe):		

Comments:

Core Two: GPS Point _____

	Depth	pH
☐ Fibirc Peat:		
☐ Hemic Peat:		
☐ Sapric Peat (muck):		
☐ Marl (depth):		
☐ Other (describe):		

Comments:

Core Three: GPS Point _____

	Depth	pH
☐ Fibirc Peat:		
☐ Hemic Peat:		
☐ Sapric Peat (muck):		
☐ Marl (depth):		
☐ Other (describe):		

Comments:

Mineral Soil Depth (average): _____

pH: _____

Surface Soil Texture (Upper 10 cm of soil profile)

- ☐ Sand
- ☐ Loamy sand
- ☐ Sandy loam
- ☐ Loam
- ☐ Silt loam
- ☐ Sandy Clay loam
- ☐ Clay loam
- ☐ Silty clay loam
- ☐ Sandy clay
- ☐ Clay
- ☐ Silty clay
- ☐ Other: _____

Soil Series: _____

Comments:

Wetland Mineral Soil Indicators:

- ☐ Gleyed soils (list soil texture and depth):

_____

- ☐ Iron mottling (list soil texture and depth):

_____

Depth to saturation: _____

Depth to water table: _____

Hydrologic Regime:

Wetlands:

- ☐ Intermittently flooded
- ☐ Permanently flooded
- ☐ Semipermanently flooded
- ☐ Temporarily flooded (e.g., floodplains)
- ☐ Seasonally flooded (e.g., seasonal ponds)
- ☐ Saturated (e.g., bogs, perennial seeps)
- ☐ Unknown

Non-Wetlands:

- ☐ Wet Mesic
- ☐ Mesic (moist)
- ☐ Dry-Mesic
- ☐ Xeric (dry)

Groundcover:
(with >5% cover, 20 m x 20 m area)

_____ % Bedrock
_____ % Wood (>1cm)
_____ % Litter, duff
_____ % Large rocks (cobbles, boulders >10 cm)
_____ % Small rocks (gravel, 0.2 - 10 cm)
_____ % Bare soil
_____ % Water
_____ % Other
100% (Total = 100%)

Light:

- ☐ Open
- ☐ Partial
- ☐ Filtered
- ☐ Shade

Cowardin System:

- ☐ Upland
- ☐ Riverine
- ☐ Lacustrine
- ☐ Palustrine

Slope:

Measured Slope: _____ ° _____ %

☐ Flat	0°	0%
☐ Gentle	0 - 5°	0 - 9%
☐ Moderate	6 - 14°	10 - 25%
☐ Somewhat steep	15 - 25°	26 - 49%
☐ Steep	26 - 45°	50 - 100%
☐ Very Steep	45 - 69°	101 - 275%
☐ Abrupt	70 - 100°	276 - 300%
☐ Overhanging/sheltered	> 100°	> 300%

Aspect (down slope):

Measured Aspect: _____ ° (N = 0°)

☐ Flat	
☐ Variable	
☐ N	338 - 22°
☐ NE	23 - 67°
☐ E	68 - 112°
☐ SE	113 - 157°
☐ S	158 - 202°
☐ SW	203 - 247°
☐ W	248 - 292°
☐ NW	293 - 337°

Topographic position:

- ☐ Ridge, summit, or crest
- ☐ High slope (upper slope, convex slope)
- ☐ Midslope (middle slope)
- ☐ Lowslope (lower slope, footslope)
- ☐ Toeslope (alluvial toeslope)
- ☐ Low level (terrace lakeplain, outwash plan, lake bed, etc)
- ☐ Channel
- ☐ Other: _____

Soil Type - Describe soil profile, pH, and method of assessment

CONDITION: VEGETATIVE FIELD DATA FOR THE ELEMENT

DBH (indicate cm or inches) of several dominant tree species, include age in years of cored trees:

Species	DBH(AGE)	DBH(AGE)	DBH(AGE)	DBH(AGE)	DBH(AGE)	DBH(AGE)

Density:

	Tree canopy	Shrub layer	Herb layer
Closed			
Open			
Patchy			
Sparse			
Absent			

Appendix 1. Ecology Community Field Survey Form (continued)

Complete one or more of the quantitative vegetation data boxes below. If completing only box indicate whether data represents a synthesis of overall community or community is relatively homogeneous throughout.

QUANTITATIVE VEGETATION DATA FOR THE ELEMENT

Method used (e.g., ocular estimation, quantitative transect, fixed plot, prism plot): _____

Sample Point 1: _____ GPS Point: _____

STRATA	COVER CLASS	DOMINANT SPECIES in order to relative importance (>> much greater than, > greater than, and =)
T2 - Tree Canopy		
T3 - Subcanopy		
S1 - Tall Shrub		
S2 - Low Shrub		
G - Ground cover		
N - Nonvascular		
V - Woody Vine		

Cover Class *

1	trace
2	0.1 - 1%
3	1 - 2%
4	2 - 5%
5	5 - 10%
6	10 - 25%
7	25 - 50%
8	50 - 75%
9	75 - 95%
10	> 95%

Sample Point 2: _____ GPS Point: _____

STRATA	COVER CLASS	DOMINANT SPECIES in order to relative importance (>> much greater than, > greater than, and =)
T2 - Tree Canopy		
T3 - Subcanopy		
S1 - Tall Shrub		
S2 - Low Shrub		
G - Ground cover		
N - Nonvascular		
V - Woody Vine		

Cover Class *

1	trace
2	0.1 - 1%
3	1 - 2%
4	2 - 5%
5	5 - 10%
6	10 - 25%
7	25 - 50%
8	50 - 75%
9	75 - 95%
10	> 95%

Sample Point 3: _____ GPS Point: _____

STRATA	COVER CLASS	DOMINANT SPECIES in order to relative importance (>> much greater than, > greater than, and =)
T2 - Tree Canopy		
T3 - Subcanopy		
S1 - Tall Shrub		
S2 - Low Shrub		
G - Ground cover		
N - Nonvascular		
V - Woody Vine		

Cover Class *

1	trace
2	0.1 - 1%
3	1 - 2%
4	2 - 5%
5	5 - 10%
6	10 - 25%
7	25 - 50%
8	50 - 75%
9	75 - 95%
10	> 95%

Sample Point 4: _____ GPS Point: _____

STRATA	COVER CLASS	DOMINANT SPECIES in order to relative importance (>> much greater than, > greater than, and =)
T2 - Tree Canopy		
T3 - Subcanopy		
S1 - Tall Shrub		
S2 - Low Shrub		
G - Ground cover		
N - Nonvascular		
V - Woody Vine		

Cover Class *

1	trace
2	0.1 - 1%
3	1 - 2%
4	2 - 5%
5	5 - 10%
6	10 - 25%
7	25 - 50%
8	50 - 75%
9	75 - 95%
10	> 95%

CONDITION - An integrated measure of the quality of biotic and abiotic factors, structures and processes within the observed area, and the degree to which they may affect the continued existence of the Element a that location. Factors to consider include evidence of stability/presence of old growth, richness/distirbution of species, presence of invasive species, degree of disturbance, changes to ecological processes, stability of substrate and water quality.

1. Species composition:

2. Community structure:

3. Ecological processes:

Natural and Anthropogenic Disturbance: information on disturbances(s) (either natural or caused by humans)

- ☐ Logging
- ☐ Grazing/browsing
- ☐ Agriculture
- ☐ Soil erosion
- ☐ Mining
- ☐ Dumping
- ☐ Trails/roads
- ☐ ORV/vehicular disturbance
- ☐ Hydrologic alteration (drainage, ditches, blocked culverts, etc.)
- ☐ Fire supression
- ☐ Other: _____

- ☐ Plant disease: _____
- ☐ Insect damage: _____
- ☐ Exotic animal activity: _____
- ☐ Herbivore impact (e.g., deer): _____
- ☐ Invasive plants: _____

- ☐ Wild fire
- ☐ Prescribed fire
- ☐ Windthrow
- ☐ Ice storm
- ☐ Ice scour
- ☐ Desiccation
- ☐ Flooding
- ☐ Beaver flooding
- ☐ Beaver chewed trees
- ☐ Other: _____

Comment on disturbance(s) and changes to ecological processes (e.g., hydrologic and fire regimes) within in observed area:

Comment on invasives present within the observed area and describe resulting impacts:

CONDITION RANK (comments):

MANAGEMENT CONSIDERATIONS

Threats (e.g., fire suppression, invasive species, ORVs, hydrologic alteration, logging, high deer densities etc.)

Management (stewardship and restoration), **Monitoring and Research Needs** for the Element at this location (e.g., burn periodically, open the canopy, control invasives, ban ORV's, remove drainage ditches, clear blocked culvert, break drain tile, reduce deer densities, study effects of herbivore impacts)

Protection Needs for the Element at this location (e.g., protect the entire marsh, the slope and crest of slope)

SUMMARY OF ELEMENT OCCURRENCE

General Description of the Element: Provide a brief "word picture" of the community focusing on abiotic and biotic factors. Describe the landforms, geological formations, soils/substrates, topography, slope, aspect, hydrology, aquatic features, vegetative layers, significant species etc.

Description of the Vegetation: Describe variation within the observed area in terms of vegetation structure and environment. Describe dominant and characteristic species and any inclusion communities. If a mosaic, describe spatial distribution and associated community types.

OVERALL RANK (comments):

Appendix 1. Ecology Community Field Survey Form (continued)

SPECIES LIST

Group and record species for each relevant strata (e.g., Overstory, Sub-canopy, Tall Shrub, Low Shrub, Ground Cover).
For each species, include abundance rank: **D = dominant A = abundant C = common O = occasional U = uncommon R = scarce L = local (modifier)**

Appendix 1. Ecology Community Field Survey Form (continued)

Sketch the most descriptive cross-section through the natural community, depicting the topography, vegetative structure and composition:

Appendix 1. Ecology Community Field Survey Form (continued)

GPS WAYPOINTS AND DESCRIPTIONS

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Appendix 2. Threat Assessment Form

Threat	Severity	Scope	Reversibility	Threat Score	Comments
Invasive Species					
Fire Suppression					
Deer Herbivory					
ORV Activity					
Hydrologic Alteration					
Infrastructure/ Trail Development					
Water Quality/ Contamination					
Invasive Plant #1:					
Invasive Plant #2:					
Invasive Plant #3:					
Invasive Plant #4:					
Invasive Plant #5:					

Rank each observed threat in terms of **Severity**, **Scope**, and **Reversibility** on a scale of 1 to 5.
Severity is the level of damage to the site and a score of 1 means the site is slightly damaged and a score of 5 means the site has been extensively damaged.
Scope is the geographic extent of impact and a score of 1 means the threat occupies a trace area within the site and a score of 5 means the threat is ubiquitous.
Reversibility is the probability of controlling the threat and reversing the damage and a score of 1 means the threat can be easily controlled and a score of 5 means the threat is unlikely to be controlled.
Threat Score is a sum of the rankings for **Severity**, **Scope**, and **Reversibility**.

Severity:

5: Without action, the community will likely be destroyed or eliminated (beyond restoration) within 10-15 years

4: Without action, the community will likely be seriously degraded (potentially lowered by 1 EO Rank) within 10-15 years

3: Without action, the community will likely be moderately degraded (potentially lowered by 1/2 EO Rank) within 10-15 years

2: Without action, the community will likely be slightly impaired by this threat within 10-15 years

1: Without action, the community may be slightly impaired by this threat within 15+ years

0: No threat

Scope:

5: Threat impacts the entire community EO (90%+)

4: Threat impacts large portions of the community EO (roughly 50-89%)

3: Threat impacts moderate portions of the community EO (roughly 15-49%)

2: Threat impacts localized portions of the community EO (roughly 5-14%, possibly in several scattered small patches)

1: Threat impacts only one small patch within or on the edge of the community EO, or is currently outside EO in the vicinity but likely to impact EO within the next 10 years

0: No threat

Reversibility:

5: Threat is not reversible (e.g., parking lot/paving)

4: Threat is reversible but not practically affordable without major investment of $ and time (potentially hundreds of thousands of dollars or full time staff effort)

3: Threat is reversible but moderately difficult and requires a fair investment of $ and/or time (potentially tens of thousands of dollars or 2+ weeks of staff time/year)

2: Threat is reversible at relatively low cost (potentially several days of staff time/year or up to a few thousand dollars)

1: Threat is easily reversible with only a few hours of effort (potentially annually) by a small group of people such as volunteers or state workers

0: No threat

Appendix 3. Global and State Element Ranking Criteria

GLOBAL RANKS

G1 = critically imperiled: at very high risk of extinction due to extreme rarity (often 5 or fewer occurrences), very steep declines, or other factors.

G2 = imperiled: at high risk of extinction due to very restricted range, very few occurrences (often 20 or fewer), steep declines, or other factors.

G3 = vulnerable: at moderate risk of extinction due to a restricted range, relatively few occurrences (often 80 or fewer), recent and widespread declines, or other factors.

G4 = apparently secure: uncommon but not rare; some cause for long-term concern due to declines or other factors.

G5 = secure: common; widespread.

GU = currently unrankable due to lack of information or due to substantially conflicting information about status or trends.

GX = eliminated: eliminated throughout its range, with no restoration potential due to extinction of dominant or characteristic species.

G? = incomplete data.

STATE RANKS

S1 = critically imperiled in the state because of extreme rarity (often 5 or fewer occurrences) or because of some factor(s) such as very steep declines making it especially vulnerable to extirpation from the state.

S2 = imperiled in the state because of rarity due to very restricted range, very few occurrences (often 20 or fewer), steep declines, or other factors making it very vulnerable to extirpation from the state.

S3 = vulnerable in the state due to a restricted range, relatively few occurrences (often 80 or fewer), recent and widespread declines, or other factors making it vulnerable to extirpation.

S4 = uncommon but not rare; some cause for long-term concern due to declines or other factors.

S5 = common and widespread in the state.

SX = community is presumed to be extirpated from the state. Not located despite intensive searches of historical sites and other appropriate habitat, and virtually no likelihood that it will be rediscovered.

S? = incomplete data.