Natural Community Surveys of Known Element Occurrences on State Park and Recreation Area Lands




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Cover photos: top left, Belle Isle Flatwoods wet-mesic flatwoods from Belle Isle Park; top right, Sturgeon Bay wooded dune and swale complex from Wilderness State Park; lower left, Copper Harbor Lighthouse, Norland Trust volcanic bedrock lakeshore from Fort Wilkins Historic State Park; and lower right, Porcupine Mountains mesic northern forest from Porcupine Mountains Wilderness State Park. Photos by Joshua G. Cohen.

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ACKNOWLEDGMENTS

We thank the Michigan Department of Natural Resources (DNR) Parks and Recreation Division (PRD) for funding this effort to survey 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. In addition, the DNR's Lindsay Ross provided critical assistance in compiling site packages. This report relies heavily on data collected by many present and former Michigan Natural Features Inventory (MNFI) field scientists, especially: Joshua Cohen, Michael Kost, Bradford Slaughter, Dennis Albert, Patrick Comer, Jacqueline Courteau, Kim Chapman, Harvey Ballard, Gary Reese, William MacKinnon, and Mark Tomboulian. Editorial support and insightful comments were provided by Martha Gove. Finally, we thank the following MNFI colleagues: Kraig Korroch and Rebecca Rogers assisted with report formatting, the development of an electronic natural community field form, and database management; Helen Enander offered technological support; and Sue Ridge, Nancy Toben, Yu Man Lee, and Brian Klatt provided administrative support.

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, 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. In addition, the DNR's Biodiversity Conservation Planning Process (BCPP) is identifying Biodiversity Stewardship Areas (BSAs), many of which will include portions of State Parks and Recreation Areas. Within the BSAs, biodiversity conservation will be a primary management priority. The goal of the BCPP is to establish a network of representative natural communities that contribute to functioning landscape ecosystems across the state.

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, or threat assessments. To inform the PRD management planning process, the DNR BCPP, 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. Through work on this project, MNFI has initiated a multi-year survey and assessment on State Park and Recreation Area lands of known 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). During the summer of 2012, MNFI scientists conducted surveys of ten high-quality natural communities previously identified on State Park and Recreation Area lands. According to MNFI's natural community classification, there are 76 natural community types in Michigan (Kost et al. 2007). Five different natural community types are represented in the ten element occurrences surveyed (Table 1). Surveys assessed the current ranking, classification, and delineation of these 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 such as the BCPP. This report summarizes the findings of MNFI's fourth year of ecological surveys.

METHODS

Field Preparation

Prioritization of sites to visit during the fourth survey year was determined in consultation with PRD staff. This process resulted in the selection of the final ten sites within eight different State Parks or Recreation Areas (Table 1) including the following: Fort Custer Recreation Area (1 site), Fayette Historic State Park (1 site), Craig Lake State Park (1 site), Old Mission Peninsula State Park (1 site), Porcupine Mountains Wilderness State Park (1 site), Wilderness State Park (1 site), Indian Lake State Park (1 sites), and Fort Wilkins Historic State Park (3 sites).

These sites were made a priority for the 2012 field season for one or more of the following reasons: PRD is in the process of writing and updating management plans; restoration work is in progress and needs evaluation; surveys have not been conducted within these areas for many years; and/or limited information has been recorded about the site. In addition, PRD staff requested that MNFI conduct a preliminary evaluation of the wet-mesic flatwoods on Belle Isle, since the stewardship of this island may be transferred to PRD.

Site preparation involved the creation by MNFI and PRD staff of Arcview GIS projects utilizing several layers, including the intersection of the natural community boundaries in MNFI's Biotics database (MNFI 2012) with PRD lands, topographic maps, 1998 digital orthographic photos, 2005 color aerial imagery, MNFI's circa 1800 vegetation map (Comer et al. 1995), and Rockford PLAT maps. For each of the ten occurrences, a site package was printed that included the polygon of the natural community overlaying the aforementioned data layers and a copy of the existing Element Occurrence Record. In addition to printed site packages, digital site packages were created for use with handheld Global Positioning System (GPS) units and ArcPad. The element occurrence polygons, PRD boundary maps, topographic maps, PLAT maps, and aerial imagery were saved to four- and sixteen-GB storage cards compatible with HP iPAQ units, which were paired with Bluetooth GPS receivers, and eight-GB microSDHC cards compatible with Ashtech Mobile Mapper 10 units.

In preparation for field surveys for this project, the Ecological Community Field Survey Form was revised and converted to a writable portable document format (pdf) to facilitate electronic archiving of the collected data (see Appendix 1). In addition, MNFI staff worked with PRD staff to develop a Threat Assessment Form to allow for the scoring of each observed threat in terms of severity, scope, and reversibility (see Appendix 2). 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.

Field Surveys

Natural Heritage and MNFI methodology 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 (from July 3, 2012 through September 10, 2012) to evaluate the condition and classification of the sites. PRD staff requested a preliminary evaluation of the Belle Isle wet-mesic flatwoods after the growing season and this initial survey was conducted November 9, 2012. 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. Given the vast size of the mesic northern forest element occurrence in the Porcupine Mountains Wilderness State Park, surveyors spent three weeks evaluating this site. For sites that occur on multiple ownerships, surveys were restricted to PRD portions of the occurrences. For each site visited, an Ecological Community Field Survey Form (Appendix 1) and a Threat Assessment Form (Appendix 2) were completed. The surveys 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 (both Garmin, HP iPAQ, and Ashtech Mobile Mapper 10 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) updating or assigning 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 2012). When necessary, natural community boundaries were re-mapped or mapped in the case of the Belle Isle wet-mesic flatwoods. Information from the 2012 field surveys and from surveys conducted prior to this project was used to produce threat assessments and management recommendations for each natural community occurrence, which appear within the following Results section.

RESULTS

Ten occurrences of high-quality natural communities were surveyed during the 2012 field season. As noted above, the ten sites surveyed were within eight different State Parks or Recreation Areas (see above and Table 1). A total of five different natural communities were visited including floodplain forest (1 element occurrence or EO), limestone lakeshore cliff (1 EO, formerly classified as limestone cliff), mesic northern forest (3 EOs), volcanic bedrock lakeshore (3 EOs), and wooded dune and swale complex (2 EOs). Table 1 lists the visited sites, their previous element occurrence ranks, and their current element occurrence ranks. Fifty percent of the sites (five of the ten sites) maintained their prior element occurrence ranking and 50% of the sites (five of ten sites) received lower element occurrence ranks compared to their prior ranking (Table 1). Of the ten sites surveyed, all were re-mapped.

MNFI staff conducted a preliminary evaluation of the wet-mesic flatwoods on Belle Isle. This site will likely qualify as an element occurrence wet-mesic flatwoods but an additional growing season survey is recommended to provide a more thorough evaluation of the site's floristic composition.

The following site summaries contain a detailed discussion for each of these ten natural communities organized alphabetically by community type and then by element occurrence. A site summary for the Belle Isle wet-mesic flatwoods is also included within this section. 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). 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 or preliminary rank assessment for the Belle Isle wet-mesic flatwoods
e) size
f) locational information
g) digital photograph(s)
h) threat assessment
i) management recommendations

Community Type	EO ID	County	Survey Site	Management Area	PRIOR EO RANK	CURRENT EO RANK	Surveyor
Floodplain Forest	11053	Kalamazoo	Augusta Floodplain	Fort Custer Recreation Area	BC	C	J. Cohen
Limestone Lakeshore Cliff*	3234	Delta	Middle Bluff	Fayette Historic State Park	AB	AB	J. Cohen
Mesic Northern Forest	7496	Baraga	Craig Lake	Craig Lake State Park	AB	B	B. Slaughter
Mesic Northern Forest	1435	Grand Traverse	Old Mission Point	Old Mission Peninsula State Park	C	C	J. Cohen
Mesic Northern Forest	4387	Gogebic and Ontonogan	Porcupine Mountains	Porcupine Mountains Wilderness State Park	A	AB	J. Cohen and B. Slaughter
Volcanic Bedrock Lakeshore	4634	Keweenaw	Copper Harbor Lighthouse, Norland Trust	Fort Wilkins Historic State Park	B	B	J. Cohen
Volcanic Bedrock Lakeshore	13106	Keweenaw	Fort Wilkins	Fort Wilkins Historic State Park	BC	BC	J. Cohen
Volcanic Bedrock Lakeshore	6528	Keweenaw	Porters Island	Fort Wilkins Historic State Park	B	BC	J. Cohen
Wet-Mesic Flatwoods	19059	Wayne	Belle Island Flatwoods	Belle Isle Park	NA	D	J. Cohen and S. Campbell
Wooded Dune and Swale Complex	8136	Emmet	Sturgeon Bay	Wilderness State Park	A	AB	J. Cohen
Wooded Dune and Swale Complex	986	Schoolcraft	Thompson	Indian Lake State Park	C	C	J. Cohen

Table 1. Summary of 2012 Surveys (* indicates element occurrence natural community type was re-classified).

SITE SUMMARIES

FLOODPLAIN FOREST

Overview: Floodplain forest is a bottomland, deciduous or deciduous-conifer forest community occupying low-lying areas adjacent to streams and rivers of third order or greater, and subject to periodic over-the-bank flooding and cycles of erosion and deposition. Species composition and community structure vary regionally and are influenced by flooding frequency and duration. Silver maple (*Acer saccharinum*) and green ash (*Fraxinus pennsylvanica*) are typically major overstory dominants, although green ash is declining in importance with the spread of emerald ash borer (*Agrilus planipennis*). Floodplain forests occur along major rivers throughout the state, but are most extensive in the Lower Peninsula. Species richness is greatest in the southern Lower Peninsula, where many floodplain species reach the northern extent of their range (Kost et al. 2007).

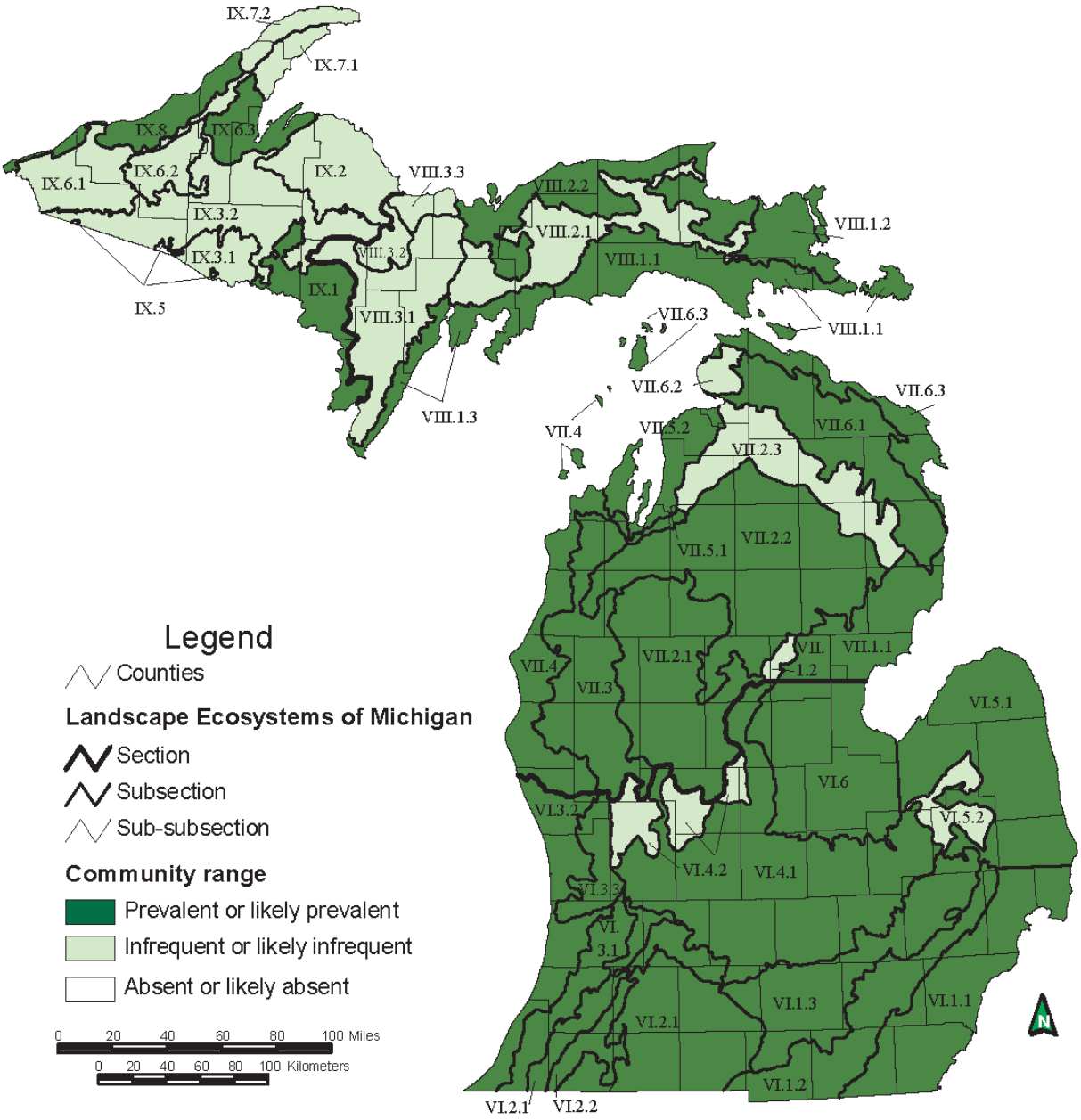

Figure 1. Distribution of floodplain forest in Michigan.

1. Augusta Floodplain
Natural Community Type: Floodplain Forest
Rank: G3? S3, vulnerable throughout range
Element Occurrence Rank: C
Size: 601 acres
Location: Fort Custer Recreation Area
Element Occurrence Identification Number: 11053

Threats: Species composition, vegetative structure, and successional trajectory are strongly influenced by gap dynamics and over-the-bank-flooding but they are also impacted by invasive species and deer herbivory. Emerald ash borer (*Agrilus planipennis*) is beginning to kill the canopy ash within this floodplain forest. Invasive species (i.e., garlic mustard, Japanese barberry, privet, honeysuckles, glossy buckthorn, and multiflora rose) are locally common and compete with native understory species. Deer browse and deer trails were noted throughout the floodplain. The Enbridge Oil Spill of July 2010 occurred in a tributary (Talmadge Creek) east of the site. It is not clear if this stretch of river and this floodplain forest were contaminated by the oil spill or if the floodplain was impacted by the clean-up efforts. Stabilizing netting along the bank of the river was noted near the boat launch and picnic area.

Management Recommendations: The primary management recommendation is to allow natural processes (i.e., flooding and windthrow) to operate unhindered (e.g., prohibit salvage logging and avoid altering the hydrology of the Kalamazoo River), control invasives through cutting, herbiciding, and manual removal, monitor for invasives and deer browse, and retain an intact buffer of natural communities surrounding the floodplain forest. Additional management recommendations include controlling invasives in the surrounding uplands to reduce the non-native seed source in the surrounding landscape and monitoring for oil contamination within the floodplain. In addition, pursuit of acquisition of adjacent private lands or discussion of compatible management with private landowners is recommended.

Photo 1. Augusta Floodplain. Photo by Joshua G. Cohen.

LIMESTONE LAKESHORE CLIFF

Overview: Limestone lakeshore cliff consists of vertical or near-vertical exposures of bedrock, which typically support less than 25% vascular plant coverage, although some rock surfaces can be densely covered with lichens, mosses, and liverworts. The community occurs in the Upper Peninsula along the shorelines of Lake Michigan and Lake Huron. Like all of Michigan's lakeshore cliffs, vegetation cover is sparse but abundant cracks and crevices combined with calcareous conditions result in greater plant diversity and coverage than on most other cliff types. Limestone lakeshore cliffs are characterized by high site moisture due to the proximity to the Great Lakes and a stressed and unstable environment because of severe waves, wind, and winter ice (Kost et al. 2007).

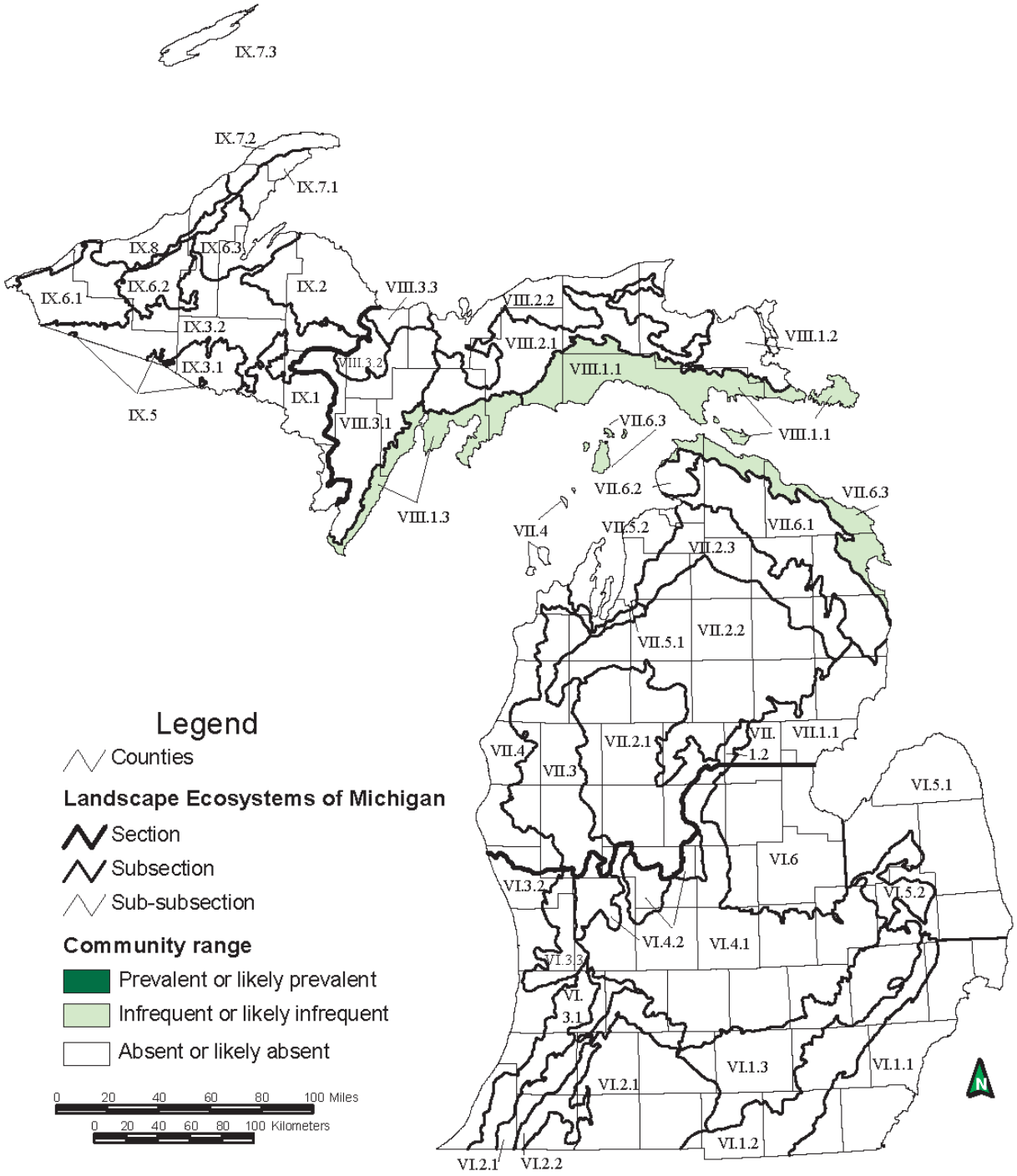

Figure 2. Distribution of limestone lakeshore cliff in Michigan.

2. Middle Bluff
Natural Community Type: Limestone Lakeshore Cliff (re-classified from Limestone Cliff)
Rank: G4G5 S1, apparently secure globally and critically imperiled within the state
Element Occurrence Rank: AB
Size: 25 acres
Location: Fayette Historic State Park
Element Occurrence Identification Number: 3234

Threats: Species composition and vegetative structure are influenced by natural processes. Non-native weeds occur along the trail at the top of the cliff and include Canada bluegrass (*Poa compressa*), common hemp nettle (*Galeopsis tetrahit*), and common mullein (*Verbascum thapsus*). Bittersweet nightshade (*Solanum dulcamara*) occurs at the base of the cliffs in the talus slopes and along the adjacent limestone cobble shore. Logging of the surrounding forests could increase the seed source for weedy species, which could be windblown or bird-dispersed onto the cliff.

Management Recommendations: The main management recommendations are to maintain a forested buffer adjacent to the cliffs to minimize the threat of invasion by non-native species and allow natural processes (i.e., fire and windthrow) to operate unhindered. Monitoring should be implemented for non-native plant populations.

Photo 2. Middle bluff limestone lakeshore cliff. Photo by Joshua G. Cohen.

MESIC NORTHERN FOREST

Overview: Mesic northern forest is a forest type of moist to dry-mesic sites lying mostly north of the climatic tension zone, characterized by the dominance of northern hardwoods, particularly sugar maple (*Acer saccharum*) and American beech (*Fagus grandifolia*). Conifers such as hemlock (*Tsuga canadensis*) and white pine (*Pinus strobus*) are frequently important canopy associates. This community type breaks into two broad classes: northern hardwood forest and hemlock-hardwood forest. It is primarily found on coarse-textured ground and end moraines, and soils are typically loamy sand to sandy loam. The natural disturbance regime is characterized by gap-phase dynamics; frequent, small windthrow gaps allow for the regeneration of the shade-tolerant canopy species. Catastrophic windthrow occurred infrequently with several generations of trees passing between large-scale, severe disturbance events. Historically, mesic northern forest occurred as a matrix system, dominating vast areas of mesic uplands in the Great Lakes region. These forests were multi-generational, with old-growth conditions lasting many centuries (Kost et al. 2007).

Figure 3. Distribution of mesic northern forest in Michigan.

3. Craig Lake
Natural Community Type: Mesic Northern Forest
Rank: G4 S3, apparently secure globally and vulnerable within the state
Element Occurrence Rank: B
Size: 200 acres
Location: Craig Lake State Park
Element Occurrence Identification Number: 7496

Threats: High deer densities are the primary threat to community structure, composition, and successional dynamics. Deer browse has apparently reduced vigor and fecundity of ground layer species and may be limiting advanced regeneration of some overstory species (i.e., northern white -cedar). In addition, non-native earthworms that consume leaf litter are also a potential threat.

Management Recommendations: Management recommendations include allowing natural processes (i.e., fire and windthrow) to operate unhindered (e.g., prohibit salvage logging), and monitoring for deer browse and invasives (including non-native plants and earthworms).

Photo 3. Craig Lake mesic northern forest. Photo by Bradford S. Slaughter.

4. Old Mission Point
Natural Community Type: Mesic Northern Forest
Rank: G4 S3, apparently secure globally and vulnerable within the state
Element Occurrence Rank: C
Size: 152 acres
Location: Old Mission Peninsula State Park
Element Occurrence Identification Number: 1435

Threats: Species composition and structure are patterned by gap-phase dynamics but are also influenced by anthropogenic factors, deer herbivory, and invasive species. Hiking trails occur throughout the forest and there is also a two-track that passes through the southern portion of the forest. Overstory beech (*Fagus grandifolia*) has recently been infected by beech bark disease and is beginning to succumb to this disease. Deer browse was noted throughout the forest and may be impacting species composition and floristic structure. Canada yew (*Taxus canadensis*) occurs in the low shrub layer but is not taller than two feet, suggesting that this shrub is browsed during the winter. In addition, hemlock (*Tsuga canadensis*) and northern white-cedar (*Thuja occidentalis*) regeneration are likely limited by deer browse. Scattered cut stumps occur within the forest. Many of the canopy oaks are multi-stemmed suggesting that they were cut or burned and then regenerated as stump sprouts following the disturbance. Along the trails and the two-track, coarse woody debris has been cut and moved. In addition, some off-road vehicle damage was noted near the parking area in the southeastern portion of the occurrence.

Management Recommendations: Management recommendations include allowing natural processes (i.e., windthrow and fire) to operate unhindered (e.g., prohibit salvage logging and moving and removal of coarse woody debris), reducing local deer densities, and monitoring for invasives and deer browse. Given the recent outbreak of beech bark disease, infected trees could be cut down to try to limit the spread of this disease to non-infected beech.

Photo 4. Old Mission Point mesic northern forest. Photo by Joshua G. Cohen.

5. Porcupine Mountains
Natural Community Type: Mesic Northern Forest
Rank: G4 S3, apparently secure globally and vulnerable within the state
Element Occurrence Rank: AB
Size: 49,418 acres
Location: Porcupine Mountains Wilderness State Park
Element Occurrence Identification Number: 4387

Threats: The primary threat to the forest is likely deer browse. Deer trails, pellets, and browse were noted throughout the forest. Deer herbivory is locally limiting species composition and vegetative structure. Deer browse pressure is greatest in the western portion of the park where the terrain is flat and the forest is narrowest. High deer herbivory is likely also correlated with proximity to the South Boundary Road, which borders the forest to the south. Locally, deer browse is limiting understory species (i.e., reducing hemlock, yellow birch, sugar maple, and red oak regeneration, especially in the western portion of the complex) and reducing the reproductive success and vigor of palatable herbaceous species (browsed forbs were often sterile). Within these heavily browsed areas, substrate for hemlock establishment (i.e., nurse logs and tip-up mounds) and hemlock seedlings are common but hemlock saplings are noticeably absent. In areas of heavily browsed deciduous old-growth, sugar maple (*Acer saccharum*) is heavily browsed but remains dominant in the understory and ground cover. Deer herbivory was noted on sugar maple, red-berried elder (*Sambucus racemosa*), false Solomon's seal (*Smilacina racemosa*), doll's eyes (*Actaea pachypoda*), bluebead lily (*Clintonia borealis*), currants (*Ribes* spp.), goldenrods (*Solidago* spp.), jewelweed (*Impatiens capensis*), and helleborine (*Epipactis helleborine*). Deer are likely wintering within the forest. Within heavily browsed portions of the forest, browsed saplings are less than 30 to 40 cm tall, which likely corresponds to the snow depth.

Photo 5. Porcupine Mountains mesic northern forest. Photo by Joshua G. Cohen.

Threats (continued): An extensive network of hiking trails occurs throughout the forest: the trail system includes over 87 miles of trails. Some of these trails are also open to mountain biking and cross-country skiing. Erosion, soil compaction, and root exposure are locally occurring along the trails and negative impacts from trail usage are most notable along steep slopes and where the trails pass through wetland inclusions. Trails traversing seasonally wet areas and stretches with organic soils have locally impacted soils. Many of these areas have boardwalks but hikers use both the boardwalks and the areas adjacent to the boardwalks.

Non-native species occur scattered along these trails but are uncommon in the forest interior, occurring infrequently along drainages (i.e., bittersweet nightshade) and in windthrow gaps. Non-native weeds observed along the trails include bittersweet nightshade (*Solanum dulcamara*), common dandelion (*Taraxacum officinale*), common burdock (*Arctium minor*), common mullein (*Verbascum thapsus*), wild carrot (*Daucus carota*), helleborine, common hemp nettle (*Galeopsis tetrahit*), common buttercup (*Ranunculus acris*), red clover (*Trifolium pratense*), lawn prunella (*Prunella vulgaris*), common speedwell (*Veronica officinalis*), common plantain (*Plantago major*), and spotted knapweed (*Centaurea maculosa*). The trails within the forest serve as conduit for both native and non-native species that spread by sticking to fur or clothing. Non-native species occurring along the roads within the forest and bordering the forest include common St. John's-wort (*Hypericum perforatum*), Canada bluegrass (*Poa compressa*), autumn olive (*Elaeagnus umbellata*), chicory (*Cichorium intybus*), red clover, timothy (*Phleum pratense*), ox-eye daisy (*Chrysanthemum leucanthemum*), spotted knapweed, and reed canary grass (*Phalaris arundinacea*).

One patch of garlic mustard (*Alliaria petiolata*) was documented along the Lake Superior Trail in section 11 (50N 45W) and was likely introduced into the park by hikers. Eradication efforts to eliminate this patch of garlic mustard appear to have been successful. No other populations of garlic mustard were documented during over a month of surveys within the park. In addition to non-native plants, non-native earthworms were observed locally. Research by Lee Frelich in the park suggests that earthworms are impacting soil processes and properties.

Numerous back country camp sites and rustic cabins occur within the forest. Localized disturbance is associated with these sites. Some cutting for firewood of understory vegetation and coarse woody debris was noted near camp sites and cabins. In addition, coarse woody debris has been cut along the hiking trails. In most instances, bucked coarse woody debris is moved off the trail and placed bole side down. However, in one instance bucked coarse wood was oriented perpendicular to the bole (cut side down).

Portions of the mapped forest were historically logged and/or logged and burned. Charred large-diameter sugar maple snags occur along the margin of old-growth forest and stands of burned forest with younger northern hardwoods and early-successional species. A spot fire was also noted within the western portion of the complex in old-growth forest and is likely of anthropogenic origin. Cutting included clear-cutting as well as selective cutting especially for northern white-cedar (*Thuja occidentalis*) in the northeastern portion of the complex. The old-growth landscape includes scattered stands of maturing northern hardwoods, senescing early-successional species, and stands of old-growth forest with scattered cut stumps. Old-logging trails/skid trails occur scattered throughout the forest. Several paved roads and parking areas occur within the mapped area and an impoundment occurs within the complex.

Management Recommendations: The main management recommendations are to allow natural processes (i.e., windthrow and fire) to operate unhindered (e.g., prohibit salvage logging), to control and monitor for invasive species (i.e., garlic mustard), to eliminate removal of vegetation and CWD for firewood, and to reduce deer densities and deer browse pressure and monitor control efforts. Establishing boot scrapes and companion signage explaining invasive species may reduce the risk of future infestation of invasives such as garlic mustard. Trail erosion can be reduced by the continued development of boardwalks, especially through stretches of trail that traverse wetlands, areas with organic soils, and seasonally inundated areas. In addition, portions of trail open to mountain biking that have been heavily eroded may need to be evaluated and could be seasonally or permanently closed to biking. Where coarse woody debris has been removed from trails, the bucked sections of wood should be placed bole side down within the forest since this is a more functional orientation for decomposing wood.

Photos 6 and 7. Porcupine Mountains mesic northern forest. Photos by Joshua G. Cohen.

VOLCANIC BEDROCK LAKESHORE

Overview: Volcanic bedrock lakeshore is a sparsely vegetated community dominated by mosses and lichens, with a scattered coverage of vascular plants. The community is located primarily along the Lake Superior shoreline on the Keweenaw Peninsula and Isle Royale. This Great Lakes coastal community includes all types of volcanic bedrock, including basalt, conglomerate composed of volcanic rock, and rhyolite (Kost et al. 2007).

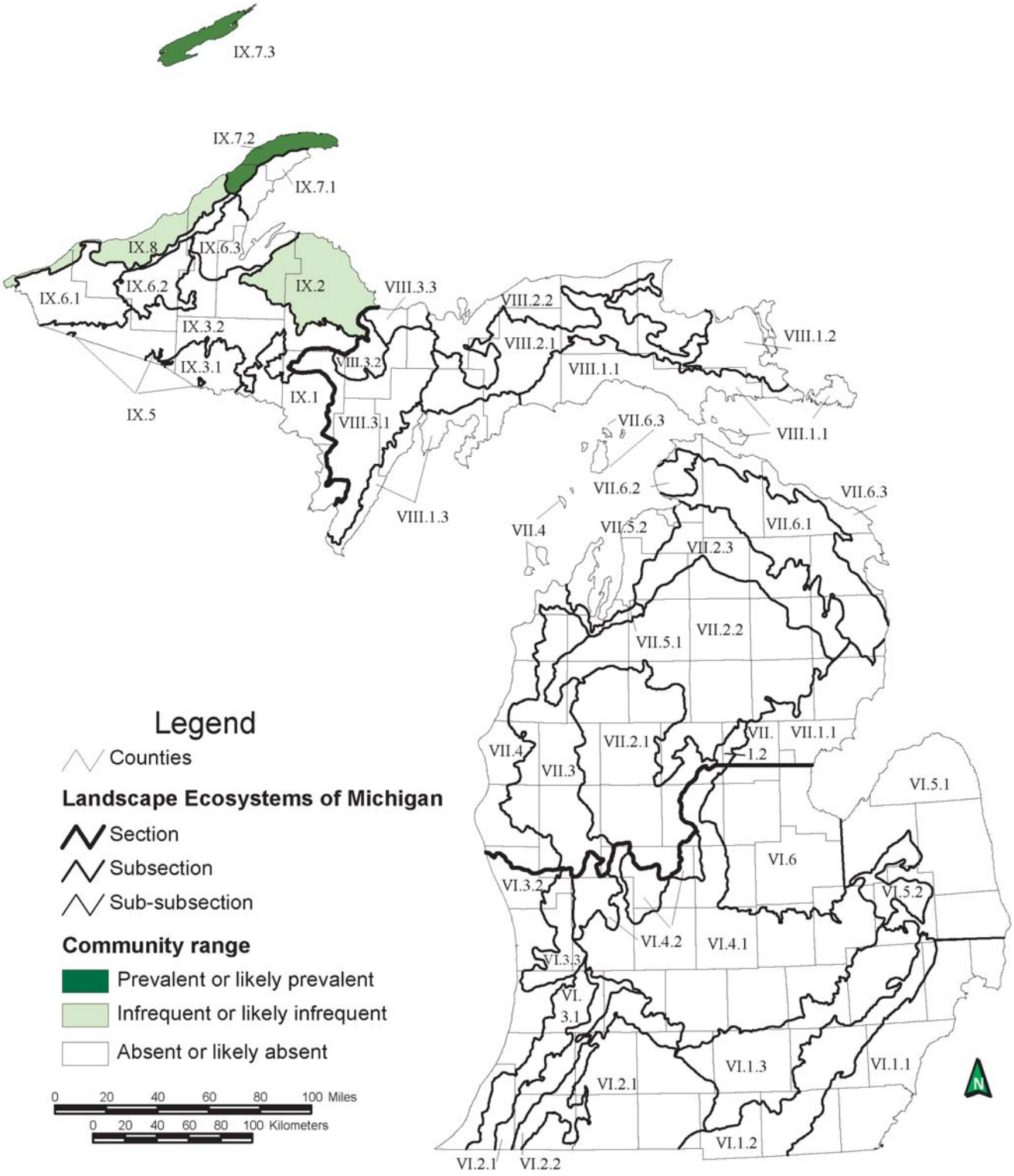

Figure 4. Distribution of volcanic bedrock lakeshore in Michigan.

6. Copper Harbor Lighthouse, Norland Trust
Natural Community Type: Volcanic Bedrock Lakeshore
Rank: G4G5 S2, apparently secure globally and imperiled within the state
Element Occurrence Rank: B
Size: 46 acres
Location: Fort Wilkins Historic State Park
Element Occurrence Identification Number: 4634

Threats: Species composition and vegetative structure are determined by natural processes. Dispersed foot traffic occurs along the shore but is concentrated near the boat dock, lighthouse, and hiking trail that runs parallel to the shoreline. Several weedy species occur along the shoreline including St. John's-wort (*Hypericum perforatum*) and ox-eye daisy (*Chrysanthemum leucanthemum*), which are especially concentrated near the boat dock. The eastern portion of the volcanic bedrock lakeshore occurs on private land with houses set back from the shoreline.

Management Recommendations: The main management recommendations are to allow natural processes to operate unhindered and to maintain a natural community buffer surrounding the lakeshore to prevent the increase of a weedy seed source. Current populations of non-native species along this stretch of shoreline should be removed. Monitoring efforts to detect invasive species and evaluate control efforts should be implemented. In addition, pursuit of acquisition of adjacent private lands or discussion of compatible management with private landowners is recommended.

Photo 8. Copper Harbor Lighthouse, Norland Trust volcanic bedrock lakeshore. Photo by Joshua G. Cohen.

7. Fort Wilkins
Natural Community Type: Volcanic Bedrock Lakeshore
Rank: G4G5 S2, apparently secure globally and imperiled within the state
Element Occurrence Rank: BC
Size: 10 acres
Location: Fort Wilkins Historic State Park
Element Occurrence Identification Number: 13106

Threats: Species composition and vegetative structure are determined by natural processes. Dispersed foot traffic occurs along the shore but is concentrated near the hiking trail that runs parallel to the shoreline. Several weedy species occur along the shoreline including St. John's-wort (*Hypericum perforatum*), ox-eye daisy (*Chrysanthemum leucanthemum*), spotted knapweed (*Centaurea maculosa*), timothy (*Phleum pratense*), and Canada bluegrass (*Poa compressa*). Some cement slabs were noted in the western portion of the site. The eastern portion of the volcanic bedrock lakeshore occurs on private land with houses set back from the shoreline.

Management Recommendations: The main management recommendations are to allow natural processes to operate unhindered and to maintain a natural community buffer surrounding the lakeshore to prevent the increase of a weedy seed source. Current populations of non-native species along this stretch of shoreline should be removed. Monitoring efforts to detect invasive species and evaluate control efforts should be implemented. In addition, pursuit of acquisition of adjacent private lands or discussion of compatible management with private landowners is recommended.

Photo 9. Fort Wilkins volcanic bedrock lakeshore. Photo by Joshua G. Cohen.

8. Porters Island
Natural Community Type: Volcanic Bedrock Lakeshore
Rank: G4G5 S2, apparently secure globally and imperiled within the state
Element Occurrence Rank: BC
Size: 7.5 acres
Location: Fort Wilkins Historic State Park
Element Occurrence Identification Number: 6528

Threats: Species composition and vegetative structure are determined by natural processes. Dispersed foot traffic occurs along the shore, concentrated along the southern portion of the shore from kayakers and canoers, who access the island from Copper Harbor. Several weedy species occur along the shoreline including St. John's-wort (*Hypericum perforatum*) and ox-eye daisy (*Chrysanthemum leucanthemum*), which are also common within the inclusions of volcanic cobble shore.

Management Recommendations: The main management recommendations are to allow natural processes to operate unhindered and to maintain a natural community buffer on the island to prevent the increase of a weedy seed source. Current populations of non-native species along this stretch of shoreline should be removed. Monitoring efforts to detect invasive species and evaluate control efforts should be implemented.

Photo 10. Porters Island volcanic bedrock lakeshore. Photo by Joshua G. Cohen.

WET-MESIC FLATWOODS

Overview: Wet-mesic flatwoods is a wet to mesic forest on mineral soils dominated by a highly diverse mixture of upland and lowland hardwoods. The community occurs almost exclusively on poorly drained glacial lakeplain in southeastern Lower Michigan and is typically characterized by the presence of an impervious clay layer. Seasonal inundation is the primary natural disturbance factor influencing wet-mesic flatwoods. Dominant trees may include oaks, hickories, maples, ashes, and basswood (Kost et al. 2007).

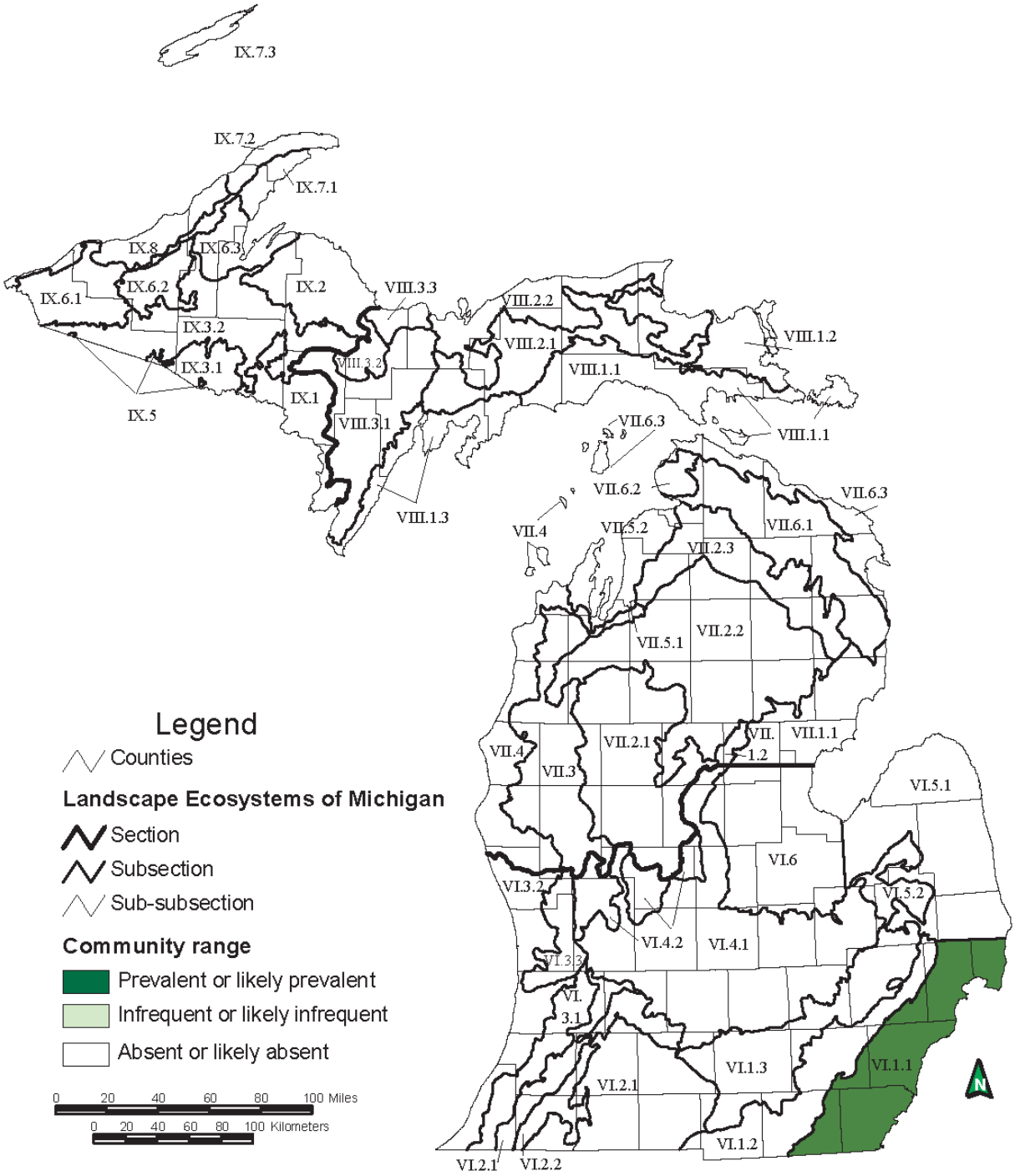

Figure 5. Historical distribution of wet-mesic flatwoods in Michigan.

9. Belle Isle Flatwoods
Natural Community Type: Wet-Mesic Flatwoods
Rank: G2G3 S3, vulnerable to imperiled globally and imperiled within the state
Preliminary Element Occurrence Rank: D
Size: 197 acres
Location: Belle Isle Park
Element Occurrence Identification Number: 19059

Threats: Species composition, vegetative structure, and successional trajectory are strongly influenced by seasonal inundation and gap-phase dynamics but have also been impacted by altered hydrology (from development of ditches, paved roads and pathways, and dumping of fill), altered soils (from dumping of fill), and invasive species (including die-back of canopy ash from emerald ash borer (*Agrilus planipennis*), competition from invasive shrubs and graminoids, and browse pressure from introduced European fallow deer). It is not clear if fire suppression has altered the fire regime of the flatwoods.

A herd of 375 European fallow deer (*Dama dama*) ranged freely on the island for over 80 years. The deer were introduced in the 1920s and were captured and contained in enclosures in 2004. This non-native deer herd had a significant impact on the understory and ground cover of the flatwoods. Oak regeneration in the understory and low shrub layer is present but at low levels and has likely been impacted by deer browse pressure. Currently low levels of white-tailed deer (likely less than ten) are known to inhabit the island.

The hydrologic regime of the flatwoods has been altered by the development of paved paths and roads, the creation of ditches, and the dumping of fill. In addition, the canals and lakes on Belle Isle were likely historically low wet swales that were dredged and exaggerated by anthropogenic activity.

Paved bike paths, paved roads, and ditches occur throughout the flatwoods and likely provide conduits for invasive species spread. Runoff from road salts has likely resulted in localized eutrophication and spread of invasives that favor these conditions (i.e., reed canary grass). Understory competition from invasive shrubs occurs locally and is most prevalent along the trail and road margins, along the outer edges of the flatwoods, in areas of the flatwoods that are narrow, and where fill has been dumped and local soil and hydrologic properties have been altered.

Amur honeysuckle (*Lonicera maackii*) is locally dominant and additional Eurasian honeysuckles (*Lonicera* spp.), glossy buckthorn (*Rhamnus frangula*), common buckthorn (*R. cathartica*), multiflora rose (*Rosa multiflora*), and common privet (*Ligustrum vulgare*) are locally common. Numerous escaped cultivars occur within the flatwoods. Less common understory invasives include spindle tree (*Euonymus europaea*), European highbush cranberry (*Viburnum opulus*), and Norway maple (*Acer platanoides*). Snowberry (*Symphoricarpus albus* var. *laevigatus*), an escaped cultivar occurs locally. Japanese knotweed (*Polygonum cuspidatum*) occurs locally south of the Nashua Canal. A road heading east from the zoo was buried with fill. The area between this slight rise and the paved bike path to the south is dominated by an invasive shrub understory with Amur honeysuckle most prevalent. Reed (*Phragmites australis*) and reed canary grass (*Phalaris arundinacea*) occur locally. A large patch of reed occurs just south of the Nature Center and in the northeast portion of the flatwoods; this invasive is encroaching along the margins of the woods and along the paved roads. Reed canary grass is locally dominant and may be associated with the dumping of fill and the runoff of road salts. In addition, bittersweet nightshade (*Solanum dulcamara*), common mullein (*Verbascum thapsus*), periwinkle (*Vinca minor*), wintercreeper (*Euonymus fortunei*), and Oriental bittersweet (*Celastrus orbiculatus*) were noted locally.

The majority of canopy ash, both pumpkin ash (*Fraxinus profunda*) and green ash (*F. pennsylvanica*), have been killed by emerald ash borer. Some scattered canopy ash trees remain alive. Following the die-back of canopy ash, there has been a pulse of ash sprouting and both pumpkin ash and green ash saplings are locally dominant in the understory. The canopy die-back and the opening of the canopy has likely also favored invasive species in the understory and ground cover. Reed canary grass appears to be prevalent in some areas where canopy ash mortality was high.

Non-native earthworms were documented in 2012 and non-native slugs have also been observed by Suzan Campbell. These non-native invertebrates are likely impacting the soil properties and soil development processes.

Management Recommendations: Invasive species monitoring and removal efforts should continue to be implemented, especially in the highest quality stretches of wet-mesic flatwoods. The Belle Isle Conservancy has been cutting and herbiciding invasive shrubs. In addition, the patch of *Phragmites australis* near the Nature Center has been treated, thirty pumpkin ash were treated to try to prevent mortality from emerald ash borer, and three different species of emerald ash borer parasatoids. These stewardship efforts should be evaluated. Impacts of decades of deer herbivory should be evaluated. Monitoring for oak regeneration is recommended to ascertain if suitable recruitment is present. Efforts to restore the site's hydrology should be implemented (e.g., removal of paved pathways and roads, removal of dredged fill). Prescribed fire should be evaluated as a stewardship tool to promote oak regeneration and reduce invasive shrub cover.

Photo 11. Belle Isle Flatwoods. Photo by Joshua G. Cohen.

WOODED DUNE AND SWALE COMPLEX

Overview: Wooded dune and swale complex is a large complex 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 upland dune ridges are typically forested, while the low swales support a variety of herbaceous or forested wetland types, with open wetlands more common near the shoreline and forested wetlands more prevalent further from the lake. Wooded dune and swale complexes occur primarily in the northern Lower and Upper Peninsulas and Thumb region (Kost et al. 2007).

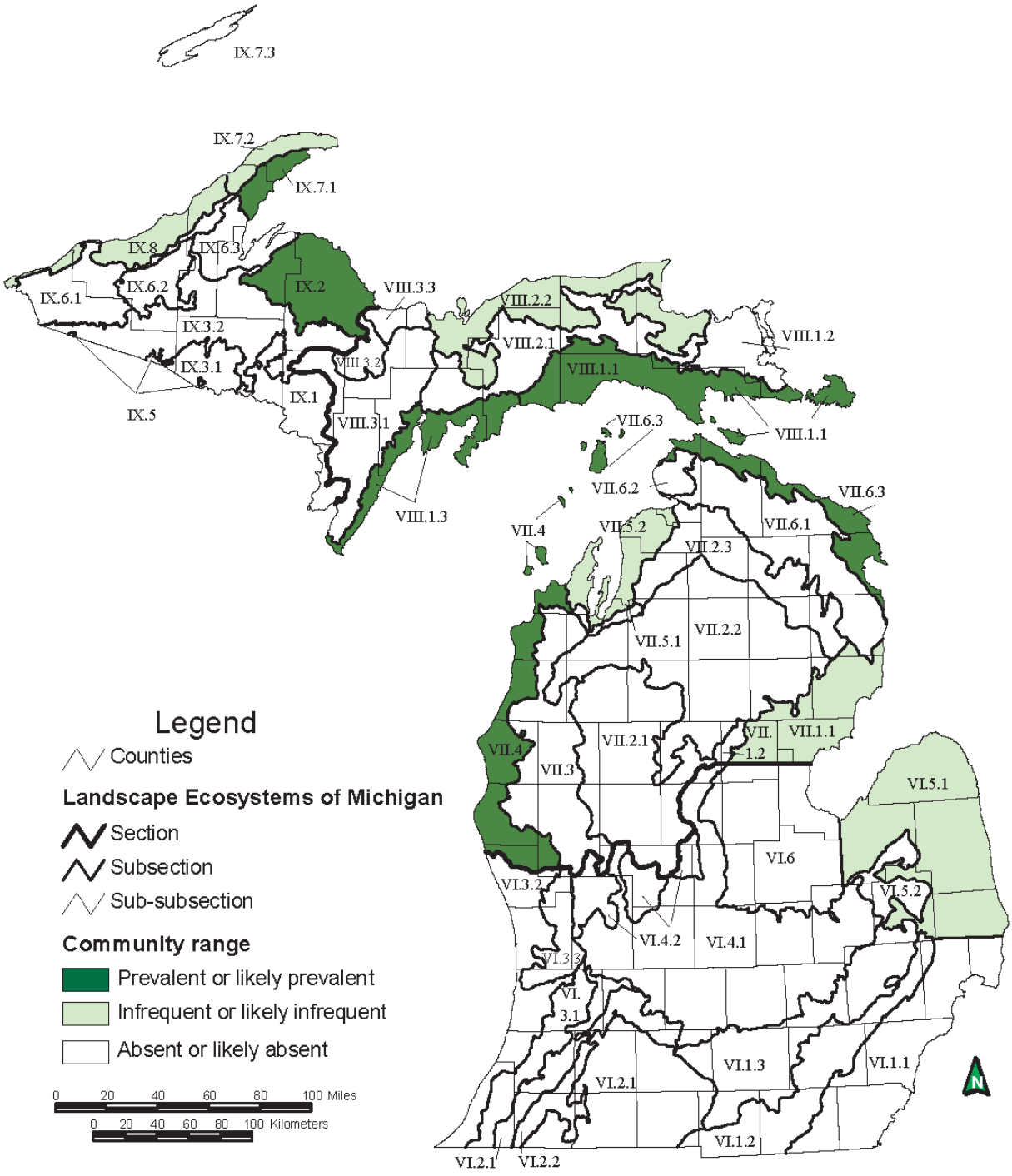

Figure 6. Distribution of wooded dune and swale complex in Michigan.

10. Sturgeon Bay
Natural Community Type: Wooded Dune and Swale Complex
Rank: G3 S3, vulnerable throughout range
Element Occurrence Rank: AB
Size: 1979 acres
Location: Wilderness State Park
Element Occurrence Identification Number: 8136

Threats: Several linear anthropogenic disturbances (i.e., dirt roads and hiking trails) fragment this dune and swale complex. Non-native weeds that are concentrated along these linear disturbances include spotted knapweed (*Centaurea maculosa*), Canada bluegrass (*Poa compressa*), common hemp nettle (*Galeopsis tetrahit*), red clover (*Trifolium pratense*), and white sweet-clover (*Melilotus alba*). Cut stumps occur within portions of the complex and in some cases, the harvested trees were larger in diameter than the remaining canopy cohort. Deer browse and trails are prevalent throughout the complex.

Management Recommendations: Management recommendations include allowing natural processes (i.e., windthrow and fire) to operate unhindered (e.g., prohibit salvage logging and moving and removal of coarse woody debris), reducing local deer densities, controlling non-native species, and monitoring for invasives and deer browse.

Photo 12. Sturgeon Bay wooded dune and swale complex. Photo by Joshua G. Cohen.

11. Thompson
Natural Community Type: Wooded Dune and Swale Complex
Rank: G3 S3, vulnerable throughout range
Element Occurrence Rank: C
Size: 6524 acres
Location: Indian Lake State Park
Element Occurrence Identification Number: 986

Threats: Roads, railroads, powerlines, and pipelines that pass through the site impact the hydrology locally and could introduce invasive species into the wooded dune and swale complex. Recent logging activity, including strip cutting could also lead to the increase in non-native species. Forested ridges and swales were also historically logged. Several non-native species were noted along the roadsides including lawn prunella (*Prunella vulgaris*) and European marsh thistle (*Cirsium palustre*). Deer herbivory is impacting species composition and structure. Deer paths, pellets, and browse occur throughout the complex. Shoreline housing development could further fragment the wooded dune and swale complex and increase the potential for off-road vehicle damage.

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. Critical stewardship needs include the reduction of deer densities and monitoring deer herbivory, which can help resource managers assess whether species composition and structure are being negatively impacted by deer browse. To reduce deer browse pressure, the surrounding forests could be managed for late-successional habitat and direct measures could be taken to reduce population densities. Along the shoreline, it is imperative to eliminate off-road vehicle traffic and monitor for invasive species. Portions of the complex occurring on private lands could be acquired or protected through conservation easements.

Photo 13. Thompson wooded dune and swale complex. Photo by Joshua G. Cohen.

DISCUSSION

This report provides site-based assessments of ten natural community element occurrences on PRD lands and the preliminary evaluation of the Belle Isle wet-mesic flatwoods. 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. A growing season survey will be conducted in Belle Isle to finish the evaluation of the wet-mesic flatwoods. In addition, over the next year, MNFI will survey for new natural community element occurrences within State Parks and Recreation Areas that have yet to be surveyed or were not thoroughly surveyed during past efforts. In addition to this continued survey effort, a much needed future step is the development of a framework for prioritizing stewardship efforts across these sites. 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.

Photo 14. Copper Harbor Lighthouse, Norland Trust volcanic bedrock lakeshore. Photo by Joshua G. Cohen.

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Photo 15. Porcupine Mountains mesic northern forest. Photo by Joshua G. Cohen.

Appendix 1. Ecology Community Field Survey Form

Michigan Natural Features Inventory

Ecological Community Field Survey Form

MICHIGAN STATE UNIVERSITY EXTENSION

SURVEY INFORMATION

Survey date: _____ Time: from _____ AM PM to _____ AM PM 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 ☐ ? _____

Appendix 1, continued. Ecology Community Field Survey Form.

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)**:**

Appendix 1, continued. Ecology Community Field Survey Form.

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:

Appendix 1, continued. Ecology Community Field Survey Form.

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, continued. Ecology Community Field Survey Form.

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%

Appendix 1, continued. Ecology Community Field Survey Form.

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):

Appendix 1, continued. Ecology Community Field Survey Form.

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, continued. Ecology Community Field Survey Form.

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, continued. Ecology Community Field Survey Form.

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

Appendix 1, continued. Ecology Community Field Survey Form.

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**.

Appendix 2, continued. Threat Assessment Form.

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.