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



Prepared by: Joshua G. Cohen and Bradford S. Slaughter

Michigan Natural Features Inventory P.O. Box 30444 Lansing, MI 48909-7944

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Cover photos: top left, Escarpment Trail northern bald from Porcupine Mountains Wilderness State Park; top right, Pickerel Lake Complex oak barrens from Pinckney State Recreation Area; lower left, Betsy Lake mesic northern forest from Tahquamenon Falls State Park; and lower right, Sturgeon Bay Great Lakes barrens, interdunal wetland, and open dunes from Wilderness State Park. Photos by Joshua G. Cohen.

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#### ACKNOWLEDGMENTS

We thank the Michigan Department of Natural Resources and Environment (DNRE) Recreation Division (RD) for funding this effort to survey high-quality natural communities in Michigan's State Parks and Recreation Areas. Special thanks are due to RD'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 DNRE's Lindsay Ross provided critical assistance in compiling site packages and Burr Mitchell and Craig Krepps facilitated field surveys. 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, Mike Penskar, Patrick Comer, Phyllis Higman, Kim Chapman, Gary Reese, Will MacKinnon, Jodi Spieles, Lawrence Brewer, William Larsen, Leon Schaddelee, Michael Scott, Hannah Dunevitz Texler, and Gerard Donnelly. Editorial support and insightful comments were provided by Martha Gove and Michael Kost. 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 and Environment (DNRE), Recreation Division (RD) is responsible for managing Michigan's State Parks, Recreation Areas, Boating Access Sites, and Harbors. Part of RD'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 RD 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 DNRE's Biodiversity Conservation Planning Process (BCPP) is identifying biodiversity stewardship areas (BSAs), 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 RD Management Planning process, the DNRE 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 2010, MNFI scientists conducted surveys of 73 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). Twenty-eight different natural community types are represented in the 73 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 second year of ecological surveys.

#### **METHODS**

#### **Field Preparation**

Prioritization of sites to visit during the second survey year was determined in consultation with PRD staff. This process resulted in the selection of 73 sites within 22 different State Parks or Recreation Areas (Table 1) including the following: Algonac State Park (1 site), Cheboygan State Park (3 sites), Duck Lake State Park (1 site), Fisherman's Island State Park (2 sites), Grand Mere State Park (2 sites), Hoffmaster State Park (2 sites), Leelanau State Park (4 sites), Ludington State Park (3 sites), Muskegon State Park (5 sites), Pinckney State Recreation Area (3 sites), Porcupine Mountains Wilderness State Park (1 site), Port Crescent State Park (1 site), Rifle River State Recreation Area (1 site), Saugatuck Dunes State Park (3 sites), Silver Lake State Park (3 sites), Sleeper State Park (2 sites), Tahquamenon Falls State Park (15 sites), Van Buren State Park (1 site), Van Riper State Park (1 site), Warren Dunes State Park (4 sites), Warren Woods State Park (2 sites), and Wilderness State Park (13 sites). These sites were made a priority for the 2010 field season for one or more of the following reasons: RD 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.

Site preparation involved the creation by MNFI and RD staff of Arcview GIS projects utilizing several layers, including the intersection of the natural community boundaries in MNFI's Biotics database (MNFI 2011) with RD 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 73 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, RD boundary maps, topographic maps, PLAT maps, and aerial imagery were saved to one- and four-GB storage cards compatible with HP iPAQ units, which were paired with Bluetooth GPS receivers.

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 RD 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 June 7, 2010 through September 30, 2010) 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 public 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 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) 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 the element occurrence records in MNFI's statewide biodiversity conservation database (MNFI 2011). When necessary, natural community boundaries were re-mapped. Information from the 2010 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

Seventy-three occurrences of high-quality natural communities were surveyed during the 2010 field season. As noted above, the 73 sites surveyed were within 22 different State Parks or Recreation Areas (see above and Table 1). A total of 28 different natural communities were visited including boreal forest (3 element occurrences or EOs), coastal plain marsh (1 EO), dry northern forest, (2 EOs) dry-mesic northern forest (2 EOs), dry-mesic southern forest (1 EO), floodplain forest (1 EO), granite cliff (1 EO), Great Lakes barrens (5 EOs), Great Lakes marsh (3 EOs), hardwood-conifer swamp (1 EO), interdunal wetland (10 EOs), intermittent wetland (3 EOs), lakeplain oak openings (1 EO), lakeplain wet-mesic prairie (1 EO), mesic northern forest (9 EOs), mesic sand prairie (1 EO), mesic southern forest (2 EOs), muskeg (1 EO), northern bald (1 EO), northern fen (1 EO), oak barrens (1 EO), oak-pine barrens (1 EO), open dunes (11 EOs), patterned fen (1 EO), rich conifer swamp (4 EOs), sand and gravel beach (1 EO), wet-mesic prairie (1 EO), and wooded dune and swale complex (3 EOs). Table 1 lists the visited sites, their previous element occurrence ranks, and their current element occurrence ranks. Forty-five percent of the sites (33 of the 73 sites) maintained their prior element occurrence ranking, 22% of the sites (16 of 73 sites) had an improved ranking, and 33% of the sites (24 of 73 sites) received lower element occurrence ranks compared to their prior ranking (Table 1). Of the 73 sites surveyed, all but the Devil's Kitchen hardwood-conifer swamp were re-mapped.

The following site summaries contain a detailed discussion for each of these 73 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). 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(s)
- h) threat assessment
- i) management recommendations

					PRIOR	CURRENT	
Community Type	EO ID	County	Survey Site	Management Area	<b>EO RANK</b>	<b>EO RANK</b>	Surveyor
Boreal Forest	2127	Emmet	Cap's Cabin	Wilderness State Park	BC	AB	J. Cohen
Boreal Forest	12329	Emmet	Waugoshance Island	Wilderness State Park	Α	AB	J. Cohen
Boreal Forest	7678	Emmet	Waugoshance Point	Wilderness State Park	В	В	J. Cohen
Coastal Plain Marsh	11484	Muskegon	Hidden Lake	Muskegon State Park	В	В	B. Slaughter
Dry Northern Forest	5133	Chippewa & Luce	Clark Lake Pine Ridges	Taqhuamenon Falls State Park	В	AB	J. Cohen
Dry Northern Forest	708	Luce	Fisher Bridge Red Pines	Taqhuamenon Falls State Park	С	D	J. Cohen
Dry-Mesic Northern Forest	3129	Muskegon	Muskegon State Park	Muskegon State Park	С	BC	B. Slaughter
Dry-Mesic Northern Forest	13195	Emmet	Nebo Trail	Wilderness State Park	В	В	J. Cohen
Dry-Mesic Southern Forest	943	Berrien	Grand Mere	Grand Mere State Park	BC	BC	B. Slaughter
Floodplain Forest	12084	Berrien	Warren Woods	Warren Woods State Park	AB	B	B. Slaughter
Granite Cliff	4004	Marquette	Van Riper State Park	Van Riper State Park	В	В	J. Cohen
Great Lakes Barrens	8689	Leelanau	Cathead Bay	Leelanau State Park	В	В	J. Cohen
Great Lakes Barrens	4392	Cheboygan	Cheboygan State Park	Cheboygan State Park	С	BC	B. Slaughter
Great Lakes Barrens	11891	Mason	Nordhouse Dunes	Ludington State Park	A	AB	J. Cohen
Great Lakes Barrens	2826	Oceana	Silver Lake Dunes	Silver Lake State Park	В	В	J. Cohen
Great Lakes Barrens	3324	Emmet	Sturgeon Bay	Wilderness State Park	В	AB	J. Cohen
Great Lakes Marsh	2786	Cheboygan	Cheboygan Point	Cheboygan State Park	AB	В	B. Slaughter
Great Lakes Marsh	3468	Emmet	Temperance and Waugoshance Islands	Wilderness State Park	AB	AB	J. Cohen
Great Lakes Marsh	11690	Emmet	Waugoshance Point	Wilderness State Park	AB	AB	J. Cohen
Hardwood-Conifer Swamp	2519	Muskegon	Devil's Kitchen	Muskegon State Park	С	С	B. Slaughter
Interdunal Wetland	3342	Leelanau	Cathead Bay	Leelanau State Park	С	В	J. Cohen
Interdunal Wetland	3071	Cheboygan	Cheboygan State Park	Cheboygan State Park	BC	BC	J. Cohen
Interdunal Wetland	8003	Charlevoix	Fisherman's Island State Park	Fisherman's Island State Park	С	С	J. Cohen
Interdunal Wetland	12019	Muskegon	Muskegon State Park	Muskegon State Park	В	В	B. Slaughter
Interdunal Wetland	3898	Mason	Nordhouse Dunes	Ludington State Park	Α	Α	J. Cohen
Interdunal Wetland	10033	Allegan	Saugatuck Dunes	Saugatuck Dunes State Park	В	BC	B. Slaughter
Interdunal Wetland	11697	Oceana	Silver Lake Dunes	Silver Lake State Park	AB	В	J. Cohen
Interdunal Wetland	5053	Emmet	Sturgeon Bay	Wilderness State Park	В	В	J. Cohen
Interdunal Wetland	4857	Berrien	Warren Dunes	Warren Dunes State Park	CD	BC	B. Slaughter
Interdunal Wetland	4686	Emmet	Waugoshance Point	Wilderness State Park	С	В	J. Cohen
Intermittent Wetland	8547	Chippewa	Camp 10 Lakes	Taqhuamenon Falls State Park	A	Α	J. Cohen
Intermittent Wetland	323	Chippewa	Prison Camp Intermittent Wetland	Taqhuamenon Falls State Park	A	A	J. Cohen
Intermittent Wetland	5805	Chippewa	Water Tank Lakes Northwest	Taqhuamenon Falls State Park	В	В	J. Cohen
Lakeplain Oak Openings	4430	St. Clair	Algonac State Park	Algonac State Park	BC	D	B. Slaughter
Lakeplain Wet-Mesic Prairie	7263	Berrien	Grand Mere	Grand Mere State Park	D	C	B. Slaughter
Mesic Northern Forest	9955	Chippewa & Luce	Betsy Lake	Taqhuamenon Falls State Park	AB	BC	J. Cohen
Mesic Northern Forest	6100	Leelanau	Cathead Bay	Leelanau State Park	BC	BC	J. Cohen

Table 1. Summary of 2010 Surveys.

					PRIOR	CURRENT	
Community Type	EO ID	County	Survey Site	Management Area	<b>EO RANK</b>	<b>EO RANK</b>	Surveyor
Mesic Northern Forest	9617	7 Muskegon	Duck Lake	Duck Lake State Park	BC	CD	B. Slaughter
Mesic Northern Forest	7219	Van Buren	Dyckman Woods	Van Buren State Park	В	С	B. Slaughter
Mesic Northern Forest	8155	Muskegon & Ottawa	Hoffmaster State Park	Hoffmaster State Park	В	BC	B. Slaughter
Mesic Northern Forest	2836	(Luce	Parcell Lakes	Taqhuamenon Falls State Park	BC	С	J. Cohen
Mesic Northern Forest	5018	{ Chippewa	Prison Camp Forest	Taqhuamenon Falls State Park	D	С	J. Cohen
Mesic Northern Forest	941	Allegan	Saugatuck Dunes	Saugatuck Dunes State Park	BC	С	B. Slaughter
Mesic Northern Forest	12895	5 Chippewa	Timberlost Forest	Taqhuamenon Falls State Park	В	BC	J. Cohen
Mesic Sand Prairie	10066	Washtenaw	Pinckney Prairie	<b>Pinckney State Recreation Area</b>	В	С	J. Cohen & M. Penskar
Mesic Southern Forest	9309	) Berrien	Warren Dunes	Warren Dunes State Park	В	В	B. Slaughter
Mesic Southern Forest	3637	7 Berrien	Warren Woods	Warren Woods State Park	A	В	B. Slaughter
Muskeg	10471	Chippewa & Luce	Prison Camp Muskeg	Taqhuamenon Falls State Park	A	AB	J. Cohen
Northern Bald	3482	2 Ontonagon	Escarpment Trail	Porcupine Mountains State Park	С	В	J. Cohen
Northern Fen	2508	3 Ogemaw	Pintail Pond	Rifle River State Recreation Area	В	BC	J. Cohen
Oak Barrens	1342	2 Washtenaw	Pickerel Lake Complex	<b>Pinckney State Recreation Area</b>	С	С	J. Cohen & M. Penskar
Oak-Pine Barrens	10114	Huron	Sleeper State Park	Albert E. Sleeper State Park	BC	BC	J. Cohen
Open Dunes	4888	{ Leelanau	Cathead Bay	Leelanau State Park	В	В	J. Cohen
Open Dunes	4074	I Charlevoix	Fisherman's Island State Park	Fisherman's Island State Park	С	С	J. Cohen
Open Dunes	12670	) Muskegon & Ottawa	Hoffmaster State Park	Hoffmaster State Park	В	В	B. Slaughter
Open Dunes	6702	Allegan	Kalamazoo River Mouth	Saugatuck Dunes State Park	В	BC	B. Slaughter
Open Dunes	7936	Muskegon	Muskegon State Park	Muskegon State Park	В	В	B. Slaughter
Open Dunes	126	Mason	Nordhouse Dunes	Ludington State Park	A	AB	J. Cohen
Open Dunes	983	) Oceana	Silver Lake Dunes	Silver Lake State Park	В	BC	J. Cohen
Open Dunes	9228	{ Emmet	Sturgeon Bay	Wilderness State Park	BC	В	J. Cohen
Open Dunes	2862	Emmet	Sturgeon Bay Point	Wilderness State Park	D	CD	J. Cohen
Open Dunes	1830	) Berrien	Warren Dunes	Warren Dunes State Park	BC	BC	B. Slaughter
Open Dunes	5305	Emmet	Waugoshance Point	Wilderness State Park	BC	BC	J. Cohen
Patterned Fen	8531	Chippewa	Park Patterned Peatland	Taqhuamenon Falls State Park	В	В	B. Slaughter
Rich Conifer Swamp	15906	Chippewa & Luce	Anchard Creek Hemlocks	Taqhuamenon Falls State Park	С	В	J. Cohen
Rich Conifer Swamp	3669	Chippewa & Luce	Clark Lake Cedars	Taqhuamenon Falls State Park	С	В	J. Cohen
Rich Conifer Swamp	11968	3 Chippewa	Lynch Creek Cedar Swamp	Taqhuamenon Falls State Park	CD	С	J. Cohen
Rich Conifer Swamp	7811	Chippewa	Tahquamenon River Cedar Swamp	Taqhuamenon Falls State Park	AB	AB	J. Cohen
Sand and Gravel Beach	7495	Berrien	Warren Dunes	Warren Dunes State Park	BC	CD	B. Slaughter
Wet-Mesic Prairie	10440	) Washtenaw	Pinckney Prairie	Pinckney State Recreation Area	В	В	J. Cohen & M. Penskar
Wooded Dune & Swale Complex	599	) Emmet	Big Stone Bay	Wilderness State Park	С	С	J. Cohen
Wooded Dune & Swale Complex	1349	Huron	Port Crescent	Port Crescent State Park	С	С	J. Cohen
Wooded Dune & Swale Complex	10656	Huron	Sleeper State Park	Albert E. Sleeper State Park	BC	С	J. Cohen

Table 1 (continued). Summary of 2010 Surveys.

### SITE SUMMARIES

#### **BOREAL FOREST**

**Overview:** Boreal forest is a conifer or conifer-hardwood forest type occurring on moist to dry sites characterized by species dominant in the Canadian boreal forest. It typically occupies upland sites along shores of the Great Lakes, on islands in the Great Lakes, and locally inland. The community occurs north of the climatic tension zone primarily on sand dunes, glacial lakeplains, and thin soil over bedrock or cobble. Soils of sand and sandy loam are typically moderately acid to neutral, but heavier soils and more acid conditions are common. Proximity to the Great Lakes results in high levels of windthrow and climatic conditions characterized by low summer temperatures and high levels of humidity, snowfall, and summer fog and mist. Additional important forms of natural disturbance include fire and insect epidemics (Kost et al. 2007).



Figure 1. Distribution of boreal forest in Michigan.

1. Cap's Cabin Natural Community Type: Boreal Forest Rank: GU S3, globally unrankable, and vulnerable within the state Element Occurrence Rank: AB Size: 232 acres Location: Wilderness State Park Element Occurrence Identification Number: 2127

**Threats:** The primary threat is posed by invasive plant species. The site is very weedy, likely because of the frequent wind disturbance and the high usage of this forest as a stopover point for birds, which are likely dispersing non-native plant seeds. Currently noted non-natives [ox-eye daisy (*Chrysanthemum leucanthemum*), yellow dog mustard (*Erucastrum gallicum*), lawn prunella (*Prunella vulgaris*), multiflora rose (*Rosa multiflora*), common mullein (*Verbascum thapsus*), and common speedwell (*Veronica officinalis*)] appear to be mainly weedy opportunists and not invasive. Deer browse could limit the regeneration capacity of the overstory conifers.

**Management Recommendations:** The main management recommendations are to allow natural processes to operate unhindered, control populations of multiflora rose, and to monitor for invasive species and deer herbivory.



Photo 1. Cap's Cabin boreal forest. Photo by Joshua G. Cohen.

2. Waugoshance and Temperance Islands Natural Community Type: Boreal Forest Rank: GU S3, globally unrankable, and vulnerable within the state Element Occurrence Rank: AB Size: 105 acres Location: Wilderness State Park Element Occurrence Identification Number: 12329

**Threats:** The primary threat is posed by invasive plant species. The site is very weedy, likely because of the frequent wind disturbance and the high usage of this forest as a stopover point for birds, which are likely dispersing non-native plant seeds. Currently noted non-natives [ox-eye daisy (*Chrysanthemum leucanthemum*), common St. John's-wort (*Hypericum perforatum*), helleborine (*Epipactis helleborine*), and common speedwell (*Veronica officinalis*)] appear to be mainly weedy opportunists and not invasive. Deer browse could limit the regeneration capacity of the overstory conifers.

**Management Recommendations:** The main management recommendations are to allow natural processes to operate unhindered, control populations of common St. John's-wort, and to monitor for invasive species and deer herbivory.



Photo 2. Waugoshance Island boreal forest. Photo by Joshua G. Cohen.

3. Waugoshance Point Natural Community Type: Boreal Forest Rank: GU S3, globally unrankable, and vulnerable within the state Element Occurrence Rank: B Size: 139 acres Location: Wilderness State Park Element Occurrence Identification Number: 7678

**Threats:** The primary threat is posed by invasive plant species. The site is very weedy, likely because of the frequent wind disturbance and the high usage of this forest as a stopover point for birds, which are likely dispersing non-native plant seeds. Currently noted non-natives [helleborine (*Epipactis helleborine*), yellow dog mustard (*Erucastrum gallicum*), lawn prunella (*Prunella vulgaris*), and bittersweet nightshade (*Solanum dulcamara*)] appear to be mainly weedy opportunists and not invasive. Deer browse could limit the regeneration capacity of the overstory conifers.

**Management Recommendations:** The main management recommendations are to allow natural processes to operate unhindered and to monitor for invasive species and deer herbivory.



Photo 3. Waugoshance Point boreal forest. Photo by Joshua G. Cohen.

#### **COASTAL PLAIN MARSH**

**Overview:** Coastal plain marsh is a grass-, spike-rush-, and rush-dominated wetland community that contains numerous plant disjuncts from the Atlantic and Gulf coastal plains. The community occurs in depressions on sand deposits associated with postglacial lakes and outwash channels in western Lower Michigan, northern Indiana, northern and central Wisconsin, and the southeastern Georgian Bay region of Ontario (Kost et al. 2007).



Figure 2. Distribution of coastal plain marsh in Michigan.

4. Hidden Lake Natural Community Type: Coastal Plain Marsh Rank: G2 S2, imperiled throughout range Element Occurrence Rank: B Size: 13 acres Location: Muskegon State Park Element Occurrence Identification Number: 11484

**Threats:** The fire regime has been altered in the surrounding landscape. Historically, periodic fires within the adjacent dry-mesic forest would have carried into the margins of the coastal plain marsh, particularly when the wetland was dry and fuels were abundant. A potential species of concern within this wetland is the native broad-leaved cat-tail (*Typha latifolia*), which may be introgressed with narrow-leaved cat-tail (*Typha angustifolia*), and may spread if the wetland is disturbed (i.e., if water levels are manipulated or if there is significant nutrient input). Hydrologic alteration or nutrient inputs could lead to an increase in broad-leaved cat-tail and also reed (*Phragmites australis*). Deer browse was noted to be high along the edges of the wetland.

**Management Recommendations:** The main management recommendations are to allow natural processes to operate unhindered (i.e., allow fires to burn in the surrounding uplands and within the coastal plain marsh), prevent off-road vehicle activity, and monitor for invasive species (including invasive native species such as broad-leaved cat-tail) and deer herbivory. Re-introducing fire as a primary disturbance factor and reducing deer densities in the surrounding landscape will benefit the coastal plain marsh and surrounding uplands.



Photo 4. Hidden Lake coastal plain marsh. Photo by Bradford S. Slaughter.

#### **DRY NORTHERN FOREST**

**Overview:** Dry northern forest is a pine- or pine-hardwood–dominated forest type that occurs on dry sandy sites lying mostly north of the climatic tension zone. Dry northern forest occurs principally on sandy glacial outwash and sandy glacial lakeplains, and also commonly on sand ridges within peatlands on glacial outwash or glacial lakeplains. Soils are coarse-textured, well-sorted, excessively drained dry sands with low amounts of organic matter and low water-holding capacity. The droughty soils are extremely acid to very strongly acid with low nutrient content and high frost proclivity. Two distinct variants are included within this community type, one dominated by jack pine (*Pinus banksiana*) or jack pine and hardwoods, and the other dominated by red pine (*P. resinosa*). Prior to European settlement, dry northern forest typically originated in the wake of catastrophic fire. Frequent, low-intensity surface fires maintained red pine systems (Kost et al. 2007).



Figure 3. Distribution of dry northern forest in Michigan.

5. Clark Lake Pine Ridges Natural Community Type: Dry Northern Forest Rank: G3? S3, vulnerable throughout range Element Occurrence Rank: AB Size: 45 acres Location: Tahquamenon Falls State Park Element Occurrence Identification Number: 5133

Threats: The main threat to this site is fire suppression.

**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 employed to promote pine regeneration. The site's relatively open canopy conditions will likely result in a surface fire with localized areas of crowning. Following fire, monitoring should be implemented to gauge the vegetative response to fire. In the event of a wildfire or if prescribed fire is used, 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.



Photo 5. Clark Lake Pine Ridges dry northern forest. Photo by Joshua G. Cohen.

6. Fisher Bridge Red Pines Natural Community Type: Dry Northern Forest Rank: G3? S3, vulnerable throughout range Element Occurrence Rank: D Size: 246 acres Location: Tahquamenon Falls State Park Element Occurrence Identification Number: 708

**Threats:** Fisher Bridge Red Pines is a managed dry northern forest that has been thinned several times. Numerous roads occur throughout the forest and off-road vehicle activity was noted along the hiking trail. Non-native species are concentrated along road margins and in parking areas. Invasive plant species observed include St. John's-wort (*Hypericum perforatum*), ox-eye daisy (*Chrysanthemum leucanthemum*), timothy (*Phleum pratense*), and spotted knapweed (*Centaurea maculosa*).

**Management Recommendations:** Prescribed fire should be employed to mimic surface fires. 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. Stewardship of the site should also include control of invasive species along the roads and within the forest. Efforts to control invasives should be monitored.



Photo 6. Fisher Bridge Red Pines dry northern forest. Photo by Joshua G. Cohen.

### **DRY-MESIC NORTHERN FOREST**

**Overview:** Dry-mesic northern forest is a pine or pine-hardwood forest type of generally dry-mesic sites located mostly north of the transition zone. Dry-mesic northern forest is characterized by acidic, coarse- to medium-textured sand or loamy sand and occurs principally on sandy glacial outwash and sandy glacial lakeplains, and less often on inland dune ridges, coarse-textured moraines, and thin glacial drift over bedrock. The community historically originated in the wake of catastrophic fire and was maintained by frequent, low-intensity surface fires (Kost et al. 2007).



Figure 4. Distribution of dry-mesic northern forest in Michigan.

7. Muskegon State Park Natural Community Type: Dry-Mesic Northern Forest Rank: G4 S3, apparently secure globally and vulnerable within the state Element Occurrence Rank: BC Size: 215 acres Location: Muskegon State Park Element Occurrence Identification Number: 3129

**Threats:** The forest is severely impacted by excessive deer browse, which has eliminated significant portions of the ground and shrub layers within the occurrence and altered the species composition and vegetative structure. Impacts have been greatest in the mesic hardwood-hemlock areas, where only the unpalatable evergreen woodfern (*Dryopteris intermedia*) remains in significant numbers. In the oak- and oak-pine–dominated areas that primarily comprise this occurrence, ericaceous shrubs remain. Browse on woody species has primarily affected hardwoods, including oaks, but conifer regeneration, particularly white pine, is prevalent.

In addition, fire suppression and invasive species have also impacted this forest. Several invasive species were noted within the forest. Canada bluegrass (*Poa compressa*) is locally common along trails and on dry ridgetops, but likely has minor effects on native species. Japanese barberry (*Berberis thunbergii*) was observed along roads and trails and in blowdowns, but was nowhere particularly abundant. Garlic mustard (*Alliaria petiolata*) was noted as locally present.

**Management Recommendations:** The primary management recommendations are to reduce deer densities to allow for the recovery of the ground and understory layers, utilize prescribed fire, and monitor and control non-native species. In addition, monitoring could be implemented to assess erosion along well-used trails.



Photo 7. Muskegon State Park dry-mesic northern forest. Photo by Bradford S. Slaughter.

8. Nebo Trail Natural Community Type: Dry-Mesic Northern Forest Rank: G4 S3, apparently secure globally and vulnerable within the state Element Occurrence Rank: B Size: 684 acres Location: Wilderness State Park Element Occurrence Identification Number: 13195

**Threats:** Deer herbivory may be limiting oak regeneration as most seedlings have been browsed and oaks within the sapling and pole-sized classes are virtually absent. Salvage harvest of windthrow in the northern portion of the forest has locally reduced the volume of coarse woody debris and snags. Invasive species are confined to road and trail edges and do not appear to be affecting species structure and composition in the forest interior. Trails and roads are acting as conduits for weeds including St. John's-wort (*Hypericum perforatum*), spotted knapweed (*Centaurea maculosa*), white sweet-clover (*Melilotus alba*), Canada bluegrass (*Poa compressa*), and hawkweeds (*Hieracium* spp.).

**Management Recommendations:** The primary management recommendation is to allow natural processes to operate unhindered (i.e., allow wildfires to burn through site and surrounding wetlands). Salvage logging of windthrow, which occurred in sections 25 and 35, should be avoided. Monitoring for oak and pine regeneration over time would facilitate the assessment of whether prescribed fire is needed as a management tool and whether deer herbivory is limiting regeneration. Currently, red and white pine regeneration is abundant but oak regeneration is limited by deer herbivory, suggesting that reduction of deer herbivory is an immediate stewardship need.



Photo 8. Nebo Trail dry-mesic northern forest. Photo by Joshua G. Cohen.

#### **DRY-MESIC SOUTHERN FOREST**

**Overview:** Dry-mesic southern forest is a fire-dependent, oak or oak-hickory forest type on generally dry-mesic sites found south of the climatic tension zone in southern Lower Michigan. This natural community occurs principally on glacial outwash, coarse-textured moraines, sandy glacial lakeplains, kettle-kame topography, and sand dunes. Soils are typically sandy loam or loam and slightly acid to neutral in pH. Frequent fires maintain semi-open conditions, promoting oak regeneration and ground and shrub layer diversity (Kost et al. 2007).



Figure 5. Distribution of dry-mesic southern forest in Michigan.

9. Grand Mere Natural Community Type: Dry-Mesic Southern Forest Rank: G4 S3, apparently secure globally and vulnerable within the state Element Occurrence Rank: BC Size: 344 acres Location: Grand Mere State Park Element Occurrence Identification Number: 943

**Threats:** Historic logging has simplified community composition and structure. Construction of homes and driveways has fragmented the forest, causing local erosion of sand and gravel following storm events. Moderate deer browse has reduced populations of some sensitive forbs. Historically, occasional fires may have acted in conjunction with edaphic factors to maintain oak dominance. Fire suppression has likely contributed to the spread of mesophytic vegetation from ravines and bowls to upper slopes and ridgetops. Common invasive plant species include garlic mustard (*Alliaria petiolata*), Japanese barberry (*Berberis thunbergii*), and multiflora rose (*Rosa multiflora*). Garlic mustard is concentrated in the southern portion of the occurrence, where it is especially common along roads and trails. Japanese barberry and multiflora rose occur throughout the site, sometimes in abundance. Overall, the impacts of invasive plant species have been modest to date.

**Management Recommendations:** The primary needs are an assessment of the deer population, followed by reduction of numbers if necessary, and monitoring and control of invasive plant species, primarily garlic mustard, Japanese barberry, and multiflora rose.



Photo 9. Grand Mere dry-mesic southern forest. Photo by Bradford S. Slaughter.

#### **FLOODPLAIN FOREST**

**Overview:** Floodplain forest is a bottomland, deciduous or deciduous-conifer forest community occupying lowlying 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. 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 6. Distribution of floodplain forest in Michigan.

10. Warren Woods Natural Community Type: Floodplain Forest Rank: G3? S3, vulnerable throughout range Element Occurrence Rank: B Size: 98 acres Location: Warren Woods State Park Element Occurrence Identification Number: 12084

**Threats:** The primary threats to the site include invasive species, deer herbivory, and hydrologic alteration. Historically, portions of the floodplain were cut and the area of the forest east of the Galien River was grazed by cattle and horses. Invasives noted within the site include garlic mustard (*Alliaria petiolata*), Japanese barberry (*Berberis thunbergii*), multiflora rose (*Rosa multiflora*), and moneywort (*Lysimachia nummularia*). Multiflora rose is the most widespread invasive species within the floodplain, occurring generally in small patches. Japanese barberry often co-occurs with multiflora rose. Garlic mustard is locally distributed within the floodplain. Moneywort is abundant on low, wet floodplain throughout; however, its impacts to the community are unclear based on this single site visit. Deer densities in the surrounding landscape are high but the floodplain does not appear to have been heavily browsed. Road crossings have disrupted the drainage and may have caused highly erosive flash floods, especially along small streams at road crossings.

**Management Recommendations:** The primary management needs are to survey, control, and monitor invasive species. Control measures of invasive species could include targeted use of herbicide, hand-pulling, and cutting to reduce garlic mustard, Japanese barberry, and multiflora rose. Deer impacts should be monitored and actions should be taken if deer browse is found to be reducing woody regeneration and populations of sensitive herbs. The integrity of culverts should be maintained to limit the erosive impacts of flash floods.



Photo 10. Warren Woods floodplain forest. Photo by Bradford S. Slaughter.

#### **GRANITE CLIFF**

**Overview:** Granite cliff consists of vertical or near-vertical exposures of bedrock with sparse coverage of vascular plants, lichens, mosses, and liverworts. The community occurs in several counties of the western Upper Peninsula, including Dickinson, Gogebic, Houghton, Iron, Marquette, and Menominee (Kost et al. 2007).



Figure 7. Distribution of granite cliff in Michigan.

11. Van Riper State Park Natural Community Type: Granite Cliff Rank: G4G5 S2, apparently secure globally and imperiled within the state Element Occurrence Rank: B Size: 0.89 acres Location: Van Riper State Park Element Occurrence Identification Number: 4004

**Threats:** No major threats were identified during the surveys. Non-native weedy species found on the granite cliff included common speedwell (*Veronica officinalis*), timothy (*Phleum pratense*), and sheep sorrel (*Rumex acetosella*). Invasives in the surrounding area include sheep sorrel, common speedwell, and spotted knapweed (*Centaurea maculosa*).

**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 11. Van Riper State Park granite cliff. Photo by Joshua G. Cohen.

#### **GREAT LAKES BARRENS**

**Overview:** Great Lakes barrens is a coniferous savanna community of scattered and clumped trees, and an often dense, low or creeping shrub layer. The community occurs along the shores of the Great Lakes where it is often associated with interdunal wetlands and open dunes (Kost et al. 2007).



Figure 8. Distribution of Great Lakes barrens in Michigan.

12. Cathead Bay Natural Community Type: Great Lakes Barrens Rank: G3 S2, vulnerable globally and imperiled within the state Element Occurrence Rank: B Size: 34 acres Location: Leelanau State Park Element Occurrence Identification Number: 8689

**Threats:** Threats include illegal off-road vehicle activity, erosion from foot traffic, and invasive plants. Spotted knapweed (*Centaurea maculosa*) is locally common within the Great Lakes barrens and adjacent open dunes, especially in the northern portion of the complex close to the housing development, North Hansen Road, and the powerline. Erosion from foot traffic is also most evident here.

**Management Recommendations:** The primary management recommendations are to allow natural processes to operate unhindered, to eliminate clusters of non-native plants, especially spotted knapweed, and monitor for invasive species following control efforts.



Photo 12. Cathead Bay Great Lakes barrens. Photo by Joshua G. Cohen.



**Photos 13 and 14.** Cathead Bay Great Lakes barrens (above) and Nordhouse Dunes Great Lakes barrens (below). Photos by Joshua G. Cohen.



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13. Cheboygan State Park Natural Community Type: Great Lakes Barrens (Formerly Open Dunes) Rank: G3 S2, vulnerable globally and imperiled within the state Element Occurrence Rank: BC Size: 25 acres Location: Cheboygan State Park Element Occurrence Identification Number: 4392

**Threats:** The primary impact to the community has been trail construction and associated soil erosion and spread of invasive plant species. Spotted knapweed (*Centaurea maculosa*) is common on the open foredunes, where it is concentrated along trails and in otherwise disturbed areas. However, spotted knapweed is less common on the inland dune field that supports Great Lakes barrens. Other non-native species with local infestations include butter-and-eggs (*Linaria vulgaris*), Canada bluegrass (*Poa compressa*), and smooth brome (*Bromus inermis*). Deer browse is high in adjacent boreal forest areas, but the severity and impacts of deer browse in the dune system is unclear.

**Management Recommendations:** The primary management recommendations are to monitor and control invasive species, prevent the construction of new, unsanctioned trails in sensitive dune areas, and promote awareness of fragile dune ecology to keep foot traffic on trails.



Photo 15. Cheboygan State Park Great Lakes barrens. Photo by Bradford S. Slaughter.

14. Nordhouse Dunes Natural Community Type: Great Lakes Barrens Rank: G3 S2, vulnerable globally and imperiled within the state Element Occurrence Rank: AB Size: 2088 acres Location: Ludington State Park Element Occurrence Identification Number: 11891

**Threats:** Several invasive species have been noted within the Great Lakes barrens and in the adjacent open dunes including Japanese barberry (*Berberis thunbergii*), St. John's-wort (*Hypericum perforatum*), spotted knapweed (*Centaurea maculosa*), and common mullein (*Verbascum thapsus*). Invasive plants such as spotted knapweed, common St. John's-wort, and common mullein can stabilize vegetation and result in the loss of dune plants that rely on shifting sand.

**Management Recommendations:** The primary management recommendation is to allow natural processes to operate unhindered (i.e., allow wildfires to burn across the barrens). In addition, monitoring and control efforts to detect and remove invasive species are critical to the long-term viability of this Great Lakes barrens.



**Photo 16.** Nordhouse Dunes Great Lakes barrens is nested within high-quality open dunes. Photo by Joshua G. Cohen.

15. Silver Lake Dunes Natural Community Type: Great Lakes Barrens Rank: G3 S2, vulnerable globally and imperiled within the state Element Occurrence Rank: B Size: 222 acres Location: Silver Lake State Park Element Occurrence Identification Number: 2826

**Threats:** A road and several hiking trails pass through this dune system. Threats include illegal off-road vehicle activity, recreational overuse (erosion from foot traffic), deer browsing, and invasive plants. Spotted knapweed (*Centaurea maculosa*) was noted as locally common especially near the Off-Road Vehicle Area. Illegal off-road vehicle activity has been degrading the open dunes and interdunal wetlands along the boundary of the Pedestrian Area and the Off-Road Vehicle Area.

**Management Recommendations:** The primary management recommendation is to allow natural processes to operate unhindered (i.e., allow wildfires to burn across the barrens). In addition, monitoring and control efforts to detect and remove invasive species are critical to the long-term viability of this Great Lakes barrens. Periodic monitoring to ensure that off-road vehicle activity is not disrupting the Great Lakes barrens should also be implemented.



Photo 17. Silver Lake Dunes Great Lakes barrens. Photo by Joshua G. Cohen.
16. Sturgeon Bay Natural Community Type: Great Lakes Barrens Rank: G3 S2, vulnerable globally and imperiled within the state Element Occurrence Rank: AB Size: 51 acres Location: Wilderness State Park Element Occurrence Identification Number: 3324

**Threats:** Threats include illegal off-road vehicle activity, deer browsing, and invasive plants. Spotted knapweed (*Centaurea maculosa*) was noted as locally common within the Great Lakes barrens, and spotted knapweed, white sweet-clover (*Melilotus alba*), ox-eye daisy (*Chrysanthemum leucanthemum*), and timothy (*Phleum pratense*) were noted as locally common within the adjacent open dunes. Illegal off-road vehicle activity has been degrading the nearshore areas and likely facilitates non-native plant invasion. These dunes may be used for illicit and deviant anthropogenic activity as advertised in the outhouse in the parking lot south of the complex.

**Management Recommendations:** The primary management recommendations are to allow natural processes to operate unhindered and to eliminate illegal off-road vehicle activity and clusters of non-native plants, especially spotted knapweed within the Great Lakes barrens and spotted knapweed, white sweet-clover, ox-eye daisy, and timothy within the nearby open dunes. Monitoring should be implemented to evaluate efforts to control invasives and the impact of deer herbivory.



**Photo 18.** Sturgeon Bay Great Lakes barrens occurs adjacent to high-quality interdunal wetland. Photo by Joshua G. Cohen.

# **GREAT LAKES MARSH**

**Overview:** Great Lakes marsh is an herbaceous wetland community occurring statewide along the shoreline of the Great Lakes and their major connecting rivers. Vegetational patterns are strongly influenced by water level fluctuations and type of coastal feature, but generally include the following: a deep marsh with submerged plants; an emergent marsh of mostly narrow-leaved species; and a sedge-dominated wet meadow that is inundated by storms. Great Lakes marsh provides important habitat for migrating and breeding waterfowl, shore-birds, spawning fish, and medium-sized mammals (Kost et al. 2007).



Figure 9. Distribution of Great Lakes marsh in Michigan.

17. Cheboygan Point Natural Community Type: Great Lakes Marsh Rank: G2 S3, globally imperiled and vulnerable within the state Element Occurrence Rank: B Size: 248 acres Location: Cheboygan State Park Element Occurrence Identification Number: 2786

**Threats:** The wetland has been impacted by local establishment and spread of narrow-leaved cat-tail (*Typha angustifolia*). Narrow-leaved cat-tail is patchy and, where it occurs, common to co-dominant. Several other non-native species also occur within the site, but are less problematic. A portion of the marsh was degraded by park development; a powerline cut passes through the wetland areas, and its maintenance has locally degraded the wetland. A large area of exposed sand flats has been seriously damaged by off-road vehicle use.

**Management Recommendations:** The primary management recommendations are to control populations of narrow-leaved cat-tail, monitor for invasive species, restrict off-road vehicle access along the shoreline, and avoid further development within the marsh (i.e., trails and powerline corridors).



Photo 19. Cheboygan Point Great Lakes marsh. Photo by Bradford S. Slaughter.

18. Temperance and Waugoshance Islands
Natural Community Type: Great Lakes Marsh
Rank: G2 S3, globally imperiled and vulnerable within the state
Element Occurrence Rank: AB
Size: 559 acres
Location: Wilderness State Park
Element Occurrence Identification Number: 3468

**Threats:** The primary threat is posed by invasive plant species. Scattered clumps of narrow-leaved cat-tail (*Typha angustifolia*) occur within the Great Lakes marsh.

**Management Recommendations:** The primary management recommendations are to allow natural processes to operate unhindered, to control populations of narrow-leaved cat-tail and monitor for invasive species.



**Photo 20.** Great Lakes marsh and limestone cobble shore intergrade on Temperance and Waugoshance Islands. Photo by Joshua G. Cohen.

19. Waugoshance Point Natural Community Type: Great Lakes Marsh Rank: G2 S3, globally imperiled and vulnerable within the state Element Occurrence Rank: AB Size: 789 acres Location: Wilderness State Park Element Occurrence Identification Number: 11690

**Threats:** The primary threat is posed by invasive plant species. Scattered clumps of narrow-leaved cat-tail (*Typha angustifolia*) occur within the Great Lakes marsh. Several other non-native plant species occur within the wetland and pose a minor risk to the marsh, including marsh thistle (*Cirsium palustre*), lawn prunella (*Prunella vulgaris*), and hawkweeds (*Hieracium spp.*).

**Management Recommendations:** The primary management recommendations are to allow natural processes to operate unhindered, to control populations of narrow-leaved cat-tail and monitor for other invasive species, and to restrict vehicular traffic from entering the wetland complex.



Photo 21. Waugoshance Point Great Lakes marsh. Photo by Bradford S. Slaughter.

# HARDWOOD-CONIFER SWAMP

**Overview:** Hardwood-conifer swamp is a minerotrophic forested wetland dominated by a mixture of lowland hardwoods and conifers, occurring on organic (i.e., peat) and poorly drained mineral soils throughout Michigan. The community occurs on a variety of landforms, often associated with headwater streams and areas of groundwater discharge. Species composition and dominance patterns can vary regionally. Windthrow and fluctuating water levels are the primary natural disturbances that structure hardwood-conifer swamp (Kost et al. 2007).



Figure 10. Distribution of hardwood-conifer swamp in Michigan.

20. Devil's Kitchen Natural Community Type: Hardwood-Conifer Swamp Rank: G4 S3, apparently secure globally and vulnerable within the state Element Occurrence Rank: C Size: 16 acres Location: Muskegon State Park Element Occurrence Identification Number: 2519

**Threats:** The primary threats to the site are posed by deer browse and invasive species. Severe deer browse was noted throughout the swamp, with almost all deciduous vegetation being affected, including greater than 90% of the cinnamon fern (*Osmunda cinnamomea*) in the area. Deciduous shrubs, especially winterberry (*Ilex verticillata*), and tree sprouts and seedlings have been heavily browsed. Deer browse has severely altered the successional trajectory, vegetative structure, and species composition of this swamp, eliminating regeneration of woody deciduous vegetation and favored ground layer species.

Invasives noted within the swamp include multiflora rose (*Rosa multiflora*) and Japanese barberry (*Berberis thunbergii*). Multiflora rose is locally common, particularly in large canopy gaps and in the shrub-dominated wetland that borders the swamp. Numerous colonies of multiflora rose are present along the Snug Harbor Picnic Area entrance drive, and may serve as the seed source for the individuals within the hardwood-conifer swamp. Japanese barberry was also noted, although with less frequency, in the same areas as the multiflora rose.

**Management Recommendations:** The primary management recommendations are to reduce deer densities and control and monitor for invasive species. Multiflora rose occurring along the park road should also be treated and monitored.



Photo 22. Devil's Kitchen hardwood-conifer swamp. Photo by Bradford S. Slaughter.

# **INTERDUNAL WETLAND**

**Overview:** Interdunal wetland is a rush-, sedge-, and shrub-dominated wetland situated in depressions within open dunes or between beach ridges along the Great Lakes, experiencing a fluctuating water table seasonally and yearly in synchrony with lake level changes (Kost et al. 2007).



Figure 11. Distribution of interdunal wetland in Michigan.

21. Cathead Bay Natural Community Type: Interdunal Wetland Rank: G2? S2, imperiled throughout range Element Occurrence Rank: B Size: 12 acres Location: Leelanau State Park Element Occurrence Identification Number: 3342

**Threats:** Threats include illegal off-road vehicle activity and invasive plants. Yellow dog mustard (*Erucastrum gallicum*) is common and reed (*Phragmites australis*) is locally common in more recently formed areas of interdunal wetland.

**Management Recommendations:** The primary management recommendations are to allow natural processes to operate unhindered and to eliminate clusters of non-native plants, especially reed and yellow dog mustard. Clumps of reed appear to have been herbicided this past year. It is important to monitor for invasive species following such control efforts.



Photo 23. Cathead Bay interdunal wetland. Photo by Joshua G. Cohen.

22. Cheboygan State Park Natural Community Type: Interdunal Wetland Rank: G2? S2, imperiled throughout range Element Occurrence Rank: BC Size: 28 acres Location: Cheboygan State Park Element Occurrence Identification Number: 3071

**Threats:** Narrow-leaved cat-tail (*Typha angustifolia*) is locally common within the interdunal wetlands, although it is more common in the adjacent Great Lakes marsh.

**Management Recommendations:** The primary management recommendations are to allow natural processes to operate unhindered and to control and monitor invasive plant populations, especially narrow-leaved cat-tail.



Photo 24. Cheboygan State Park interdunal wetland. Photo by Bradford S. Slaughter.

23. Fisherman's Island State Park Natural Community Type: Interdunal Wetland Rank: G2? S2, imperiled throughout range Element Occurrence Rank: C Size: 10 acres Location: Fisherman's Island State Park Element Occurrence Identification Number: 8003

**Threats:** Threats include illegal off-road vehicle activity and invasive plants. Yellow dog mustard (*Erucastrum gallicum*) is occasional within the more inland swales and reed (*Phragmites australis*) is locally common in more recently formed areas of interdunal wetland and also along the low foredunes. Off-road vehicle tracks were noted within portions of the interdunal wetland.

**Management Recommendations:** The primary management recommendations are to allow natural processes to operate unhindered, to eliminate illegal off-road vehicle activity, and control clusters of non-native plants, especially reed and yellow dog mustard. Clumps of reed appear to have been herbicided this past year. It is important to monitor for invasive species following such control efforts.



Photo 25. Fisherman's Island State Park interdunal wetland. Photo by Joshua G. Cohen.

24. Muskegon State Park Natural Community Type: Interdunal Wetland Rank: G2? S2, imperiled throughout range Element Occurrence Rank: B Size: 57 acres Location: Muskegon State Park Element Occurrence Identification Number: 12019

**Threats:** The main threats to the site include invasive species, foot and off-road vehicle traffic, fire suppression, and deer browse pressure. Fire suppression within the surrounding landscape has likely reduced the local fire frequency. Historically, fires may have occurred in the interdunal wetland in areas with significant fuel accumulation. Trails are common in the surrounding dunes and some trails pass near or through the interdunal wetlands. Off-road vehicle use was noted near the road but not in the dune field. Invasive species noted within the interdunal wetlands include Canada bluegrass (*Poa compressa*), common St. John's-wort (*Hypericum perforatum*), and reed (*Phragmites australis*). Canada bluegrass forms a turf at the margins of some of the interdunal wetlands where jack pine (*Pinus banksiana*) forms a partial or closed canopy. Canada bluegrass would be difficult to eradicate, and poses little threat to the integrity of the wetlands. Common St. John's-wort has established in some of the open wetlands near the park road. A very small population of sterile individuals of reed was noted in one wetland (the nativity of this species needs to be confirmed).

**Management Recommendations:** The primary management recommendations are to control invasive species (particularly common St. John's-wort), monitor deer browse, monitor and eliminate off-road vehicle traffic, and consider use of prescribed fire to foster jack pine regeneration, reduce thatch, and create open microsites. The nativity of reed within this site needs to be confirmed.



Photo 26. Muskegon State Park interdunal wetland. Photo by Bradford S. Slaughter.

25. Nordhouse Dunes Natural Community Type: Interdunal Wetland Rank: G2? S2, imperiled throughout range Element Occurrence Rank: A Size: 2838 acres Location: Ludington State Park Element Occurrence Identification Number: 3898

**Threats:** Several invasive species have been noted within the adjacent Great Lakes barrens and open dunes including Japanese barberry (*Berberis thunbergii*), common St. John's-wort (*Hypericum perforatum*), spotted knapweed (*Centaurea maculosa*), and common mullein (*Verbascum thapsus*).

**Management Recommendations:** The primary management recommendations are to allow natural processes to operate unhindered, monitor for invasive species within the interdunal wetlands, and control invasive plant populations in the adjacent dune communities (i.e., Japanese barberry, spotted knapweed, common St. John's-wort, and common mullein).



Photo 27. Nordhouse Dunes interdunal wetland. Photo by Joshua G. Cohen.



**Photos 28 and 29.** The Nordhouse Dunes interdunal wetlands occur in a vast dune complex. Photos by Joshua G. Cohen.



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26. Saugatuck Dunes Natural Community Type: Interdunal Wetland Rank: G2? S2, imperiled throughout range Element Occurrence Rank: BC Size: 25 acres Location: Saugatuck Dunes State Park Element Occurrence Identification Number: 10033

**Threats:** These wetlands are relatively undisturbed with moderate impacts from foot traffic and scattered invasive species. Invasive species noted within the interdunal wetlands include purple loosestrife (*Lythrum salicaria*), Canada bluegrass (*Poa compressa*), Austrian pine (*Pinus nigra*), and reed (*Phragmites australis*) (the nativity of this species needs to be confirmed).

**Management Recommendations:** The primary management recommendations are to allow natural processes to operate unhindered and to eliminate and monitor clusters of non-native plants. The nativity of reed within this site needs to be confirmed.



Photo 30. Saugatuck Dunes interdunal wetland. Photo by Bradford S. Slaughter.

27. Silver Lake Dunes Natural Community Type: Interdunal Wetland Rank: G2? S2, imperiled throughout range Element Occurrence Rank: B Size: 41 acres Location: Silver Lake State Park Element Occurrence Identification Number: 11697

**Threats:** A road and several hiking trails pass through this dune system. Threats include illegal off-road vehicle activity, recreational overuse (erosion from foot traffic), deer browsing, and invasive plants. Reed (*Phragmites australis*) and narrow-leaved cat-tail (*Typha angustifolia*) were noted as locally common. Illegal off-road vehicle activity has been degrading the open dunes and interdunal wetlands along the boundary of the Pedestrian Area and the Off-Road Vehicle Area. Interdunal wetlands that have been degraded by off-road vehicle activity have been denuded of vegetation.

**Management Recommendations:** The primary management recommendations are to allow natural processes to operate unhindered, to eliminate illegal off-road vehicle activity encroaching from the Off-Road Vehicle Area to the north of the hiking area, and to control and monitor invasive plant populations, especially narrow-leaved cat-tail and reed. A fence and/or additional signs may be needed to deter further trespass of off-road vehicles into the Pedestrian Area.



**Photo 31.** Off-road vehicle activity in the Silver Lake Dunes Off-Road Vehicle Area has degraded interdunal wetlands and remains a threat to interdunal wetlands and open dunes in the Pedestrian Area. Photo by Joshua G. Cohen.



Photo 32. Silver Lake Dunes interdunal wetland. Photo by Joshua G. Cohen.



Photo 33. Sturgeon Bay interdunal wetland. Photo by Joshua G. Cohen.

28. Sturgeon Bay Natural Community Type: Interdunal Wetland Rank: G2? S2, imperiled throughout range Element Occurrence Rank: B Size: 25 acres Location: Wilderness State Park Element Occurrence Identification Number: 5053

**Threats:** Threats include illegal off-road vehicle activity and invasive plants. Reed (*Phragmites australis*) and narrow-leaved cat-tail (*Typha angustifolia*) were noted as locally common within the interdunal wetlands. Illegal off-road vehicle activity has been degrading the nearshore areas and likely facilitates non-native plant invasion. Purple loosestrife (*Lythrum salicaria*) and yellow dog mustard (*Erucastrum gallicum*) were also noted in nearby coastal wetlands and could invade the interdunal wetlands.

**Management Recommendations:** The primary management recommendations are to allow natural processes to operate unhindered, eliminate illegal off-road vehicle activity, control clusters of non-native plants especially reed, narrow-leaved cat-tail, and purple loosestrife within the adjacent nearshore areas, and monitor for invasive plant populations following control efforts.



**Photo 34.** Sturgeon Bay interdunal wetland occurs adjacent to high-quality open dunes (lakeward) and Great Lakes barrens (inland). Photo by Joshua G. Cohen.

29. Warren Dunes Natural Community Type: Interdunal Wetland Rank: G2? S2, imperiled throughout range Element Occurrence Rank: BC Size: 4.5 acres Location: Warren Dunes State Park Element Occurrence Identification Number: 4857

**Threats:** The primary threats to the interdunal wetlands include foot traffic and invasive plants. Unsanctioned trails are common throughout the dune complex, and one of these trails passes through one of the interdunal wetlands. Invasive plants noted within the interdunal wetlands include Canada bluegrass (*Poa compressa*), spotted knapweed (*Centaurea maculosa*), and reed (*Phragmites australis*) (the nativity of this species needs to be confirmed for this site). Small patches of reed were noted in the deepest portions of several of the depressions. Canada bluegrass locally dominated one relatively dry wetland. Spotted knapweed is patchy, but rather local, in surrounding dunes, and may encroach on the wetlands during dry periods.

**Management Recommendations:** The primary management recommendations are to allow natural processes to operate unhindered, control and monitor clusters of non-native plants, and limit foot traffic by eliminating unsanctioned trails in sensitive dune areas and promoting awareness of fragile dune ecology. The nativity of reed within this site needs to be confirmed.



Photo 35. Warren Dunes interdunal wetland. Photo by Bradford S. Slaughter.

30. Waugoshance Point Natural Community Type: Interdunal Wetland Rank: G2? S2, imperiled throughout range Element Occurrence Rank: B Size: 49 acres Location: Wilderness State Park Element Occurrence Identification Number: 4686

**Threats:** Threats include illegal off-road vehicle activity and invasive plants. Reed (*Phragmites australis*) (both native and non-native) and narrow-leaved cat-tail (*Typha angustifolia*) occur locally.

**Management Recommendations:** The primary management recommendations are to allow natural processes to operate unhindered, control clusters of non-native plants, especially reed and narrow-leaved cat-tail, and monitor for invasive species following control efforts.



Photo 36. Waugoshance Point interdunal wetland. Photo by Joshua G. Cohen.

### **INTERMITTENT WETLAND**

**Overview:** Intermittent wetland is a graminoid- and herb-dominated wetland found along lakeshores or in depressions and characterized by fluctuating water levels, both seasonally and from year to year. Intermittent wetlands exhibit traits of both peatlands and marshes, with characteristic vegetation including sedges (*Carex* spp.), rushes (*Juncus* spp.), sphagnum mosses, and ericaceous shrubs. The community occurs statewide (Kost et al. 2007).



Figure 12. Distribution of intermittent wetland in Michigan.

**31. Camp 10 Lakes** Natural Community Type: Intermittent Wetland Rank: G3 S3, vulnerable throughout range Element Occurrence Rank: A Size: 59 acres Location: Tahquamenon Falls State Park Element Occurrence Identification Number: 8547

**Threats:** There is a limited threat from off-road vehicles and invasive plant species. Off-road vehicle damage was noted near the Camp 10 Lake Road. Maintaining barriers at the end of this road will help minimize potential anthropogenic threats to this site.

**Management Recommendations:** The primary management recommendation is to allow natural processes to operate unhindered (i.e., allow wildfires to burn across this wetland). Localized off-road vehicle damage was noted and barriers preventing illegal off-road vehicle access should be monitored and maintained.



Photo 37. Camp 10 Lakes intermittent wetland. Photo by Joshua G. Cohen.



Photo 38. Camp 10 Lakes intermittent wetland. Photo by Joshua G. Cohen.



Photo 39. Prison Camp Intermittent Wetland. Photo by Joshua G. Cohen.

32. Prison Camp Intermittent Wetland Natural Community Type: Intermittent Wetland Rank: G3 S3, vulnerable throughout range Element Occurrence Rank: A Size: 40 acres Location: Tahquamenon Falls State Park Element Occurrence Identification Number: 323

**Threats:** There is a limited threat from off-road vehicles and invasive plant species since the trail to the east has been closed to vehicular traffic. Keeping this road closed will help minimize potential anthropogenic threats to this site.

**Management Recommendations:** The primary management recommendation is to allow natural processes to operate unhindered (i.e., allow wildfires to burn across this wetland). Moose tracks were noted throughout the wetlands. An interesting research question is to examine the impacts of moose browsing on species composition and vegetative structure of this intermittent wetland.



Photo 40. Prison Camp Intermittent Wetland. Photo by Joshua G. Cohen.

33. Water Tank Lakes Northwest Natural Community Type: Intermittent Wetland Rank: G3 S3, vulnerable throughout range Element Occurrence Rank: B Size: 20 acres Location: Tahquamenon Falls State Park Element Occurrence Identification Number: 5805

**Threats:** There is a limited threat from off-road vehicles and invasive plant species. Off-road vehicle damage was noted north of the wetland where a snowmobile trail passes through the wetland.

**Management Recommendations:** The primary management recommendation is to allow natural processes to operate unhindered (i.e., allow wildfires to burn across this wetland). Localized off-road vehicle damage was noted to the north along the snowmobile trail. Off-road vehicle activity should be restricted to this trail and to snowmobiles during winter months.



Photo 41. Water Tank Lakes Northwest intermittent wetland. Photo by Joshua G. Cohen.

# LAKEPLAIN OAK OPENINGS

**Overview:** Lakeplain oak openings is a fire-dependent savanna community, dominated by oaks and characterized by a graminoid-dominated ground layer of species associated with both lakeplain prairie and forest communities. Lakeplain oak openings occurs within the southern Lower Peninsula on glacial lakeplains on sand ridges, level sandplains, or adjacent depressions. Soils are typically mildly alkaline, very fine sandy loams, loamy sands, or sands with moderate water-retaining capacity. Open conditions were historically maintained by frequent fire, and in depressions, by seasonal flooding (Kost et al. 2007).



Figure 13. Distribution of lakeplain oak openings in Michigan.

34. Algonac State Park Natural Community Type: Lakeplain Oak Openings Rank: G2? S1, globally imperiled and critically imperiled in the state Element Occurrence Rank: D Size: 45 acres Location: Algonac State Park Element Occurrence Identification Number: 4430

**Threats:** Long-term fire suppression has resulted in conversion of former oak savanna to dry-mesic southern forest throughout the lakeplain. This stand is now mostly closed-in dry-mesic southern forest, although a portion of the site is being managed for more open savanna conditions. The site was historically logged and at least in part grazed. Extensive networks of drains and ditches have altered the natural hydrology at the landscape scale, degrading, fragmenting, and reducing wetlands. The occurrence is infested with invasive plant species, particularly glossy buckthorn (*Rhamnus frangula*), common buckthorn (*R. cathartica*), multiflora rose (*Rosa multiflora*), and Oriental bittersweet (*Celastrus orbiculatus*) on the sandy ridges, and glossy buckthorn, reed (*Phragmites australis*), Japanese barberry (*Berberis thunbergii*), and multiflora rose in adjacent swales.

**Management Recommendations:** The main management recommendation is to continue restoration of the lakeplain oak openings by utilizing prescribed fire and aggressive control measures to eliminate invasive species. Restoration management, especially invasive species control, should be expanded to include the entire park since the seed source of invasives surrounds the lakeplain oak openings. The lakeplain oak openings is subject to edge effects due to its long, narrow configuration and landscape context between two degraded wetlands infested with invasive plants that disperse seed into canopy gaps and open areas. Shrub removal and prescribed fires in the lakeplain oak openings have opened the canopy on one beach ridge, but root sprouts, tree saplings, and shrubs form dense cover in places and threaten to close the canopy again. Varying the seasonality of burning, including growing season burns, will help check sprouting of woody stems.



Photo 42. Algonac State Park lakeplain oak openings. Photo by Bradford S. Slaughter.

### LAKEPLAIN WET-MESIC PRAIRIE

**Overview:** Lakeplain wet-mesic prairie is a species-rich, lowland prairie community that occurs on moist, level, seasonally inundated glacial lakeplains of the Great Lakes. Soils of this natural community are fine-textured, slightly acid to moderately alkaline sands, sandy loams, or silty clays with poor to moderate water-retaining capacity. Seasonal flooding, cyclic changes in Great Lakes water levels, beaver flooding, and fire historically maintained the species composition and community structure of lakeplain wet-mesic prairies (Kost et al. 2007).



Figure 14. Distribution of lakeplain wet-mesic prairie in Michigan.

35. Grand Mere Natural Community Type: Lakeplain Wet-Mesic Prairie Rank: G1? S1, critically imperiled globally and in the state Element Occurrence Rank: C Size: 1.3 acres Location: Grand Mere State Park Element Occurrence Identification Number: 7263

**Threats:** Without control of woody vegetation and/or prescribed fires, the site will eventually succeed to southern hardwood swamp, which surrounds the opening. Narrow-leaved cat-tail (*Typha angustifolia*) is locally abundant and reed (*Phragmites australis*) occurs in the ditch along the road east of the site and may establish within the prairie. Equipment used during management has created tire ruts and disturbed the soil in portions of the occurrence.

**Management Recommendations:** The primary management recommendation is to maintain fire as a fundamental disturbance factor promoting open conditions. Varying the seasonality of burning, including growing season burns, will help check sprouting of woody stems. Because narrow-leaved cat-tail responds positively to fire, populations of this species should be controlled with herbicide application prior to use of prescribed fire. Monitoring should be implemented to assess efforts to control non-native plant populations and evaluate the success of fire management. During the course of management, efforts should be made to avoid soil disturbance (i.e., minimize the creation of new ruts by limiting use of vehicles and establishment of new fire lines).



Photo 43. Grand Mere lakeplain wet-mesic prairie. Photo by Bradford S. Slaughter.

# **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).





36. Betsy Lake Natural Community Type: Mesic Northern Forest Rank: G4 S3, apparently secure globally and vulnerable within the state Element Occurrence Rank: BC Size: 2500 acres Location: Tahquamenon Falls State Park Element Occurrence Identification Number: 9955

**Threats:** Scattered cut stumps occur sporadically throughout the forest, especially closer to the river. Numerous linear disturbances occur within the forest including M-123, hiking trails, and some old logging trails. The recent onslaught of beech bark disease will drastically change the species composition, structure, and successional pathways within the deciduous-dominated portions of the forest. Infested trees close to trails and roads have been cut for safety. The recent cutting has introduced numerous weedy species to these areas. Deer browse was noted along hiking trails and in seepage areas.

**Management Recommendations:** The main management recommendations are to allow natural processes (i.e., fire and windthrow) to operate unhindered (e.g., limit salvage logging to areas where safety is a concern), control invasive plants along trail systems, monitor for invasives and deer browse, and retain an intact buffer of natural communities surrounding the forest. In addition, pursuit of acquisition of adjacent private lands or discussion of compatible management with private landowners is recommended.



Photo 44. Betsy Lake mesic northern forest. Photo by Joshua G. Cohen.



**Photo 45.** Betsy Lake mesic northern forest along the Tahquamenon River. Photo by Joshua G. Cohen.



**Photo 46.** Significant portions of the Betsy Lake mesic northern have been impacted by beech bark disease. Photo by Joshua G. Cohen.

**37. Cathead Bay Natural Community Type: Mesic Northern Forest Rank: G4 S3,** apparently secure globally and vulnerable within the state **Element Occurrence Rank: BC Size: 907 acres Location: Leelanau State Park Element Occurrence Identification Number: 6100** 

**Threats:** Early signs of beech bark disease were noted within this forest. Beech bark disease will likely change the species composition, structure, and successional pathways within the deciduous-dominated portions of the forest. Canopy beech will die and create large light gaps that will be filled by a dense undergrowth of beech sprouts. Non-native plants were restricted to trails within the forest and included honeysuckles (*Lonicera* spp.), autumn olive (*Elaeagnus umbellata*), and ox-eye daisy (*Chrysanthemum leucanthemum*).

**Management Recommendations:** The main management recommendations are to allow natural processes (i.e., fire and windthrow) to operate unhindered (e.g., limit salvage logging of beech to areas where safety is a concern), control invasive plants along trail systems, monitor for invasives and deer browse, and retain an intact buffer of natural communities surrounding the forest. In addition, pursuit of acquisition of adjacent private lands or discussion of compatible management with private landowners is recommended.



Photo 47. Cathead Bay mesic northern forest. Photo by Joshua G. Cohen.

38. Duck Lake
Natural Community Type: Mesic Northern Forest
Rank: G4 S3, apparently secure globally and vulnerable within the state
Element Occurrence Rank: CD
Size: 13 acres
Location: Duck Lake State Park
Element Occurrence Identification Number: 9617

**Threats:** This site was likely selectively logged and the current forest canopy consists largely of mature, secondgrowth trees. The primary disturbances to the site are trail construction, which has led to soil erosion, and severe deer browse, which has eliminated hardwood regeneration and significantly reduced populations of native shrubs and forbs. Invasives noted within the site include Canada bluegrass (*Poa compressa*) and Japanese barberry (*Berberis thunbergii*). To date, invasive plants have not had significant negative impacts on the forest. Canada bluegrass is locally common, especially on loose sands on ridgetops, and one colony of Japanese barberry was noted. An increase in residential dock construction along Duck Lake may degrade the forest. Dock construction within the park was recently approved by Fruitland Township.

**Management Recommendations:** The main management recommendations are to monitor erosion from trail use, control and monitor populations of invasive species (i.e., Japanese barberry), and reduce deer browse pressure.



Photo 48. Duck Lake mesic northern forest. Photo by Bradford S. Slaughter.

**39. Dyckman Woods** Natural Community Type: Mesic Northern Forest (formerly Mesic Southern Forest) Rank: G4 S3, apparently secure globally and vulnerable within the state Element Occurrence Rank: C Size: 81 acres Location: Van Buren State Park Element Occurrence Identification Number: 7219

**Threats:** The entire area has been cut over, with more recent selective removal of trees for lumber and firewood especially concentrated near private developments to the north. Primary threats to the forest include high deer densities, invasive species, and foot traffic. Trails, roads, and invasive species are pervasive throughout the forest. Garlic mustard (*Alliaria petiolata*) is locally common along trails, but has not yet significantly impacted the forest interior. Japanese barberry (*Berberis thunbergii*) is common throughout the occurrence, especially along trails, roads, and the ditch. Multiflora rose (*Rosa multiflora*) is occasional in the same areas as Japanese barberry.

**Management Recommendations:** The main management recommendations are to control and monitor invasive species, reduce deer densities to prevent severe reduction or elimination of forbs and hardwood regeneration, monitor impacts of road and trail use, and eliminate illegal tree harvest.



Photo 49. Dyckman Woods mesic northern forest. Photo by Bradford S. Slaughter.

40. Hoffmaster State Park Natural Community Type: Mesic Northern Forest (formerly Mesic Southern Forest) Rank: G4 S3, apparently secure globally and vulnerable within the state Element Occurrence Rank: BC Size: 582 acres Location: Hoffmaster State Park Element Occurrence Identification Number: 8155

**Threats:** The main threats to this forest are severe deer herbivory and invasive species. High deer populations have dramatically impacted the ground cover and understory, leaving only unpalatable ferns and graminoids and patchy conifer regeneration. Garlic mustard (*Alliaria petiolata*) is locally common in the southern portion of the occurrence, where it appears to have spread along and away from trails. Japanese barberry (*Berberis thunbergii*) is uncommon and Canada bluegrass (*Poa compressa*) is locally important on sandy ridgetops but poses little threat to the overall integrity of the site. Construction of trails has led to local erosion.

**Management Recommendations:** The primary management recommendations are to reduce deer browse pressure by reducing deer densities and erecting exclosures, control and monitor invasive species (especially garlic mustard), and promote awareness of fragile dune ecology to keep foot traffic on trails.



Photo 50. Hoffmaster State Park mesic northern forest. Photo by Bradford S. Slaughter.


**Photos 51 and 52.** Intensive deer browse pressure has dramatically impacted the species composition and floristic structure of the Hoffmaster State Park mesic northern forest. Photos by Bradford S. Slaughter.



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41. Parcell Lakes Natural Community Type: Mesic Northern Forest Rank: G4 S3, apparently secure globally and vulnerable within the state Element Occurrence Rank: C Size: 25 acres Location: Tahquamenon Falls State Park Element Occurrence Identification Number: 2836

**Threats:** Recent onslaught of beech bark disease will drastically change the species composition, structure, and successional pathways within the deciduous-dominated portions of the forest. Within these areas, canopy beech are dead or dying creating large light gaps that are inundated with dense undergrowth of sprouting beech seedlings and saplings, many of which already have been impaired by the disease. If deer densities increase due to a string of mild winters, deer browse could eliminate significant amounts of conifer advanced regeneration.

**Management Recommendations:** The main management recommendations are to allow natural processes (i.e., fire and windthrow) to operate unhindered (e.g., prohibit salvage logging, even of dead and dying beech), monitor for invasives and deer browse, and retain an intact buffer of natural communities surrounding the forest. In addition, pursuit of acquisition of adjacent private lands or discussion of compatible management with private landowners is recommended.



Photo 53. Parcell Lakes mesic northern forest. Photo by Joshua G. Cohen.

42. Prison Camp Forest Natural Community Type: Mesic Northern Forest Rank: G4 S3, apparently secure globally and vulnerable within the state Element Occurrence Rank: C Size: 16 acres Location: Tahquamenon Falls State Park Element Occurrence Identification Number: 5018

**Threats:** Moose droppings were noted within the hemlock-dominated portions of the forest. Moose may be browsing understory species.

**Management Recommendations:** The main management recommendations are to allow natural processes to operate unhindered, monitor for invasives and moose browse, and retain an intact buffer of natural communities surrounding the forest.



Photo 54. Prison Camp Forest mesic northern forest. Photo by Joshua G. Cohen.

43. Saugatuck Dunes Natural Community Type: Mesic Northern Forest (formerly Mesic Southern Forest) Rank: G4 S3, apparently secure globally and vulnerable within the state Element Occurrence Rank: C Size: 204 acres Location: Saugatuck Dunes State Park Element Occurrence Identification Number: 941

**Threats:** The primary threats are deer browse and invasive species. Severe deer browse has eliminated woody regeneration and reduced populations of sensitive forbs to scattered sterile, stunted individuals. Invasive species are present along trails and roads and may slowly expand into the surrounding forest without control measures. Multiflora rose (*Rosa multiflora*) and garlic mustard (*Alliaria petiolata*) were primarily restricted to individual plants or small colonies immediately adjacent to trails and roads, with little evidence of spread. Canada bluegrass (*Poa compressa*) was occasional on sandy ridgetops.

**Management Recommendations:** The primary management recommendations are to reduce deer densities and browse pressure and to control and monitor invasive species, especially garlic mustard and multiflora rose.



Photo 55. Saugatuck Dunes mesic northern forest. Photo by Bradford S. Slaughter.

44. Timberlost Forest Natural Community Type: Mesic Northern Forest Rank: G4 S3, apparently secure globally and vulnerable within the state Element Occurrence Rank: BC Size: 109 acres Location: Tahquamenon Falls State Park Element Occurrence Identification Number: 12895

**Threats:** Scattered cut stumps occur sporadically, especially closer to the river, and some old logging trails occur within the site. The recent onslaught of beech bark disease will drastically change the species composition, structure, and successional pathways within the deciduous-dominated portions of the forest. Within these areas, canopy beech are dead or dying, creating large light gaps that are inundated with dense undergrowth of sprouting beech seedlings and saplings, many of which already have been impaired by the disease.

**Management Recommendations:** The main management recommendations are to allow natural processes (i.e., fire and windthrow) to operate unhindered (e.g., limit salvage logging to areas where safety is a concern), control invasives along trail systems, monitor for invasives and deer browse, and retain an intact buffer of natural communities surrounding the forest. In addition, pursuit of acquisition of adjacent private lands or discussion of compatible management with private landowners is recommended.



Photo 56. Timberlost Forest mesic northern forest. Photo by Joshua G. Cohen.

# MESIC SAND PRAIRIE

**Overview:** Mesic sand prairie is a native grassland community occurring on sandy loam, loamy sand, or sand soils on nearly level glacial outwash plains and lakeplains in both the northern and southern Lower Peninsula. Mesic sand prairie occurs in shallow depressions within glacial outwash plains and lakeplains, and on old, abandoned glacial lakebeds, stream channels, and river terraces. Soils are predominantly strongly acid to neutral sandy loam and occasionally loamy sand. Sites that support mesic sand prairie experience fluctuating water tables, with relatively high water tables occurring in the spring followed by drought conditions in late summer and fall. The community contains species from a broad range of moisture classes, but is dominated by species of upland affinity. Dominant grasses include little bluestem (*Andropogon scoparius*), big bluestem (*Andropogon gerardii*), and Indian grass (*Sorghastrum nutans*) (Kost et al. 2007).



Figure 16. Distribution of mesic sand prairie in Michigan.

45. Pinckney Prairie Natural Community Type: Mesic Sand Prairie Rank: G2 S1, imperiled globally and critically imperiled within the state Element Occurrence Rank: C Size: 1.3 acres Location: Pinckney State Recreation Area Element Occurrence Identification Number: 10066

**Threats:** Decades of fire suppression have resulted in the invasion of woody stems including dogwoods and willows (*Cornus* spp. and *Salix* spp.). The site was likely hayed in the past. Scattered non-native species include autumn olive (*Elaeagnus umbellata*), Canada bluegrass (*Poa compressa*), and timothy (*Phleum pratense*).

**Management Recommendations:** The primary management recommendation is to maintain fire as a fundamental disturbance factor promoting open conditions. The prairie should be burned in concert with the surrounding wetlands and wet-mesic prairie. Varying the seasonality of burning, including growing season burns, will help check sprouting of woody stems. 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., trails, roads and wetlands) should be used. New fire breaks could allow for additional invasive species encroachment. Cutting and herbiciding of autumn olive is warranted. Monitoring should be implemented to assess efforts to control non-native plant populations, gauge the influence of deer herbivory, and evaluate the success of fire management.



Photo 57. Pinckney Prairie mesic sand prairie. Photo by Joshua G. Cohen.

### **MESIC SOUTHERN FOREST**

**Overview:** Mesic southern forest is an American beech– and sugar maple–dominated forest distributed south of the climatic tension zone and found on flat to rolling topography with predominantly loam soils. Mesic southern forest is found principally on medium- or fine-textured ground moraine, medium- or fine-textured end moraine, and on silty/clayey glacial lakeplains. Sand dunes and sandy lakeplains can support these systems where proximity to the Great Lakes modifies the local climate. The community can also occur on ice-contact topography and coarse-textured end moraines, as well as floodplain terraces in a diversity of landforms. Prevalent topographic positions of this community are gentle to moderate slopes and low, level areas with moderate to good drainage. The community occurs on a variety of soil types, but loam is the predominant texture. Soils supporting mesic southern forest include sand, sandy loam, loamy sand, loam, silt loam, silty clay loam, clay loam, and clay. Soils are typically well-drained with high water-holding capacity and high nutrient and soil organism content. The natural disturbance regime is characterized by gap-phase dynamics; frequent, small windthrow gaps allow for the regeneration of shade-tolerant, canopy species. Historically, mesic southern forest occurred as a matrix system, dominating vast areas of rolling to level, loamy uplands of the Great Lakes region. These forests were multi-generational, with old-growth conditions lasting many centuries (Kost et al. 2007).



Figure 17. Distribution of mesic southern forest in Michigan.

46. Warren Dunes Natural Community Type: Mesic Southern Forest Rank: G2G3 S3, imperiled to vulnerable globally and vulnerable within the state Element Occurrence Rank: B Size: 751 acres Location: Warren Dunes State Park Element Occurrence Identification Number: 9309

**Threats:** The primary threats are invasive species and deer browse. Deer browse was modest over a large portion of the site, but scat and heavier browse were noted in an area in the northern part of the occurrence. Deer browse may be responsible for a lack of hemlock (*Tsuga canadensis*) regeneration, and the tiny population of generally stunted Canada yew (*Taxus canadensis*). However, the presence of very large populations of deer-favored herbs, and their robust, fertile condition, is evidence that deer browse is not severe at this time. Invasives noted within the forest include garlic mustard (*Alliaria petiolata*), multiflora rose (*Rosa multiflora*), Japanese barberry (*Berberis thunbergii*), and Canada bluegrass (*Poa compressa*). Numerous trails crisscross the site, creating local areas of erosion and providing conduits for invasive species. Garlic mustard is abundant in approximately 30% of the site, and is especially concentrated south of Floral Lane on ridgetops, slopes, and along trails. Garlic mustard is much less prevalent in the western portion of the occurrence, and is quite local or absent from large areas of the forest. Multiflora rose and Japanese barberry are distributed throughout the forest and are concentrated along trails and on ridgetops in old gaps. Canada bluegrass is local on ridgetops and loose sand along trails, and poses little threat to the site.

**Management Recommendations:** The primary management needs are to control and monitor invasive species populations and to monitor deer browse pressure and reduce deer densities if necessary.



Photo 58. Warren Dunes mesic southern forest. Photo by Bradford S. Slaughter.

47. Warren Woods Natural Community Type: Mesic Southern Forest Rank: G2G3 S3, imperiled to vulnerable globally and vulnerable within the state Element Occurrence Rank: B Size: 106 acres Location: Warren Woods State Park Element Occurrence Identification Number: 3637

**Threats:** Warren Woods is a diverse old-growth mesic southern forest impacted historically by selective tree removal, Dutch elm disease, and likely grazing east of the Galien River. Currently the forest is impacted by foot trail construction and traffic and the spread of invasive plant species. Invasive plants are relatively localized within the forest. Garlic mustard (*Alliara petiolata*) occurs primarily on floodplain terraces, ravine slopes and crests, and in canopy gaps that are relatively infrequently distributed throughout the forest. The largest infestation of garlic mustard was noted north of Warren Woods Road along the roadside near the bridge. Multiflora rose (*Rosa multiflora*) and Japanese barberry (*Berberis thunbergii*) occur infrequently throughout the forest. Deer densities in the surrounding landscape are high but the mesic southern forest does not appear to have been heavily browsed. Road crossings have disrupted the drainage and may have caused highly erosive flash floods, especially along small streams at road crossings.

**Management Recommendations:** The primary management needs are to survey, control, and monitor invasive species. Control measures of invasive species could include targeted use of herbicide, hand-pulling, and cutting to reduce garlic mustard, Japanese barberry, and multiflora rose. Deer impacts should be monitored and actions should be taken if deer browse is found to be reducing woody regeneration and populations of sensitive herbs. The integrity of culverts should be maintained to limit the erosive impacts of flash floods.



Photo 59. Warren Woods mesic southern forest. Photo by Bradford S. Slaughter.

#### MUSKEG

**Overview:** Muskeg is a nutrient-poor peatland characterized by acidic, saturated peat, and scattered or clumped, stunted conifer trees set in a matrix of sphagnum mosses and ericaceous shrubs. Black spruce (*Picea mariana*) and tamarack (*Larix laricina*) are typically the most prevalent tree species. The community primarily occurs in large depressions on glacial outwash and sandy glacial lakeplains. Fire occurs naturally during periods of drought and can alter the hydrology, mat surface, and floristic composition of muskegs. Windthrow, beaver flooding, and insect defoliation are also important disturbance factors that influence species composition and structure (Kost et al. 2007).



Figure 18. Distribution of muskeg in Michigan.

48. Prison Camp Muskeg Natural Community Type: Muskeg Rank: G4G5 S3, apparently secure globally and vulnerable within the state Element Occurrence Rank: AB Size: 20,680 acres Location: Tahquamenon Falls State Park Element Occurrence Identification Number: 10471

**Threats:** Following a wildfire along a dune ridge north of Betsy Lake, an unnecessary fire line was established north of the ridge within the peatland, locally altering the hydrology and degrading the vegetation.

**Management Recommendations:** The main management recommendation is to allow natural processes to operate unhindered. Wildfires should be allowed to burn the muskeg as well as the surrounding uplands. In the event of a wildfire, establishment of new fire lines should be avoided and existing fire breaks (i.e., roads and wetlands) should be used. New fire breaks locally alter the hydrology of peatlands and can allow for invasive species encroachment. Vehicular traffic should be avoided through this peatland. Forested inclusions (dry-mesic northern forest and dry northern forest on dune ridges) adjacent to and intersecting the muskeg should be left uncut.



Photo 60. Prison Camp Muskeg. Photo by Joshua G. Cohen.



Photos 61 and 62. Prison Camp Muskeg. Photos by Joshua G. Cohen .



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### **NORTHERN BALD**

**Overview:** Northern bald is a low shrub and herbaceous community with scattered flagged trees and trees distorted into a krummholz growth form by branch breakage due to heavy snow, thick ice, and extreme winds off Lake Superior. Northern balds are restricted to large escarpments of volcanic bedrock ridges and are characterized by sparse vegetation, areas of exposed bedrock, and thin, slightly acidic soils. The community is also referred to as krummholz ridgetop (Kost et al. 2007).



Figure 19. Distribution of northern bald in Michigan.

49. Escarpment Trail Natural Community Type: Northern Bald Rank: GU S1, globally unrankable and critically imperiled within the state Element Occurrence Rank: B Size: 51 acres Location: Porcupine Mountains Wilderness State Park Element Occurrence Identification Number: 3482

**Threats:** A popular hiking trail (Escarpment Trail) passes along the escarpment and through significant portions of the northern bald causing localized erosion. Invasive species are locally common along the hiking trail and unsanctioned feeder trails. Invasives also occur sporadically throughout the northern bald and surrounding volcanic bedrock glade. In addition to spreading along the hiking trail, many of these species have spread throughout the bald and surrounding volcanic bedrock glade through bird dispersal. Invasives common along the northern bald include ox-eye daisy (*Chrysanthemum leucanthemum*), lawn prunella (*Prunella vulgaris*), common mullein (*Verbascum thapsus*), spotted knapweed (*Centaurea maculosa*), common St. John's-wort (*Hypericum perforatum*), Canada bluegrass (*Poa compressa*), and timothy (*Phleum pratense*). Cut stumps are scattered along the margin of the northern bald where they were cut to enhance the view.

**Management Recommendations:** The main management recommendations are to limit foot traffic to the established trails, increase education efforts to encourage visitors to stay on trails, control and monitor invasive species, maintain a forested buffer adjacent to the escarpment to minimize the threat of invasion by additional non-native species, and allow natural processes (i.e., fire and windthrow) to operate unhindered.



Photo 63. Escarpment Trail northern bald. Photo by Joshua G. Cohen.



Photos 64 and 65. Escarpment Trail northern bald. Photos by Joshua G. Cohen .



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# **NORTHERN FEN**

**Overview:** Northern fen is a sedge- and rush-dominated wetland occurring on neutral to moderately alkaline saturated peat and/or marl influenced by groundwater rich in calcium and magnesium carbonates. The community occurs north of the climatic tension zone and is found primarily where calcareous bedrock underlies a thin mantle of glacial drift on flat areas or shallow depressions of glacial outwash and glacial lakeplains and also in kettle depressions on pitted outwash and moraines (Kost et al. 2007).



Figure 20. Distribution of northern fen in Michigan.

50. Pintail Pond Natural Community Type: Northern Fen Rank: G3G5 S3, vulnerable to secure globally and vulnerable within the state Element Occurrence Rank: BC Size: 4.7 acres Location: Rifle River State Recreation Area Element Occurrence Identification Number: 2508

**Threats:** Threats are limited to localized anthropogenic disturbance. A boardwalk passes through the fen's perimeter and several pockets of narrow-leaved cat-tail (*Typha angustifolia*) occur along the outer margin of the fen near the boardwalk.

**Management Recommendations:** The main management recommendations are to maintain a forested buffer adjacent to the fen to minimize disturbance to the wetland hydrology and the threat of invasion by non-native species. Control of the narrow-leaved cat-tail should be undertaken and followed by monitoring.



Photo 66. Pintail Pond northern fen. Photo by Joshua G. Cohen.

## **OAK BARRENS**

**Overview:** Oak barrens is a fire-dependent savanna type dominated by oaks, having between 5 and 60% canopy, with or without a shrub layer. Black oak (*Quercus velutina*) and white oak (*Q. alba*) typically dominate the scattered overstory. The predominantly graminoid ground layer is composed of species associated with both prairie and forest communities. Oak barrens are found on droughty soils and occur typically on nearly level to slightly undulating glacial outwash in southern Lower Michigan (Kost et al. 2007).



Figure 21. Distribution of oak barrens in Michigan.

51. Pickerel Lake Complex Natural Community Type: Oak Barrens Rank: G2? S1, globally imperiled and critically imperiled in the state Element Occurrence Rank: C Size: 39 acres Location: Pinckney State Recreation Area Element Occurrence Identification Number: 1342

**Threats:** Decades of fire suppression have resulted in the invasion of mesophytic and/or fire-intolerant species into the canopy, sub-canopy, and understory including red maple (*Acer rubrum*), sassafras (*Sassafras albidum*), black cherry (*Prunus serotina*), and red cedar (*Juniperus virginiana*). Woody encroachment has resulted in the shift in structure from barrens to predominantly woodland. The site was likely grazed and/or farmed in the past. Scattered cut stumps occur within the site. In addition, portions of the remnant may have been excavated for sand.

**Management Recommendations:** The main management recommendation is to continue prescribed fire and vary the seasonality of burning, including growing season burns to help check sprouting sassafras and other woody stems. It is also recommended that the burn unit be extended to Hankard Lake Road to help check encroachment of invasive species, which are concentrated along this border. The burn unit should also be expanded to include the surrounding wetlands and dry-mesic southern forest. Finally, monitoring should be implemented to evaluate deer herbivory, impacts of fire on vegetation composition and structure, and efforts to control invasive species.



Photo 67. Pickerel Lake Complex oak barrens. Photo by Joshua G. Cohen.

#### **OAK-PINE BARRENS**

**Overview:** Oak-pine barrens is a fire-dependent, savanna community dominated by oaks and pines, having between 5 and 60% canopy cover, with or without a shrub layer. The predominantly graminoid ground layer contains plant species associated with both prairie and forest. The community occurs on a variety of landforms on droughty, infertile sand or loamy sands occasionally within southern Lower Michigan but mostly north of the climatic tension zone in the northern Lower and Upper Peninsulas (Kost et al. 2007).



Figure 22. Distribution of oak-pine barrens in Michigan.

52. Sleeper State Park Natural Community Type: Oak-Pine Barrens Rank: G3 S2, globally vulnerable and imperiled in the state Element Occurrence Rank: BC Size: 292 acres Location: Sleeper State Park Element Occurrence Identification Number: 10114

**Threats:** Several trails pass through the oak-pine barrens remnants and may provide access for illegal off-road vehicle activity and non-native species invasion. Canada bluegrass (*Poa compressa*) was noted as common within the oak-pine barrens. Deer browse is likely limiting oak recruitment. Portions of the oak-pine barrens have recently burned.

**Management Recommendations:** The main management recommendation is to continue prescribed fire. Monitoring should be implemented to evaluate deer herbivory, impacts of fire on vegetation composition and structure, and efforts to control invasive species.



Photo 68. Sleeper State Park oak-pine barrens. Photo by Joshua G. Cohen.

#### **OPEN DUNES**

**Overview:** Open dunes is a grass- and shrub-dominated multi-seral community located on wind-deposited sand formations near the shorelines of the Great Lakes. Dune formation and the patterning of vegetation are strongly affected by lake-driven winds. The greatest concentration of open dunes occurs along the eastern and northern shorelines of Lake Michigan, with the largest dunes occurring along the eastern shoreline due to the prevailing southwest winds (Kost et al. 2007).



Figure 23. Distribution of open dunes in Michigan.

53. Cathead Bay Natural Community Type: Open Dunes Rank: G3 S3, vulnerable throughout range Element Occurrence Rank: B Size: 182 acres Location: Leelanau State Park Element Occurrence Identification Number: 4888

**Threats:** Threats include illegal off-road vehicle activity, erosion from foot traffic, and invasive plants. Spotted knapweed (*Centaurea maculosa*) is locally common within the dunes, especially in the northern portion of the complex close to the housing development, North Hansen Road, and the powerline. Erosion from foot traffic is also most evident here.

**Management Recommendations:** The primary management recommendations are to allow natural processes to operate unhindered, eliminate clusters of non-native plants, especially spotted knapweed, and increase education efforts to encourage visitors to stay on trails. Monitoring for invasive species should be implemented following control efforts.



Photo 69. Cathead Bay open dunes. Photo by Joshua G. Cohen.

54. Fisherman's Island State Park Natural Community Type: Open Dunes Rank: G3 S3, vulnerable throughout range Element Occurrence Rank: C Size: 35 acres Location: Fisherman's Island State Park Element Occurrence Identification Number: 4074

**Threats:** Threats include illegal off-road vehicle activity and invasive plants. Spotted knapweed (*Centaurea maculosa*) is locally common to occasional within the open dunes and reed (*Phragmites australis*) is locally common in more recently formed areas of interdunal wetland and also along the low foredunes. Off-road vehicle tracks were noted within portions of the interdunal wetland. Portions of the dunes have been degraded by foot traffic with some areas of high traffic having been de-vegetated.

**Management Recommendations:** The primary management recommendations are to allow natural processes to operate unhindered, eliminate illegal off-road vehicle activity, control clusters of non-native plants, especially reed and spotted knapweed, limit erosion of dune vegetation from foot traffic, and increase education efforts to encourage visitors to stay on trails. Clumps of reed appear to have been herbicided this past year. Finally, it is important to monitor for invasive species following such control efforts.



Photo 70. Fisherman's Island State Park open dunes. Photo by Joshua G. Cohen.

55. Hoffmaster State Park Natural Community Type: Open Dunes Rank: G3 S3, vulnerable throughout range Element Occurrence Rank: B Size: 125 acres Location: Hoffmaster State Park Element Occurrence Identification Number: 12670

**Threats:** The main disturbance to the dunes is human foot traffic along trails and adjacent slopes. The foot traffic causes erosion of sand and loss of vegetation in areas. The non-native species bouncing bet (*Saponaria officinalis*) was noted as occasional in the dunes, especially in stabilized areas such as forest borders. The species does not appear to be significantly impacting the community at this time.

**Management Recommendations:** The main management recommendations are to prevent the construction of new trails, increase education efforts to encourage visitors to stay on trails, and monitor for invasive species and deer browse pressure.



Photo 71. Hoffmaster State Park open dunes. Photo by Bradford S. Slaughter.

56. Kalamazoo River Mouth Natural Community Type: Open Dunes Rank: G3 S3, vulnerable throughout range Element Occurrence Rank: BC Size: 294 acres Location: Saugatuck Dunes State Park Element Occurrence Identification Number: 6702

**Threats:** Portions of the dunes were historically disturbed by settlement; the town of Singapore is now buried under the dunes. Historically, occasional wildfires likely impacted the dunes. Currently, trails, foot traffic, and invasive species are the primary threats to the occurrence. Erosion associated with foot trails occurs throughout the site. Invasive species are patchy within the dunes with localized impacts. Spotted knapweed (*Centaurea maculosa*) occurs locally. Austrian pines (*Pinus nigra*) are common, having been planted for erosion control, but have been reduced significantly through removal. In addition, morrow honeysuckle (*Lonicera morrowii*) and black locust (*Robinia pseudoacacia*) occur locally. Finally, evidence of off-road vehicle use was noted.

**Management Recommendations:** The main management recommendations are to continue the removal of the Austrian pine and monitor the re-vegetation of cleared areas, control and monitor additional invasive species, eliminate illegal off-road vehicle use, prevent the construction of new trails, and increase education efforts to encourage visitors to stay on trails.



Photo 72. Kalamazoo River Mouth open dunes. Photo by Bradford S. Slaughter.

57. Muskegon State Park Natural Community Type: Open Dunes Rank: G3 S3, vulnerable throughout range Element Occurrence Rank: B Size: 284 acres Location: Muskegon State Park Element Occurrence Identification Number: 7936

**Threats:** The construction of the park road, establishment of trails, channelization of the Muskegon River mouth, and industrial development at the Muskegon River mouth have altered the open dunes. However, the portion of the open dunes in the State Park is of generally high quality despite these disturbances. The main threats to these dunes are invasive species and erosion from foot traffic. Spotted knapweed (*Centaurea maculosa*), common St. John's-wort (*Hypericum perforatum*), and bouncing bet (*Saponaria officinalis*) are locally common along the park road, and are encroaching into the open dunes from this area, where they are having a locally detrimental impact on the open dunes and interdunal wetland communities.

**Management Recommendations:** The main management recommendations are to control invasive species, monitor foot traffic on dunes, prevent the construction of new trails, increase education efforts to encourage visitors to stay on trails, and study the impacts of deer on open dunes vegetation.



Photo 73. Muskegon State Park open dunes. Photo by Bradford S. Slaughter.

58. Nordhouse Dunes Natural Community Type: Open Dunes Rank: G3 S3, vulnerable throughout range Element Occurrence Rank: AB Size: 4139 acres Location: Ludington State Park Element Occurrence Identification Number: 126

**Threats:** A road and several trails pass through this dune system. Threats include off-road vehicles, recreational overuse (erosion from foot traffic), deer browsing, and invasive plants. Invasive plants that threaten the diversity and community structure of these open dunes include Lyme grass (*Elymus arenarius*), spotted knapweed (*Centaurea maculosa*), and common St. John's-wort (*Hypericum perforatum*). Deer browse has impacted northern white-cedar (*Thuja occidentalis*) and sand cherry (*Prunus pumila*).

**Management Recommendations:** The primary management recommendation are to allow natural processes to operate unhindered, monitor for invasive species and deer herbivory, control invasive plant populations, especially lyme grass, and increase education efforts to encourage visitors to stay on trails.



Photo 74. Nordhouse Dunes open dunes. Photo by Joshua G. Cohen.



**Photo 75.** The Nordhouse Dunes is an extensive open dunes that contains high-quality interdunal wetlands and Great Lakes barrens. Photo by Joshua G. Cohen.



Photo 76. Silver Lake Dunes open dunes. Photo by Joshua G. Cohen.

59. Silver Lake Dunes Natural Community Type: Open Dunes Rank: G3 S3, vulnerable throughout range Element Occurrence Rank: BC Size: 814 acres Location: Silver Lake State Park Element Occurrence Identification Number: 983

**Threats:** A road and several hiking trails pass through this dune system. Threats include illegal off-road vehicle activity, recreational overuse (erosion from foot traffic), deer browsing, and invasive plants. Spotted knapweed (*Centaurea maculosa*) was noted as locally common within these dunes, especially near the Off-Road Vehicle Area. Illegal off-road vehicle activity has been degrading the dunes and interdunal wetlands along the boundary of the Pedestrian Area and the Off-Road Vehicle Area. Open dunes that have been degraded by off-road vehicle activity have been denuded of vegetation.

**Management Recommendations:** The primary management recommendations are to allow natural processes to operate unhindered, control invasive species populations (especially spotted knapweed), and eliminate illegal off-road vehicle activity encroaching from the Off-Road Vehicle Area to the north of the Pedestrian Area. A fence and/or additional signs may be needed to deter further trespass of off-road vehicles into the Pedestrian Area. Monitoring should be implemented to evaluate deer herbivory and efforts to control off-road vehicle activity and invasive plants.



**Photo 77.** Off-road vehicle activity has degraded open dunes in the Silver Lake State Park Off-Road Vehicle Area and also threatens the open dunes within the Pedestrian Area. Photo by Joshua G. Cohen.

60. Sturgeon Bay Natural Community Type: Open Dunes Rank: G3 S3, vulnerable throughout range Element Occurrence Rank: B Size: 69 acres Location: Wilderness State Park Element Occurrence Identification Number: 9228

**Threats:** Threats include illegal off-road vehicle activity, recreational overuse (erosion from foot traffic), deer browsing, and invasive plants. Spotted knapweed (*Centaurea maculosa*), white sweet-clover (*Melilotus alba*), ox-eye daisy (*Chrysanthemum leucanthemum*), and timothy (*Phleum pratense*) were noted as locally common within these dunes. Illegal off-road vehicle activity has been degrading the nearshore areas and likely facilitates non-native plant invasion.

**Management Recommendations:** The primary management recommendations are to allow natural processes to operate unhindered, eliminate illegal off-road vehicle activity, control clusters of non-native plants, monitor for deer herbivory and efforts to control invasive species, and increase education efforts to encourage visitors to stay on trails.



Photo 78. Sturgeon Bay open dunes. Photo by Joshua G. Cohen.

61. Sturgeon Bay Point Natural Community Type: Open Dunes Rank: G3 S3, vulnerable throughout range Element Occurrence Rank: CD Size: 155 acres Location: Wilderness State Park Element Occurrence Identification Number: 2862

**Threats:** Threats include illegal off-road vehicle activity, erosion from foot traffic, and invasive plants. Spotted knapweed (*Centaurea maculosa*), bladder campion (*Silene vulgaris*), and white sweet-clover (*Melilotus alba*) were noted as locally common within these dunes, especially near the road and in flat areas. A major road that passes through the dunes is a conduit for invasive species (especially spotted knapweed) and has allowed for easy access by humans. Excessive foot traffic occurs in areas of blowouts and has resulted in significant erosion and devegetation. Heavy deer browse of northern white-cedar (*Thuja occidentalis*) was noted.

**Management Recommendations:** The primary management recommendations are to control non-native plants, especially spotted knapweed, bladder campion, and white sweet-clover, monitor deer herbivory and efforts to control invasives, restrict off-trail hiking to reduce erosion of the dunes, and increase education efforts to encourage visitors to stay on designated trails.



Photo 79. Sturgeon Bay Point open dunes. Photo by Joshua G. Cohen.

62. Warren Dunes Natural Community Type: Open Dunes Rank: G3 S3, vulnerable throughout range Element Occurrence Rank: BC Size: 290 acres Location: Warren Dunes State Park Element Occurrence Identification Number: 1830

**Threats:** The primary threats to these dunes are invasive species and erosion from excessive foot traffic. Many of the blowouts are disturbed by trail construction and erosion associated with foot traffic, which is especially damaging near the main parking lot, where foot traffic has eliminated vegetation over a significant area. Invasive plant species are patchy and local. Invasive plants noted within the dunes include spotted knapweed (*Centaurea maculosa*), white sweet-clover (*Melilotus alba*), common St. John's-wort (*Hypericum perforatum*), and bouncing bet (*Saponaria officinalis*). Several small colonies of lyme grass (*Elymus arenarius*) were documented in the open foredune. Lyme grass has the potential to spread and replace native dune grasses.

**Management Recommendations:** The primary management need is to eliminate the colonies of lyme grass from the open foredunes. Additional management recommendations include controlling and monitoring the additional invasive species noted above, monitoring foot traffic on dunes, preventing the construction of new trails, increasing education efforts to encourage visitors to stay on trails, and studying the impacts of deer on open dunes vegetation.



Photo 80. Warren Dunes open dunes. Photo by Bradford S. Slaughter.

63. Waugoshance Point Natural Community Type: Open Dunes Rank: G3 S3, vulnerable throughout range Element Occurrence Rank: BC Size: 68 acres Location: Wilderness State Park Element Occurrence Identification Number: 5305

**Threats:** Threats include off-road vehicle activity, deer browsing, erosion from foot traffic, and invasive plants. Spotted knapweed (*Centaurea maculosa*), white sweet-clover (*Melilotus alba*), and common mullein (*Verbascum thapsus*) were noted as locally common within these dunes with spotted knapweed occurring as a dominant in stretches. Reed (*Phragmites australis*) occurs within nearshore areas and interdunal wetlands. Off-road vehicle activity has locally degraded nearshore areas and may facilitate non-native plant invasion. Erosion from foot traffic is concentrated near the parking area and the rustic cabin.

**Management Recommendations:** The primary management recommendations are to allow natural processes to operate unhindered, eliminate illegal off-road vehicle activity, increase education efforts to encourage visitors to stay on trails, control clusters of non-native plants (especially spotted knapweed and white sweet-clover), and monitor efforts to control invasive species. Spotted knapweed has been treated in large areas of these open dunes.



Photo 81. Waugoshance Point open dunes. Photo by Joshua G. Cohen.

# **PATTERNED FEN**

**Overview:** Patterned fen is a minerotrophic shrub- and herb-dominated peatland mosaic characterized by a series of peat ridges (strings) and hollows (flarks) oriented parallel to the slope of the landform and perpendicular to the flow of groundwater. The strings vary in height, width, and spacing, but are generally less than one meter tall, resulting in a faint wave-like pattern that may be discernable only from aerial photographs. The flarks are saturated to inundated open lawns of sphagnum mosses, sedges, and rushes, while the strings are dominated by sedges, shrubs, and scattered, stunted trees. Patterned fens occur primarily in the eastern Upper Peninsula, with the highest concentration found in Schoolcraft County. Patterned fens are also referred to as patterned bogs, patterned peatlands, strangmoor, aapamires, and string bogs (Kost et al. 2007).




64. Park Patterned Peatland Natural Community Type: Patterned Fen Rank: GU S2, globally unrankable and imperiled within the state Element Occurrence Rank: B Size: 207 acres Location: Tahquamenon Falls State Park Element Occurrence Identification Number: 8531

**Threats:** The local hydrology appears to be disrupted by M-123, an altered stream channel in the eastern portion of the peatland, and a wide, compacted road/snowmobile trail that passes through the fen. There is significant shrub encroachment at the margins of the fen that may be related to this hydrologic disruption.

**Management Recommendations:** The main management recommendations are to allow natural processes to operate unhindered, monitor for invasives and herbivore browse (i.e., deer and moose), and retain an intact buffer of natural communities surrounding the wetland. Wildfires should be allowed to burn the patterned fen as well as the surrounding wetlands and uplands. In the event of a wildfire, establishment of new fire lines should be avoided and existing fire breaks (i.e., roads, streams, and wetlands) should be used. New fire breaks locally alter the hydrology of peatlands and allow for invasive species encroachment. Vehicular traffic should be avoided through this peatland. Use of prescribed fire should be considered as a means of reducing shrub encroachment.



Photo 82. Park Patterned Peatland patterned fen. Photo by Bradford S. Slaughter.

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### **RICH CONIFER SWAMP**

**Overview:** Rich conifer swamp is a groundwater-influenced, minerotrophic, forested wetland dominated by northern white-cedar (*Thuja occidentalis*) that occurs on organic soils (i.e., peat) primarily north of the climatic tension zone in the northern Lower and Upper Peninsulas. Rich conifer swamp occurs in outwash channels, outwash plains, glacial lakeplains, and in depressions on coarse- to medium-textured ground moraines. It is common in outwash channels of drumlin fields and where groundwater seeps occur at the bases of moraines. Rich conifer swamp typically occurs in association with lakes and cold, groundwater-fed streams. It also occurs along the Great Lakes shoreline in old abandoned embayments and in swales between former beach ridges where it may be part of a wooded dune and swale complex. Windthrow is common, especially on broad, poorly drained sites. Fire was historically infrequent. Rich conifer swamp is characterized by diverse microtopography and ground cover. The community is also referred to as cedar swamp (Kost et al. 2007).



Figure 25. Distribution of rich conifer swamp in Michigan.

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65. Anchard Creek Hemlocks Natural Community Type: Rich Conifer Swamp Rank: G4 S3, apparently secure globally and vulnerable within the state Element Occurrence Rank: B Size: 42 acres Location: Tahquamenon Falls State Park Element Occurrence Identification Number: 15906

**Threats:** There is a sharp contrast in the management of the adjacent private lands and the management of the state park. Private lands adjacent to the western polygon have been managed intensively for deer. A blind and plowed food plot occur on the private land adjacent to the State Park. Deer herbivory was noted within the rich conifer swamp.

**Management Recommendations:** The main management recommendations are to allow natural processes to operate unhindered, monitor for invasives and deer browse, and retain an intact buffer of natural communities surrounding the wetland. In addition, pursuit of acquisition of adjacent private lands or discussion of compatible management with private landowners is recommended.



Photo 83. Anchard Creek Hemlocks rich conifer swamp. Photo by Joshua G. Cohen.

66. Clark Lake Cedars Natural Community Type: Rich Conifer Swamp Rank: G4 S3, apparently secure globally and vulnerable within the state Element Occurrence Rank: B Size: 16 acres Location: Tahquamenon Falls State Park Element Occurrence Identification Number: 3669

**Threats:** A northward shift in deer wintering range with less severe winters could result in overbrowsing of cedar regeneration.

**Management Recommendations:** The main management recommendations are to allow natural processes to operate unhindered, monitor for invasives and deer browse, and to retain an intact buffer of natural communities surrounding the wetland.



Photo 84. Clark Lake Cedars rich conifer swamp. Photo by Joshua G. Cohen.

67. Lynch Creek Cedar Swamp Natural Community Type: Rich Conifer Swamp Rank: G4 S3, apparently secure globally and vulnerable within the state Element Occurrence Rank: C Size: 9.2 acres Location: Tahquamenon Falls State Park Element Occurrence Identification Number: 11968

**Threats:** A northward shift in deer wintering range with less severe winters could result in overbrowsing of cedar regeneration. Cut stumps occur scattered throughout the swamp.

**Management Recommendations:** The main management recommendations are to allow natural processes to operate unhindered, monitor for invasives and deer browse, and to retain an intact buffer of natural communities surrounding the wetland.



Photo 85. Lynch Creek Cedar Swamp rich conifer swamp. Photo by Joshua G. Cohen.

68. Tahquamenon River Cedar Swamp Natural Community Type: Rich Conifer Swamp Rank: G4 S3, apparently secure globally and vulnerable within the state Element Occurrence Rank: AB Size: 79 acres Location: Tahquamenon Falls State Park Element Occurrence Identification Number: 7811

**Threats:** A northward shift in deer wintering range with less severe winters could result in overbrowsing of cedar regeneration.

**Management Recommendations:** The main management recommendations are to allow natural processes to operate unhindered, monitor for invasives and deer browse, and to retain an intact buffer of natural communities surrounding the wetland.



Photo 86. Tahquamenon River Cedar Swamp rich conifer swamp. Photo by Joshua G. Cohen.

## SAND AND GRAVEL BEACH

**Overview:** Sand and gravel beaches occur along the shorelines of the Great Lakes and on some of Michigan's larger freshwater lakes, where wind, waves, and winter ice cause the shoreline to be too unstable to support aquatic vegetation. Because of the high levels of disturbance, these beaches are typically quite open, with sand and gravel sediments and little or no vegetation (Kost et al. 2007).



Figure 26. Distribution of sand and gravel beach in Michigan.

69. Warren Dunes Natural Community Type: Sand and Gravel Beach Rank: G3? S3, vulnerable throughout range Element Occurrence Rank: CD Size: 27 acres Location: Warren Dunes State Park Element Occurrence Identification Number: 7495

**Threats:** The beach is primarily unvegetated, in part due to excessive foot traffic throughout the site. Foot traffic is especially concentrated in the immediate vicinity of the popular beach areas at Warren Dunes State Park and Weko Beach Park to the north. Off-road vehicle tracks were noted along the beach (see photo below). Reed (*Phragmites australis*) occurs in patches along a small stream south of the Weko Beach Park and a few patches of lyme grass (*Elymus arenarius*) were noted in the foredunes adjacent to the beach.

**Management Recommendations:** The primary management recommendations are to eliminate off-road vehicle activity along the beach and monitor and control invasive species along and adjacent to the sand and gravel beach.



Photo 87. Warren Dunes sand and gravel beach. Photo by Bradford S. Slaughter.

### WET-MESIC PRAIRIE

**Overview:** Wet-mesic prairie is a native lowland grassland occurring on moist, occasionally inundated stream and river floodplains, lake margins, and isolated depressions in southern Lower Michigan. It is typically found on outwash plains and channels near moraines. Soils are primarily loam or silt loam with neutral pH and high organic content. Dominants or subdominants include big bluestem (*Andropogon gerardii*), Indian grass (*Sorghastrum nutans*), bluejoint grass (*Calamagrostis canadensis*), cordgrass (*Spartina pectinata*), and sedges (*Carex* spp.) (Kost et al. 2007).



Figure 27. Distribution of wet-mesic prairie in Michigan.

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70. Pinckney Prairie Natural Community Type: Wet-mesic Prairie Rank: G2 S2, imperiled throughout range Element Occurrence Rank: B Size: 5.1 acres Location: Pinckney State Recreation Area Element Occurrence Identification Number: 10440

**Threats:** Decades of fire suppression have resulted in the invasion of woody stems including dogwoods and willows (*Cornus* spp. and *Salix* spp.). The site was likely hayed and drained in the past. Scattered non-native species include autumn olive (*Elaeagnus umbellata*) and purple loosestrife (*Lythrum salicaria*).

**Management Recommendations:** The primary management recommendation is to maintain fire as a fundamental disturbance factor promoting open conditions. The prairie should be burned in concert with the surrounding wetlands and mesic sand prairie. Varying the seasonality of burning, including growing season burns, will help check sprouting of woody stems. 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., trails, roads and wetlands) should be used. New fire breaks could allow for additional invasive species encroachment. Cutting and herbiciding of autumn olive is warranted. Monitoring should be implemented to assess efforts to control non-native plant populations, gauge the influence of deer herbivory, and evaluate the success of fire management.



**Photo 88.** Pinckney Prairie wet-mesic prairie (foreground) occurs adjacent to high-quality mesic sand prairie (background). 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 28. Distribution of wooded dune and swale complex in Michigan.

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71. Big Stone Bay Natural Community Type: Wooded Dune and Swale Complex Rank: G3 S3, vulnerable throughout range Element Occurrence Rank: C Size: 247 acres Location: Wilderness State Park Element Occurrence Identification Number: 599

**Threats:** Several linear anthropogenic disturbances have impacted the complex. Roads and trails have likely provided a conduit for non-native species. Invasives are primarily confined to roadsides, and include spotted knapweed (*Centaurea maculosa*), St. John's-wort (*Hypericum perforatum*), ox-eye daisy (*Chrysanthemum leucanthemum*), Canada bluegrass (*Poa compressa*), and wild carrot (*Daucus carota*), which do not appear to pose an imminent threat to the wooded dune and swale complex. Selective logging has occurred in portions of the complex.

**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 non-natives along linear disturbances, and monitoring of control efforts.



Photo 89. Big Stone Bay wooded dune and swale complex. Photo by Joshua G. Cohen.

72. Port Crescent Natural Community Type: Wooded Dune and Swale Complex Rank: G3 S3, vulnerable throughout range Element Occurrence Rank: C Size: 1445 acres Location: Port Crescent State Park Element Occurrence Identification Number: 1349

**Threats:** Numerous linear anthropogenic disturbances fragment this dune and swale complex including roads, powerlines, and hiking trails. Cut stumps occur throughout the complex and the presence of white pine (*Pinus strobus*) in the understory but absence in the overstory suggests that white pine was historically an important canopy associate. A sand mining operation occurred within the dunes near the mouth of the Pinnebog River from 1881-1936. This area and the residential areas (current and former) are excluded from the element occurrence polygon but provide a seed source of non-native species. Invasive species are locally common within the wooded dune and swale complex and include Japanese barberry (*Berberis thunbergii*), spotted knapweed (*Centaurea maculosa*), timothy (*Phleum pratense*), and wild carrot (*Daucus carota*). Reed (*Phragmites australis*) occurs along the foredunes.

**Management Recommendations:** Management should focus on controlling invasive species populations, monitoring control efforts, and utilizing prescribed fire within portions of the dune and swale complex dominated by dry-mesic northern forest and oak woodlands. In addition, pursuit of acquisition of adjacent private lands or discussion of compatible management with private landowners is recommended.



Photo 90. Port Crescent wooded dune and swale complex. Photo by Joshua G. Cohen.

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73. Sleeper State Park Natural Community Type: Wooded Dune and Swale Complex Rank: G3 S3, vulnerable throughout range Element Occurrence Rank: C Size: 1852 acres Location: Sleeper State Park Element Occurrence Identification Number: 10656

**Threats:** Numerous linear anthropogenic disturbances fragment this dune and swale complex including roads, powerlines, and hiking trails. Cut stumps occur along the dune ridges and the prevalence of early-successional forest along the dune ridges indicates that logging has been widespread within this wooded dune and swale complex. Deer herbivory is likely limiting oak regeneration. Invasive species are locally common within the wooded dune and swale complex and include spotted knapweed (*Centaurea maculosa*), timothy (*Phleum pratense*), Canada bluegrass (*Poa compressa*), and common burdock (*Arctium minus*) along the dune ridges and reed (*Phragmites australis*) and narrow-leaved cat-tail (*Typha angustifolia*), which are locally dominant in the swales.

**Management Recommendations:** Management should focus on controlling invasive species populations and monitoring for deer herbivory and efforts to control invasives. Use of prescribed fire within portions of the dune and swale complex dominated by dry-mesic northern forest and oak woodlands is recommended. In addition, pursuit of acquisition of adjacent private lands or discussion of compatible management with private landowners and game area managers is recommended.



Photo 91. Sleeper State Park wooded dune and swale complex. Photo by Joshua G. Cohen.

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### DISCUSSION

This report provides site-based assessments of 73 natural community element occurrences on RD 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. Over the next several years, MNFI will continue to survey the remaining natural community element occurrences within the State Parks and Recreation Areas. 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 92. Nordhouse Dunes interdunal wetland and open dunes. Photo by Joshua G. Cohen.

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Photo 93. Prison Camp Muskeg. Photo by Joshua G. Cohen.

# Appendix 1. Ecology Community Field Survey Form

Michigan Natural Features Inventory	Ecological Community Field Survey Form	MICHIGAN STATE
SURVEY INFORMATION		
Survey date:	Time: from AM PM to AM PM Sourcecode:	
Surveyors (principal surveyor fir	rst, include first & last name):	
Weather conditions:		
Revisit needed? Yes I	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, expla	in:	
Photo/slide taken?  Yes	No Where has photo been deposited?	
If associated plot, list project na	ime, and reference #:	
Township/Range/Section: DIRECTIONS: Provide detailed d	County:	directions.
Landowner type: Dublic	Private Other:	
Landowner Contact Information	n:	
Notes:		
Was a GPS used?  Yes	No Type of unit: Unit number:	
Waypoint name/#:	File name:	
Latitude:	Longitude:	
Feature Information (mandatory	y): Source feature: 🗌 Single Source E	0 🗌 Multiple Source EO
SIZE - Measure of the area Observed area (unit): Acres	a of the Element at the observed location. s 🗌 Hectares Type of measurement: 🗌 Precise 📄 Estimate	
Basis for estimate:		
SIZE RANK (comments):		
CONFIDENCE EXTENT		
Indicate whether there is confid (Y = confidence that the full ext	dence that the observed area represents the full extent of the community element at that location. tent is known; N = confidence that the full extent is <u>not</u> known; ? = uncertainty whether full extent is known)	
☐ Yes ☐ No ☐ ?		

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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%	w					
Check all that apply						
Dominant land use: Dominant land cover:						
Natural cover						
Managed timber/forest Savanna/grassland						
Agriculture Forested wetland						
Mining Non-forested wetland						
Urban/suburban Agriculture						
Other:          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	🗌 Pla	int disease:	Wild fire
Grazing/browsing	🗌 Inse	ect damage:	Prescribed fire
Agriculture	Exc	ptic animal activity:	Windthrow
Soil erosion		rbivere impact (e.g. deer):	Ice storm
Mining			lce scour
Dumping	Inv	vasive plants:	Desiccation
Trails/roads			Flooding
ORV/vehicular disturbance			Beaver flooding
Hydrologic alteration			Beaver chewed trees
(drainage, ditches, blocked culverts, etc.)			Other:
Fire supression			
Other:			

#### LANDSCAPE RANK (comments):

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CONDITION: ABIOTIC DATA					
Geology	Metamorphic Rocks	Sedimentary Rocks			
Igneous nocks	Felsic Gneiss and Schist (Granitic)	Volcanic Conglomerates			
Dioritic (Diorite Dacite Andesite)	Mafic Gneiss and Schist	Rreccias			
Gabbroic (Gabbro Basalt Pyroxenite, Peridotite, Diabase, Traprock)		Sandstone			
Rhvolite		Siltstone (calcareous or noncalcareous)			
Other		Limestone and Dolomite			
		☐ C)psa			
		☐ Other:			
Landform					
Glacial	River/Lakeshore	Aeolian			
Lake plain	Shoreline	Dunes			
End or lateral moraine	Sand dune	Aeolian sand flats			
Ground moraine (till plain)	☐ Barrier dune	☐ Other:			
	☐ Spit				
Ice Contact Feature	☐ Offshore bar	<u>Other</u>			
Drumlin	Riverine estuary	Cliff			
Esker	Delta	Ledge			
Kame	Stream bed	Lakeshore bedrock outcrop			
Kettle	Stream terrace	Ridgetop bedrock outcrop			
Lake bed	Alluvial fan	Inland level-to-sloping bedrock outcrop			
Outwash channel	Alluvial flat	Ravine			
	□ □ □ □ □ □ □ □ □ □ □ □ □ □ □ □ □ □ □	Seep			
Outwash	□ Dike	Slide			
	☐ Other: ☐ Talus				
Outwash plain		Other:			
Pitted outwash					
Other:					
Organic Soil Deposits:					
Core One: GPS Point Co	re Two: GPS Point	Core Three: GPS Point			
Depth pH	Depth pH	Depth pH			
	Fibirc Peat:	Fibirc Peat:			
Hemic Peat:	Hemic Peat:	Hemic Peat:			
Sapric Peat (muck):	Sapric Peat (muck):	Sapric Peat (muck):			
Marl (depth):	Marl (depth):	Marl (depth):			
Other (describe):	Other (describe):	Other (describe):			
Comments: Co	imments:	Comments:			

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Mineral Soil Depth (average):			Wetland Mir	eral Soil Indicators:	Groundcover: (with $\geq 5\%$ cover 20 m v 20 m erec)
рН:			Gleyed	soils (list soil texture and depth):	% Bedrock
Surface Soil Texture (Upper 10 cm of soil profile)				% Wood (>1cm)	
		Iron mo	ttling (list soil texture and depth):	% Litter, duff	
Loamy sand					W Large rocks (cobbles, boulders >10 cm)
Sandy loam			Depth to sat	turation:	% Small rocks (gravel, 0.2 - 10 cm)
🗌 Loam			Dopth to wa	tor table:	
Silt loam			Depth to wa		
Sandy Clay loam			Hydrologic F	Regime:	% Water
Clay loam			Wetlands:		% Other
Silty clay loam			lntermi	tently flooded	<u>100%</u> (Total = 100%)
Sandy clay			Perman	ently flooded	Light:
Clay			Semipe	rmanently flooded	
Silty clay			Tempor	arily flooded (e.g., floodplains)	
Other:			Seasona	ally flooded (e.g., seasonal ponds)	
			Saturate	ed (e.g., bogs, perennial seeps)	
			Unknov	vn	
Comments:			Non-Wetlan	de.	Cowardin System:
				<u></u>	Upland
			wet Me	SIC	Riverine
					Lacustrine
				sic ,	Palustrine
			Xeric (d	ry)	
Slope:			Aspect (dow	n slope):	Topographic position:
Measured Slope:	0	%	Measured As	spect: $\circ (N = 0^{\circ})$	Ridge, summit, or crest
			Elat		High slope (upper slope, convex slope)
Flat	00	0%			Midslope (middle slope)
Gentle	0 - 5°	0 - 9%		- >>>>	Lowslope (lower slope, footslope)
Moderate	6 - 14°	10 - 25%		220 - 22 22 - 67°	Toeslope (alluvial toeslope)
Somewhat steep	15 - 25°	26 - 49%		25-07 69 112°	Low level (terrace lakeplain, outwash plan, lake bed, etc)
Steep	26 - 45°	50 - 100%		00-112	Channel
Very Steep	45 - 69°	101 - 275%		113 - 157	Other:
Abrupt	70 - 100°	276 - 300%		158 - 202	
Overhanging/sheltered	> 100°	> 300%	∐ SW	203 - 24/~	
			U W	248 - 292	
			L NW	293 - 337°	
Soil Type - Describe soil profi	ile, pH, and r	method of assessi	ment		

#### 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 Iayer	Herb layer
Closed			
Open			
Patchy			
Sparse			
Absent			

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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 = )	<u>Cover (</u> 1	<u>Class *</u> trace
T2 - Tree Canopy			2 3	0.1 - 1% 1 - 2%
T3 - Subcanopy			4 5	2 - 5% 5 - 10%
S1 - Tall Shrub			6	10 - 25%
S2 - Low Shrub			/ 8	25 - 50% 50 - 75%
G - Ground cover			9 10	75 - 95%
N - Nonvascular			10	2 23 70
V - Woody Vine				

### Sample Point 2: \_\_\_\_\_

GPS Point: \_\_\_\_\_

<b>ΣΤΡΑΤΑ</b>		DOMINANT SPECIES in order to relative importance ( $>>$ much greater than $>$ greater than $=$ )	Cover C	Class *
JINAIA	COVER CLASS	Down where STECES in order to relative importance (>> inder greater than, > greater than, and = )	1	trace
T2 - Tree Canopy			2	0.1 - 1% 1 - 2%
T3 - Subcanopy			4	2 - 5%
S1 - Tall Shrub			5 6	5 - 10% 10 - 25%
S2 - Low Shrub			7 8	25 - 50% 50 - 75%
G - Ground cover			9	75 - 95%
N - Nonvascular			10	> 95%
V - Woody Vine				

Sample Point 3:

#### GPS Point: \_\_\_\_\_

<b>ΣΤΡΑΤΑ</b>		DOMINANT SPECIES in order to relative importance ( $>>$ much greater than $>$ greater than $ad = $ )	Cover (	Class *
JINAIA	COVENCERSS	Downward St ECIES in order to relative importance (>> inder greater than, > greater than, and = )	1	trace
T2 - Tree Canopy			2	0.1 - 1%
12 1100 00100)			3	1 - 2%
T3 - Subcanopy			4	2 - 5%
			5	5 - 10%
S1 - Tall Shrub			6	10 - 25%
S2 - Low Shrub			7	25 - 50%
52 LOW SHILD			8	50 - 75%
G - Ground cover			9	75 - 95%
			10	> 95%
N - Nonvascular				
V - Woody Vine				

#### Sample Point 4: \_\_\_\_\_

GPS Point: \_\_\_\_\_

STRATA	COVER CLASS	DOMINANT SPECIES in order to relative importance (>> much greater than, > greater than, and = )	<u>Cover</u> 1	<u>lass *</u> trace
T2 - Tree Canopy			2 3	0.1 - 1% 1 - 2%
T3 - Subcanopy			4	2 - 5% 5 - 10%
S1 - Tall Shrub			6	10 - 25%
S2 - Low Shrub			7 8	25 - 50% 50 - 75%
G - Ground cover			9 10	75 - 95%
N - Nonvascular			10	2 23 /0
V - Woody Vine				

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**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:

Community structure:		
Ecological processes:		
tural and Anthropogenic Disturbance:	information on disturbances(s) (either natural or caused by humans)	
Logging	Plant disease:	Wild fire
Grazing/browsing	Insect damage:	Prescribed fire
Agriculture	Exotic animal activity:	Windthrow
Soil erosion	Herbivore impact (e.g., deer):	Ice storm
] Mining	Invasive plants:	Ice scour
Dumping		Desiccation
] Trails/roads		Flooding
] ORV/vehicular disturbance		Beaver flooding
] Hydrologic alteration		Beaver chewed trees
(drainage, ditches, blocked culverts, etc.)		Other:
] Fire supression		
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):

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#### 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):

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#### 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)

		-		
	L			

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

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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.