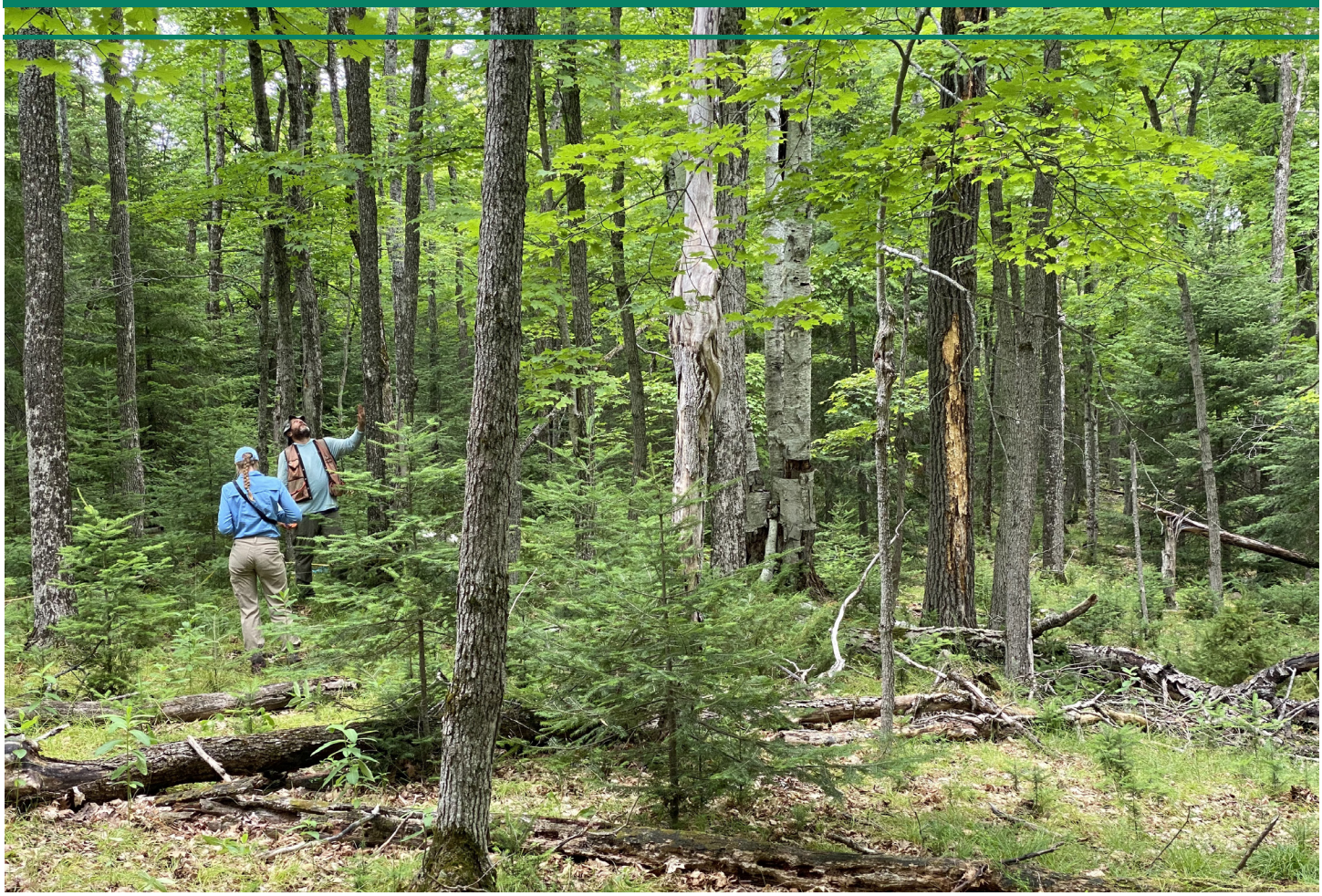
Natural Community Surveys of Harbor Island, Seney National Wildlife Refuge, Lake Huron



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Prepared For:
U.S. Fish and Wildlife Service
National Wildlife Refuge

March 31, 2023

MNFI Report Number 2023-06

Michigan Natural Features Inventory

MICHIGAN STATE UNIVERSITY | Extension

Suggested Citation: Cohen, J.G., J.M. Lincoln, T.J. Bassett, S.M. Warner, E.A. Haber, H.D. Enander, and R.A. Hackett. 2023. Natural Community Surveys of Harbor Island, Seney National Wildlife Refuge, Lake Huron. Michigan Natural Features Inventory, Report Number 2023-06, Lansing, MI. 87 pp.

Cover Photo: Michigan Natural Features Inventory's ecologist Joshua Cohen and botanist Elizabeth Haber surveying mesic northern forest on Harbor Island. Photo by Jesse M. Lincoln.

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

Acknowledgements

This project (F20AC11089-01) was funded by the United States Fish and Wildlife Service (USFWS) to inform management of Great Lakes Islands that are part of the National Wildlife Refuge. We are grateful to USFWS Region 3 sponsors Richard King and Joshua Booker and Sara Siekierski with the Seney National Wildlife Refuge for their guidance throughout the project. Numerous Michigan Natural Features Inventory (MNFI) staff contributed to this work including Michael Monfils, Courtney Ross, Paul Schilke, Brian Klatt, Ashley Adkins, Sarah Carter, Debra Richardson, and Kraig Korroch. We are especially grateful for the contributions of John Paskus and Phyllis Higman, who contributed to the project conceptualization. Matt Preisser with Michigan's Department of Energy, Environment, and Great Lakes played a critical role facilitating the project by connecting MNFI with NWR staff. We thank the Sault Sainte Marie Tribe of Chippewa Indians Natural Resources Department for logistical support, particularly Michael Castagne, Colton Hudak, Eric Clark, and Dani Fegan.

We are indebted to the Sault Sainte Marie Tribe of Chippewa Indians Natural Resources Department for providing logistical support for our inventory of Harbor Island. Our surveys would not have been possible without their sea-worthy research vessel and seasoned boat captains Michael Castagne and Colton Hudak who safely transported us to and from the island. Photo by Joshua G. Cohen.

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Introduction

Great Lakes islands provide critical habitat for native biodiversity and support rare and endemic natural communities. A diverse assemblage of over 32,000 islands occurs across the Great Lakes and in the connecting channels (Henson et al. 2010). The United States Fish and Wildlife Service (USFWS) National Wildlife Refuge (NWR) system includes thirty-six islands across the Great Lakes. These islands are managed to maintain the ecological integrity of natural communities in order to support the needs of priority and migratory bird species, threatened and endangered species, and resident wildlife and also to provide stopover habitat for birds and pollinators migrating across the Great Lakes.

Many of the islands within the Great Lakes that are part of the NWR system are remote, difficult to access, and challenging to survey due to lack of infrastructure and rugged terrain. Despite limited access, these islands face a variety of threats to native biodiversity and rare taxa including establishment and spread of invasive plant and animal species and the impacts of climate change. Unfortunately, within these unique geographies biodiversity data is limited or outdated, which hinders effective management and decision-making.

To address this information gap, the USFWS contracted Michigan Natural Features Inventory (MNFI) to conduct rare and invasive plant species mapping, qualitative natural community surveys, and quantitative forest sampling over the course of two years on NWR Great Lakes islands. In 2021, surveys were conducted in the Shiawassee and Horicon Complexes. Within the Horicon Complex, work was completed in the Green Bay NWR and natural communities were evaluated on Detroit, Plum, Poverty, Rocky, and Saint Martin Islands in northern Lake Michigan (Cohen et al. 2022a). Within the Shiawassee Complex, work was completed in the Michigan Islands NWR and natural community surveys and forest plot sampling were conducted on Big Charity, Crooked, and Sugar Islands in Lake Huron (Cohen et al. 2022b). In 2022, surveys were conducted in the Ottawa and Seney Complexes. Within the Ottawa Complex natural community surveys and forest plot sampling were conducted on West Sister Island in Lake Erie. Within the Seney Complex natural community surveys were conducted on the Huron Islands in Lake Superior, Harbor Island in Lake Huron (Figure 1), and Gull Island in Lake Michigan. In addition, forest plot sampling was conducted on the Huron Islands and Harbor Island (USFWS 2021a).

Harbor Island Great Lakes marsh. Photo by Jesse M. Lincoln.

This report focuses on the natural community surveys conducted in 2022 on Harbor Island. For information on the natural community surveys conducted on Gull Island (Lake Michigan), the Huron Islands, and West Sister Island refer to Cohen et al. 2023a, Cohen et al. 2023b, and Cohen et al. 2023c. For information on the rare and invasive plant species surveys conducted on Harbor and Standerson Islands, refer to USFWS 2021b and Bassett et al. 2023.

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. Historically, Indigenous Peoples were an integral part of natural communities across the Great Lakes region with many natural community types being maintained by native management practices such as prescribed fire, wildlife management, and plant harvesting, seeding, and planting. MNFI's natural community classification recognizes 77 natural community types in Michigan (Kost et al. 2007, Cohen et al. 2015). 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 evolved over the millennia (Kost et al. 2007, Cohen et al. 2015).

A critical goal of this project was to collect updated and new data for natural communities to provide natural resource managers and planners with accurate, detailed, standardized baseline information on the current status of ecosystems on these islands that can help guide biodiversity stewardship and restoration and ongoing planning efforts with a focus on invasive species management. Qualitative surveys assessed the integrity, classification, and delineation of natural community occurrences and detailed the vegetative structure and composition, ecological boundaries, landscape and abiotic context, threats, management needs, and restoration opportunities associated with each site. This baseline information is critical for facilitating site-level decisions about biodiversity stewardship; prioritizing protection, management and restoration; monitoring the success of management and restoration; and informing landscape-level biodiversity planning efforts. This report summarizes the findings of MNFI's natural community surveys and also presents a prioritization of stewardship and monitoring of the natural communities documented on Harbor Island.

Figure 1. Map of Harbor Island. Harbor Island occurs just north of Drummond Island in Potagannissing Bay.

Methods

Study Area

Harbor Island occurs in the Potagannissing Bay of Lake Huron, Michigan, approximately a mile north of the town of Drummond on Drummond Island and 3.5 miles south of the Canadian border (Figure 1). Harbor Island spans 695 acres and is the largest of more than 50 islands in Potagannissing Bay, and as such is a significant reservoir for native biodiversity (Scharf and Chamberlin 1978). The horseshoe shape of Harbor Island generates a large, protected bay that is used by fishermen and boaters for overnight anchorage and provides critical sheltered habitat for Great Lakes species. Much of the inner natural harbor of Harbor Island supports Great Lakes marsh, a natural community type that provides critical spawning habitat for fish and nesting and foraging habitat for secretive marsh birds. Harbor Island occurs on shallow glacial drift overlying Silurian-aged sedimentary bedrocks, principally shale of the Cabot Head formation in the southern half of the island and dolomite of the Manitoulin formation in the northern half (Reed and Daniels 1987). The gently rolling terrain of the island peaks around 100 feet above lake level.

Harbor Island became a part of the National Wildlife Refuge system when it was purchased from The Nature Conservancy in 1983 and is managed by the NWR to maintain the existing natural communities in order to support the needs of priority and migratory bird species, rare species, and resident wildlife. The island is open to day use and is primarily utilized for fishing and boating in the sheltered bay and swimming along the sand beaches along the northern and northeastern shoreline. The interior of the island is less frequented but is open to visitors for hiking, foraging, and hunting.

Natural community surveys were conducted on Harbor Island from June 1st through June 2nd, July 11th through July 15th, and July 25th through July 27th, 2022. Prior to this survey effort, Harbor Island was last visited by MNFI staff in 2000.

Harbor Island boreal forest. Photo by Jesse M. Lincoln.

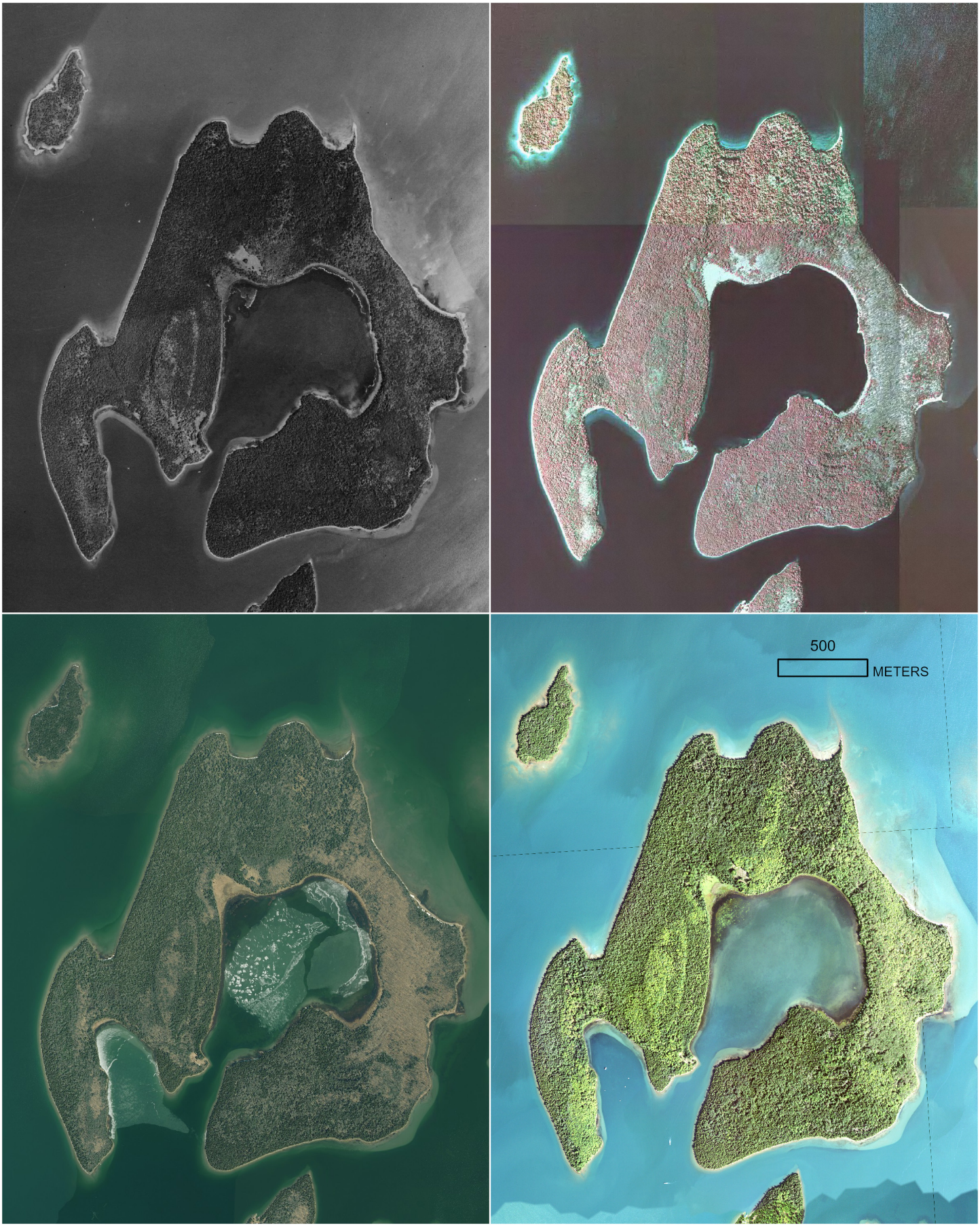


Figure 2. Imagery used to prioritize survey effort. Clockwise from top left: historical black-and-white imagery (1939), color infrared imagery (1998), recent true color leaf-on imagery (2018), and recent true color leaf-off imagery (2016) (USDA 1939, USDA 1998, State of Michigan 2016, USDA 2018).

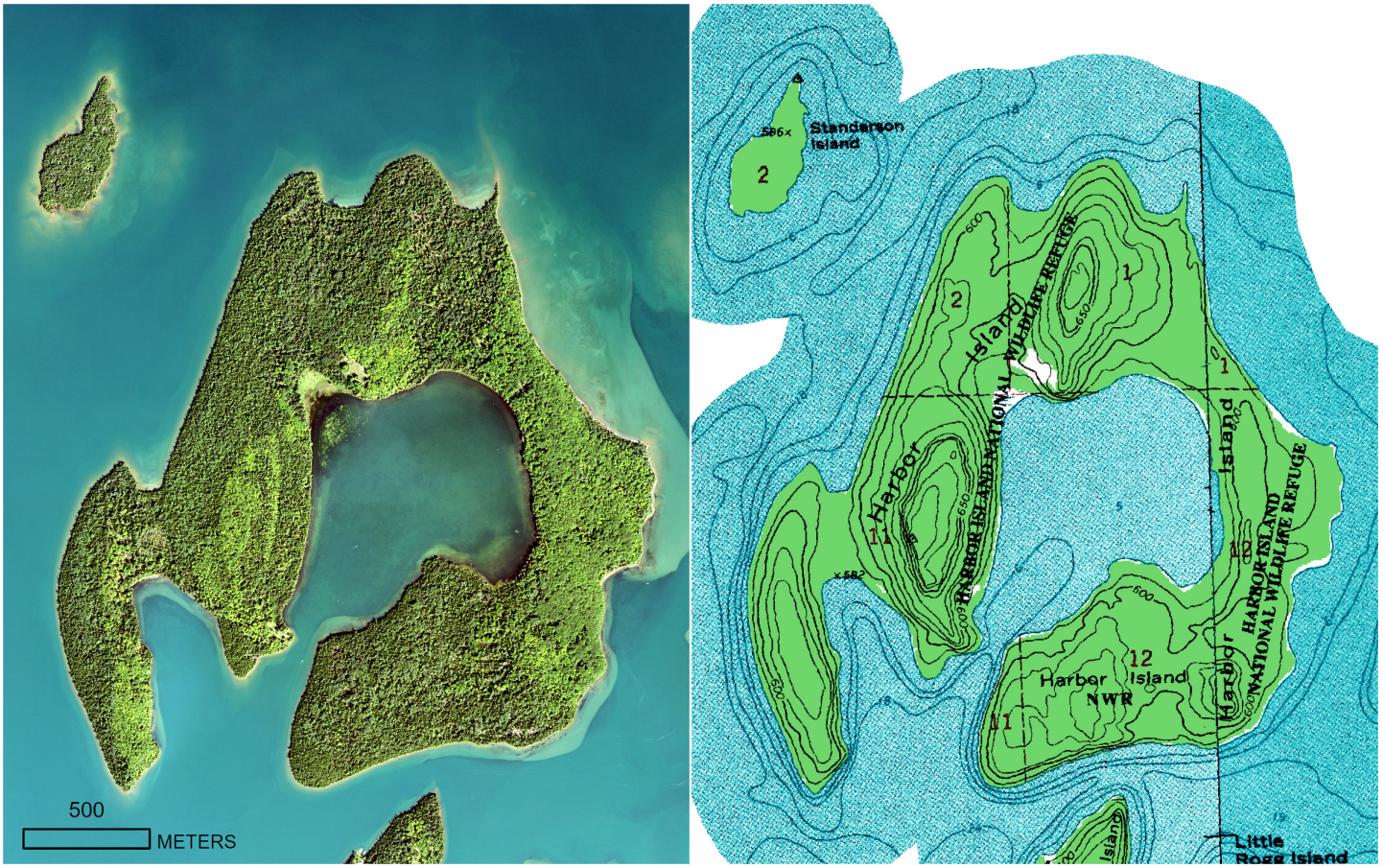


Figure 3. Spatial data layers and imagery used to prioritize survey effort. From left to right: 2020 leaf-on imagery and topographic map of Harbor Island (USDA 2020, USGS 2022).

Harbor Island Great Lakes marsh. Photo by Jesse M. Lincoln.

Field Survey Prioritization

Prior to on-the-ground-surveys, MNFI ecologists conducted Geographic Information System (GIS) analysis and aerial photo interpretation to delineate preliminary natural communities for Harbor Island and identify potential survey targets. To assist with delineation, we evaluated topographic maps and multiple series of aerial imagery, including historical black-and-white imagery (1939), color infrared imagery (1998), recent true color leaf-off imagery (2016-2018), and recent true color leaf-on imagery (2018-2020) (Figures 2 and 3). The preliminary delineation of natural community types across the island helped focus subsequent surveys of high-quality natural communities as well as invasive species and rare plant surveys and provided the framework for stratifying random sampling for the forest plot sampling effort. The MNFI natural community classification system was used as the classification framework (Kost et al. 2007, Cohen et al. 2015, Cohen et al. 2020).

The targets for the natural community assessment were prioritized based on the rarity and estimated integrity of the preliminarily delineated natural communities using the Natural Heritage sampling prioritization principal. This prioritization principal emphasizes that natural community survey efforts should be focused on the rarest and highest quality natural communities (Figure 4) (NatureServe 2002, Rocchio et al. 2018). Rarity is determined by evaluating a natural community's conservation status both at the state and global levels (i.e., S and G Ranks) (Appendix 1). Integrity is determined by employing Natural Heritage methodology, which considers three factors to assess a natural community's ecological integrity or quality: size, landscape context, and condition (Faber-Langendoen et al. 2008, Faber-Langendoen et al. 2016,).

Field Survey

A qualitative, plotless sampling design was employed to survey natural communities on the NWR islands. For every island, MNFI ecologists evaluated each natural community type that was delineated during the GIS analysis described above and each natural community type polygon was ground-truthed through meander surveys. The meander survey covered a representative sample of each polygon, and involved investigating typical and unique aerial signatures, traversing topographic variation, and visiting noticeable vegetation zones and soil moisture types. A Samsung Tablet in tracking mode was used during the meander surveys to create a record of routes taken within the surveyed natural community polygons. Prioritized communities (rare community types and high-quality examples of any community type) received more survey effort than common and degraded communities. According to Natural Heritage Methodology, if a site meets defined requirements for ecological condition, landscape context, and size of the area of interest (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 letter rank. Ecological field surveys were conducted during the growing season to evaluate the condition and classification of the sites. To assess natural community size and landscape context, a combination of field surveys, aerial photographic interpretation, and GIS analysis was employed.

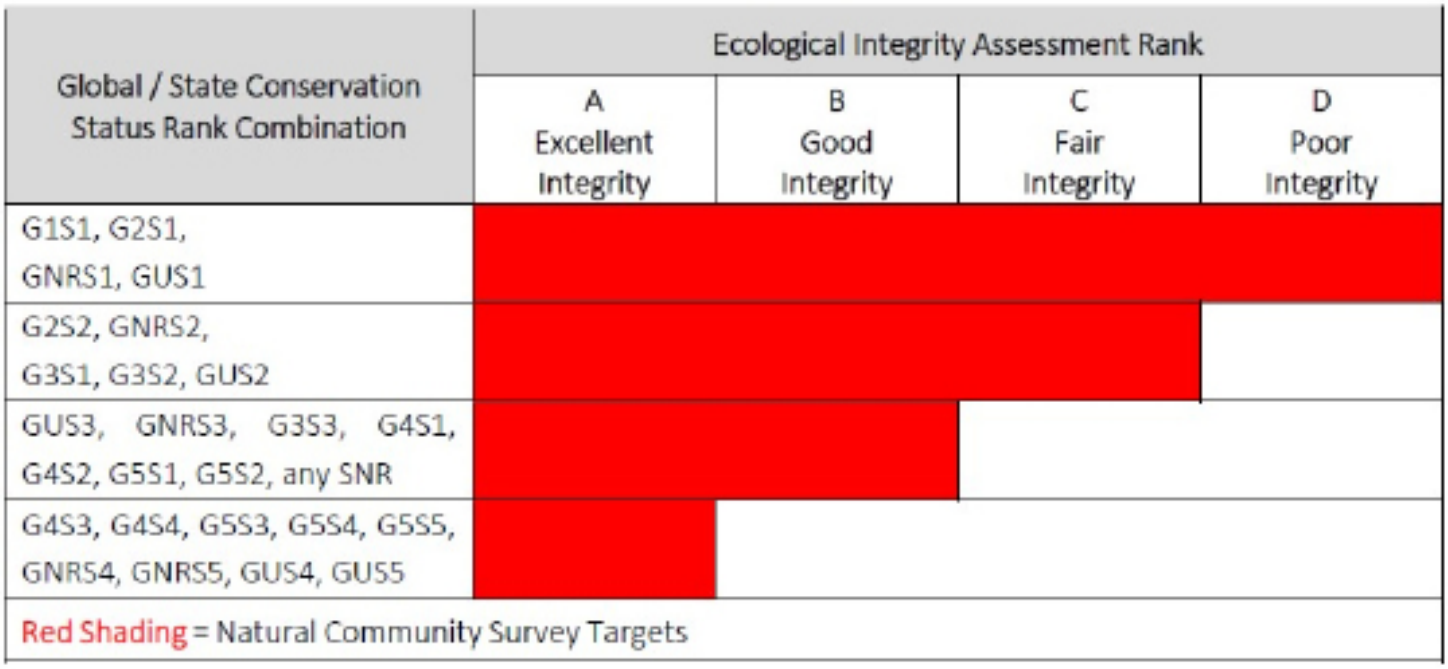


Figure 4. Decision matrix to determine natural community survey targets (NatureServe 2002, Rocchio et al. 2018). G = Global Rank, S = State Rank, U = currently unrankable, NR = not ranked; lower numbers are more imperiled than higher numbers. For more information, see Appendix 1.

The ecological field surveys involved:

a) compiling comprehensive plant species lists to be summarized in a floristic quality index and noting dominant, co-dominant, and representative species

b) estimating percent coverage of prevalent or key overstory and understory species

c) describing site-specific structural attributes (e.g., vegetative zonation, vegetative strata, and coarse woody debris) and ecological processes (e.g., windthrow, ground-water seepage, paludification, wildfire, and beaver flooding)

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

e) analyzing soils and recording representative soil texture, pH, and depth

f) describing hydrology (e.g., noting high-water marks, indicator vegetation, and soil mottling)

g) noting current and historical anthropogenic disturbances (e.g., ditching, trails, pollutants, and logging)

h) evaluating potential threats to ecological integrity (i.e., invasive plant species, pests, diseases, deer herbivory) with an emphasis on recording geospatial locations of invasive plant infestations

i) ground-truthing aerial photographic interpretation using GPS (Garmin units and Samsung Tablets were utilized)

j) taking digital photos and GPS points at significant locations

k) surveying adjacent lands when possible to assess landscape context

l) evaluating the natural community classification and mapped ecological boundaries

m) determining the ecological integrity of mapped high-quality natural communities by assigning or updating element occurrence ranks

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

For each high-quality natural community element occurrence, MNFI scientists compiled comprehensive plant species lists. Harbor Island Great Lakes marsh. Photo by Joshua G. Cohen.

Following completion of the field surveys, the collected data were analyzed and transcribed to update or create element occurrence records in MNFI's statewide biodiversity conservation database (MNFI 2023). Tracks and GPS points collected during the field visits were transposed on aerial imagery to facilitate the generation of natural community boundaries for new element occurrences or re-mapping of previously documented element occurrences. This natural community element occurrence mapping is distinct from the preliminary delineation of natural community types that was based solely on GIS analysis and aerial photo interpretation and was used strictly for planning purposes. Data compiled from the field surveys were used to produce site descriptions, threat assessments, and management recommendations for each natural community element occurrence, which appear within the **Survey Results** section.

For each high-quality natural community, floristic data were compiled into the Universal Floristic Quality Assessment Calculator (Reznicek et al. 2014, Freyman et al. 2016) to determine the Floristic Quality Index (FQI) for each natural community element occurrence. The floristic quality assessment is derived from a mean coefficient of conservatism and floristic quality index. Each native species is assigned a coefficient of conservatism, a value of 0 to 10 based on probability of its occurrence in a natural versus degraded habitat. Species restricted to a specialized or undisturbed habitat are assigned a value of 10, implying the species has extremely strong fidelity to a specific habitat. Native species that are not particular or indicative of natural conditions are assigned a low value of 0 or 1. The coefficient of conservatism is determined by experts on the flora of a region, and so may vary for a given plant species from region to region. We employed a regionally

Representative canopy trees were measured and aged in forested natural community types. Harbor Island mesic northern forest. Photo by Joshua G. Cohen.

appropriate FQA for islands in Michigan (Reznicek et al. 2014). From the total list of plant species for an area, a mean C value is calculated and then multiplied by the square root of the total number of plant species to calculate the FQI. Michigan sites with an FQI of 35 or greater possess sufficient conservatism and richness that they are considered floristically important from a statewide perspective (Herman et al. 2001). Species lists for each natural community element occurrence are provided in Appendix 2. Nomenclature of plant species for these lists and throughout the report follows Michigan Flora (Voss and Reznicek 2012). We provide a crosswalk of Ojibwe names to scientific and common names in Appendix 3.1 for all species observed in the Huron Islands that are listed in "Plants used by the Great Lakes Ojibwa" (Meeker et al. 1993). These culturally significant plants are also indexed to natural community type (Appendix 3.2).

In addition to these natural community surveys, MNFI conducted two distinct and concurrent surveys in 2022 on Harbor Island. This included rare plant and invasive species mapping and forest plot sampling. The plot sampling included evaluation of soil texture and moisture, aging representative canopy trees, measuring tree diameters, and quantifying floristic composition and coverage by stratum (USFWS 2021a). Data gathered from these survey efforts were also used to inform the documentation and description of high-quality natural communities on Harbor Island. For details on the rare plant and invasive species survey efforts please refer to Bassett 2023.

Natural Community Stewardship Prioritization

MNFI developed a scoring matrix for natural community element occurrences to provide a framework for the prioritization of stewardship. For this scoring matrix, we developed the following three indices: an ecological integrity index, a rarity index, and an invasive index. We used the element occurrence rank to determine the ecological integrity rank, with higher scores for higher-ranked element occurrences. The rarity index was calculated by assigning a score for each natural community type's state rank and global rank (Appendix 1) and averaging the two scores. For both state and global ranks, higher scores were assigned to rarer types. The invasive index was derived by calculating the average of an invasive threat severity index and a treatment feasibility index. The threat severity index incorporates knowledge of impacts of invasive plant species to natural community types and site-specific information gained during surveys on invasive infestations. Higher scores for the threat severity index correspond to increased degradation due to invasive infestation. The treatment feasibility index was derived by assigning a score to each natural community element occurrence based on the ease of treating the invasive species recorded within that site. Higher scores for the treatment feasibility index correspond to a greater likelihood of successful treatment and control of targeted invasive species. The threat severity index and treatment feasibility index were assigned based on professional judgement and familiarity with species, systems, and ecological regions. Each index was scored on a scale of 0 to 5. For each natural community element occurrence, the sum of the scores for the ecological integrity index, rarity index, and invasive index was calculated to sort the natural community element occurrences by their stewardship prioritization score (Figure 5). Higher scores indicate a higher priority for stewardship intervention. The stewardship prioritization for the natural community element occurrences is presented in the **Stewardship Prioritization Results** section.

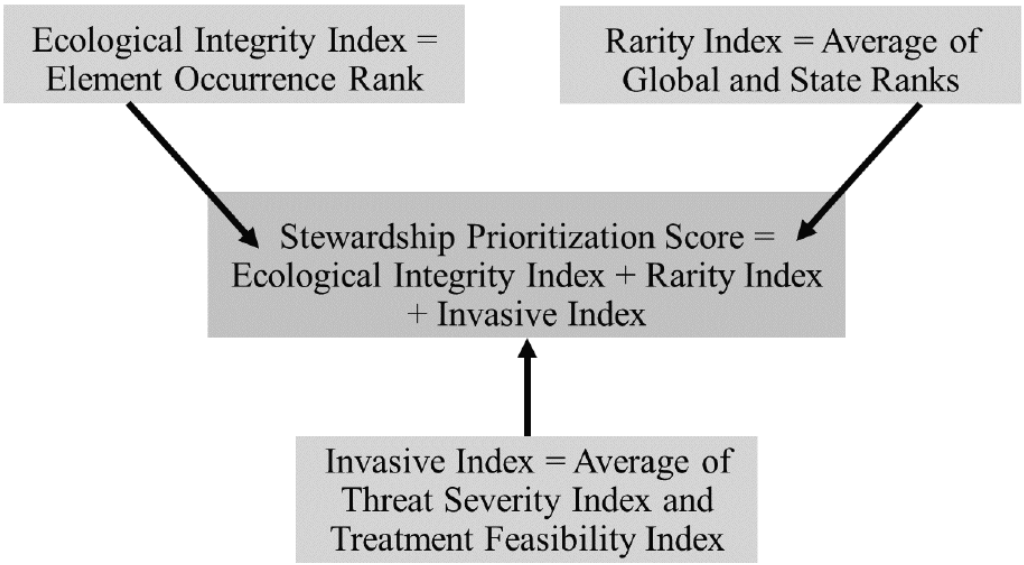


Figure 5. The stewardship prioritization score is the sum of the ecological integrity index, rarity index, and invasive index. This prioritization scoring was derived to help focus finite resources for biodiversity stewardship.

Survey Results

The following results section is organized alphabetically by natural community type. We provide detailed **Site Summaries** for each of the natural community element occurrences documented on Harbor Island. Nomenclature of plant species for all islands follows Michigan Flora (Voss and Reznicek 2012).

Six high-quality natural communities occur on Harbor Island including boreal forest, dry-mesic northern forest, Great Lakes marsh, limestone cobble shore, mesic northern forest, and rich conifer swamp. Table 1 lists the visited sites, their element occurrence ranks, and their acreage. Mapped natural community boundaries are provided for each natural community element occurrence in Figure 6.

The following site summaries detail threats and management recommendations for each of the six natural community element occurrences visited in 2022. Appendix 4 provides an overview of the natural community types adapted from MNFI's natural community classification (Kost et al. 2007, Cohen et al. 2015) and an accompanying ecoregional distribution map for each natural community type (Albert et al. 2008). For each site summary, we indicate if the site is an update of a previously identified element occurrence or a new element occurrence and provide the following information:

a) site name

b) natural community type

c) global and state rank (see Appendix 1 for ranking criteria)

d) current element occurrence rank

e) size

f) locational information

g) digital photographs

h) site description

i) threat assessment

j) management recommendations

Harbor Island boreal forest. Photo by Joshua G. Cohen.

Table 1. Natural community element occurrences (EOs) surveyed in 2022 on Harbor Island. EO rank abbreviations are as follows: AB, excellent to good estimated viability; B, good estimated viability; and BC, good to fair estimated viability.

Community Type	EO ID	Acreage	EO Rank
Boreal Forest	1231	394	BC
Dry-Mesic Northern Forest	26260	16	BC
Great Lakes Marsh	6682	67	AB
Limestone Cobble Shore	26258	8	B
Mesic Northern Forest	11688	155	B
Rich Conifer Swamp	26259	22	BC

Harbor Island dry-mesic northern forest. Increment borers were used to age canopy trees across the island. Photo by Joshua G. Cohen.

Figure 6. Natural community element occurrences on Harbor Island.

SITE SUMMARIES

1. Harbor Island - Boreal Forest
Natural Community Type: Boreal Forest
Rank: GU S3, globally unrankable and vulnerable within the state
Element Occurrence Rank: BC
Size: 394 acres
Location: Harbor Island, Seney Wildlife Refuge, Lake Huron
Element Occurrence Identification Number: 1231 (EO Update)

Site Description: The Harbor Island boreal forest occurs across Harbor Island on gently rolling terrain on shallow glacial drift and sand overlying Silurian-aged sedimentary bedrocks, principally limestone and dolomite cobble. The boreal forest intergrades locally with mesic northern forest along the slopes of the upland terraces and also intergrades with rich conifer swamp along the margins of the low areas along the island's western arm and swales along the eastern arm. This boreal forest element occurrence is composed of three distinct polygons. Harbor Island occurs in Potagannissing Bay in Lake Huron and is subject to frequent storm events. Windthrow is prevalent throughout the boreal forest, which is characterized by high volumes of coarse woody debris. Windthrow events are most highly concentrated and extensive in the north-central portion of the island. The coarse woody debris load of snags and downed logs is primarily composed of early-successional species, namely, paper birch (*Betula papyrifera*), balsam fir (*Abies balsamea*), and trembling aspen (*Populus tremuloides*) but also includes a significant component of northern white-cedar (*Thuja occidentalis*). Portions of boreal forest along the interior of the harbor have been impacted by beaver activity with beaver felling understory and subcanopy species.

Harbor Island boreal forest. Photo by Joshua G. Cohen.

Harbor Island boreal forest delineated in yellow on 2016 imagery.

The boreal forest is characterized by shallow fine- to medium-textured loams and sandy loams mixed with organics and sands that are slightly acidic to alkaline and of variable depth over limestone cobble. Measured soil depths over the cobble ranged from 3 to 45 cm with the majority of plots (14 of 22) with soil depths between 10 and 20 cm and an average soil depth of 14.4 cm. Measured pH ranged from 5.5 to 8.0 with an average of 7.5 across the 22 soil plots. A thin layer (1-2 cm) of cedar duff typically occurs on the surface of the soil profile. Burnt stumps and charcoal within the soil indicates that wildfire has impacted this boreal forest. Scattered large, moss-covered boulders occur throughout the boreal forest.

Numerous canopy dominants were cored across the boreal forest to determine the age range of canopy trees. Twenty-two canopy trees were cored and the average age of canopy dominants is 149 years with estimated canopy ages ranging from 74 to 220 years and cored canopy trees including northern white-cedar, trembling aspen, and white spruce (*Picea glauca*). A 45.1 cm white spruce was estimated to be over 220 years old, and a 34.3 cm northern white-cedar was estimated to be over 195 years old.

The boreal forest is dominated by northern white-cedar with canopy associates including balsam fir, trembling aspen, paper birch, white spruce, and white pine (*Pinus strobus*). Infrequent canopy associates include mountain-ash (*Sorbus decora*), green ash (*Fraxinus pennsylvanica*), and sugar maple (*Acer saccharum*), and supercanopy white pine occurs locally. Of the 646 canopy trees measured in 22 overstory plots 70% of those trees were northern white-cedar. Canopy coverage ranges from 60 to 90% with some local patches having more open canopy (40-60%) where blowdown is more prevalent. Canopy trees typically range in diameter from 20 to 40 cm with some scattered northern white-cedar, paper birch, white pine, and trembling aspen reaching 40 to 75 cm. Localized pockets of old-growth northern white-cedar are typically 50 to 70 cm. The average diameter of measured canopy trees was 27.3 cm (n = 646). The subcanopy includes mountain maple (*Acer spicatum*), striped maple (*A. pensylvanicum*), balsam fir, northern white-cedar, paper birch, mountain-ash, and white spruce. The understory layer is patchy to locally dense (25-45%) with balsam fir, balsam poplar (*Populus balsamifera*), trembling aspen, and white spruce. The low shrub layer is also patchy to dense (15-30%) with balsam fir, trembling aspen, and white pine. Yew (*Taxus canadensis*) seedlings occur infrequently, below the high snow level. The ground cover is patchy to dense (25-55%) with characteristic species including sedges (*Carex deweyana*,

Harbor Island boreal forest. Photo by Joshua G. Cohen.

C. eburnea, *C. aurea*, *C. pedunculata*), woodferns (*Dryopteris* spp.), Canada mayflower (*Maianthemum canadense*), starflower (*Trientalis borealis*), bracken fern (*Pteridium aquilinum*), dwarf scouring rush (*Equisetum scirpoides*), gay-wings (*Polygala paucifolia*), striped coral-root (*Corallorhiza striata*), and oak fern (*Gymnocarpium dryopteris*). One small patch of limestone oak fern (*Gymnocarpium robertianum*, state threatened) was located along the western arm of the island. Feathermoss is common throughout the boreal forest on boles of trees and coarse woody debris.

The Harbor Island boreal forest was surveyed from June 1st through June 2nd, July 11th through July 15th, and July 25th through July 27th, 2022. One hundred and one plant species were documented with 83 native species and 18 non-native species (Appendix 2.1). The total FQI was 36.2.

The Harbor Island boreal forest is subject to frequent windthrow and coarse woody debris is prevalent throughout the forest. Photo by Jesse M. Lincoln.

Limestone oak fern (*Gymnocarpium robertianum*, state threatened) was documented within the Harbor Island boreal forest. Photos by Joshua G. Cohen.

Threats: Species composition and vegetative structure of the boreal forest on Harbor Island are highly variable and influenced by the interaction of soil texture; depth to limestone cobble; time and intensity of past disturbance factors including windthrow, fire, and logging; and deer herbivory. Understory and ground cover species have been heavily browsed by deer with signs of herbivory even on balsam fir, which is typically a starvation food for wintering deer. Deer browse of sapling trembling aspen was prevalent. Yew and northern white-cedar were noticeably absent from the tall shrub layer. Across the boreal forest, the bark at the base of canopy cedars has been shredded. This is possibly caused by starving deer. Deer trails occur throughout the island. Non-natives observed infrequently in the boreal forest include wall lettuce (*Mycelis muralis*), hound's-tongue (*Cynoglossum officinale*), Canada bluegrass (*Poa compressa*), field scorpion grass (*Myosotis arvensis*), garden forget-me-not (*M. sylvatica*), mouse-ear chickweed (*Cerastium fontanum*), marsh thistle (*Cirsium palustre*, locally common in the north-central portion of island), sweetbrier (*Rosa rubiginosa*), helleborine (*Epipactis helleborine*), and common dandelion (*Taraxacum officinale*). Non-native earthworms have locally impacted the soils of the boreal forest. Earthworms and earthworm frass/castings were noted locally in the soil profile of the boreal forest. From a regional perspective, the persistence of relatively healthy green ash in the canopy is noteworthy. However, ash trees across the island are threatened by an incipient infestation of emerald ash borer (*Agrilus planipennis*).

Management Recommendations: The main management recommendations are to allow natural processes to operate unhindered, retain an intact buffer of natural communities surrounding the boreal forest, cull the deer population on Harbor Island and nearby Drummond Island, control the invasive species, monitor control and culling efforts, and investigate techniques for controlling emerald ash borer. Maintaining low deer densities on Harbor Island is critical for maintaining the integrity of the island's forested systems. Given the presence of healthy canopy ash within the boreal forest, we recommend the release of biological controls for the emerald ash borer on Harbor Island. Sweetbrier is occasional on Harbor Island including within the boreal forest and mesic northern forest. Though it is generally not considered a pernicious invasive, it should be eradicated, as its strongly armed stems allow it to escape herbivory and become locally dominant (Michigan Flora Online 2011).

Deer herbivory has drastically altered the floristic composition and vegetative structure of the Harbor Island boreal forest. Regenerating northern white-cedar are absent from the understory and we suspect the stripped bark on the boles of northern white-cedar observed throughout the boreal forest can be attributed to starving deer. Photo by Jesse M. Lincoln.

2. Harbor Island - Dry-mesic Northern Forest
Natural Community Type: Dry-mesic Northern Forest
Rank: G4 S3, apparently secure globally and vulnerable within the state
Element Occurrence Rank: BC
Size: 16 acres
Location: Harbor Island, Seney Wildlife Refuge, Lake Huron
Element Occurrence Identification Number: 26260

Site Description: Localized pockets of dry-mesic northern forest occur along the eastern arm of Harbor Island where deeper sand deposits occur. The dry-mesic northern forest is composed of three distinct polygons with the northernmost polygon following the contour of the sandy shoreline and occurring on the interior margin of the adjacent crescent bay and sand and gravel beach. Dry-mesic northern forest occurs on undulating topography of former dune shoreline.
The dry-mesic northern forest is starting to accrue attributes of a mature forest including a canopy dominated by large-diameter trees and coarse woody debris with slowly decomposing and long-lasting species including white pine (*Pinus strobus*) and red pine (*P. resinosa*) snags and downed red oak (*Quercus rubra*) and white pine logs. Numerous canopy dominants were cored across the dry-mesic northern forest to help determine the age range of canopy trees. Seventeen canopy trees were cored in 16 overstory plots and the average age of canopy dominants is 165 years with estimated canopy ages ranging from 77 to 230 years and cored canopy trees including red pine, red oak, and white pine. A 53.3 cm red pine was estimated to be over 230 years old, and a 60 cm red pine was estimated to be over 192 years old.

Harbor Island dry-mesic northern forest. Photo by Joshua G. Cohen.

Harbor Island dry-mesic northern forest delineated in yellow on 2016 imagery.

The dry-mesic northern forest occurs on deep fine-textured to medium-textured sands overlying limestone cobble or bedrock. Soils are characterized by a shallow (1-4 cm) organic or mor humus (coniferous leaf litter) that is strongly acidic (pH 4.5-5.0) and overlies the sands that are acidic to slightly acidic (pH 5.5-6.5) with an average pH of 5.7 across 16 soil plots. Soil acidity tends to decrease with increasing depth in the soil profile. The sands are deep with 10 of the 16 soil plots having greater than 100 cm of sands over the limestone cobble or bedrock (we used a 100-cm soil probe to gauge depth of mineral soil over bedrock). Depth to limestone cobble in the remaining six plots ranged from 25 to 90 cm with an average of 50 cm.

Harbor Island was likely utilized for thousands of years by Indigenous Peoples as a base for fishing and hunting. Suspected cache pits were observed throughout the eastern arm of the island, primarily within the oak-dominated mesic northern forest but also within the dry-mesic northern forest. Caching pits were used by Indigenous Peoples for food storage. It is likely that these Native Americans used fire on the island to maintain open understories for foraging, hunting, travel, resin production, and camping. Many of the overstory red pine within the dry-mesic northern forest have charring and fire scars on their boles. A two-meter fire scar was documented on one of the canopy red pine. In addition, we believe several of the canopy red pine have peel scars from scraping. This cultural practice was used in combination with fire to induce the flow of resin. The pine pitch was used for waterproofing canoes, patching clothing, the production of gum for trading, and as medicine (Larson et al. 2020).

The dry-mesic northern forest is dominated by red pine, white pine and red oak with canopy associates including red maple (*Acer rubrum*), paper birch (*Betula papyrifera*), white spruce (*Picea glauca*), trembling aspen (*Populus tremuloides*), and northern white-cedar (*Thuja occidentalis*). Canopy coverage ranges from 60 to 80% with some local patches having more open canopy (50-60%) closer to the shoreline. Canopy trees typically range in diameter from 20 to 40 cm with scattered red pine, white pine, and red oak reaching 60 to 80 cm. The average diameter of measured canopy

The overstory of the dry-mesic northern forest is dominated by red pine, red oak, and white pine. Overstory pines and oaks ranged in age from 77 to 230 years old. Photo by Joshua G. Cohen.

Signs of past fire were evident throughout the dry-mesic northern forest including fire scars (above left) and charred snags (below). In addition, we believe we also documented peel scars on culturally modified trees that were scraped to facilitate resin harvesting (above right). The morphology of the peel scar is distinct from the fire scar, which extends to the ground, is triangular in shape, and is widest at the tree base (Larson et al. 2020). We recommend the application of prescribed fire to promote pine and oak regeneration as well as floristic diversity. We also recommend archaeological studies on Harbor Island to learn about the Indigenous occupancy and use of the island. Photos by Joshua G. Cohen.

trees was 27.5 cm (n = 327). The subcanopy is sparse (5-15%) with balsam fir (*Abies balsamea*), red maple, white spruce, trembling aspen, red oak, and northern white-cedar. The understory is sparse to patchy (2-5%) with scattered balsam fir, white spruce, and white pine. The low shrub layer is sparse (5-10%) with low sweet blueberry (*Vaccinium angustifolium*) and common juniper (*Juniperus communis*) along with scattered tree seedlings including balsam fir, red maple, sugar maple (*Acer saccharum*), and white pine. The ground cover is patchy to dense (45-65%) with prevalent species including bracken fern (*Pteridium aquilinum*), sedges (*Carex deweyana*, *C. arctata*, *C. pensylvanica*, *C. pedunculata*), and rice grass (*Oryzopsis asperifolia*) and associates including poverty grass (*Danthonia spicata*), western fescue (*Festuca occidentalis*), Canada mayflower (*Maianthemum canadense*), starflower (*Trientalis borealis*), gay-wings (*Polygala paucifolia*), and stiff clubmoss (*Spinulum annotinum*).

The Harbor Island dry-mesic northern forest was surveyed June 2nd, July 11th through July 15th, and July 25th through July 27th, 2022. Forty plant species were documented with 34 native species and 6 non-native species (Appendix 2.2). The total FQI was 22.8.

Threats: The presence of mesophytic species (i.e., red maple and balsam fir) in the subcanopy and understory suggests that the dry-mesic northern forest may have been impacted by fire suppression. Deer herbivory was noted on understory species in the adjacent mesic northern forest and boreal forest and has likely also impacted the species composition and vegetative structure of the dry-mesic northern forest as well. Potentially problematic non-natives observed infrequently in the dry-mesic northern forest include Kentucky bluegrass (*Poa pratensis*), hound's-tongue (*Cynoglossum officinale*), and common St. John's-wort (*Hypericum perforatum*).

Management Recommendations: The main management recommendations are to allow natural processes to operate unhindered, retain an intact buffer of natural communities surrounding the dry-mesic northern forest, monitor for invasive species and deer herbivory, and implement prescribed fire to promote oak and pine regeneration and reduce the density and abundance of mesophytic species.

Harbor Island dry-mesic northern forest. Photo by Joshua G. Cohen.

3. Harbor Island - Great Lakes Marsh
Natural Community Type: Great Lakes Marsh
Rank: G4 S4, apparently secure globally and within the state
Element Occurrence Rank: AB
Size: 67 acres
Location: Harbor Island, Seney Wildlife Refuge, Lake Huron
Element Occurrence Identification Number: 6682 (EO Update)

Site Description: Great Lakes marsh occurs throughout the sheltered harbor of Harbor Island. This Great Lakes marsh is composed of two distinct polygons. The marsh occupies both the large protected embayment that spans the central portion of the eastern and western arms of the island and also the small embayment along the western arm. Along the western arm, the marsh is backed by rich conifer swamp and along the eastern arm, the marsh abruptly transitions to mesic northern forest. The hydrologic regime of Great Lakes marsh is directly linked to that of the Great Lakes. As such, the water level is not stable, being subject to seasonal fluctuations in Great Lakes water levels, short-term changes due to seiches and storm surges, and long-term, multi-year lake level fluctuations. Storm waves frequently disturb Great Lakes marsh, reconfiguring the substrate and removing fine mineral sediments and organic soils. This process is much less pronounced in the inner harbor and this portion of the marsh features plants that are more typical of less dynamic inland lakes. Long-term cyclic fluctuations of Great Lakes water levels significantly influence vegetation patterns of Great Lakes marsh, with vegetation and organic soils becoming well established during low-water periods and reduced or eliminated during high-water periods. In 2022, the marsh was visited in the early growing season (June 1-2) and in the late growing season (July 25-27). The evaluation of the marsh across the same growing season allowed us to ascertain how dynamic these systems are within the same year. The Great Lakes marsh significantly increased in extent over the course of this single growing season. In June, the marsh was primarily wet meadow but by the end of July, the emergent marsh zone was well developed and made up the majority of the area of Great Lakes marsh. The Great Lakes marsh has also been recently impacted by five years of high Great Lakes water levels (from 2016 through 2020). High water level has resulted in the die back of trees and shrubs within the Great Lakes marsh and adjacent limestone cobble shore. The marsh is also impacted by beaver. A beaver lodge was documented in 2022 within the wet meadow zone of the marsh and beaver are actively felling tag alder (*Alnus incana*) within the shrub margin of the marsh and balsam poplar (*Populus balsamifera*) in the adjacent forested swamp and even bigtooth aspen (*Populus grandidentata*) in portions of mesic northern forest adjacent to the inner harbor. In addition, waterfowl are actively browsing bulrushes (*Schoenoplectus* spp.) within the emergent zone of the marsh. The soils of the Great Lakes marsh are characterized by shallow organics (5-10 cm, pH 7.2-7.3) occurring over wet, alkaline (pH 7.2-7.3) sands. In July of 2022, areas of emergent marsh were characterized by 20 to 100 cm of water.

The Great Lakes marsh changed dramatically throughout the growing season. The emergent marsh zone was sparsely vegetated in the early growing season (June 1-2) but filled in with bulrush in the late growing season (July 25-27). Photos by Joshua G. Cohen

Harbor Island Great Lakes marsh delineated in yellow on 2016 imagery.

Species composition and ecological zonation of the marsh are patterned by water depth and variability of the substrate. The Great Lakes marsh is characterized by diverse zonation with submergent marsh, emergent marsh, and wet meadow. Over the course of the growing season, the marsh is most dominated by emergent graminoid vegetation with hardstem bulrush (*Schoenoplectus acutus*), blue-joint (*Calamagrostis canadensis*), tussock sedge (*Carex stricta*), and other sedges (*Carex* spp.). Additional species include silverweed (*Potentilla anserina*), pondweeds (*Potamogeton* spp.), marsh St. John's-wort (*Triadenum fraseri*), marsh fern (*Thelypteris palustris*), water smartweed (*Persicaria amphibia*), reed (*Phragmites australis* subspecies *americanus*), swamp milkweed (*Asclepias incarnata*), common water horehound (*Lycopus americanus*), fowl meadow grass (*Poa palustris*), creeping buttercup (*Ranunculus reptans*), horned bladderwort (*Utricularia cornuta*), spike-rush (*Eleocharis flavescens*), and spotted touch-me-not (*Impatiens capensis*). The submersed and floating-leaf aquatic community is diverse, and prevalent species within the submergent marsh include common waterweed (*Elodea canadensis*), slender naiad (*Najas flexilis*), yellow pond-lily (*Nuphar variegata*), sweet-scented waterlily (*Nymphaea odorata*), water smartweed, grass-leaved arrowhead (*Sagittaria graminea*), diverse pondweeds (e.g., *Potamogeton foliosus*, *P. friesii, P. gramineus, P. natans, P. richardsonii, P. robbinsii, P. zosteriformis*), Vasey's pondweed (*Potamogeton vaseyi*, state threatened), mermaid-weed (*Proserpinaca palustris*), and eel-grass (*Vallisneria americana*). Areas of emergent marsh are dominated by hardstem bulrush and green-fruited bur-reed (*Sparganium emersum*) while the wet meadow is characterized by sedges (*Carex stricta* and *C. lacustris*), blue-joint, wild blue flag (*Iris versicolor*), and Pennsylvania bitter cress (*Cardamine pensylvanica*). The native variety of reed is locally dominant within the marsh, occurring along the ecotone between the emergent and wet meadow zones. Scattered shrubs and trees along the transitional margin between the Great Lakes marsh and the adjacent forested swamp include green ash (*Fraxinus pennsylvanica*), balsam poplar, tag alder, and sweet gale (*Myrica gale*) with many woody species having recently been flood-killed following five years of high-water levels.

Wet meadow zone of the Great Lakes marsh. Photo by Joshua G. Cohen.

The Harbor Island Great Lakes marsh was surveyed June 1st through June 2nd, July 15th, July 25th, and July 27th, 2022. One hundred and seven plant species were documented with 95 native species and 12 non-native species (Appendix 2.3). The total FQI was 47.6.

Threats: Noteworthy non-native species recorded within the marsh include bull thistle (*Cirsium vulgare*), marsh thistle (*C. palustre*), Canada thistle (*C. arvense*), common St. John's-wort (*Hypericum perforatum*), Eurasian water-milfoil (*Myriophyllum spicatum*), and European frog's-bit (*Hydrocharis morsus-ranae*). European frog's-bit represents an especially severe threat to the marsh but the infestation is in the incipient phase and can be mitigated with prompt action. Boat traffic within the inner harbor is likely impacting the Great Lakes marsh by increasing wave activity, introducing invasive species (i.e., European frog's-bit), and dumping effluent.

Management Recommendations: Following surveys, MNFI scientists reported the European frog's-bit to the Michigan Aquatic Invasive Species Strike Team, Three Shores Cooperative Invasive Species Management Area, and the Sault Sainte Marie Tribe of Chippewa Indians Natural Resources Department. Since the initial documentation of the European frog's-bit in late July of 2022, the marsh has been visited twice for hand-pulling and future treatment is scheduled for 2023. Efforts to control European frog's-bit should be continued and these stewardship efforts should be monitored. As a means of protecting the long-term integrity of the marsh, we recommend closing the inner harbor to boat traffic to prevent increased wave activity, introduction of invasive species, and sewage disposal.

An incipient infestation of European frog's-bit was documented within the Great Lakes marsh. Immediate control of this pernicious invader is the highest stewardship priority for Harbor Island. Photo by Elizabeth A. Haber.

4. Harbor Island - Limestone Cobble Shore
Natural Community Type: Limestone Cobble Shore
Rank: G2G3 S3, imperiled to vulnerable globally and vulnerable within the state
Element Occurrence Rank: BC
Size: 8 acres
Location: Harbor Island, Seney Wildlife Refuge, Lake Huron
Element Occurrence Identification Number: 26258

Site Description: Over three miles of limestone cobble shore occurs primarily along the outer shoreline of Harbor Island in Potagannissing Bay in Lake Huron. This limestone cobble shore element occurrence is composed of six distinct polygons. The outer margin of Harbor Island has straight, long, unprotected shorelines on the western and eastern coasts that are subject to high energy disturbance in the form of frequent storms, high wave activity, and ice scour. Soil accumulation and vegetative establishment are limited in areas of high wave activity. The inner harbor of Harbor Island supports localized pockets of limestone cobble shoreline but is primarily characterized by Great Lakes marsh. Limestone cobble shore is backed by boreal forest.

Limestone cobble shore is subject to seasonal fluctuations in Great Lakes water levels, short-term changes due to seiches and storm surges, and long-term, multi-year lake level fluctuations. Storm waves frequently disturb limestone cobble shore, reconfiguring the substrate and removing fine mineral sediments and organic soils. Long-term cyclic fluctuations of Great Lakes water levels significantly influence vegetation patterns of limestone cobble shore, with vegetation and organic soils becoming well established during low-water periods and reduced or eliminated during high-water periods. The limestone cobble shore has been recently impacted by five years of high Great Lakes water levels (from 2016 through 2020) resulting in the decrease in the extent of the limestone cobble shore. The limestone cobble shore is of variable width but during the 2022 surveys ranged from 10 to 20 feet wide. High water levels have caused the dieback of trees and shrubs within the limestone cobble shore. In addition, high water levels and increased wave activity have likely reduced the overall cover of herbaceous species. Ample non-woody plant debris and coarse woody debris in the form of driftwood have accumulated along the margin of the cobble shore. The coarse woody debris along the shoreline provides important habitat for insects and herptiles and the non-woody plant debris provides organic matter for soil development. Rocks within the limestone cobble shore range from small cobble to large boulders (including pudding stones[1]) up to nearly 2 m wide. Large boulders around 1 m in diameter are common but most rocks are 10 to 30 cm across. The underlying substrate is typically limestone cobble. Surficial cobble includes a mix dominated by limestone with granite, basalts, pudding stones, and fossils. Wet gravelly, alkaline (pH 7.5-7.8) sands mixed with organics occur between and beneath the cobble.

Vegetation within the limestone cobble shore is absent to sparse. Where vegetation has become established, it occurs between cobbles and along the upper margin of the shore. Vegetation was likely especially sparse in 2022 since surveys were conducted following 5 years of high Great Lakes water levels from 2016 through 2020. Scattered trees and tree seedlings (1-4%) occur rarely along the upper margins of the limestone cobble shore and include northern white-cedar (*Thuja occidentalis*), green ash (*Fraxinus pennsylvanica*), tamarack (*Larix laricina*), red maple (*Acer rubrum*), and balsam fir (*Abies balsamea*). A high percentage of these woody species have died recently following the high-water levels with balsam fir snags observed. Characteristic ground cover (5-8%) species include birds-eye primrose (*Primula mistassinica*), panic grasses (*Dichanthelium implicatum* and *D. lindheimeri*), sedges (*Carex scoparia, C. hystericina, C. viridula*), northern bog violet (*Viola nephrophylla*), silverweed (*Potentilla anserina*), wild blue flag (*Iris versicolor*), spotted touch-me-not (*Impatiens capensis*), variegated scouring rush (*Equisetum variegatum*), and golden-seeded spike rush (*Eleocharis elliptica*).

The Harbor Island limestone cobble shore was surveyed from June 1st through June 2nd, July 11th through July 15th, and July 25th through July 27th, 2022. One hundred and three plant species were documented with 88 native species and 15 non-native species (Appendix 2.4). The total FQI was 35.5.

Threats: Noteworthy invasive species noted within the limestone cobble shore include common mullein (*Verbascum thapsus*), bull thistle (*Cirsium vulgare*), marsh thistle (*C. palustre*), Canada thistle (*C. arvense*), narrow-leaved cat-tail (*Typha angustifolia*), and reed canary grass (*Phalaris arundinacea*).

Management Recommendations: Efforts to control invasive species should be implemented and these control efforts should be monitored.

[1] The pudding stones on Harbor Island and nearby Drummond Island are characterized as jasper conglomerate, which consists of subrounded pebbles of red jasper, black chert, white quartzite, hematite, and semi-transparent quartz in a matrix of coarsely grained quartzite.

Harbor Island limestone cobble shore delineated in yellow on 2016 imagery.

Harbor Island limestone cobble shore. Photos by Jesse M. Lincoln (above) and Joshua G. Cohen (below).

5. Harbor Island - Mesic Northern Forest
Natural Community Type: Mesic Northern Forest
Rank: G4 S3, apparently secure globally and vulnerable within the state
Element Occurrence Rank: B
Size: 155 acres
Location: Harbor Island, Seney Wildlife Refuge, Lake Huron
Element Occurrence Identification Number: 11688 (EO Update)

Site Description: Mesic northern forest on Harbor Island occurs on shallow glacial drift overlying Silurian-aged sedimentary bedrocks, principally limestone and dolomite. The gently rolling terrain of the island peaks around 100-feet above lake level. The interior of the island is primarily upland with boreal forest and mesic northern forest. Boreal forest occurs on shallow soils overlying limestone cobble or sands. Mesic northern forest occurs on the more elevated portions of the island and is found typically on deeper soils overlying the underlying bedrock. This mesic northern forest element occurrence is composed of four distinct polygons corresponding to the island's terraces that formed during glacial retreat when historic lake levels were much higher than today. The topography along the terraces is gentle to rolling with localized portions of the mesic northern forest occurring on moderate slopes of the terraces. The eastern arm supports the largest block of mesic northern forest and is characterized by the largest and oldest trees with sugar maple (*Acer saccharum*) and red oak (*Quercus rubra*) co-dominating over a carpet of sedges (*Carex* spp.). Within this stretch of mesic northern forest we documented numerous suspected caching pits. The pits were approximately three feet in diameter and two feet deep. Caching pits were used by Indigenous Peoples for food storage.

Harbor Island mesic northern forest. Photo by Joshua G. Cohen.

Harbor Island mesic northern forest delineated in yellow on 2016 imagery.

Harbor Island occurs in Potagannissing Bay in Lake Huron and is subject to frequent storm events. Windthrow is common within the mesic northern forest, which is characterized by moderate volumes of coarse woody debris composed of both early-successional and late-successional species. The forest is starting to accrue large coarse woody debris of long-lived, large diameter species including sugar maple and red oak. Windthrow events are most highly concentrated and extensive in the north-central portion of the island and along the eastern arm where multiple windthrow gaps from a straight-line wind event were documented. Portions of mesic northern forest along the interior of the harbor have been impacted by beaver activity with beaver felling understory and subcanopy species.

The soils of the mesic northern forest are heterogenous and vary in texture, chemistry, and depth to the underlying cobble, which was often tightly interlocked. Observed soils included sands, loamy sand, sandy loam, silty-loam, loam, and sandy clay loam with sands being the most common and soil texture typically ranging from fine- to medium-textured with coarse-textured sands occurring locally. Measured soil depths over the cobble ranged from 2 to 80 cm with the majority of plots (11 of 20) with soil depths between 10 and 35 cm and an average soil depth of 27 cm. Measured pH ranged widely from 5.0 to 8.0 with an average of 6.5 across the 20 soil plots. A thin layer (1-2 cm) of mull humus (deciduous leaf litter) typically occurs on the surface of the soil profile. Earthworms and frass/castings were noted throughout the soil profile of the mesic northern forest. Moss-covered pudding-stone boulders, granite boulders, and limestone cobble occur scattered throughout the mesic northern forest especially along the western arm of the island. In addition to the higher concentration of boulders, the mesic northern forest along the western arm is also characterized by shallower soils and smaller diameter canopy trees.

Numerous canopy dominants were cored across the mesic northern forest to help determine the age range of canopy trees in the uneven-aged mesic northern forest. Twenty-one canopy trees were cored in 20 overstory plots and the average age of canopy dominants is 142 years with estimated canopy ages ranging from 94 to 200 years and cored canopy trees including sugar maple, red oak, red maple (*Acer rubrum*), white ash (*Fraxinus americana*), and ironwood (*Ostrya virginiana*). A 49.4 cm red oak was estimated to be over 200 years old, and a 34 cm sugar maple was estimated to be over 173 years old. The presence of living large diameter canopy ash trees scattered across the island's mesic northern forest is noteworthy given the prevalence of ash mortality on the nearby mainland due to the invasive insect emerald ash borer (*Agrilus planipennis*). The relative isolation of Harbor Island may be limiting dispersal of emerald ash borer to the island and preventing sufficient numbers of emerald ash borer from overwhelming canopy ash.

The uneven-aged mesic northern forest is dominated by sugar maple with diverse canopy associates including red oak, red maple, northern white-cedar (*Thuja occidentalis*), paper birch (*Betula papyrifera*), trembling aspen (*Populus tremuloides*), and white ash and infrequent white pine (*Pinus strobus*) and yellow birch (*Betula alleghaniensis*). Of the 358 canopy trees measured in 20 overstory plots 71% of those trees were sugar maple. Canopy coverage typically ranges from 60 to 90% with some local patches having more open canopy (40-60%) where blowdown is more prevalent. Canopy trees typically range in diameter from 20 to 40 cm with older and larger sugar maple, red oak, northern white-cedar, and red maple frequently reaching 40 to 60 cm and scattered red oak and white pine reaching 70 to 90 cm. The average diameter of measured canopy trees was 25.8 cm (n = 358). The subcanopy ranges from 5 to 15% and is characterized by sugar maple, ironwood, balsam fir (*Abies balsamea*), and white spruce (*Picea glauca*).

The understory layer is sparse to patchy (10-25%) with balsam fir, ironwood, white pine, white spruce, and sugar maple. Deer browse is limiting the development of tree saplings and therefore contributing to the sparse to patchy understory layer. Tree seedlings make up the sparse to patchy low shrub layer (10-20%) with recorded species including balsam fir, sugar maple, red maple, white ash, ironwood, paper birch, trembling aspen, northern white-cedar, white pine, and mountain-ash (*Sorbus decora*). The ground cover is dense (70-80%) and graminoid dominated with characteristic species including sedges (*Carex deweyana*, *C. pedunculata*, and *C. pensylvanica*), bracken fern (*Pteridium aquilinum*), and stiff clubmoss (*Spinulum annotinum*). Additional ground cover species include starflower (*Trientalis borealis*), downy Solomon seal (*Polygonatum pubescens*), false melic (*Schizachne purpurascens*), Canada mayflower (*Maianthemum canadense*), rough-leaved rice-grass (*Oryzopsis asperifolia*), western fescue (*Festuca occidentalis*), and bottlebrush grass (*Elymus hystrix*). The overwhelming dominance of a few species of sedge and grasses in the herbaceous layer reflects the superabundance of deer, which are reducing and eliminating more palatable forbs. Mosses are locally prevalent on the boles of large canopy dominants.

The Harbor Island mesic northern forest was surveyed from June 1st through June 2nd, July 11th through July 15th, and July 25th through July 27th, 2022. One hundred and three plant species were documented with 81 native species and 22 non-native species (Appendix 2.5). The total FQI was 31.5.

The eastern arm of Harbor Island supports mesic northern forest dominated by red oak. Within this forest we documented numerous potential caching pits (below, round feature in the center of the photo where there is no vegetation). We suspect Indigenous Peoples used fire on the island for centuries to maintain open understories for foraging, hunting, travel, and camping. Photos by Joshua G. Cohen.

Threats: Species composition and vegetative structure of the mesic northern forest on Harbor Island are highly variable and are influenced by the interaction of soil texture, depth of soil to limestone substrate, deer herbivory, and time and intensity of past disturbance factors including windthrow, fire, and logging. Understory and ground cover species have been heavily browsed by deer with signs of herbivory even on balsam fir, which is typically a starvation food for wintering deer. A small deer exclosure was recorded along the eastern arm of the island. Advanced sugar maple regeneration was abundant within this exclosure and is virtually absent from the rest of the forest. Earthworms were noted locally and it appears that worm herbivory is locally reducing the mull humus of the mesic northern forest. Earthworms have locally impacted soil decomposition processes. Non-native plants are locally common within the mesic northern forest with noteworthy non-natives including Kentucky bluegrass (*Poa pratensis*), hound's-tongue (*Cynoglossum officinale*), bull thistle (*Cirsium vulgare*), marsh thistle (*C. palustre*), Canada thistle (*C. arvense*), hemp-nettle (*Galeopsis tetrahit*), gromwell (*Lithospermum officinale*), common St. John's-wort (*Hypericum perforatum*), mouse-ear chickweed (*Cerastium fontanum*), helleborine (*Epipactis helleborine*), common dandelion (*Taraxacum officinale*), common mullein (*Verbascum thapsus*), Canada bluegrass (*Poa compressa*), common speedwell (*Veronica officinalis*), garden forget-me-not (*Myosotis sylvatica*), wall lettuce (*Mycelis muralis*), yellowtop (*Packera glabella*), sweetbrier (*Rosa rubiginosa*), and common buttercup (*Ranunculus acris*). Kentucky bluegrass is locally problematic and forms extensive lawns in places. Compared to the adjacent boreal forest, non-native species are more pervasive in the mesic northern forest.

Management Recommendations: The main management recommendations are to allow natural processes to operate unhindered, retain an intact buffer of natural communities surrounding the mesic northern forest, cull the deer population on Harbor Island and nearby Drummond Island, control the invasive species, and monitor control and culling efforts. Maintaining low deer densities on Harbor Island is critical for maintaining the integrity of the island's forested systems. Given the presence of healthy canopy ash within the mesic northern forest, we recommend the release of biological controls for the emerald ash borer on Harbor Island. Sweetbrier is occasional on Harbor Island including within the mesic northern forest and boreal forest. Though it is generally not considered a pernicious invasive, it should be eradicated, as its strongly armed stems allow it to escape herbivory and become locally dominant (Michigan Flora Online 2011).

High deer browse pressure within the mesic northern forest has favored unpalatable species, especially sedges, in the ground cover. Forbs and understory regeneration are noticeably sparse. Photo by Joshua G. Cohen.

Understory and ground cover species have been heavily browsed by deer with signs of herbivory even on balsam fir, which is typically a starvation food for wintering deer (above). The highest concentration of regenerating sugar maple within the mesic northern forest was found in a small deer exclosure (below). Reducing deer densities on Harbor Island is critical for maintaining the integrity of the island's forested systems. Photos by Joshua G. Cohen.

6. Harbor Island - Rich Conifer Swamp
Natural Community Type: Rich Conifer Swamp
Rank: G4 S3, apparently secure globally and vulnerable within the state
Element Occurrence Rank: BC
Size: 22 acres
Location: Harbor Island, Seney Wildlife Refuge, Lake Huron
Element Occurrence Identification Number: 26259

Site Description: Rich conifer swamp occurs in low areas along both arms of Harbor Island. The western arm of the island contains two low areas corresponding to tombolos. A tombolo is a narrow strip of land formed by deposition that connects two formerly distinct islands. The tombolos on Harbor Island's western arm are characterized by wetland ecosystems with rich conifer swamp being prevalent in both areas. Rich conifer swamp intergrades locally with boreal forest along the margins of the low areas along the island's western arm. Towards the harbor side of the island along the western arm, the rich conifer swamp transition to hardwood-conifer swamp, northern hardwood swamp, and then to Great Lakes marsh. High levels of overstory ash mortality were noted locally along this western arm due to the combination of recent high water levels of the Great Lakes and impact from emerald ash borer. These areas of open canopy are characterized by a highly diverse herbaceous flora. One small pocket of rich conifer swamp occurs along the eastern arm of Harbor Island in a low area in between the Great Lakes marsh and the mesic northern forest on the adjacent terrace.

Sphagnum hummocks and hollow microtopography and tip ups from windthrow generate fine-scale gradients in soil moisture and soil chemistry, which contribute to the high floristic diversity of the rich conifer swamp. Groundwater seepage generates saturated growing conditions. Harbor Island occurs in Potagannissing Bay in Lake Huron and is subject to frequent storm events. Windthrow is prevalent throughout the rich conifer swamp and decades of windthrow and

Harbor Island rich conifer swamp. Photo by Joshua G. Cohen.

Harbor Island rich conifer swamp delineated in yellow on 2016 imagery.

subsequent layering of cedar have created complex horizontal and vertical structure within the swamp. Coarse woody debris is prevalent throughout the swamp in the form of standing snags and downed logs of both early-successional species, namely balsam fir (*Abies balsamea*), white spruce (*Picea glauca*), trembling aspen (*Populus tremuloides*), and paper birch (*Betula papyrifera*), and late-successional species, namely northern white-cedar (*Thuja occidentalis*).

The rich conifer swamp is characterized by shallow organic soils (10-30 cm) overlying heterogenous mineral soils. Peats range from fibric to hemic to sapric and are alkaline (pH 7.3 to 7.8) with an average pH of 7.6 across 15 plots. Within the 15 soil plots, recorded soil texture included sand, loamy sand, clayey sand, sandy clay, clay, and clay loam. The variability of mineral soils suggests the areas where the rich conifer swamp developed were subject to dynamic hydrological conditions that resulted in a wide range of depositional and erosional processes. In one plot, mineral soils were 40 cm deep over the limestone cobble. In the remaining 14 plots, the peat and mineral soils were greater than 100 cm deep and no underlying cobble or bedrock was reached with the 100-cm soil probe.

Numerous canopy dominants were cored across the rich conifer swamp to help determine the age range of canopy trees. Sixteen canopy trees were cored in 15 overstory plots and the average age of canopy dominants is 155 years with estimated canopy ages ranging from 109 to 210 years and cored canopy trees including only northern white-cedar. A 41.4 cm northern white-cedar was cored and estimated to be over 210 years old, and a 38.8 cm northern white-cedar was cored and estimated to be over 208 years old. Tree cores from many of the canopy northern white-cedar trees displayed a growth release that began in 2017, likely corresponding to the canopy dieback of ash from the invasive insect emerald ash borer (*Agrilus planipennis*).

Harbor Island rich conifer swamp. Photo by Joshua G. Cohen.

The rich conifer swamp is dominated by northern white-cedar with canopy associates including balsam fir, white spruce, trembling aspen, black ash (*Fraxinus nigra*), balsam poplar (*Populus balsamifera*), paper birch, and green ash (*Fraxinus pennsylvanica*). Of the 486 canopy trees measured in 15 overstory plots 46% of those trees were northern white-cedar. Canopy coverage ranges widely from 50 to 80% with local patches closer to the shoreline having more open canopy (30-50%) where blowdown is more prevalent. Canopy trees typically range in diameter from 10 to 30 cm with pockets of larger northern white-cedar and occasional white spruce reaching 40 to 60 cm. The average diameter of measured canopy trees was 21.9 cm (n = 486). The understory layer is patchy (15-30%) with balsam fir, balsam poplar, trembling aspen, white spruce, mountain maple (*Acer spicatum*), and northern white-cedar. Northern white-cedar regeneration is noticeably sparse within the rich conifer swamp and is composed of layering cedar. The low shrub layer is patchy to dense (15-25%) with balsam fir, northern white-cedar, red maple (*Acer rubrum*), black ash, green ash, mountain maple, paper birch, balsam poplar, and mountain-ash (*Sorbus decora*).

The ground cover is diverse and dense (45-65%) with characteristic species including sedges (*Carex disperma*, *C. trisperma*, *C. pedunculata*, *C. arctata*, *C. canescens*, *C. gracillima*, *C. laxiflora*, and *C. stipata*), oak fern (*Gymnocarpium dryopteris*), starflower (*Trientalis borealis*), mad-dog skullcap (*Scutellaria lateriflora*), blue-joint (*Calamagrostis canadensis*), northern bugleweed (*Lycopus uniflorus*), fragrant bedstraw (*Galium triflorum*), marsh bedstraw (*G. palustre*), marsh fern (*Thelypteris palustris*), spotted touch-me-not (*Impatiens capensis*), goldthread (*Coptis trifolia*), wood reedgrass (*Cinna latifolia*), woodferns (*Dryopteris* spp.), scouring rush (*Equisetum scirpoides*), water horsetail (*Equisetum fluviatile*), fowl manna grass (*Glyceria striata*), swamp-candles (*Lysimachia terrestris*), Canada mayflower (*Maianthemum canadense*), naked miterwort (*Mitella nuda*), sensitive fern (*Onoclea sensibilis*), cinnamon fern (*Osmunda cinnamomea*), royal fern (*Osmunda regalis*), small-flowered buttercup (*Ranunculus abortivus*), and dwarf raspberry (*Rubus pubescens*).

The Harbor Island rich conifer swamp was surveyed from June 1st through June 2nd, July 11th through July 15th, and July 25th through July 27th, 2022. One hundred and thirty-four plant species were documented with 122 native species and 12 non-native species (Appendix 2.6). The total FQI was 49.8.

Harbor Island rich conifer swamp. Photo by Joshua G. Cohen.

Threats: Species composition and vegetative structure of the rich conifer swamp on Harbor Island is highly variable and is influenced by the interaction of soil texture, depth to limestone cobble, time and intensity of past disturbance factors including windthrow, fire, and logging, and deer herbivory. Scattered cut stumps occur locally within the swamp. Across Harbor Island, understory and ground cover species have been heavily browsed by deer with signs of herbivory even including balsam fir, which is typically a starvation food for wintering deer. Deer browse of sapling trembling aspen was also prevalent. Deer trails occur throughout the island. Non-natives observed infrequently in the rich conifer swamp include Kentucky bluegrass (*Poa pratensis*), common dandelion (*Taraxacum officinale*), common speedwell (*Veronica officinalis*), marsh thistle (*Cirsium palustre*), helleborine (*Epipactis helleborine*), wall lettuce (*Mycelis muralis*), common buttercup (*Ranunculus acris*), and common St. John's-wort (*Hypericum perforatum*).

Management Recommendations: The main management recommendations are to allow natural processes to operate unhindered, retain an intact buffer of natural communities surrounding the rich conifer swamp, cull the deer population on Harbor Island and nearby Drummond Island, control the invasive species, and monitor control and culling efforts. Maintaining low deer densities on Harbor Island is critical for maintaining the integrity of the island's forested systems.

Harbor Island rich conifer swamp. Photo by Joshua G. Cohen.

Stewardship Prioritization Results

The stewardship prioritization scores for each natural community element occurrence from Harbor Island are presented in Table 2 and graphically displayed in Figure 7. We sorted the element occurrences by their stewardship prioritization scores and assigned them a high (≥ 10; red), medium (≥ 9 and < 10; yellow), or low (< 9; blue) stewardship priority. The highest ranking natural community element occurrence for stewardship intervention on Harbor Island is the Great Lakes marsh. Compared to other natural community element occurrences across the National Wildlife Refuge island (Table 3), this marsh received the highest stewardship priority score. Great Lakes marsh is a Great Lakes endemic natural community type and this example is characterized by high native diversity and integrity threatened by an incipient invasive species infestation of European frog's-bit. When a stewardship prioritization analysis was run for Northern Michigan, a similar result was found with Great Lakes marsh ranking highly; Great Lakes marsh was consistently the most abundant natural community in the sites categorized as high stewardship priority (Cohen and Slaughter 2015). Great Lakes marsh is particularly susceptible to infestation by invasive species. The invasives that become established within Great Lakes marsh can quickly expand and dominate, with homogenous beds of reed (*Phragmites australis* subspecies *australis*) and invasive cat-tails (*Typha angustifolia* and *T.* × *glauca*) dramatically altering floristic composition and structure of affected sites.

Table 2. Stewardship prioritization for natural community element occurrences (EOs) on Harbor Island. EOs are sorted by their stewardship prioritization scores and assigned a high (red), medium (yellow), or low (blue) stewardship priority.

EO ID	Natural Community	EO Rank	Ecological Integrity Index	Gobal Rank	Global Rank Score	State Rank	State Rank Score	Rarity Index	Invasive Threat Severity	Treatment Feasability	Invasive Index	Stewardship Priority Score
6682	Great Lakes Marsh	AB	4.5	G2	4	S3	3	3.5	4	4	4	12
11688	Mesic Northern Forest	B	4	G4	2	S3	3	2.5	3	3	3	9.5
1231	Boreal Forest	BC	3.5	GU	3	S3	3	3	3	3	3	9.5
26260	Dry-Mesic Northern Forest	BC	3.5	G4	2	S3	3	2.5	2	4	3	9
26259	Rich Conifer Swamp	BC	3.5	G4	2	S3	3	2.5	3	3	3	9
26258	Limestone Cobble Shore	BC	3.5	G2G3	3.5	S3	3	3.25	2	2	2	8.75

The Great Lakes marsh on Harbor Island ranked as the high stewardship priority. This site represents a Great Lakes endemic natural community type and is characterized by high integrity threatened by an incipient invasive species infestation of European frog's-bit that is readily treated given immediate and decisive stewardship action. Photo by Joshua G. Cohen.

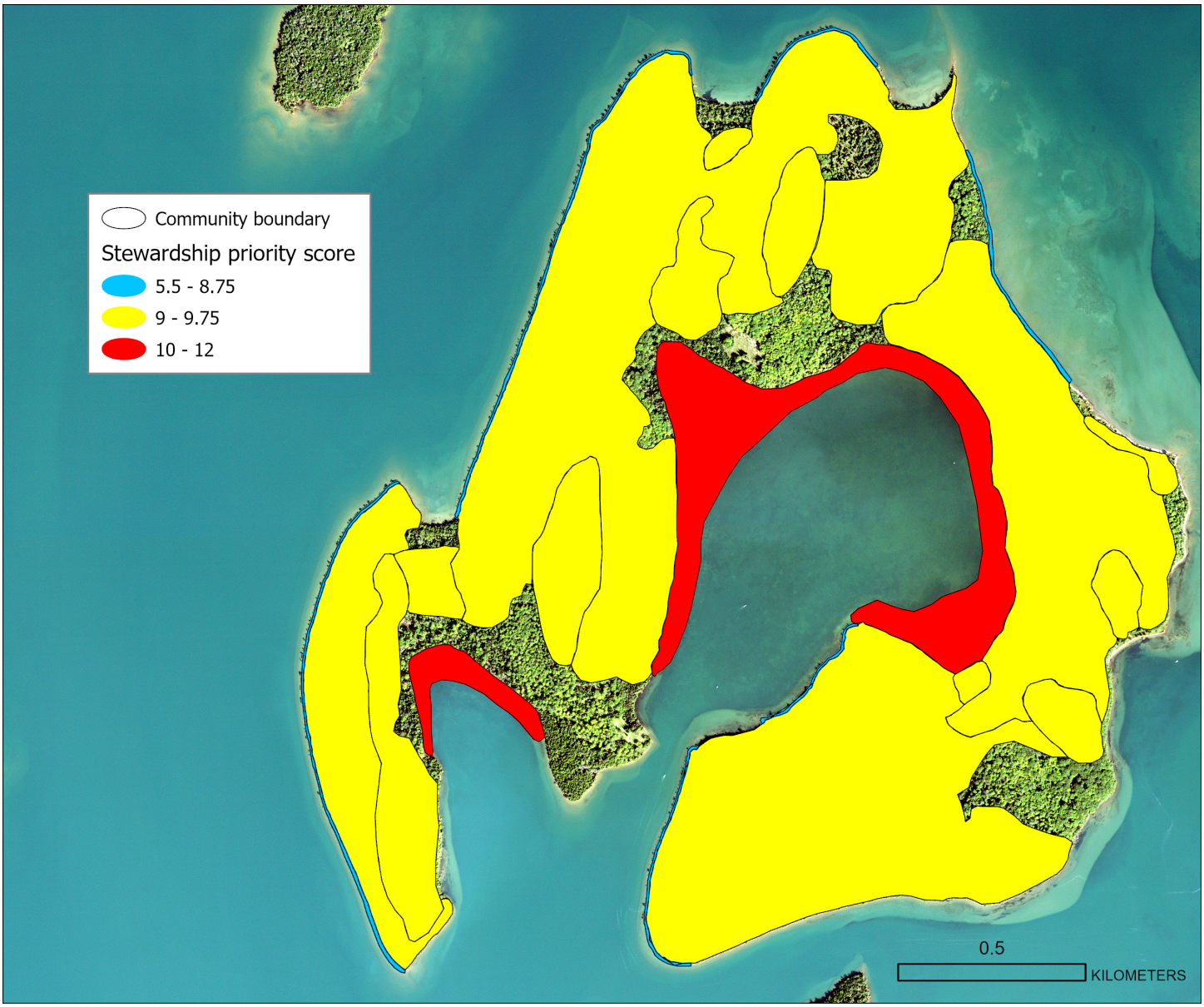


Figure 7. Stewardship prioritization for natural community element occurrences on Harbor Island. Element occurrences are displayed by their stewardship prioritization scores and assigned a high (red), medium (yellow), or low (blue) stewardship priority.

Harbor Island Great Lakes marsh. Photo by Jesse M. Lincoln.

Table 3. Stewardship prioritization for all surveyed National Wildlife Refuge islands. This table includes 66 natural community element occurrences (EOs) from 15 islands. EOs are sorted by their stewardship prioritization scores and assigned a high (red), medium (yellow), or low (blue) stewardship priority. The Harbor Island natural community EOs are highlighted in bold and underlined. The Harbor Island Great Lakes marsh received the highest stewardship priority score.

EO ID	Natural Community	Island	EO Rank	Ecological Integrity Index	Gobal Rank	Global Rank Score	State Rank	State Rank Score	Rarity Index	Invasive Threat Severity	Treatment Feasability	Invasive Index	Stewardship Priority Score
6682	**Great Lakes Marsh**	**Harbor Island**	**AB**	**4.5**	**G2**	**4**	**S3**	**3**	**3.5**	**4**	**4**	**4**	**12**
24356	Interdunal Wetland	Crooked Island	BC	3.5	G2?	4	S2	4	4	4	5	4.5	12
24382	Interdunal Wetland	Big Charity Island	C	3	G2?	4	S2	4	4	4	5	4.5	11.5
24355	Open Dunes	Crooked Island	B	4	G3	3	S3	3	3	5	4	4.5	11.5
24358	Great Lakes Marsh	Crooked Island	BC	3.5	G2	4	S3	3	3.5	4	4	4	11
24381	Open Dunes	Big Charity Island	C	3	G3	3	S3	3	3	5	4	4.5	10.5
24365	Great Lakes Marsh	Sugar Island	BC	3.5	G2	4	S3	3	3.5	4	3	3.5	10.5
7488	Boreal Forest	Poverty Island	B	4	GU	3	S3	3	3	3	4	3.5	10.5
4159	Limestone Bedrock Lakeshore	Poverty Island	AB	4.5	G3	3	S2	4	3.5	2	3	2.5	10.5
26246	Granite Bedrock Lakeshore	West Huron Island	AB	4.5	G4G5	1.5	S2	4	2.75	3	3	3	10.25
24354	Coastal Fen	Crooked Island	AB	4.5	G1G2	4.5	S2	4	4.25	1	2	1.5	10.25
26250	Granite Lakeshore Cliff	East Huron Island	A	5	GU	3	S1	5	4	1	1	1	10
26255	Granite Bedrock Glade	West Huron Island	B	4	G3G5	2	S2	4	3	3	3	3	10
26248	Granite Lakeshore Cliff	West Huron Island	A	5	GU	3	S1	5	4	1	1	1	10
24374	Limestone Bedrock Lakeshore	Detroit Island	B	4	G3	3	S2	4	3.5	2	3	2.5	10
1437	Limestone Lakeshore Cliff	Poverty Island	A	5	G4G5	1.5	S2	4	2.75	2	2.5	2.25	10
24348	Limestone Lakeshore Cliff	Saint Martin Island	A	5	G4G5	1.5	S2	4	2.75	2	2.5	2.25	10
26247	Granite Bedrock Lakeshore	Cattle Island	AB	4.5	G4G5	1.5	S2	4	2.75	2	3	2.5	9.75
26245	Granite Bedrock Lakeshore	East Huron Island	AB	4.5	G4G5	1.5	S2	4	2.75	2	3	2.5	9.75
26268	Mesic Southern Forest	West Sister Island	C	3	G2G3	3.5	S3	3	3.25	3	4	3.5	9.75
24359	Limestone Cobble Shore	Crooked Island	B	4	G2G3	3.5	S3	3	3.25	2	3	2.5	9.75
24362	Coastal Fen	Sugar Island	C	3	G1G2	4.5	S2	4	4.25	2	3	2.5	9.75
24363	Limestone Cobble Shore	Sugar Island	B	4	G2G3	3.5	S3	3	3.25	2	3	2.5	9.75
26254	Granite Bedrock Glade	Cattle Island	B	4	G3G5	2	S2	4	3	2	3	2.5	9.5
26249	Granite Lakeshore Cliff	Cattle Island	AB	4,5	GU	3	S1	5	4	1	1	1	9.5
26257	Granite Bedrock Glade	East Huron Island	AB	4.5	G3G5	2	S2	4	3	2	2	2	9.5
11688	**Mesic Northern Forest**	**Harbor Island**	**B**	**4**	**G4**	**2**	**S3**	**3**	**2.5**	**3**	**3**	**3**	**9.5**
1231	**Boreal Forest**	**Harbor Island**	**BC**	**3.5**	**GU**	**3**	**S3**	**3**	**3**	**3**	**3**	**3**	**9.5**
24384	Sand and Gravel Beach	Big Charity Island	BC	3.5	G3?	3	S3	3	3	3	3	3	9.5
24357	Boreal Forest	Crooked Island	C	3	GU	3	S3	3	3	4	3	3.5	9.5
24361	Limestone Bedrock Lakeshore	Sugar Island	C	3	G3	3	S2	4	3.5	3	3	3	9.5
24375	Limestone Cobble Shore	Detroit Island	BC	3.5	G3	3	S2	4	3.5	2	3	2.5	9.5
26265	Limestone Cobble Shore	Gull Island (Lake Michigan)	C	3	G2G3	3.5	S3	3	3.25	3	3	3	9.25
24385	Limestone Cobble Shore	Big Charity Island	BC	3.5	G2G3	3.5	S3	3	3.25	2	3	3	9.25
24350	Limestone Cliff	Saint Martin Island	B	4	G4G5	1.5	S2	4	2.75	2	3	2.5	9.25
24353	Limestone Cobble Shore	Saint Martin Island	B	4	G2G3	3.5	S3	3	3.25	1	3	2	9.25
26251	Granite Lakeshore Cliff	Gull Island (Lake Superior)	B	4	GU	3	S1	5	4	1	1	1	9
26264	Sand and Gravel Beach	Gull Island (Lake Michigan)	C	3	G3?	3	S3	3	3	3	3	3	9
26260	**Dry-Mesic Northern Forest**	**Harbor Island**	**BC**	**3.5**	**G4**	**2**	**S3**	**3**	**2.5**	**2**	**4**	**3**	**9**
26259	**Rich Conifer Swamp**	**Harbor Island**	**BC**	**3.5**	**G4**	**2**	**S3**	**3**	**2.5**	**3**	**3**	**3**	**9**
24367	Great Lakes Marsh	Plum Island	C	3	G4	2	S4	4	3	3	3	3	9
24349	Mesic Northern Forest	Saint Martin Island	BC	3.5	G4	2	S3	3	2.5	3	3	3	9
26244	Granite Bedrock Lakeshore	Gull Island (Lake Superior)	B	4	G4G5	1.5	S2	4	2.75	2	2	2	8.75
26258	**Limestone Cobble Shore**	**Harbor Island**	**BC**	**3.5**	**G2G3**	**3.5**	**S3**	**3**	**3.25**	**2**	**2**	**2**	**8.75**
24366	Limestone Cobble Shore	Rocky Island	C	3	G2G3	3.5	S3	3	3.25	3	2	2.5	8.75
26252	Granite Bedrock Glade	Gull Island (Lake Superior)	BC	3.5	G3G5	2	S2	4	3	2	2	2	8.5
26256	Boreal Forest	West Huron Island	B	4	GU	3	S3	3	3	2	1	1.5	8.5
26266	Limestone Bedrock Lakeshore	West Sister Island	C	3	G3	3	S2	4	3.5	2	2	2	8.5
24370	Limestone Cobble Shore	Plum Island	C	3	G3	3	S2	4	3.5	2	2	2	8.5
24372	Limestone Lakeshore Cliff	Detroit Island	BC	3.5	GNR	3	S4	2	2.5	2	3	2.5	8.5
24368	Limestone Lakeshore Cliff	Plum Island	C	3	GNR	3	S4	2	2.5	4	2	3	8.5
24352	Northern Hardwood Swamp	Saint Martin Island	C	3	G4	2	S3	3	2.5	3	3	3	8.5
24351	Boreal Forest	Saint Martin Island	B	4	GU	3	S3	3	3	1	2	1.5	8.5
26269	Limestone Lakeshore Cliff	West Sister Island	C	3	G4G5	1.5	S1	5	3.25	2	2	2	8.25
26263	Boreal Forest	Gull Island (Lake Michigan)	C	3	GU	3	S3	3	3	2	2	2	8
24379	Northern Hardwood Swamp	Big Charity Island	C	3	G4	2	S3	3	2.5	2	3	2.5	8
24360	Boreal Forest	Sugar Island	B	4	GU	3	S3	3	3	1	1	1	8
24369	Mesic Northern Forest	Plum Island	D	2	G4	2	S3	3	2.5	5	2	3.5	8
26253	Boreal Forest	East Huron Island	AB	4.5	GU	3	S3	3	3	0	NA	0	7.5
24373	Limestone Cliff	Detroit Island	BC	3.5	G4G5	1.5	S5	1	1.25	2	3	2.5	7.25
24387	Sand and Gravel Beach	Detroit Island	BC	3.5	G3?	3	S2	4	3.5	0	NA	0	7
24378	Dry-Mesic Northern Forest	Big Charity Island	C	3	G4	2	S3	3	2.5	1	1	1	6.5
24380	Limestone Bedrock Lakeshore	Big Charity Island	C	3	G3	3	S2	4	3.5	0	NA	0	6.5
26262	Mesic Northern Forest	Gull Island (Lake Michigan)	C	3	G4	2	S3	3	2.5	0	NA	0	5.5
24377	Mesic Northern Forest	Big Charity Island	C	3	G4	2	S3	3	2.5	0	NA	0	5.5
24364	Mesic Northern Forest	Sugar Island	CD	2.5	G4	2	S3	3	2.5	0	NA	0	5

Discussion

The framework for stewardship prioritization presented in this report offers a method for targeting biodiversity management. In addition, it can be used to focus long-term monitoring targets. Furthermore, this method could be catered to suit the specific and local needs of resource agencies. This stewardship prioritization could also be refined within broader ecological or political regions such as ecological subsection, county, or the entire National Wildlife Refuge system. In addition, other indices could be incorporated into the stewardship prioritization matrix, which focused on invasive plant species management. Additional indices to consider incorporating include indices that incorporate the presence of rare species, priority wildlife species, deer browse pressure, cultural significance, and the functionality of the landscape surrounding the site. The drastic impacts that deer can have on the floristic composition, structure, and successional trajectory of forested ecosystems are amplified on islands. An essential component of holistic management of Harbor Island should also include reduction of deer populations to abate the deleterious impacts of overbrowsing. Given the proximity of Harbor Island to Drummond Island, effort to reduce deer populations on Harbor Island should occur in coordination with parallel efforts on Drummond Island. Implementation of stewardship efforts within prioritized areas will also need to be followed by monitoring to gauge the success of biodiversity management and adjust future stewardship prioritization.

In addition to providing opportunities for monitoring past management actions to inform adaptive management, the islands within the National Wildlife Refuge provide critical learning environments where ecologists can study pattern and process to inform ecosystem management and conservation design. In the absence of shoreline development (e.g., breakwaters, jetties, and residences) dynamic coastal ecosystems on Harbor Island can change in spatial extent, floristic composition, and vegetative structure as the Great Lakes water levels fluctuate. The long-term conservation of Great Lakes coastal ecosystems depends on their capacity to change through time and space. The incipient infestations of European frog's-bit in the Great Lakes marsh on Harbor Island offers the opportunity to evaluate the effectiveness of early detection and rapid response. If culling of deer is implemented on Harbor Island, scientists can track the recovery of ground cover and understory species. Given the presence of potential caching pits and culturally modified trees, we also recommend archaeological studies on Harbor Island to learn about the Indigenous occupancy and use of the island.

Across the Great Lakes region, natural habitats are declining due to habitat destruction and are eroding in ecological integrity due to habitat fragmentation. Threats associated with habitat fragmentation include invasive species infestation, deer herbivory, predation by mesopredators, and fire suppression. Great Lakes islands, especially uninhabited ones like Harbor Island, provide unique and essential refuges for native biodiversity. Though these islands face less pressure from habitat destruction and fragmentation, they are still susceptible to the threats prevalent on the mainland. Biodiversity stewardship actions within these isolated and less disturbed settings have a high likelihood of success if they are prompt and decisive.

Boat traffic within the inner harbor is likely impacting the Great Lakes marsh by increasing wave activity and introducing invasive species. We recommend prohibiting recreational boat traffic in the inner harbor to reduce negative impacts to the Great Lakes marsh and ensure its resilience to respond to fluctuations in Great Lakes water levels. Photo by Jesse M. Lincoln.

Within the mesic northern forest, the primary management recommendations are to control populations of invasive species and reduce deer densities. If culling is implemented we recommend implementation of monitoring to gauge the vegetative response. Photos by Jesse M. Lincoln.

Conclusion

Through this project we evaluated the ecological integrity of high-quality natural communities on Harbor Island. We updated three element occurrences (boreal forest, Great Lakes marsh, and mesic northern forest) and documented three new element occurrences (dry-mesic northern forest, limestone cobble shore, and rich conifer swamp). This report provides site-based assessments of these six natural community element occurrences. Threats, management needs, and restoration opportunities specific to each individual site have been discussed. The baseline information presented in the 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. The framework for prioritizing stewardship and monitoring efforts across sites will help facilitate difficult decisions regarding the distribution of finite stewardship resources for site-based management. Based on our stewardship prioritization framework, we recommend focusing invasive plant species control efforts on the Great Lakes marsh. Limiting or banning recreational boating in the inner harbor will also reduce negative impacts to the Great Lakes marsh and ensure its resilience to respond to fluctuations in Great Lakes water levels. Given the presence of living canopy ash within Harbor Island's upland forests despite the presence of emerald ash borer on the island, we recommend the release of biological controls for emerald ash. In addition, we emphasize the importance of reducing deer densities on Harbor Island to facilitate the floristic recovery of the island's forested ecosystems.

The presence of living canopy ash trees within the mesic northern forest is noteworthy given the prevalence of ash mortality from emerald ash borer (*Agrilus planipennis*) on the nearby mainland. The relative isolation of Harbor Island may be limiting dispersal of emerald ash borer to the island and preventing sufficient numbers of emerald ash borer from overwhelming canopy ash. Islands such as Harbor Island may be serving as refuges from invasive pests and provide excellent research opportunities to evaluate the efficiency of biocontrol agents. Photo by Joshua G. Cohen.

References

Albert, D.A., J.G. Cohen, M.A. Kost, B.S. Slaughter, and H.D. Enander. 2008. Distribution Maps of Michigan's Natural Communities. Michigan Natural Features Inventory, Report No. 2008-01, Lansing, MI. 314 pp.

Bassett, T.J., E.A. Haber, R.A. Hackett, S.M. Warner, J.G. Cohen, J.M. Lincoln, H.D. Enander, and P.R. Schilke. 2023. Rare and Invasive Plant Surveys of Great Lakes Islands in the Harbor Island National Wildlife Refuge. Michigan Natural Features Inventory, Report No. 2023-12, Lansing, MI.

Cohen, J.G., M.A. Kost, B.S. Slaughter, and D.A. Albert. 2015. A Field Guide to the Natural Communities of Michigan. Michigan State University Press, East Lansing, MI. 362 pp.

Cohen, J.G., M.A. Kost, B.S. Slaughter, D.A. Albert, J.M. Lincoln, A.P. Kortenhoven, C.M. Wilton, H.D. Enander, and K.M. Korroch. 2020. Michigan Natural Community Classification[web application]. Michigan Natural Features Inventory, Michigan State University Extension, Lansing, Michigan. Available https://mnfi.anr.msu.edu/communities/classification. (Accessed: March 7, 2022).

Cohen, J.G., J.M. Lincoln, T.J. Bassett, S.M. Warner, H.D. Enander, E.A. Haber, and R.A. Hackett. 2022a. Natural Community Surveys of Great Lakes Islands in the Green Bay National Wildlife Refuge. Michigan Natural Features Inventory, Report Number 2022-07, Lansing, MI. 160 pp.

Cohen, J.G., J.M. Lincoln, T.J. Bassett, S.M. Warner, H.D. Enander, E.A. Haber, and R.A. Hackett. 2022b. Natural Community Surveys of Michigan Islands National Wildlife Refuge: Big Charity, Crooked, and Sugar Islands. Michigan Natural Features Inventory, Report Number 2022-08, Lansing, MI. 137 pp.

Cohen, J.G., T.J. Bassett, S.M. Warner, and H.D. Enander. 2023b. Natural Community Surveys of Gull Island, Lake Michigan. Michigan Natural Features Inventory, Report Number 2023-08, Lansing, MI. 44 pp.

Cohen, J.G., J.M. Lincoln, T.J. Bassett, S.M. Warner, H.D. Enander, E.A. Haber, and R.A. Hackett. 2023a. Natural Community Surveys of the Huron Islands, Lake Superior. Michigan Natural Features Inventory, Report Number 2023-06, Lansing, MI. 135 pp.

Cohen, J.G., S.M. Warner, E.A. Haber, H.D. Enander, and R.A. Hackett. 2023c. Natural Community Surveys of West Sister Island, Lake Erie. Michigan Natural Features Inventory, Report Number 2023-07, Lansing, MI. 39 pp.

Faber-Langendoen, D., J. Rocchio, P. Comer, G. Kudray, L. Vance, E. Byers, M. Schafale, C. Nordman, E. Muldavin, G. Kittel, L. Sneddon, M. Pyne, and S. Menard. 2008. Overview of Natural Heritage Methodology for Ecological Element Occurrence Ranking based on Ecological Integrity Assessment Methods [Draft for Network Review]. NatureServe, Arlington, VA.

Faber-Langendoen, D., W. Nichols, F.J. Rocchio, K. Walz, and J. Lemly. 2016. An Introduction to NatureServe's Ecological Integrity Assessment Method. NatureServe, Arlington, VA. 33 pp.

Freyman, W.A., L.A. Masters, and S. Packard. 2016. The Universal Floristic Quality Assessment (FQA) Calculator: An online tool for ecological assessment and monitoring. Methods in Ecology and Evolution 7(3): 380–383.

Henson, B.L., D.T. Kraus, M.J. McMurtry, and D.N. Ewert. 2010. Islands of Life: A Biodiversity and Conservation Atlas of the Great Lakes Islands. Nature Conservancy of Canada. 154 pp.

Herman, K.D., L.A. Masters, M.R. Penskar, A.A. Reznicek, G.S. Wilhelm, W.W. Brodovich, and K.P. Gardiner. 2001. Floristic quality assessment with wetland categories and examples of computer applications for the State of Michigan - Revised, 2nd Edition. Michigan Department of Natural Resources, Wildlife, Natural Heritage Program, Lansing, MI. 19 pp. + appendices.

Kost, M.A., D.A. Albert, J.G. Cohen, B.S. Slaughter, R.K. Schillo, C.R. Weber, and K.A. Chapman. 2007. Natural Communities of Michigan: Classification and Description. Michigan Natural Features Inventory Report Number 2007-21, Lansing, MI. 314 pp.

Michigan Flora Online. 2011. A.A. Reznicek, E.G. Voss, and B.S. Walters. University of Michigan, Ann Arbor, Michigan. Available: https://lsa-miflora-p.lsait.lsa.umich.edu/#/record/2545 (Accessed: February 15, 2023).

Larson, E.R., K.F. Kipfmueller, and L.B. Johnson. 2021. People, Fire, and Pine: Linking Human Agency and Landscape in the Boundary Waters Canoe Area Wilderness and Beyond. Annals of the American Association of Geographers 111(1): 1–25.

Meeker, J.E., J.E. Elias, and J.A. Heim. 1993. Plants used by the Great Lakes Ojibwa. Great Lakes Indian Fish and Wildlife Commission. Odanah, WI. 400 pp.

Michigan Natural Features Inventory (MNFI). 1988. Draft criteria for determining natural quality and condition grades, element occurrence size-classes and significance levels for palustrine and terrestrial natural communities in Michigan. Michigan Natural Features Inventory, Lansing, MI. 39 pp.

Michigan Natural Features Inventory (MNFI). 2023. Biotics database. Michigan Natural Features Inventory, Lansing, MI.

NatureServe. 2002. Element Occurrence Standard. NatureServe: Arlington, VA. 201 pp.

Reed, R.C., and J. Daniels. 1987. Bedrock Geology of Northern Michigan: Michigan Department of Natural Resources, Michigan Geological Survey, Geological Publication BG-01, scale 1:500,000.

Reznicek, A.A., M.R. Penskar, B.S. Walters, and B.S. Slaughter. 2014. Michigan Floristic Quality Assessment Database. Herbarium, University of Michigan, Ann Arbor, MI and Michigan Natural Features Inventory, Michigan State University, Lansing, MI. http://michiganflora.net

Rocchio, F.J., T. Ramm-Granberg, and R.C. Crawford. 2018. Field Manual for Applying Rapid Ecological Integrity Assessments in Upland Plant Communities of Washington State. Washington Natural Heritage Program, Washington Department of Natural Resources, Olympia, Washington. 113 pp.

Scharf, W.C., and M.L. Chamberlin. 1978. Ecological Inventory of Harbor Island. The Nature Conservancy, Midwest Regional Office. 17 pp.

State of Michigan. 2016. Michigan Imagery Solution. Best Available Imagery layer. Leaf-off current image service. Imagery date varies by County. [Accessed 2021-03]. County/Year: Chippewa County, 2016.

U.S. Department of Agriculture (USDA). 1939. Aerial photographs from 1937-1940. Nominal scale 1: 20,000, Black and White Panchromatic. USDA Farm Service Agency (FSA) Aerial Photography Field Office (APFO).

U.S .Department of Agriculture (USDA). 1998. Michigan color infra-red (CIR) imagery flown at 1:40,000. National Aerial Photography Program (NAPP). [Accessed from the State of Michigan Imagery Server, 2021-03].

U.S. Department of Agriculture (USDA). 2018. National Agriculture Imagery Program (NAIP) Imagery for Michigan. Farm Service Agency Aerial Photography Field Office (APFO). [Accessed from https://gis.apfo.usda.gov/arcgis/rest/services].

U.S. Department of Agriculture (USDA). 2020. 2020 National Agriculture Imagery Program (NAIP) Imagery for Michigan. Farm Service Agency Aerial Photography Field Office (APFO). [Accessed from https://gis.apfo.usda.gov/arcgis/rest/services].

U.S. Fish and Wildlife Service (USFWS). 2021a. Inventory and Monitoring of Natural Communities and Forests on Great Lakes Islands. Version 0.1. Department of Interior Great Lakes Region, US Fish and Wildlife Service Regional Office, Bloomington, MN.

U.S. Fish and Wildlife Service (USFWS). 2021b. Regional Protocol Framework for Rare and Invasive Plant Monitoring on Great Lakes Islands. Version 0.1. Department of Interior Great Lakes Region, US Fish and Wildlife Service Regional Office, Bloomington, MN.

U.S. Geological Survey (USGS). 2022. U.S. Topos. The National Map: https://basemap.nationalmap.gov/arcgis/rest/services. [Accessed 2021-03].

Voss, E.G., and A.A. Reznicek. 2012. Field Manual of Michigan Flora. University of Michigan Press, Ann Arbor, MI. 990 pp.

Harbor Island limestone cobble shore. Photo by Joshua G. Cohen.

Appendix 1 - 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.

GNR = Global rank not yet assessed. Unranked.

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.

SNR = State rank not yet assessed. Unranked.

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.

Appendix 2 - Floristic Quality Assessments

For each high-quality natural community, floristic data were compiled into the Universal Floristic Quality Assessment Calculator (Reznicek et al. 2014, Freyman et al. 2016) to determine the Floristic Quality Index (FQI) for each natural community element occurrence. The floristic quality assessment is derived from a mean coefficient of conservatism and floristic quality index. Each native species is assigned a coefficient of conservatism, a value of 0 to 10 based on probability of its occurrence in a natural versus degraded habitat. Species restricted to a specialized or undisturbed habitat are assigned a value of 10, implying the species has extremely strong fidelity to a specific habitat. Native species that are not particular or indicative of natural conditions are assigned a low value of 0 or 1. The coefficient of conservatism is determined by experts on the flora of a region, and so may vary for a given plant species from region to region. We employed regionally appropriate FQA for islands in Michigan (Reznicek et al. 2014). From the total list of plant species for an area, a mean C value is calculated and then multiplied by the square root of the total number of plant species to calculate the FQI. In addition, each species is assigned a coefficient of wetness (W) based on its affinity to wetland or upland habitat. Michigan sites with an FQI of 35 or greater possess sufficient conservatism and richness that they are considered floristically important from a statewide perspective (Herman et al. 2001).

For each high-quality natural community element occurrence, we generated a floristic quality assessment (FQA). The FQA includes a comprehensive list of the species documented in the element occurrence along with each species C and W values. In addition, for each site we present the accompanying conservatism-based metrics, species richness, species wetness, physiognomy metrics, and duration metrics. Within the plant lists for each natural community element occurrence, non-native species have been highlighted in bold.

We used the Michigan FQA (Reznicek et al. 2014) and nomenclature within the species lists follows Michigan Flora (Voss and Reznicek 2012).

Appendix 2.1. Harbor Island Boreal Forest FQA

Conservatism-Based Metrics:

Total Mean C:	3.6
Native Mean C:	4.4
Total FQI:	36.2
Native FQI:	40.1
Adjusted FQI:	39.9
% C value 0:	19.8
% C value 1-3:	29.7
% C value 4-6:	36.6
% C value 7-10:	13.9
Native Tree Mean C:	3.8
Native Shrub Mean C:	3.4
Native Herbaceous Mean C:	4.7

Species Richness:

Total Species:	101	
Native Species:	83	82.20%
Non-native Species:	18	17.80%

Species Wetness:

Mean Wetness:	1.2
Native Mean Wetness:	1

Physiognomy Metrics:

Tree:	17	16.80%
Shrub:	8	7.90%
Vine:	2	2.00%
Forb:	39	38.60%
Grass:	5	5.00%
Sedge:	18	17.80%
Rush:	0	0%
Fern:	12	11.90%
Bryophyte:	0	0%

Duration Metrics:

Annual:	1	1.00%
Perennial:	91	90.10%
Biennial:	9	8.90%
Native Annual:	1	1.00%
Native Perennial:	80	79.20%
Native Biennial:	2	2.00%

Appendix 2.1. Harbor Island Boreal Forest FQA (continued)

Scientific Name	Common Name	Acronym	Native?	C	W
Abies balsamea	balsam fir	ABIBAL	native	3	0
Acer pensylvanicum	striped maple	ACEPEN	native	5	3
Acer saccharum	sugar maple	ACESAU	native	5	3
Acer spicatum	mountain maple	ACESPI	native	5	3
Agrostis stolonifera	**creeping bent**	**AGRSTO**	**non-native**	**0**	**-3**
Amelanchier arborea	juneberry	AMEARB	native	4	3
Anaphalis margaritacea	pearly everlasting	ANAMAR	native	3	5
Aralia nudicaulis	wild sarsaparilla	ARANUD	native	5	3
Betula alleghaniensis	yellow birch	BETALL	native	7	0
Betula papyrifera	paper birch	BETPAP	native	2	3
Botrypus virginianus	rattlesnake fern	BOTVIR	native	5	3
Carex arctata	sedge	CXARTT	native	3	5
Carex aurea	sedge	CXAURE	native	3	-3
Carex bebbii	sedge	CXBEBB	native	4	-5
Carex deweyana	sedge	CXDEWE	native	3	3
Carex disperma	sedge	CXDISP	native	10	-5
Carex eburnea	sedge	CXEBUR	native	7	3
Carex garberi	sedge	CXGARB	native	8	-3
Carex gracillima	sedge	CXGRAA	native	4	3
Carex granularis	sedge	CXGRAN	native	2	-3
Carex intumescens	sedge	CXINTU	native	3	-3
Carex laxiflora	sedge	CXLAXF	native	8	0
Carex pedunculata	sedge	CXPEDU	native	5	3
Carex projecta	sedge	CXPROJ	native	3	-3
Carex retrorsa	sedge	CXRETS	native	3	-5
Carex rosea; c. convoluta	curly-styled wood sedge	CXROSE	native	2	5
Carex scoparia	sedge	CXSCOP	native	4	-3
Carex stipata	sedge	CXSTIP	native	1	-5
Carex tuckermanii	sedge	CXTUCK	native	8	-5
Cerastium fontanum	**mouse-ear chickweed**	**CERFON**	**non-native**	**0**	**3**
Circaea alpina	small enchanters-nightshade	CIRALP	native	4	-3
Cirsium arvense	**canada thistle**	**CIRARV**	**non-native**	**0**	**3**
Cirsium palustre	**marsh thistle**	**CIRPAL**	**non-native**	**0**	**-3**
Cirsium vulgare	**bull thistle**	**CIRVUL**	**non-native**	**0**	**3**
Clinopodium vulgare	wild-basil	CLIVUL	native	3	5
Corallorhiza striata	striped coral-root	CORSTR	native	6	3
Corallorhiza trifida	early coral-root	CORTRF	native	6	-3
Cornus sericea; c. stolonifera	red-osier	CORSER	native	2	-3
Cynoglossum officinale	**hounds-tongue**	**CYNOFF**	**non-native**	**0**	**5**
Dendrolycopodium dendroideum	tree clubmoss	DENDEN	native	5	3
Diervilla lonicera	bush-honeysuckle	DIELON	native	4	5
Dryopteris carthusiana	spinulose woodfern	DRYCAR	native	5	-3
Dryopteris intermedia	evergreen woodfern	DRYINT	native	5	0
Epipactis helleborine	**helleborine**	**EPIHEL**	**non-native**	**0**	**0**
Equisetum arvense	common horsetail	EQUARV	native	0	0

Appendix 2.1. Harbor Island Boreal Forest FQA (continued)

Scientific Name	Common Name	Acronym	Native?	C	W
Equisetum scirpoides	dwarf scouring rush	EQUSCI	native	7	0
Festuca occidentalis	western fescue	FESOCC	native	6	5
Fragaria virginiana	wild strawberry	FRAVIR	native	2	3
Fraxinus americana	white ash	FRAAME	native	5	3
Fraxinus nigra	black ash	FRANIG	native	6	-3
Fraxinus pennsylvanica	red ash	FRAPEN	native	2	-3
Galium palustre	marsh bedstraw	GALPAL	native	3	-5
Galium triflorum	fragrant bedstraw	GALTRR	native	4	3
Geranium robertianum	herb robert	GERROB	native	3	3
Goodyera oblongifolia	menzies rattlesnake plantain	GOOOBL	native	8	3
Gymnocarpium dryopteris	oak fern	GYMDRY	native	5	3
Gymnocarpium robertianum	limestone oak fern	GYMROB	native	10	3
Hackelia deflexa	stickseed	HACDEF	native	2	5
Hackelia virginiana	beggars lice	HACVIR	native	1	3
Hepatica americana	round-lobed hepatica	HEPAME	native	6	5
Hypericum perforatum	**common st. johns-wort**	**HYPPER**	**non-native**	**0**	**5**
Lathyrus ochroleucus	pale vetchling	LATOCH	native	8	5
Linnaea borealis	twinflower	LINBOR	native	6	0
Maianthemum canadense	canada mayflower	MAICAN	native	4	3
Maianthemum racemosum	false spikenard	MAIRAC	native	5	3
Mitella nuda	naked miterwort	MITNUD	native	8	-3
Mycelis muralis; lactuca m.	**wall lettuce**	**MYCMUR**	**non-native**	**0**	**5**
Myosotis arvensis	**field scorpion-grass**	**MYOARV**	**non-native**	**0**	**3**
Oryzopsis asperifolia	rough-leaved rice-grass	ORYASP	native	6	5
Phegopteris connectilis	northern beech-fern	PHECON	native	5	3
Picea glauca	white spruce	PICGLA	native	3	3
Pinus strobus	white pine	PINSTR	native	3	3
Poa compressa	**canada bluegrass**	**POACOM**	**non-native**	**0**	**3**
Polygala paucifolia	gay-wings	POLPAU	native	7	3
Polygonatum pubescens	downy solomon seal	POLPUB	native	5	5
Polypodium virginianum	common polypody	POLVIR	native	8	5
Populus balsamifera	balsam poplar	POPBAL	native	2	-3
Populus tremuloides	quaking aspen	POPTRE	native	1	0
Prunus pensylvanica	pin cherry	PRUPEN	native	3	3
Prunus virginiana	choke cherry	PRUVIR	native	2	3
Pteridium aquilinum	bracken fern	PTEAQU	native	0	3
Pyrola americana	round-leaved pyrola	PYRAME	native	7	0
Ranunculus acris	**tall or common buttercup**	**RANACR**	**non-native**	**0**	**0**
Ribes lacustre	swamp black currant	RIBLAC	native	6	-3
Rosa rubiginosa	**sweetbrier**	**ROSRUB**	**non-native**	**0**	**3**
Rubus strigosus	wild red raspberry	RUBSTR	native	2	0
Sambucus racemosa	red-berried elder	SAMRAC	native	3	3
Schizachne purpurascens	false melic	SCHPUP	native	5	3
Scutellaria lateriflora	mad-dog skullcap	SCULAT	native	5	-5
Solanum dulcamara	**bittersweet nightshade**	**SOLDUL**	**non-native**	**0**	**0**
Sorbus decora	mountain-ash	SORDEC	native	4	3

Appendix 2.1. Harbor Island Boreal Forest FQA (continued)

Scientific Name	Common Name	Acronym	Native?	C	W
Spinulum annotinum	stiff clubmoss	SPIANN	native	5	0
Taraxacum officinale	**common dandelion**	**TAROFF**	**non-native**	**0**	**3**
Taxus canadensis	yew	TAXCAN	native	5	3
Thuja occidentalis	arbor vitae	THUOCC	native	4	-3
Tragopogon dubius	**goats beard**	**TRADUB**	**non-native**	**0**	**5**
Trientalis borealis	star-flower	TRIBOR	native	5	0
Urtica dioica	stinging nettle	URTDIO	native	1	0
Verbascum thapsus	**common mullein**	**VERTHA**	**non-native**	**0**	**5**
Veronica officinalis	**common speedwell**	**VEROOF**	**non-native**	**0**	**3**
Viola labradorica	dog violet	VIOLAB	native	3	0

Appendix 2.2. Harbor Island Dry-Mesic Northern Forest FQA

Conservatism-Based Metrics:

Total Mean C:	3.6
Native Mean C:	4.2
Total FQI:	22.8
Native FQI:	24.5
Adjusted FQI:	38.7
% C value 0:	17.5
% C value 1-3:	25
% C value 4-6:	50
% C value 7-10:	7.5
Native Tree Mean C:	3.4
Native Shrub Mean C:	4.3
Native Herbaceous Mean C:	4.7

Species Richness:

Total Species:	40	
Native Species:	34	85.00%
Non-native Species:	6	15.00%

Species Wetness:

Mean Wetness:	2.1
Native Mean Wetness:	1.9

Physiognomy Metrics:

Tree:	12	30.00%
Shrub:	3	7.50%
Vine:	0	0.00%
Forb:	13	32.50%
Grass:	6	15.00%
Sedge:	4	10.00%
Rush:	0	0%
Fern:	2	5.00%
Bryophyte:	0	0%

Duration Metrics:

Annual:	1	2.50%
Perennial:	37	92.50%
Biennial:	2	5.00%
Native Annual:	1	2.50%
Native Perennial:	32	80.00%
Native Biennial:	1	2.50%

Appendix 2.2. Harbor Island Dry-Mesic Northern Forest FQA (continued)

Scientific Name	Common Name	Acronym	Native?	C	W
Abies balsamea	balsam fir	ABIBAL	native	3	0
Acer rubrum	red maple	ACERUB	native	1	0
Acer saccharum	sugar maple	ACESAU	native	5	3
Actaea rubra	red baneberry	ACTRUB	native	7	3
Betula papyrifera	paper birch	BETPAP	native	2	3
Cardamine pensylvanica	pennsylvania bitter cress	CARPEN	native	1	-3
Carex arctata	sedge	CXARTT	native	3	5
Carex deweyana	sedge	CXDEWE	native	3	3
Carex pedunculata	sedge	CXPEDU	native	5	3
Carex pensylvanica	sedge	CXPENS	native	4	5
Conopholis americana	squaw-root	CONAME	native	10	5
Cynoglossum officinale	**hounds-tongue**	**CYNOFF**	**non-native**	**0**	**5**
Danthonia spicata	poverty grass; oatgrass	DANSPI	native	4	5
Epipactis helleborine	**helleborine**	**EPIHEL**	**non-native**	**0**	**0**
Festuca occidentalis	western fescue	FESOCC	native	6	5
Fraxinus nigra	black ash	FRANIG	native	6	-3
Galium triflorum	fragrant bedstraw	GALTRR	native	4	3
Hypericum perforatum	**common st. johns-wort**	**HYPPER**	**non-native**	**0**	**5**
Juniperus communis	common or ground juniper	JUNCOI	native	4	3
Maianthemum canadense	canada mayflower	MAICAN	native	4	3
Maianthemum stellatum	starry false solomon-seal	MAISTE	native	5	0
Melampyrum lineare	cow-wheat	MELLIN	native	6	3
Oryzopsis asperifolia	rough-leaved rice-grass	ORYASP	native	6	5
Picea glauca	white spruce	PICGLA	native	3	3
Pinus resinosa	red pine	PINRES	native	6	3
Pinus strobus	white pine	PINSTR	native	3	3
Poa nemoralis	**bluegrass**	**POANEM**	**non-native**	**0**	**3**
Poa pratensis	**kentucky bluegrass**	**POAPRA**	**non-native**	**0**	**3**
Polygala paucifolia	gay-wings	POLPAU	native	7	3
Populus balsamifera	balsam poplar	POPBAL	native	2	-3
Populus tremuloides	quaking aspen	POPTRE	native	1	0
Pteridium aquilinum	bracken fern	PTEAQU	native	0	3
Quercus rubra	red oak	QUERUB	native	5	3
Rosa palustris	swamp rose	ROSPAL	native	5	-5
Schizachne purpurascens	false melic	SCHPUP	native	5	3
Spinulum annotinum	stiff clubmoss	SPIANN	native	5	0
Taraxacum officinale	**common dandelion**	**TAROFF**	**non-native**	**0**	**3**
Thuja occidentalis	arbor vitae	THUOCC	native	4	-3
Trientalis borealis	star-flower	TRIBOR	native	5	0
Vaccinium angustifolium	low sweet blueberry	VACANG	native	4	3

Appendix 2.3. Harbor Island Great Lakes Marsh FQA

Conservatism-Based Metrics:

Total Mean C:	4.6
Native Mean C:	5.2
Total FQI:	47.6
Native FQI:	50.7
Adjusted FQI:	49
% C value 0:	14
% C value 1-3:	23.4
% C value 4-6:	38.3
% C value 7-10:	24.3
Native Tree Mean C:	2.9
Native Shrub Mean C:	7.3
Native Herbaceous Mean C:	5.3

Physiognomy Metrics:

Tree:	7	6.50%
Shrub:	4	3.70%
Vine:	2	1.90%
Forb:	56	52.30%
Grass:	11	10.30%
Sedge:	22	20.60%
Rush:	3	3%
Fern:	2	1.90%
Bryophyte:	0	0%

Species Richness:

Total Species:	107	
Native Species:	95	88.80%
Non-native Species:	12	11.20%

Duration Metrics:

Annual:	7	6.50%
Perennial:	95	88.80%
Biennial:	5	4.70%
Native Annual:	4	3.70%
Native Perennial:	89	83.20%
Native Biennial:	2	1.90%

Species Wetness:

Mean Wetness:	-3.4
Native Mean Wetness:	-3.9

Appendix 2.3. Harbor Island Great Lakes Marsh FQA (continued)

Scientific Name	Common Name	Acronym	Native?	C	W
Abies balsamea	balsam fir	ABIBAL	native	3	0
Acer rubrum	red maple	ACERUB	native	1	0
Agrostis gigantea	**redtop**	**AGRGIG**	**non-native**	**0**	**-3**
Agrostis scabra	ticklegrass	AGRSCA	native	4	0
Alnus incana; a. rugosa	speckled alder	ALNINC	native	5	-3
Asclepias incarnata	swamp milkweed	ASCINC	native	6	-5
Betula papyrifera	paper birch	BETPAP	native	2	3
Bidens beckii	water-marigold	BIDBEC	native	10	-5
Bromus ciliatus	fringed brome	BROCIL	native	6	-3
Calamagrostis canadensis	blue-joint	CALCAN	native	3	-5
Campanula aparinoides	marsh bellflower	CAMAPA	native	7	-5
Capsella bursa-pastoris	**shepherds-purse**	**CAPBUR**	**non-native**	**0**	**3**
Cardamine pensylvanica	pennsylvania bitter cress	CARPEN	native	1	-3
Carex buxbaumii	sedge	CXBUXB	native	10	-5
Carex crawei	sedge	CXCRAE	native	10	-3
Carex diandra	sedge	CXDIAN	native	8	-5
Carex disperma	sedge	CXDISP	native	10	-5
Carex flava	sedge	CXFLAV	native	4	-5
Carex hystericina	sedge	CXHYST	native	2	-5
Carex lacustris	sedge	CXLACU	native	6	-5
Carex lasiocarpa	sedge	CXLASI	native	8	-5
Carex pellita	sedge	CXPELL	native	2	-5
Carex sterilis	sedge	CXSTER	native	10	-5
Carex stipata	sedge	CXSTIP	native	1	-5
Carex stricta	sedge	CXSTRI	native	4	-5
Carex utriculata	sedge	CXUTRI	native	5	-5
Carex vulpinoidea	sedge	CXVULP	native	1	-5
Cirsium arvense	**canada thistle**	**CIRARV**	**non-native**	**0**	**3**
Cirsium palustre	**marsh thistle**	**CIRPAL**	**non-native**	**0**	**-3**
Cirsium vulgare	**bull thistle**	**CIRVUL**	**non-native**	**0**	**3**
Cladium mariscoides	twig-rush	CLAMAR	native	10	-5
Comarum palustre	marsh cinquefoil	COMPAL	native	7	-5
Dasiphora fruticosa	shrubby cinquefoil	DASFRU	native	8	-3
Dichanthelium implicatum	panic grass	DICIMP	native	3	0
Dichanthelium lindheimeri	panic grass	DICLID	native	8	-5
Eleocharis elliptica	golden-seeded spike rush	ELEELL	native	6	-5
Eleocharis quinqueflora	spike-rush	ELEQUI	native	10	-5
Elodea canadensis	common waterweed	ELOCAN	native	1	-5
Erigeron annuus	daisy fleabane	ERIANN	native	0	3
Erucastrum gallicum	**dog mustard**	**ERUGAL**	**non-native**	**0**	**3**
Eupatorium perfoliatum	boneset	EUPPER	native	4	-3
Fraxinus nigra	black ash	FRANIG	native	6	-3
Fraxinus pennsylvanica	red ash	FRAPEN	native	2	-3
Galium asprellum	rough bedstraw	GALASP	native	5	-5
Galium palustre	marsh bedstraw	GALPAL	native	3	-5
Hydrocharis morsus-ranae	**european frogs-bit**	**HYDMOR**	**non-native**	**0**	**-5**

Appendix 2.3. Harbor Island Great Lakes Marsh FQA (continued)

Scientific Name	Common Name	Acronym	Native?	C	W
Hypericum majus	larger canada st. johns-wort	HYPMAJ	native	4	-3
Hypericum perforatum	**common st. johns-wort**	**HYPPER**	**non-native**	**0**	**5**
Impatiens capensis	spotted touch-me-not	IMPCAP	native	2	-3
Iris versicolor	wild blue flag	IRIVER	native	5	-5
Juncus balticus	rush	JUNBAL	native	4	-5
Juncus canadensis	canadian rush	JUNCAN	native	6	-5
Juncus effusus	soft-stemmed rush	JUNEFF	native	3	-5
Lathyrus palustris	marsh pea	LATPAL	native	7	-3
Lemna turionifera	red duckweed	LEMTUR	native	5	-5
Lobelia kalmii	bog lobelia	LOBKAL	native	10	-5
Lycopus americanus	common water horehound	LYCAME	native	2	-5
Lycopus uniflorus	northern bugle weed	LYCUNI	native	2	-5
Lysimachia thyrsiflora	tufted loosestrife	LYSTHY	native	6	-5
Mentha canadensis	wild mint	MENCAS	native	3	-3
Myrica gale	sweet gale	MYRGAL	native	6	-5
Myriophyllum spicatum	**eurasian water-milfoil**	**MYRSPI**	**non-native**	**0**	**-5**
Najas flexilis	slender naiad	NAJFLE	native	5	-5
Nuphar variegata	yellow pond-lily	NUPVAR	native	7	-5
Nymphaea odorata	sweet-scented waterlily	NYMODO	native	6	-5
Onoclea sensibilis	sensitive fern	ONOSEN	native	2	-3
Persicaria amphibia	water smartweed	PERAMP	native	6	-5
Phalaris arundinacea	**reed canary grass**	**PHAARU**	**non-native**	**0**	**-3**
Phragmites australis var. americanus	reed	PHRAUM	native	5	-3
Platanthera aquilonis	northern green orchid	PLAAQU	native	5	-3
Poa palustris	fowl meadow grass	POAPAS	native	3	-3
Poa pratensis	**kentucky bluegrass**	**POAPRA**	**non-native**	**0**	**3**
Populus balsamifera	balsam poplar	POPBAL	native	2	-3
Potamogeton foliosus	leafy pondweed	POTFOL	native	4	-5
Potamogeton friesii	friess pondweed	POTFRI	native	6	-5
Potamogeton gramineus	pondweed	POTGRM	native	5	-5
Potamogeton natans	pondweed	POTNAT	native	5	-5
Potamogeton richardsonii	richardsons pondweed	POTRIC	native	5	-5
Potamogeton robbinsii	pondweed	POTROB	native	10	-5
Potamogeton vaseyi	vaseys pondweed	POTVAS	native	10	-5
Potamogeton zosteriformis	flat-stemmed pondweed	POTZOS	native	5	-5
Potentilla anserina	silverweed	POTANS	native	5	-3
Potentilla norvegica	rough cinquefoil	POTNOR	native	0	0
Primula mistassinica	birds-eye primrose	PRIMIS	native	10	-3
Proserpinaca palustris	mermaid-weed	PROPAL	native	6	-5
Ranunculus reptans	creeping buttercup	RANRET	native	8	-3
Rorippa palustris	yellow cress	RORPAL	native	1	-5
Sagittaria graminea	grass-leaved arrowhead	SAGGRA	native	10	-5
Salix cordata	sand-dune willow	SALCOR	native	10	0
Schoenoplectus acutus	hardstem bulrush	SCHACU	native	5	-5
Schoenoplectus pungens	threesquare	SCHPUN	native	5	-5
Schoenoplectus tabernaemontani	softstem bulrush	SCHTAB	native	4	-5

Appendix 2.3. Harbor Island Great Lakes Marsh FQA (continued)

Scientific Name	Common Name	Acronym	Native?	C	W
Scirpus atrovirens	bulrush	SCIATV	native	3	-5
Scirpus cyperinus	wool-grass	SCICYP	native	5	-5
Scutellaria galericulata	marsh skullcap	SCUGAL	native	5	-5
Sparganium fluctuans	bur-reed	SPAFLU	native	10	-5
Sphenopholis intermedia	slender wedgegrass	SPHINT	native	4	0
Thelypteris palustris	marsh fern	THEPAL	native	2	-3
Thuja occidentalis	arbor vitae	THUOCC	native	4	-3
Triadenum fraseri	marsh st. johns-wort	TRIFRA	native	6	-5
Trifolium campestre	**low hop clover**	**TRICAM**	**non-native**	**0**	**5**
Typha latifolia	broad-leaved cat-tail	TYPLAT	native	1	-5
Utricularia cornuta	horned bladderwort	UTRCOR	native	10	-5
Vallisneria americana	eel-grass	VALAME	native	7	-5
Verbascum thapsus	**common mullein**	**VERTHA**	**non-native**	**0**	**5**
Verbena hastata	blue vervain	VERHAS	native	4	-3
Viola nephrophylla	northern bog violet	VIONEP	native	8	-3

Appendix 2.4. Harbor Island Limestone Cobble Shore FQA

Conservatism-Based Metrics:

Total Mean C:	3.5
Native Mean C:	4.1
Total FQI:	35.5
Native FQI:	38.5
Adjusted FQI:	37.9
% C value 0:	19.4
% C value 1-3:	34
% C value 4-6:	30.1
% C value 7-10:	16.5
Native Tree Mean C:	2.8
Native Shrub Mean C:	2
Native Herbaceous Mean C:	4.4

Physiognomy Metrics:

Tree:	12	11.70%
Shrub:	2	1.90%
Vine:	2	1.90%
Forb:	43	41.70%
Grass:	11	10.70%
Sedge:	21	20.40%
Rush:	7	7%
Fern:	5	4.90%
Bryophyte:	0	0%

Species Richness:

Total Species:	103	
Native Species:	88	85.40%
Non-native Species:	15	14.60%

Duration Metrics:

Annual:	7	6.80%
Perennial:	88	85.40%
Biennial:	8	7.80%
Native Annual:	6	5.80%
Native Perennial:	79	76.70%
Native Biennial:	3	2.90%

Species Wetness:

Mean Wetness:	-1.8
Native Mean Wetness:	-2.4

Appendix 2.4. Harbor Island Limestone Cobble Shore FQA (continued)

Scientific Name	Common Name	Acronym	Native?	C	W
Abies balsamea	balsam fir	ABIBAL	native	3	0
Acer rubrum	red maple	ACERUB	native	1	0
Acer saccharum	sugar maple	ACESAU	native	5	3
Agalinis purpurea	purple false foxglove	AGAPUR	native	7	-3
Agrostis gigantea	**redtop**	**AGRGIG**	**non-native**	**0**	**-3**
Anaphalis margaritacea	pearly everlasting	ANAMAR	native	3	5
Anemone canadensis	canada anemone	ANECAN	native	4	-3
Arabis pycnocarpa	hairy rock cress	ARAPYC	native	6	3
Barbarea vulgaris	**yellow rocket**	**BARVUL**	**non-native**	**0**	**0**
Betula papyrifera	paper birch	BETPAP	native	2	3
Calamagrostis canadensis	blue-joint	CALCAN	native	3	-5
Cardamine pensylvanica	pennsylvania bitter cress	CARPEN	native	1	-3
Carex aquatilis	sedge	CXAQUA	native	7	-5
Carex aurea	sedge	CXAURE	native	3	-3
Carex bebbii	sedge	CXBEBB	native	4	-5
Carex buxbaumii	sedge	CXBUXB	native	10	-5
Carex crawei	sedge	CXCRAE	native	10	-3
Carex flava	sedge	CXFLAV	native	4	-5
Carex granularis	sedge	CXGRAN	native	2	-3
Carex hystericina	sedge	CXHYST	native	2	-5
Carex lasiocarpa	sedge	CXLASI	native	8	-5
Carex pellita	sedge	CXPELL	native	2	-5
Carex scoparia	sedge	CXSCOP	native	4	-3
Carex stricta	sedge	CXSTRI	native	4	-5
Carex tetanica	sedge	CXTETA	native	9	-3
Carex viridula	sedge	CXVIRU	native	4	-5
Carex vulpinoidea	sedge	CXVULP	native	1	-5
Cirsium arvense	**canada thistle**	**CIRARV**	**non-native**	**0**	**3**
Cirsium palustre	**marsh thistle**	**CIRPAL**	**non-native**	**0**	**-3**
Cirsium vulgare	bull thistle	CIRVUL	non-native	0	3
Cladium mariscoides	twig-rush	CLAMAR	native	10	-5
Conyza canadensis	horseweed	CONCAN	native	0	3
Cornus amomum	silky dogwood	CORAMO	native	2	-3
Cynoglossum officinale	**hounds-tongue**	**CYNOFF**	**non-native**	**0**	**5**
Dichanthelium boreale	northern panic grass	DICBOR	native	7	0
Dichanthelium implicatum	panic grass	DICIMP	native	3	0
Dichanthelium lindheimeri	panic grass	DICLID	native	8	-5
Eleocharis elliptica	golden-seeded spike rush	ELEELL	native	6	-5
Eleocharis quinqueflora	spike-rush	ELEQUI	native	10	-5
Elymus canadensis	canada wild rye	ELYCAN	native	5	3
Elymus trachycaulus	slender wheatgrass	ELYTRA	native	8	3
Epilobium coloratum	cinnamon willow-herb	EPICOL	native	3	-5
Equisetum arvense	common horsetail	EQUARV	native	0	0
Equisetum sylvaticum	woodland horsetail	EQUSYL	native	5	-3
Equisetum variegatum	variegated scouring rush	EQUVAR	native	6	-3
Erigeron annuus	daisy fleabane	ERIANN	native	0	3

Appendix 2.4. Harbor Island Limestone Cobble Shore FQA (continued)

Scientific Name	Common Name	Acronym	Native?	C	W
Erigeron philadelphicus	philadelphia fleabane	ERIPHI	native	2	0
Fraxinus pennsylvanica	red ash	FRAPEN	native	2	-3
Halenia deflexa	spurred gentian	HALDEF	native	7	0
Hordeum jubatum	**squirrel-tail grass**	**HORJUB**	**non-native**	**0**	**0**
Hypericum perforatum	**common st. johns-wort**	**HYPPER**	**non-native**	**0**	**5**
Impatiens capensis	spotted touch-me-not	IMPCAP	native	2	-3
Iris versicolor	wild blue flag	IRIVER	native	5	-5
Juncus articulatus	jointed rush	JUNART	native	3	-5
Juncus balticus	rush	JUNBAL	native	4	-5
Juncus brachycephalus	rush	JUNBRP	native	7	-5
Juncus canadensis	canadian rush	JUNCAN	native	6	-5
Juncus dudleyi	dudleys rush	JUNDUD	native	1	-3
Juncus effusus	soft-stemmed rush	JUNEFF	native	3	-5
Juncus tenuis	path rush	JUNTEN	native	1	0
Larix laricina	tamarack	LARLAR	native	5	-3
Lathyrus palustris	marsh pea	LATPAL	native	7	-3
Leucanthemum vulgare	**ox-eye daisy**	**LEUVUL**	**non-native**	**0**	**5**
Lobelia kalmii	bog lobelia	LOBKAL	native	10	-5
Lycopus americanus	common water horehound	LYCAME	native	2	-5
Medicago lupulina	**black medick**	**MEDLUP**	**non-native**	**0**	**3**
Ostrya virginiana	ironwood; hop-hornbeam	OSTVIR	native	5	3
Persicaria amphibia	water smartweed	PERAMP	native	6	-5
Phalaris arundinacea	**reed canary grass**	**PHAARU**	**non-native**	**0**	**-3**
Phragmites australis var. americanus	reed	PHRAUM	native	5	-3
Picea glauca	white spruce	PICGLA	native	3	3
Populus balsamifera	balsam poplar	POPBAL	native	2	-3
Populus tremuloides	quaking aspen	POPTRE	native	1	0
Potentilla anserina	silverweed	POTANS	native	5	-3
Potentilla norvegica	rough cinquefoil	POTNOR	native	0	0
Primula mistassinica	birds-eye primrose	PRIMIS	native	10	-3
Rorippa palustris	yellow cress	RORPAL	native	1	-5
Rubus strigosus	wild red raspberry	RUBSTR	native	2	0
Rumex crispus	**curly dock**	**RUMCRI**	**non-native**	**0**	**0**
Schizachyrium scoparium	little bluestem	SCHSCO	native	5	3
Schoenoplectus pungens	threesquare	SCHPUN	native	5	-5
Schoenoplectus tabernaemontani	softstem bulrush	SCHTAB	native	4	-5
Scirpus atrovirens	bulrush	SCIATV	native	3	-5
Scutellaria galericulata	marsh skullcap	SCUGAL	native	5	-5
Selaginella eclipes	selaginella	SELECL	native	5	-3
Sisyrinchium montanum	mountain blue-eyed-grass	SISMON	native	4	0
Symphyotrichum puniceum	swamp aster	SYMPUN	native	5	-5
Taraxacum officinale	**common dandelion**	**TAROFF**	**non-native**	**0**	**3**
Teucrium canadense	wood-sage	TEUCAN	native	4	-3
Thelypteris palustris	marsh fern	THEPAL	native	2	-3
Thuja occidentalis	arbor vitae	THUOCC	native	4	-3
Trifolium repens	**white clover**	**TRIREP**	**non-native**	**0**	**3**

Appendix 2.4. Harbor Island Limestone Cobble Shore FQA (continued)

Scientific Name	Common Name	Acronym	Native?	C	W
Typha angustifolia	**narrow-leaved cat-tail**	**TYPANG**	**non-native**	**0**	**-5**
Typha latifolia	broad-leaved cat-tail	TYPLAT	native	1	-5
Ulmus americana	american elm	ULMAME	native	1	-3
Urtica dioica	stinging nettle	URTDIO	native	1	0
Verbascum thapsus	**common mullein**	**VERTHA**	**non-native**	**0**	**5**
Verbena hastata	blue vervain	VERHAS	native	4	-3
Veronica anagallis-aquatica	water speedwell	VERANA	native	4	-5
Viola labradorica	dog violet	VIOLAB	native	3	0
Viola nephrophylla	northern bog violet	VIONEP	native	8	-3
Viola sororia	common blue violet	VIOSOR	native	1	0
Vitis riparia	river-bank grape	VITRIP	native	3	0

Appendix 2.5. Harbor Island Mesic Northern Forest FQA

Conservatism-Based Metrics:

Total Mean C:	3.1
Native Mean C:	3.9
Total FQI:	31.5
Native FQI:	35.1
Adjusted FQI:	34.6
% C value 0:	23.3
% C value 1-3:	33
% C value 4-6:	37.9
% C value 7-10:	5.8
Native Tree Mean C:	3.4
Native Shrub Mean C:	3.3
Native Herbaceous Mean C:	4.1

Physiognomy Metrics:

Tree:	16	15.50%
Shrub:	5	4.90%
Vine:	2	1.90%
Forb:	41	39.80%
Grass:	15	14.60%
Sedge:	14	13.60%
Rush:	0	0%
Fern:	10	9.70%
Bryophyte:	0	0%

Species Richness:

Total Species:	103	
Native Species:	81	78.60%
Non-native Species:	22	21.40%

Duration Metrics:

Annual:	2	1.90%
Perennial:	92	89.30%
Biennial:	9	8.70%
Native Annual:	1	1.00%
Native Perennial:	78	75.70%
Native Biennial:	2	1.90%

Species Wetness:

Mean Wetness:	1.3
Native Mean Wetness:	1

Appendix 2.5. Harbor Island Mesic Northern Forest FQA (continued)

Scientific Name	Common Name	Acronym	Native?	C	W
Abies balsamea	balsam fir	ABIBAL	native	3	0
Acer rubrum	red maple	ACERUB	native	1	0
Acer saccharum	sugar maple	ACESAU	native	5	3
Anaphalis margaritacea	pearly everlasting	ANAMAR	native	3	5
Asclepias syriaca	common milkweed	ASCSYR	native	1	5
Betula papyrifera	paper birch	BETPAP	native	2	3
Botrypus virginianus	rattlesnake fern	BOTVIR	native	5	3
Calamagrostis canadensis	blue-joint	CALCAN	native	3	-5
Carex arctata	sedge	CXARTT	native	3	5
Carex aurea	sedge	CXAURE	native	3	-3
Carex deweyana	sedge	CXDEWE	native	3	3
Carex gracillima	sedge	CXGRAA	native	4	3
Carex intumescens	sedge	CXINTU	native	3	-3
Carex leptonervia	sedge	CXLEPO	native	3	0
Carex ormostachya	sedge	CXORMO	native	5	5
Carex pedunculata	sedge	CXPEDU	native	5	3
Carex pensylvanica	sedge	CXPENS	native	4	5
Carex retrorsa	sedge	CXRETS	native	3	-5
Carex rosea	curly-styled wood sedge	CXROSE	native	2	5
Carex stipata	sedge	CXSTIP	native	1	-5
Carex tuckermanii	sedge	CXTUCK	native	8	-5
Cerastium fontanum	**mouse-ear chickweed**	**CERFON**	**non-native**	**0**	**3**
Cinna latifolia	wood reedgrass	CINLAT	native	5	-3
Cirsium arvense	**canada thistle**	**CIRARV**	**non-native**	**0**	**3**
Cirsium palustre	**marsh thistle**	**CIRPAL**	**non-native**	**0**	**-3**
Cirsium vulgare	**bull thistle**	**CIRVUL**	**non-native**	**0**	**3**
Clinopodium vulgare	wild-basil	CLIVUL	native	3	5
Conopholis americana	squaw-root	CONAME	native	10	5
Cynoglossum officinale	**hounds-tongue**	**CYNOFF**	**non-native**	**0**	**5**
Danthonia spicata	poverty grass; oatgrass	DANSPI	native	4	5
Dendrolycopodium dendroideum	tree clubmoss	DENDEN	native	5	3
Dendrolycopodium obscurum	ground-pine	DENOBS	native	5	3
Dryopteris carthusiana	spinulose woodfern	DRYCAR	native	5	-3
Dryopteris intermedia	evergreen woodfern	DRYINT	native	5	0
Elymus hystrix	bottlebrush grass	ELYHYS	native	5	3
Epipactis helleborine	**helleborine**	**EPIHEL**	**non-native**	**0**	**0**
Festuca occidentalis	western fescue	FESOCC	native	6	5
Fraxinus americana	white ash	FRAAME	native	5	3
Fraxinus pennsylvanica	red ash	FRAPEN	native	2	-3
Galeopsis tetrahit	**hemp-nettle**	**GALTET**	**non-native**	**0**	**3**
Galium palustre	marsh bedstraw	GALPAL	native	3	-5
Galium triflorum	fragrant bedstraw	GALTRR	native	4	3
Glyceria striata	fowl manna grass	GLYSTR	native	4	-5
Gymnocarpium dryopteris	oak fern	GYMDRY	native	5	3
Hackelia deflexa	stickseed	HACDEF	native	2	5
Hackelia virginiana	beggars lice	HACVIR	native	1	3

Appendix 2.5. Harbor Island Mesic Northern Forest FQA (continued)

Scientific Name	Common Name	Acronym	Native?	C	W
Halenia deflexa	spurred gentian	HALDEF	native	7	0
Hypericum perforatum	**common st. johns-wort**	**HYPPER**	**non-native**	**0**	**5**
Juniperus communis	common or ground juniper	JUNCOI	native	4	3
Lathyrus ochroleucus	pale vetchling	LATOCH	native	8	5
Lithospermum officinale	**gromwell**	**LITOFF**	**non-native**	**0**	**5**
Maianthemum canadense	canada mayflower	MAICAN	native	4	3
Maianthemum racemosum	false spikenard	MAIRAC	native	5	3
Mitella nuda	naked miterwort	MITNUD	native	8	-3
Muhlenbergia mexicana	leafy satin grass	MUHMEX	native	3	-3
Mycelis muralis	**wall lettuce**	**MYCMUR**	**non-native**	**0**	**5**
Myosotis arvensis	**field scorpion-grass**	**MYOARV**	**non-native**	**0**	**3**
Onoclea sensibilis	sensitive fern	ONOSEN	native	2	-3
Oryzopsis asperifolia	rough-leaved rice-grass	ORYASP	native	6	5
Ostrya virginiana	ironwood; hop-hornbeam	OSTVIR	native	5	3
Packera glabella	**yellowtop**	**PACGLA**	**non-native**	**0**	**-3**
Picea glauca	white spruce	PICGLA	native	3	3
Pinus resinosa	red pine	PINRES	native	6	3
Pinus strobus	white pine	PINSTR	native	3	3
Poa alsodes	bluegrass	POAALS	native	9	0
Poa compressa	**canada bluegrass**	**POACOM**	**non-native**	**0**	**3**
Poa nemoralis	**bluegrass**	**POANEM**	**non-native**	**0**	**3**
Poa palustris	fowl meadow grass	POAPAS	native	3	-3
Poa pratensis	**kentucky bluegrass**	**POAPRA**	**non-native**	**0**	**3**
Poa saltuensis	bluegrass	POASAL	native	5	5
Polygonatum pubescens	downy solomon seal	POLPUB	native	5	5
Populus balsamifera	balsam poplar	POPBAL	native	2	-3
Populus tremuloides	quaking aspen	POPTRE	native	1	0
Prunus pensylvanica	pin cherry	PRUPEN	native	3	3
Pteridium aquilinum	bracken fern	PTEAQU	native	0	3
Quercus rubra	red oak	QUERUB	native	5	3
Ranunculus abortivus	small-flowered buttercup	RANABO	native	0	0
Ranunculus acris	**tall or common buttercup**	**RANACR**	**non-native**	**0**	**0**
Rosa acicularis	wild rose	ROSACI	native	4	3
Rosa rubiginosa	**sweetbrier**	**ROSRUB**	**non-native**	**0**	**3**
Rubus strigosus	wild red raspberry	RUBSTR	native	2	0
Sambucus racemosa	red-berried elder	SAMRAC	native	3	3
Schizachne purpurascens	false melic	SCHPUP	native	5	3
Scirpus atrovirens	bulrush	SCIATV	native	3	-5
Scutellaria galericulata	marsh skullcap	SCUGAL	native	5	-5
Scutellaria lateriflora	mad-dog skullcap	SCULAT	native	5	-5
Sorbus decora	mountain-ash	SORDEC	native	4	3
Spinulum annotinum	stiff clubmoss	SPIANN	native	5	0
Symphyotrichum ciliolatum	northern heart-leaved aster	SYMCIO	native	4	5
Symphyotrichum lateriflorum	calico aster	SYMLAT	native	2	0
Taraxacum officinale	**common dandelion**	**TAROFF**	**non-native**	**0**	**3**
Thelypteris noveboracensis	new york fern	THENOV	native	5	0

Appendix 2.5. Harbor Island Mesic Northern Forest FQA (continued)

Scientific Name	Common Name	Acronym	Native?	C	W
Thuja occidentalis	arbor vitae	THUOCC	native	4	-3
Trientalis borealis	star-flower	TRIBOR	native	5	0
Trifolium repens	**white clover**	**TRIREP**	**non-native**	**0**	**3**
Trillium grandiflorum	common trillium	TRIGRA	native	5	3
Urtica dioica	stinging nettle	URTDIO	native	1	0
Verbascum thapsus	**common mullein**	**VERTHA**	**non-native**	**0**	**5**
Veronica officinalis	**common speedwell**	**VEROOF**	**non-native**	**0**	**3**
Veronica serpyllifolia	**thyme-leaved speedwell**	**VERSER**	**non-native**	**0**	**0**
Viola blanda	sweet white violet	VIOBLA	native	5	-3
Viola labradorica	dog violet	VIOLAB	native	3	0
Vitis riparia	river-bank grape	VITRIP	native	3	0

Appendix 2.6. Harbor Island Rich Conifer Swamp FQA

Conservatism-Based Metrics:

Total Mean C:	4.3
Native Mean C:	4.8
Total FQI:	49.8
Native FQI:	53
Adjusted FQI:	45.8
% C value 0:	10.4
% C value 1-3:	24.6
% C value 4-6:	47
% C value 7-10:	17.9
Native Tree Mean C:	3.7
Native Shrub Mean C:	4.8
Native Herbaceous Mean C:	4.9

Physiognomy Metrics:

Tree:	16	11.90%
Shrub:	12	9.00%
Vine:	0	0.00%
Forb:	52	38.80%
Grass:	9	6.70%
Sedge:	29	21.60%
Rush:	0	0%
Fern:	16	11.90%
Bryophyte:	0	0%

Species Richness:

Total Species:	134	
Native Species:	122	91.00%
Non-native Species:	12	9.00%

Duration Metrics:

Annual:	1	0.70%
Perennial:	130	97.00%
Biennial:	3	2.20%
Native Annual:	1	0.70%
Native Perennial:	120	89.60%
Native Biennial:	1	0.70%

Species Wetness:

Mean Wetness:	-1.8
Native Mean Wetness:	-2.1

Appendix 2.6. Harbor Island Rich Conifer Swamp FQA (continued)

Scientific Name	Common Name	Acronym	Native?	C	W
Abies balsamea	balsam fir	ABIBAL	native	3	0
Acer pensylvanicum	striped maple	ACEPEN	native	5	3
Acer rubrum	red maple	ACERUB	native	1	0
Acer saccharum	sugar maple	ACESAU	native	5	3
Acer spicatum	mountain maple	ACESPI	native	5	3
Agrostis gigantea	**redtop**	**AGRGIG**	**non-native**	**0**	**-3**
Agrostis scabra	ticklegrass	AGRSCA	native	4	0
Aralia nudicaulis	wild sarsaparilla	ARANUD	native	5	3
Betula alleghaniensis	yellow birch	BETALL	native	7	0
Betula papyrifera	paper birch	BETPAP	native	2	3
Calamagrostis canadensis	blue-joint	CALCAN	native	3	-5
Caltha palustris	marsh-marigold	CALPAR	native	6	-5
Campanula aparinoides	marsh bellflower	CAMAPA	native	7	-5
Cardamine pensylvanica	pennsylvania bitter cress	CARPEN	native	1	-3
Carex aquatilis	sedge	CXAQUA	native	7	-5
Carex arctata	sedge	CXARTT	native	3	5
Carex aurea	sedge	CXAURE	native	3	-3
Carex bebbii	sedge	CXBEBB	native	4	-5
Carex canescens	sedge	CXCANE	native	8	-5
Carex deweyana	sedge	CXDEWE	native	3	3
Carex diandra	sedge	CXDIAN	native	8	-5
Carex disperma	sedge	CXDISP	native	10	-5
Carex eburnea	sedge	CXEBUR	native	7	3
Carex gracillima	sedge	CXGRAA	native	4	3
Carex granularis	sedge	CXGRAN	native	2	-3
Carex interior	sedge	CXINTE	native	3	-5
Carex intumescens	sedge	CXINTU	native	3	-3
Carex lacustris	sedge	CXLACU	native	6	-5
Carex laxiflora	sedge	CXLAXF	native	8	0
Carex leptalea	sedge	CXLEPA	native	5	-5
Carex pedunculata	sedge	CXPEDU	native	5	3
Carex prairea	sedge	CXPRAI	native	10	-3
Carex pseudo-cyperus	sedge	CXPSEU	native	5	-5
Carex retrorsa	sedge	CXRETS	native	3	-5
Carex sterilis	sedge	CXSTER	native	10	-5
Carex stipata	sedge	CXSTIP	native	1	-5
Carex stricta	sedge	CXSTRI	native	4	-5
Carex trisperma	sedge	CXTRIS	native	9	-5
Carex tuckermanii	sedge	CXTUCK	native	8	-5
Carex vesicaria	sedge	CXVESI	native	7	-5
Cicuta bulbifera	water hemlock	CICBUL	native	5	-5
Cinna latifolia	wood reedgrass	CINLAT	native	5	-3
Circaea alpina	small enchanters-nightshade	CIRALP	native	4	-3
Cirsium palustre	**marsh thistle**	**CIRPAL**	**non-native**	**0**	**-3**
Clinopodium vulgare	wild-basil	CLIVUL	native	3	5
Coptis trifolia	goldthread	COPTRI	native	5	-3

Appendix 2.6. Harbor Island Rich Conifer Swamp FQA (continued)

Scientific Name	Common Name	Acronym	Native?	C	W
Cornus canadensis	bunchberry	CORCAA	native	6	0
Cornus sericea	red-osier	CORSER	native	2	-3
Cystopteris bulbifera	bulblet fern	CYSBUL	native	5	-3
Diervilla lonicera	bush-honeysuckle	DIELON	native	4	5
Dryopteris carthusiana	spinulose woodfern	DRYCAR	native	5	-3
Dryopteris cristata	crested shield fern	DRYCRI	native	6	-5
Dryopteris intermedia	evergreen woodfern	DRYINT	native	5	0
Eleocharis palustris	spike-rush	ELEPAL	native	5	-5
Epilobium hirsutum	**great hairy willow-herb**	**EPIHIR**	**non-native**	**0**	**-3**
Epilobium leptophyllum	fen willow-herb	EPILEP	native	6	-5
Epipactis helleborine	**helleborine**	**EPIHEL**	**non-native**	**0**	**0**
Equisetum arvense	common horsetail	EQUARV	native	0	0
Equisetum fluviatile	water horsetail	EQUFLU	native	7	-5
Equisetum scirpoides	dwarf scouring rush	EQUSCI	native	7	0
Equisetum sylvaticum	woodland horsetail	EQUSYL	native	5	-3
Fraxinus nigra	black ash	FRANIG	native	6	-3
Fraxinus pennsylvanica	red ash	FRAPEN	native	2	-3
Galium palustre	marsh bedstraw	GALPAL	native	3	-5
Galium tinctorium	stiff bedstraw	GALTIN	native	5	-5
Galium triflorum	fragrant bedstraw	GALTRR	native	4	3
Gaultheria hispidula	creeping-snowberry	GAUHIS	native	8	-3
Glyceria striata	fowl manna grass	GLYSTR	native	4	-5
Gymnocarpium dryopteris	oak fern	GYMDRY	native	5	3
Hypericum perforatum	**common st. johns-wort**	**HYPPER**	**non-native**	**0**	**5**
Impatiens capensis	spotted touch-me-not	IMPCAP	native	2	-3
Iris versicolor	wild blue flag	IRIVER	native	5	-5
Larix laricina	tamarack	LARLAR	native	5	-3
Lemna turionifera	red duckweed	LEMTUR	native	5	-5
Linnaea borealis	twinflower	LINBOR	native	6	0
Lonicera canadensis	canadian fly honeysuckle	LONCAN	native	5	3
Lycopus uniflorus	northern bugle weed	LYCUNI	native	2	-5
Lysimachia terrestris	swamp-candles	LYSTER	native	6	-5
Lysimachia thyrsiflora	tufted loosestrife	LYSTHY	native	6	-5
Maianthemum canadense	canada mayflower	MAICAN	native	4	3
Matteuccia struthiopteris	ostrich fern	MATSTR	native	3	0
Mitella nuda	naked miterwort	MITNUD	native	8	-3
Moneses uniflora	one-flowered pyrola	MONEUN	native	8	0
Mycelis muralis	**wall lettuce**	**MYCMUR**	**non-native**	**0**	**5**
Nuphar advena	yellow pond-lily	NUPADV	native	8	-5
Onoclea sensibilis	sensitive fern	ONOSEN	native	2	-3
Orthilia secunda	one-sided pyrola	ORTSEC	native	7	0
Osmunda cinnamomea	cinnamon fern	OSMCIN	native	5	-3
Osmunda regalis	royal fern	OSMREG	native	5	-5
Persicaria amphibia	water smartweed	PERAMP	native	6	-5
Phegopteris hexagonoptera	broad beech-fern	PHEHEX	native	8	3
Picea glauca	white spruce	PICGLA	native	3	3

Appendix 2.6. Harbor Island Rich Conifer Swamp FQA (continued)

Scientific Name	Common Name	Acronym	Native?	C	W
Poa compressa	**canada bluegrass**	**POACOM**	**non-native**	**0**	**3**
Poa palustris	fowl meadow grass	POAPAS	native	3	-3
Poa pratensis	**kentucky bluegrass**	**POAPRA**	**non-native**	**0**	**3**
Polygala paucifolia	gay-wings	POLPAU	native	7	3
Populus balsamifera	balsam poplar	POPBAL	native	2	-3
Populus tremuloides	quaking aspen	POPTRE	native	1	0
Potamogeton natans	pondweed	POTNAT	native	5	-5
Ranunculus abortivus	small-flowered buttercup	RANABO	native	0	0
Ranunculus acris	**tall or common buttercup**	**RANACR**	**non-native**	**0**	**0**
Ranunculus recurvatus	hooked crowfoot	RANREC	native	5	-3
Ribes hirtellum	swamp gooseberry	RIBHIR	native	6	-3
Ribes lacustre	swamp black currant	RIBLAC	native	6	-3
Rubus pubescens	dwarf raspberry	RUBPUB	native	4	-3
Rubus strigosus	wild red raspberry	RUBSTR	native	2	0
Salix bebbiana	bebbs willow	SALBEB	native	1	-3
Scirpus atrovirens	bulrush	SCIATV	native	3	-5
Scirpus cyperinus	wool-grass	SCICYP	native	5	-5
Scutellaria galericulata	marsh skullcap	SCUGAL	native	5	-5
Scutellaria lateriflora	mad-dog skullcap	SCULAT	native	5	-5
Sium suave	water-parsnip	SIUSUA	native	5	-5
Sorbus americana	american mountain-ash	SORAME	native	4	0
Sorbus decora	mountain-ash	SORDEC	native	4	3
Sparganium fluctuans	bur-reed	SPAFLU	native	10	-5
Sphenopholis intermedia	slender wedgegrass	SPHINT	native	4	0
Symphyotrichum lateriflorum	calico aster	SYMLAT	native	2	0
Symphyotrichum puniceum	swamp aster	SYMPUN	native	5	-5
Taraxacum officinale	**common dandelion**	**TAROFF**	**non-native**	**0**	**3**
Taxus canadensis	yew	TAXCAN	native	5	3
Thelypteris noveboracensis	new york fern	THENOV	native	5	0
Thelypteris palustris	marsh fern	THEPAL	native	2	-3
Thuja occidentalis	arbor vitae	THUOCC	native	4	-3
Trientalis borealis	star-flower	TRIBOR	native	5	0
Trillium grandiflorum	common trillium	TRIGRA	native	5	3
Typha latifolia	broad-leaved cat-tail	TYPLAT	native	1	-5
Urtica dioica	stinging nettle	URTDIO	native	1	0
Vaccinium macrocarpon	large cranberry	VACMAC	native	8	-5
Veronica officinalis	**common speedwell**	**VEROOF**	**non-native**	**0**	**3**
Veronica serpyllifolia	**thyme-leaved speedwell**	**VERSER**	**non-native**	**0**	**0**
Viola blanda	sweet white violet	VIOBLA	native	5	-3
Viola cucullata	marsh violet	VIOCUC	native	5	-5
Viola labradorica	dog violet	VIOLAB	native	3	0
Viola renifolia	kidney-leaved violet	VIOREN	native	6	-3

Appendix 3 - Ojibwe Names for Plants Observed on Harbor Island

This appendix includes a crosswalk between Ojibwe names, scientific names, and common English names for all species observed on Harbor Island that are listed in "Plants used by the Great Lakes Ojibwa" (Meeker et al. 1993). The crosswalk constitutes Appendix 3.1. In addition, in Appendix 3.2 we list the observed plants by their Ojibwe names indexed by the natural community types where they were recorded on Harbor Island.

Within the crosswalk, when multiple Ojibwe names are known for the same plant, the Ojibwe names are separated by a semi-colon. Many names were originally documented by non-Ojibwe speakers and the spellings of some of the names were not restored by Ojibwe speakers so are reproduced here phonetically (28; 24%). We indicate whether or not a plant has been restored. Note that we do not reproduce accents (diacritical marks) for names included only under a phonetic name in Meeker et al. (1993) and this may affect pronunciation (for example, some "s" = "zh"). Multiple scientific names separated by semi-colons indicate closely related species we have crosswalked to a single Ojibwe name. The first scientific name listed is the species listed in Meeker et al. (1993). If Meeker et al. (1993) lists a synonym or only includes a closely related species, then the scientific name used in Meeker et al. (1993) is listed in parentheses (*different but closely related species). Page numbers within the crosswalk indicate the page in Meeker et al. (1993) where the plant is referenced.

Appendix 3.1. Crosswalk between Ojibwe names and scientific and English names

Ojibwe Name	Restored	Page	Scientific Name	English Name
(gi)chigamiiwashk, -oon	Yes	112	*Juncus tenuis*	path rush
(gi)chi-mazaanashk	Yes	103	*Cirsium vulgare*	bull thistle
?bebaamaabiig; okaaadaak; waaboozojiibik	Yes	235	*Antennaria howellii (*A. neglecta)*	small pussytoes
aaboojigan	Yes	145	*Phragmites australis var. americanus*	reed
aagimaak	Yes	358	*Fraxinus pennsylvanica*	red ash
aagimaak; baapaagimaak	Yes	288	*Fragaria virginiana*	wild strawberry
aagimaak; wiisagaak	Yes	380	*Fraxinus nigra*	black ash
aandegobagoons; namepin; namewashkoons	Yes	343	*Mentha canadensis (M. arvensis)*	field mint
aandegopin	Yes	174	*Lycopus americanus; Lycopus uniflorus (*L. asper)*	common water horehound
agongosimin, -ag	Yes	217	*Maianthemum stellatum (Smilacina stellata)*	starry false solomons-seal
agongosimin, -an	Yes	177	*Persicaria amphibia (Polygonum amphibium)*	water smartweed
agongosimin, -an, -ag	Yes	326	*Linnaea borealis*	twinflower
agongosimizh (plant); agongosimin, -an (berry); agongosi(wi)jiibik; ginebigwashk	Yes	260	*Maianthemum canadense*	canada mayflower
ah-o-je-mahg (adjimag)	No	333	*Sorbus americana; Sorbus decora*	american mountain-ash
ajidamoowaanow	Yes	111	*Hepatica americana*	round-lobed hepatica
ajidamoowaanow; waabigwan	Yes	93	*Acer spicatum*	mountain maple
akandamoo	Yes	143	*Nuphar variegata*	yellow pond-lily
ana ' ganuck	No	378	*Diervilla lonicera*	bush-honeysuckle
anaakan; anaakanashk; (gi)chigamiiwashk, -oon	Yes	151	*Schoenoplectus tabernaemontani (Scirpus validus)*	softstem bulrush
aniib, -iig	Yes	310	*Ulmus americana*	american elm
aniibimin	Yes	204	*Vaccinium macrocarpon*	large cranberry
animozid	Yes	323	*Gaultheria hispidula*	creeping-snowberry
aninaandag, -oog; ininaandag, -oog; bigiwaandag, -oog; zhinbog, --g; zhingobaaandag, -oog; zhingob bigiwaandag	Yes	313	*Abies balsamea*	balsam fir
aninaatig, -oog	Yes	270	*Acer rubrum*	red maple
anungokauh	No	56	*Maianthemum racemosum (Smilacina racemosa)*	false spikenard

Appendix 3.1. Crosswalk between Ojibwe names and scientific and English names (continued)

Ojibwe Name	Restored	Page	Scientific Name	English Name
apakwanagemag; bapakwanagemag; zhingobiins; zhingwaak	Yes	219	*Picea mariana*	black spruce
apakway; apakweshk; apakweshkway; nabagashk	Yes	152	*Typha latifolia*	broad-leaved cat-tail
asa/isaweminagaawanzh (plant); asa/isawemin (berry)	Yes	256	*Prunus virginiana*	choke cherry
azaadi(i); azaadiins	Yes	253	*Populus tremuloides*	quaking aspen
azaadi(i); maanazaadi(i)	Yes	328	*Populus balsamifera*	balsam poplar
baasibagak; nameswashk; namewashkoons	Yes	120	*Potentilla norvegica*	rough cinquefoil
bagizowin; zesab	Yes	156	*Asclepias incarnata*	swamp milkweed
bagwajipin, iig; baasibagak	Yes	249	*Juniperus communis*	common or ground juniper
bawa'iminaan; gozigwaakomin, -ag	Yes	329	*Prunus pensylvanica*	pin cherry
bebezhigooganshii-mashkiki	Yes	172	*Lathyrus palustris*	marsh pea
bima ' kwit wa 'bigons	No	365	*Menispermum canadense*	moonseed
bine(wi)bag	Yes	223	*Pyrola americana (P. rotundifolia)*	round-leaved pyrola
bine(wi)bag; gidagi-bineobag; mashkiigojiibik	Yes	199	*Comarum palustre (Potentilla palustris)*	marsh cinquefoil
cigona ' gan	No	250	*Cornus sericea*	red-osier
doodooshaaboojiibik; mindimooyenh	Yes	134	*Taraxacum officinale*	common dandelion
gaagaagiwanzh; zesegaandag; zhingob; zhingob gaawaandag	Yes	382	*Pastinaca sativa*	wild parsnip
gaagigebag	Yes	15	*Anemone cylindrica*	thimbleweed
gaanda'igwaasoning ezhinaagwak	Yes	206	*Amelanchier arborea; A. interior; A. sanguinea (*A. laevis)*	juneberry
gaawaandag; gaawaandagwaatig; mina'ig; wadab; zesegaandag	Yes	327	*Picea glauca*	white spruce
gaie 'wuckuk	No	150	*Scirpus cyperinus*	wool-grass
gichi-ode'iminijiibik	Yes	49	*Polygonatum pubescens*	downy solomon seal
gickensine ' namukuk	Yes	240	*Betula alleghaniensis*	yellow birch
giizhigaandagizi; ogaawa/inzh	Yes	43	*Juncus effusus*	soft-stemmed rush
giizhik, -ag; gizhikens, -ag; giizhikenh	Yes	387	*Scutellaria galericulata*	marsh skullcap
ginoozhewashk; ozawijiibik; zhiiwibag	Yes	127	*Rumex crispus*	curly dock
gozwgwaakominagaawanzh (plant); gozigwaakomin, -ag (berry); ozagadigom; zazigaakominagaawamzh	Yes	231	*Actaea rubra*	red baneberry
ini ' niwin ' dibige ' gun'; baushkindjibgwaun	No	308	*Trillium grandiflorum*	common trillium

Appendix 3.1. Crosswalk between Ojibwe names and scientific and English names (continued)

Ojibwe Name	Restored	Page	Scientific Name	English Name
ininiwa/inzh; zhaabozigan	Yes	99	*Asclepias syriaca*	common milkweed
ishkodewijiibik	Yes	101	*Caltha palustris*	marsh-marigold
jasibonskok; aiankosing; gezibnusk; giji ' binusk	No	107	*Dryopteris cristata*	crested shield fern
maananoons, -ag	Yes	297	*Nymphaea odorata*	sweet-scented waterlily
mashkiigwaatig	Yes	381	*Larix laricina*	tamarack
mashkode-miizhimizh; mitigomizh; wiisagi-mitigomizh	Yes	304	*Quercus rubra*	red oak
mauwidaekwaegozeediwushk	No	139	*Lathyrus ochroleucus*	pale vetchling
mazaan; mazaanaatig	Yes	373	*Thuja occidentalis*	arbor vitae
mazaanashk	Yes	102	*Cirsium arvense*	canada thistle
midewijiibik	Yes	155	*Anemone canadensis*	canada anemone
midodjidamo ' anuk	No	17	*Turritis glabra (Arabis glabra)*	tower mustard
migiziibag; migiziwibag; naemgosibag	Yes	237	*Erigeron strigosus; E. annus*	daisy fleabane
miinagaawanzh (plant); miin, -an (berry)	Yes	227	*Vaccinium angustifolium*	low sweet blueberry
miskominagaawanzh; miskwiminagaawanzh; miskomin, -ag; miskimin, -ag	Yes	125	*Rubus pubescens*	dwarf raspberry
miskoobimizh; miskwaabiimizh	Yes	340	*Cornus canadensis*	bunchberry
moozomizh	Yes	314	*Verbena hastata*	blue vervain
naaniibide'oodegin	Yes	303	*Polygala paucifolia*	gay-wings
nabagashk; wiikenh; zhaabozigan	Yes	170	*Iris versicolor*	wild blue flag
naubishkaukoot	No	129	*Sisyrinchium montanum*	mountain blue-eyed-grass
nawo 'buguk; wunukibugauh	No	336	*Trientalis borealis*	star-flower
nbiish-waawaasgone; gauwaukmeesh	No	142	*Nuphar advena*	yellow pond-lily
ne 'bagandag '; pebamabid-singup	No	335	*Taxus canadensis*	yew
neezhodaeyun	No	325	*Lemna minor; L. turionifera*	common or red duckweed
niya 'wibukuk '; siabuksing, sasabwaksing; piskagamisag	No	163	*Eupatorium perfoliatum*	boneset
nookwezigan	Yes	71	*Erigeron philadelphicus*	philadelphia fleabane
nookwezigan	Yes	161	*Equisetum sylvaticum*	woodland horsetail
ode'imin, -an; ode'iminijiibik	Yes	109	*Eurybia macrophylla (Aster macrophyllus)*	big-leaved aster
ode'iminijiibik; zhakaagomin; zhaashaagomin; zhaashaagominens	Yes	319	*Coptis trifolia*	goldthread
oga ' da mun; odite 'abug	No	141	*Melampyrum lineare*	cow-wheat
oginiiminagaawanzh	Yes	82	*Rosa acicularis*	wild rose
ogitebag	Yes	158	*Botrypus virginianus (Botrychium virginianum)*	rattlesnake fern

Appendix 3.1. Crosswalk between Ojibwe names and scientific and English names (continued)

Ojibwe Name	Restored	Page	Scientific Name	English Name
ojiibikens; waashkobijiibikak; wiishkbobijiibik	Yes	316	*Achillea millefolium*	yarrow
ojiibwe ' owe ' cuwun	No	165	*Galium tinctorium*	stiff bedstraw
ozaawaajiibik; ozaawijiibik	Yes	375	*Conyza canadensis*	horseweed
ozaawashkojiibik	Yes	360	*Impatiens capensis*	spotted touch-me-not
papshkisiganak; papskatciksi ' gana 'tig	Yes	305	*Sambucus racemosa*	red-berried elder
pigwe 'wunusk	No	118	*Ostrya virginiana*	ironwood; hop-hornbeam
pis-naknishkuns	No	171	*Hordeum jubatum*	squirrel-tail grass
siba ' muckun	Yes	320	*Equisetum arvense*	common horsetail
sus-sabu-min	No	383	*Ribes hirtellum*	swamp gooseberry
tcatcabonu ' ksik; zheebaunkudohnse	No	182	*Rubus strigosus (R. idaeus)*	wild red raspberry
tikizidgeebikohnse	Yes	24	*Pinus strobus*	white pine
wa 'sawasni 'mike	No	175	*Myrica gale*	sweet gale
waabigwan	Yes	104	*Capsella bursa-pastoris*	shepherds-purse
waabigwan; baasibagak	Yes	14	*Anaphalis margaritacea*	pearly everlasting
waabiziipin	Yes	149	*Sagittaria graminea (*S. latifolia)*	grass-leaved arrowhead
waaboozobagoons; waaboozobanzh	Yes	42	*Galium trifidum*	small bedstraw
waboskiki ' minun	No	164	*Fraxinus americana*	white ash
wadoop, -iin	Yes	339	*Alnus incana*	speckled alder
wewai ' bugug	Yes	338	*Viola labradorica (V. conspersa)*	dog violet
wezauskwagmik; osawa ' skanet	No	245	*Dendrolycopodium obscurum; D. dendroideum (*Lycopodium o.)*	ground-pine
wiigwaas, -an, -ag; wiigwaasaatig; wiigwaasi-mitig; wiigwaasimizh	Yes	239	*Betula papyrifera*	paper birch
wiiniziikens	Yes	157	*Symphyotrichum puniceum; S. firmum (Aster puniceus)*	swamp aster
wiinizik	Yes	277	*Aralia nudicaulis*	wild sarsaparilla
zhaashaagobiimag	Yes	315	*Acer saccharum*	sugar maple
zhawaseshkoohnse	No	186	*Urtica dioica*	stinging nettle
zhiishiiginewanzh, iig; zhiishiigimiiwanzh, -iig	Yes	229	*Acer pensylvanicum*	striped maple
zhingwaak	Yes	220	*Pinus resinosa*	red pine
No name given (*P. vulgaris*)	No	180	*Prunella vulgaris*	self-heal

Appendix 3.2. Ojibwe plant names indexed by natural community type.

Ojibwe Name	Scientific Name	English Name	Boreal Forest	Dry-mesic Northern Forest	Great Lakes Marsh	Limestone Cobble Shore	Mesic Northern Forest	Rich Conifer Swamp
(gi)chigamiiwashk, -oon	*Juncus tenuis*	path rush				X		
(gi)chi-mazaanashk	*Cirsium vulgare*	bull thistle	X		X	X	X	
?bebaamaabiig; okaaadaak; waaboozojiibik	*Antennaria howellii (*A. neglecta)*	small pussytoes						
aaboojigan	*Phragmites australis var. americanus*	reed			X			
aagimaak	*Fraxinus pennsylvanica*	red ash	X		X	X	X	X
aagimaak; baapaagimaak	*Fragaria virginiana*	wild strawberry	X					
aagimaak; wiisagaak	*Fraxinus nigra*	black ash	X	X	X			X
aandegobagoons; namepin; namewashkoons	*Mentha canadensis (M. arvensis)*	field mint	X		X			
aandegopin	*Lycopus americanus; Lycopus uniflorus (*L. asper)*	common water horehound			X	X		X
agongosimin, -ag	*Maianthemum stellatum (Smilacina stellata)*	starry false solomons-seal		X				
agongosimin, -an	*Persicaria amphibia (Polygonum amphibium)*	water smartweed			X	X		
agongosimin, -an, -ag	*Linnaea borealis*	twinflower	X					X
agongosimizh (plant); agongosimin, -an (berry); agongosi(wi)jiibik; ginebigwashk	*Maianthemum canadense*	canada mayflower	X	X			X	X
ah-o-je-mahg (adjimag)	*Sorbus americana; Sorbus decora*	american mountain-ash	X					X
ajidamoowaanow	*Hepatica americana*	round-lobed hepatica	X					
ajidamoowaanow; waabigwan	*Acer spicatum*	mountain maple	X					X
akandamoo	*Nuphar variegata*	yellow pond-lily			X			
ana ' ganuck	*Diervilla lonicera*	bush-honeysuckle	X					X
anaakan; anaakanashk; (gi)chigamiiwashk, -oon	*Schoenoplectus tabernaemontani (Scirpus validus)*	softstem bulrush			X	X		
aniib, -iig	*Ulmus americana*	american elm				X		
aniibimin	*Vaccinium macrocarpon*	large cranberry						X
animozid	*Gaultheria hispidula*	creeping-snowberry						X
aninaandag, -oog; ininaandag, -oog; bigiwaandag, -oog; zhinbog, --g; zhingobaaandag, -oog; zhingob bigiwaandag	*Abies balsamea*	balsam fir	X	X	X	X	X	X
aninaatig, -oog	*Acer rubrum*	red maple		X	X	X	X	X
anungokauh	*Maianthemum racemosum (Smilacina racemosa)*	false spikenard	X				X	
apakwanagemag; bapakwanagemag; zhingobiins; zhingwaak	*Picea mariana*	black spruce						X
apakway; apakweshk; apakweshkway; nabagashk	*Typha latifolia*	broad-leaved cat-tail			X	X		X

Appendix 3.2. Ojibwe plant names indexed by natural community type (continued).

Ojibwe Name	Scientific Name	English Name	Boreal Forest	Dry-mesic Northern Forest	Great Lakes Marsh	Limestone Cobble Shore	Mesic Northern Forest	Rich Conifer Swamp
asa/isaweminagaawanzh (plant); asa/isawemin (berry)	*Prunus virginiana*	choke cherry	X					
azaadi(i); azaadiins	*Populus tremuloides*	quaking aspen	X	X		X	X	X
azaadi(i); maanazaadi(i)	*Populus balsamifera*	balsam poplar	X	X	X	X	X	
baasibagak; nameswashk; namewashkoons	*Potentilla norvegica*	rough cinquefoil			X	X		
bagizowin; zesab	*Asclepias incarnata*	swamp milkweed			X			
bagwajipin, iig; baasibagak	*Juniperus communis*	common or ground juniper		X			X	
bawa'iminaan; gozigwaakomin, -ag	*Prunus pensylvanica*	pin cherry	X				X	
bebezhigooganshii-mashkiki	*Lathyrus palustris*	marsh pea			X	X		
bima ' kwit wa 'bigons	*Menispermum canadense*	moonseed				X		
bine(wi)bag	*Pyrola americana (P. rotundifolia)*	round-leaved pyrola	X					
bine(wi)bag; gidagi-bineobag; mashkiigojiibik	*Comarum palustre (Potentilla palustris)*	marsh cinquefoil			X			
cigona ' gan	*Cornus sericea*	red-osier	X					X
doodooshaaboojiibik; mindimooyenh	*Taraxacum officinale*	common dandelion	X	X		X	X	X
gaagaagiwanzh; zesegaandag; zhingob; zhingob gaawaandag	*Pastinaca sativa*	wild parsnip						
gaagigebag	*Anemone cylindrica*	thimbleweed						
gaanda'igwaasoning ezhinaagwak	*Amelanchier arborea; A. interior; A. sanguinea (*A. laevis)*	juneberry	X					
gaawaandag; gaawaandagwaatig; mina'ig; wadab; zesegaandag	*Picea glauca*	white spruce	X	X		X	X	X
gaie 'wuckuk	*Scirpus cyperinus*	wool-grass			X			X
gichi-ode'iminijiibik	*Polygonatum pubescens*	downy solomon seal	X				X	
gickensine ' namukuk	*Betula alleghaniensis*	yellow birch	X					X
giizhigaandagizi; ogaawa/inzh	*Juncus effusus*	soft-stemmed rush			X	X		
giizhik, -ag; gizhikens, -ag; giizhikenh	*Scutellaria galericulata*	marsh skullcap			X	X	X	X
ginoozhewashk; ozawijiibik; zhiiwibag	*Rumex crispus*	curly dock				X		
gozwgwaakominagaawanzh (plant); gozigwaakomin, -ag (berry); ozagadigom; zazigaakominagaawamzh	*Actaea rubra*	red baneberry		X				
ini ' niwin ' dibige ' gun'; baushkindjibgwaun	*Trillium grandiflorum*	common trillium					X	X
ininiwa/inzh; zhaabozigan	*Asclepias syriaca*	common milkweed					X	
ishkodewijiibik	*Caltha palustris*	marsh-marigold						X
jasibonskok; aiankosing; gezibnusk; giji ' binusk	*Dryopteris cristata*	crested shield fern						X
maananoons, -ag	*Nymphaea odorata*	sweet-scented waterlily			X			
mashkiigwaatig	*Larix laricina*	tamarack				X		
mashkode-miizhimizh; mitigomizh; wiisagi-mitigomizh	*Quercus rubra*	red oak		X			X	
mauwidaekwaegozeediwushk	*Lathyrus ochroleucus*	pale vetchling	X				X	

Appendix 3.2. Ojibwe plant names indexed by natural community type (continued).

Ojibwe Name	Scientific Name	English Name	Boreal Forest	Dry-mesic Northern Forest	Great Lakes Marsh	Limestone Cobble Shore	Mesic Northern Forest	Rich Conifer Swamp
mazaan; mazaanaatig	*Thuja occidentalis*	arbor vitae	X	X	X	X	X	X
mazaanashk	*Cirsium arvense*	canada thistle	X		X	X	X	
midewijiibik	*Anemone canadensis*	canada anemone				X		
midodjidamo ' anuk	*Turritis glabra (Arabis glabra)*	tower mustard						
migiziibag; migiziwibag; naemgosibag	*Erigeron strigosus; E. annus*	daisy fleabane			X	X		
miinagaawanzh (plant); miin, -an (berry)	*Vaccinium angustifolium*	low sweet blueberry		X				
miskominagaawanzh; miskwiminagaawanzh; miskomin, -ag; miskimin, -ag	*Rubus pubescens*	dwarf raspberry						X
miskoobimizh; miskwaabiimizh	*Cornus canadensis*	bunchberry						X
moozomizh	*Verbena hastata*	blue vervain			X	X		
naaniibide'oodegin	*Polygala paucifolia*	gay-wings	X	X				X
nabagashk; wiikenh; zhaabozigan	*Iris versicolor*	wild blue flag	X		X	X		X
naubishkaukoot	*Sisyrinchium montanum*	mountain blue-eyed-grass				X		
nawo 'buguk; wunukibugauh	*Trientalis borealis*	star-flower	X	X			X	X
nbiish-waawaasgone; gauwaukmeesh	*Nuphar advena*	yellow pond-lily						X
ne 'bagandag '; pebamabid-singup	*Taxus canadensis*	yew	X					X
neezhodaeyun	*Lemna minor; L. turionifera*	common or red duckweed			X			X
niya 'wibukuk '; siabuksing, sasabwaksing; piskagamisag	*Eupatorium perfoliatum*	boneset			X			
nookwezigan	*Erigeron philadelphicus*	philadelphia fleabane				X		
nookwezigan	*Equisetum sylvaticum*	woodland horsetail						X
ode'imin, -an; ode'iminijiibik	*Eurybia macrophylla (Aster macrophyllus)*	big-leaved aster					X	
ode'iminijiibik; zhakaagomin; zhaashaagomin; zhaashaagominens	*Coptis trifolia*	goldthread						X
oga ' da mun; odite 'abug	*Melampyrum lineare*	cow-wheat		X				
oginiiminagaawanzh	*Rosa acicularis*	wild rose					X	
ogitebag	*Botrypus virginianus (Botrychium virginianum)*	rattlesnake fern	X				X	
ojiibikens; waashkobijiibikak; wiishkbobijiibik	*Achillea millefolium*	yarrow						
ojiibwe ' owe ' cuwun	*Galium tinctorium*	stiff bedstraw						
ozaawaajiibik; ozaawijiibik	*Conyza canadensis*	horseweed				X		
ozaawashkojiibik	*Impatiens capensis*	spotted touch-me-not			X	X		X
papshkisiganak; papskatciksi ' gana 'tig	*Sambucus racemosa*	red-berried elder	X				X	
pigwe 'wunusk	*Ostrya virginiana*	ironwood; hop-hornbeam				X	X	
pis-naknishkuns	*Hordeum jubatum*	squirrel-tail grass				X		X
siba ' muckun	*Equisetum arvense*	common horsetail	X			X		X
sus-sabu-min	*Ribes hirtellum*	swamp gooseberry						X

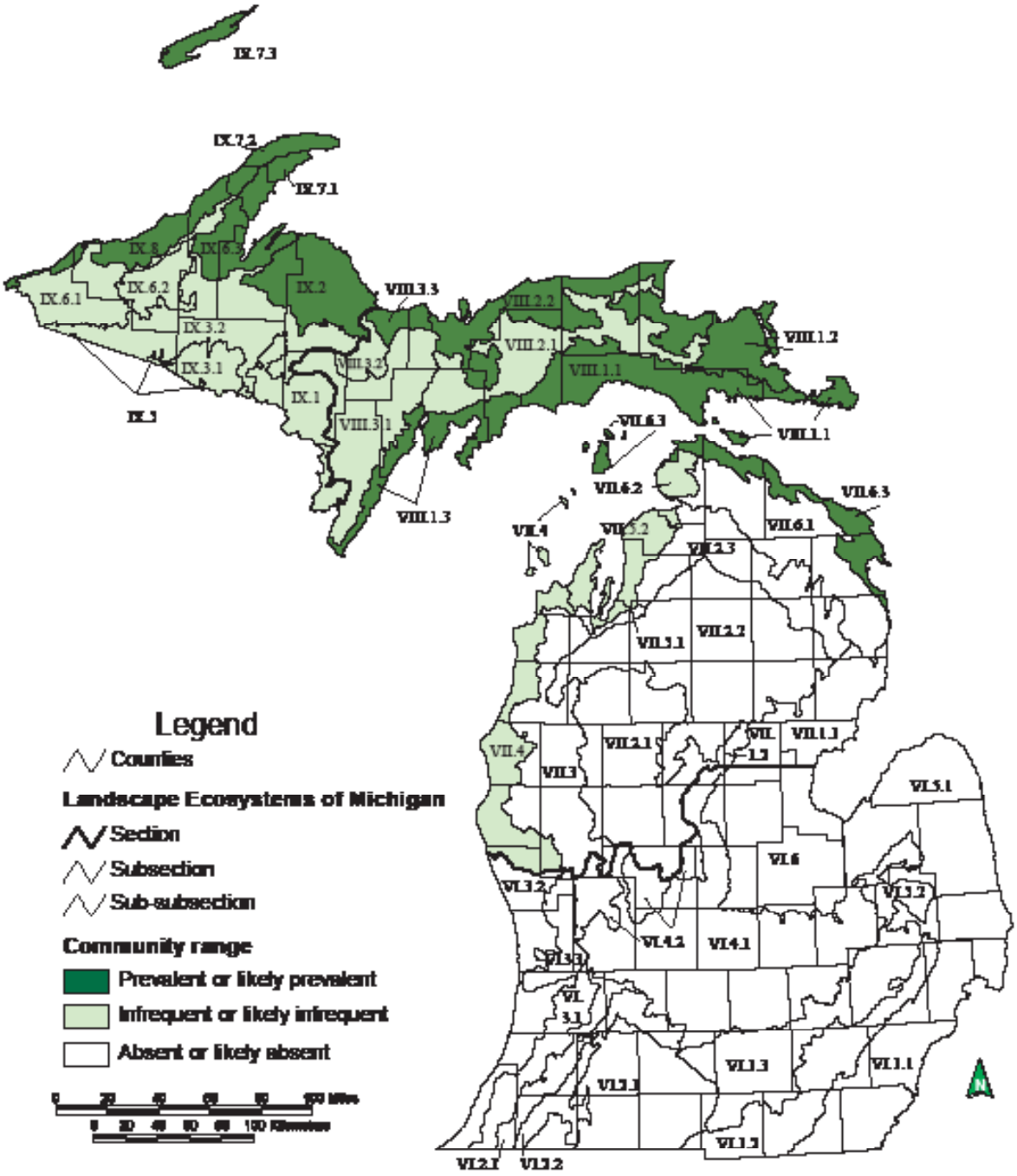
Appendix 3.2. Ojibwe plant names indexed by natural community type (continued).

Ojibwe Name	Scientific Name	English Name	Boreal Forest	Dry-mesic Northern Forest	Great Lakes Marsh	Limestone Cobble Shore	Mesic Northern Forest	Rich Conifer Swamp
tcatcabonu ' ksik; zheebaunkudohnse	*Rubus strigosus (R. idaeus)*	wild red raspberry	X			X	X	X
tikizidgeebikohnse	*Pinus strobus*	white pine	X	X			X	
wa 'sawasni 'mike	*Myrica gale*	sweet gale			X	X		
waabigwan	*Capsella bursa-pastoris*	shepherds-purse			X			
waabigwan; baasibagak	*Anaphalis margaritacea*	pearly everlasting	X			X	X	
waabiziipin	*Sagittaria graminea (*S. latifolia)*	grass-leaved arrowhead			X			
waaboozobagoons; waaboozobanzh	*Galium trifidum*	small bedstraw						X
waboskiki ' minun	*Fraxinus americana*	white ash	X				X	
wadoop, -iin	*Alnus incana*	speckled alder			X			
wewai ' bugug	*Viola labradorica (V. conspersa)*	dog violet	X			X	X	X
wezauskwagmik; osawa ' skanet	*Dendrolycopodium obscurum; D. dendroideum (*Lycopodium o.)*	ground-pine	X				X	
wiigwaas, -an, -ag; wiigwaasaatig; wiigwaasi-mitig; wiigwaasimizh	*Betula papyrifera*	paper birch	X	X	X	X	X	X
wiiniziikens	*Symphyotrichum puniceum; S. firmum (Aster puniceus)*	swamp aster				X		
wiinizik	*Aralia nudicaulis*	wild sarsaparilla	a					X
zhaashaagobiimag	*Acer saccharum*	sugar maple	X	X		X	X	
zhawaseshkoohnse	*Urtica dioica*	stinging nettle	X			X	X	X
zhiishiiginewanzh, iig; zhiishiigimiiwanzh, -iig	*Acer pensylvanicum*	striped maple	X					X
zhingwaak	*Pinus resinosa*	red pine		X			X	
No name given (*P. vulgaris*)	*Prunella vulgaris*	self-heal						

Appendix 4 - Natural Community Overviews and Distribution Maps

BOREAL FOREST

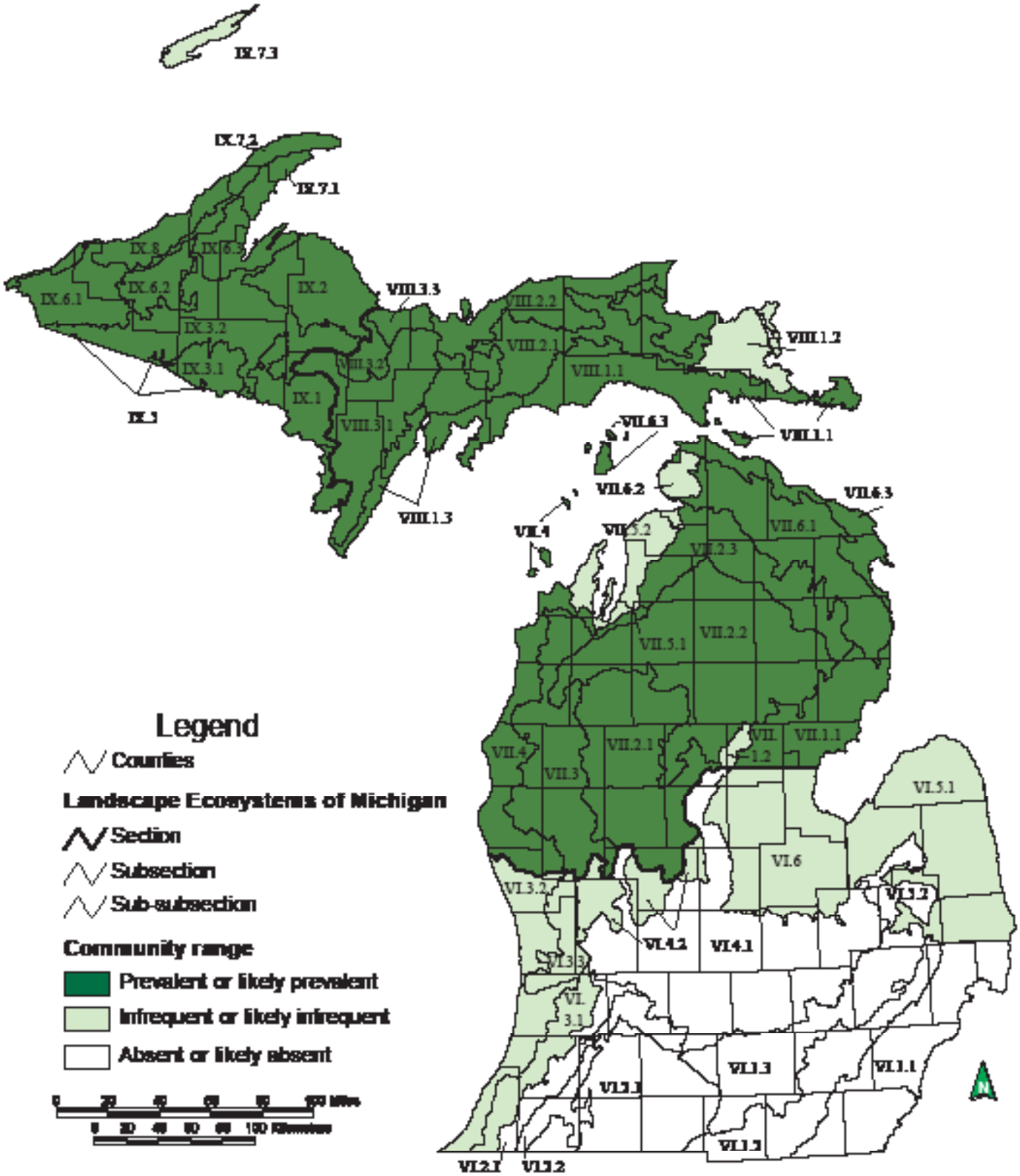
Overview: Boreal forest is a conifer or conifer-hardwood forest type occurring on moist to dry sites characterized by species dominant in the Canadian boreal forest. It typically occupies upland sites along shores of the Great Lakes, on islands in the Great Lakes, and locally inland. The community occurs 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, Cohen et al. 2015).



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

DRY-MESIC NORTHERN FOREST

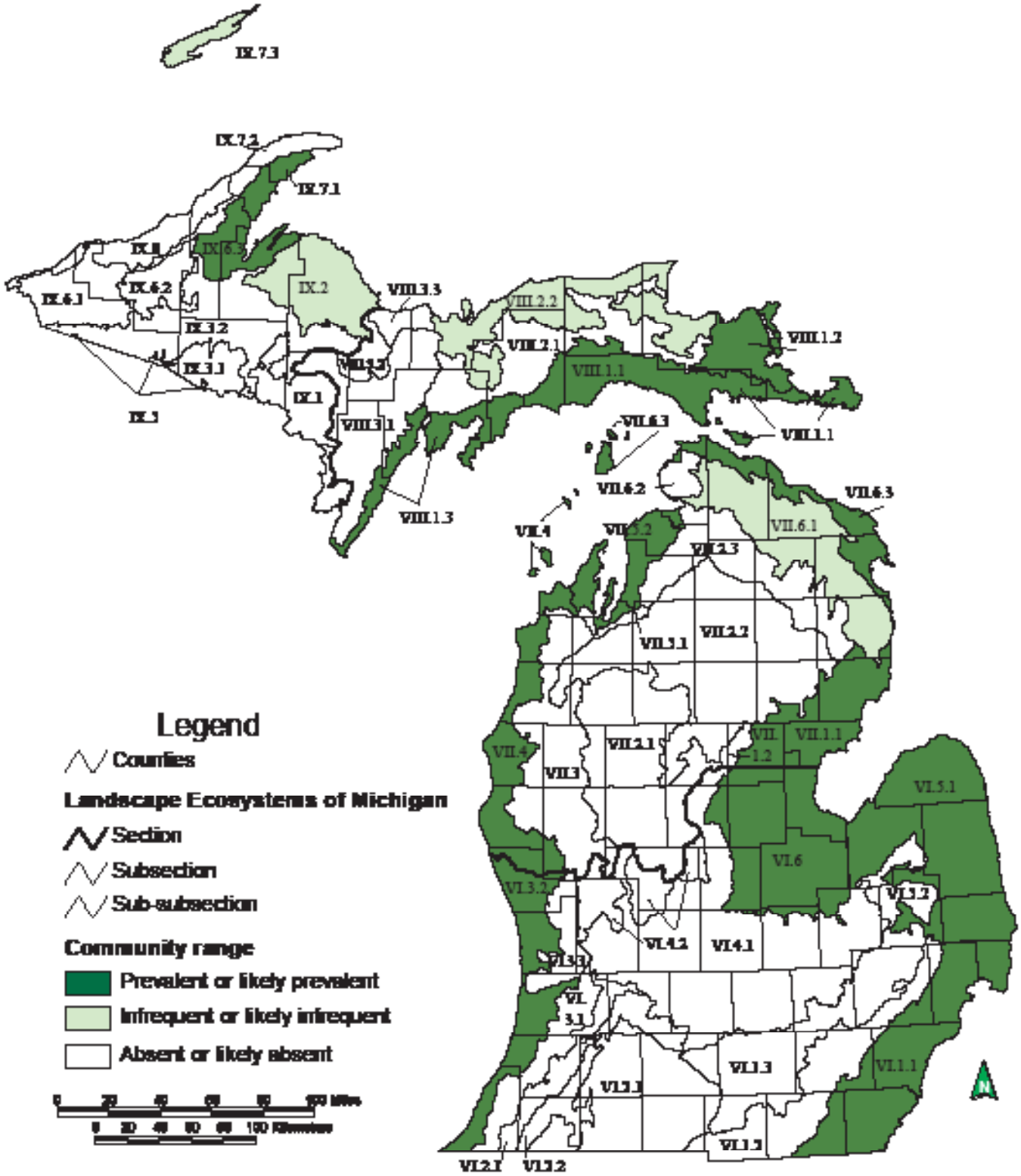
Overview: Dry-mesic northern forest is a pine or pine-hardwood forest type of generally dry-mesic sites located mostly north of the transition zone. Dry-mesic northern forest is characterized by acidic, coarse- to medium-textured sand or loamy sand and occurs principally on sandy glacial outwash, sandy 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 ground fires (Kost et al. 2007, Cohen et al. 2015).



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

GREAT LAKES MARSH

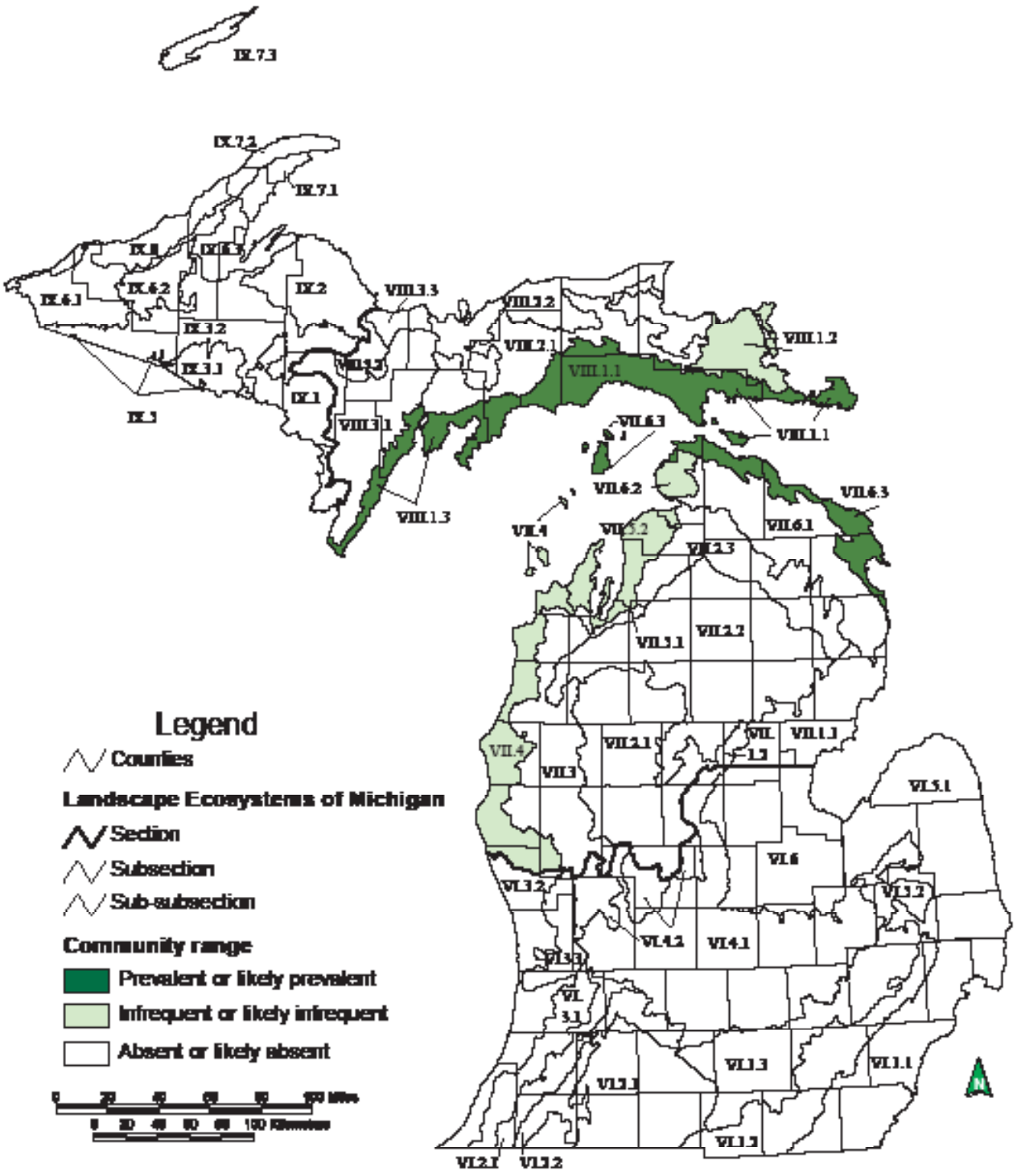
Overview: Great Lakes marsh is an herbaceous wetland community occurring statewide along the shoreline of the Great Lakes and their major connecting rivers. Vegetational patterns are strongly influenced by water level fluctuations and type of coastal feature, but generally include the following: a deep 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, Cohen et al. 2015).



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

LIMESTONE COBBLE SHORE

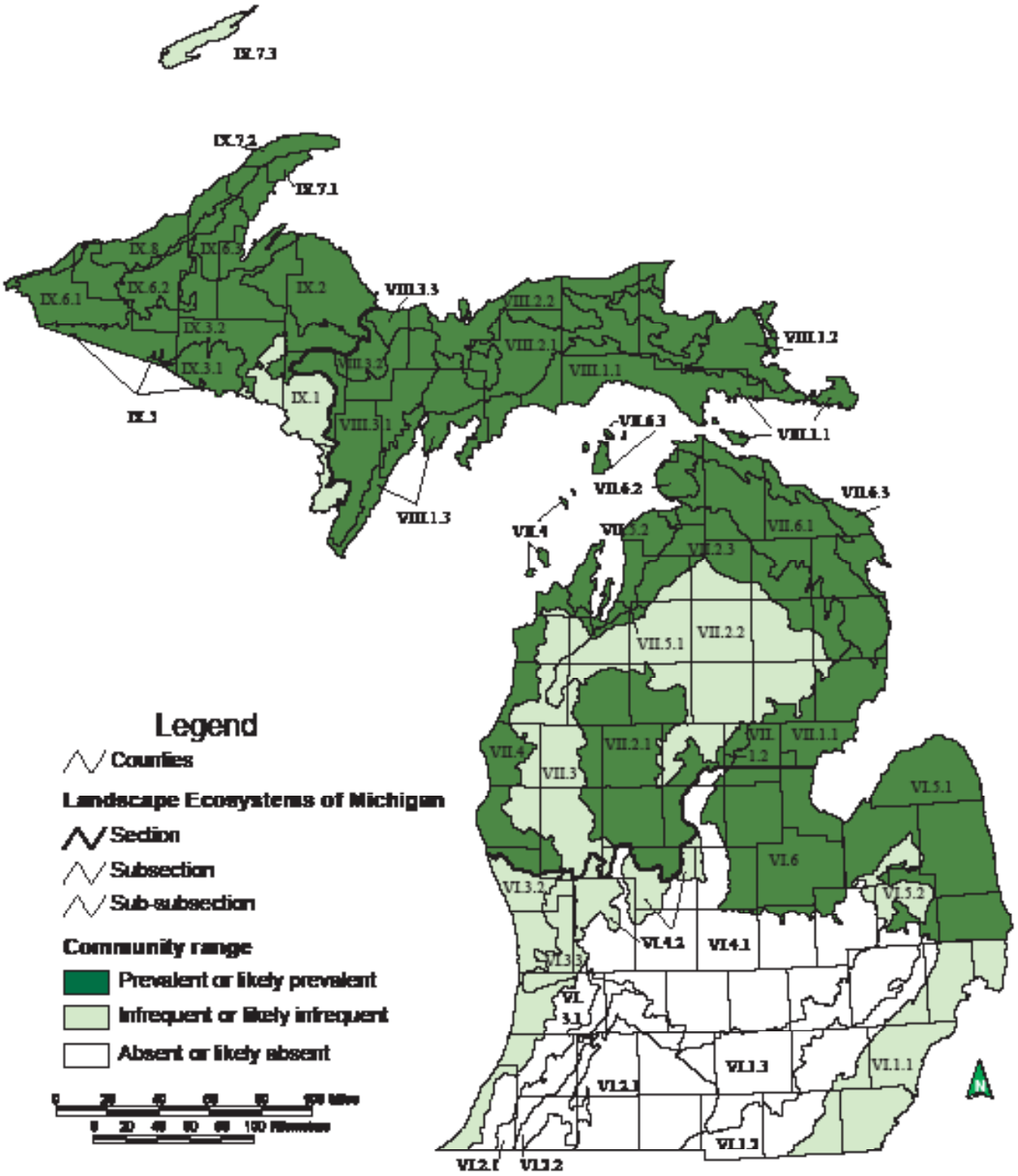
Overview: Limestone cobble shore occurs along gently sloping shorelines of Lake Michigan and Lake Huron. The community is studded with cobbles and boulders and is frequently inundated by storms and periods of high water. Limestone cobble shore is typically sparsely vegetated, because cobbles cover most of the surface and storm waves and ice scour prevent the development of a diverse, persistent plant community. Soils are neutral to slightly alkaline mucks and sands that accumulate between cobbles and boulders. Limestone cobble shore is subject to seasonal fluctuations in Great Lakes water levels, short-term changes due to seiches and storm surges, and long-term, multi-year lake level fluctuations. Storm waves frequently disturb limestone cobble shore, reconfiguring the substrate and removing fine mineral sediments and organic soils. Long-term cyclic fluctuations of Great Lakes water levels significantly influence vegetation patterns of limestone cobble shore, with vegetation and organic soils becoming well established during low-water periods and reduced or eliminated during high-water periods (Kost et al. 2007, Cohen et al. 2015).



Map 4. Distribution of limestone cobble shore in Michigan (Albert et al. 2008).

MESIC NORTHERN FOREST

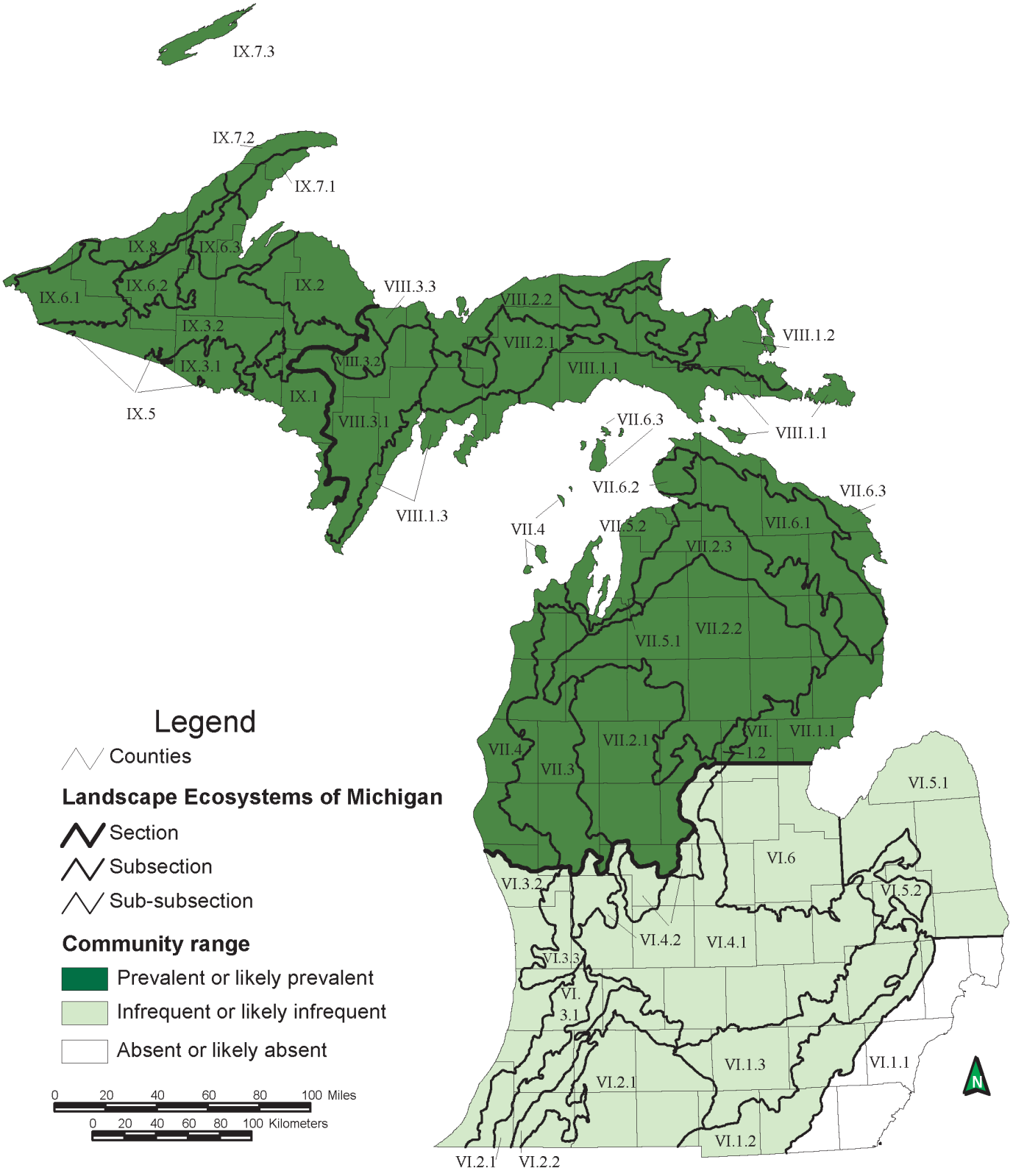
Overview: Mesic northern forest is a forest type of moist to dry-mesic sites lying mostly north of the climatic tension zone, characterized by the dominance of northern hardwoods, particularly sugar maple (*Acer saccharum*) and American beech (*Fagus grandifolia*). Conifers such as hemlock (*Tsuga canadensis*) 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 occurs 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, Cohen et al. 2015).



Map 5. Distribution of mesic northern forest in Michigan (Albert et al. 2008).

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. Seasonal water level fluctuations, beaver flooding, windthrow, and fire are all important forms of natural disturbance for rich conifer swamp. Although rich conifer swamp is primarily groundwater fed, seasonal water-level fluctuations are common with water levels highest in spring and lowest in late summer and fall. (Kost et al. 2007, Cohen et al. 2015).



Map 6. Distribution of rich conifer swamp in Michigan (Albert et al. 2008).