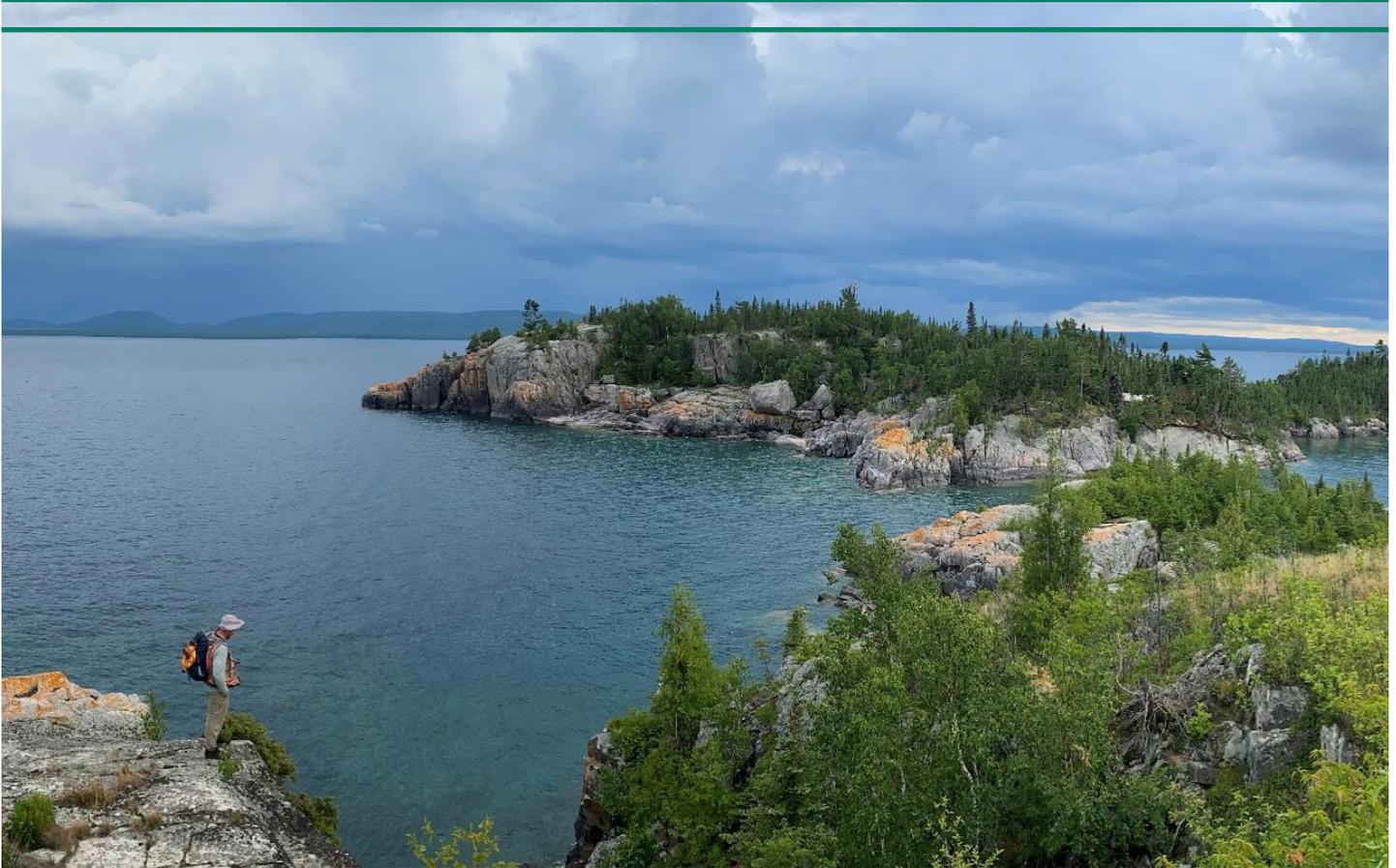


# Natural Community Surveys of Huron Islands, Seney National Wildlife Refuge, Lake Superior



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**Cover Photo:** Michigan Natural Features Inventory's ecologist Joshua Cohen surveying granite bedrock glade on West Huron Island with Cattle Island in the background. Photo by Jesse M. Lincoln.

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**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.

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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 (Figures 1 and 2), Harbor Island in Lake Huron, and Gull Island in Lake Michigan. In addition, forest plot sampling was conducted on the Huron Islands and Harbor Island (USFWS 2021a). This report focuses on



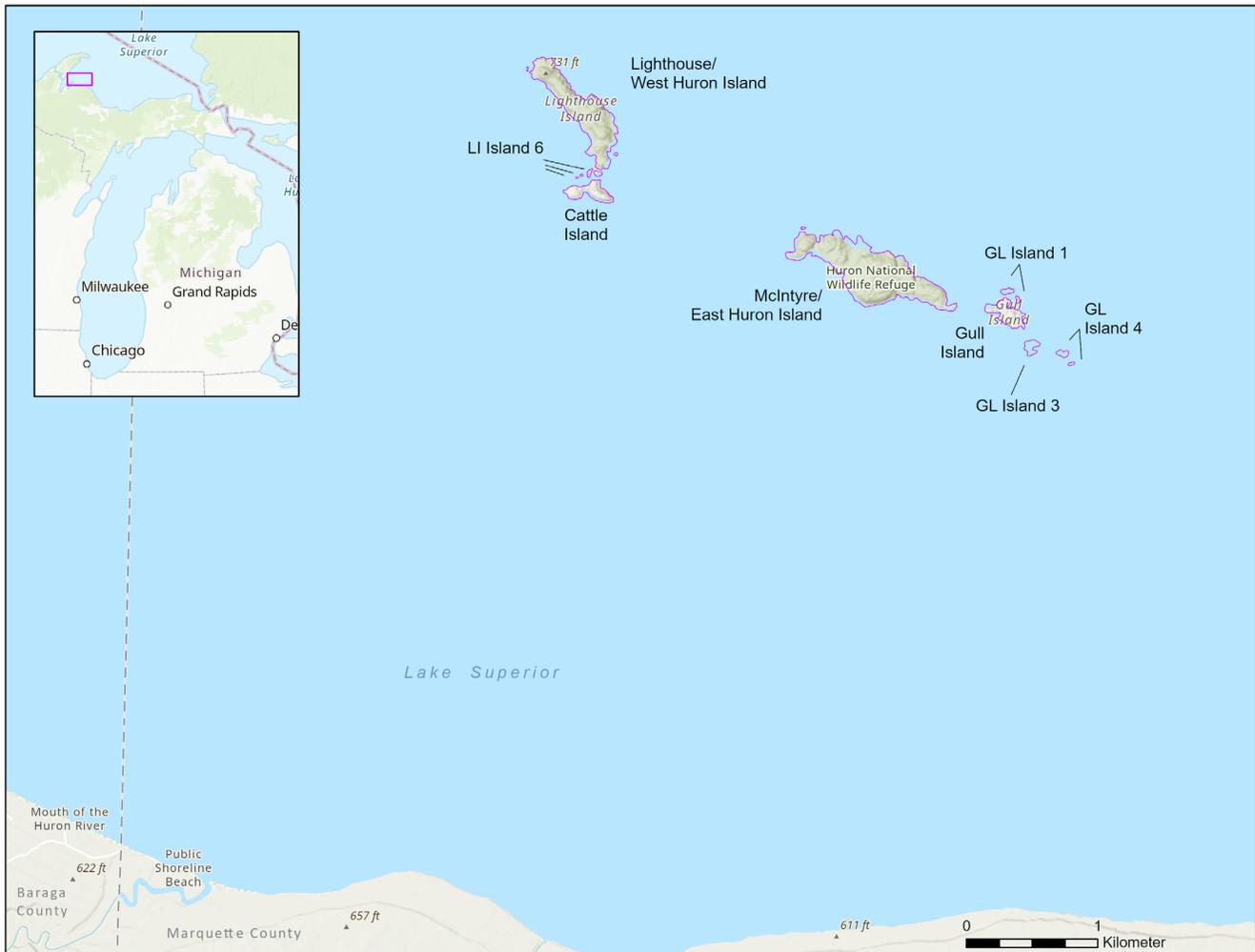
East Huron Island granite lakeshore cliff. Photo by Elizabeth A. Haber.

the natural community surveys conducted in 2022 in the Huron Islands National Wildlife Refuge. For information on the natural community surveys conducted on Gull Island (Lake Michigan), Harbor Island, 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 in the Huron 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 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 the Huron Islands.



**Figure 1.** Topographic map of the Huron Islands National Wildlife Refuge (GL = Gull and LI = Lighthouse).

# Methods

## Study Area

The Huron Islands are a group of 12 islands that occur in Lake Superior and comprise the Huron National Wildlife Refuge (Figures 1 and 2). These islands are composed of granitic outcroppings of Precambrian origin and are located about three miles north of the mouth of the Huron River in northwestern Marquette County. The islands are situated north of the Huron Mountain Club, east of Point Abbaye, and south and southwest of the Keweenaw Peninsula. The lakebed surrounding the Huron Islands is part of the Huron Islands Unit of the Marquette Underwater Preserve, providing strict protections for nearby shipwrecks and their artifacts. The Huron National Wildlife Refuge was established in 1905 as a refuge and breeding ground for migratory birds and other wildlife (Butcher 2008). Public access to the Huron Islands is prohibited with the exception of West Huron Island (Lighthouse Island), which is open for day use only.

Natural community surveys were conducted on the Huron Islands from August 15<sup>th</sup> through August 19<sup>th</sup>, and August 22<sup>nd</sup> through August 26<sup>th</sup>, 2022. Prior to this survey effort, the Huron Islands had never been surveyed by MNFI staff.

## Cattle Island

Cattle Island is approximately nine acres in size and is located in the western cluster of the Huron Islands, just south of West Huron Island. The interior of Cattle Island is characterized by granite bedrock glade that occurs on rugged topography. The shoreline of Cattle Island supports granite bedrock lakeshore and Michigan's third largest granite lakeshore cliff. Cattle Island occurs in close proximity to four small unnamed islands, the largest about 0.6 acres (0.2 ha). The eastern most island supports granite lakeshore cliff and the remaining three islands support granite bedrock lakeshore.



**Figure 2.** Aerial imagery of the Huron Islands National Wildlife Refuge (State of Michigan 2017) (GL = Gull and LI = Lighthouse)..

In 1860 the side-wheel steamer *Arctic*, which was carrying passengers and freight including cattle from Marquette to Portage Entry, ran aground on one of the western Huron Islands and began to sink. All the passengers and cattle made it safely ashore and were marooned for two days on what is now known as Cattle Island (The New York Times 1860).

#### East Huron Island (McIntyre Island)

East Huron Island or McIntyre Island is approximately 73 acres and is the largest island in the eastern cluster of islands. The interior of the island is characterized by intergrading granite bedrock glade and boreal forest that occur on rugged topography and the shoreline supports granite lakeshore cliff and granite bedrock lakeshore. The shoreline of East Huron Island supports granite bedrock lakeshore and Michigan's largest documented occurrence of granite lakeshore cliff.

#### Gull Island

Gull Island is approximately 9 acres in size and is located in the eastern cluster of islands approximately 0.15 miles east of East Huron Island. Gull Island is composed of three distinct and connected granitic knobs with each knob supporting granite bedrock glade. The knobs are separated by steep ravines that support early-successional boreal forest with localized wetland pockets. The shoreline of Gull Island supports granite lakeshore cliff and granite bedrock lakeshore. Gull Island occurs in close proximity to four unnamed islands. The northernmost island supports granite lakeshore cliff and the remaining three islands are unvegetated granite bedrock lakeshore. This complex of granitic islands provides critical nesting habitat for colonial nesting waterbirds, especially herring gulls (*Larus argentatus*) (USFWS 1978, Cuthbert and Wires 2011).



Looking east across granite bedrock glade and boreal forest on East Huron Island towards Gull Island and four unnamed islands to the southeast of Gull Island. Photo by Rachel A. Hackett.

### West Huron Island (Lighthouse Island)

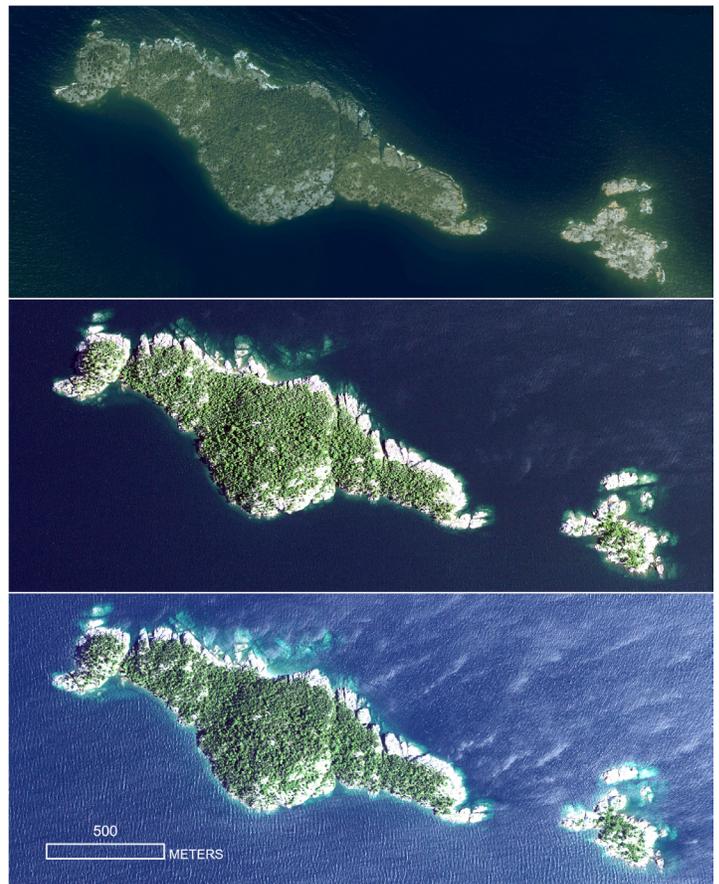
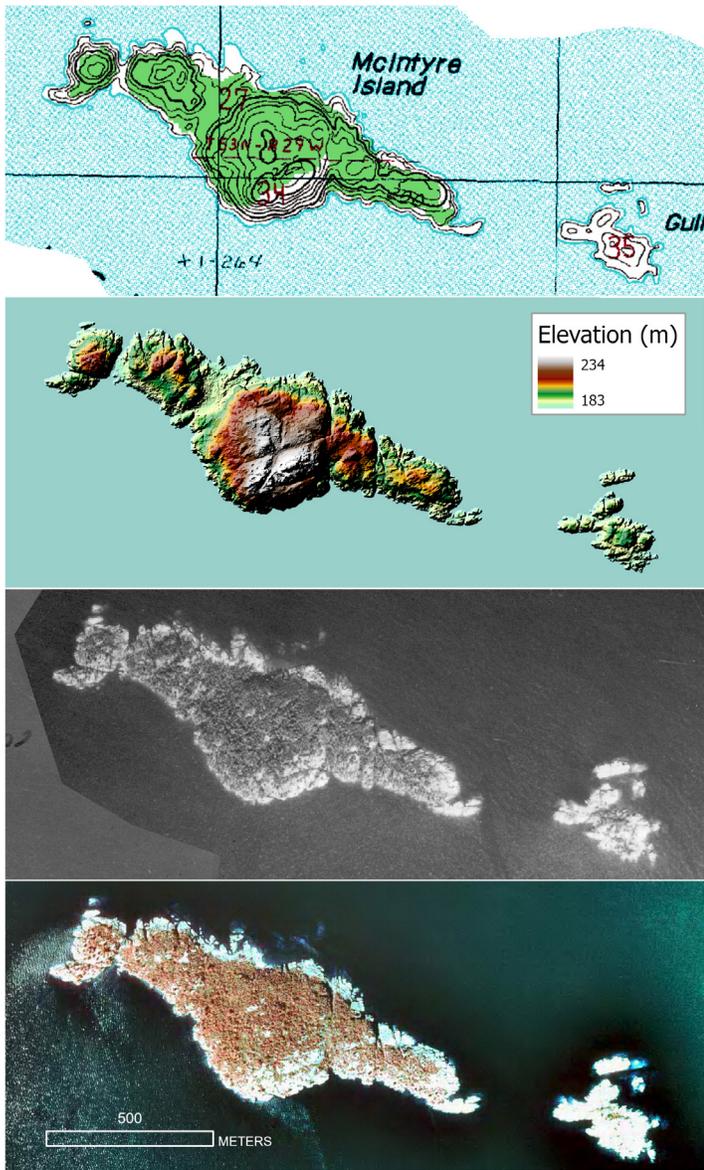
West Huron Island or Lighthouse Island is approximately 46 acres and is the largest island in the western cluster of islands. The interior of the island is characterized by intergrading boreal forest and granite bedrock glade that occur on rugged topography. The shoreline of West Huron Island supports granite bedrock lakeshore and Michigan's second largest documented occurrence of granite lakeshore cliff.

The Huron Islands are located along an important shipping channel for vessels entering Huron Bay, Keweenaw Bay, or Portage Entry. Often shrouded in fog, they constituted a navigational hazard during the copper and iron ore boom of the mid-nineteenth century and caused numerous shipwrecks. Because of the 1860 wreck of the *Arctic*, pressure to build a lighthouse on the Huron Islands intensified and a lighthouse was constructed in 1868 on the highest point of West Huron Island along with a privy and an oil house. In addition, a boat dock was constructed at

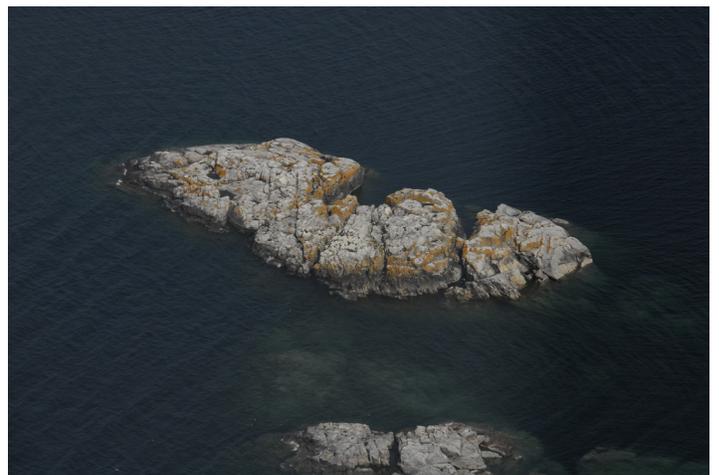
the southern end of the island and the dock and lighthouse were connected by a tramway (currently a pathway). Granite from the island was quarried to supplement the construction of the lighthouse and associated buildings, as well as the construction of a lighthouse on nearby Granite Island. Bridges spanning chasms along this tramway were constructed with paper birch (*Betula papyrifera*) harvested from the island. In addition, in 1876 and 1881 two fog signal buildings were constructed a half-mile away from the lighthouse along the northern end of the island and a pathway between the lighthouse and the fog signal buildings was also constructed. The lighthouse was electrified in 1939 and staffed from 1868 through 1972 until the light was automated (U.S. Coast Guard 2019). The light still functions as an active aid to navigation. While the lighthouse was occupied, selective logging for firewood and building materials likely occurred. As noted above, West Huron Island is the only island within this Huron National Wildlife Refuge that is open to the public with access being restricted to day use (Butcher 2008).



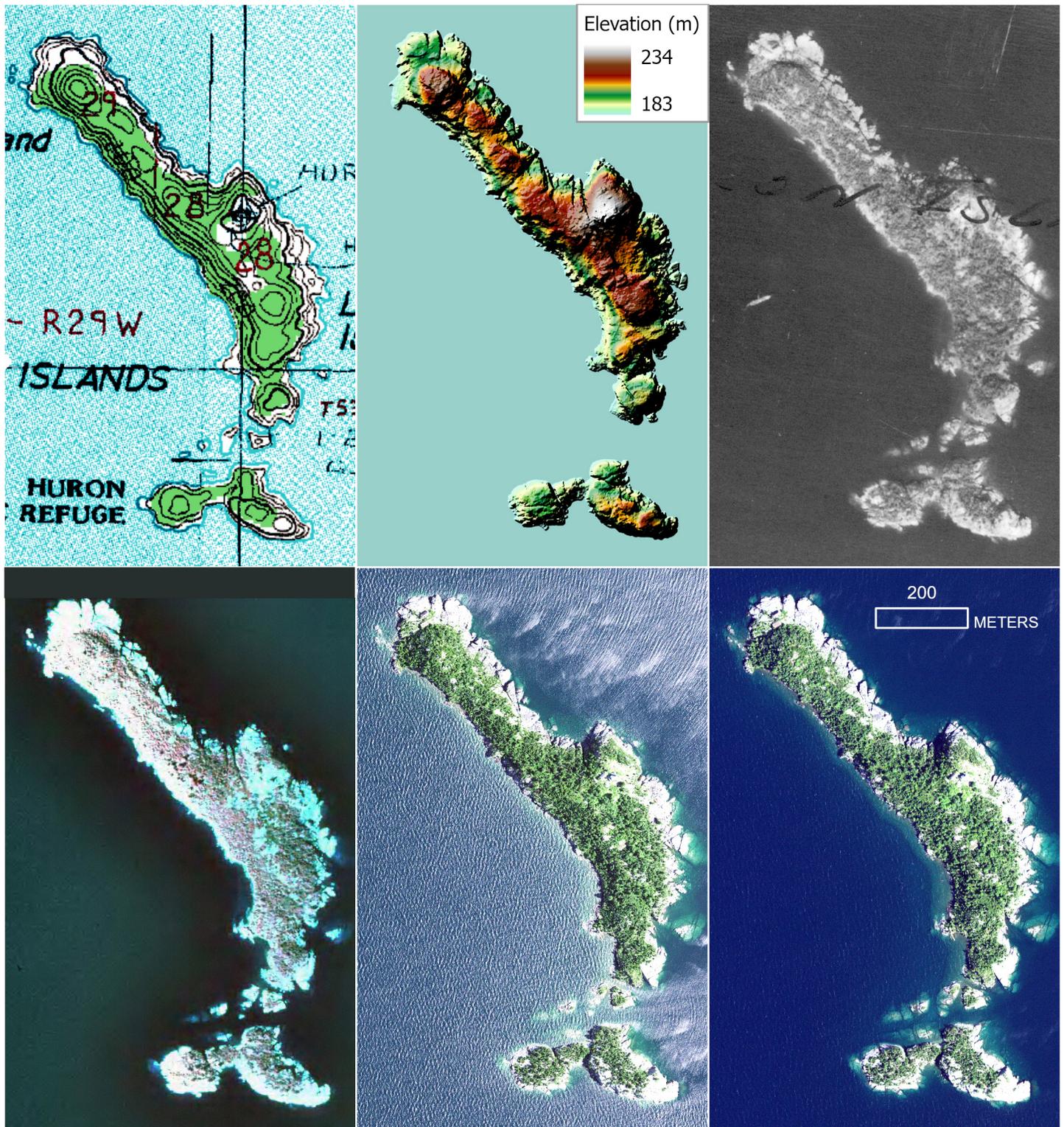
The lighthouse on West Huron Island is perched atop 200 foot tall granite lakeshore cliff. Photo by Tyler J. Bassett.



**Figure 3.** Spatial data layers and imagery used to prioritize survey effort on East Huron Island, Gull Island, and adjacent unnamed islands. Left panel from top to bottom: topographic map, elevation with shaded relief, historical black-and-white imagery (1939), and color infrared imagery (1998) (USGS 2022, USGS 2015, USDA 1939, and USDA 1998). Right panel from top to bottom: recent true color leaf-off imagery (2017), recent true color leaf-on imagery (2018), and recent true color leaf-on imagery (2020) (State of Michigan 2017, USDA 2018, USDA 2020).



Imagery from a 2007 flight conducted to census colonial nesting waterbirds on the Huron Islands. The photo on the left shows the full chain of the Huron Islands looking northwest. The islands in the foreground are the unnamed islands that occur just southeast of Gull Island, which is the first island in the foreground with visible vegetation. The large island just behind Gull Island is East Huron Island. The photo on the right is an unnamed island that is situated just southeast of Gull Island. Photos by Francesca J. Cuthbert, University of Minnesota.



**Figure 4.** Spatial data layers and imagery used to prioritize survey effort on West Huron Island, Cattle Island, and adjacent unnamed islands. Clockwise from top left: topographic map, elevation with shaded relief, historical black-and-white imagery (1939), recent true color leaf-on imagery (2020), recent true color leaf-on imagery (2018), and color infrared imagery (1998) (USGS 2022, USGS 2015, USDA 1939, USDA 1998, State of Michigan 2017, USDA 2018, USDA 2020).

**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 Huron Islands and identify potential survey targets. To assist with delineation, we evaluated multiple series of aerial imagery and spatial data layers including historical black-and-white imagery (1939), color infrared imagery (1998), recent true color leaf-off imagery (2015-2018), recent true color leaf-on imagery (2018-2020), topographic maps, digital elevation models, and hillshade (a grayscale 3D representation of the terrain surface) (Figures 3 and 4). The preliminary delineation of natural community types across the islands 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 5) (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.

Global / State Conservation Status Rank Combination	Ecological Integrity Assessment Rank			
	A Excellent Integrity	B Good Integrity	C Fair Integrity	D Poor Integrity
G1S1, G2S1, GNRS1, GUS1				
G2S2, GNRS2, G3S1, G3S2, GUS2				
GUS3, GNRS3, G3S3, G4S1, G4S2, G5S1, G5S2, any SNR				
G4S3, G4S4, G5S3, G5S4, G5S5, GNRS4, GNRS5, GUS4, GUS5				
<b>Red Shading</b> = Natural Community Survey Targets				

**Figure 5.** 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.

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.

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., 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 element occurrence ranks
- n) noting management needs and restoration opportunities



For each high-quality natural community element occurrence, MNFI scientists compiled comprehensive plant species list. East Huron Island granite bedrock glade. Photo by Joshua G. Cohen.

Following completion of the field surveys, the collected data were analyzed and transcribed to 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. 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



Representative canopy trees were measured and aged in forested natural community types. East Huron Island boreal forest. Photo by Elizabeth A. Haber.

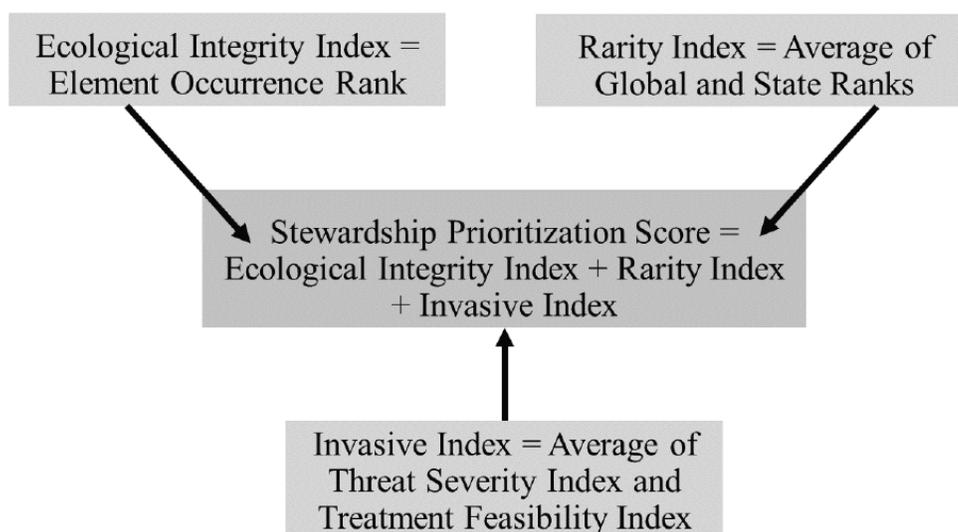
species from region to region. We employed a regionally appropriate FQA for islands in Michigan (Reznicek et al. 2014). From the total list of plant species for an area, a mean C value is calculated and then multiplied by the square root of the total number of plant species to calculate the FQI. Michigan 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 for each island (Appendix 3.2).

In addition to the natural community surveys, MNFI conducted two distinct and concurrent surveys in 2022 on the Huron Islands. 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 the Huron Island. For details on rare plant and invasive species survey efforts please refer to USFWS 2021b and Bassett et al. 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 6). 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 6.** 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 island. We provide detailed **Site Summaries** for each of the natural community element occurrences documented on those islands.

Fourteen high-quality natural communities were surveyed during the 2022 field season within the Huron Islands. A total of four different natural community types were visited including: boreal forest (2 element occurrences or EOs), granite bedrock glade (4 EOs), granite bedrock lakeshore (4 EOs), and granite lakeshore cliff (4 EOs). Table 1 lists the visited sites, their element occurrence ranks, and their acreage. Mapped natural community boundaries are provided for Cattle, East Huron, Gull, and West Huron Islands (Figures 7-10).

The following site summaries detail threats and management recommendations for each of the 14 natural community element occurrences visited in 2022 organized by island and then alphabetically by community type. 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 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



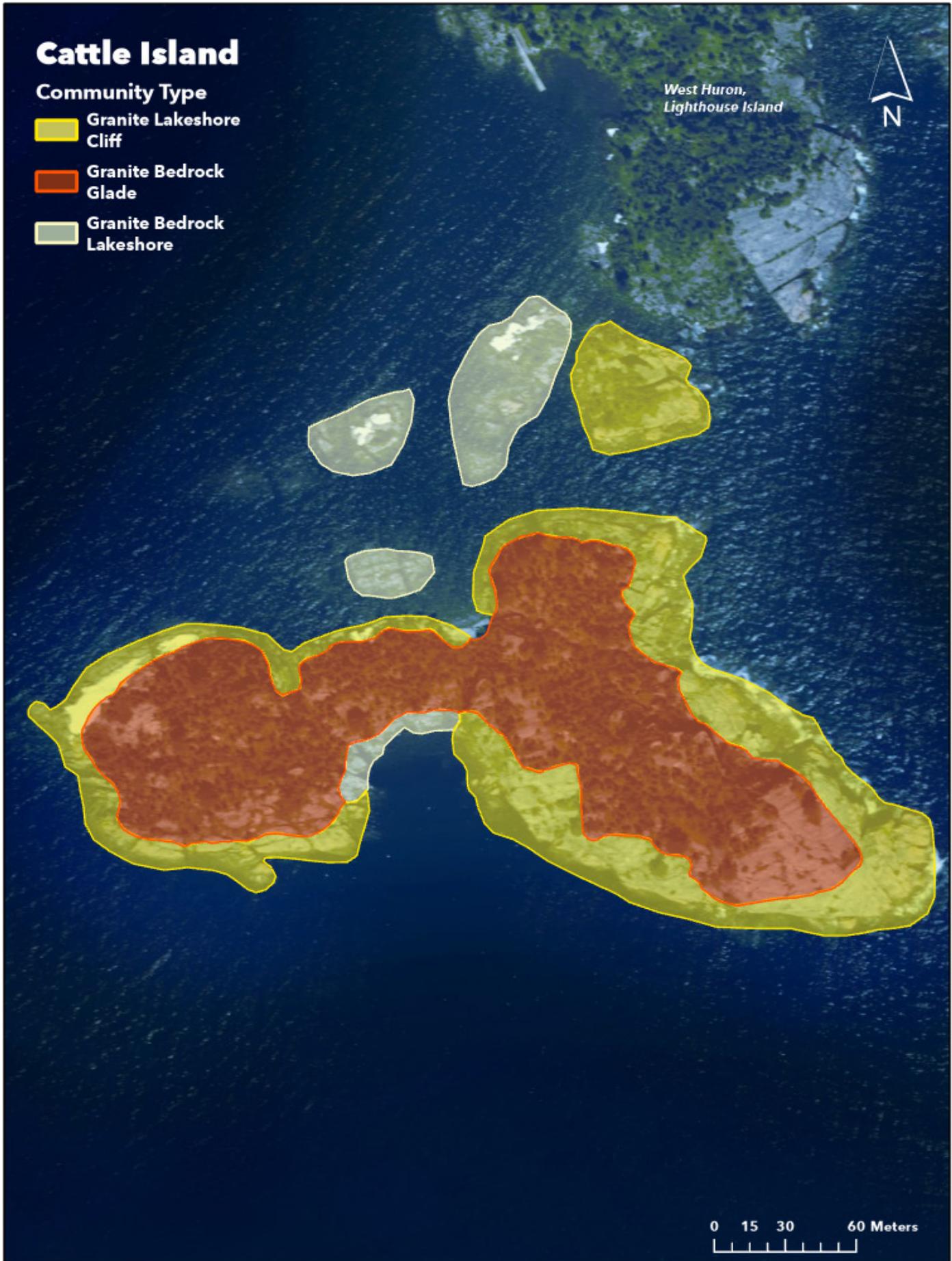
West Huron Island granite lakeshore cliff. Photo by Joshua G. Cohen.

**Table 1.** Natural community element occurrences (EOs) surveyed in 2022 in the Huron Islands National Wildlife Refuge. EO rank abbreviations are as follows: A, excellent estimated viability; AB, excellent to good estimated viability; B, good estimated viability; and BC, good to fair estimated viability.

<b>Community Type</b>	<b>Island</b>	<b>EO ID</b>	<b>Acreage</b>	<b>EO RANK</b>
Granite Bedrock Glade	Cattle Island	26254	5	B
Granite Bedrock Lakeshore	Cattle Island	26247	1	AB
Granite Lakeshore Cliff	Cattle Island	26249	4	AB
Boreal Forest	East Huron Island	26253	37	AB
Granite Bedrock Glade	East Huron Island	26257	23	AB
Granite Bedrock Lakeshore	East Huron Island	26245	6	AB
Granite Lakeshore Cliff	East Huron Island	26250	18	A
Granite Bedrock Glade	Gull Island	26252	3	BC
Granite Bedrock Lakeshore	Gull Island	26247	1	B
Granite Lakeshore Cliff	Gull Island	26251	5	B
Boreal Forest	West Huron Island	26256	15	B
Granite Bedrock Glade	West Huron Island	26255	14	B
Granite Bedrock Lakeshore	West Huron Island	26246	2	AB
Granite Lakeshore Cliff	West Huron Island	26248	13	A



West Huron Island granite bedrock lakeshore. Photo by Joshua G. Cohen.



**Figure 7.** Natural community element occurrences on Cattle Island, Huron Islands National Wildlife Refuge.

## SITE SUMMARIES

### 1. Cattle Island - Granite Bedrock Glade

**Natural Community Type:** Granite Bedrock Glade

**Rank:** G3G5 S2, vulnerable to secure globally and imperiled within the state

**Element Occurrence Rank:** B

**Size:** 5 acres

**Location:** Cattle Island, Seney Wildlife Refuge, Lake Superior

**Element Occurrence Identification Number:** 26254

**Site Description:** Cattle Island is composed of two distinct granitic knobs with each knob supporting granite bedrock glade. The knobs are separated by a steep ravine that supports a narrow band of early-successional boreal forest. Granite bedrock glade intergrades lakeward to granite lakeshore cliff and granite bedrock lakeshore.

The soils are shallow (typically 0-3 cm) very acidic organics and loams overlying granitic bedrock. Soil development is restricted to cracks, fissures, and low depressions with the majority of the glade characterized by exposed granitic bedrock. Exposed bedrock covered 51 to 71% of the observed area in most plots (3 of 5), 76 to 95% in 1 plot, and 6 to 25% in one plot. Measured pH ranged from 4.5 to 5.5 with an average of 4.7 across 5 soil plots. Measured soil depths over the granite bedrock ranged from 0 to 10 cm with the majority of plots (4 of 5) with soil depths between 1 and 2 cm. Sphagnum peat is accumulating locally on sloping bedrock along the northern side of the island. These sphagnum peats are strongly acidic and range in depth from 2 to 50 cm. Vertical rock faces, ledges, and fissures occur throughout the granite bedrock glade.



Cattle Island granite bedrock glade. Photo by Joshua G. Cohen.



Cattle Island granite bedrock glade delineated in yellow on 2017 imagery.

Areas of exposed bedrock are covered by a diverse array of lichens and mosses. Soils and vegetation are accumulating in flat areas, depressions, crevices, and at the base of tree boles. Fire has been an important disturbance factor within the granite bedrock glade and charring was noted on coarse woody debris and charcoal was observed in the soil. The scattered and stunted trees and shrubs are drought-, wind-, and freeze-stressed. Extreme cold and heat generate challenging growing conditions for the plants within the glade contributing to the open canopy of the glade. Many trees within the granite bedrock glade are stressed and canopy mortality is common. Snags and coarse woody debris occur throughout the glade. Observed canopy closure within the glade ranged from 5 to 30%. The canopy cohort of the glade is uneven aged and young. Five canopy trees were cored in 5 overstory plots and the average age of canopy dominants is 90 years with estimated canopy ages ranging from 53 to 146 years. Cored canopy trees included balsam fir (*Abies balsamea*), black spruce (*Picea mariana*), northern white-cedar (*Thuja occidentalis*), and red pine (*Pinus resinosa*).

Bear-flipped rocks and excavated ant mounds, prevalent on glades in the nearby mainland to the south, were noticeably absent within this glade. A prolific crop of blueberries was observed within the glade and the absence of bear and other frugivores found on the mainland is likely contributing to the abundant crop. The distance of the island to the mainland results in the absence of deer and accompanying browse pressure.

Similar to areas described on East and West Huron Islands, sloping bedrock along the northern shore of the Cattle Island supports small inclusions of hanging peatland. These areas are characterized by very acidic (pH 4.5) sphagnum peat that is 2 to 50 cm deep and overlies the granite bedrock. In addition to sphagnum mosses, these areas support dense shrub cover of Labrador tea (*Rhododendron groenlandicum*) and Canada blueberry (*Vaccinium myrtilloides*) with a scattered overstory of black spruce. Peat accumulates in these cool microsites because of the northern aspect and the prevalence of summer fogs. This type of peatland occurring on sloping bedrock has never been documented in Michigan and this unique type merits consideration as a new natural community type for Michigan. Comparable systems have been documented in Ontario (D. Albert, Oregon State University, personal communication) and Maine (Gawler and Cutko 2018).



Hanging peatlands occur locally on northern exposures of Cattle, East Huron, and West Huron Islands. These micropeatlands occurring on sloping granitic bedrock have not been documented in Michigan and likely constitute a new natural community type. Photo by Joshua G. Cohen.

The granite bedrock glade overstory is scattered and stunted (5-15%) with canopy species including balsam fir, northern white-cedar, black spruce, white pine (*Pinus strobus*), red pine, and paper birch (*Betula papyrifera*). Canopy trees typically range in diameter from 10 to 20 cm with scattered pines and northern white-cedar reaching 30 to 70 cm. The average diameter of measured canopy trees was 14.5 cm (n = 63), and the range was 10 to 69.8 cm. The understory is sparse (10-20%) with characteristic species including pin cherry (*Prunus pensylvanica*), balsam fir, paper birch, round-leaved serviceberry (*Amelanchier sanguinea*), mountain-ash (*Sorbus decora*), yew (*Taxus canadensis*), and black spruce.

The low shrub layer is patchy (15-30%) with common shrubs including bearberry (*Arctostaphylos uva-ursi*), Canada blueberry, yew, skunk currant (*Ribes glandulosum*), meadowsweet (*Spiraea alba*), and ninebark (*Physocarpus opulifolius*), and tree seedlings including northern white-cedar, balsam fir, paper birch, mountain-ash, white pine, and red pine. Labrador tea, Canada blueberry, and black spruce occur locally on sloping bedrock along the northern shore of the island where sphagnum peat develops locally.

Sparse ground cover (10-20%) is concentrated where soils have accumulated along cracks, crevices, and depressions in the granite bedrock. A diverse array of lichens, mosses, and feathermosses cover the exposed granite within the granite bedrock glade. Prevalent ground cover species include hair grass (*Avenella flexuosa*), harebell (*Campanula rotundifolia*), pale corydalis (*Capnoides sempervirens*), hairy goldenrod (*Solidago hispida*), ticklegrass (*Agrostis scabra*), common polypody (*Polypodium virginianum*), white lettuce (*Prenanthes alba*), yarrow (*Achillea millefolium*), bristly sarsaparilla (*Aralia hispida*), sedge (*Carex scoparia*), Canada mayflower (*Maianthemum canadense*), rough cinquefoil (*Potentilla norvegica*), and twinflower (*Linnaea borealis*).

The Cattle Island granite bedrock glade was surveyed August 15<sup>th</sup> and August 18<sup>th</sup>. One hundred and four plant species were documented with 95 native species and 9 non-native species (Appendix 2.1). The total FQI was 44.8.

**Threats:** Species composition and structure are patterned by natural processes. Scattered non-native species occur locally and include Canada bluegrass (*Poa compressa*), Kentucky bluegrass (*Poa pratensis*), king devil (*Hieracium caespitosum*), common St. John's-wort (*Hypericum perforatum*), mouse-ear chickweed (*Cerastium fontanum*), orange hawkweed (*Hieracium aurantiacum*), ox-eye daisy (*Leucanthemum vulgare*), sheep sorrel (*Rumex acetosella*), and common speedwell (*Veronica officinalis*).

**Management Recommendations:** The main management recommendations are to allow natural processes to operate unhindered (i.e., let wildfires burn) and to maintain a natural buffer surrounding the glade to prevent the increase of a weedy seed source. Efforts to control non-native species should be implemented and these control efforts should be monitored.



Cattle Island granite bedrock glade. Photo by Joshua G. Cohen.

## 2. Cattle Island - Granite Bedrock Lakeshore

**Natural Community Type:** Granite Bedrock Lakeshore

**Rank:** G4G5 S2, apparently secure to secure globally and imperiled within the state

**Element Occurrence Rank:** AB

**Size:** 1 acre

**Location:** Cattle Island, Seney Wildlife Refuge, Lake Superior

**Element Occurrence Identification Number:** 26247

**Site Description:** Close to a quarter-mile of granite bedrock lakeshore occurs along the south-central portion of Cattle Island and on three unnamed islands immediately north of Cattle Island. The majority of Cattle Island's shoreline is characterized by granite lakeshore cliff. On Cattle Island, both granite bedrock lakeshore and granite lakeshore cliff are backed by granite bedrock glade.

The soils of the granite bedrock lakeshore are characterized by shallow (1-2 cm) acidic organics accumulating in cracks, crevices, and small depressions. Soil chemistry is variable and is dependent on the composition of the decomposing organic material. Shallow pools of water or splash pools occur locally on the granite bedrock lakeshore with some of the pools supporting wetland vegetation.

This site was surveyed in 2022, a year after five consecutive years of high Great Lakes water levels (from 2016 through 2020) resulting in the decrease in the extent of the granite bedrock lakeshore. High water levels and increased wave activity have likely reduced the overall cover of herbaceous species in the granite bedrock lakeshore.



Cattle Island granite bedrock lakeshore. Photo by Joshua G. Cohen.



Cattle Island granite bedrock lakeshore delineated in yellow on 2017 imagery.

The bedrock lakeshore is sparsely vegetated and dominated by non-vascular species with herbaceous plants (2-10%) and scattered tree cover (1-2%) and shrub cover (4-8%) restricted to the inland edge and cracks and crevices. A diverse array of lichens and mosses cover the exposed granite within the granite bedrock lakeshore. Characteristic herbaceous species include pale corydalis (*Capnoides sempervirens*), hair grass (*Avenella flexuosa*), hairy goldenrod (*Solidago hispida*), purple meadow-rue (*Thalictrum dasycarpum*), grass-leaved goldenrod (*Euthamia graminifolia*), yarrow (*Achillea millefolium*), and harebell (*Campanula rotundifolia*). Herbaceous vegetation is primarily found in the infrequent cracks and crevices within the granite bedrock but also locally occurs along the margins of the splash pools with common species flanking the pools including grass-leaved goldenrod and northern bugle weed (*Lycopus uniflorus*). Scattered trees and tall shrubs include white pine (*Pinus strobus*), northern white-cedar (*Thuja occidentalis*), paper birch (*Betula papyrifera*), trembling aspen (*Populus tremuloides*), balsam fir (*Abies balsamea*), ninebark (*Physocarpus opulifolius*), choke cherry (*Prunus virginiana*), speckled alder (*Alnus incana*), and Michigan holly (*Ilex verticillata*). Characteristic low shrubs include creeping juniper (*Juniperus horizontalis*), sweet gale (*Myrica gale*), ninebark, meadowsweet (*Spiraea alba*), and Canada blueberry (*Vaccinium myrtilloides*).

The Cattle Island granite bedrock lakeshore was surveyed August 15<sup>th</sup> and August 18<sup>th</sup>, 2022. Fifty-seven plant species were documented with 54 native species and 3 non-native species (Appendix 2.2). The total FQI was 30.2.

**Threats:** Species composition and structure are patterned by natural processes. Non-native species occur locally and include Canada thistle (*Cirsium arvense*), reed canary grass (*Phalaris arundinacea*), and Canada bluegrass (*Poa compressa*).

**Management Recommendations:** Efforts to control invasive species should be implemented and these control efforts should be monitored. Canada thistle and reed canary grass should be treated immediately while they are still rare throughout the archipelago.



Granite bedrock lakeshore occurs along three unnamed islands that occur north of Cattle Island. Photo by Joshua G. Cohen.

### 3. Cattle Island - Granite Lakeshore Cliff

**Natural Community Type:** Granite Lakeshore Cliff

**Rank:** GU S1, globally unrankable and critically imperiled within the state

**Element Occurrence Rank:** AB

**Size:** 4 acres

**Location:** Cattle Island, Seney Wildlife Refuge, Lake Superior

**Element Occurrence Identification Number:** 26249

**Site Description:** Approximately 0.7 miles of granite lakeshore cliff occurs along the shore of Cattle Island and a nearby unnamed island in between Cattle Island and West Huron Island. In addition to granite lakeshore cliff, the shoreline of Cattle Island also supports granite bedrock lakeshore and granite cobble shore. Localized pockets of granite bedrock lakeshore and granite cobble shore occur between and at the base of some of the cliff outcroppings. The cliffs transition to granite bedrock glade in the interior of the island. The cliffs range widely from 10 to 80 ft tall but are typically between 30 and 60 feet with the tallest cliffs (60 to 80 ft) occurring along the southeastern shoreline. Large granite boulders occur locally at the base of the granite lakeshore cliff and are typically submerged or emerging from the water. Very shallow (0-1 cm) fine-textured, acidic (pH 4.5) soils with organics accumulate on the ledges and crevices. Soil chemistry is variable and depends on the decomposing plant material that makes up the organic matter. Thin soils, cold winter temperatures, steady winds, wave splash, and summer droughts make for harsh growing conditions for vegetation.

The northern white-cedar (*Thuja occidentalis*) and pines (*Pinus* spp.) occurring along the granite lakeshore cliff are often gnarled and twisted, exhibiting bonsai growth forms due to centuries of surviving stressful growing conditions and eking out an existence growing from narrow crevices. Some of the trees are growing downward along the cliff face to maximize interception of light. A 69.1 cm white pine (*Pinus strobus*) on the top of the cliff escarpment was cored and estimated to be over 190 years (109 rings were counted on one-third of the rotten core).

Vegetation is sparse and generally restricted to the flat, exposed bedrock at the upper edge of the cliff; cracks and joints in the cliff face; and ledges along the cliff face. The majority of the vertical cliff face is bare of all vascular vegetation, but lichens and mosses are prevalent. Sparse herbaceous cover (4-8%) includes hair grass (*Avenella flexuosa*), harebell (*Campanula rotundifolia*), yarrow (*Achillea millefolium*), hairy goldenrod (*Solidago hispida*), and common polypody (*Polypodium virginianum*). Sparse shrub cover (1-4%) includes creeping juniper (*Juniperus horizontalis*), meadowsweet (*Spiraea alba*), ninebark (*Physocarpus opulifolius*), speckled alder (*Alnus incana*), and mountain alder (*A. viridis*). Stunted and scattered trees (1-2%) occur along the lip and on ledges and crevices and include northern white-cedar, white pine, paper birch (*Betula papyrifera*), balsam fir (*Abies balsamea*), red pine (*Pinus resinosa*), and mountain-ash (*Sorbus decora*).

The Cattle Island granite lakeshore cliff was surveyed August 15<sup>th</sup> and August 18<sup>th</sup>, 2022. Eighty-one plant species were documented with 74 native species and 7 non-native species (Appendix 2.3). The total FQI was 37.8.



Cattle Island granite lakeshore cliff. Photo by Joshua G. Cohen.



Cattle Island granite lakeshore cliff delineated in yellow on 2017 imagery.

**Threats:** Species composition and structure are patterned by natural processes. Non-native species occur locally and include common St. John's-wort (*Hypericum perforatum*), Canada bluegrass (*Poa compressa*), Kentucky bluegrass (*P. pratensis*), sheep sorrel (*Rumex acetosella*), ox-eye daisy (*Leucanthemum vulgare*), common speedwell (*Veronica officinalis*), and common dandelion (*Taraxacum officinale*).

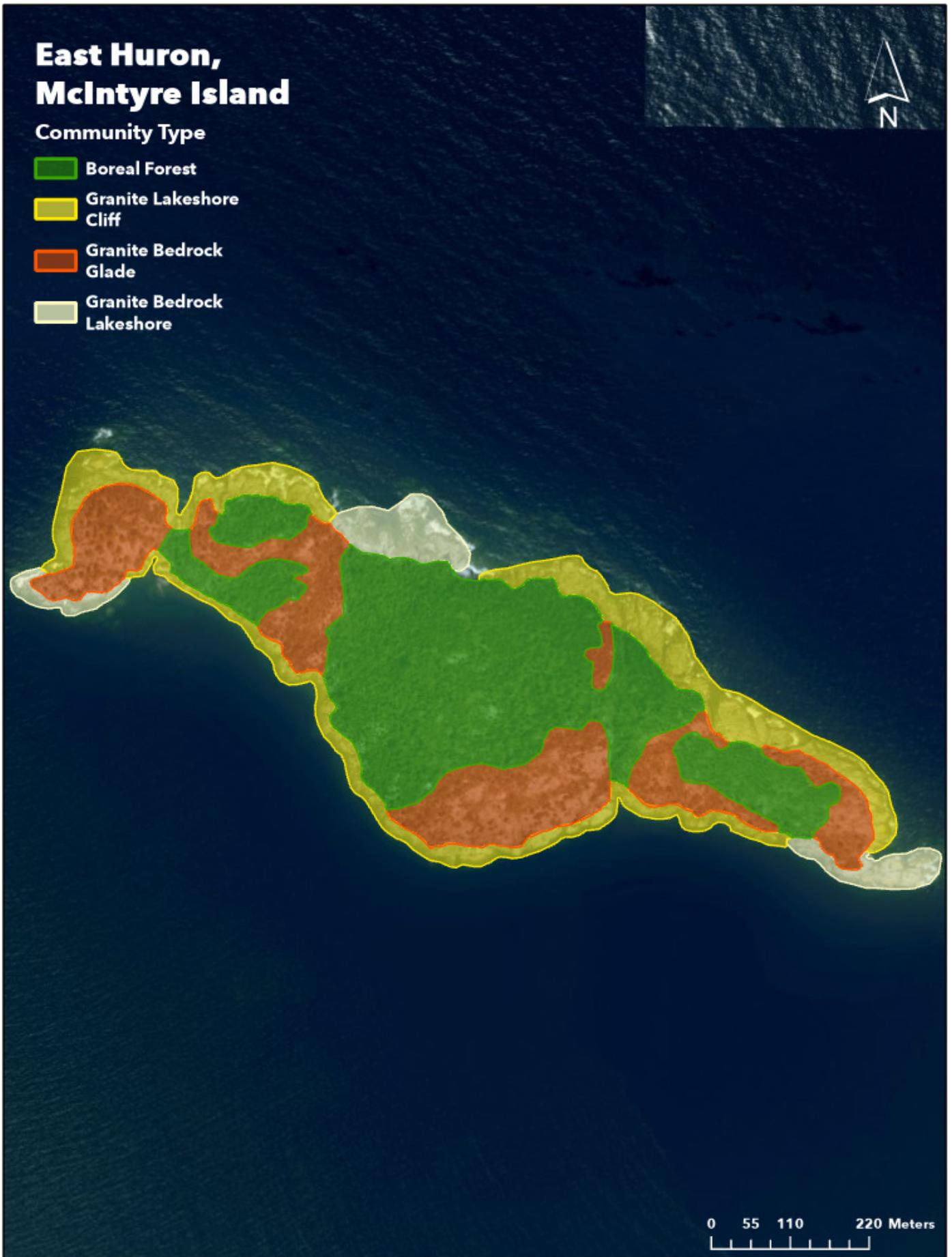
**Management Recommendations:** The main management recommendations are to allow natural processes to operate unhindered and to maintain a buffer of natural communities surrounding the granite lakeshore cliff to prevent the increase of a weedy seed source and desiccation. Efforts to control invasive species should be implemented and these control efforts should be monitored.



The combination of strong winds, waves, ice, and bedrock exfoliation maintain open conditions on the cliff face. The thin soils and full exposure to wind, ice, and sun produce desiccating conditions for many plants. Abundant fog provides moisture for the establishment of mosses and lichens on more protected rock surfaces, while vascular plants are restricted to crevices or moisture-holding depressions in the rock. Cattle Island granite lakeshore cliff. Photo by Joshua G. Cohen.



Cattle Island granite lakeshore cliff. Photo by Joshua G. Cohen.



**Figure 8.** Natural community element occurrences on East Huron Island, Huron Islands National Wildlife Refuge.

#### 4. East Huron Island - Boreal Forest

**Natural Community Type:** Boreal Forest

**Rank:** GU S3, globally unrankable and vulnerable within the state

**Element Occurrence Rank:** AB

**Size:** 37 acres

**Location:** East Huron Island, Seney Wildlife Refuge, Lake Superior

**Element Occurrence Identification Number:** 26253

**Site Description:** East Huron Island is composed of four granitic knobs separated by steep ravines. The interior of the island is characterized by boreal forest and granite bedrock glade on shallow soils over the bedrock. The boreal forest and granite bedrock glade intergrade locally and occur on moderate to very steep topography. The boreal forest is composed of four distinct polygons occurring on all but the westernmost knob. The boreal forest occurs on both sloping granite bedrock and talus and is characterized by shallow fine-textured soils overlying the bedrock.

The soils are shallow (typically 10-30 cm), very acidic and fine-textured. Soils are variable and include organics, loams, loamy sands, and locally sands overlying the granitic bedrock, cobble, and talus. Small inclusions of granite bedrock exposure and cliffs occur infrequently within the boreal forest. Measured pH ranged from 4.0 to 6.2 with an average of 4.6 across 20 soil plots. Depth of organic and mineral soil overlying granite bedrock is variable but typically ranges from 10 to 30 cm. Measured soil depths over the granite bedrock ranged from 5 to 60 cm with the majority of plots (14 of 20) with soil depths between 10 and 32 cm and an average soil depth of 27 cm. Leaf litter depth ranged from 2 to 4 cm and where pines occur in the canopy, the needle duff was deeper, ranging from 2 to 20 cm.



East Huron Island boreal forest. Photo by Joshua G. Cohen.

Given the landscape position of the boreal forest on East Huron Island in Lake Superior and the shallow soils across the forest, windthrow is prevalent. As a result, the boreal forest is characterized by high volumes of coarse woody debris including both snags and downed logs. Coarse woody debris is composed of both small diameter and fast decomposing early-successional species (i.e., balsam fir [*Abies balsamea*] and paper birch [*Betula papyrifera*]) as well as large diameter and slow decomposing pines.

Numerous canopy dominants were cored across the boreal forest to help determine the age range of canopy trees. The boreal forest is uneven aged, both across the island and at the stand level; different patches of boreal forest represent distinct canopy cohorts and areas of boreal forest with two-tiered canopy have canopy trees of different ages with the overtopping pines being significantly older than the trees in the lower canopy layer. Twenty canopy trees in 20 overstory plots were cored and the average age of canopy dominants is 111 years with estimated canopy ages ranging widely from 38 to 305 years and cored canopy trees including balsam fir, northern white-cedar (*Thuja occidentalis*), red pine (*Pinus resinosa*), paper birch, red maple (*Acer rubrum*), trembling aspen (*Populus tremuloides*), and black spruce (*Picea mariana*). Noteworthy old trees documented within the boreal forest include a 59.5 cm red pine (over 305 yrs) and a 74 cm red pine (over 220 yrs).

Areas of sloping bedrock within the boreal forest and granite bedrock glade along the northern shore of the island support small inclusions of hanging peatland with vegetation characteristic of bog and poor conifer swamp. These areas are characterized by acidic (pH 4.5) sphagnum peat that is 2 to 50 cm deep and overlies granite bedrock. In addition to sphagnum mosses, these areas support dense shrub cover of Labrador tea (*Rhododendron groenlandicum*) and leatherleaf (*Chamaedaphne calyculata*), with a scattered overstory of black spruce. Peat accumulates in these cool microsites because of the northern aspect and the prevalence of summer fogs. This type of peatland occurring on sloping bedrock has never been documented in Michigan and this unique type merits consideration as a new natural community type for Michigan. Comparable systems have been documented in Ontario (D. Albert, Oregon State University, personal communication) and Maine (Gawler and Cutko 2018).



The East Huron Island boreal forest is characterized by dense understory yew, indicating the absence of deer on the island. Photo by Joshua G. Cohen.



East Huron Island boreal forest delineated in yellow on 2017 imagery.

Canopy composition of the boreal forest is variable with early-successional species being prevalent due to the frequency of wind disturbance on the island. Canopy dominants throughout the boreal forest include balsam fir and paper birch. Additional canopy associates include northern white-cedar, black spruce, white spruce (*Picea glauca*), trembling aspen, mountain-ash (*Sorbus decora*), pin cherry (*Prunus pensylvanica*), mountain maple (*Acer spicatum*), and red maple. Areas of boreal forest with deeper soils tend to exhibit an increased importance of deciduous species in the canopy. In localized portions of the island with more protection from windthrow, the boreal forest is characterized by a two-tiered canopy with large diameter white pine (*Pinus strobus*) and red pine overtopping the lower-stature balsam fir and paper birch.

Canopy coverage typically ranges from 40 to 70% with some local patches having more open canopy (30-50%) where blowdown is more prevalent and areas protected from windthrow having more closed canopy (70-90%). Canopy trees typically range in diameter from 10 to 20 cm with scattered white pine, red pine, red maple, and paper birch ranging from 60 to 80 cm. A 111 cm supercanopy white pine was recorded. The average diameter of measured canopy trees was 17 cm (n = 638). Prevalent species in the subcanopy layer include balsam fir, mountain-ash, mountain maple, and pin cherry.

The understory layer is patchy to dense (25-50%) with yew (*Taxus canadensis*) and balsam fir locally dominant and additional species including mountain maple, pin cherry, red maple, paper birch, black spruce, red pine, and trembling aspen. Understory yew is locally dense and tall, ranging between 6 to 12 feet in height, indicating the absence of deer on East Huron Island. The low shrub layer is patchy to dense (25-25%) with common species including yew, bush-honeysuckle (*Diervilla lonicera*), mountain maple, Labrador tea, skunk currant (*Ribes glandulosum*), and low sweet blueberry (*Vaccinium angustifolium*). Tree seedlings occurring within the low shrub layer include balsam fir, red maple, paper birch, mountain-ash, and trembling aspen.



East Huron Island boreal forest. Photo by Joshua G. Cohen.

The ground cover is sparse to patchy (10-25%) with characteristic species including sedges (*Carex deweyana* and *C. pensylvanica*), starflower (*Trientalis borealis*), twinflower (*Linnaea borealis*), bracken fern (*Pteridium aquilinum*), bunchberry (*Cornus canadensis*), creeping-snowberry (*Gaultheria hispidula*), wild sarsaparilla (*Aralia nudicaulis*), woodferns (*Dryopteris* spp., including state special concern *D. filix-mas*), tree clubmoss (*Dendrolycopodium dendroideum*), and stiff clubmoss (*Spinulum annotinum*).

The East Huron Island boreal forest was surveyed from August 17<sup>th</sup> through August 19<sup>th</sup>, and August 22<sup>nd</sup> through August 26<sup>th</sup>, 2022. Fifty-seven native plant species were documented with no non-native species recorded (Appendix 2.4). The total FQI was 36.2.

**Threats:** Species composition and structure of the boreal forest are patterned by natural processes. No non-native species were documented within the boreal forest. Public access to East Huron Island is prohibited and as a result, anthropogenic disturbance has been limited. Furthermore, the distance of the island to the mainland results in the absence of white-tailed deer (*Odocoileus virginianus*) and accompanying browse pressure. Snowshoe hare (*Lepus americanus*) and browsing by snowshoe hare were noted across the island.

**Management Recommendations:** The main management recommendations are to allow natural processes to operate unhindered (i.e., allow coarse woody debris to accumulate and let wildfires burn), maintain a natural buffer surrounding the boreal forest, and monitor for invasive species. Monitoring to determine hare browse impact should be implemented.



East Huron Island boreal forest. Photo by Joshua G. Cohen.



Windthrow is prevalent throughout the East Huron Island boreal forest, which is characterized by high volumes of coarse woody debris including both snags and downed logs. Photos by Jesse M. Lincoln (above) and Joshua G. Cohen (below).





The boreal forest is locally characterized by a two-tiered canopy with large diameter red pine overtopping the lower-stature balsam fir and paper birch. Cored and aged supercanopy pine include a 59.5 cm red pine that was estimated to be over 305 years old. Photos by Joshua G. Cohen.



## 5. East Huron Island - Granite Bedrock Glade

**Natural Community Type:** Granite Bedrock Glade

**Rank:** G3G5 S2, vulnerable to secure globally and imperiled within the state

**Element Occurrence Rank:** AB

**Size:** 23 acres

**Location:** East Huron Island, Seney Wildlife Refuge, Lake Superior

**Element Occurrence Identification Number:** 26257

**Site Description:** East Huron Island is composed of four granitic knobs separated by steep ravines. The interior of the island is characterized by granite bedrock glade and boreal forest on shallow soils over the bedrock. The granite bedrock glade and boreal forest intergrade locally and occur on moderate to very steep topography. The site is composed of six distinct polygons of granite bedrock glade. The soils of the glade are shallow (typically 0-8 cm) very acidic organics and loams overlying granitic bedrock. Soil development is restricted to cracks, fissures, and low depressions with the majority of the glade being characterized by exposed granitic bedrock. Exposed bedrock covered 76 to 95% in most plots (11 of 21), 26 to 50% in several plots (6 of 21), and 51 to 75% in few plots (4 of 21). Measured pH ranged from 4.0 to 4.7 with an average of 4.3 across 21 soil plots. Measured soil depths over the granite bedrock ranged from 0 to 19 cm with the majority of plots (14 of 21) with soil depths between 0 and 8 cm.

Areas of exposed bedrock are covered by a diverse array of lichens and mosses. Soils and vegetation are accumulating in flat areas, depressions, crevices, and at the base of tree boles. Infrequent fire from lightning strike has likely been an important disturbance factor within the granite bedrock glade and charring and lightning-struck pines were noted within the glade and charcoal was observed locally in the soil. The scattered and stunted trees and shrubs are drought-, wind-, and freeze-stressed. Extreme cold and heat generate very challenging growing conditions for the plants within the glade. Many trees are stressed and canopy mortality is prevalent. Snags and coarse woody debris are common.



East Huron Island granite bedrock glade. Photo by Joshua G. Cohen.



East Huron Island granite bedrock glade delineated in yellow on 2017 imagery.

The canopy cohort of the glade is uneven aged. Twenty-four canopy trees were cored in 21 overstory plots and the average age of canopy dominants is 112 years with estimated canopy ages ranging from 25 to 370 years. Cored canopy trees include white pine (*Pinus strobus*), red pine (*Pinus resinosa*), red oak (*Quercus rubra*), balsam fir (*Abies balsamea*), red maple (*Acer rubrum*), black spruce (*Picea mariana*), and mountain-ash (*Sorbus decora*). Noteworthy old trees documented within the granite bedrock glade include a 59.1 cm red pine (over 370 yrs), a 45.3 cm white pine (over 318 yrs), and a 65.5 cm red pine (over 270 yrs).

Bear-flipped rocks and excavated ant mounds, prevalent on glades in the nearby mainland to the south, were noticeably absent within the glades on the Huron Islands. A prolific crop of blueberries was observed within the glade and the absence of black bear (*Ursus americanus*) and other frugivores found on the mainland is likely contributing to the abundant crop. The distance of the island to the mainland results in the absence of white-tailed deer (*Odocoileus virginianus*) and accompanying browse pressure. Snowshoe hare (*Lepus americanus*) and browsing by snowshoe hare were noted across the island.

Granite bedrock glade intergrades lakeward to granite lakeshore cliff and inland to boreal forest. Within the glade there are numerous fissures and ledges and cliff faces and talus slopes occur locally. In addition, the glade is characterized by numerous pools that contain standing water from precipitation and/or wave splash and contain localized pockets of bog vegetation.



The oldest trees on the Huron Islands were recorded within the East Huron Island granite bedrock glade and along the upper margin of the granite lakeshore cliff. Aged white pine and red pine were consistently over 200 years old and often over 300 years old with the oldest aged red pine in the granite bedrock glade being over 370 years old. Photo by Jesse M. Lincoln.

The granite bedrock glade is characterized by a scattered and stunted overstory (5-25%) with diverse canopy composition, including white pine, red oak, balsam fir, red pine, and black spruce with less frequent associates including northern white-cedar (*Thuja occidentalis*), mountain-ash, red maple, and paper birch (*Betula papyrifera*). A solitary jack pine (*Pinus banksiana*) was documented within the glade on the south-central portion of the island. Canopy trees typically range in diameter from 10 to 30 cm. The average diameter of measured canopy trees was 20 cm (n = 188) and the range was 10 to 82 cm. The understory is sparse (5-15%) with characteristic species including balsam fir, white pine, red pine, red oak, paper birch, black spruce, mountain-ash, northern white-cedar, red maple, trembling aspen (*Populus tremuloides*), round-leaved serviceberry (*Amelanchier sanguinea*), choke cherry (*Prunus virginiana*), and pin cherry (*P. pensylvanica*). Yew (*Taxus canadensis*) occurs infrequently in the understory.

The low shrub layer is patchy (10-25%) with common species including low sweet blueberry (*Vaccinium angustifolium*), Canada blueberry (*V. myrtilloides*), bearberry (*Arctostaphylos uva-ursi*), bristly blackberry (*Rubus setosus*), wild rose (*Rosa acicularis*), skunk currant (*Ribes glandulosum*), round-leaved serviceberry, choke cherry, pin cherry, chokeberry (*Aronia prunifolia*), red-berried elder (*Sambucus racemosa*), huckleberry (*Gaylussacia baccata*), and yew. Leatherleaf (*Chamaedaphne calyculata*), Labrador tea (*Rhododendron groenlandicum*), and black spruce occur locally both along the margins of inundated depressions and on sloping bedrock along the northern shore of the island where sphagnum peat develops locally. Tree seedlings occurring within the low shrub layer include white pine, balsam fir, red maple, paper birch, red oak, northern white-cedar, mountain-ash, and black spruce.



East Huron Island granite bedrock glade. Photo by Joshua G. Cohen.

Sparse to patchy ground cover (10-25%) is concentrated where soils have accumulated along cracks, crevices, and depressions in the granite bedrock. A diverse array of lichens and mosses cover the exposed granite within the granite bedrock glade. Prevalent ground cover species include hair grass (*Avenella flexuosa*), harebell (*Campanula rotundifolia*), pale corydalis (*Capnoides sempervirens*), cow-wheat (*Melampyrum lineare*), three-toothed cinquefoil (*Sibbaldiopsis tridentata*), hairy goldenrod (*Solidago hispida*), upland white goldenrod (*S. ptarmicoides*), ticklegrass (*Agrostis scabra*), poverty grass (*Danthonia spicata*), common polypody (*Polypodium virginianum*), and big-leaved aster (*Eurybia macrophylla*). Additional ground cover species include yarrow (*Achillea millefolium*), fireweed (*Chamaenerion angustifolium*), fireweed (*Erechtites hieraciifolius*), male fern (*Dryopteris filix-mas*, state special concern), and fringed false buckwheat (*Fallopia cilinodis*). Margins of pools within the granite bedrock glade support wetland vegetation including stunted black spruce, sweet gale (*Myrica gale*), leatherleaf, Labrador tea, grass-leaved goldenrod (*Euthamia graminifolia*), blue-joint (*Calamagrostis canadensis*), sedge (*Carex magellanica*), and round-leaved sundew (*Drosera rotundifolia*).

The East Huron Island granite bedrock glade was surveyed from August 17<sup>th</sup> through August 19<sup>th</sup>, and August 22<sup>nd</sup> through August 26<sup>th</sup>, 2022. Seventy plant species were documented with 67 native species and 3 non-native species (Appendix 2.5). The total FQI was 39.3.

**Threats:** Species composition and structure are patterned by natural processes. Scattered non-native species occur locally and include sheep sorrel (*Rumex acetosella*), Canada bluegrass (*Poa compressa*), and king devil (*Hieracium caespitosum*). At the eastern edge of the most westerly polygon, near the boundary with boreal forest, isolated occurrences of Canada thistle (*Cirsium arvense*), marsh thistle (*C. palustre*), and cat-tail (*Typha sp.*, i.e. narrow-leaved or hybrid cat-tail) were observed in a strip of low ground between the granite bedrock glade and the boreal forest.

**Management Recommendations:** The main management recommendations are to allow natural processes to operate unhindered (i.e., let wildfires burn), maintain a natural buffer surrounding the glades to prevent the increase of a weedy seed source, control invasive species, and monitor control efforts. The thistles and cat-tail that occur in close proximity to the glade should be treated immediately while they are still rare throughout the archipelago. Monitoring to determine the impact of hare browsing should be implemented.



Male fern (*Dryopteris filix-mas*, state special concern) was documented within the East Huron Island granite bedrock glade. Photo by Jesse M. Lincoln.

## 6. East Huron Island - Granite Bedrock Lakeshore

**Natural Community Type:** Granite Bedrock Lakeshore

**Rank:** G4G5 S2, apparently secure to secure globally and imperiled within the state

**Element Occurrence Rank:** AB

**Size:** 6 acres

**Location:** East Huron Island, Seney Wildlife Refuge, Lake Superior

**Element Occurrence Identification Number:** 26245

**Site Description:** Approximately a half mile of granite bedrock lakeshore occurs in three discrete segments along the eastern, western, and north-central shoreline of East Huron Island. The majority of the shoreline is characterized by granite lakeshore cliff. The localized pockets of granite bedrock lakeshore occur between and at the base of some of the cliff outcroppings. Both granite bedrock lakeshore and granite lakeshore cliff are backed by granite bedrock glade and boreal forest, which intergrade in the interior of the island. This site was surveyed in 2022, a year after five consecutive years of high Great Lakes water levels (from 2016 through 2020) resulting in the decrease in the extent of the granite bedrock lakeshore. High water levels and increased wave activity have likely reduced the overall cover of herbaceous species in the granite bedrock lakeshore. The eastern polygon of granite bedrock lakeshore has been impacted by colonial nesting waterbirds, likely herring gulls (*Larus argentatus*) based on the nests and similar nesting habitat on nearby Gull Island (Cuthbert and Wires 2011). Guano enrichment has likely influenced floristic composition.

The soils of the granite bedrock lakeshore are characterized by shallow (1-2 cm) organics accumulating in cracks, crevices, and small depressions. Measured soil chemistry ranged widely from acidic to circumneutral (pH 5.0-7.0) and is likely linked to the decomposition of the local organic material. Shallow pools of water or splash pools occur locally on the granite bedrock lakeshore with some of the pools supporting wetland and aquatic vegetation.



Shallow splash pools occur locally within the East Huron Island granite bedrock lakeshore. Photo by Joshua G. Cohen.



East Huron Island granite bedrock lakeshore delineated in yellow on 2017 imagery.

The granite bedrock lakeshore is sparsely vegetated and dominated by non-vascular species with herbaceous plants (2-8%) and scattered tree and shrub cover (1-4%) restricted to the inland edge and cracks and crevices. A diverse array of lichens and mosses cover the exposed granite within the granite bedrock lakeshore. Characteristic herbaceous species include hair grass (*Avenella flexuosa*), harebell (*Campanula rotundifolia*), three-toothed cinquefoil (*Sibbaldiopsis tridentata*), hairy goldenrod (*Solidago hispida*), ticklegrass (*Agrostis scabra*), yarrow (*Achillea millefolium*), wild blue flag (*Iris versicolor*), purple meadow-rue (*Thalictrum dasycarpum*), white lettuce (*Prenanthes alba*), poverty grass (*Danthonia spicata*), pale corydalis (*Capnoides sempervirens*), bluegrass (*Poa glauca*), and grass-leaved goldenrod (*Euthamia graminifolia*). Herbaceous vegetation is primarily found in the infrequent cracks and crevices within the granite bedrock but also locally occurs along the margins of the depressions or splash pools. Species common along the margins of these pools include grass-leaved goldenrod, blue-joint (*Calamagrostis canadensis*), and northern bugle weed (*Lycopus uniflorus*).

Scattered trees and tall shrubs within the granite bedrock lakeshore include paper birch (*Betula papyrifera*), northern white-cedar (*Thuja occidentalis*), red maple (*Acer rubrum*), mountain-ash (*Sorbus decora*), and ninebark (*Physocarpus opulifolius*). Characteristic low shrubs include sweet gale (*Myrica gale*), ninebark, bearberry (*Arctostaphylos uva-ursi*), skunk currant (*Ribes glandulosum*), chokeberry (*Aronia prunifolia*), meadowsweet (*Spiraea alba*), and wild rose (*Rosa acicularis*).

The East Huron Island granite bedrock lakeshore was surveyed from August 17<sup>th</sup> through August 19<sup>th</sup>, and August 22<sup>th</sup> through August 26<sup>th</sup>, 2022. One hundred and forty plant species were documented with 131 native species and 9 non-native species (Appendix 2.6). The total FQI was 50.9.

**Threats:** Species composition and structure are patterned by natural processes. Non-native species recorded within the granite bedrock lakeshore include common St. John's-wort (*Hypericum perforatum*), sheep sorrel (*Rumex acetosella*), dog mustard (*Erucastrum gallicum*), king devil (*Hieracium caespitosum*), ox-eye daisy (*Leucanthemum vulgare*), and annual bluegrass (*Poa annua*). Isolated occurrences of Canada thistle (*Cirsium arvense*), marsh thistle (*C. palustre*), and cat-tail (*Typha sp.*, i.e., narrow-leaved or hybrid cat-tail) were observed in a strip of low ground northeast of the westernmost polygon of granite bedrock lakeshore between the granite bedrock glade and the boreal forest.

**Management Recommendations:** The main management recommendations are to allow natural processes to operate unhindered, maintain a natural buffer surrounding the lakeshore to prevent the increase of a weedy seed source, control invasive species, and monitor control efforts. The thistles and cat-tail that occur just northeast of the westernmost polygon of granite bedrock lakeshore should be treated immediately while they are still rare throughout the archipelago.



*Xanthera elegans*, the orange lichen dominant along granite bedrock lakeshore along the eastern shore of East Huron Island is associated with bird guano. Herring gulls have nested along this stretch of shoreline. Photo by Jesse M. Lincoln.



Michigan's largest documented granite bedrock lakeshore (above) and granite lakeshore cliff (below) occur along the shoreline of East Huron Island. Photos by Jesse M. Lincoln.



## 7. East Huron Island - Granite Lakeshore Cliff

**Natural Community Type:** Granite Lakeshore Cliff

**Rank:** GU S1, globally unrankable and critically imperiled within the state

**Element Occurrence Rank:** A

**Size:** 18 acres

**Location:** East Huron Island, Seney Wildlife Refuge, Lake Superior

**Element Occurrence Identification Number:** 26250

**Site Description:** Approximately two miles of granite lakeshore cliff occurs along the shoreline of East Huron Island. Localized pockets of granite bedrock lakeshore occur between and at the base of some of the cliff outcroppings with notable exposures found at the eastern and western ends of the island and also along the northern shore. The cliffs transition to granite bedrock glade and boreal forest, which intergrade in the interior of the island. The cliffs range widely from 10 to 120 ft tall but are typically between 40 and 80 feet in height with the tallest cliffs (80 to 120 ft) occurring along the south-central and north-central shoreline. The complex is primarily composed of cliff exposure that is immediately adjacent to the lakeshore but also includes granitic fissures that cut into the interior of the island. The fissures are characterized by vertical cliff faces on either side of cool ravines and these features continue into Lake Superior, generating underwater chasms that likely provide important deep-water habitat for fish. Large granite boulders occur locally at the base of the granite lakeshore cliff and are typically submerged or emerging from the water. Very shallow (0-2 cm) fine-textured, alkaline (pH 7.5-7.8) soils with organics accumulate on the ledges and crevices. Thin soils, cold winter temperatures, steady winds, and summer droughts make for harsh growing conditions for vegetation.

The northern white-cedar (*Thuja occidentalis*) and pines (*Pinus* spp.) occurring along the granite lakeshore cliff are often gnarled and twisted, exhibiting bonsai growth forms due to centuries of surviving stressful growing conditions and eking out an existence growing from narrow crevices. Multiple northern white-cedar and pines were cored along the top of the cliffs and estimated ages ranged from 200 to 300 years old. Many of the cored trees had rotten centers and older trees likely occur throughout. Noteworthy old trees documented along upper margin of the granite lakeshore cliff include a 30.5 cm red pine (*Pinus resinosa*) (over 376 yrs), a 17.8 cm white pine (*P. strobus*) (over 250 yrs), and a 25.4 cm northern white-cedar (over 260 yrs).



East Huron Island granite lakeshore cliff. Photo by Joshua G. Cohen.



East Huron Island granite lakeshore cliff delineated in yellow on 2017 imagery.



The oldest recorded trees in the Huron Islands were documented in the East Huron Island granite lakeshore cliff. The 30.5 cm red pine pictured above and below was estimated to be over 376 years old, which is the second oldest red pine documented in Michigan by Michigan Natural Features Inventory scientists in over 40 years of surveys. Photos by Jesse M. Lincoln.



Vegetation is sparse, being generally restricted to the flat, exposed bedrock at the upper edge of the cliff (i.e., lip), cracks and joints in the cliff face, and ledges along the cliff face. The majority of the vertical cliff face is bare of all vascular vegetation, but lichens and mosses are prevalent. Sparse herbaceous cover (2-8%) includes grass-leaved goldenrod (*Euthamia graminifolia*), harebell (*Campanula rotundifolia*), white lettuce (*Prenanthes alba*), fireweed (*Chamaenerion angustifolium*), common polypody (*Polypodium virginianum*), and sedge (*Carex eburnea*). Sparse shrub cover (2-8%) includes creeping juniper (*Juniperus horizontalis*), ninebark (*Physocarpus opulifolius*), and mountain-ash (*Sorbus decora*). Stunted and scattered trees (1-4%) occur along the lip and on ledges and crevices and include northern white-cedar, white pine, red pine, black spruce (*Picea mariana*), paper birch (*Betula papyrifera*), and balsam fir (*Abies balsamea*).

The East Huron Island granite lakeshore cliff was surveyed from August 17<sup>th</sup> through August 19<sup>th</sup>, and August 22<sup>nd</sup> through August 26<sup>th</sup>, 2022. Seventy-five plant species were documented with 72 native species and 3 non-native species (Appendix 2.7). The total FQI was 45.

**Threats:** Species composition and structure are patterned by natural processes. Non-native species infrequently recorded within the granite lakeshore cliff include common sheep sorrel (*Rumex acetosella*), king devil (*Hieracium caespitosum*), and marsh thistle (*Cirsium palustre*).

**Management Recommendations:** The main management recommendations are to allow natural processes to operate unhindered, maintain a natural buffer surrounding the cliff to prevent the increase of a weedy seed source, control invasive species, and monitor control efforts. Marsh thistle should be treated immediately while it is still rare throughout the archipelago.

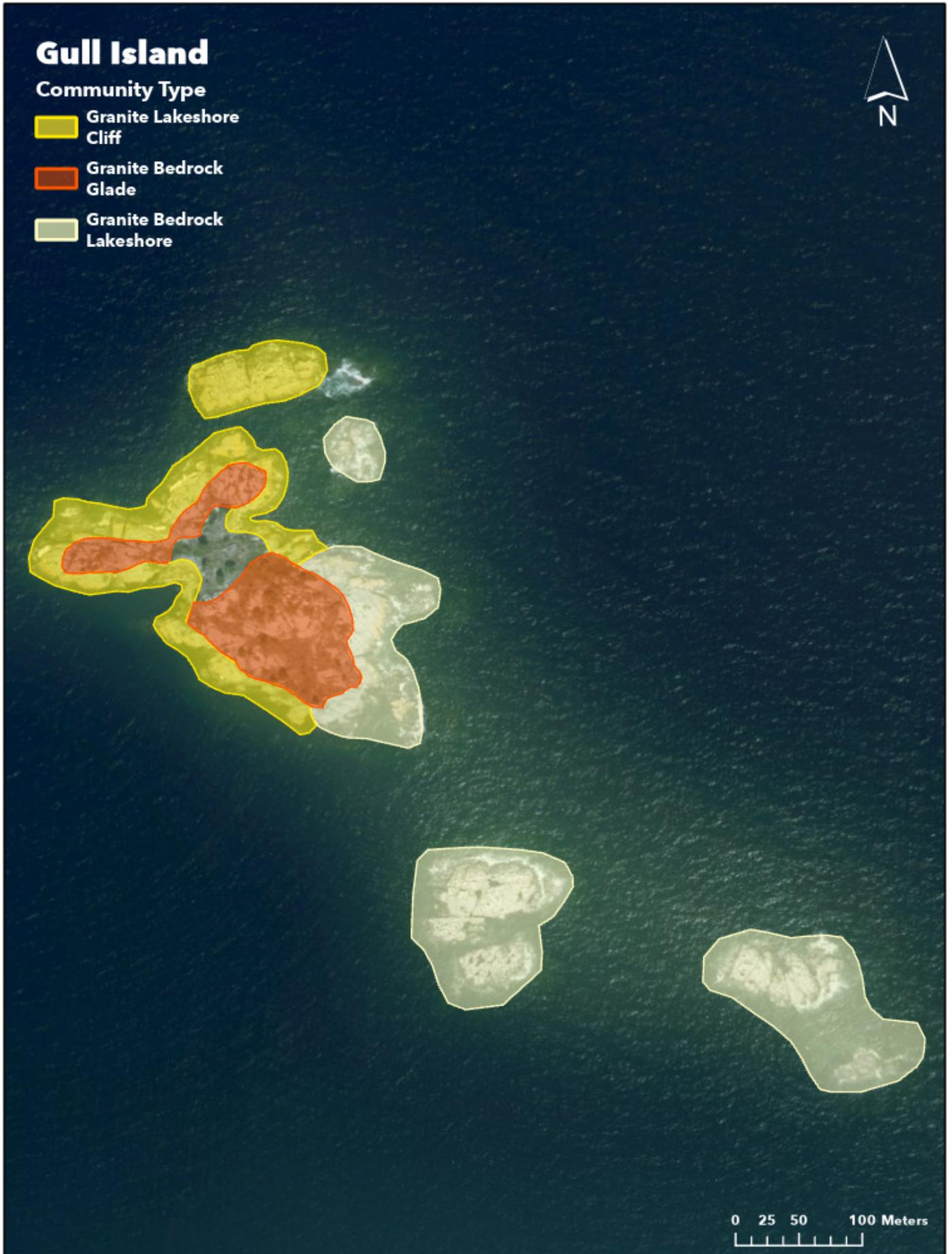


East Huron Island granite lakeshore cliff. Photo by Joshua G. Cohen.



East Huron Island granite lakeshore cliff. Photos by Joshua G. Cohen.





**Figure 9.** Natural community element occurrences on Gull Island, Huron Islands National Wildlife Refuge.

## 8. Gull Island - Granite Bedrock Glade

**Natural Community Type:** Granite Bedrock Glade

**Rank:** G3G5 S2, vulnerable to secure globally and imperiled within the state

**Element Occurrence Rank:** BC

**Size:** 3 acres

**Location:** Gull Island, Seney Wildlife Refuge, Lake Superior

**Element Occurrence Identification Number:** 26252

**Site Description:** Gull Island is composed of three distinct granitic knobs with each knob supporting granite bedrock glade. The knobs are separated by steep ravines that support early-successional boreal forest with localized wetland pockets.

The soils are shallow (typically 0-5 cm) very acidic, organics and loams and sandy loam overlying granitic bedrock. Soil development is restricted to cracks, fissures, and low depressions with the majority of the glade being characterized by exposed granitic bedrock. Exposed bedrock covered 51 to 75% of the observed area in 3 plots and 76 to 95% in 2 plots. Measured pH ranged from 4.3 to 5.5 with an average of 4.6 across 5 soil plots. Measured soil depths over the granite bedrock was variable and ranged from 0 to 30 cm with observed soil depths including 0 to 20 cm, 2 cm, 0 to 30 cm, 0 to 21 cm, and 0 to 7 cm.

Areas of exposed bedrock are covered by a diverse array of lichens and mosses. Soils and vegetation are accumulating in flat areas, depressions, crevices, and at the base of tree boles. The scattered and stunted trees and shrubs are drought-, wind-, and freeze-stressed. Extreme cold and heat generate challenging growing conditions for the plants within the glade contributing to the open canopy.



Gull Island granite bedrock glade. Photo by Joshua G. Cohen.



Gull Island granite bedrock glade delineated in yellow on 2017 imagery.

Canopy closure ranges from 5 to 20%. The canopy cohort of the glade is uneven aged and young. Five canopy trees were cored in 5 overstory plots and the average age of canopy dominants is 44 years with estimated canopy ages ranging from 25 to 109 years and cored canopy trees including white pine (*Pinus strobus*) and mountain-ash (*Sorbus decora*).

The granite bedrock glade is characterized by a scattered and stunted overstory (5-20%) with canopy species including white pine, balsam fir (*Abies balsamea*), paper birch (*Betula papyrifera*), trembling aspen (*Populus tremuloides*), and mountain-ash. Canopy trees typically range in diameter from 10 to 20 cm with scattered white pine reaching 40 to 50 cm. The average diameter of measured canopy trees was 19.8 cm (n = 15) and the range was 10 to 50.4 cm. The understory is sparse to patchy (10-20%) with characteristic species including pin cherry (*Prunus pensylvanica*), mountain maple (*Acer spicatum*), trembling aspen, paper birch, mountain-ash, round-leaved serviceberry (*Amelanchier sanguinea*), and white pine. The low shrub layer is patchy (15-30%) with common shrubs including wild red raspberry (*Rubus strigosus*), bristly blackberry (*R. setosus*), skunk currant (*Ribes glandulosum*), yew (*Taxus canadensis*), low sweet blueberry (*Vaccinium angustifolium*), pin cherry, and round-leaved serviceberry, and tree seedlings including paper birch, white pine, balsam fir, and mountain-ash.

Sparse to patchy ground cover (10-20%) is concentrated where soils have accumulated along cracks, crevices, and depressions in the granite bedrock. A diverse array of lichens and mosses cover the exposed granite within the granite bedrock glade. Documented ground cover species include pale corydalis (*Capnoides sempervirens*), harebell (*Campanula rotundifolia*), three-toothed cinquefoil (*Sibbaldiopsis tridentata*), ticklegrass (*Agrostis scabra*), grass-leaved goldenrod (*Euthamia graminifolia*), yarrow (*Achillea millefolium*), sedge (*Carex brunnescens*), and fringed false buckwheat (*Fallopia cilinodis*).

The Gull Island granite bedrock glade was surveyed August 17<sup>th</sup> and August 26<sup>th</sup>. Fifty-nine plant species were documented with 53 native species and 6 non-native species (Appendix 2.8). The total FQI was 27.7.

**Threats:** Species composition and structure are patterned by natural processes. Scattered non-native species occur locally and include Canada bluegrass (*Poa compressa*), Kentucky bluegrass (*P. pratensis*), king devil (*Hieracium caespitosum*), common St. John's-wort (*Hypericum perforatum*), sheep sorrel (*Rumex acetosella*), and common mullein (*Verbascum thapsus*).

**Management Recommendations:** Efforts to control non-native species should be implemented and these control efforts should be monitored.



The interior of Gull Island is characterized by granite bedrock glade. The glade transitions to granite bedrock lakeshore and granite lakeshore cliff along the island's shoreline. Photo by Joshua G. Cohen.

## 9. Gull Island - Granite Bedrock Lakeshore

**Natural Community Type:** Granite Bedrock Lakeshore

**Rank:** G4G5 S2, apparently secure to secure globally and imperiled within the state

**Element Occurrence Rank:** B

**Size:** 1 acre

**Location:** Gull Island, Seney Wildlife Refuge, Lake Superior

**Element Occurrence Identification Number:** 26244

**Site Description:** Approximately a mile of granite bedrock lakeshore occurs along the eastern shore of Gull Island and also includes the three unnamed islands to the north and southeast of Gull Island. Gull Island also supports granite lakeshore cliff. Both the granite bedrock lakeshore and granite lakeshore cliff are backed by granite bedrock glade. This site was surveyed in 2022, shortly after five consecutive years of high Great Lakes water levels (from 2016 through 2020) resulting in the decrease in the extent of the granite bedrock lakeshore. High water levels and increased wave activity have likely reduced the overall cover of herbaceous species in the granite bedrock lakeshore. In addition, this stretch of granite bedrock lakeshore is used extensively by colonial nesting shorebirds and this activity has likely also contributed to the paucity of vascular plants.

The soils of the granite bedrock lakeshore are characterized by shallow (1-2 cm) organics accumulating in cracks, crevices, and small depressions. Soil chemistry ranges widely from acidic to circumneutral and is linked to the decomposition of the local organic material, which includes plant material as well as bird guano. Shallow pools of water or splash pools occur locally on the granite bedrock lakeshore with some of the pools supporting wetland vegetation.



Gull Island granite bedrock lakeshore. Photo by Joshua G. Cohen.



Gull Island granite bedrock lakeshore delineated in yellow on 2017 imagery.

The granite bedrock lakeshore is sparsely vegetated and dominated by non-vascular species with herbaceous plants (2-4%) and scattered tree and shrub cover (1-3%) restricted to the inland edge and cracks and crevices. A diverse array of lichens and mosses cover the exposed granite within the granite bedrock lakeshore. One of the most prevalent lichens is *Xantheria elegans*, an orange lichen whose presence is often associated with bird guano. The granite bedrock lakeshore on Gull Island and adjacent unnamed islands are utilized by colonial nesting waterbirds. Characteristic herbaceous species include grass-leaved goldenrod (*Euthamia graminifolia*), fireweed (*Chamaenerion angustifolium*), yarrow (*Achillea millefolium*), and blue-joint (*Calamagrostis canadensis*).

Herbaceous vegetation is primarily found in the infrequent cracks and crevices within the granite bedrock. Scattered trees and tall shrubs include paper birch (*Betula papyrifera*), trembling aspen (*Populus tremuloides*), northern white-cedar (*Thuja occidentalis*), and Michigan holly (*Ilex verticillata*). Characteristic low shrubs include wild red raspberry (*Rubus strigosus*), round-leaved serviceberry (*Amelanchier sanguinea*), and ninebark (*Physocarpus opulifolius*).

The Gull Island granite bedrock lakeshore was surveyed August 17<sup>th</sup> and August 26<sup>th</sup>, 2022. Seventy-four plant species were documented with 61 native species and 13 non-native species (Appendix 2.9). The total FQI was 30.1.

**Threats:** Species composition and structure are patterned by natural processes. Scattered non-native species are common and include common St. John's-wort (*Hypericum perforatum*), sheep sorrel (*Rumex acetosella*), ox-eye daisy (*Leucanthemum vulgare*), yellow rocket (*Barbarea vulgaris*), common dandelion (*Taraxacum officinale*), king devil (*Hieracium caespitosum*), and white clover (*Trifolium repens*).

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



Gull Island granite bedrock lakeshore. Photo by Joshua G. Cohen.

## 10. Gull Island - Granite Lakeshore Cliff

**Natural Community Type:** Granite Lakeshore Cliff

**Rank:** GU S1, globally unrankable and critically imperiled within the state

**Element Occurrence Rank:** B

**Size:** 5 acres

**Location:** Gull Island, Seney Wildlife Refuge, Lake Superior

**Element Occurrence Identification Number:** 26251

**Site Description:** Approximately a half mile of granite lakeshore cliff occurs along the northern, western, and southern shore of Gull Island and also on the unnamed island to the north of Gull Island. Gull Island also supports granite bedrock lakeshore. On Gull Island, both granite bedrock lakeshore and granite lakeshore cliff are backed by granite bedrock glade. The cliffs range widely from 10 to 30 ft tall. Very shallow (0-2 cm) fine-textured, organic soils accumulate on the ledges and crevices. Thin soils, cold winter temperatures, steady winds, and summer droughts make for harsh growing conditions for vegetation.

Vegetation is sparse and generally restricted to the flat, exposed bedrock at the upper edge of the cliff (i.e., lip); cracks and joints in the cliff face; and ledges along the cliff face. The majority of the vertical cliff face is bare of all vascular vegetation, but lichens and mosses are prevalent. Sparse herbaceous cover (2-4%) includes grass-leaved goldenrod (*Euthamia graminifolia*), harebell (*Campanula rotundifolia*), common polypody (*Polypodium virginianum*), fireweed (*Chamaenerion angustifolium*), yarrow (*Achillea millefolium*), blue-joint (*Calamagrostis canadensis*), ticklegrass (*Agrostis scabra*), hair grass (*Avenella flexuosa*), and three-toothed cinquefoil (*Sibbaldiopsis tridentata*). Sparse shrub cover (2-8%) includes creeping juniper (*Juniperus horizontalis*), ninebark (*Physocarpus opulifolius*), and mountain-ash (*Sorbus decora*). Stunted and scattered trees and shrubs (1-2%) occur along the lip and on ledges and crevices and include white pine (*Pinus strobus*), paper birch (*Betula papyrifera*), and mountain-ash.

The Gull Island granite lakeshore cliff was surveyed August 17<sup>th</sup> and August 26<sup>th</sup>, 2022. Thirty-one plant species were documented with 28 native species and 3 non-native species (Appendix 2.10). The total FQI was 22.3.

**Threats:** Species composition and structure are patterned by natural processes. Scattered non-native species occur locally and include Kentucky bluegrass (*Poa pratensis*), common St. John's-wort (*Hypericum perforatum*), and sheep sorrel (*Rumex acetosella*).

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



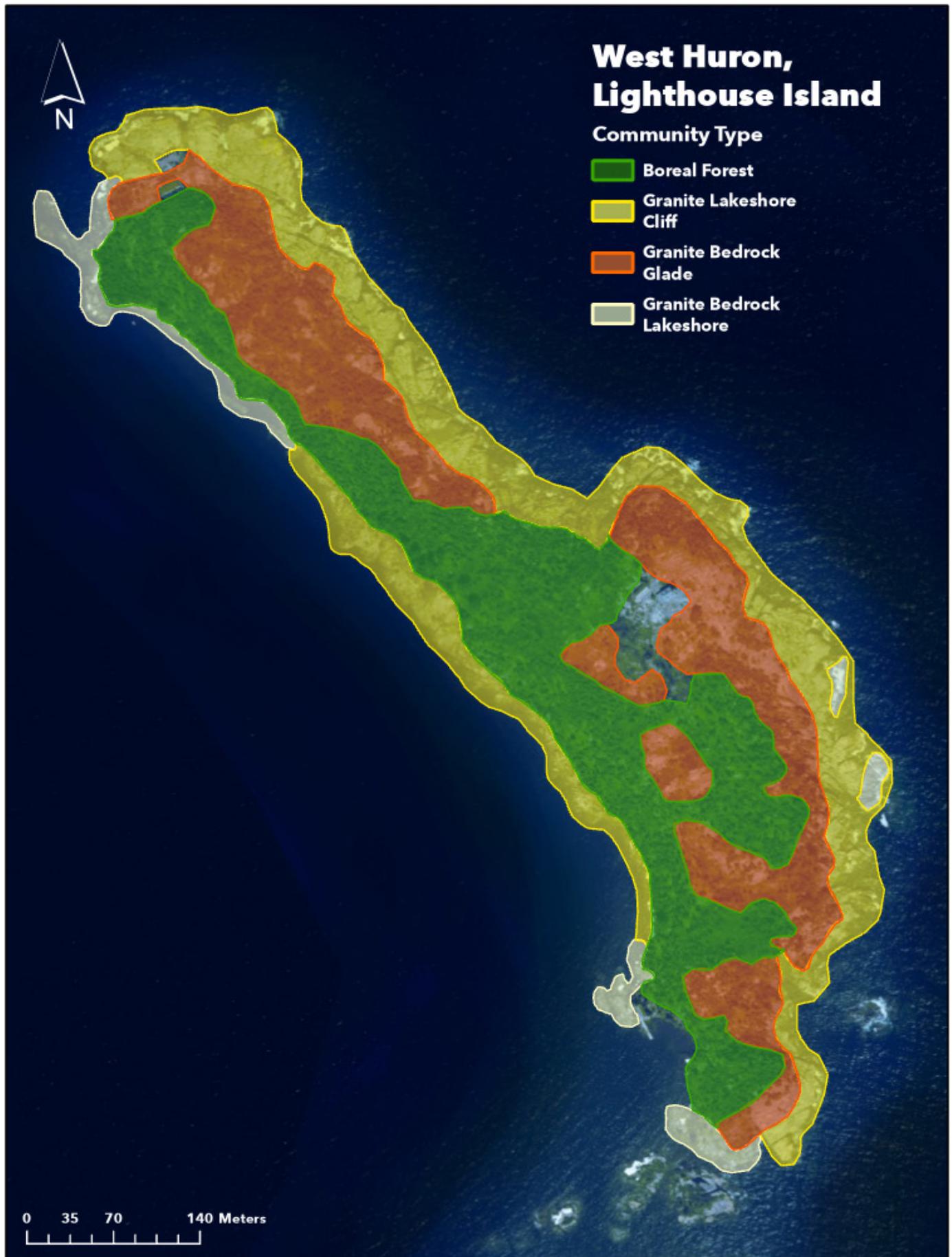
Gull Island granite lakeshore cliff. Photo by Joshua G. Cohen.



Gull Island granite lakeshore cliff delineated in yellow on 2017 imagery.



Gull Island granite lakeshore cliff. Photo by Joshua G. Cohen.



**Figure 10.** Natural community element occurrences on West Huron Island, Huron Islands National Wildlife Refuge.

## 11. West Huron Island - Boreal Forest

**Natural Community Type:** Boreal Forest

**Rank:** GU S3, globally unrankable and vulnerable within the state

**Element Occurrence Rank:** B

**Size:** 15 acres

**Location:** West Huron Island, Seney Wildlife Refuge, Lake Superior

**Element Occurrence Identification Number:** 26256

**Site Description:** West Huron Island is composed of six granitic knobs separated by steep ravines. The interior of the island is characterized by boreal forest and granite bedrock glade on shallow soils over the bedrock. The boreal forest and granite bedrock glade intergrade locally and occur on moderate to very steep topography. The boreal forest is composed of one polygon that spans the island. The boreal forest occurs on both sloping granite bedrock and talus and is characterized by shallow (typically 5-25 cm) very acidic organics and loams overlying granitic bedrock. Measured pH ranged from 4.0 to 5.5 with an average of 4.9 across 10 soil plots. Depth of organic and mineral soil overlying granite bedrock is variable. Measured soil depths over the granite bedrock ranged from 4 to 50 cm with the majority of plots (7 of 10) with soil depths between 10 and 20 cm and an average soil depth of 14 cm. Where pines occur in the canopy, a needle litter occurs and ranges from 4 to 8 cm. Boreal forest occurring on talus is characterized by loose unconsolidated organics and loams occurring between and beneath the granite talus. Vertical rock faces, crevices, and granite boulders occur locally within the boreal forest. Estimated slope over most of the boreal forest ranged between 20 and 60 degrees.



West Huron Island boreal forest. Photo by Joshua G. Cohen.



West Huron Island boreal forest delineated in yellow on 2017 imagery.



Summer fog (pictured above), growing season thunderstorms (pictured below) and associated windthrow, and heavy snowfall influence the floristic composition, vegetative structure, and successional trajectory of the boreal forest on West Huron Island. Photos by Jesse M. Lincoln.



Given the landscape position of the boreal forest on West Huron Island in Lake Superior and the shallow soils across the forest, windthrow is prevalent. As a result, the boreal forest is characterized by high volumes of coarse woody debris including both snags and downed logs. The coarse woody debris load is composed primarily of small diameter and fast decomposing early-successional species, namely balsam fir (*Abies balsamea*), paper birch (*Betula papyrifera*), and trembling aspen (*Populus tremuloides*). Layering balsam fir was documented within the boreal forest. Layering occurs when a windblown tree's lateral branches grow vertically following windthrow. This layering is unusual for this species in Michigan.

Numerous canopy dominants were cored across the boreal forest to help determine the age range of canopy trees. The boreal forest is uneven aged, both across the island and at the stand level; different patches of boreal forest represent distinct canopy cohorts and stands of boreal forest have canopy trees of different ages with the overtopping pines being significantly older than the trees in the lower canopy layer. Ten canopy trees in 10 overstory plots were cored and the average age of canopy dominants is 83 years with estimated canopy ages ranging widely from 39 to 150 years. Cored canopy trees include balsam fir, paper birch, northern white-cedar (*Thuja occidentalis*), white pine (*Pinus strobus*), and black spruce (*Picea mariana*). Aged trees documented within the boreal forest include a 47.3 cm white pine (over 150 yrs), a 36.9 cm black spruce (over 116 yrs), a 74 cm paper birch (over 105 yrs), a 22.4 cm northern white-cedar (over 100 yrs), and a 17.3 cm balsam fir (over 77 yrs). Canopy tree ages within the boreal forest on West Huron Island (39-150 yrs) are markedly lower than estimated ages of trees within the boreal forest on East Huron Island (38-305 yrs). This is likely due to the selective logging for building materials and firewood that occurred while the lighthouse was occupied on West Huron Island.

On southwesterly aspects, boreal forest grades locally to dry-mesic northern forest and pine becomes more prevalent in the canopy. There is also a small inclusion of inland granite cliff in the northwestern portion of the island. Areas of sloping bedrock along the northern shore of the island support small inclusions of hanging peatland. These areas are characterized by acidic (pH 4.5) sphagnum peat that is 2 to 80 cm deep and overlies the granite bedrock. In addition to sphagnum mosses, these areas support dense shrub cover of Labrador tea (*Rhododendron groenlandicum*) and leatherleaf (*Chamaedaphne calyculata*) with a scattered overstory of black spruce (*Picea mariana*). Peat accumulates in these cool microsites because of the northern aspect and the prevalence of summer fogs. Within one of the areas of sloping peatland nested within the boreal forest a 19.1 cm black spruce was cored and estimated to be over 180 years old (171 growth rings counted). This type of peatland occurring on sloping bedrock has never been documented in Michigan and this unique type merits consideration as a new natural community type for Michigan. Comparable systems have been documented in Ontario (D. Albert, Oregon State University, personal communication) and Maine (Gawler and Cutko 2018).

Canopy composition of the boreal forest is variable with early-successional species being prevalent due to the frequency of wind disturbance on the island. Canopy dominants include balsam fir and paper birch. Additional canopy associates include northern white-cedar, white pine, trembling aspen, black spruce, mountain-ash (*Sorbus decora*), pin cherry (*Prunus pensylvanica*), mountain maple (*Acer spicatum*), and red maple (*A. rubrum*). Areas of boreal forest with deeper soils tend to exhibit an increased importance of deciduous species in the canopy. White pine and northern white-cedar increase in importance in the boreal forest along the margins of boreal forest and granite bedrock glade or granite lakeshore cliff. In localized portions of the island with more protection from windthrow, supercanopy white pine occur within the boreal forest and generate a two-tiered canopy with large diameter white pine overtopping the lower stature canopy trees. Canopy coverage typically ranges from 40 to 60% with some local patches having more open canopy (30-40%) where blowdown is more prevalent, and areas protected from windthrow having more closed canopy (60-70%). Canopy trees typically range in diameter from 10 to 30 cm with scattered supercanopy white pine reaching 60 to 80 cm and canopy red maple and paper birch reaching 30 to 55 cm. A 78.3 cm supercanopy white pine was recorded. The average diameter of measured canopy trees was 17 cm (n = 266). Prevalent species in the subcanopy layer include balsam fir, mountain-ash, mountain maple, and pin cherry.

The understory layer is patchy to dense (15-50%) with yew (*Taxus canadensis*) and balsam fir locally dominant and additional species including mountain maple, pin cherry, choke cherry (*Prunus virginiana*), red maple, paper birch, mountain-ash, trembling aspen, red-berried elder (*Sambucus racemosa*), round-leaved serviceberry (*Amelanchier sanguinea*), and round-leaved dogwood (*Cornus rugosa*). Understory yew is locally dense and tall, ranging between 6 and 12 feet tall, indicating the absence of deer on West Huron Island. The low shrub layer is patchy to dense (25-40%) with common species including yew, bush-honeysuckle (*Diervilla lonicera*), mountain maple, bristly blackberry (*Rubus setosus*), wild rose (*Rosa acicularis*), skunk currant (*Ribes glandulosum*), Canada blueberry (*Vaccinium myrtilloides*),

round-leaved serviceberry, red-berried elder, pin cherry, choke cherry, Canadian fly honeysuckle (*Lonicera canadensis*), and Labrador tea. Tree seedlings occurring within the low shrub layer include red maple, paper birch, trembling aspen, and mountain-ash.

The ground cover is patchy to dense (10-25%) with characteristic species including Canada mayflower (*Maianthemum canadense*), twinflower (*Linnaea borealis*), wild sarsaparilla (*Aralia nudicaulis*), common polypody (*Polypodium virginianum*), bluebead-lily (*Clintonia borealis*), bunchberry (*Cornus canadensis*), creeping-snowberry (*Gaultheria hispida*), big-leaved aster (*Eurybia macrophylla*), woodferns (*Dryopteris* spp., include state special concern *D. filix-mas*), sedges (*Carex arctata*, *C. brunnescens*, and *C. pedunculata*), bluegrass (*Poa glauca*), and cow-wheat (*Melampyrum lineare*). Usnea lichen is locally common within the forest drooping from branches of conifers.

The West Huron Island boreal forest was surveyed from August 15<sup>th</sup> through August 19<sup>th</sup>. Eighty-four plant species were documented with 80 native species and 4 non-native species (Appendix 2.11). The total FQI was 41.2.

**Threats:** Species composition and structure are patterned by natural processes and past selective logging that occurred when the lighthouse was occupied. Scattered non-native species include roving bellflower (*Campanula rapunculoides*), garden phlox (*Phlox paniculata*), bluegrass (*Poa nemoralis*), and Canada bluegrass (*P. compressa*). The distance of the island to the mainland results in the absence of deer and accompanying browse pressure.

**Management Recommendations:** The main management recommendations are to allow natural processes to operate unhindered (i.e., let wildfires burn) and to maintain a natural buffer surrounding the boreal forest.



Usnea lichen is locally common within the West Huron Island boreal forest. Photo by Joshua G. Cohen.



West Huron Island boreal forest. Photos by Jesse M. Lincoln.



## 12. West Huron Island - Granite Bedrock Glade

**Natural Community Type:** Granite Bedrock Glade

**Rank:** G3G5 S2, vulnerable to secure globally and imperiled within the state

**Element Occurrence Rank:** AB

**Size:** 14 acres

**Location:** West Huron Island, Seney Wildlife Refuge, Lake Superior

**Element Occurrence Identification Number:** 26255

**Site Description:** West Huron Island is composed of six granitic knobs separated by steep ravines. The island's interior is characterized by granite bedrock glade and boreal forest on shallow soils over the bedrock. The granite bedrock glade and boreal forest intergrade locally and occur on moderate to very steep topography. Lakeward, granite bedrock glade transitions to granite lakeshore cliff and granite bedrock lakeshore. The site is composed of five distinct polygons of granite bedrock glade. The soils are shallow (typically 0-3 cm), very acidic organics and loams overlying granitic bedrock. Soil development is restricted to cracks, fissures, and low depressions with the majority of the glade being characterized by exposed granitic bedrock. Exposed bedrock covered 26 to 50% of the observed area in 3 plots, 51 to 75% in 1 plot, and 76 to 95% in 1 plot. Measured pH ranged from 4.5 to 5.5 with an average of 5.0 across 10 soil plots. Measured soil depths over the granite bedrock within the 10 plots ranged from 0 to 20 cm with the majority of plots (9 of 10) with soil depths between 1 and 5 cm and soil depths being greater on flatter exposures of bedrock. Vertical rock faces occur locally within the granite bedrock glade.

Areas of exposed bedrock are covered by a diverse array of lichens and mosses. Soils and vegetation are accumulating in flat areas, depressions, crevices, and at the base of tree boles. Fire has likely been an important disturbance factor within the granite bedrock glade and charring was noted on the boles of canopy trees within the glade. The scattered and stunted trees and shrubs are drought-, wind-, and freeze-stressed. Extreme cold and heat generate challenging growing conditions



West Huron Island granite bedrock glade. Photo by Joshua G. Cohen.



West Huron Island granite bedrock glade delineated in yellow on 2017 imagery.

for the plants within the glade. Many trees within the granite bedrock glade are stressed and canopy mortality is common. Snags and coarse woody debris occur throughout the glade.

The canopy cohort of the glade is uneven aged. Eleven canopy trees were cored in 10 overstory plots and the average age of canopy dominants is 75 years with estimated canopy ages ranging from 33 to 180 years and cored canopy trees including northern white-cedar (*Thuja occidentalis*), white pine (*Pinus strobus*), red pine (*P. resinosa*), balsam fir (*Abies balsamea*), mountain-ash (*Sorbus decora*), and trembling aspen (*Populus tremuloides*). Aged trees documented within the granite bedrock glade include a 24.5 cm northern white-cedar (over 180 yrs), a 28.4 cm red pine (over 170 yrs), and a 23.9 cm northern white-cedar (over 100 yrs).

Bear-flipped rocks and excavated ant mounds, prevalent on glades in the nearby mainland to the south, were noticeably absent within this glade. A prolific crop of blueberries was observed within the glade and the absence of bear and other frugivores found on the mainland is likely contributing to the abundant crop. The distance of the island to the mainland results in the absence of deer and accompanying browse pressure.

Granite bedrock glade intergrades lakeward to granite lakeshore cliff and granite bedrock lakeshore and inland to boreal forest. Within the glade there are numerous fissures and ledges, and cliff faces and talus slopes occur locally. In addition, the glade is characterized by numerous pools that contain standing water from precipitation and/or wave splash and contain localized pockets of wetland vegetation.



Margins of pools within the West Huron Island granite bedrock glade support wetland vegetation including stunted northern white-cedar, and leatherleaf. Photo by Joshua G. Cohen.

The overstory is scattered and stunted (5-30%) with diverse canopy composition including white pine, red pine, northern white-cedar, paper birch (*Betula papyrifera*), balsam fir, trembling aspen, black spruce (*Picea mariana*), mountain-ash, and red maple (*Acer rubrum*). Canopy trees typically range in diameter from 10 to 20 cm. The average diameter of measured canopy trees was 15 cm (n = 100) and the range was 10 to 39.4 cm. The understory is also sparse (5-15%) with characteristic species including pin cherry (*Prunus pensylvanica*), choke cherry (*P. virginiana*), paper birch, northern white-cedar, balsam fir, trembling aspen, mountain-ash, ninebark (*Physocarpus opulifolius*), round-leaved serviceberry (*Amelanchier sanguinea*), mountain maple (*Acer spicatum*), red maple, and red-osier dogwood (*Cornus sericea*).

The low shrub layer is patchy (15-30%) with common species including Canada blueberry (*Vaccinium myrtilloides*), bearberry (*Arctostaphylos uva-ursi*), creeping juniper (*Juniperus horizontalis*), low sweet blueberry (*Vaccinium angustifolium*), bush-honeysuckle (*Diervilla lonicera*), bristly blackberry (*Rubus setosus*), wild rose (*Rosa acicularis*), skunk currant (*Ribes glandulosum*), round-leaved serviceberry, red-berried elder (*Sambucus racemosa*), meadowsweet (*Spiraea alba*), and yew (*Taxus canadensis*). Tree seedlings occurring within the low shrub layer include white pine, balsam fir, paper birch, red maple, northern white-cedar, and mountain-ash. Leatherleaf (*Chamaedaphne calyculata*), Labrador tea (*Rhododendron groenlandicum*), and black spruce occur locally both along the margins of inundated depressions and on sloping bedrock along the northern shore of the island where sphagnum peat develops locally.

Sparse to patchy ground cover (10-25%) is concentrated where soils have accumulated along cracks, crevices, and depressions in the granite bedrock. A diverse array of lichens, mosses, and feathermosses cover the exposed granite within the granite bedrock glade. Prevalent ground cover species include hair grass (*Avenella flexuosa*), harebell (*Campanula rotundifolia*), pale corydalis (*Capnoides sempervirens*), three-toothed cinquefoil (*Sibbaldiopsis tridentata*), hairy goldenrod (*Solidago hispida*), ticklegrass (*Agrostis scabra*), poverty grass (*Danthonia spicata*), common polypody (*Polypodium virginianum*), fireweed (*Chamaenerion angustifolium*), white lettuce (*Prenanthes alba*), western fescue (*Festuca occidentalis*), wild strawberry (*Fragaria virginiana*), bristly sarsaparilla (*Aralia hispida*), Pennsylvania sedge (*Carex pensylvanica*), grass-leaved goldenrod (*Euthamia graminifolia*), and pearly everlasting (*Anaphalis margaritacea*). Where canopy closure is greater (20-30%), common ground cover species include cow-wheat (*Melampyrum lineare*), bunchberry (*Cornus canadensis*), creeping-snowberry (*Gaultheria hispidula*), twinflower (*Linnaea borealis*), starflower (*Trientalis borealis*), sedge (*Carex pedunculata*), woodferns (*Dryopteris* spp.), big-leaved aster (*Eurybia macrophylla*), and bracken fern (*Pteridium aquilinum*).

Margins of pools within the granite bedrock glade support wetland vegetation including stunted northern white-cedar, leatherleaf, Labrador tea, chokeberry (*Aronia prunifolia*), blue-joint (*Calamagrostis canadensis*), sedges (*Carex* spp.), and round-leaved sundew (*Drosera rotundifolia*).

The West Huron Island granite bedrock glade was surveyed from August 15<sup>th</sup> through August 19<sup>th</sup>. One hundred and fifteen plant species were documented with 106 native species and 9 non-native species (Appendix 2.12). The total FQI was 48.3.

**Threats:** Species composition and structure are patterned by natural processes. Scattered non-native species occur locally and include sheep sorrel (*Rumex acetosella*), Canada bluegrass (*Poa compressa*), king devil (*Hieracium caespitosum*), mouse-ear chickweed (*Cerastium fontanum*), orange hawkweed (*Hieracium aurantiacum*), common St. John's-wort (*Hypericum perforatum*), ox-eye daisy (*Leucanthemum vulgare*), garden phlox (*Phlox paniculata*), and Kentucky bluegrass (*Poa pratensis*). Non-native species are most prevalent in the areas of glade occurring adjacent to the lighthouse and fog signal station and associated buildings.

**Management Recommendations:** The main management recommendations are to allow natural processes to operate unhindered (i.e., let wildfires burn) and to maintain a natural buffer surrounding the glades to prevent the increase of a weedy seed source. Efforts to control non-native species should be implemented and these control efforts should be monitored.



Glacial striations occur locally within the West Huron Island granite bedrock glade. These long, straight, parallel grooves or abrasions were scratched onto the granite bedrock surface by rock fragments lodged in the base of the moving glacier. Photo by Joshua G. Cohen.



Gnarled, twisted, and weathered pine snag within the West Huron Island granite bedrock glade. Photo by Jesse M. Lincoln.

### 13. West Huron Island - Granite Bedrock Lakeshore

**Natural Community Type:** Granite Bedrock Lakeshore

**Rank:** G4G5 S2, apparently secure to secure globally and imperiled within the state

**Element Occurrence Rank:** B

**Size:** 2 acres

**Location:** West Huron Island, Seney Wildlife Refuge, Lake Superior

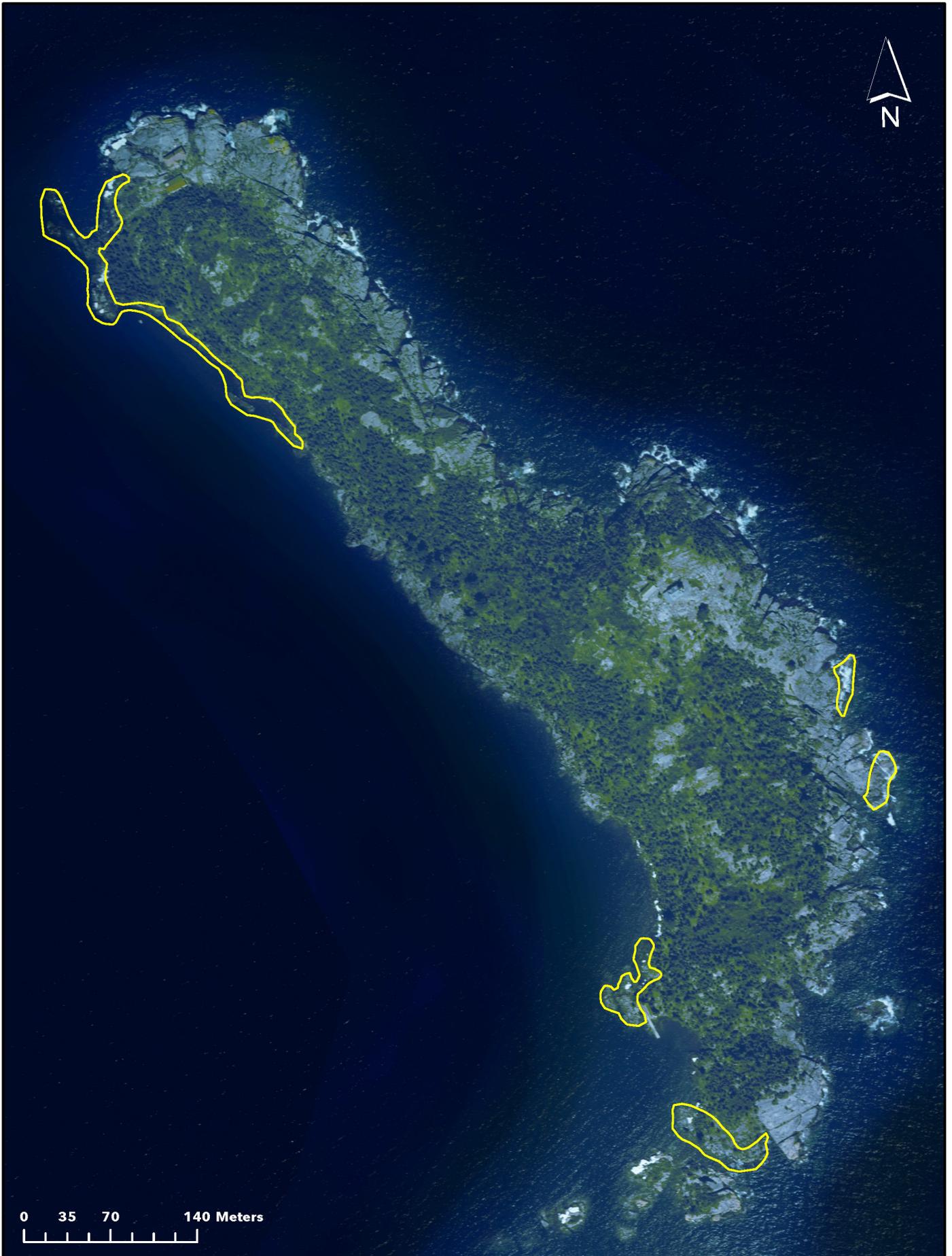
**Element Occurrence Identification Number:** 26246

**Site Description:** Over a third of a mile of granite bedrock lakeshore occurs in five discrete polygons along the northern and southern shoreline of West Huron Island. The majority of the shoreline is characterized by granite lakeshore cliff. The localized pockets of granite bedrock lakeshore occur between and at the base of some of the cliff outcroppings. Both granite bedrock lakeshore and granite lakeshore cliff are backed by granite bedrock glade and boreal forest, which intergrade in the interior of the island. This site was surveyed in 2022, a year after five consecutive years of high Great Lakes water levels (from 2016 through 2020) resulting in the decrease in the extent of the granite bedrock lakeshore. High water levels and increased wave activity have likely reduced the overall cover of herbaceous species in the granite bedrock lakeshore.

The soils of the granite bedrock lakeshore are characterized by shallow (1-2 cm) acidic (pH 5.5) organics accumulating in cracks, crevices, and small depressions. Soil chemistry is variable and is dependent on the composition of the decomposing organic material. Shallow pools of water or splash pools occur locally on the granite bedrock lakeshore with some of the pools supporting wetland vegetation. An 8.5 cm northern white-cedar (*Thuja occidentalis*) along the upper margin of the granite bedrock lakeshore was cored and estimated to be over 30 years old.



West Huron Island granite bedrock lakeshore. Photo by Joshua G. Cohen.



West Huron Island granite bedrock lakeshore delineated in yellow on 2017 imagery.

The granite bedrock lakeshore is sparsely vegetated and dominated by non-vascular species with herbaceous plants (2-10%) and scattered tree cover (1-2%) and shrub cover (4-8%) restricted to the inland edge and cracks and crevices. A diverse array of lichens and mosses cover the exposed granite within the granite bedrock lakeshore. Characteristic herbaceous species include hair grass (*Avenella flexuosa*), harebell (*Campanula rotundifolia*), pale corydalis (*Capnoides sempervirens*), three-toothed cinquefoil (*Sibbaldiopsis tridentata*), hairy goldenrod (*Solidago hispida*), fireweed (*Chamaenerion angustifolium*), common polypody (*Polypodium virginianum*), poverty grass (*Danthonia spicata*), and grass-leaved goldenrod (*Euthamia graminifolia*). Herbaceous vegetation is primarily found in the infrequent cracks and crevices within the granite bedrock but also locally occurs along the margins of the splash pools with common species flanking the pools including grass-leaved goldenrod, round-leaved sundew (*Drosera rotundifolia*), and northern bugle weed (*Lycopus uniflorus*).

Scattered trees and tall shrubs include northern white-cedar, trembling aspen (*Populus tremuloides*), balsam fir (*Abies balsamea*), white pine (*Pinus strobus*), red maple (*Acer rubrum*), mountain-ash (*Sorbus decora*), choke cherry (*Prunus virginiana*), pin cherry (*P. pensylvanica*), round-leaved serviceberry (*Amelanchier sanguinea*), and ninebark (*Physocarpus opulifolius*). Characteristic low shrubs include bearberry (*Arctostaphylos uva-ursi*), creeping juniper (*Juniperus horizontalis*), leatherleaf (*Chamaedaphne calyculata*), low sweet blueberry (*Vaccinium angustifolium*), Canada blueberry (*V. myrtilloides*), mountain fly honeysuckle (*Lonicera villosa*), and wild rose (*Rosa acicularis*).

The West Huron Island granite bedrock lakeshore was surveyed from August 15<sup>th</sup> through August 19<sup>th</sup>, 2022. Sixty-seven plant species were documented with 62 native species and 5 non-native species (Appendix 2.13). The total FQI was 36.

**Threats:** Species composition and structure are patterned by natural processes. Non-native species occur locally and include pearlwort (*Sagina procumbens*), Canada bluegrass (*Poa compressa*), spotted knapweed (*Centaurea stoebe*), king devil (*Hieracium caespitosum*), and common St. John's-wort (*Hypericum perforatum*).

**Management Recommendations:** Efforts to control invasive species, especially spotted knapweed, should be implemented and these control efforts should be monitored.



Granite bedrock lakeshore is subject to winter storms and ice that scour vegetation from granite bedrock lakeshore. Pictured here is granite bedrock lakeshore from Marquette County from the winter of 2023. Photo by Joshua G. Cohen.



West Huron Island granite bedrock lakeshore. Photos by Joshua G. Cohen.





Michigan's second largest documented granite bedrock lakeshore (above) and granite lakeshore cliff (below) occur along the shoreline of West Huron Island. Photos by Jesse M. Lincoln.



#### 14. West Huron Island - Granite Lakeshore Cliff

**Natural Community Type:** Granite Lakeshore Cliff

**Rank:** GU S1, globally unrankable and critically imperiled within the state

**Element Occurrence Rank:** A

**Size:** 13 acres

**Location:** West Huron Island, Seney Wildlife Refuge, Lake Superior

**Element Occurrence Identification Number:** 26248

**Site Description:** Approximately a mile of granite lakeshore cliff occurs along the eastern and western shorelines of West Huron Island. In addition to granite lakeshore cliff, the shoreline also supports granite bedrock lakeshore. Localized pockets of granite bedrock lakeshore occur between and at the base of some of the cliff outcroppings with notable exposures found at the northern and southern ends of the island. The cliffs transition to granite bedrock glade and boreal forest, which intergrade in the interior of the island. The cliffs range widely from 10 to 120 ft tall but are typically between 30 and 60 feet in height with the tallest cliffs (80 to 120 ft) occurring along the eastern and western-central shorelines. The complex is primarily composed of cliff exposure that is immediately adjacent to the lakeshore but also includes granitic fissures that cut into the interior of the island. The fissures are characterized by vertical cliff faces on either side of cool ravines and these features continue into Lake Superior, generating underwater chasms that likely provide important deep-water habitat for fish. These fissures are most prevalent along the east-central portion of the island and exhibit significantly cooler temperatures (estimated to be 20°F cooler on a hot August day). Numerous fern species occur within these cooler granite slot canyons and the only frog observed on the island was found within one. Large granite boulders occur locally at the base of the granite lakeshore cliff and are typically submerged or emerging from the water. Very shallow (0-3 cm) fine-textured, acidic (pH 4.5-6.5) soils with organics accumulate on the ledges and crevices. Soil chemistry is variable and depends on the decomposing plant material that makes up the organic matter. Thin soils, cold winter temperatures, steady winds, wave splash, and summer droughts make for harsh growing conditions for vegetation. In 1909 during a significant spring storm event, the lighthouse keeper on the island noted wave splash reaching nearly 200 feet in height (The Labour World 1909).



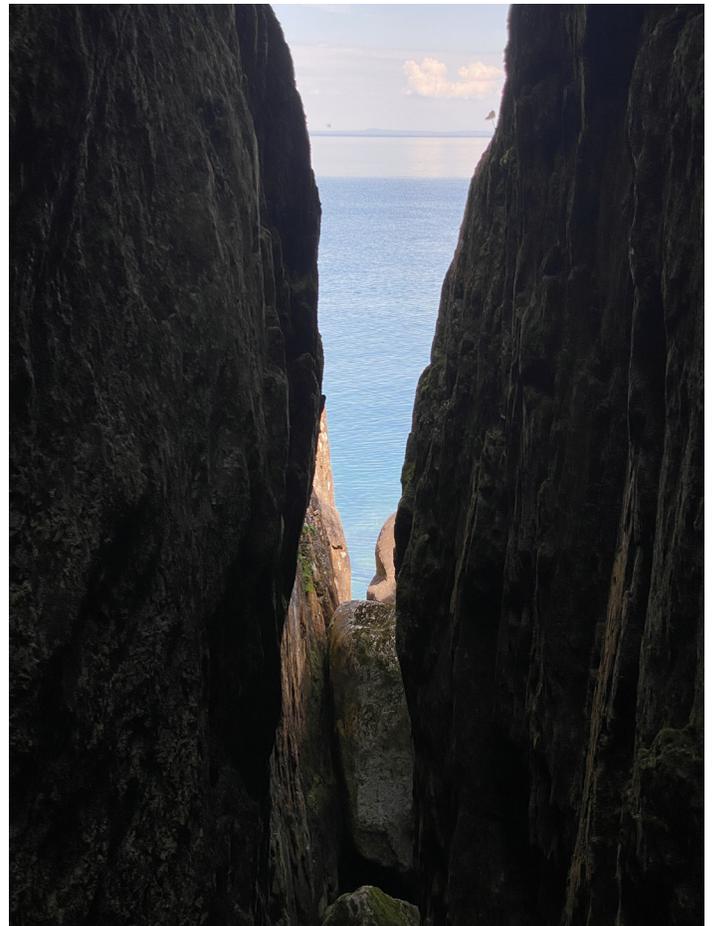
West Huron Island granite lakeshore cliff. Photo by Joshua G. Cohen.



West Huron Island granite lakeshore cliff delineated in yellow on 2017 imagery.



Several fissures extend from the interior of the island and continue into Lake Superior. These granitic slot canyons are a unique feature of the granite lakeshore cliff and are characterized by a cooler microclimate. Photos by Joshua G. Cohen.



The northern white-cedar (*Thuja occidentalis*) and pines (*Pinus* spp.) occurring along the granite lakeshore cliff are often gnarled and twisted, exhibiting bonsai growth forms due to centuries of surviving stressful conditions and eking out an existence growing from narrow crevices on thin soils. Multiple northern-white cedars and pines were cored along the top of the cliffs and estimated ages ranged from 150 to 200 years old. A 37.3 cm northern white-cedar was estimated to be over 200 years old and a 35.5 cm red pine (*Pinus resinosa*) was estimated to be over 155 years old. Many of the cored trees had rotten centers and older trees on inaccessible ledges and cliff faces likely occur throughout.

Vegetation is sparse and generally restricted to the flat, exposed bedrock at the upper edge of the cliff (i.e., lip), cracks and joints in the cliff face, and ledges along the cliff face. The majority of the vertical cliff face is bare of all vascular vegetation, but lichens and mosses are prevalent. Sparse herbaceous cover (5-10%) includes yarrow (*Achillea millefolium*), grass-leaved goldenrod (*Euthamia graminifolia*), harebell (*Campanula rotundifolia*), three-toothed cinquefoil (*Sibbaldiopsis tridentata*), hairy goldenrod (*Solidago hispida*), hair grass (*Avenella flexuosa*), pearly everlasting (*Anaphalis margaritacea*), and wild strawberry (*Fragaria virginiana*). Male fern (*Dryopteris filix-mas*, state special concern) occurs locally in crevices within the cliff. Sparse shrub cover (2-8%) includes creeping juniper (*Juniperus horizontalis*), common juniper (*J. communis*), bearberry (*Arctostaphylos uva-ursi*), low sweet blueberry (*Vaccinium angustifolium*), Canada blueberry (*V. myrtilloides*), red-osier dogwood (*Cornus sericea*), wild red raspberry (*Rubus strigosus*), wild rose (*Rosa acicularis*), and red-berried elder (*Sambucus racemosa*). Stunted and scattered trees (1-4%) occur along the lip and on ledges and crevices and include northern white-cedar, white pine (*Pinus strobus*), red pine, paper birch (*Betula papyrifera*), balsam fir (*Abies balsamea*), black spruce (*Picea mariana*), trembling aspen (*Populus tremuloides*), and mountain-ash (*Sorbus decora*).

The West Huron Island granite lakeshore cliff was surveyed from August 15<sup>th</sup> through August 19<sup>th</sup>, 2022. Ninety-five plant species were documented with 89 native species and 6 non-native species (Appendix 2.14). The total FQI was 45.8.

**Threats:** Species composition and structure are patterned by natural processes. Non-native species occur locally and include common St. John's-wort (*Hypericum perforatum*), Canada bluegrass (*Poa compressa*), sheep sorrel (*Rumex acetosella*), and common dandelion (*Taraxacum officinale*).

**Management Recommendations:** The main management recommendations are to allow natural processes to operate unhindered and to maintain a buffer of natural communities surrounding the granite lakeshore cliff to prevent the increase of a weedy seed source and desiccation. Efforts to control invasive species should be implemented and these control efforts should be monitored.



West Huron Island granite lakeshore cliff. Photo by Joshua G. Cohen.



Ledges and crevices along the cliff support gnarled and stunted bonsai cedars and pines that are centuries old. Photos by Jesse M. Lincoln (above) and Joshua G. Cohen (below).



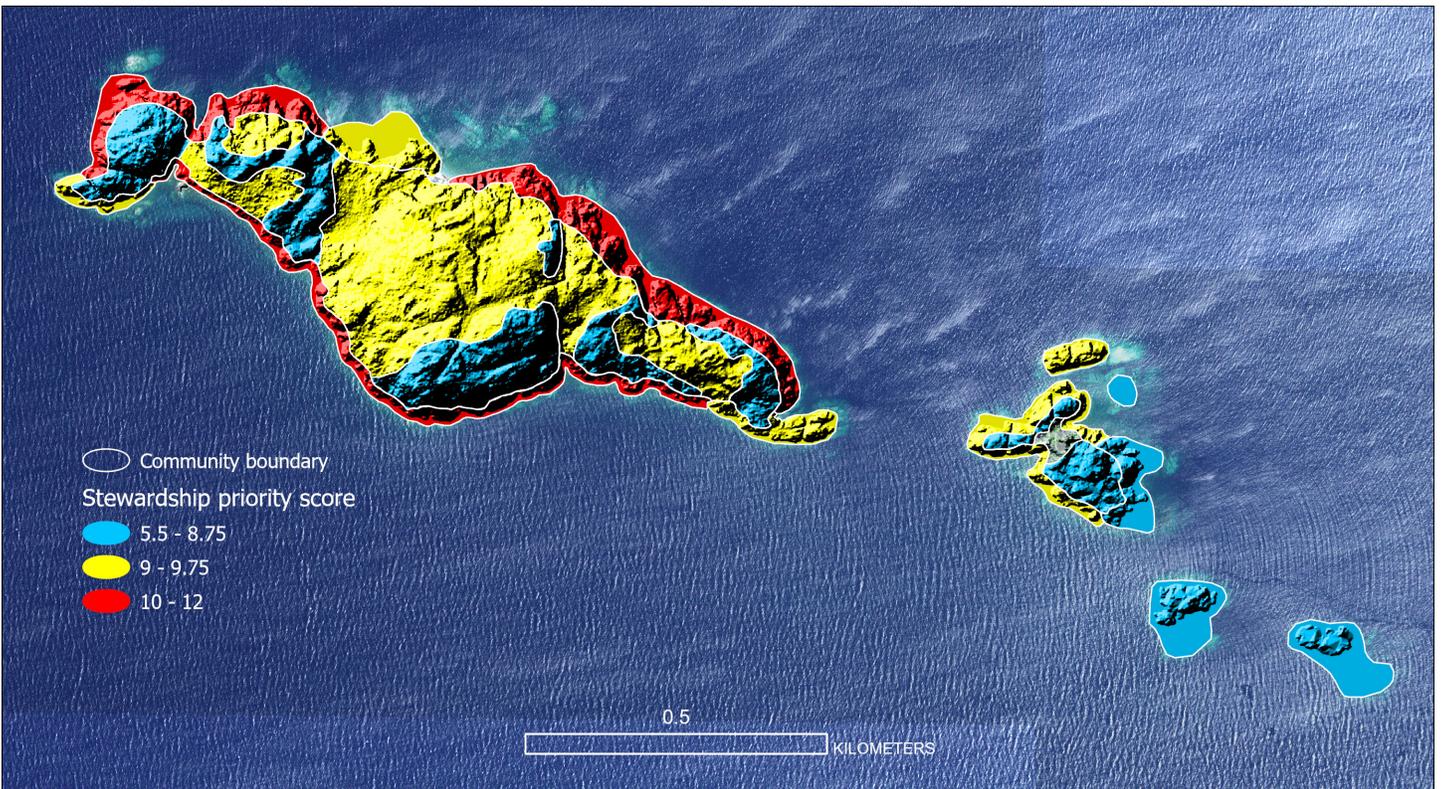
# Stewardship Prioritization Results

The stewardship prioritization scores for each natural community element occurrence within the Huron Islands are presented in Table 2 and graphically displayed in Figures 11 and 12. We sorted the element occurrences by their stewardship prioritization scores and assigned them a high ( $\geq 10$ ; red), medium ( $\geq 9$  and  $< 10$ ; yellow), or low ( $< 9$ ; blue) stewardship priority. The highest ranking natural community element occurrence is the granite bedrock lakeshore from West Huron Island. Granite bedrock lakeshore is a Great Lakes endemic natural community

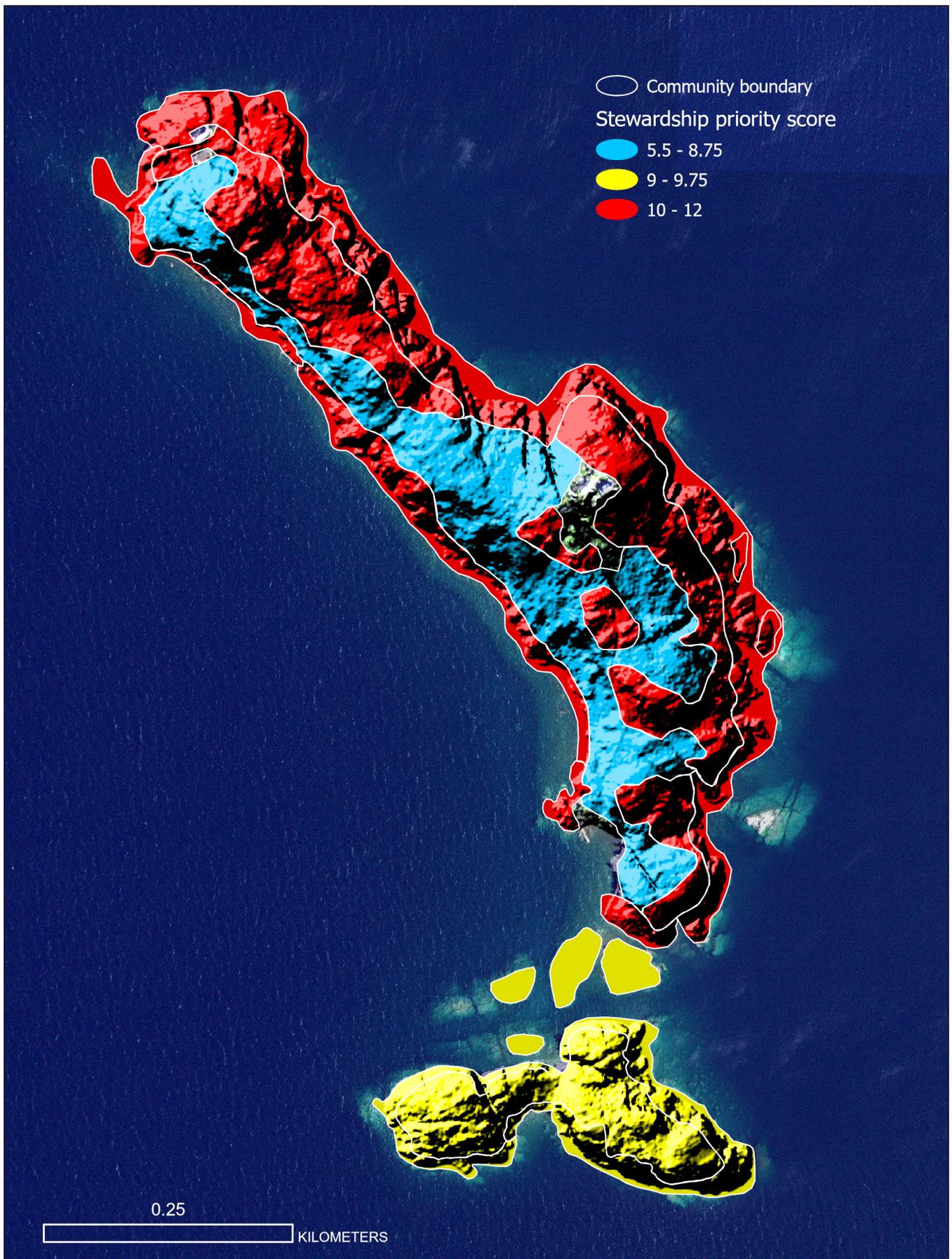
type and this example is characterized by high native diversity and integrity threatened by an incipient invasive species infestation of spotted knapweed. Additional natural community element occurrences that ranked as the highest priority for stewardship included the granite lakeshore cliffs from West Huron Island and East Huron Island and also the granite bedrock glade from West Huron Island. Compared to other islands in the National Wildlife Refuge (Table 3), these are high priority scores.

**Table 2.** Stewardship prioritization for natural community element occurrences in the Huron Islands National Wildlife Refuge. Element occurrences are sorted by their stewardship prioritization scores and assigned a high (red), medium (yellow), or low (blue) stewardship priority.

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 Feasibility	Invasive Index	Stewardship Priority Score
26246	Granite Bedrock Lakeshore	West Huron Island	AB	4.5	G4G5	1.5	S2	4	2.75	3	3	3	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
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
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
26251	Granite Lakeshore Cliff	Gull Island	B	4	GU	3	S1	5	4	1	1	1	9
26244	Granite Bedrock Lakeshore	Gull Island	B	4	G4G5	1.5	S2	4	2.75	2	2	2	8.75
26252	Granite Bedrock Glade	Gull Island	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
26253	Boreal Forest	East Huron Island	AB	4.5	GU	3	S3	3	3	0	NA	0	7.5



**Figure 11.** Stewardship prioritization for natural community element occurrences on East Huron Island, Gull Island, and the adjacent unnamed islands. Element occurrences are displayed by their stewardship prioritization scores and assigned a high (red), medium (yellow), or low (blue) stewardship priority.



**Figure 12.** Stewardship prioritization for natural community element occurrences on West Huron Island, Cattle Island, and the adjacent unnamed islands. Element occurrences are displayed by their stewardship prioritization scores and assigned a high (red), medium (yellow), or low (blue) stewardship priority.

**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 Huron Islands natural community EOs are highlighted in bold and underlined and include some of the highest stewardship priorities across the network of islands.

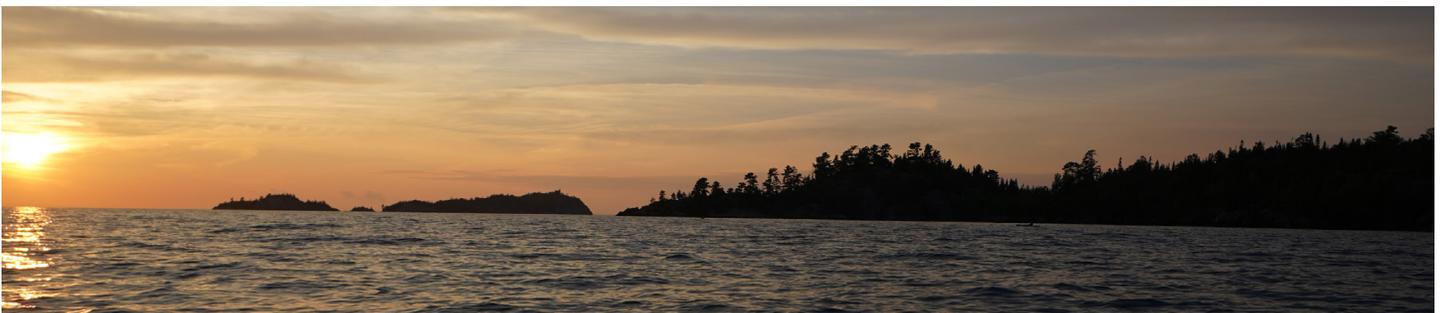
EO ID	Natural Community	Island	EO Rank	Ecological Integrity Index	Global Rank	Global Rank Score	State Rank	State Rank Score	Rarity Index	Invasive Threat Severity	Treatment Feasibility	Invasive Index	Stewardship Priority Score
6682	Great Lakes Marsh	Harbor Island	AB	4.5	G2	4	S3	3	3.5	4	4	4	12
24356	Interdunal 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
<b>26246</b>	<b>Granite Bedrock Lakeshore</b>	<b>West Huron Island</b>	<b>AB</b>	<b>4.5</b>	<b>G4G5</b>	<b>1.5</b>	<b>S2</b>	<b>4</b>	<b>2.75</b>	<b>3</b>	<b>3</b>	<b>3</b>	<b>10.25</b>
24354	Coastal Fen	Crooked Island	AB	4.5	G1G2	4.5	S2	4	4.25	1	2	1.5	10.25
<b>26250</b>	<b>Granite Lakeshore Cliff</b>	<b>East Huron Island</b>	<b>A</b>	<b>5</b>	<b>GU</b>	<b>3</b>	<b>S1</b>	<b>5</b>	<b>4</b>	<b>1</b>	<b>1</b>	<b>1</b>	<b>10</b>
<b>26255</b>	<b>Granite Bedrock Glade</b>	<b>West Huron Island</b>	<b>B</b>	<b>4</b>	<b>G3G5</b>	<b>2</b>	<b>S2</b>	<b>4</b>	<b>3</b>	<b>3</b>	<b>3</b>	<b>3</b>	<b>10</b>
<b>26248</b>	<b>Granite Lakeshore Cliff</b>	<b>West Huron Island</b>	<b>A</b>	<b>5</b>	<b>GU</b>	<b>3</b>	<b>S1</b>	<b>5</b>	<b>4</b>	<b>1</b>	<b>1</b>	<b>1</b>	<b>10</b>
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
<b>26247</b>	<b>Granite Bedrock Lakeshore</b>	<b>Cattle Island</b>	<b>AB</b>	<b>4.5</b>	<b>G4G5</b>	<b>1.5</b>	<b>S2</b>	<b>4</b>	<b>2.75</b>	<b>2</b>	<b>3</b>	<b>2.5</b>	<b>9.75</b>
<b>26245</b>	<b>Granite Bedrock Lakeshore</b>	<b>East Huron Island</b>	<b>AB</b>	<b>4.5</b>	<b>G4G5</b>	<b>1.5</b>	<b>S2</b>	<b>4</b>	<b>2.75</b>	<b>2</b>	<b>3</b>	<b>2.5</b>	<b>9.75</b>
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
<b>26254</b>	<b>Granite Bedrock Glade</b>	<b>Cattle Island</b>	<b>B</b>	<b>4</b>	<b>G3G5</b>	<b>2</b>	<b>S2</b>	<b>4</b>	<b>3</b>	<b>2</b>	<b>3</b>	<b>2.5</b>	<b>9.5</b>
<b>26249</b>	<b>Granite Lakeshore Cliff</b>	<b>Cattle Island</b>	<b>AB</b>	<b>4.5</b>	<b>GU</b>	<b>3</b>	<b>S1</b>	<b>5</b>	<b>4</b>	<b>1</b>	<b>1</b>	<b>1</b>	<b>9.5</b>
<b>26257</b>	<b>Granite Bedrock Glade</b>	<b>East Huron Island</b>	<b>AB</b>	<b>4.5</b>	<b>G3G5</b>	<b>2</b>	<b>S2</b>	<b>4</b>	<b>3</b>	<b>2</b>	<b>2</b>	<b>2</b>	<b>9.5</b>
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
<b>26251</b>	<b>Granite Lakeshore Cliff</b>	<b>Gull Island (Lake Superior)</b>	<b>B</b>	<b>4</b>	<b>GU</b>	<b>3</b>	<b>S1</b>	<b>5</b>	<b>4</b>	<b>1</b>	<b>1</b>	<b>1</b>	<b>9</b>
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
<b>26244</b>	<b>Granite Bedrock Lakeshore</b>	<b>Gull Island (Lake Superior)</b>	<b>B</b>	<b>4</b>	<b>G4G5</b>	<b>1.5</b>	<b>S2</b>	<b>4</b>	<b>2.75</b>	<b>2</b>	<b>2</b>	<b>2</b>	<b>8.75</b>
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
<b>26252</b>	<b>Granite Bedrock Glade</b>	<b>Gull Island (Lake Superior)</b>	<b>BC</b>	<b>3.5</b>	<b>G3G5</b>	<b>2</b>	<b>S2</b>	<b>4</b>	<b>3</b>	<b>2</b>	<b>2</b>	<b>2</b>	<b>8.5</b>
<b>26256</b>	<b>Boreal Forest</b>	<b>West Huron Island</b>	<b>B</b>	<b>4</b>	<b>GU</b>	<b>3</b>	<b>S3</b>	<b>3</b>	<b>3</b>	<b>2</b>	<b>1</b>	<b>1.5</b>	<b>8.5</b>
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
<b>26253</b>	<b>Boreal Forest</b>	<b>East Huron Island</b>	<b>AB</b>	<b>4.5</b>	<b>GU</b>	<b>3</b>	<b>S3</b>	<b>3</b>	<b>3</b>	<b>0</b>	<b>NA</b>	<b>0</b>	<b>7.5</b>
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 Wild Refuge. 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, the diversity of non-vascular plants, cultural significance, and the functionality of the landscape surrounding the site. Implementation of stewardship efforts within prioritized areas will also need to be followed by monitoring to gauge the success of biodiversity management efforts and adjust future stewardship prioritization efforts.

In addition to providing opportunities for monitoring past management actions to inform adaptive management, the NWR islands provide critical learning environments where ecologists can study composition, disturbance histories, pattern, and process to inform ecosystem management and conservation design. The history of human occupancy of West Huron Island while the lighthouse was staffed is correlated with a period of intense anthropogenic disturbance that included building construction; tramway development and use; granite mining; and selective logging for building materials and firewood. In contrast, East Huron Island was not impacted by modern anthropogenic disturbance. A marked difference between the boreal forests of the two islands was noted with older and larger trees being more prevalent on East Huron Island, which also supported a greater component of white and red pines in the overstory. Plot data collected within the boreal forests on each island could be analyzed to elucidate differences in floristic composition and structure between the two islands.

Anthropogenic disturbance within the bedrock communities across the Huron Islands was limited to localized disturbance associated with the structures and trail on West Huron Islands. Lichens and mosses that thrive in primary ecosystems are susceptible to trampling from hikers that explore these bedrock systems on the mainland (MNFI 2023). Because of the general lack of anthropogenic disturbance, the glades, lakeshores, and cliffs across the Huron Islands would make for excellent study sites for research on the lichens and mosses that are prevalent on exposed granitic bedrock systems. Evaluating non-vascular plants and lichens, including their diversity and ecological role, was beyond the scope of this project but we provide some information here to convey the importance of this often-overlooked component of natural communities. Lichens on the Huron Islands play a critical role in community assembly of the bedrock community types and drive microprocesses within those systems. The soil building process caused by lichens is driven by the root-like hyphal structures of the lichen that anchor it to the rock and penetrate microscopic mineral cleavages of the rock. This facilitates the granite weathering process and slowly leads to soil development (Brodo et al. 2001). Additionally, the organic material from shed lichens accumulates in low places and in cracks, leading to moss development and likely expanding available niches on the granite slabs. On granite bedrock glades, lichens slightly mitigate the most intense drought conditions by absorbing large amounts of moisture during rain events. Species in the genus *Umbilicaria* are especially prevalent and absorptive. Through a gradual release of moisture, they appear to keep the relative humidity higher for days after rain. This drought mitigating feature of lichens was less pronounced on glades of West Huron Island that occurred near trails where high traffic reduced the extent and diversity of lichens on the exposed, flat areas of granite. On the Huron Islands, lichen composition is driven



This photo depicts from left to right West Huron Island, Cattle Island, and East Huron Island. The silhouettes of these islands illustrate the striking difference in canopy between East Huron Island and West Huron Island and Cattle Island with pines clearly more prevalent on East Huron Island. We encourage use of the quantitative data collected across these islands to elucidate the compositional differences among the islands. Photo by Jesse M. Lincoln.

by aspect of the rock; aspect of the area on the island; humidity levels influenced by prevailing winds; unique rock formations (crevasses and overhangs); proximity to storm line above the water levels; guano deposition; canopy coverage; and degree of foot traffic (namely on West Huron). We strongly encourage focused studies to evaluate the diversity and ecological role of non-vascular plants and lichens within the Huron Island bedrock ecosystems.

Invasive species, particularly common St. John's-wort, were more prevalent in the West Huron Island granite bedrock glade compared to the glades from East Huron, Cattle, and Gull Islands. The degree of difference could be further elucidated by analyzing the plot data collected across the islands. The effectiveness of early detection and rapid response can be tested if the incipient infestations of spotted knapweed along the granite bedrock lakeshore of West Huron Island and thistles and cat-tail on East Huron Island. The absence of large herbivores on the Huron Islands and the contrasting presence of deer and moose on the nearby mainland presents a research opportunity to investigate how ungulate herbivory impacts the floristic composition, vegetative structure, and successional trajectory of both boreal forest and granite bedrock glade.

Given the presence of snowshoe hare on East Huron Island and their absence on West Huron Island, research could be implemented to comparatively evaluate the impacts of hare herbivory. As noted above, the pockets of sloping peatland that were documented on West Huron, East Huron, and Cattle Islands represents the first documentation of this micro peatland in Michigan. Further research is merited to determine if this unique type merits consideration as a new natural community type for Michigan.

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 the Huron Islands, 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.



The Huron National Wildlife Refuge was established as a refuge and breeding ground for migratory birds and other wildlife. In addition to providing habitat for numerous nesting bird species and supporting numerous Great Lakes endemic natural communities, the Huron Islands are critical for conservation in the Great Lakes region because they provide refugia from stressors pervasive on the mainland including fragmentation and deer herbivory. Though these islands face less pressure from invasive plant species, they are still susceptible to invasive infestation. Treating incipient infestations of invasive species is the primary biodiversity stewardship recommendation for the Huron Islands. Photo by Jesse M. Lincoln.



*Umbilicaria mammulata* (pictured above) was regularly observed growing on vertical rock faces of the glades and cliffs that were north-facing or slightly shaded. Lichen composition of the Huron Islands is driven by aspect of the rockface; aspect of the specific area on the island; frequent growing-season fog; humidity levels influenced by prevailing winds; and unique rock formations (i.e., crevasses and overhangs). Photo by Jesse M. Lincoln.

Lichens mitigate drought conditions by absorbing moisture during rain events. Species in the genus *Umbilicaria* (*U. muhlenbergii* pictured above) are especially prevalent and absorptive on the Huron Island glades. This drought mitigating feature of lichens was less pronounced on glades of West Huron Island that occurred near trails where foot traffic has reduced the extent and diversity of lichens on the exposed, flat areas of granite. Photo by Joshua G. Cohen.



Lichen composition along the East Huron Island shoreline is influenced by proximity to the storm line above the current water level and guano deposition from migratory birds. In this image, lakezone lichen (*Staurothele fissa*) forms the dark, film-like zone just above the water. Above the lakezone lichen, the bright orange *Xanthoria elegans* occupies exposed bedrock above the splash zone where guano from nesting birds provides nutrients. Both lichens occur where ice and winter storms prevent the accumulation of soil and establishment of vascular plants except in cracks and protected crevices. Photo by Joshua G. Cohen.



Northern exposures along sloping granitic bedrock on Cattle Island, East Huron Island, and West Huron Islands support local pockets of hanging peatland, likely a newly documented natural community type for Michigan. Sphagnum peat locally accumulates in these cool microsites because of the northern aspect and the prevalence of summer fogs. The peats range in depth from 2 to 50 cm and are strongly acidic. In addition to sphagnum mosses, these micro peatlands support dense shrub cover of Labrador tea and leatherleaf with a scattered overstory of black spruce. Photos by Joshua G. Cohen.



## Conclusion

Through this project we evaluated the ecological integrity of high-quality natural communities on the Huron Islands. We documented a total of 14 new natural community element occurrences across the Huron Islands including three element occurrences on Cattle Island (granite bedrock glade, granite bedrock lakeshore, and granite lakeshore cliff), four element occurrences on East Huron Island (boreal forest, granite bedrock glade, granite bedrock lakeshore, and granite lakeshore cliff), three element occurrences on Gull Island (granite bedrock glade, granite bedrock lakeshore, and granite lakeshore cliff), and four element occurrences on West Huron Island (boreal forest, granite bedrock glade, granite bedrock lakeshore, and granite lakeshore cliff). This report provides site-based assessments of these 14 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 granite bedrock lakeshore on West Huron Island to address the incipient infestation of spotted knapweed. In addition, invasive species control is recommended within the West Huron Island granite bedrock glade, along the West Huron Island and East Huron Island granite lakeshore cliffs, and along the ecotone between the East Huron Island granite bedrock glade and boreal forest.



We recommend prioritizing invasive species control within the West Huron Island granite bedrock lakeshore, the granite lakeshore cliffs from West Huron Island (pictured below) and East Huron Island, and also the West Huron Island granite bedrock glade (pictured above). Photos by Jesse M. Lincoln (above) and Joshua G. Cohen (below).



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# 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). We provide a crosswalk of Ojibwe names to scientific and common names in Appendix 3 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 for each island.

## Appendix 2.1. Cattle Island Granite Bedrock Glade FQA

### Conservatism-Based Metrics:

Total Mean C:	4.2
Native Mean C:	4.6
Total FQI:	42.8
Native FQI:	44.8
Adjusted FQI:	44
% C value 0:	11.5
% C value 1-3:	24
% C value 4-6:	52.9
% C value 7-10:	11.5
Native Tree Mean C:	3.6
Native Shrub Mean C:	4.5
Native Herbaceous Mean C:	4.8

### Species Richness:

Total Species:	104	
Native Species:	95	91.30%
Non-native Species:	9	8.70%

### Species Wetness:

Mean Wetness:	1.6
Native Mean Wetness:	1.3

### Physiognomy Metrics:

Tree:	14	13.50%
Shrub:	22	21.20%
Vine:	3	2.90%
Forb:	37	35.60%
Grass:	10	9.60%
Sedge:	8	7.70%
Rush:	0	0%
Fern:	10	9.60%
Bryophyte:	0	0%

### Duration Metrics:

Annual:	3	2.90%
Perennial:	100	96.20%
Biennial:	1	1.00%
Native Annual:	3	2.90%
Native Perennial:	91	87.50%
Native Biennial:	1	1.00%

## Appendix 2.1. Cattle Island Granite Bedrock Glade FQA (continued)

Scientific Name	Common Name	Acronym	Native?	C	W
<i>Abies balsamea</i>	balsam fir	ABIBAL	native	3	0
<i>Acer rubrum</i>	red maple	ACERUB	native	1	0
<i>Acer saccharum</i>	sugar maple	ACESAU	native	5	3
<i>Acer spicatum</i>	mountain maple	ACESPI	native	5	3
<i>Achillea millefolium</i>	yarrow	ACHMIL	native	1	3
<i>Agrostis scabra</i>	ticklegrass	AGRSCA	native	4	0
<i>Amelanchier interior</i>	serviceberry	AMEINT	native	4	5
<i>Amelanchier sanguinea</i>	round-leaved serviceberry	AMESAN	native	5	5
<i>Aquilegia canadensis</i>	wild columbine	AQUCAN	native	5	3
<i>Aralia hispida</i>	bristly sarsaparilla	ARAHIS	native	3	5
<i>Aralia nudicaulis</i>	wild sarsaparilla	ARANUD	native	5	3
<i>Arctostaphylos uva-ursi</i>	bearberry	ARCUVA	native	8	5
<i>Avenella flexuosa</i>	hair grass	AVEFLE	native	6	5
<i>Betula papyrifera</i>	paper birch	BETPAP	native	2	3
<i>Calamagrostis canadensis</i>	blue-joint	CALCAN	native	3	-5
<i>Campanula rotundifolia</i>	harebell	CAMROT	native	6	3
<i>Capnoides sempervirens</i>	pink or pale corydalis	CAPSEM	native	5	5
<i>Carex arctata</i>	sedge	CXARTT	native	3	5
<i>Carex brunnescens</i>	sedge	CXBRUN	native	5	-3
<i>Carex canescens</i>	sedge	CXCANE	native	8	-5
<i>Carex crawei</i>	sedge	CXCRAE	native	10	-3
<i>Carex pedunculata</i>	sedge	CXPEDU	native	5	3
<i>Carex pensylvanica</i>	sedge	CXPENS	native	4	5
<i>Carex scoparia</i>	sedge	CXSCOP	native	4	-3
<i>Carex viridula</i>	sedge	CXVIRU	native	4	-5
<b><i>Cerastium fontanum</i></b>	<b>mouse-ear chickweed</b>	<b>CERFON</b>	<b>non-native</b>	<b>0</b>	<b>3</b>
<i>Chamerion angustifolium</i>	fireweed	CHAANG	native	3	0
<i>Clinopodium vulgare</i>	wild-basil	CLIVUL	native	3	5
<i>Clintonia borealis</i>	bluebead-lily; corn-lily	CLIBOR	native	5	0
<i>Coptis trifolia</i>	goldthread	COPTRI	native	5	-3
<i>Cornus canadensis</i>	bunchberry	CORCAA	native	6	0
<i>Cornus rugosa</i>	round-leaved dogwood	CORRUG	native	6	5
<i>Cornus sericea</i>	red-osier	CORSER	native	2	-3
<i>Cystopteris fragilis</i>	fragile fern	CYSFRA	native	4	3
<i>Danthonia spicata</i>	poverty grass; oatgrass	DANSPI	native	4	5
<i>Dendrolycopodium dendroideum</i>	tree clubmoss	DENDEN	native	5	3
<i>Deschampsia cespitosa</i>	hair grass	DESCES	native	9	-3
<i>Diervilla lonicera</i>	bush-honeysuckle	DIELON	native	4	5
<i>Dryopteris carthusiana</i>	spinulose woodfern	DRYCAR	native	5	-3
<i>Dryopteris intermedia</i>	evergreen woodfern	DRYINT	native	5	0
<i>Dryopteris marginalis</i>	marginal woodfern	DRYMAR	native	5	3
<i>Epilobium coloratum</i>	cinnamon willow-herb	EPICOL	native	3	-5
<i>Eurybia macrophylla</i>	big-leaved aster	EURMAC	native	4	5
<i>Euthamia graminifolia</i>	grass-leaved goldenrod	EUTGRA	native	3	0
<i>Fallopia cilinodis</i>	fringed false buckwheat	FALCIL	native	3	5
<i>Festuca occidentalis</i>	western fescue	FESOCC	native	6	5

## Appendix 2.1. Cattle Island Granite Bedrock Glade FQA (continued)

Scientific Name	Common Name	Acronym	Native?	C	W
<i>Fragaria virginiana</i>	wild strawberry	FRAVIR	native	2	3
<i>Galium triflorum</i>	fragrant bedstraw	GALTRR	native	4	3
<i>Gaultheria hispidula</i>	creeping-snowberry	GAUHIS	native	8	-3
<i>Gymnocarpium dryopteris</i>	oak fern	GYMDRY	native	5	3
<i>Hepatica americana</i>	round-lobed hepatica	HEPAME	native	6	5
<b><i>Hieracium aurantiacum</i></b>	<b>orange hawkweed</b>	<b>HIEAUR</b>	<b>non-native</b>	<b>0</b>	<b>5</b>
<b><i>Hieracium caespitosum</i></b>	<b>king devil</b>	<b>HIECAE</b>	<b>non-native</b>	<b>0</b>	<b>5</b>
<b><i>Hypericum perforatum</i></b>	<b>common st. johns-wort</b>	<b>HYPPER</b>	<b>non-native</b>	<b>0</b>	<b>5</b>
<i>Iris versicolor</i>	wild blue flag	IRIVER	native	5	-5
<i>Lathyrus japonicus</i>	beach pea	LATJAP	native	10	3
<b><i>Leucanthemum vulgare</i></b>	<b>ox-eye daisy</b>	<b>LEUVUL</b>	<b>non-native</b>	<b>0</b>	<b>5</b>
<i>Linnaea borealis</i>	twinflower	LINBOR	native	6	0
<i>Lonicera canadensis</i>	canadian fly honeysuckle	LONCAN	native	5	3
<i>Lonicera dioica</i>	red honeysuckle	LONDIO	native	5	3
<i>Lysimachia terrestris</i>	swamp-candles	LYSTER	native	6	-5
<i>Maianthemum canadense</i>	canada mayflower	MAICAN	native	4	3
<i>Melampyrum lineare</i>	cow-wheat	MELLIN	native	6	3
<i>Monotropa uniflora</i>	indian-pipe	MONOUN	native	5	3
<i>Physocarpus opulifolius</i>	ninebark	PHYOPU	native	4	-3
<i>Picea glauca</i>	white spruce	PICGLA	native	3	3
<i>Picea mariana</i>	black spruce	PICMAR	native	6	-3
<i>Pinus resinosa</i>	red pine	PINRES	native	6	3
<i>Pinus strobus</i>	white pine	PINSTR	native	3	3
<b><i>Poa compressa</i></b>	<b>canada bluegrass</b>	<b>POACOM</b>	<b>non-native</b>	<b>0</b>	<b>3</b>
<i>Poa glauca</i>	bluegrass	POAGLA	native	10	5
<b><i>Poa pratensis</i></b>	<b>kentucky bluegrass</b>	<b>POAPRA</b>	<b>non-native</b>	<b>0</b>	<b>3</b>
<i>Polypodium virginianum</i>	common polypody	POLVIR	native	8	5
<i>Populus grandidentata</i>	big-tooth aspen	POPGRA	native	4	3
<i>Populus tremuloides</i>	quaking aspen	POPTRE	native	1	0
<i>Portulaca oleracea</i>	purslane	POROLE	native	0	3
<i>Potentilla norvegica</i>	rough cinquefoil	POTNOR	native	0	0
<i>Prenanthes alba</i>	white lettuce	PREALB	native	5	3
<i>Prunus pensylvanica</i>	pin cherry	PRUPEN	native	3	3
<i>Prunus virginiana</i>	choke cherry	PRUVIR	native	2	3
<i>Pteridium aquilinum</i>	bracken fern	PTEAQU	native	0	3
<i>Pyrola americana</i>	round-leaved pyrola	PYRAME	native	7	0
<i>Rhododendron groenlandicum</i>	labrador-tea	RHOGRO	native	8	-5
<i>Ribes glandulosum</i>	skunk currant	RIBGLA	native	5	-3
<i>Rosa acicularis</i>	wild rose	ROSACI	native	4	3
<i>Rubus setosus</i>	bristly blackberry	RUBSET	native	3	-3
<i>Rubus strigosus</i>	wild red raspberry	RUBSTR	native	2	0
<b><i>Rumex acetosella</i></b>	<b>sheep sorrel</b>	<b>RUMACL</b>	<b>non-native</b>	<b>0</b>	<b>3</b>
<i>Sambucus racemosa</i>	red-berried elder	SAMRAC	native	3	3
<i>Schizachne purpurascens</i>	false melic	SCHPUP	native	5	3
<i>Selaginella rupestris</i>	sand club moss	SELRUP	native	8	5
<i>Sibbaldiopsis tridentata</i>	three-toothed cinquefoil	SIBTRI	native	10	3

## Appendix 2.2. Cattle Island Granite Bedrock Lakeshore FQA

### Conservatism-Based Metrics:

Total Mean C:	4
Native Mean C:	4.1
Total FQI:	30.2
Native FQI:	30.4
Adjusted FQI:	40.3
% C value 0:	10.5
% C value 1-3:	38.6
% C value 4-6:	33.3
% C value 7-10:	17.5
Native Tree Mean C:	2.5
Native Shrub Mean C:	5.5
Native Herbaceous Mean C:	4.1

### Species Richness:

Total Species:	57
Native Species:	55 96.50%
Non-native Species:	2 3.50%

### Species Wetness:

Mean Wetness:	-0.6
Native Mean Wetness:	-0.8

### Physiognomy Metrics:

Tree:	8	14.00%
Shrub:	12	21.10%
Vine:	1	1.80%
Forb:	24	42.10%
Grass:	6	10.50%
Sedge:	5	8.80%
Rush:	0	0%
Fern:	1	1.80%
Bryophyte:	0	0%

### Duration Metrics:

Annual:	2	3.50%
Perennial:	53	93.00%
Biennial:	2	3.50%
Native Annual:	2	3.50%
Native Perennial:	51	89.50%
Native Biennial:	2	3.50%

## Appendix 2.2. Cattle Island Granite Bedrock Lakeshore FQA (continued)

Scientific Name	Common Name	Acronym	Native?	C	W
<i>Abies balsamea</i>	balsam fir	ABIBAL	native	3	0
<i>Acer rubrum</i>	red maple	ACERUB	native	1	0
<i>Achillea millefolium</i>	yarrow	ACHMIL	native	1	3
<i>Alnus incana; a. rugosa</i>	speckled alder	ALNINC	native	5	-3
<i>Aquilegia canadensis</i>	wild columbine	AQUCAN	native	5	3
<i>Arctostaphylos uva-ursi</i>	bearberry	ARCUVA	native	8	5
<i>Avenella flexuosa</i>	hair grass	AVEFLE	native	6	5
<i>Betula papyrifera</i>	paper birch	BETPAP	native	2	3
<i>Calamagrostis canadensis</i>	blue-joint	CALCAN	native	3	-5
<i>Caltha palustris</i>	marsh-marigold	CALPAR	native	6	-5
<i>Campanula rotundifolia</i>	harebell	CAMROT	native	6	3
<i>Capnoides sempervirens</i>	pink or pale corydalis	CAPSEM	native	5	5
<i>Carex aquatilis</i>	sedge	CXAQUA	native	7	-5
<i>Carex communis</i>	sedge	CXCOMM	native	2	5
<i>Carex crinita</i>	sedge	CXCRIN	native	4	-5
<i>Carex hystericina</i>	sedge	CXHYST	native	2	-5
<i>Carex stipata</i>	sedge	CXSTIP	native	1	-5
<i>Chelone glabra</i>	turtlehead	CHEGLB	native	7	-5
<b><i>Cirsium arvense</i></b>	<b>canada thistle</b>	<b>CIRARV</b>	<b>non-native</b>	<b>0</b>	<b>3</b>
<i>Deschampsia cespitosa</i>	hair grass	DESCES	native	9	-3
<i>Equisetum arvense</i>	common horsetail	EQUARV	native	0	0
<i>Euthamia graminifolia</i>	grass-leaved goldenrod	EUTGRA	native	3	0
<i>Fraxinus pennsylvanica</i>	red ash	FRAPEN	native	2	-3
<i>Gentiana rubricaulis</i>	great lakes gentian	GENRUB	native	7	-5
<i>Ilex verticillata</i>	michigan holly	ILEVER	native	5	-3
<i>Iris versicolor</i>	wild blue flag	IRIVER	native	5	-5
<i>Juniperus horizontalis</i>	creeping juniper	JUNHOR	native	10	3
<i>Lathyrus japonicus</i>	beach pea	LATJAP	native	10	3
<i>Lobelia inflata</i>	indian-tobacco	LOBINF	native	0	3
<i>Lobelia kalmii</i>	bog lobelia	LOBKAL	native	10	-5
<i>Lycopus americanus</i>	common water horehound	LYCAME	native	2	-5
<i>Lycopus uniflorus</i>	northern bugle weed	LYCUNI	native	2	-5
<i>Mentha canadensis</i>	wild mint	MENCAS	native	3	-3
<i>Myrica gale</i>	sweet gale	MYRGAL	native	6	-5
<i>Oenothera biennis</i>	common evening-primrose	OENBIE	native	2	3
<b><i>Phalaris arundinacea</i></b>	<b>reed canary grass</b>	<b>PHAARU</b>	<b>non-native</b>	<b>0</b>	<b>-3</b>
<i>Physocarpus opulifolius</i>	ninebark	PHYOPU	native	4	-3
<i>Pinus strobus</i>	white pine	PINSTR	native	3	3
<b><i>Poa compressa</i></b>	<b>canada bluegrass</b>	<b>POACOM</b>	<b>non-native</b>	<b>0</b>	<b>3</b>
<i>Poa palustris</i>	fowl meadow grass	POAPAS	native	3	-3
<i>Populus grandidentata</i>	big-tooth aspen	POPGRA	native	4	3
<i>Populus tremuloides</i>	quaking aspen	POPTRE	native	1	0
<i>Potentilla norvegica</i>	rough cinquefoil	POTNOR	native	0	0
<i>Prenanthes alba</i>	white lettuce	PREALB	native	5	3
<i>Prunus virginiana</i>	choke cherry	PRUVIR	native	2	3

## Appendix 2.2. Cattle Island Granite Bedrock Lakeshore FQA (continued)

Scientific Name	Common Name	Acronym	Native?	C	W
<i>Salix myricoides</i>	blueleaf willow	SALMYR	native	9	-3
<i>Scutellaria galericulata</i>	marsh skullcap	SCUGAL	native	5	-5
<i>Sibbaldiopsis tridentata</i>	three-toothed cinquefoil	SIBTRI	native	10	3
<i>Solidago hispida</i>	hairy goldenrod	SOLHIS	native	3	5
<i>Solidago rugosa</i>	rough-leaved goldenrod	SOLRUG	native	3	0
<i>Spiraea alba</i>	meadowsweet	SPIALB	native	4	-3
<i>Symphoricarpos albus var. albus</i>	snowberry	SYMALA	native	5	3
<i>Symphotrichum lanceolatum</i>	panicled aster	SYMLAN	native	2	-3
<i>Thalictrum dasycarpum</i>	purple meadow-rue	THADAS	native	3	-3
<i>Thuja occidentalis</i>	arbor vitae	THUOCC	native	4	-3
<i>Vaccinium angustifolium</i>	low sweet blueberry	VACANG	native	4	3
<i>Vaccinium myrtilloides</i>	canada blueberry	VACMYR	native	4	-3

## Appendix 2.3. Cattle Island Granite Lakeshore Cliff FQA

### Conservatism-Based Metrics:

Total Mean C:	4.2
Native Mean C:	4.6
Total FQI:	37.8
Native FQI:	39.6
Adjusted FQI:	44
% C value 0:	11.1
% C value 1-3:	28.4
% C value 4-6:	42
% C value 7-10:	18.5
Native Tree Mean C:	3.6
Native Shrub Mean C:	4.7
Native Herbaceous Mean C:	4.7

### Species Richness:

Total Species:	81
Native Species:	74 91.40%
Non-native Species:	7 8.60%

### Species Wetness:

Mean Wetness:	0.7
Native Mean Wetness:	0.5

### Physiognomy Metrics:

Tree:	9	11.10%
Shrub:	22	27.20%
Vine:	2	2.50%
Forb:	25	30.90%
Grass:	8	9.90%
Sedge:	7	8.60%
Rush:	3	4%
Fern:	5	6.20%
Bryophyte:	0	0%

### Duration Metrics:

Annual:	1	1.20%
Perennial:	78	96.30%
Biennial:	2	2.50%
Native Annual:	1	1.20%
Native Perennial:	71	87.70%
Native Biennial:	2	2.50%

### Appendix 2.3. Cattle Island Granite Lakeshore Cliff FQA (continued)

Scientific Name	Common Name	Acronym	Native?	C	W
<i>Abies balsamea</i>	balsam fir	ABIBAL	native	3	0
<i>Achillea millefolium</i>	yarrow	ACHMIL	native	1	3
<i>Agrostis scabra</i>	ticklegrass	AGRSCA	native	4	0
<i>Alnus incana</i>	speckled alder	ALNINC	native	5	-3
<i>Alnus viridis</i>	mountain alder	ALNVIR	native	8	0
<i>Amelanchier sanguinea</i>	round-leaved serviceberry	AMESAN	native	5	5
<i>Aquilegia canadensis</i>	wild columbine	AQUCAN	native	5	3
<i>Arabidopsis lyrata</i>	sand cress	ARALYR	native	7	3
<i>Aralia hispida</i>	bristly sarsaparilla	ARAHIS	native	3	5
<i>Arctostaphylos uva-ursi</i>	bearberry	ARCUVA	native	8	5
<i>Athyrium filix-femina</i>	lady fern	ATHFIL	native	4	0
<i>Avenella flexuosa</i>	hair grass	AVEFLE	native	6	5
<i>Betula papyrifera</i>	paper birch	BETPAP	native	2	3
<i>Calamagrostis canadensis</i>	blue-joint	CALCAN	native	3	-5
<i>Campanula rotundifolia</i>	harebell	CAMROT	native	6	3
<i>Capnoides sempervirens</i>	pink or pale corydalis	CAPSEM	native	5	5
<i>Carex aquatilis</i>	sedge	CXAQUA	native	7	-5
<i>Carex arctata</i>	sedge	CXARTT	native	3	5
<i>Carex aurea</i>	sedge	CXAURE	native	3	-3
<i>Carex canescens</i>	sedge	CXCANE	native	8	-5
<i>Carex echinata</i>	sedge	CXECHA	native	6	-5
<i>Carex scoparia</i>	sedge	CXSCOP	native	4	-3
<i>Chamerion angustifolium</i>	fireweed	CHAANG	native	3	0
<i>Cornus canadensis</i>	bunchberry	CORCAA	native	6	0
<i>Cornus sericea</i>	red-osier	CORSER	native	2	-3
<i>Cystopteris fragilis</i>	fragile fern	CYSFRA	native	4	3
<i>Danthonia spicata</i>	poverty grass; oatgrass	DANSPI	native	4	5
<i>Deschampsia cespitosa</i>	hair grass	DESCES	native	9	-3
<i>Diervilla lonicera</i>	bush-honeysuckle	DIELON	native	4	5
<i>Dryocallis arguta</i>	tall or prairie cinquefoil	DRYARG	native	8	3
<i>Dryopteris intermedia</i>	evergreen woodfern	DRYINT	native	5	0
<i>Epilobium coloratum</i>	cinnamon willow-herb	EPICOL	native	3	-5
<i>Euthamia graminifolia</i>	grass-leaved goldenrod	EUTGRA	native	3	0
<i>Fragaria vesca</i>	woodland strawberry	FRAVES	native	2	3
<i>Gaultheria hispidula</i>	creeping-snowberry	GAUHIS	native	8	-3
<b><i>Hypericum perforatum</i></b>	<b>common st. johns-wort</b>	<b>HYPPER</b>	<b>non-native</b>	<b>0</b>	<b>5</b>
<i>Ilex verticillata</i>	michigan holly	ILEVER	native	5	-3
<i>Juncus brevicaudatus</i>	rush	JUNBRE	native	8	-5
<i>Juncus dudleyi</i>	dudleys rush	JUNDUD	native	1	-3
<i>Juncus tenuis</i>	path rush	JUNTEN	native	1	0
<i>Juniperus horizontalis</i>	creeping juniper	JUNHOR	native	10	3
<i>Lathyrus japonicus</i>	beach pea	LATJAP	native	10	3
<b><i>Leucanthemum vulgare</i></b>	<b>ox-eye daisy</b>	<b>LEUVUL</b>	<b>non-native</b>	<b>0</b>	<b>5</b>
<i>Lonicera dioica</i>	red honeysuckle	LONDIO	native	5	3
<i>Lycopodium lagopus</i>	running ground-pine	LYCLAG	native	5	3

## Appendix 2.3. Cattle Island Granite Lakeshore Cliff FQA (continued)

Scientific Name	Common Name	Acronym	Native?	C	W
<i>Maianthemum canadense</i>	canada mayflower	MAICAN	native	4	3
<i>Micranthes virginensis</i>	early saxifrage	MICVIR	native	10	3
<i>Physocarpus opulifolius</i>	ninebark	PHYOPU	native	4	-3
<i>Picea glauca</i>	white spruce	PICGLA	native	3	3
<i>Picea mariana</i>	black spruce	PICMAR	native	6	-3
<i>Pinus resinosa</i>	red pine	PINRES	native	6	3
<i>Pinus strobus</i>	white pine	PINSTR	native	3	3
<i>Plantago rugelii</i>	red-stalked plantain	PLARUG	native	0	0
<b><i>Poa compressa</i></b>	<b>canada bluegrass</b>	<b>POACOM</b>	<b>non-native</b>	<b>0</b>	<b>3</b>
<i>Poa palustris</i>	fowl meadow grass	POAPAS	native	3	-3
<b><i>Poa pratensis</i></b>	<b>kentucky bluegrass</b>	<b>POAPRA</b>	<b>non-native</b>	<b>0</b>	<b>3</b>
<i>Polypodium virginianum</i>	common polypody	POLVIR	native	8	5
<i>Populus tremuloides</i>	quaking aspen	POPTRE	native	1	0
<i>Potentilla norvegica</i>	rough cinquefoil	POTNOR	native	0	0
<i>Prenanthes alba</i>	white lettuce	PREALB	native	5	3
<i>Prunus virginiana</i>	choke cherry	PRUVIR	native	2	3
<i>Ribes glandulosum</i>	skunk currant	RIBGLA	native	5	-3
<i>Rosa acicularis</i>	wild rose	ROSACI	native	4	3
<i>Rubus strigosus</i>	wild red raspberry	RUBSTR	native	2	0
<b><i>Rumex acetosella</i></b>	<b>sheep sorrel</b>	<b>RUMACL</b>	<b>non-native</b>	<b>0</b>	<b>3</b>
<i>Salix bebbiana</i>	bebb's willow	SALBEB	native	1	-3
<i>Scirpus cyperinus</i>	wool-grass	SCICYP	native	5	-5
<i>Sibbaldiopsis tridentata</i>	three-toothed cinquefoil	SIBTRI	native	10	3
<i>Sisyrinchium montanum</i>	mountain blue-eyed-grass	SISMON	native	4	0
<i>Solidago hispida</i>	hairy goldenrod	SOLHIS	native	3	5
<i>Sorbus decora</i>	mountain-ash	SORDEC	native	4	3
<i>Spiraea alba</i>	meadowsweet	SPIALB	native	4	-3
<i>Symphoricarpos albus var. albus</i>	snowberry	SYMALA	native	5	3
<b><i>Taraxacum officinale</i></b>	<b>common dandelion</b>	<b>TAROFF</b>	<b>non-native</b>	<b>0</b>	<b>3</b>
<i>Taxus canadensis</i>	yew	TAXCAN	native	5	3
<i>Thuja occidentalis</i>	arbor vitae	THUOCC	native	4	-3
<i>Typha latifolia</i>	broad-leaved cat-tail	TYPLAT	native	1	-5
<i>Vaccinium angustifolium</i>	low sweet blueberry	VACANG	native	4	3
<i>Vaccinium myrtilloides</i>	canada blueberry	VACMYR	native	4	-3
<b><i>Veronica officinalis</i></b>	<b>common speedwell</b>	<b>VEROOF</b>	<b>non-native</b>	<b>0</b>	<b>3</b>
<i>Viola nephrophylla</i>	northern bog violet	VIONEP	native	8	-3

## Appendix 2.4. East Huron Island Boreal Forest FQA

### Conservatism-Based Metrics:

Total Mean C:	4.8
Native Mean C:	4.8
Total FQI:	36.2
Native FQI:	36.2
Adjusted FQI:	48
% C value 0:	1.8
% C value 1-3:	19.3
% C value 4-6:	66.7
% C value 7-10:	12.3
Native Tree Mean C:	3.9
Native Shrub Mean C:	4.9
Native Herbaceous Mean C:	5.3

### Species Richness:

Total Species:	57	
Native Species:	57	100.00%
Non-native Species:	0	0.00%

### Species Wetness:

Mean Wetness:	1.4
Native Mean Wetness:	1.4

### Physiognomy Metrics:

Tree:	16	28.10%
Shrub:	17	29.80%
Vine:	2	3.50%
Forb:	12	21.10%
Grass:	2	3.50%
Sedge:	2	3.50%
Rush:	0	0%
Fern:	6	10.50%
Bryophyte:	0	0%

### Duration Metrics:

Annual:	1	1.80%
Perennial:	55	96.50%
Biennial:	1	1.80%
Native Annual:	1	1.80%
Native Perennial:	55	96.50%
Native Biennial:	1	1.80%

## Appendix 2.4. East Huron Island Boreal Forest FQA (continued)

Scientific Name	Common Name	Acronym	Native?	C	W
<i>Abies balsamea</i>	balsam fir	ABIBAL	native	3	0
<i>Acer pensylvanicum</i>	striped maple	ACEPEN	native	5	3
<i>Acer rubrum</i>	red maple	ACERUB	native	1	0
<i>Acer saccharum</i>	sugar maple	ACESAU	native	5	3
<i>Acer spicatum</i>	mountain maple	ACESPI	native	5	3
<i>Alnus incana; a. rugosa</i>	speckled alder	ALNINC	native	5	-3
<i>Amelanchier interior</i>	serviceberry	AMEINT	native	4	5
<i>Amelanchier sanguinea</i>	round-leaved serviceberry	AMESAN	native	5	5
<i>Aquilegia canadensis</i>	wild columbine	AQUCAN	native	5	3
<i>Aralia nudicaulis</i>	wild sarsaparilla	ARANUD	native	5	3
<i>Arctostaphylos uva-ursi</i>	bearberry	ARCUVA	native	8	5
<i>Avenella flexuosa</i>	hair grass	AVEFLE	native	6	5
<i>Betula alleghaniensis</i>	yellow birch	BETALL	native	7	0
<i>Betula papyrifera</i>	paper birch	BETPAP	native	2	3
<i>Capnoides sempervirens</i>	pink or pale corydalis	CAPSEM	native	5	5
<i>Carex deweyana</i>	sedge	CXDEWE	native	3	3
<i>Carex pensylvanica</i>	sedge	CXPENS	native	4	5
<i>Cornus canadensis</i>	bunchberry	CORCAA	native	6	0
<i>Cypripedium acaule</i>	pink lady-slipper; moccasin flower	CYPACA	native	5	-3
<i>Dendrolycopodium dendroideum</i>	tree clubmoss	DENDEN	native	5	3
<i>Diervilla lonicera</i>	bush-honeysuckle	DIELON	native	4	5
<i>Dryopteris carthusiana</i>	spinulose woodfern	DRYCAR	native	5	-3
<i>Dryopteris filix-mas</i>	male fern	DRYFIL	native	10	5
<i>Dryopteris intermedia</i>	evergreen woodfern	DRYINT	native	5	0
<i>Eurybia macrophylla</i>	big-leaved aster	EURMAC	native	4	5
<i>Gaultheria hispidula</i>	creeping-snowberry	GAUHis	native	8	-3
<i>Ilex verticillata</i>	michigan holly	ILEVER	native	5	-3
<i>Iris versicolor</i>	wild blue flag	IRIVER	native	5	-5
<i>Linnaea borealis</i>	twinline	LINBOR	native	6	0
<i>Lonicera dioica</i>	red honeysuckle	LONDIO	native	5	3
<i>Lonicera hirsuta</i>	hairy honeysuckle	LONHIR	native	6	0
<i>Lysimachia terrestris</i>	swamp-candles	LYSTER	native	6	-5
<i>Maianthemum canadense</i>	canada mayflower	MAICAN	native	4	3
<i>Melampyrum lineare</i>	cow-wheat	MELLIN	native	6	3
<i>Oxalis acetosella</i>	northern wood-sorrel	OXAACE	native	7	3
<i>Picea glauca</i>	white spruce	PICGLA	native	3	3
<i>Picea mariana</i>	black spruce	PICMAR	native	6	-3
<i>Pinus resinosa</i>	red pine	PINRES	native	6	3
<i>Pinus strobus</i>	white pine	PINSTR	native	3	3
<i>Poa glauca</i>	bluegrass	POAGLA	native	10	5
<i>Populus tremuloides</i>	quaking aspen	POPTRE	native	1	0
<i>Prunus pensylvanica</i>	pin cherry	PRUPEN	native	3	3
<i>Prunus virginiana</i>	choke cherry	PRUVIR	native	2	3
<i>Pteridium aquilinum</i>	bracken fern	PTEAQU	native	0	3
<i>Quercus rubra</i>	red oak	QUERUB	native	5	3

## Appendix 2.4. East Huron Island Boreal Forest FQA (continued)

Scientific Name	Common Name	Acronym	Native?	C	W
<i>Rhododendron groenlandicum</i>	labrador-tea	RHOGRO	native	8	-5
<i>Ribes glandulosum</i>	skunk currant	RIBGLA	native	5	-3
<i>Rosa acicularis</i>	wild rose	ROSACI	native	4	3
<i>Rubus setosus</i>	bristly blackberry	RUBSET	native	3	-3
<i>Sambucus racemosa</i>	red-berried elder	SAMRAC	native	3	3
<i>Sorbus decora</i>	mountain-ash	SORDEC	native	4	3
<i>Spinulum annotinum</i>	stiff clubmoss	SPIANN	native	5	0
<i>Taxus canadensis</i>	yew	TAXCAN	native	5	3
<i>Thuja occidentalis</i>	arbor vitae	THUOCC	native	4	-3
<i>Trientalis borealis</i>	star-flower	TRIBOR	native	5	0
<i>Vaccinium angustifolium</i>	low sweet blueberry	VACANG	native	4	3
<i>Vaccinium myrtilloides</i>	canada blueberry	VACMYR	native	4	-3

## Appendix 2.5. East Huron Island Granite Bedrock Glade FQA

### Conservatism-Based Metrics:

Total Mean C:	3.6
Native Mean C:	4.4
Total FQI:	36.4
Native FQI:	40.1
Adjusted FQI:	39.7
% C value 0:	20.6
% C value 1-3:	29.4
% C value 4-6:	36.3
% C value 7-10:	13.7
Native Tree Mean C:	3.8
Native Shrub Mean C:	3.4
Native Herbaceous Mean C:	4.7

### Species Richness:

Total Species:	102
Native Species:	83 81.40%
Non-native Species:	19 18.60%

### Species Wetness:

Mean Wetness:	1.2
Native Mean Wetness:	1

### Physiognomy Metrics:

Tree:	17	16.70%
Shrub:	8	7.80%
Vine:	3	2.90%
Forb:	39	38.20%
Grass:	5	4.90%
Sedge:	18	17.60%
Rush:	0	0%
Fern:	12	11.80%
Bryophyte:	0	0%

### Duration Metrics:

Annual:	1	1.00%
Perennial:	92	90.20%
Biennial:	9	8.80%
Native Annual:	1	1.00%
Native Perennial:	80	78.40%
Native Biennial:	2	2.00%

## Appendix 2.5. East Huron Island Granite Bedrock Glade FQA (continued)

Scientific Name	Common Name	Acronym	Native?	C	W
<i>Abies balsamea</i>	balsam fir	ABIBAL	native	3	0
<i>Acer rubrum</i>	red maple	ACERUB	native	1	0
<i>Acer spicatum</i>	mountain maple	ACESPI	native	5	3
<i>Achillea millefolium</i>	yarrow	ACHMIL	native	1	3
<i>Agrostis scabra</i>	ticklegrass	AGRSCA	native	4	0
<i>Amelanchier sanguinea</i>	round-leaved serviceberry	AMESAN	native	5	5
<i>Aralia hispida</i>	bristly sarsaparilla	ARAHIS	native	3	5
<i>Arctostaphylos uva-ursi</i>	bearberry	ARCUVA	native	8	5
<i>Aronia prunifolia</i>	chokeberry	AROPRU	native	5	-3
<i>Avenella flexuosa</i>	hair grass	AVEFLE	native	6	5
<i>Betula papyrifera</i>	paper birch	BETPAP	native	2	3
<i>Calamagrostis canadensis</i>	blue-joint	CALCAN	native	3	-5
<i>Campanula rotundifolia</i>	harebell	CAMROT	native	6	3
<i>Capnoides sempervirens</i>	pink or pale corydalis	CAPSEM	native	5	5
<i>Carex deweyana</i>	sedge	CXDEWE	native	3	3
<i>Carex magellanica</i>	sedge	CXMAGE	native	8	-5
<i>Carex pensylvanica</i>	sedge	CXPENS	native	4	5
<i>Chamaedaphne calyculata</i>	leatherleaf	CHACAL	native	8	-5
<i>Chamerion angustifolium</i>	fireweed	CHAANG	native	3	0
<i>Cornus rugosa</i>	round-leaved dogwood	CORRUG	native	6	5
<i>Cypripedium acaule</i>	pink lady-slipper; moccasin flower	CYPACA	native	5	-3
<i>Danthonia spicata</i>	poverty grass; oatgrass	DANSPI	native	4	5
<i>Dendrolycopodium dendroideum</i>	tree clubmoss	DENDEN	native	5	3
<i>Deschampsia cespitosa</i>	hair grass	DESCES	native	9	-3
<i>Drosera rotundifolia</i>	round-leaved sundew	DROROT	native	6	-5
<i>Dryopteris filix-mas</i>	male fern	DRYFIL	native	10	5
<i>Dryopteris intermedia</i>	evergreen woodfern	DRYINT	native	5	0
<i>Erechtites hieraciifolius</i>	fireweed	EREHIE	native	2	3
<i>Eurybia macrophylla</i>	big-leaved aster	EURMAC	native	4	5
<i>Euthamia graminifolia</i>	grass-leaved goldenrod	EUTGRA	native	3	0
<i>Fallopia cilinodis</i>	fringed false buckwheat	FALCIL	native	3	5
<i>Gaultheria hispidula</i>	creeping-snowberry	GAUHIS	native	8	-3
<i>Gaylussacia baccata</i>	huckleberry	GAYBAC	native	7	3
<i>Heracleum maximum</i>	cow-parsnip	HERMAX	native	3	-3
<b><i>Hieracium caespitosum</i></b>	<b>king devil</b>	<b>HIECAE</b>	<b>non-native</b>	<b>0</b>	<b>5</b>
<i>Ilex verticillata</i>	michigan holly	ILEVER	native	5	-3
<i>Juncus brevicaudatus</i>	rush	JUNBRE	native	8	-5
<i>Lonicera dioica</i>	red honeysuckle	LONDIO	native	5	3
<i>Maianthemum canadense</i>	canada mayflower	MAICAN	native	4	3
<i>Melampyrum lineare</i>	cow-wheat	MELLIN	native	6	3
<i>Myrica gale</i>	sweet gale	MYRGAL	native	6	-5
<i>Picea glauca</i>	white spruce	PICGLA	native	3	3
<i>Picea mariana</i>	black spruce	PICMAR	native	6	-3
<i>Pinus banksiana</i>	jack pine	PINBAN	native	5	3
<i>Pinus resinosa</i>	red pine	PINRES	native	6	3

## Appendix 2.5. East Huron Island Granite Bedrock Glade FQA (continued)

Scientific Name	Common Name	Acronym	Native?	C	W
<i>Pinus strobus</i>	white pine	PINSTR	native	3	3
<b><i>Poa compressa</i></b>	<b>canada bluegrass</b>	<b>POACOM</b>	<b>non-native</b>	<b>0</b>	<b>3</b>
<i>Poa glauca</i>	bluegrass	POAGLA	native	10	5
<i>Polypodium virginianum</i>	common polypody	POLVIR	native	8	5
<i>Populus tremuloides</i>	quaking aspen	POPTRE	native	1	0
<i>Prunus pensylvanica</i>	pin cherry	PRUPEN	native	3	3
<i>Prunus virginiana</i>	choke cherry	PRUVIR	native	2	3
<i>Quercus rubra</i>	red oak	QUERUB	native	5	3
<i>Rhododendron groenlandicum</i>	labrador-tea	RHOGRO	native	8	-5
<i>Ribes glandulosum</i>	skunk currant	RIBGLA	native	5	-3
<i>Rosa acicularis</i>	wild rose	ROSACI	native	4	3
<i>Rubus pubescens</i>	dwarf raspberry	RUBPUB	native	4	-3
<i>Rubus setosus</i>	bristly blackberry	RUBSET	native	3	-3
<b><i>Rumex acetosella</i></b>	<b>sheep sorrel</b>	<b>RUMACL</b>	<b>non-native</b>	<b>0</b>	<b>3</b>
<i>Sambucus racemosa</i>	red-berried elder	SAMRAC	native	3	3
<i>Sibbaldiopsis tridentata</i>	three-toothed cinquefoil	SIBTRI	native	10	3
<i>Solidago hispida</i>	hairy goldenrod	SOLHIS	native	3	5
<i>Solidago ptarmicoides</i>	upland white goldenrod	SOLPTA	native	6	3
<i>Sorbus decora</i>	mountain-ash	SORDEC	native	4	3
<i>Taxus canadensis</i>	yew	TAXCAN	native	5	3
<i>Thuja occidentalis</i>	arbor vitae	THUOCC	native	4	-3
<i>Trientalis borealis</i>	star-flower	TRIBOR	native	5	0
<i>Tsuga canadensis</i>	hemlock	TSUCAN	native	5	3
<i>Vaccinium angustifolium</i>	low sweet blueberry	VACANG	native	4	3
<i>Vaccinium myrtilloides</i>	canada blueberry	VACMYR	native	4	-3

## Appendix 2.6. East Huron Island Granite Bedrock Lakeshore FQA

### Conservatism-Based Metrics:

Total Mean C:	4.3
Native Mean C:	4.6
Total FQI:	50.9
Native FQI:	52.6
Adjusted FQI:	44.5
% C value 0:	9.3
% C value 1-3:	30
% C value 4-6:	42.9
% C value 7-10:	17.9
Native Tree Mean C:	3.4
Native Shrub Mean C:	4.8
Native Herbaceous Mean C:	4.7

### Species Richness:

Total Species:	140
Native Species:	131 93.60%
Non-native Species:	9 6.40%

### Species Wetness:

Mean Wetness:	-0.7
Native Mean Wetness:	-0.9

### Physiognomy Metrics:

Tree:	14	10.00%
Shrub:	26	18.60%
Vine:	2	1.40%
Forb:	60	42.90%
Grass:	10	7.10%
Sedge:	16	11.40%
Rush:	4	3%
Fern:	8	5.70%
Bryophyte:	0	0%

### Duration Metrics:

Annual:	11	7.90%
Perennial:	126	90.00%
Biennial:	3	2.10%
Native Annual:	8	5.70%
Native Perennial:	120	85.70%
Native Biennial:	3	2.10%

**Appendix 2.6.** East Huron Island Granite Bedrock Lakeshore FQA (continued)

Scientific Name	Common Name	Acronym	Native?	C	W
<i>Abies balsamea</i>	balsam fir	ABIBAL	native	3	0
<i>Acer rubrum</i>	red maple	ACERUB	native	1	0
<i>Acer saccharum</i>	sugar maple	ACESAU	native	5	3
<i>Acer spicatum</i>	mountain maple	ACESPI	native	5	3
<i>Achillea millefolium</i>	yarrow	ACHMIL	native	1	3
<i>Agrimonia striata</i>	roadside agrimony	AGRSTR	native	3	3
<i>Agrostis scabra</i>	ticklegass	AGRSCA	native	4	0
<i>Alnus incana</i>	speckled alder	ALNINC	native	5	-3
<i>Alnus viridis</i>	mountain alder	ALNVIR	native	8	0
<i>Anaphalis margaritacea</i>	pearly everlasting	ANAMAR	native	3	5
<i>Aquilegia canadensis</i>	wild columbine	AQUCAN	native	5	3
<i>Aralia hispida</i>	bristly sarsaparilla	ARAHIS	native	3	5
<i>Arctostaphylos uva-ursi</i>	bearberry	ARCUVA	native	8	5
<i>Aronia prunifolia</i>	chokeberry	AROPRU	native	5	-3
<i>Asplenium trichomanes</i>	maidenhair spleenwort	ASPTRI	native	10	5
<i>Athyrium filix-femina</i>	lady fern	ATHFIL	native	4	0
<i>Avenella flexuosa</i>	hair grass	AVEFLE	native	6	5
<i>Betula papyrifera</i>	paper birch	BETPAP	native	2	3
<i>Bidens cernua</i>	nodding beggar-ticks	BIDCER	native	3	-5
<i>Calamagrostis canadensis</i>	blue-joint	CALCAN	native	3	-5
<i>Callitriche palustris</i>	water-starwort	CALPAS	native	6	-5
<i>Caltha palustris</i>	marsh-marigold	CALPAR	native	6	-5
<i>Campanula rotundifolia</i>	harebell	CAMROT	native	6	3
<i>Capnoides sempervirens</i>	pink or pale corydalis	CAPSEM	native	5	5
<i>Carex aquatilis</i>	sedge	CXAQUA	native	7	-5
<i>Carex bebbii</i>	sedge	CXBEBB	native	4	-5
<i>Carex blanda</i>	sedge	CXBLAN	native	1	0
<i>Carex buxbaumii</i>	sedge	CXBUXB	native	10	-5
<i>Carex canescens</i>	sedge	CXCANE	native	8	-5
<i>Carex crinita</i>	sedge	CXCRIN	native	4	-5
<i>Carex eburnea</i>	sedge	CXEBUR	native	7	3
<i>Carex echinata</i>	sedge	CXECHA	native	6	-5
<i>Carex flava</i>	sedge	CXFLAV	native	4	-5
<i>Carex magellanica</i>	sedge	CXMAGE	native	8	-5
<i>Carex stipata</i>	sedge	CXSTIP	native	1	-5
<i>Carex stricta</i>	sedge	CXSTRI	native	4	-5
<i>Carex trisperma</i>	sedge	CXTRIS	native	9	-5
<i>Carex vesicaria</i>	sedge	CXVESI	native	7	-5
<i>Chamaedaphne calyculata</i>	leatherleaf	CHACAL	native	8	-5
<i>Chamerion angustifolium</i>	fireweed	CHAANG	native	3	0
<i>Chelone glabra</i>	turtlehead	CHEGLB	native	7	-5
<i>Cicuta bulbifera</i>	water hemlock	CICBUL	native	5	-5
<i>Conyza canadensis</i>	horseweed	CONCAN	native	0	3
<i>Cornus rugosa</i>	round-leaved dogwood	CORRUG	native	6	5
<i>Cornus sericea</i>	red-osier	CORSER	native	2	-3
<i>Danthonia spicata</i>	poverty grass; oatgrass	DANSPI	native	4	5

**Appendix 2.6.** East Huron Island Granite Bedrock Lakeshore FQA (continued)

Scientific Name	Common Name	Acronym	Native?	C	W
<i>Deschampsia cespitosa</i>	hair grass	DESCES	native	9	-3
<i>Diervilla lonicera</i>	bush-honeysuckle	DIELON	native	4	5
<i>Drosera rotundifolia</i>	round-leaved sundew	DROROT	native	6	-5
<i>Dryopteris carthusiana</i>	spinulose woodfern	DRYCAR	native	5	-3
<i>Epilobium ciliatum</i>	willow-herb	EPICIL	native	3	-3
<b><i>Epipactis helleborine</i></b>	<b>helleborine</b>	<b>EPIHEL</b>	<b>non-native</b>	<b>0</b>	<b>0</b>
<i>Equisetum arvense</i>	common horsetail	EQUARV	native	0	0
<b><i>Erucastrum gallicum</i></b>	<b>dog mustard</b>	<b>ERUGAL</b>	<b>non-native</b>	<b>0</b>	<b>3</b>
<i>Euthamia graminifolia</i>	grass-leaved goldenrod	EUTGRA	native	3	0
<i>Eutrochium maculatum</i>	joe-pye-weed	EUTMAC	native	4	-5
<i>Fallopia cilinodis</i>	fringed false buckwheat	FALCIL	native	3	5
<i>Fragaria virginiana</i>	wild strawberry	FRAVIR	native	2	3
<i>Fraxinus pennsylvanica</i>	red ash	FRAPEN	native	2	-3
<b><i>Galeopsis tetrahit</i></b>	<b>hemp-nettle</b>	<b>GALTET</b>	<b>non-native</b>	<b>0</b>	<b>3</b>
<i>Galium triflorum</i>	fragrant bedstraw	GALTRR	native	4	3
<i>Gaultheria procumbens</i>	wintergreen	GAUPRO	native	5	3
<i>Geranium bicknellii</i>	northern cranes-bill	GERBIC	native	4	5
<i>Glyceria grandis</i>	reed manna grass	GLYGRA	native	6	-5
<i>Glyceria striata</i>	fowl manna grass	GLYSTR	native	4	-5
<i>Heracleum maximum</i>	cow-parsnip	HERMAX	native	3	-3
<b><i>Hieracium caespitosum</i></b>	<b>king devil</b>	<b>HIECAE</b>	<b>non-native</b>	<b>0</b>	<b>5</b>
<i>Hypericum majus</i>	larger canada st. johns-wort	HYPMAJ	native	4	-3
<b><i>Hypericum perforatum</i></b>	<b>common st. johns-wort</b>	<b>HYPPER</b>	<b>non-native</b>	<b>0</b>	<b>5</b>
<i>Ilex verticillata</i>	michigan holly	ILEVER	native	5	-3
<i>Impatiens capensis</i>	spotted touch-me-not	IMPCAP	native	2	-3
<i>Iris versicolor</i>	wild blue flag	IRIVER	native	5	-5
<i>Juncus brachycephalus</i>	rush	JUNBRP	native	7	-5
<i>Juncus brevicaudatus</i>	rush	JUNBRE	native	8	-5
<i>Juncus dudleyi</i>	dudleys rush	JUNDUD	native	1	-3
<i>Juncus effusus</i>	soft-stemmed rush	JUNEFF	native	3	-5
<i>Juniperus communis</i>	common or ground juniper	JUNCOI	native	4	3
<i>Juniperus horizontalis</i>	creeping juniper	JUNHOR	native	10	3
<i>Lactuca biennis</i>	tall blue lettuce	LACBIE	native	2	0
<i>Lactuca canadensis</i>	tall lettuce	LACCAN	native	2	3
<i>Lathyrus japonicus</i>	beach pea	LATJAP	native	10	3
<i>Lemna minor</i>	common duckweed	LEMMIN	native	5	-5
<i>Lemna turionifera</i>	red duckweed	LEMTUR	native	5	-5
<b><i>Leucanthemum vulgare</i></b>	<b>ox-eye daisy</b>	<b>LEUVUL</b>	<b>non-native</b>	<b>0</b>	<b>5</b>
<i>Lobelia kalmii</i>	bog lobelia	LOBKAL	native	10	-5
<i>Lycopus uniflorus</i>	northern bugle weed	LYCUNI	native	2	-5
<i>Lysimachia terrestris</i>	swamp-candles	LYSTER	native	6	-5
<i>Lysimachia thysiflora</i>	tufted loosestrife	LYSTHY	native	6	-5
<i>Maianthemum canadense</i>	canada mayflower	MAICAN	native	4	3
<i>Menyanthes trifoliata</i>	buckbean	MENTRI	native	8	-5
<i>Myosotis laxa</i>	small forget-me-not	MYOLAX	native	6	-5
<i>Myrica gale</i>	sweet gale	MYRGAL	native	6	-5
<i>Osmunda claytoniana</i>	interrupted fern	OSMCLN	native	6	0

Appendix 2.6. East Huron Island Granite Bedrock Lakeshore FQA (continued)

Scientific Name	Common Name	Acronym	Native?	C	W
<i>Osmunda regalis</i>	royal fern	OSMREG	native	5	-5
<i>Persicaria hydropiper</i>	water-pepper	PERHYR	native	1	-5
<i>Persicaria sagittata</i>	arrow-leaved tear-thumb	PERSAG	native	5	-5
<i>Phegopteris connectilis</i>	northern beech-fern	PHECON	native	5	3
<i>Physocarpus opulifolius</i>	ninebark	PHYOPU	native	4	-3
<i>Picea glauca</i>	white spruce	PICGLA	native	3	3
<i>Picea mariana</i>	black spruce	PICMAR	native	6	-3
<i>Pinus resinosa</i>	red pine	PINRES	native	6	3
<i>Pinus strobus</i>	white pine	PINSTR	native	3	3
<i>Poa annua</i>	annual bluegrass	POAANN	non-native	0	3
<b><i>Poa glauca</i></b>	<b>bluegrass</b>	<b>POAGLA</b>	<b>native</b>	<b>10</b>	<b>5</b>
<i>Poa palustris</i>	fowl meadow grass	POAPAS	native	3	-3
<i>Polypodium virginianum</i>	common polypody	POLVIR	native	8	5
<i>Populus tremuloides</i>	quaking aspen	POPTRE	native	1	0
<i>Potamogeton praelongus</i>	white-stemmed pondweed	POTPRA	native	8	-5
<i>Potentilla norvegica</i>	rough cinquefoil	POTNOR	native	0	0
<i>Prenanthes alba</i>	white lettuce	PREALB	native	5	3
<i>Prunella vulgaris</i>	self-heal	PRUVUL	native	0	0
<i>Prunus pensylvanica</i>	pin cherry	PRUPEN	native	3	3
<i>Prunus virginiana</i>	choke cherry	PRUVIR	native	2	3
<b><i>Ranunculus acris</i></b>	<b>tall or common buttercup</b>	<b>RANACR</b>	<b>non-native</b>	<b>0</b>	<b>0</b>
<i>Ranunculus pensylvanicus</i>	bristly crowfoot	RANPEN	native	6	-5
<i>Rhododendron groenlandicum</i>	labrador-tea	RHOGRO	native	8	-5
<i>Ribes glandulosum</i>	skunk currant	RIBGLA	native	5	-3
<i>Rosa acicularis</i>	wild rose	ROSACI	native	4	3
<i>Rubus setosus</i>	bristly blackberry	RUBSET	native	3	-3
<i>Rubus strigosus</i>	wild red raspberry	RUBSTR	native	2	0
<b><i>Rumex acetosella</i></b>	<b>sheep sorrel</b>	<b>RUMACL</b>	<b>non-native</b>	<b>0</b>	<b>3</b>
<i>Salix bebbiana</i>	bebbs willow	SALBEB	native	1	-3
<i>Sambucus racemosa</i>	red-berried elder	SAMRAC	native	3	3
<i>Scirpus cyperinus</i>	wool-grass	SCICYP	native	5	-5
<i>Scutellaria lateriflora</i>	mad-dog skullcap	SCULAT	native	5	-5
<i>Sibbaldiopsis tridentata</i>	three-toothed cinquefoil	SIBTRI	native	10	3
<i>Solidago altissima</i>	tall goldenrod	SOLALT	native	1	3
<i>Solidago hispida</i>	hairy goldenrod	SOLHIS	native	3	5
<i>Solidago ptarmicoides</i>	upland white goldenrod	SOLPTA	native	6	3
<i>Sorbus decora</i>	mountain-ash	SORDEC	native	4	3
<i>Spiraea alba</i>	meadowsweet	SPIALB	native	4	-3
<i>Symphotrichum lanceolatum</i>	panicled aster	SYMLAN	native	2	-3
<i>Symphotrichum lateriflorum</i>	calico aster	SYMLAT	native	2	0
<i>Taxus canadensis</i>	yew	TAXCAN	native	5	3
<i>Thalictrum dasycarpum</i>	purple meadow-rue	THADAS	native	3	-3
<i>Thuja occidentalis</i>	arbor vitae	THUOCC	native	4	-3
<i>Trichophorum cespitosum</i>	bulrush	TRICES	native	10	-5
<i>Triosteum aurantiacum</i>	horse-gentian	TRIAUN	native	5	5
<i>Urtica dioica</i>	stinging nettle	URTDIO	native	1	0
<i>Vaccinium angustifolium</i>	low sweet blueberry	VACANG	native	4	3

**Appendix 2.7.** East Huron Island Granite Lakeshore Cliff FQA

**Conservatism-Based Metrics:**

Total Mean C:	5.2
Native Mean C:	5.4
Total FQI:	45
Native FQI:	45.8
Adjusted FQI:	52.9
% C value 0:	4
% C value 1-3:	17.3
% C value 4-6:	52
% C value 7-10:	26.7
Native Tree Mean C:	3.8
Native Shrub Mean C:	5.4
Native Herbaceous Mean C:	5.9

**Species Richness:**

Total Species:	75
Native Species:	72 96.00%
Non-native Species:	3 4.00%

**Species Wetness:**

Mean Wetness:	0.2
Native Mean Wetness:	0.2

**Physiognomy Metrics:**

Tree:	11	14.70%
Shrub:	20	26.70%
Vine:	1	1.30%
Forb:	22	29.30%
Grass:	5	6.70%
Sedge:	8	10.70%
Rush:	1	1%
Fern:	7	9.30%
Bryophyte:	0	0%

**Duration Metrics:**

Annual:	2	2.70%
Perennial:	70	93.30%
Biennial:	3	4.00%
Native Annual:	2	2.70%
Native Perennial:	68	90.70%
Native Biennial:	2	2.70%

Appendix 2.7. East Huron Island Granite Lakeshore Cliff FQA (continued)

Scientific Name	Common Name	Acronym	Native?	C	W
<i>Abies balsamea</i>	balsam fir	ABIBAL	native	3	0
<i>Acer saccharum</i>	sugar maple	ACESAU	native	5	3
<i>Amelanchier interior</i>	serviceberry	AMEINT	native	4	5
<i>Amelanchier sanguinea</i>	round-leaved serviceberry	AMESAN	native	5	5
<i>Antennaria howellii</i>	small pussytoes	ANTHOW	native	2	5
<i>Arabidopsis lyrata</i>	sand cress	ARALYR	native	7	3
<i>Aralia nudicaulis</i>	wild sarsaparilla	ARANUD	native	5	3
<i>Arctostaphylos uva-ursi</i>	bearberry	ARCUVA	native	8	5
<i>Asplenium trichomanes</i>	maidenhair spleenwort	ASPTRI	native	10	5
<i>Athyrium filix-femina</i>	lady fern	ATHFIL	native	4	0
<i>Avenella flexuosa</i>	hair grass	AVEFLE	native	6	5
<i>Betula papyrifera</i>	paper birch	BETPAP	native	2	3
<i>Calamagrostis canadensis</i>	blue-joint	CALCAN	native	3	-5
<i>Campanula rotundifolia</i>	harebell	CAMROT	native	6	3
<i>Capnoides sempervirens</i>	pink or pale corydalis	CAPSEM	native	5	5
<i>Carex aquatilis</i>	sedge	CXAQUA	native	7	-5
<i>Carex buxbaumii</i>	sedge	CXBUXB	native	10	-5
<i>Carex canescens</i>	sedge	CXCANE	native	8	-5
<i>Carex eburnea</i>	sedge	CXEBUR	native	7	3
<i>Carex magellanica</i>	sedge	CXMAGE	native	8	-5
<i>Carex viridula</i>	sedge	CXVIRU	native	4	-5
<i>Chamaedaphne calyculata</i>	leatherleaf	CHACAL	native	8	-5
<i>Chamerion angustifolium</i>	fireweed	CHAANG	native	3	0
<b><i>Cirsium palustre</i></b>	<b>marsh thistle</b>	<b>CIRPAL</b>	<b>non-native</b>	<b>0</b>	<b>-3</b>
<i>Cornus canadensis</i>	bunchberry	CORCAA	native	6	0
<i>Cornus rugosa</i>	round-leaved dogwood	CORRUG	native	6	5
<i>Danthonia spicata</i>	poverty grass; oatgrass	DANSPI	native	4	5
<i>Deschampsia cespitosa</i>	hair grass	DESCES	native	9	-3
<i>Dichanthelium implicatum</i>	panic grass	DICIMP	native	3	0
<i>Diervilla lonicera</i>	bush-honeysuckle	DIELON	native	4	5
<i>Drosera rotundifolia</i>	round-leaved sundew	DROROT	native	6	-5
<i>Eleocharis intermedia</i>	spike-rush	ELEINT	native	7	-5
<i>Euthamia graminifolia</i>	grass-leaved goldenrod	EUTGRA	native	3	0
<i>Gaultheria hispidula</i>	creeping-snowberry	GAUHIS	native	8	-3
<i>Gaultheria procumbens</i>	wintergreen	GAUPRO	native	5	3
<b><i>Hieracium caespitosum</i></b>	<b>king devil</b>	<b>HIECAE</b>	<b>non-native</b>	<b>0</b>	<b>5</b>
<i>Hypericum majus</i>	larger canada st. johns-wort	HYPMAJ	native	4	-3
<i>Juncus brevicaudatus</i>	rush	JUNBRE	native	8	-5
<i>Juniperus communis</i>	common or ground juniper	JUNCOI	native	4	3
<i>Juniperus horizontalis</i>	creeping juniper	JUNHOR	native	10	3
<i>Lobelia kalmii</i>	bog lobelia	LOBKAL	native	10	-5
<i>Lonicera dioica</i>	red honeysuckle	LONDIO	native	5	3
<i>Maianthemum canadense</i>	canada mayflower	MAICAN	native	4	3
<i>Melampyrum lineare</i>	cow-wheat	MELLIN	native	6	3
<i>Menyanthes trifoliata</i>	buckbean	MENTRI	native	8	-5

**Appendix 2.7.** East Huron Island Granite Lakeshore Cliff FQA (continued)

Scientific Name	Common Name	Acronym	Native?	C	W
<i>Myrica gale</i>	sweet gale	MYRGAL	native	6	-5
<i>Onoclea sensibilis</i>	sensitive fern	ONOSEN	native	2	-3
<i>Osmunda claytoniana</i>	interrupted fern	OSMCLN	native	6	0
<i>Osmunda regalis</i>	royal fern	OSMREG	native	5	-5
<i>Phegopteris connectilis</i>	northern beech-fern	PHECON	native	5	3
<i>Physocarpus opulifolius</i>	ninebark	PHYOPU	native	4	-3
<i>Picea glauca</i>	white spruce	PICGLA	native	3	3
<i>Picea mariana</i>	black spruce	PICMAR	native	6	-3
<i>Pinus resinosa</i>	red pine	PINRES	native	6	3
<i>Pinus strobus</i>	white pine	PINSTR	native	3	3
<i>Polypodium virginianum</i>	common polypody	POLVIR	native	8	5
<i>Populus tremuloides</i>	quaking aspen	POPTRE	native	1	0
<i>Prenanthes alba</i>	white lettuce	PREALB	native	5	3
<i>Quercus rubra</i>	red oak	QUERUB	native	5	3
<i>Rhododendron groenlandicum</i>	labrador-tea	RHOGRO	native	8	-5
<i>Ribes glandulosum</i>	skunk currant	RIBGLA	native	5	-3
<i>Rosa acicularis</i>	wild rose	ROSACI	native	4	3
<i>Rubus pubescens</i>	dwarf raspberry	RUBPUB	native	4	-3
<b><i>Rumex acetosella</i></b>	<b>sheep sorrel</b>	<b>RUMACL</b>	<b>non-native</b>	<b>0</b>	<b>3</b>
<i>Salix bebbiana</i>	bebbs willow	SALBEB	native	1	-3
<i>Scirpus cyperinus</i>	wool-grass	SCICYP	native	5	-5
<i>Sibbaldiopsis tridentata</i>	three-toothed cinquefoil	SIBTRI	native	10	3
<i>Solidago hispida</i>	hairy goldenrod	SOLHIS	native	3	5
<i>Solidago ptarmicoides</i>	upland white goldenrod	SOLPTA	native	6	3
<i>Sorbus decora</i>	mountain-ash	SORDEC	native	4	3
<i>Spiraea alba</i>	meadowsweet	SPIALB	native	4	-3
<i>Spiranthes romanzoffiana</i>	hooded ladies-tresses	SPIROM	native	8	-5
<i>Thuja occidentalis</i>	arbor vitae	THUOCC	native	4	-3
<i>Trientalis borealis</i>	star-flower	TRIBOR	native	5	0
<i>Vaccinium angustifolium</i>	low sweet blueberry	VACANG	native	4	3

## Appendix 2.8. Gull Island Granite Bedrock Glade FQA

### Conservatism-Based Metrics:

Total Mean C:	3.6
Native Mean C:	4
Total FQI:	27.7
Native FQI:	29.1
Adjusted FQI:	37.9
% C value 0:	13.6
% C value 1-3:	37.3
% C value 4-6:	42.4
% C value 7-10:	6.8
Native Tree Mean C:	3.2
Native Shrub Mean C:	3.8
Native Herbaceous Mean C:	4.3

### Species Richness:

Total Species:	59
Native Species:	53 89.80%
Non-native Species:	6 10.20%

### Species Wetness:

Mean Wetness:	1
Native Mean Wetness:	0.7

### Physiognomy Metrics:

Tree:	9	15.30%
Shrub:	12	20.30%
Vine:	1	1.70%
Forb:	14	23.70%
Grass:	8	13.60%
Sedge:	10	16.90%
Rush:	1	2%
Fern:	4	6.80%
Bryophyte:	0	0%

### Duration Metrics:

Annual:	2	3.40%
Perennial:	55	93.20%
Biennial:	2	3.40%
Native Annual:	2	3.40%
Native Perennial:	50	84.70%
Native Biennial:	1	1.70%

**Appendix 2.8.** Gull Island Granite Bedrock Glade FQA (continued)

Scientific Name	Common Name	Acronym	Native?	C	W
<i>Abies balsamea</i>	balsam fir	ABIBAL	native	3	0
<i>Acer spicatum</i>	mountain maple	ACESPI	native	5	3
<i>Achillea millefolium</i>	yarrow	ACHMIL	native	1	3
<i>Agrostis scabra</i>	ticklegrass	AGRSCA	native	4	0
<i>Amelanchier interior</i>	serviceberry	AMEINT	native	4	5
<i>Amelanchier sanguinea</i>	round-leaved serviceberry	AMESAN	native	5	5
<i>Aralia hispida</i>	bristly sarsaparilla	ARAHIS	native	3	5
<i>Aronia prunifolia</i>	chokeberry	AROPRU	native	5	-3
<i>Athyrium filix-femina</i>	lady fern	ATHFIL	native	4	0
<i>Avenella flexuosa</i>	hair grass	AVEFLE	native	6	5
<i>Betula papyrifera</i>	paper birch	BETPAP	native	2	3
<i>Calamagrostis canadensis</i>	blue-joint	CALCAN	native	3	-5
<i>Campanula rotundifolia</i>	harebell	CAMROT	native	6	3
<i>Capnoides sempervirens</i>	pink or pale corydalis	CAPSEM	native	5	5
<i>Carex arctata</i>	sedge	CXARTT	native	3	5
<i>Carex brunnescens</i>	sedge	CXBRUN	native	5	-3
<i>Carex canescens</i>	sedge	CXCANE	native	8	-5
<i>Carex communis</i>	sedge	CXCOMM	native	2	5
<i>Carex echinata</i>	sedge	CXECHA	native	6	-5
<i>Carex foenea</i>	sedge	CXFOEN	native	3	5
<i>Carex merritt-fernaldii</i>	sedge	CXMERR	native	4	5
<i>Carex scoparia</i>	sedge	CXSCOP	native	4	-3
<i>Carex stricta</i>	sedge	CXSTRI	native	4	-5
<i>Chamerion angustifolium</i>	fireweed	CHAANG	native	3	0
<i>Deschampsia cespitosa</i>	hair grass	DESCES	native	9	-3
<i>Dryopteris carthusiana</i>	spinulose woodfern	DRYCAR	native	5	-3
<i>Dryopteris intermedia</i>	evergreen woodfern	DRYINT	native	5	0
<i>Euthamia graminifolia</i>	grass-leaved goldenrod	EUTGRA	native	3	0
<i>Fallopia cilinodis</i>	fringed false buckwheat	FALCIL	native	3	5
<b><i>Hieracium caespitosum</i></b>	<b>king devil</b>	<b>HIECAE</b>	<b>non-native</b>	<b>0</b>	<b>5</b>
<b><i>Hypericum perforatum</i></b>	<b>common st. johns-wort</b>	<b>HYPPER</b>	<b>non-native</b>	<b>0</b>	<b>5</b>
<i>Ilex verticillata</i>	michigan holly	ILEVER	native	5	-3
<i>Juncus effusus</i>	soft-stemmed rush	JUNEFF	native	3	-5
<i>Lysimachia terrestris</i>	swamp-candles	LYSTER	native	6	-5
<i>Maianthemum canadense</i>	canada mayflower	MAICAN	native	4	3
<i>Persicaria hydropiper</i>	water-pepper	PERHYR	native	1	-5
<i>Picea glauca</i>	white spruce	PICGLA	native	3	3
<i>Pinus strobus</i>	white pine	PINSTR	native	3	3
<b><i>Poa compressa</i></b>	<b>canada bluegrass</b>	<b>POACOM</b>	<b>non-native</b>	<b>0</b>	<b>3</b>
<i>Poa glauca</i>	bluegrass	POAGLA	native	10	5
<i>Poa palustris</i>	fowl meadow grass	POAPAS	native	3	-3
<b><i>Poa pratensis</i></b>	<b>kentucky bluegrass</b>	<b>POAPRA</b>	<b>non-native</b>	<b>0</b>	<b>3</b>
<i>Populus tremuloides</i>	quaking aspen	POPTRE	native	1	0
<i>Potentilla norvegica</i>	rough cinquefoil	POTNOR	native	0	0
<i>Prunus pensylvanica</i>	pin cherry	PRUPEN	native	3	3
<i>Prunus virginiana</i>	choke cherry	PRUVIR	native	2	3

**Appendix 2.8.** Gull Island Granite Bedrock Glade FQA (continued)

<b>Scientific Name</b>	<b>Common Name</b>	<b>Acronym</b>	<b>Native?</b>	<b>C</b>	<b>W</b>
<i>Pteridium aquilinum</i>	bracken fern	PTEAQU	native	0	3
<i>Ribes glandulosum</i>	skunk currant	RIBGLA	native	5	-3
<i>Rubus setosus</i>	bristly blackberry	RUBSET	native	3	-3
<i>Rubus strigosus</i>	wild red raspberry	RUBSTR	native	2	0
<b><i>Rumex acetosella</i></b>	<b>sheep sorrel</b>	<b>RUMACL</b>	<b>non-native</b>	<b>0</b>	<b>3</b>
<i>Sambucus racemosa</i>	red-berried elder	SAMRAC	native	3	3
<i>Scirpus cyperinus</i>	wool-grass	SCICYP	native	5	-5
<i>Sibbaldiopsis tridentata</i>	three-toothed cinquefoil	SIBTRI	native	10	3
<i>Sorbus decora</i>	mountain-ash	SORDEC	native	4	3
<i>Taxus canadensis</i>	yew	TAXCAN	native	5	3
<i>Tsuga canadensis</i>	hemlock	TSUCAN	native	5	3
<i>Vaccinium angustifolium</i>	low sweet blueberry	VACANG	native	4	3
<b><i>Verbascum thapsus</i></b>	<b>common mullein</b>	<b>VERTHA</b>	<b>non-native</b>	<b>0</b>	<b>5</b>

## Appendix 2.9. Gull Island Granite Bedrock Lakeshore FQA

### Conservatism-Based Metrics:

Total Mean C:	3.5
Native Mean C:	4.2
Total FQI:	30.1
Native FQI:	32.8
Adjusted FQI:	38.1
% C value 0:	20.3
% C value 1-3:	33.8
% C value 4-6:	32.4
% C value 7-10:	13.5
Native Tree Mean C:	2.7
Native Shrub Mean C:	4.1
Native Herbaceous Mean C:	4.7

### Species Richness:

Total Species:	74	
Native Species:	61	82.40%
Non-native Species:	13	17.60%

### Species Wetness:

Mean Wetness:	-0.1
Native Mean Wetness:	-0.8

### Physiognomy Metrics:

Tree:	10	13.50%
Shrub:	15	20.30%
Vine:	2	2.70%
Forb:	32	43.20%
Grass:	5	6.80%
Sedge:	6	8.10%
Rush:	2	3%
Fern:	2	2.70%
Bryophyte:	0	0%

### Duration Metrics:

Annual:	3	4.10%
Perennial:	69	93.20%
Biennial:	2	2.70%
Native Annual:	2	2.70%
Native Perennial:	58	78.40%
Native Biennial:	1	1.40%

Appendix 2.9. Gull Island Granite Bedrock Lakeshore FQA (continued)

Scientific Name	Common Name	Acronym	Native?	C	W
<i>Acer pensylvanicum</i>	striped maple	ACEPEN	native	5	3
<i>Acer rubrum</i>	red maple	ACERUB	native	1	0
<i>Achillea millefolium</i>	yarrow	ACHMIL	native	1	3
<i>Agrostis scabra</i>	ticklegrass	AGRSCA	native	4	0
<i>Amelanchier sanguinea</i>	round-leaved serviceberry	AMESAN	native	5	5
<i>Avenella flexuosa</i>	hair grass	AVEFLE	native	6	5
<b><i>Barbarea vulgaris</i></b>	<b>yellow rocket</b>	<b>BARVUL</b>	<b>non-native</b>	<b>0</b>	<b>0</b>
<i>Betula papyrifera</i>	paper birch	BETPAP	native	2	3
<i>Calamagrostis canadensis</i>	blue-joint	CALCAN	native	3	-5
<i>Campanula rotundifolia</i>	harebell	CAMROT	native	6	3
<i>Capnoides sempervirens</i>	pink or pale corydalis	CAPSEM	native	5	5
<i>Carex buxbaumii</i>	sedge	CXBUXB	native	10	-5
<i>Carex crinita</i>	sedge	CXCRIN	native	4	-5
<i>Carex echinata</i>	sedge	CXECHA	native	6	-5
<i>Carex vesicaria</i>	sedge	CXVESI	native	7	-5
<b><i>Cerastium fontanum</i></b>	<b>mouse-ear chickweed</b>	<b>CERFON</b>	<b>non-native</b>	<b>0</b>	<b>3</b>
<i>Chamerion angustifolium</i>	fireweed	CHAANG	native	3	0
<i>Chelone glabra</i>	turtlehead	CHEGLB	native	7	-5
<i>Conyza canadensis</i>	horseweed	CONCAN	native	0	3
<i>Cornus rugosa</i>	round-leaved dogwood	CORRUG	native	6	5
<i>Dryocallis arguta</i>	tall or prairie cinquefoil	DRYARG	native	8	3
<i>Dryopteris carthusiana</i>	spinulose woodfern	DRYCAR	native	5	-3
<b><i>Elymus repens</i></b>	<b>quack grass</b>	<b>ELYREP</b>	<b>non-native</b>	<b>0</b>	<b>3</b>
<i>Epilobium ciliatum</i>	willow-herb	EPICIL	native	3	-3
<i>Eupatorium perfoliatum</i>	boneset	EUPPER	native	4	-3
<i>Euthamia graminifolia</i>	grass-leaved goldenrod	EUTGRA	native	3	0
<i>Fallopia cilinodis</i>	fringed false buckwheat	FALCIL	native	3	5
<i>Fraxinus pennsylvanica</i>	red ash	FRAPEN	native	2	-3
<i>Galium tinctorium</i>	stiff bedstraw	GALTIN	native	5	-5
<b><i>Hieracium caespitosum</i></b>	<b>king devil</b>	<b>HIECAE</b>	<b>non-native</b>	<b>0</b>	<b>5</b>
<b><i>Hypericum perforatum</i></b>	<b>common st. johns-wort</b>	<b>HYPPER</b>	<b>non-native</b>	<b>0</b>	<b>5</b>
<i>Ilex verticillata</i>	michigan holly	ILEVER	native	5	-3
<i>Juncus dudleyi</i>	dudleys rush	JUNDUD	native	1	-3
<i>Juncus effusus</i>	soft-stemmed rush	JUNEFF	native	3	-5
<i>Lathyrus japonicus</i>	beach pea	LATJAP	native	10	3
<b><i>Leucanthemum vulgare</i></b>	<b>ox-eye daisy</b>	<b>LEUVUL</b>	<b>non-native</b>	<b>0</b>	<b>5</b>
<i>Lobelia kalmii</i>	bog lobelia	LOBKAL	native	10	-5
<i>Lycopus uniflorus</i>	northern bugle weed	LYCUNI	native	2	-5
<i>Lysimachia terrestris</i>	swamp-candles	LYSTER	native	6	-5
<i>Myrica gale</i>	sweet gale	MYRGAL	native	6	-5
<b><i>Persicaria maculosa</i></b>	<b>ladys-thumb</b>	<b>PERMAC</b>	<b>non-native</b>	<b>0</b>	<b>0</b>
<i>Physocarpus opulifolius</i>	ninebark	PHYOPU	native	4	-3
<i>Pinus strobus</i>	white pine	PINSTR	native	3	3
<i>Poa glauca</i>	bluegrass	POAGLA	native	10	5
<i>Polypodium virginianum</i>	common polypody	POLVIR	native	8	5

Appendix 2.9. Gull Island Granite Bedrock Lakeshore FQA (continued)

Scientific Name	Common Name	Acronym	Native?	C	W
<i>Populus tremuloides</i>	quaking aspen	POPTRE	native	1	0
<i>Potentilla norvegica</i>	rough cinquefoil	POTNOR	native	0	0
<b><i>Potentilla recta</i></b>	<b>rough-fruited cinquefoil</b>	<b>POTREC</b>	<b>non-native</b>	<b>0</b>	<b>5</b>
<i>Prunus pensylvanica</i>	pin cherry	PRUPEN	native	3	3
<i>Prunus serotina</i>	wild black cherry	PRUSER	native	2	3
<i>Prunus virginiana</i>	choke cherry	PRUVIR	native	2	3
<i>Ribes glandulosum</i>	skunk currant	RIBGLA	native	5	-3
<i>Rubus pubescens</i>	dwarf raspberry	RUBPUB	native	4	-3
<i>Rubus setosus</i>	bristly blackberry	RUBSET	native	3	-3
<i>Rubus strigosus</i>	wild red raspberry	RUBSTR	native	2	0
<b><i>Rumex acetosella</i></b>	<b>sheep sorrel</b>	<b>RUMACL</b>	<b>non-native</b>	<b>0</b>	<b>3</b>
<i>Salix bebbiana</i>	bebbs willow	SALBEB	native	1	-3
<i>Salix exigua</i>	sandbar willow	SALEXI	native	1	-3
<i>Salix myricoides</i>	blueleaf willow	SALMYR	native	9	-3
<i>Scirpus atrovirens</i>	bulrush	SCIATV	native	3	-5
<i>Scirpus cyperinus</i>	wool-grass	SCICYP	native	5	-5
<i>Solidago altissima</i>	tall goldenrod	SOLALT	native	1	3
<i>Sorbus decora</i>	mountain-ash	SORDEC	native	4	3
<i>Spiraea alba</i>	meadowsweet	SPIALB	native	4	-3
<b><i>Stellaria graminea</i></b>	<b>starwort</b>	<b>STEGRE</b>	<b>non-native</b>	<b>0</b>	<b>5</b>
<i>Symphyotrichum firmum</i>	smooth swamp aster	SYMFIR	native	4	-3
<i>Taraxacum officinale</i>	common dandelion	TAROFF	non-native	0	3
<i>Thalictrum dasycarpum</i>	purple meadow-rue	THADAS	native	3	-3
<i>Thuja occidentalis</i>	arbor vitae	THUOCC	native	4	-3
<b><i>Trifolium repens</i></b>	<b>white clover</b>	<b>TRIREP</b>	<b>non-native</b>	<b>0</b>	<b>3</b>
<i>Urtica dioica</i>	stinging nettle	URTDIO	native	1	0
<i>Vaccinium angustifolium</i>	low sweet blueberry	VACANG	native	4	3
<b><i>Veronica officinalis</i></b>	<b>common speedwell</b>	<b>VEROOF</b>	<b>non-native</b>	<b>0</b>	<b>3</b>
<i>Viola nephrophylla</i>	northern bog violet	VIONEP	native	8	-3

**Appendix 2.10.** Gull Island Granite Lakeshore Cliff FQA

**Conservatism-Based Metrics:**

Total Mean C:	4
Native Mean C:	4.5
Total FQI:	22.3
Native FQI:	23.8
Adjusted FQI:	42.8
% C value 0:	12.9
% C value 1-3:	32.3
% C value 4-6:	41.9
% C value 7-10:	12.9
Native Tree Mean C:	3.5
Native Shrub Mean C:	4.5
Native Herbaceous Mean C:	4.9

**Species Richness:**

Total Species:	31
Native Species:	28   90.30%
Non-native Species:	3   9.70%

**Species Wetness:**

Mean Wetness:	2.2
Native Mean Wetness:	2

**Physiognomy Metrics:**

Tree:	6	19.40%
Shrub:	10	32.30%
Vine:	0	0.00%
Forb:	9	29.00%
Grass:	5	16.10%
Sedge:	0	0.00%
Rush:	0	0%
Fern:	1	3.20%
Bryophyte:	0	0%

**Duration Metrics:**

Annual:	1	3.20%
Perennial:	29	93.50%
Biennial:	1	3.20%
Native Annual:	1	3.20%
Native Perennial:	26	83.90%
Native Biennial:	1	3.20%

## Appendix 2.10. Gull Island Granite Lakeshore Cliff FQA (continued)

Scientific Name	Common Name	Acronym	Native?	C	W
<i>Acer spicatum</i>	mountain maple	ACESPI	native	5	3
<i>Achillea millefolium</i>	yarrow	ACHMIL	native	1	3
<i>Agrostis scabra</i>	ticklegass	AGRSCA	native	4	0
<i>Amelanchier interior</i>	serviceberry	AMEINT	native	4	5
<i>Amelanchier sanguinea</i>	round-leaved serviceberry	AMESAN	native	5	5
<i>Aralia hispida</i>	bristly sarsaparilla	ARAHIS	native	3	5
<i>Avenella flexuosa</i>	hair grass	AVEFLE	native	6	5
<i>Betula papyrifera</i>	paper birch	BETPAP	native	2	3
<i>Calamagrostis canadensis</i>	blue-joint	CALCAN	native	3	-5
<i>Campanula rotundifolia</i>	harebell	CAMROT	native	6	3
<i>Capnoides sempervirens</i>	pink or pale corydalis	CAPSEM	native	5	5
<i>Chamerion angustifolium</i>	fireweed	CHAANG	native	3	0
<i>Euthamia graminifolia</i>	grass-leaved goldenrod	EUTGRA	native	3	0
<i>Hypericum perforatum</i>	common st. johns-wort	HYPPER	non-native	0	5
<i>Juniperus horizontalis</i>	creeping juniper	JUNHOR	native	10	3
<i>Physocarpus opulifolius</i>	ninebark	PHYOPU	native	4	-3
<i>Pinus strobus</i>	white pine	PINSTR	native	3	3
<i>Poa glauca</i>	bluegrass	POAGLA	native	10	5
<i>Poa pratensis</i>	kentucky bluegrass	POAPRA	non-native	0	3
<i>Polypodium virginianum</i>	common polypody	POLVIR	native	8	5
<i>Potentilla norvegica</i>	rough cinquefoil	POTNOR	native	0	0
<i>Prunus pensylvanica</i>	pin cherry	PRUPEN	native	3	3
<i>Ribes glandulosum</i>	skunk currant	RIBGLA	native	5	-3
<i>Rosa acicularis</i>	wild rose	ROSACI	native	4	3
<i>Rubus strigosus</i>	wild red raspberry	RUBSTR	native	2	0
<i>Rumex acetosella</i>	sheep sorrel	RUMACL	non-native	0	3
<i>Sambucus racemosa</i>	red-berried elder	SAMRAC	native	3	3
<i>Sibbaldiopsis tridentata</i>	three-toothed cinquefoil	SIBTRI	native	10	3
<i>Sorbus decora</i>	mountain-ash	SORDEC	native	4	3
<i>Taxus canadensis</i>	yew	TAXCAN	native	5	3
<i>Thuja occidentalis</i>	arbor vitae	THUOCC	native	4	-3

## Appendix 2.11. West Huron Island Boreal Forest FQA

### Conservatism-Based Metrics:

Total Mean C:	4.5
Native Mean C:	4.7
Total FQI:	41.2
Native FQI:	42
Adjusted FQI:	45.9
% C value 0:	4.8
% C value 1-3:	28.6
% C value 4-6:	53.6
% C value 7-10:	13.1
Native Tree Mean C:	3.4
Native Shrub Mean C:	4.7
Native Herbaceous Mean C:	5.1

### Species Richness:

Total Species:	84	
Native Species:	80	95.20%
Non-native Species:	4	4.80%

### Species Wetness:

Mean Wetness:	1.8
Native Mean Wetness:	1.8

### Physiognomy Metrics:

Tree:	13	15.50%
Shrub:	22	26.20%
Vine:	5	6.00%
Forb:	23	27.40%
Grass:	8	9.50%
Sedge:	5	6.00%
Rush:	0	0%
Fern:	8	9.50%
Bryophyte:	0	0%

### Duration Metrics:

Annual:	1	1.20%
Perennial:	82	97.60%
Biennial:	1	1.20%
Native Annual:	1	1.20%
Native Perennial:	78	92.90%
Native Biennial:	1	1.20%

Appendix 2.11. West Huron Island Boreal Forest FQA (continued)

Scientific Name	Common Name	Acronym	Native?	C	W
<i>Abies balsamea</i>	balsam fir	ABIBAL	native	3	0
<i>Acer pensylvanicum</i>	striped maple	ACEPEN	native	5	3
<i>Acer rubrum</i>	red maple	ACERUB	native	1	0
<i>Acer spicatum</i>	mountain maple	ACESPI	native	5	3
<i>Amelanchier interior</i>	serviceberry	AMEINT	native	4	5
<i>Amelanchier sanguinea</i>	round-leaved serviceberry	AMESAN	native	5	5
<i>Anaphalis margaritacea</i>	pearly everlasting	ANAMAR	native	3	5
<i>Antennaria howellii</i>	small pussytoes	ANTHOW	native	2	5
<i>Aralia nudicaulis</i>	wild sarsaparilla	ARANUD	native	5	3
<i>Athyrium filix-femina</i>	lady fern	ATHFIL	native	4	0
<i>Avenella flexuosa</i>	hair grass	AVEFLE	native	6	5
<i>Betula papyrifera</i>	paper birch	BETPAP	native	2	3
<i>Calamagrostis canadensis</i>	blue-joint	CALCAN	native	3	-5
<i>Campanula rapunculoides</i>	roving bellflower	CAMRAP	non-native	0	5
<i>Capnoides sempervirens</i>	pink or pale corydalis	CAPSEM	native	5	5
<i>Carex arctata</i>	sedge	CXARTT	native	3	5
<i>Carex brunnescens</i>	sedge	CXBRUN	native	5	-3
<i>Carex communis</i>	sedge	CXCOMM	native	2	5
<i>Carex deweyana</i>	sedge	CXDEWE	native	3	3
<i>Carex pedunculata</i>	sedge	CXPEDU	native	5	3
<i>Chamaedaphne calyculata</i>	leatherleaf	CHACAL	native	8	-5
<i>Chamerion angustifolium</i>	fireweed	CHAANG	native	3	0
<i>Clinopodium vulgare</i>	wild-basil	CLIVUL	native	3	5
<i>Clintonia borealis</i>	bluebead-lily; corn-lily	CLIBOR	native	5	0
<i>Coptis trifolia</i>	goldthread	COPTRI	native	5	-3
<i>Corallorhiza maculata</i>	spotted coral-root	CORMAC	native	5	3
<i>Cornus canadensis</i>	bunchberry	CORCAA	native	6	0
<i>Cornus rugosa</i>	round-leaved dogwood	CORRUG	native	6	5
<i>Cornus sericea</i>	red-osier	CORSER	native	2	-3
<i>Danthonia spicata</i>	poverty grass; oatgrass	DANSPI	native	4	5
<i>Diervilla lonicera</i>	bush-honeysuckle	DIELON	native	4	5
<i>Dryopteris carthusiana</i>	spinulose woodfern	DRYCAR	native	5	-3
<i>Dryopteris filix-mas</i>	male fern	DRYFIL	native	10	5
<i>Dryopteris goldiana</i>	goldies woodfern	DRYGOL	native	10	0
<i>Dryopteris intermedia</i>	evergreen woodfern	DRYINT	native	5	0
<i>Dryopteris marginalis</i>	marginal woodfern	DRYMAR	native	5	3
<i>Eurybia macrophylla</i>	big-leaved aster	EURMAC	native	4	5
<i>Fallopia cilinodis</i>	fringed false buckwheat	FALCIL	native	3	5
<i>Festuca occidentalis</i>	western fescue	FESOCC	native	6	5
<i>Galium triflorum</i>	fragrant bedstraw	GALTRR	native	4	3
<i>Gaultheria hispida</i>	creeping-snowberry	GAUHIS	native	8	-3
<i>Geum aleppicum</i>	yellow avens	GEUALE	native	3	0
<i>Gymnocarpium dryopteris</i>	oak fern	GYMDRY	native	5	3
<i>Hepatica americana</i>	round-lobed hepatica	HEPAME	native	6	5
<i>Heracleum maximum</i>	cow-parsnip	HERMAX	native	3	-3

## Appendix 2.11. West Huron Island Boreal Forest FQA (continued)

Scientific Name	Common Name	Acronym	Native?	C	W
<i>Ilex mucronata</i>	mountain holly	ILEMUC	native	7	-5
<i>Ilex verticillata</i>	michigan holly	ILEVER	native	5	-3
<i>Lathyrus japonicus</i>	beach pea	LATJAP	native	10	3
<i>Lathyrus ochroleucus</i>	pale vetchling	LATOCH	native	8	5
<i>Linnaea borealis</i>	twinflower	LINBOR	native	6	0
<i>Lonicera canadensis</i>	canadian fly honeysuckle	LONCAN	native	5	3
<i>Lonicera dioica</i>	red honeysuckle	LONDIO	native	5	3
<i>Lonicera hirsuta</i>	hairy honeysuckle	LONHIR	native	6	0
<i>Maianthemum canadense</i>	canada mayflower	MAICAN	native	4	3
<i>Melampyrum lineare</i>	cow-wheat	MELLIN	native	6	3
<i>Phlox paniculata</i>	garden phlox	PHLPAN	non-native	0	3
<i>Picea glauca</i>	white spruce	PICGLA	native	3	3
<i>Picea mariana</i>	black spruce	PICMAR	native	6	-3
<i>Pinus strobus</i>	white pine	PINSTR	native	3	3
<i>Poa compressa</i>	canada bluegrass	POACOM	non-native	0	3
<i>Poa glauca</i>	bluegrass	POAGLA	native	10	5
<i>Poa nemoralis</i>	bluegrass	POANEM	non-native	0	3
<i>Polygonatum pubescens</i>	downy solomon seal	POLPUB	native	5	5
<i>Polypodium virginianum</i>	common polypody	POLVIR	native	8	5
<i>Populus grandidentata</i>	big-tooth aspen	POPGRA	native	4	3
<i>Populus tremuloides</i>	quaking aspen	POPTRE	native	1	0
<i>Prunus pensylvanica</i>	pin cherry	PRUPEN	native	3	3
<i>Prunus virginiana</i>	choke cherry	PRUVIR	native	2	3
<i>Pyrola americana</i>	round-leaved pyrola	PYRAME	native	7	0
<i>Rhododendron groenlandicum</i>	labrador-tea	RHOGRO	native	8	-5
<i>Ribes glandulosum</i>	skunk currant	RIBGLA	native	5	-3
<i>Rosa acicularis</i>	wild rose	ROSACI	native	4	3
<i>Rubus occidentalis</i>	black raspberry	RUBOCC	native	1	5
<i>Rubus setosus</i>	bristly blackberry	RUBSET	native	3	-3
<i>Sambucus racemosa</i>	red-berried elder	SAMRAC	native	3	3
<i>Schizachne purpurascens</i>	false melic	SCHPUP	native	5	3
<i>Solidago hispida</i>	hairy goldenrod	SOLHIS	native	3	5
<i>Sorbus decora</i>	mountain-ash	SORDEC	native	4	3
<i>Symphoricarpos albus var. albus</i>	snowberry	SYMALA	native	5	3
<i>Taxus canadensis</i>	yew	TAXCAN	native	5	3
<i>Thuja occidentalis</i>	arbor vitae	THUOCC	native	4	-3
<i>Trientalis borealis</i>	star-flower	TRIBOR	native	5	0
<i>Vaccinium angustifolium</i>	low sweet blueberry	VACANG	native	4	3
<i>Vaccinium myrtilloides</i>	canada blueberry	VACMYR	native	4	-3

**Appendix 2.12.** West Huron Island Granite Bedrock Glade FQA

**Conservatism-Based Metrics:**

Total Mean C:	4.5
Native Mean C:	4.9
Total FQI:	48.3
Native FQI:	50.4
Adjusted FQI:	47
% C value 0:	8.7
% C value 1-3:	25.2
% C value 4-6:	49.6
% C value 7-10:	16.5
Native Tree Mean C:	3.7
Native Shrub Mean C:	5
Native Herbaceous Mean C:	5.1

**Species Richness:**

Total Species:	115	
Native Species:	106	92.20%
Non-native Species:	9	7.80%

**Species Wetness:**

Mean Wetness:	1.2
Native Mean Wetness:	0.9

**Physiognomy Metrics:**

Tree:	14	12.20%
Shrub:	27	23.50%
Vine:	1	0.90%
Forb:	39	33.90%
Grass:	12	10.40%
Sedge:	11	9.60%
Rush:	1	1%
Fern:	10	8.70%
Bryophyte:	0	0%

**Duration Metrics:**

Annual:	1	0.90%
Perennial:	113	98.30%
Biennial:	1	0.90%
Native Annual:	1	0.90%
Native Perennial:	104	90.40%
Native Biennial:	1	0.90%

## Appendix 2.12. West Huron Island Granite Bedrock Glade FQA (continued)

Scientific Name	Common Name	Acronym	Native?	C	W
<i>Abies balsamea</i>	balsam fir	ABIBAL	native	3	0
<i>Acer pensylvanicum</i>	striped maple	ACEPEN	native	5	3
<i>Acer rubrum</i>	red maple	ACERUB	native	1	0
<i>Acer saccharum</i>	sugar maple	ACESAU	native	5	3
<i>Acer spicatum</i>	mountain maple	ACESPI	native	5	3
<i>Agrostis scabra</i>	ticklegrass	AGRSCA	native	4	0
<i>Amelanchier sanguinea</i>	round-leaved serviceberry	AMESAN	native	5	5
<i>Anaphalis margaritacea</i>	pearly everlasting	ANAMAR	native	3	5
<i>Aquilegia canadensis</i>	wild columbine	AQUCAN	native	5	3
<i>Aralia hispida</i>	bristly sarsaparilla	ARAHIS	native	3	5
<i>Aralia nudicaulis</i>	wild sarsaparilla	ARANUD	native	5	3
<i>Arctostaphylos uva-ursi</i>	bearberry	ARCUVA	native	8	5
<i>Aronia prunifolia</i>	chokeberry	AROPRU	native	5	-3
<i>Avenella flexuosa</i>	hair grass	AVEFLE	native	6	5
<i>Betula papyrifera</i>	paper birch	BETPAP	native	2	3
<i>Calamagrostis canadensis</i>	blue-joint	CALCAN	native	3	-5
<i>Campanula rotundifolia</i>	harebell	CAMROT	native	6	3
<i>Capnoides sempervirens</i>	pink or pale corydalis	CAPSEM	native	5	5
<i>Carex arctata</i>	sedge	CXARTT	native	3	5
<i>Carex aurea</i>	sedge	CXAURE	native	3	-3
<i>Carex communis</i>	sedge	CXCOMM	native	2	5
<i>Carex echinata</i>	sedge	CXECHA	native	6	-5
<i>Carex magellanica</i>	sedge	CXMAGE	native	8	-5
<i>Carex merritt-fernaldii</i>	sedge	CXMERR	native	4	5
<i>Carex pedunculata</i>	sedge	CXPEDU	native	5	3
<i>Carex pensylvanica</i>	sedge	CXPENS	native	4	5
<i>Carex viridula</i>	sedge	CXVIRU	native	4	-5
<b><i>Cerastium fontanum</i></b>	<b>mouse-ear chickweed</b>	<b>CERFON</b>	<b>non-native</b>	<b>0</b>	<b>3</b>
<i>Chamaedaphne calyculata</i>	leatherleaf	CHACAL	native	8	-5
<i>Chamerion angustifolium</i>	fireweed	CHAANG	native	3	0
<i>Clinopodium vulgare</i>	wild-basil	CLIVUL	native	3	5
<i>Clintonia borealis</i>	bluebead-lily; corn-lily	CLIBOR	native	5	0
<i>Coptis trifolia</i>	goldthread	COPTRI	native	5	-3
<i>Cornus canadensis</i>	bunchberry	CORCAA	native	6	0
<i>Cornus rugosa</i>	round-leaved dogwood	CORRUG	native	6	5
<i>Cornus sericea</i>	red-osier	CORSER	native	2	-3
<i>Cystopteris fragilis</i>	fragile fern	CYSFRA	native	4	3
<i>Danthonia spicata</i>	poverty grass; oatgrass	DANSPI	native	4	5
<i>Dendrolycopodium dendroideum</i>	tree clubmoss	DENDEN	native	5	3
<i>Deschampsia cespitosa</i>	hair grass	DESCES	native	9	-3
<i>Dichanthelium implicatum</i>	panic grass	DICIMP	native	3	0
<i>Diervilla lonicera</i>	bush-honeysuckle	DIELON	native	4	5
<i>Drosera rotundifolia</i>	round-leaved sundew	DROROT	native	6	-5
<i>Dryopteris filix-mas</i>	male fern	DRYFIL	native	10	5
<i>Dryopteris intermedia</i>	evergreen woodfern	DRYINT	native	5	0

**Appendix 2.12.** West Huron Island Granite Bedrock Glade FQA (continued)

Scientific Name	Common Name	Acronym	Native?	C	W
<i>Dryopteris marginalis</i>	marginal woodfern	DRYMAR	native	5	3
<i>Eleocharis elliptica</i>	golden-seeded spike rush	ELEELL	native	6	-5
<i>Eurybia macrophylla</i>	big-leaved aster	EURMAC	native	4	5
<i>Euthamia graminifolia</i>	grass-leaved goldenrod	EUTGRA	native	3	0
<i>Festuca occidentalis</i>	western fescue	FESOCC	native	6	5
<i>Fragaria virginiana</i>	wild strawberry	FRAVIR	native	2	3
<i>Galium triflorum</i>	fragrant bedstraw	GALTRR	native	4	3
<i>Gaultheria hispida</i>	creeping-snowberry	GAUHIS	native	8	-3
<i>Gentiana rubricaulis</i>	great lakes gentian	GENRUB	native	7	-5
<i>Geum aleppicum</i>	yellow avens	GEUALE	native	3	0
<b><i>Hieracium aurantiacum</i></b>	<b>orange hawkweed</b>	<b>HIEAUR</b>	<b>non-native</b>	<b>0</b>	<b>5</b>
<b><i>Hieracium caespitosum</i></b>	<b>king devil</b>	<b>HIECAE</b>	<b>non-native</b>	<b>0</b>	<b>5</b>
<i>Hieracium kalmii</i>	kalms hawkweed	HIEKAL	native	3	5
<b><i>Hypericum perforatum</i></b>	<b>common st. johns-wort</b>	<b>HYPPER</b>	<b>non-native</b>	<b>0</b>	<b>5</b>
<i>Ilex verticillata</i>	michigan holly	ILEVER	native	5	-3
<i>Juncus brevicaudatus</i>	rush	JUNBRE	native	8	-5
<i>Juniperus horizontalis</i>	creeping juniper	JUNHOR	native	10	3
<b><i>Leucanthemum vulgare</i></b>	<b>ox-eye daisy</b>	<b>LEUVUL</b>	<b>non-native</b>	<b>0</b>	<b>5</b>
<i>Linnaea borealis</i>	twinline	LINBOR	native	6	0
<i>Lonicera dioica</i>	red honeysuckle	LONDIO	native	5	3
<i>Lysimachia thyrsoflora</i>	tufted loosestrife	LYSTHY	native	6	-5
<i>Maianthemum canadense</i>	canada mayflower	MAICAN	native	4	3
<i>Melampyrum lineare</i>	cow-wheat	MELLIN	native	6	3
<i>Menyanthes trifoliata</i>	buckbean	MENTRI	native	8	-5
<i>Micranthes virginiana</i>	early saxifrage	MICVIR	native	10	3
<i>Osmunda regalis</i>	royal fern	OSMREG	native	5	-5
<b><i>Phlox paniculata</i></b>	<b>garden phlox</b>	<b>PHLPAN</b>	<b>non-native</b>	<b>0</b>	<b>3</b>
<i>Physocarpus opulifolius</i>	ninebark	PHYOPU	native	4	-3
<i>Picea mariana</i>	black spruce	PICMAR	native	6	-3
<i>Pinus resinosa</i>	red pine	PINRES	native	6	3
<i>Pinus strobus</i>	white pine	PINSTR	native	3	3
<i>Platanthera clavellata</i>	small green wood orchid	PLACLA	native	6	-3
<b><i>Poa compressa</i></b>	<b>canada bluegrass</b>	<b>POACOM</b>	<b>non-native</b>	<b>0</b>	<b>3</b>
<i>Poa interior</i>	bluegrass	POAINT	native	10	0
<i>Poa palustris</i>	fowl meadow grass	POAPAS	native	3	-3
<b><i>Poa pratensis</i></b>	<b>kentucky bluegrass</b>	<b>POAPRA</b>	<b>non-native</b>	<b>0</b>	<b>3</b>
<i>Polygonatum pubescens</i>	downy solomon seal	POLPUB	native	5	5
<i>Polypodium virginianum</i>	common polypody	POLVIR	native	8	5
<i>Populus grandidentata</i>	big-tooth aspen	POPGRA	native	4	3
<i>Populus tremuloides</i>	quaking aspen	POPTRE	native	1	0
<i>Prenanthes alba</i>	white lettuce	PREALB	native	5	3
<i>Prunus pensylvanica</i>	pin cherry	PRUPEN	native	3	3
<i>Prunus virginiana</i>	choke cherry	PRUVIR	native	2	3
<i>Pteridium aquilinum</i>	bracken fern	PTEAQU	native	0	3
<i>Rhododendron groenlandicum</i>	labrador-tea	RHOGRO	native	8	-5
<i>Ribes glandulosum</i>	skunk currant	RIBGLA	native	5	-3

**Appendix 2.12.** West Huron Island Granite Bedrock Glade FQA (continued)

Scientific Name	Common Name	Acronym	Native?	C	W
<i>Rosa acicularis</i>	wild rose	ROSACI	native	4	3
<i>Rubus setosus</i>	bristly blackberry	RUBSET	native	3	-3
<i>Rubus strigosus</i>	wild red raspberry	RUBSTR	native	2	0
<b><i>Rumex acetosella</i></b>	<b>sheep sorrel</b>	<b>RUMACL</b>	<b>non-native</b>	<b>0</b>	<b>3</b>
<i>Salix cordata</i>	sand-dune willow	SALCOR	native	10	0
<i>Salix petiolaris</i>	slender willow	SALPET	native	1	-3
<i>Sambucus racemosa</i>	red-berried elder	SAMRAC	native	3	3
<i>Schizachne purpurascens</i>	false melic	SCHPUP	native	5	3
<i>Selaginella rupestris</i>	sand club moss	SELRUP	native	8	5
<i>Sibbaldiopsis tridentata</i>	three-toothed cinquefoil	SIBTRI	native	10	3
<i>Sisyrinchium montanum</i>	mountain blue-eyed-grass	SISMON	native	4	0
<i>Solidago altissima</i>	tall goldenrod	SOLALT	native	1	3
<i>Solidago canadensis</i>	canada goldenrod	SOLCAN	native	1	3
<i>Solidago hispida</i>	hairy goldenrod	SOLHIS	native	3	5
<i>Sorbus decora</i>	mountain-ash	SORDEC	native	4	3
<i>Spiraea alba</i>	meadowsweet	SPIALB	native	4	-3
<i>Symphoricarpos albus var. albus</i>	snowberry	SYMALA	native	5	3
<i>Taxus canadensis</i>	yew	TAXCAN	native	5	3
<i>Thuja occidentalis</i>	arbor vitae	THUOCC	native	4	-3
<i>Trichophorum cespitosum</i>	bulrush	TRICES	native	10	-5
<i>Trientalis borealis</i>	star-flower	TRIBOR	native	5	0
<i>Vaccinium angustifolium</i>	low sweet blueberry	VACANG	native	4	3
<i>Vaccinium myrtilloides</i>	canada blueberry	VACMYR	native	4	-3
<i>Woodsia ilvensis</i>	rusty woodsia	WOOILV	native	10	5

## Appendix 2.13. West Huron Island Granite Bedrock Lakeshore FQA

### Conservatism-Based Metrics:

Total Mean C:	4.4
Native Mean C:	4.7
Total FQI:	36
Native FQI:	37
Adjusted FQI:	45.2
% C value 0:	9
% C value 1-3:	29.9
% C value 4-6:	38.8
% C value 7-10:	22.4
Native Tree Mean C:	2.8
Native Shrub Mean C:	5.2
Native Herbaceous Mean C:	5.1

### Species Richness:

Total Species:	67	
Native Species:	62	92.50%
Non-native Species:	5	7.50%

### Species Wetness:

Mean Wetness:	0.3
Native Mean Wetness:	0

### Physiognomy Metrics:

Tree:	12	17.90%
Shrub:	21	31.30%
Vine:	0	0.00%
Forb:	20	29.90%
Grass:	6	9.00%
Sedge:	4	6.00%
Rush:	2	3%
Fern:	2	3.00%
Bryophyte:	0	0%

### Duration Metrics:

Annual:	1	1.50%
Perennial:	64	95.50%
Biennial:	2	3.00%
Native Annual:	1	1.50%
Native Perennial:	60	89.60%
Native Biennial:	1	1.50%

Appendix 2.13. West Huron Island Granite Bedrock Lakeshore FQA (continued)

Scientific Name	Common Name	Acronym	Native?	C	W
<i>Abies balsamea</i>	balsam fir	ABIBAL	native	3	0
<i>Acer rubrum</i>	red maple	ACERUB	native	1	0
<i>Acer spicatum</i>	mountain maple	ACESPI	native	5	3
<i>Achillea millefolium</i>	yarrow	ACHMIL	native	1	3
<i>Agrostis scabra</i>	ticklegrass	AGRSCA	native	4	0
<i>Alnus viridis</i>	mountain alder	ALNVIR	native	8	0
<i>Amelanchier sanguinea</i>	round-leaved serviceberry	AMESAN	native	5	5
<i>Aralia nudicaulis</i>	wild sarsaparilla	ARANUD	native	5	3
<i>Arctostaphylos uva-ursi</i>	bearberry	ARCUVA	native	8	5
<i>Aronia prunifolia</i>	chokeberry	AROPRU	native	5	-3
<i>Athyrium filix-femina</i>	lady fern	ATHFIL	native	4	0
<i>Avenella flexuosa</i>	hair grass	AVEFLE	native	6	5
<i>Betula papyrifera</i>	paper birch	BETPAP	native	2	3
<i>Calamagrostis canadensis</i>	blue-joint	CALCAN	native	3	-5
<i>Campanula rotundifolia</i>	harebell	CAMROT	native	6	3
<i>Capnoides sempervirens</i>	pink or pale corydalis	CAPSEM	native	5	5
<i>Carex canescens</i>	sedge	CXCANE	native	8	-5
<i>Carex echinata</i>	sedge	CXECHA	native	6	-5
<b><i>Centaurea stoebe</i></b>	<b>spotted knapweed</b>	<b>CENSTO</b>	<b>non-native</b>	<b>0</b>	<b>5</b>
<i>Chamaedaphne calyculata</i>	leatherleaf	CHACAL	native	8	-5
<i>Chamerion angustifolium</i>	fireweed	CHAANG	native	3	0
<i>Conyza canadensis</i>	horseweed	CONCAN	native	0	3
<i>Cornus canadensis</i>	bunchberry	CORCAA	native	6	0
<i>Cornus sericea</i>	red-osier	CORSER	native	2	-3
<i>Corylus cornuta</i>	beaked hazelnut	CORCOR	native	5	3
<i>Danthonia spicata</i>	poverty grass; oatgrass	DANSPI	native	4	5
<i>Deschampsia cespitosa</i>	hair grass	DESCES	native	9	-3
<i>Diervilla lonicera</i>	bush-honeysuckle	DIELON	native	4	5
<i>Drosera rotundifolia</i>	round-leaved sundew	DROROT	native	6	-5
<i>Dryocallis arguta</i>	tall or prairie cinquefoil	DRYARG	native	8	3
<i>Euthamia graminifolia</i>	grass-leaved goldenrod	EUTGRA	native	3	0
<i>Fraxinus pennsylvanica</i>	red ash	FRAPEN	native	2	-3
<b><i>Hieracium caespitosum</i></b>	<b>king devil</b>	<b>HIECAE</b>	<b>non-native</b>	<b>0</b>	<b>5</b>
<b><i>Hypericum perforatum</i></b>	<b>common st. johns-wort</b>	<b>HYPPER</b>	<b>non-native</b>	<b>0</b>	<b>5</b>
<i>Juncus brevicaudatus</i>	rush	JUNBRE	native	8	-5
<i>Juncus dudleyi</i>	dudleys rush	JUNDUD	native	1	-3
<i>Juniperus horizontalis</i>	creeping juniper	JUNHOR	native	10	3
<i>Lonicera villosa</i>	mountain fly honeysuckle	LONVIL	native	8	-3
<i>Lycopus uniflorus</i>	northern bugle weed	LYCUNI	native	2	-5
<i>Menyanthes trifoliata</i>	buckbean	MENTRI	native	8	-5
<i>Osmorhiza claytonii</i>	hairy sweet-cicely	OSMCLI	native	4	3
<i>Physocarpus opulifolius</i>	ninebark	PHYOPU	native	4	-3
<i>Pinus strobus</i>	white pine	PINSTR	native	3	3
<b><i>Poa compressa</i></b>	<b>canada bluegrass</b>	<b>POACOM</b>	<b>non-native</b>	<b>0</b>	<b>3</b>
<i>Polypodium virginianum</i>	common polypody	POLVIR	native	8	5

Appendix 2.13. West Huron Island Granite Bedrock Lakeshore FQA (continued)

Scientific Name	Common Name	Acronym	Native?	C	W
<i>Populus balsamifera</i>	balsam poplar	POPBAL	native	2	-3
<i>Populus grandidentata</i>	big-tooth aspen	POPGRA	native	4	3
<i>Populus tremuloides</i>	quaking aspen	POPTRE	native	1	0
<i>Prenanthes alba</i>	white lettuce	PREALB	native	5	3
<i>Prunus pensylvanica</i>	pin cherry	PRUPEN	native	3	3
<i>Prunus virginiana</i>	choke cherry	PRUVIR	native	2	3
<i>Rhododendron groenlandicum</i>	labrador-tea	RHOGRO	native	8	-5
<i>Rosa acicularis</i>	wild rose	ROSACI	native	4	3
<b><i>Sagina procumbens</i></b>	<b>pearlwort</b>	<b>SAGPRO</b>	<b>non-native</b>	<b>0</b>	<b>0</b>
<i>Salix bebbiana</i>	bebb's willow	SALBEB	native	1	-3
<i>Salix myricoides</i>	blueleaf willow	SALMYR	native	9	-3
<i>Salix petiolaris</i>	slender willow	SALPET	native	1	-3
<i>Scirpus cyperinus</i>	wool-grass	SCICYP	native	5	-5
<i>Sibbaldiopsis tridentata</i>	three-toothed cinquefoil	SIBTRI	native	10	3
<i>Solidago hispida</i>	hairy goldenrod	SOLHIS	native	3	5
<i>Sorbus decora</i>	mountain-ash	SORDEC	native	4	3
<i>Spiraea alba</i>	meadowsweet	SPIALB	native	4	-3
<i>Thuja occidentalis</i>	arbor vitae	THUOCC	native	4	-3
<i>Trichophorum cespitosum</i>	bulrush	TRICES	native	10	-5
<i>Vaccinium angustifolium</i>	low sweet blueberry	VACANG	native	4	3
<i>Vaccinium myrtilloides</i>	canada blueberry	VACMYR	native	4	-3
<i>Viola labradorica</i>	dog violet	VIOLAB	native	3	0

## Appendix 2.14. West Huron Island Granite Lakeshore Cliff FQA

### Conservatism-Based Metrics:

Total Mean C:	4.7
Native Mean C:	5
Total FQI:	45.8
Native FQI:	47.2
Adjusted FQI:	48.4
% C value 0:	7.4
% C value 1-3:	26.3
% C value 4-6:	45.3
% C value 7-10:	21.1
Native Tree Mean C:	3.3
Native Shrub Mean C:	5.2
Native Herbaceous Mean C:	5.3

### Species Richness:

Total Species:	95	
Native Species:	89	93.70%
Non-native Species:	6	6.30%

### Species Wetness:

Mean Wetness:	0.7
Native Mean Wetness:	0.4

### Physiognomy Metrics:

Tree:	12	12.60%
Shrub:	22	23.20%
Vine:	3	3.20%
Forb:	30	31.60%
Grass:	9	9.50%
Sedge:	9	9.50%
Rush:	1	1%
Fern:	9	9.50%
Bryophyte:	0	0%

### Duration Metrics:

Annual:	0	0.00%
Perennial:	94	98.90%
Biennial:	1	1.10%
Native Annual:	0	0.00%
Native Perennial:	88	92.60%
Native Biennial:	1	1.10%

Appendix 2.14. West Huron Island Granite Lakeshore Cliff FQA (continued)

Scientific Name	Common Name	Acronym	Native?	C	W
<i>Abies balsamea</i>	balsam fir	ABIBAL	native	3	0
<i>Acer rubrum</i>	red maple	ACERUB	native	1	0
<i>Acer spicatum</i>	mountain maple	ACESPI	native	5	3
<i>Achillea millefolium</i>	yarrow	ACHMIL	native	1	3
<i>Agrostis scabra</i>	ticklegass	AGRSCA	native	4	0
<i>Anaphalis margaritacea</i>	pearly everlasting	ANAMAR	native	3	5
<i>Aquilegia canadensis</i>	wild columbine	AQUCAN	native	5	3
<i>Aralia hispida</i>	bristly sarsaparilla	ARAHIS	native	3	5
<i>Arctostaphylos uva-ursi</i>	bearberry	ARCUVA	native	8	5
<i>Aronia prunifolia</i>	chokeberry	AROPRU	native	5	-3
<i>Athyrium filix-femina</i>	lady fern	ATHFIL	native	4	0
<i>Avenella flexuosa</i>	hair grass	AVEFLE	native	6	5
<i>Betula papyrifera</i>	paper birch	BETPAP	native	2	3
<i>Calamagrostis canadensis</i>	blue-joint	CALCAN	native	3	-5
<i>Campanula rotundifolia</i>	harebell	CAMROT	native	6	3
<i>Capnoides sempervirens</i>	pink or pale corydalis	CAPSEM	native	5	5
<i>Carex echinata</i>	sedge	CXECHA	native	6	-5
<i>Carex magellanica</i>	sedge	CXMAGE	native	8	-5
<i>Carex merritt-fernaldii</i>	sedge	CXMERR	native	4	5
<i>Carex scoparia</i>	sedge	CXSCOP	native	4	-3
<i>Carex viridula</i>	sedge	CXVIRU	native	4	-5
<i>Chamaedaphne calyculata</i>	leatherleaf	CHACAL	native	8	-5
<i>Chamerion angustifolium</i>	fireweed	CHAANG	native	3	0
<i>Chimaphila umbellata</i>	pipsissewa	CHIUMB	native	8	5
<i>Coptis trifolia</i>	goldthread	COPTRI	native	5	-3
<i>Cornus sericea</i>	red-osier	CORSER	native	2	-3
<i>Danthonia spicata</i>	poverty grass; oatgrass	DANSPI	native	4	5
<i>Dendrolycopodium dendroideum</i>	tree clubmoss	DENDEN	native	5	3
<i>Deschampsia cespitosa</i>	hair grass	DESCES	native	9	-3
<i>Dichanthelium implicatum</i>	panic grass	DICIMP	native	3	0
<i>Diervilla lonicera</i>	bush-honeysuckle	DIELON	native	4	5
<i>Drymocallis arguta</i>	tall or prairie cinquefoil	DRYARG	native	8	3
<i>Dryopteris filix-mas</i>	male fern	DRYFIL	native	10	5
<i>Eleocharis elliptica</i>	golden-seeded spike rush	ELEELL	native	6	-5
<i>Equisetum arvense</i>	common horsetail	EQUARV	native	0	0
<i>Euthamia graminifolia</i>	grass-leaved goldenrod	EUTGRA	native	3	0
<i>Festuca occidentalis</i>	western fescue	FESOCC	native	6	5
<i>Fragaria virginiana</i>	wild strawberry	FRAVIR	native	2	3
<i>Galium triflorum</i>	fragrant bedstraw	GALTRR	native	4	3
<i>Hieracium caespitosum</i>	king devil	HIECAE	non-native	0	5
<i>Hieracium kalmii</i>	kalms hawkweed	HIEKAL	native	3	5
<i>Hylotelephium telephium</i>	live-forever	HYLTEL	non-native	0	5
<i>Hypericum perforatum</i>	common st. johns-wort	HYPPER	non-native	0	5
<i>Ilex verticillata</i>	michigan holly	ILEVER	native	5	-3
<i>Iris versicolor</i>	wild blue flag	IRIVER	native	5	-5
<i>Juncus brevicaudatus</i>	rush	JUNBRE	native	8	-5
<i>Juniperus communis</i>	common or ground juniper	JUNCOI	native	4	3

## Appendix 2.14. West Huron Island Granite Lakeshore Cliff FQA (continued)

Scientific Name	Common Name	Acronym	Native?	C	W
<i>Juniperus horizontalis</i>	creeping juniper	JUNHOR	native	10	3
<i>Lathyrus ochroleucus</i>	pale vetchling	LATOCH	native	8	5
<i>Lonicera dioica</i>	red honeysuckle	LONDIO	native	5	3
<i>Lonicera hirsuta</i>	hairy honeysuckle	LONHIR	native	6	0
<i>Lycopodium lagopus</i>	running ground-pine	LYCLAG	native	5	3
<i>Lycopus uniflorus</i>	northern bugle weed	LYCUNI	native	2	-5
<i>Lysimachia thysiflora</i>	tufted loosestrife	LYSTHY	native	6	-5
<i>Menyanthes trifoliata</i>	buckbean	MENTRI	native	8	-5
<i>Micranthes virginensis</i>	early saxifrage	MICVIR	native	10	3
<i>Onoclea sensibilis</i>	sensitive fern	ONOSEN	native	2	-3
<i>Physocarpus opulifolius</i>	ninebark	PHYOPU	native	4	-3
<i>Picea mariana</i>	black spruce	PICMAR	native	6	-3
<i>Pinus resinosa</i>	red pine	PINRES	native	6	3
<i>Pinus strobus</i>	white pine	PINSTR	native	3	3
<i>Platanthera clavellata</i>	small green wood orchid	PLACLA	native	6	-3
<i>Poa compressa</i>	canada bluegrass	POACOM	non-native	0	3
<i>Poa glauca</i>	bluegrass	POAGLA	native	10	5
<i>Polypodium virginianum</i>	common polypody	POLVIR	native	8	5
<i>Populus balsamifera</i>	balsam poplar	POPBAL	native	2	-3
<i>Populus tremuloides</i>	quaking aspen	POPTRE	native	1	0
<i>Prenanthes alba</i>	white lettuce	PREALB	native	5	3
<i>Prunus pensylvanica</i>	pin cherry	PRUPEN	native	3	3
<i>Prunus virginiana</i>	choke cherry	PRUVIR	native	2	3
<i>Ribes glandulosum</i>	skunk currant	RIBGLA	native	5	-3
<i>Rosa acicularis</i>	wild rose	ROSACI	native	4	3
<i>Rubus strigosus</i>	wild red raspberry	RUBSTR	native	2	0
<i>Rumex acetosella</i>	sheep sorrel	RUMACL	non-native	0	3
<i>Salix cordata</i>	sand-dune willow	SALCOR	native	10	0
<i>Salix myricoides</i>	blueleaf willow	SALMYR	native	9	-3
<i>Sambucus racemosa</i>	red-berried elder	SAMRAC	native	3	3
<i>Scirpus cyperinus</i>	wool-grass	SCICYP	native	5	-5
<i>Scirpus expansus</i>	bulrush	SCIEXP	native	5	-5
<i>Sibbaldiopsis tridentata</i>	three-toothed cinquefoil	SIBTRI	native	10	3
<i>Sisyrinchium montanum</i>	mountain blue-eyed-grass	SISMON	native	4	0
<i>Solidago hispida</i>	hairy goldenrod	SOLHIS	native	3	5
<i>Sorbus decora</i>	mountain-ash	SORDEC	native	4	3
<i>Spinulum annotinum</i>	stiff clubmoss	SPIANN	native	5	0
<i>Symphoricarpos albus var. albus</i>	snowberry	SYMALA	native	5	3
<i>Taraxacum officinale</i>	common dandelion	TAROFF	non-native	0	3
<i>Taxus canadensis</i>	yew	TAXCAN	native	5	3
<i>Thuja occidentalis</i>	arbor vitae	THUOCC	native	4	-3
<i>Trichophorum cespitosum</i>	bulrush	TRICES	native	10	-5
<i>Typha latifolia</i>	broad-leaved cat-tail	TYPLAT	native	1	-5
<i>Vaccinium angustifolium</i>	low sweet blueberry	VACANG	native	4	3
<i>Vaccinium myrtilloides</i>	canada blueberry	VACMYR	native	4	-3
<i>Viola labradorica</i>	dog violet	VIOLAB	native	3	0
<i>Viola nephrophylla</i>	northern bog violet	VIONEP	native	8	-3
<i>Woodsia ilvensis</i>	rusty woodsia	WOOILV	native	10	5

## Appendix 3 - Ojibwe Names for Plants Observed in the Huron Islands

This appendix includes a crosswalk between Ojibwe names, scientific names, and English common names for all species observed in the Huron Islands National Wildlife Refuge 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 natural community type and 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 (33; 28%). 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 reference the page in Meeker et al. (1993) where the plant is referenced.

The index of plants by Ojibwe name provides the location for each observed plant by both natural community type and island. In the columns noting natural community type, letters indicate island from west to east: a) West Huron, b) Cattle, c) East Huron, d) Gull, and e) Unnamed.

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

Ojibwe Name	Restored	Page	Scientific Name	English Name
(g)odotaagaans	Yes	318	<i>Clintonia borealis</i>	bluebead-lily; corn-lily
(g)odotaagaans; ?ziiginise; ziiginish (e)	Yes	35	<i>Campanula rotundifolia</i>	harebell
(gi)chigamiiwashk, -oon	Yes	112	<i>Juncus tenuis</i>	path rush
(gi)chi-mazaan; wiisagibag, -oon;	Yes	96	<i>Arctium minus</i>	common burdock
(gi)chi-mazaanashk	Yes	103	<i>Cirsium vulgare</i>	bull thistle
?bebaamaabiig; okaadaak;	Yes	235	<i>Aralia nudicaulis</i>	wild sarsaparilla
a 'sawan; ana ' ganuck; nokomi ' skinun	No	238	<i>Athyrium filix-femina</i>	lady fern
aagimaak	Yes	358	<i>Fraxinus pennsylvanica</i>	red ash
aandegobagoons; namepin;			<i>Mentha canadensis (M.</i>	
namewashkoons	Yes	343	<i>arvensis)</i>	field mint
aandegopin	Yes	174	<i>Lycopus americanus; Lycopus uniflorus (*L. asper)</i>	common water horehound
agongosimin, -ag	Yes	217	<i>Melampyrum lineare</i>	cow-wheat
agongosimin, -an, -ag	Yes	326	<i>Maianthemum canadense</i>	canada mayflower
ah-o-je-mahg (adjimag)	No	333	<i>Sorbus americana; Sorbus decora</i>	american mountain-ash
ajidamoowaanow; giiziso-mashkiki	Yes	349	<i>Solidago canadensis; S. altissima</i>	canada goldenrod
ajidamoowaanow; waabigwan	Yes	93	<i>Achillea millefolium</i>	yarrow
animoshi-min, -an; awenisiibag	Yes	194	<i>Ilex verticillata</i>	michigan holly
animozid	Yes	323	<i>Hepatica americana</i>	round-lobed hepatica
aninaandag, -oog; ininaandag, -oog;				
bigiwaandag, -oog; zhinbog, --g;	Yes	313	<i>Abies balsamea</i>	balsam fir
aninaatig, -oog	Yes	270	<i>Acer saccharum</i>	sugar maple
apaakozigan; miskwaabiimag	Yes	18	<i>Arctostaphylos uva-ursi</i>	bearberry
apakwanagemag; bapakwanagemag;	Yes	219	<i>Pinus resinosa</i>	red pine
apakway; apakweshk; apakweshkway;	Yes	152	<i>Typha latifolia</i>	broad-leaved cat-tail
asa/isaweminagaawanzh (plant);	Yes	256	<i>Prunus virginiana</i>	choke cherry
azaadi(i)	Yes	252	<i>Populus grandidentata</i>	big-tooth aspen

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

Ojibwe Name	Restored	Page	Scientific Name	English Name
azaadi(i); azaadiins	Yes	253	<i>Populus tremuloides</i>	quaking aspen
azaadi(i); maanzaadi(i)	Yes	328	<i>Populus balsamifera</i>	balsam poplar
baasibagak; nameswashk;	Yes	120	<i>Prunella vulgaris</i>	self-heal
bagaan, -ag; bagaanens; bagaanimizh;	Yes	243	<i>Corylus cornuta</i>	beaked hazelnut
bawa'iminaan; gozigwaakomin, -ag	Yes	329	<i>Prunus pensylvanica</i>	pin cherry
beemsquandawish	No	58	<i>Spiranthes romanzoffiana</i>	hooded ladies-tresses
bibigwewanashk, -oon	Yes	167	<i>Heracleum maximum (H. lanatum)</i>	cow-parsnip
bine(wi)bag	Yes	223	<i>Pyrola americana (P. rotundifolia)</i>	round-leaved pyrola
cigona ' gan	No	250	<i>Dendrolycopodium obscurum; D. dendroideum (*Lycopodium o.)</i>	ground-pine
doodooshaabonjiibik; zhiishiigwebik	Yes	254	<i>Prenanthes alba</i>	white lettuce
doodooshaaboo	Yes	361	<i>Lactuca biennis</i>	tall blue lettuce
doodooshaaboojiibik; mindimooyenh	Yes	134	<i>Taraxacum officinale</i>	common dandelion
gaagaagimizh; gaagaagiwa/inzh	Yes	309	<i>Tsuga canadensis</i>	hemlock
gaagaagiwanzh; zeseгаandag; zhingob; zhingob gaawaandag	Yes	382	<i>Picea mariana</i>	black spruce
gaagigebag	Yes	15	<i>Antennaria howellii (*A. neglecta)</i>	small pussytoes
gaagigebag	Yes	209	<i>Chimaphila umbellata</i>	pipsissewa
gaawaandag; gaawaandagwaatig;	Yes	327	<i>Picea glauca</i>	white spruce
gaie 'wuckuk	No	150	<i>Scirpus cyperinus</i>	wool-grass
giboodiyegwaazon	Yes	37	<i>Corydalis aurea</i>	golden corydalis
gichi-ode'iminiijibik	Yes	49	<i>Potentilla norvegica</i>	rough cinquefoil
gichi-ode'iminiijibik	Yes	25	<i>Drymocallis arguta (Potentilla a.)</i>	Rosaceae
giizhigaandagizi; ogaawa/inzh	Yes	43	<i>Juniperus communis</i>	common or ground juniper

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

Ojibwe Name	Restored	Page	Scientific Name	English Name
giizhik, -ag; gizhikens, -ag; giizhikenh	Yes	387	<i>Thuja occidentalis</i>	arbor vitae
ginebigowashk; ginebegwashk; omakakiibag	Yes	119	<i>Plantago rugelii</i> (*P. major)	red-stalked plantain
ginoozhewashk; ozawijiibik; zhiiwibag	Yes	127	<i>Rumex crispus</i>	curly dock
gozgwawaakominagaawanzh (plant); gozigwaakomin, -ag (berry); ozagadigom; zazigaakominagaawamzh	Yes	231	<i>Amelanchier arborea</i> ; <i>A. interior</i> ; <i>A. sanguinea</i> (*A. laevis)	juneberry
jasibonskok; aiankosing; gezibnusk; giji '	No	107	<i>Equisetum arvense</i>	common horsetail
kokbenognik keya; sasgob-mins	No	54	<i>Salix exigua</i>	sandbar willow
maananoons, -ag	Yes	297	<i>Ostrya virginiana</i>	ironwood; hop-hornbeam
main 'gamuna 'tig; anigomiji ' minaga 'wunj	No	59	<i>Symphoricarpos albus</i> var. <i>albus</i>	snowberry
makade-miskomin; makade-miskwimin; makade-miin, -an;	Yes	30	<i>Rubus occidentalis</i>	black raspberry
manwe ' gons; manwe 'gons	No	51	<i>Ranunculus pensylvanicus</i>	bristly crowfoot
mashkiigobag; mashkiikaang niibish; waabashkikiibag	Yes	196	<i>Rhododendron groenlandicum</i> ( <i>Ledum</i> g.)	labrador-tea
mashkode-miizhimizh; mitigomizh;	Yes	304	<i>Quercus rubra</i>	red oak
mauwidaekwaegozeediwushk	No	139	<i>Lemna minor</i> ; <i>L. turionifera</i>	common or red duckweed
mazaan; mazaanaatig	Yes	373	<i>Urtica dioica</i>	stinging nettle
mazaanashk	Yes	102	<i>Cirsium arvense</i>	canada thistle
me -skwana 'kuk bu ' giso ' win; maeskwanakukbugisowin	No	162	<i>Eutrochium maculatum</i> ( <i>Eupatorium</i> m.)	joe-pye-weed
mickiminu ' nimic	No	198	<i>Ilex mucronata</i> ( <i>Nemopanthus mucronatus</i> )	mountain holly
migiziibag; migiziwibag; naemgosibag	Yes	237	<i>Eurybia macrophylla</i> ( <i>Aster macrophyllus</i> )	big-leaved aster

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

Ojibwe Name	Restored	Page	Scientific Name	English Name
miinagaawanzh (plant); miin, -an (berry)	Yes	227	<i>Vaccinium angustifolium</i>	low sweet blueberry
miskominagaawanzh; miskwiminagaawanzh; miskomin, -ag;	Yes	125	<i>Rubus strigosus (R. idaeus)</i>	wild red raspberry
miskoobimizh; miskwaabiimizh	Yes	340	<i>Cornus sericea</i>	red-osier
miskwazi-wusk	No	47	<i>Physocarpus opulifolius</i>	Rosaceae
misudidjeebik	No	234	<i>Aquilegia canadensis</i>	wild columbine
moni swa	No	264	<i>Triosteum aurantiacum (*T. perfoliatum)</i>	horse-gentian
moozomizh	Yes	314	<i>Acer pensylvanicum</i>	striped maple
naaniibide'oodegin	Yes	303	<i>Polygonatum pubescens</i>	downy solomon seal
nabagashk; wiikenh; zhaabozigan	Yes	170	<i>Iris versicolor</i>	wild blue flag
naubishkaukoot	No	129	<i>Sisyrinchium montanum</i>	mountain blue-eyed-grass
nawo 'buguk; wunukibugauh	No	336	<i>Trientalis borealis</i>	star-flower
ne 'bagandag '; pebamabid-singup	No	335	<i>Taxus canadensis</i>	yew
ne 'bone ' ankwe 'ak	No	341	<i>Geum aleppicum</i>	yellow avens
neezhodaeyun	No	325	<i>Linnaea borealis</i>	twinflower
niya 'wibukuk '; siabuksing, sasabwaksing; piskagamisag	No	163	<i>Eupatorium perfoliatum</i>	boneset
odatagaagominagaawanzh (plant);	Yes	29	<i>Rubus allegheniensis</i>	common blackberry
ode'imin	Yes	379	<i>Fragaria vesca</i>	woodland strawberry
ode'imin, -an; ode'iminiijibik	Yes	109	<i>Fragaria virginiana</i>	wild strawberry
ode'iminiijibik; zhakaagomin;	Yes	319	<i>Cornus canadensis</i>	bunchberry
odjici ' gomin	No	362	<i>Lactuca canadensis</i>	tall lettuce
oginiiminagaawanzh	Yes	82	<i>Rosa acicularis</i>	wild rose
ogitebag	Yes	158	<i>Caltha palustris</i>	marsh-marigold
okikaandag	Yes	218	<i>Pinus banksiana</i>	jack pine
ookwemizh (plant); ookwemin (berry)	Yes	255	<i>Prunus serotina</i>	wild black cherry
ozaawaajiibik; ozaawijiibik	Yes	375	<i>Coptis trifolia</i>	goldthread
ozaawashkojiibik	Yes	360	<i>Impatiens capensis</i>	spotted touch-me-not

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

Ojibwe Name	Restored	Page	Scientific Name	English Name
ozagadigom	Yes	295	<i>Osmorhiza claytonii</i>	hairy sweet-cicely
ozhaashijiibik; ozhaashijiibikens; zhooshkijiibik	Yes	106	<i>Chamerion angustifolium</i> ( <i>Epilobium a.</i> )	fireweed
papshkisiganak; papskatciksi ' gana 'tig	Yes	305	<i>Sambucus racemosa</i>	red-berried elder
pis-naknishkuns	No	171	<i>Juncus effusus</i>	soft-stemmed rush
sabankuk	No	215	<i>Lonicera dioica</i>	red honeysuckle
skizgu-min	No	331	<i>Rubus pubescens</i>	dwarf raspberry
tcatcabonu ' ksik; zheebaunkudohnse	No	182	<i>Scutellaria galericulata</i>	marsh skullcap
wa 'sawasni 'mike	No	175	<i>Myrica gale</i>	sweet gale
waabashkikiibag	Yes	350	<i>Spiraea alba</i>	meadowsweet
waabashkikiibag; mashkiigobagoons	Yes	191	<i>Chamaedaphne calyculata</i>	leatherleaf
waabigwan	Yes	104	<i>Conyza canadensis</i>	horseweed
waabigwan; baasibagak	Yes	14	<i>Anaphalis margaritacea</i>	pearly everlasting
waabigwan; memisku 'nakuk	No	20	<i>Hieracium kalmii</i>	kalms hawkweed
waaboozobagoons; waaboozobanzh	Yes	42	<i>Gaultheria hispidula</i>	creeping-snowberry
waaboozojiibik	Yes	330	<i>Ribes glandulosum</i>	skunk currant
waboskiki ' minun	No	164	<i>Galium tinctorium</i>	stiff bedstraw
wadoop, -iin	Yes	339	<i>Alnus incana</i>	speckled alder
wanukons'; apagwasi ' gons; abagwasi ' gans	No	160	<i>Cicuta bulbifera</i> (* <i>C. maculata</i> )	water hemlock
wawiaeneegaeguhnsh	No	192	<i>Drosera rotundifolia</i>	round-leaved sundew
wewai ' bugug	Yes	338	<i>Viola labradorica</i> ( <i>V. conspersa</i> )	dog violet
wezaawaaskoneg	Yes	41	<i>Euthamia graminifolia</i>	flat-topped goldenrod
wezauskwagmik; osawa ' skanet	No	245	<i>Diervilla lonicera</i>	bush-honeysuckle
wiigwaas, -an, -ag; wiigwaasaatig; wiigwaasi-mitig; wiigwaasimizh	Yes	239	<i>Betula papyrifera</i>	paper birch
wiinisiibag; wiinisiibagoons; wiinisiibagad	Yes	213	<i>Gaultheria procumbens</i>	wintergreen

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

Ojibwe Name	Restored	Page	Scientific Name	English Name
wiinziikens	Yes	157	<i>Symphotrichum puniceum</i> ; <i>S. firmum</i> ( <i>Aster puniceus</i> )	swamp aster
wiinizik	Yes	277	<i>Betula alleghaniensis</i>	yellow birch
zeewunubugushk	No	298	<i>Oxalis acetosella</i>	northern wood-sorrel
zhaashaagobiimag	Yes	315	<i>Acer spicatum</i>	mountain maple
zhiishiiginewanzh, iig;	Yes	229	<i>Acer rubrum</i>	red maple
zhingwaak	Yes	220	<i>Pinus strobus</i>	white pine
No name given ( <i>C. rugosa</i> )	No	242	<i>Cornus rugosa</i>	round-leaved dogwood
No name given ( <i>H. lucidula</i> )	No	292	<i>Huperzia lucidula</i> ( <i>Lycopodium lucidulum</i> )	shining clubmoss
No name given ( <i>O. biennis</i> )	No	116	<i>Oenothera biennis</i>	common evening-primrose
No name given ( <i>P. maculosa</i> )	No	48	<i>Persicaria maculosa</i> ( <i>Polygonum persicaria</i> )	lady's thumb
No name given ( <i>T. dasycarpum</i> )	No	185	<i>Thalictrum dasycarpum</i>	purple meadow-rue
No name given ( <i>V. myrtilloides</i> )	No	228	<i>Vaccinium myrtilloides</i>	canada blueberry

**Appendix 3.2.** Ojibwe plant names indexed by natural community type and island (a = West Huron, b = Cattle, c = East Huron, d = Gull, and e = Unnamed).

Ojibwe Name	Scientific Name	English Name	Boreal Forest	Granite Bedrock Glade	Granite Bedrock Lakeshore	Granite Lakeshore Cliff	West Huron	Cattle	East Huron	Gull	Un-named
(g)odotaagaans	<i>Clintonia borealis</i>	bluebead-lily; corn-lily	a	a, b			X	X			
(g)odotaagaans; ?ziiginise; ziiginish€	<i>Campanula rotundifolia</i>	harebell		a, b, c, d	a, b, c, d, e	a, b, c	X	X	X	X	X
(gi)chigamiwashk, -oon	<i>Juncus tenuis</i>	path rush				b		X			
(gi)chi-mazaan; wiisagibag, -oon; wiisagijibik	<i>Arctium minus</i>	common burdock					X				
(gi)chi-mazaanashk	<i>Cirsium vulgare</i>	bull thistle					X				
?bebaamaabiig; okaadaak; waaboozojibik	<i>Aralia nudicaulis</i>	wild sarsaparilla	a, b, c	a, b, c	a, c	c	X	X	X		
a 'sawan; ana ' ganuck; nokomi ' skinun	<i>Athyrium filix-femina</i>	lady fern	a	d	a, c	a, b, c	X	X	X	X	
aagimaak	<i>Fraxinus pennsylvanica</i>	red ash			a, b, c, d		X	X	X	X	
aandegobagoons; namepin; namewashkoons	<i>Mentha canadensis (M. arvensis)</i>	field mint			b			X			
aandegopin	<i>Lycopus americanus; Lycopus uniflorus (*L. asper)</i>	common water horehound			a, b, c, d	a	X	X	X	X	
agongosimin, -ag	<i>Melampyrum lineare</i>	cow-wheat	a	a, b, c		c	X	X	X		
agongosimin, -an, -ag	<i>Maianthemum canadense</i>	canada mayflower	a, b, c	a, b, c, d	c	b, c	X	X	X	X	
ah-o-je-mahg (adjimag)	<i>Sorbus americana; Sorbus decora</i>	american mountain-ash	a, c	a, b, c, d	a, c, d, e	a, b, c	X	X	X	X	X
ajidamoowaanow; giiziso-mashkiki	<i>Solidago canadensis; S. altissima</i>	canada goldenrod		a	c, d		X		X	X	
ajidamoowaanow; waabigwan	<i>Achillea millefolium</i>	yarrow		b, c, d	a, b, c, d, e	a, b	X	X	X	X	X
animoshi-min, -an; awenisiibag	<i>Ilex verticillata</i>	michigan holly	a, c	c, d	b, c, d	a, b, c	X	X	X	X	
animozid	<i>Hepatica americana</i>	round-lobed hepatica	a	b			X	X			
aninaandag, -oog; ininaandag, -oog; bigiwaandag, -oog; zhinbog, -g; zhingobaaandag, -oog; zhingob bigiwaandag	<i>Abies balsamea</i>	balsam fir	a, b, c	a, b, c, d	a, b, c	a, b, c	X	X	X	X	
aninaatig, -oog	<i>Acer saccharum</i>	sugar maple	a, c	a	c	c	X	X	X		
apaakozigan; miskwaabiimag	<i>Arctostaphylos uva-ursi</i>	bearberry	c	b, c	a, b, c	a, b, c	X	X	X		
apakwanagemag; bapakwanagemag; zhingobiins; zhingwaak	<i>Pinus resinosa</i>	red pine	c	a, b, c	c	a, b	X	X	X		
apakway; apakweshk; apakweshkway; nabagashk	<i>Typha latifolia</i>	broad-leaved cat-tail				a, b	X	X			
asa/isaweminagaawanzh (plant); asa/isawemin (berry)	<i>Prunus virginiana</i>	choke cherry	a, c	a, b, c	a, b, c, d	a, b	X	X	X	X	
azaadi(i)	<i>Populus grandidentata</i>	big-tooth aspen	a, b	a, b	a, b		X	X			
azaadi(i); azaadiins	<i>Populus tremuloides</i>	quaking aspen	a, b, c	a, b, c, d	a, b, c, d, e	a, b, c	X	X	X	X	X
azaadi(i); maanzaadi(i)	<i>Populus balsamifera</i>	balsam poplar			a	a	X				
baasibagak; nameswashk; namewashkoons	<i>Prunella vulgaris</i>	self-heal			c				X		
bagaan, -ag; bagaanens; bagaanimizh; bagaanak	<i>Corylus cornuta</i>	beaked hazelnut			a		X				
bawa'iminaan; gozigwaakomin, -ag	<i>Prunus pensylvanica</i>	pin cherry	a, b, c	a, b, c, d	a, c, d, e	a	X	X	X	X	X
beemsquandawish	<i>Spiranthes romanzoffiana</i>	hooded ladies-tresses							X		
bibigwewanashk, -oon	<i>Heracleum maximum (H. lanatum)</i>	cow-parsnip	a	c	c		X		X		
bine(wi)bag	<i>Pyrola americana (P. rotundifolia)</i>	round-leaved pyrola	a	b			X	X			
cigona ' gan	<i>Dendrolycopodium obscurum; D. dendroideum (*Lycopodium o.)</i>	ground-pine	b, c	b, c		a, b	X	X	X		
doodooshaabonjibik; zhiishiigwebik	<i>Prenanthes alba</i>	white lettuce		a, b	a, b, c	a, b, c	X	X	X		
doodooshaaboo	<i>Lactuca biennis</i>	tall blue lettuce			c				X		
doodooshaaboojibik; mindimooyenh	<i>Taraxacum officinale</i>	common dandelion			d	a, b	X	X		X	
gaagaagimizh; gaagaagiwa/inzh	<i>Tsuga canadensis</i>	hemlock			c, d				X	X	
gaagaagiwanzh; zesegeandag; zhingob; zhingob gaawaandag	<i>Picea mariana</i>	black spruce	a, b, c	a, b, c	c	a, b, c	X	X	X		
gaagigebag	<i>Antennaria howellii (*A. neglecta)</i>	small pussytoes	a			c	X		X		
gaagigebag	<i>Chimaphila umbellata</i>	pipsisewa				a	X				
gaawaandag; gaawaandagwaatig; mina'ig; wadab; zesegeandag	<i>Picea glauca</i>	white spruce	a, b, c	b, c, d	c	a, b, c	X	X	X	X	
gaie 'wuckuk	<i>Scirpus cyperinus</i>	wool-grass		d	a, c, d, e	a, b, c	X	X	X	X	X
giboodyegwaazon	<i>Corydalis aurea</i>	golden corydalis		a			X				
gichi-ode'iminiijibik	<i>Potentilla norvegica</i>	rough cinquefoil		b, d	b, c, d, e	b	X	X	X	X	X
gichi-ode'iminiijibik	<i>Drymocalis arguta (Potentilla a.)</i>	Rosaceae			a, d	a, b	X	X	X	X	
giizhigaandagizi; ogaawa/inzh	<i>Juniperus communis</i>	common or ground juniper			c	a, c	X		X		
giizhik, -ag; gizhikens, -ag; giizhikenh	<i>Thuja occidentalis</i>	arbor vitae	a, b, c	a, b, c	a, b, c, d	a, b, c	X	X	X	X	

**Appendix 3.2.** Ojibwe plant names indexed by natural community type and island (a = West Huron, b = Cattle, c = East Huron, d = Gull, and e = Unnamed) (continued).

Ojibwe Name	Scientific Name	English Name	Boreal Forest	Granite Bedrock Glade	Granite Bedrock Lakeshore	Granite Lakeshore Cliff	West Huron	East Cattle Huron	East Gull Huron	Un-named
ginebigowashk; ginebegwashk; omakakiibag	<i>Plantago rugelii</i> (*P. major)	red-stalked plantain				b		X		
ginoozhewashk; ozawijiibik; zhiiwibag	<i>Rumex crispus</i>	curly dock					X			
gozgwaaakominagaawanzh (plant); gozigaakomin, -ag (berry); ozagadigom; zazigaakominagaawamzh	<i>Amelanchier arborea</i> ; <i>A. interior</i> ; <i>A. sanguinea</i> (*A. laevis)	juneberry	a, c	a, b, c, d	a, d, e	c	X	X	X	X
jasibonskok; aiankosong; gezibnusk; giji ' binusk	<i>Equisetum arvense</i>	common horsetail			b, c	a	X	X	X	
kokbenognik keya; sasgob-mins	<i>Salix exigua</i>	sandbar willow			d				X	
maananoons, -ag	<i>Ostrya virginiana</i>	ironwood; hop-hornbeam	b					X		
main 'gamuna 'tig; anigomiji ' minaga 'wunj	<i>Symphoricarpos albus</i> var. <i>albus</i>	snowberry	a	a	b	a, b	X	X		
makade-miskomin; makade-miskwimin; makade-miin, -an; odatagaagominagaawanzh	<i>Rubus occidentalis</i>	black raspberry	a				X			
manwe ' gons; manwe 'gons	<i>Ranunculus pensylvanicus</i>	bristly crowfoot			c				X	
mashkiigobag; mashkiikaang niibish; waabashkikiibag	<i>Rhododendron groenlandicum</i> ( <i>Ledum g.</i> )	labrador-tea	a, b, c	a, b, c	a, c	c	X	X	X	
mashkode-miizhimizh; mitigomizh; wiisagi-mitigomizh	<i>Quercus rubra</i>	red oak	c	c		c			X	
mauwidaekwaegozeediwushk	<i>Lemna minor</i> ; <i>L. turionifera</i>	common or red duckweed				c, e				X
mazaan; mazaanaatig	<i>Urtica dioica</i>	stinging nettle				c, d		X	X	
mazaanashk	<i>Cirsium arvense</i>	canada thistle		c	b, c			X	X	
me -skwana 'kuk bu ' giso ' win; maeskwanakukbugisowin	<i>Eutrochium maculatum</i> ( <i>Eupatorium m.</i> )	joe-pye-weed				c			X	
mickiminu ' nimic	<i>Ilex mucronata</i> ( <i>Nemopanthus mucronatus</i> )	mountain holly	a			X				
migiziibag; migiziwibag; naemgosibag	<i>Eurybia macrophylla</i> ( <i>Aster macrophyllus</i> )	big-leaved aster	a, c	a, b, c			X	X	X	
miinagaawanzh (plant); miin, -an (berry)	<i>Vaccinium angustifolium</i>	low sweet blueberry	a, c	a, b, c, d	a, b, c, d	a, b, c	X	X	X	X
miskominagaawanzh; miskwiminagaawanzh; miskomin, -ag; miskimin, -ag	<i>Rubus strigosus</i> ( <i>R. idaeus</i> )	wild red raspberry		a, b, d	c, d, e	a, b	X	X	X	X
miskoobimizh; miskwaabiimizh	<i>Cornus sericea</i>	red-osier	a	a, b	a, c	a, b	X	X	X	
miskwazi-wusk	<i>Physocarpus opulifolius</i>	Rosaceae		a, b	a, b, c, d	a, b	X	X	X	X
misudidjeebik	<i>Aquilegia canadensis</i>	wild columbine	c	a, b	b	a, b	X	X	X	
moni swa	<i>Triosteum aurantiacum</i> (*T. perfoliatum)	horse-gentian			c				X	
moozomizh	<i>Acer pensylvanicum</i>	striped maple	a, b, c	a	d		X	X	X	X
naaniibide 'oodegin	<i>Polygonatum pubescens</i>	downy solomon seal	a	a			X			
nabagashk; wiikenh; zhaabozigan	<i>Iris versicolor</i>	wild blue flag	c	b	b, c	a, c	X	X	X	
naubishkukout	<i>Sisyrinchium montanum</i>	mountain blue-eyed-grass		a		a, b	X	X		
nawo 'buguk; wunukibugauh	<i>Trientalis borealis</i>	star-flower	a, c	a, b, c		c	X	X	X	
ne 'bagandag ' ; pebamabid-singup	<i>Taxus canadensis</i>	yew	a, b, c	a, b, c, d	c	a, b, c	X	X	X	X
ne 'bone ' ankwe 'ak	<i>Geum aleppicum</i>	yellow avens		a			X			
neezhodaeyun	<i>Linnaea borealis</i>	twinflower	a, b, c	a, b, c			X	X	X	
niya 'wibukuk ' ; siabuksing, sasabwaksing; piskagamisag	<i>Eupatorium perfoliatum</i>	boneset			d					X
odatagaagominagaawanzh (plant); odatagaagomin (berry)	<i>Rubus allegheniensis</i>	common blackberry								X
ode'immin	<i>Fragaria vesca</i>	woodland strawberry				b		X		
ode'immin, -an; ode'imminijiibik	<i>Fragaria virginiana</i>	wild strawberry		a, b	c	a	X	X	X	
ode'imminijiibik; zhakaagomin; zhaashaagomin; zhaashaagominens	<i>Cornus canadensis</i>	bunchberry	a, c	a, b, c	a	b, c	X	X	X	
odjici ' gomin	<i>Laetuca canadensis</i>	tall lettuce			c				X	
oginiinagaawanzh	<i>Rosa acicularis</i>	wild rose	a, c	a, b, c	a, c, e	a, b, c	X	X	X	X
ogitebag	<i>Caltha palustris</i>	marsh-marigold			b, c			X	X	
okikaandag	<i>Pinus banksiana</i>	jack pine		c		c			X	
ookwemizh (plant); ookwemin (berry)	<i>Prunus serotina</i>	wild black cherry			d					X
ozaawaajiibik; ozaawijiibik	<i>Coptis trifolia</i>	goldthread	a	a, b		a	X	X		
ozaawashkijiibik	<i>Impatiens capensis</i>	spotted touch-me-not			c				X	
ozagadigom	<i>Osmorhiza claytonii</i>	hairy sweet-cicely			a		X			
ozhaashijiibik; ozhaashijiibikens; zhooshkijiibik	<i>Chamerion angustifolium</i> ( <i>Epilobium a.</i> )	fireweed	a	a, b, c, d	a, c, d	a, b, c	X	X	X	X
papshkisiganak; papskatciksi ' gana 'tig	<i>Sambucus racemosa</i>	red-berried elder	a, c	a, b, c, d	c, e	a	X	X	X	X
pis-naknishkuns	<i>Juncus effusus</i>	soft-stemmed rush		d	c, d		X	X	X	X
sabankuk	<i>Lonicera dioica</i>	red honeysuckle	a, c	b, c		a, b, c	X	X	X	

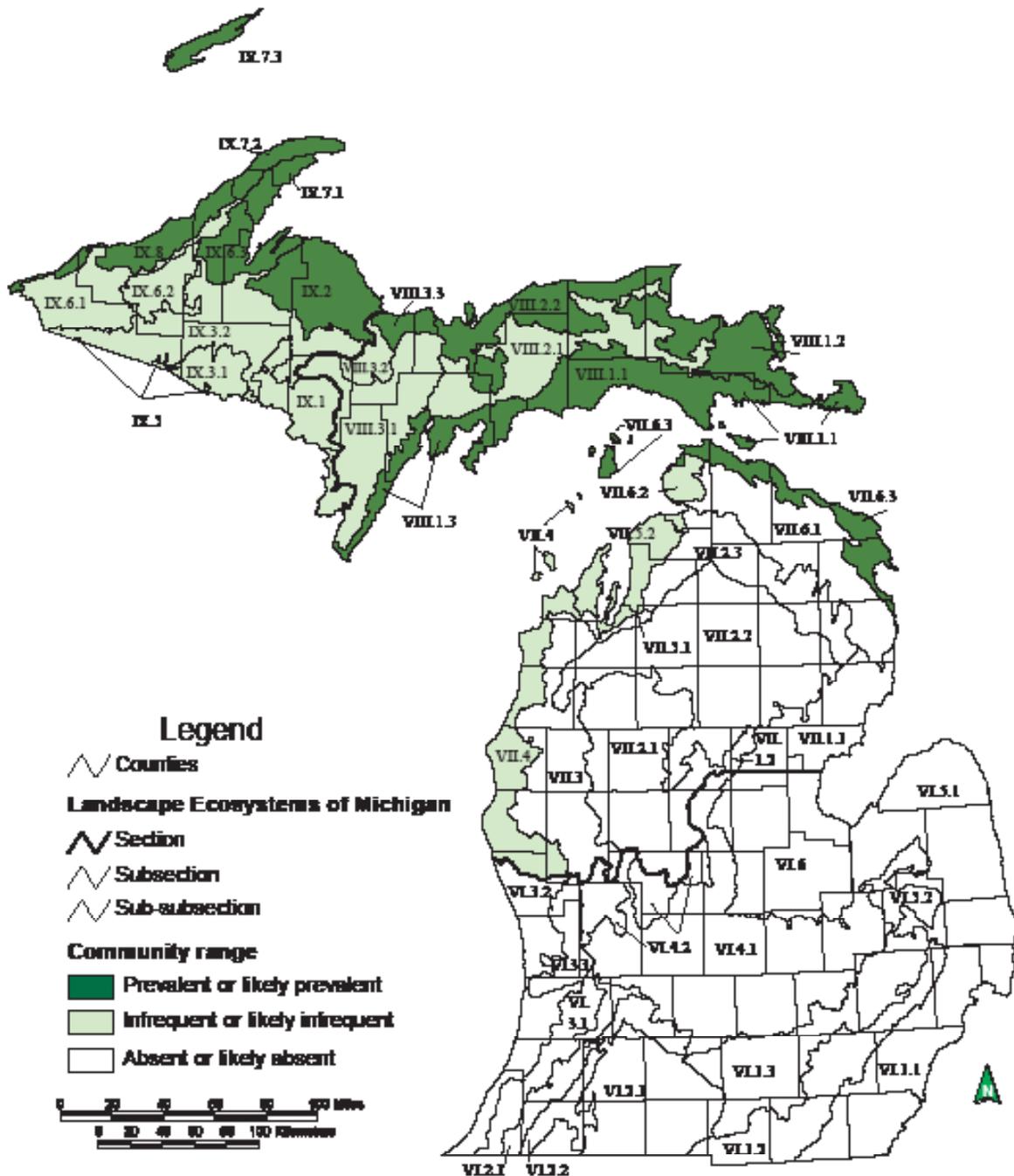
**Appendix 3.2.** Ojibwe plant names indexed by natural community type and island (a = West Huron, b = Cattle, c = East Huron, d = Gull, and e = Unnamed) (continued).

Ojibwe Name	Scientific Name	English Name	Boreal Forest	Granite Bedrock Glade	Granite Bedrock Lakeshore	Granite Lakeshore Cliff	West Huron	Cattle	East Huron	Gull	Un-named
skizgu-min	<i>Rubus pubescens</i>	dwarf raspberry		c	d	c			X	X	
tcatcabonu ' ksil; zheebaunkudohnse	<i>Scutellaria galericulata</i>	marsh skullcap			b			X			
wa 'sawasni 'mike	<i>Myrica gale</i>	sweet gale		c	b, c, d	c		X	X	X	
waabashkikiibag	<i>Spiraea alba</i>	meadowsweet		a, b	a, b, c, d, e	b, c	X	X	X	X	X
waabashkikiibag; mashkiigobagoons	<i>Chamaedaphne calyculata</i>	leatherleaf	a	a, c	a, c	a, c	X		X		
waabigwan	<i>Conyza canadensis</i>	horseweed			a, c, d		X		X	X	
waabigwan; baasibagak	<i>Anaphalis margaritacea</i>	pearly everlasting	a	a	c	a	X		X		
waabigwan; memisku 'nakuk	<i>Hieracium kalmii</i>	kalms hawkweed		a		a	X				
waaboozobagoons; waaboozobanzh	<i>Gaultheria hispida</i>	creeping-snowberry	a, c	a, b, c		b, c	X	X	X		
waaboozoiibik	<i>Ribes glandulosum</i>	skunk currant	a, c	a, b, c, d	c, d	a, b, c	X	X	X	X	
waboskiki ' minun	<i>Galium tinctorium</i>	stiff bedstraw			d						X
wadoop, -iin	<i>Alnus incana</i>	speckled alder	c		c	b		X	X		
wanukons'; apagwasi ' gons; abagwasi ' gans	<i>Cicuta bulbifera</i> (*C. maculata)	water hemlock			c				X		
wawiaeneegaeguhns	<i>Drosera rotundifolia</i>	round-leaved sundew		a, c	a, c	a, c	X		X		
wewai ' bugug	<i>Viola labradorica</i> (V. conspersa)	dog violet			a	a, c	X				
wezaawaaskoneg	<i>Euthamia graminifolia</i>	flat-topped goldenrod		a, b, c, d	b, c, d, e	a, b, c	X	X	X	X	X
wezauskwagmik; osawa ' skanet	<i>Diervilla lonicera</i>	bush-honeysuckle	a, b, c	a, b, c	a, c	a, b, c	X	X	X		
wiigwaas, -an, -ag; wiigwaasaatig; wiigwaasi-mitig; wiigwaasimizh	<i>Betula papyrifera</i>	paper birch	a, c	a, b, c, d	a, b, c, d, e	a, b, c	X	X	X	X	X
wiinisibag; wiinisibagoons; wiinisibagad	<i>Gaultheria procumbens</i>	wintergreen			c	c			X		
wiiniziikens	<i>Symphyotrichum puniceum</i> ; <i>S. firmum</i> ( <i>Aster puniceus</i> )	swamp aster			d						X
wiinizik	<i>Betula alleghaniensis</i>	yellow birch	c						X		
zeewunubugushk	<i>Oxalis acetosella</i>	northern wood-sorrel	c						X		
zhaashaagobiimag	<i>Acer spicatum</i>	mountain maple	a, b, c	a, b, c, d	a, c	a	X	X	X	X	
zhiishiiginewanzh, iig; zhiishiigimiwanzh, -iig	<i>Acer rubrum</i>	red maple	a, b, c	a, b, c	a, b, c, d	a, c	X	X	X	X	
zhingwaak	<i>Pinus strobus</i>	white pine	a, c	a, b, c, d	a, b, c, d	a, b, c	X	X	X	X	
No name given ( <i>C. rugosa</i> )	<i>Cornus rugosa</i>	round-leaved dogwood	a	a, b, c	c, d	c	X	X	X	X	
No name given ( <i>H. lucidula</i> )	<i>Huperzia lucidula</i>	shining clubmoss							X		
No name given ( <i>O. biennis</i> )	<i>Oenothera biennis</i>	common evening-primrose			b			X			
No name given ( <i>P. maculosa</i> )	<i>Persicaria maculosa</i> ( <i>Polygonum persicaria</i> )	ladys thumb			d, e					X	X
No name given ( <i>T. dasycarpum</i> )	<i>Thalictrum dasycarpum</i>	purple meadow-rue		b	b, c, d		X	X	X	X	
No name given ( <i>V. myrtilloides</i> )	<i>Vaccinium myrtilloides</i>	canada blueberry	a, c	a, b, c	a, b	a, b, c	X	X	X		

# Appendix 4 - Natural Community Overviews and Distribution Maps

## BOREAL FOREST

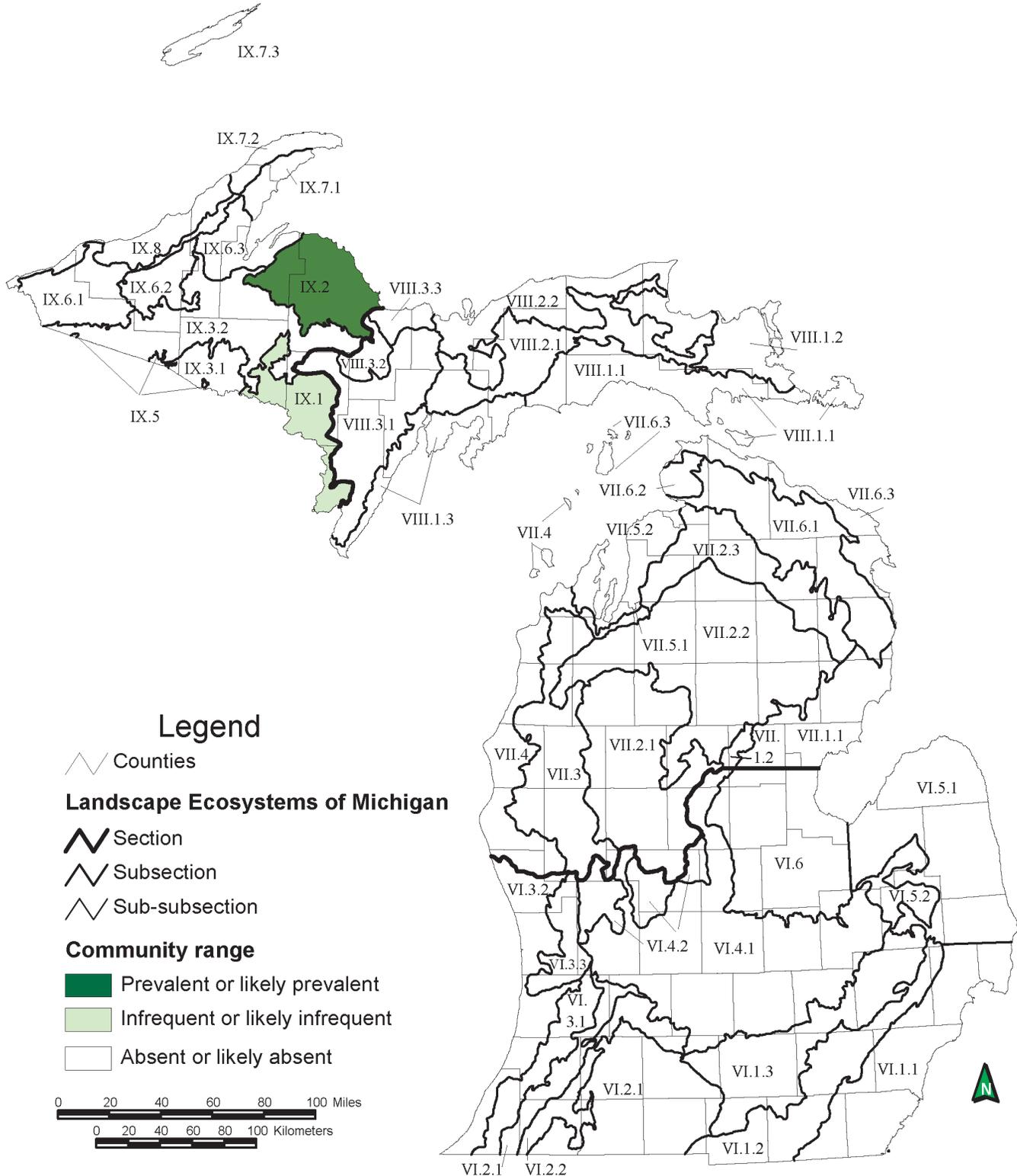
**Overview:** Boreal forest is a conifer or conifer-hardwood forest type occurring on moist to dry sites characterized by species dominant in the Canadian boreal forest. It typically occupies upland sites along shores of the Great Lakes, on islands in the Great Lakes, and locally inland. The community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

## GRANITE BEDROCK GLADE

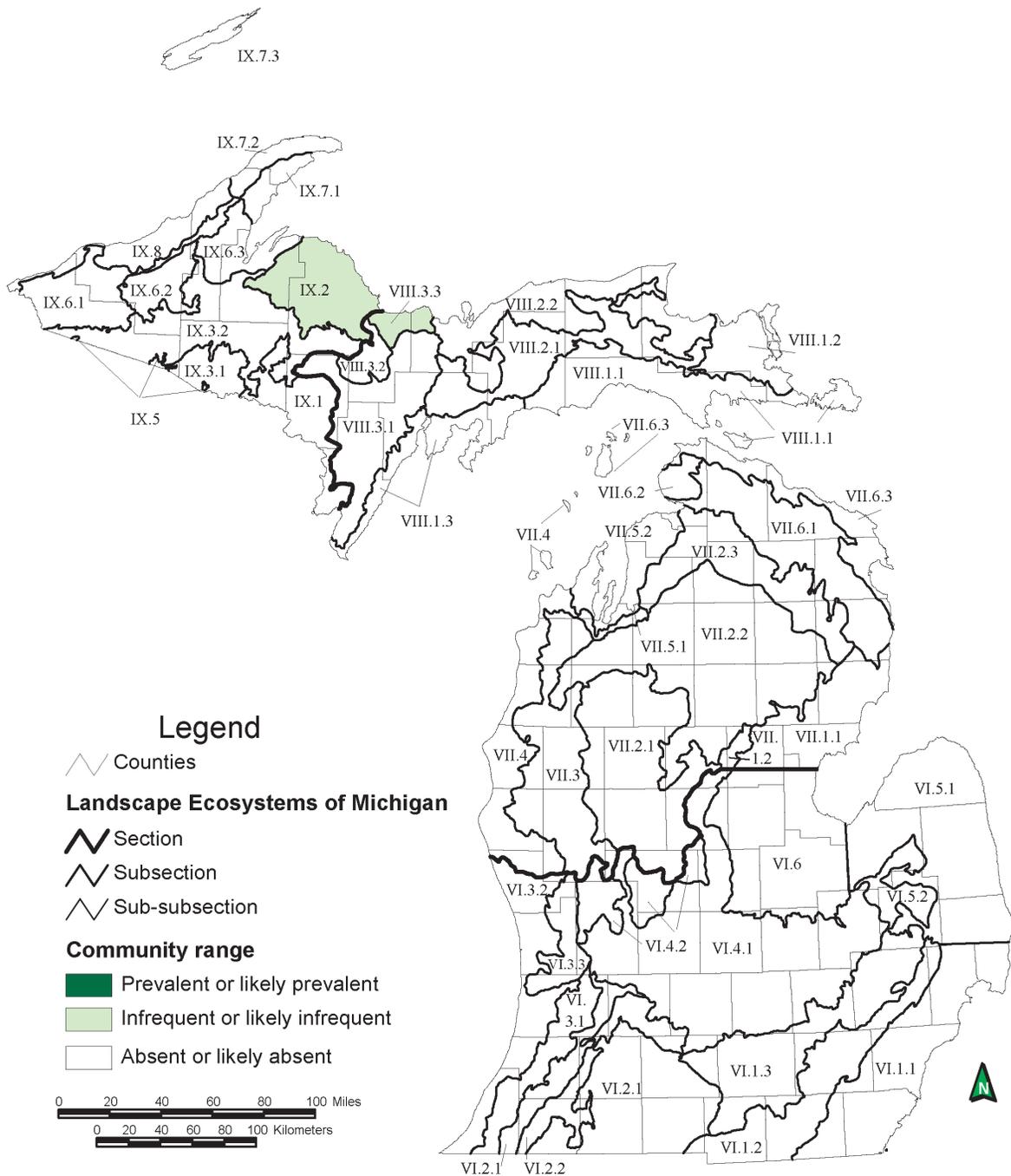
**Overview:** Granite bedrock glade consists of an open forested or savanna community found where knobs of granitic bedrock types are exposed at the surface. The sparse vegetation consists of scattered open-grown trees, scattered shrubs or shrub thickets, and a partial turf of herbs, grasses, sedges, mosses, and lichens. Granite bedrock glades typically occupy areas of steep to stair-stepped slopes, with short cliffs, and exposed knobs of bedrock. The community occurs in the western Upper Peninsula with primary concentrations in Marquette, Baraga, and Dickinson Counties (Kost et al. 2007, Cohen et al. 2015).



**Map 2.** Distribution of granite bedrock glade in Michigan (Albert et al. 2008).

## GRANITE BEDROCK LAKESHORE

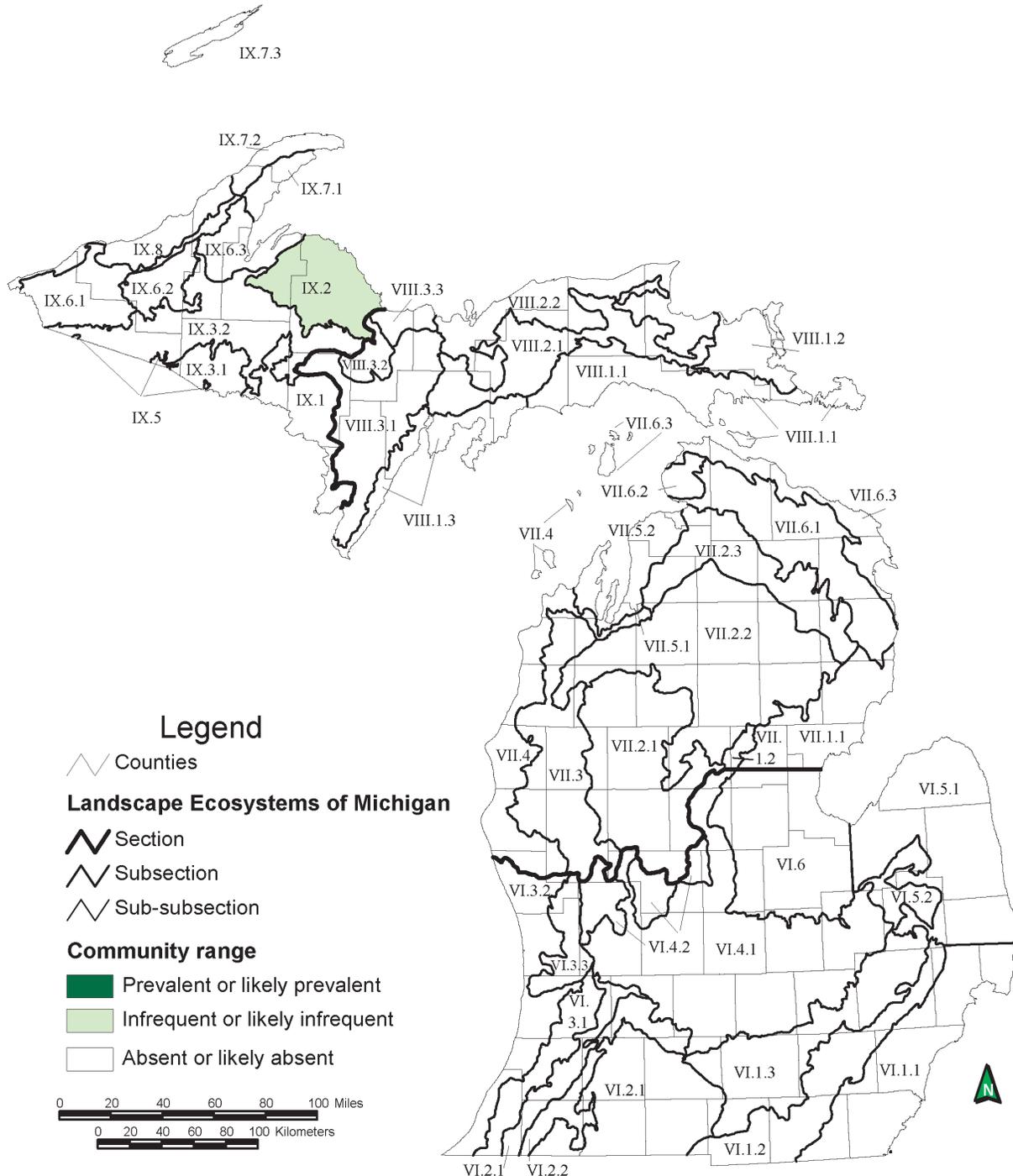
**Overview:** Granite bedrock lakeshore occurs along the Lake Superior shoreline as small knobs of sparsely vegetated granitic bedrock, typically between longer expanses of steep sandstone cliffs. Mosses and lichen dominate, with a few herbs, shrubs, and tree saplings and stunted trees restricted to areas above the strong influence of waves and ice scour. Granitic bedrock is restricted to scattered headlands (erosion-resistant knobs) along the Lake Superior shoreline between the city of Marquette and the Huron Mountain Club, about 48 km to the northwest. The Huron Islands, located just west of the Huron Mountains and about 10 km (6 miles) east of Point Abbaye, are the westernmost exposure of granitic bedrock along the southern shore of Lake Superior. Granite bedrock lakeshore 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 granite bedrock lakeshore, removing fine mineral sediments and organic soils. Winter storms scour vegetation from granite bedrock lakeshore. Long-term cyclic fluctuations of Great Lakes water levels significantly influence vegetation patterns of granite bedrock lakeshore, with vegetation and organic soils becoming established during low-water periods and reduced or eliminated during high-water periods. (Kost et al. 2007, Cohen et al. 2015).



**Map 3.** Distribution of granite bedrock lakeshore in Michigan (Albert et al. 2008).

## GRANITE LAKESHORE CLIFF

**Overview:** Granite lakeshore cliff consists of vertical or near-vertical exposures of bedrock with sparse coverage of vascular plants, lichens, mosses, and liverworts. The community occurs in the western Upper Peninsula along Lake Superior and is characterized by high site moisture due to its proximity to Lake Superior and a stressed and unstable environment because of severe waves, wind, and winter ice. The combination of strong winds, waves, ice, and bedrock exfoliation maintain open conditions on the cliff face. The thin soils and full exposure to wind, ice, and sun produce desiccating conditions for many plants. Abundant fog provides moisture for the establishment of mosses and lichens on more protected rock surfaces, while vascular plants are restricted to crevices or moisture-holding depressions in the rock. Granitic rock, formed under intense pressure deep within the earth's crust, exfoliates when it is exposed at the surface. Exfoliation adds to the instability of the ecosystem, reducing dependable habitat for plant establishment. As portions of the bedrock slough off, they form talus slopes along the shore at the base of the cliff (if a ledge is present at the cliff base) and expose fresh, bare rock substrates (Kost et al. 2007, Cohen et al. 2015).



**Map 4.** Distribution of granite lakeshore cliff in Michigan (Albert et al. 2008).