

Natural Community Surveys of Gull Island, Seney National Wildlife Refuge, Lake Michigan



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Cover Photo: Gull Island limestone cobble shore. Photo by Joshua G. Cohen.

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Introduction

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

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 Unfortunately, within these unique geographies biodiversity data is limited or outdated, which hinders effective management and decision-making.

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



Gull Island sand and gravel beach. Photo by Joshua G. Cohen.

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



Figure 1. Map of Gull Island within the Beaver Island Archipelago.

Methods

Study Area

Gull Island is part of the Beaver Island Archipelago, which occurs in northern Lake Michigan (Figure 1). This cluster of islands is characterized by limestone bedrock covered by a layer of sand and glacial till. This 230-acre island is the farthest island in the archipelago to the northwest and is located 7 miles west of High Island, 43 miles west of the Northern Lower Peninsula, and 36 miles east of the Garden Peninsula. Gull Island supports both mesic northern forest and boreal forest in the interior. The western shoreline is primarily composed of limestone cobble shore and the eastern shoreline is primarily sand and gravel beach with localized low foredunes. Nesting herring gulls (*Larus argentatus*) utilize the shoreline of Gull Island and double-crested cormorant (*Phalacrocorax auritus*) and great blue heron (*Ardea herodias*) nests are concentrated in the northern and southern portions of the island, which are both characterized by open canopies and standing snags resulting from decades of nesting shorebirds. Gull Island has been part of the Michigan Islands National Wildlife

Refuge since 1943. Gull Island is managed by the NWR to maintain the existing natural communities in order to support the needs of priority and migratory bird species, threatened and endangered species, and resident wildlife. Access to the island is restricted to permitted research and public access is prohibited.

Natural community surveys were conducted on Gull Island May 24th, and August 9th, 2022. Prior to this survey effort, Gull Island had never been surveyed by MNFI staff.

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 Gull Island 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



Nesting double-crested cormorant are concentrated in the northern and southern portions of the island where the canopy is open and standing snags are prevalent from decades of nesting shorebirds. Photo by Joshua G. Cohen

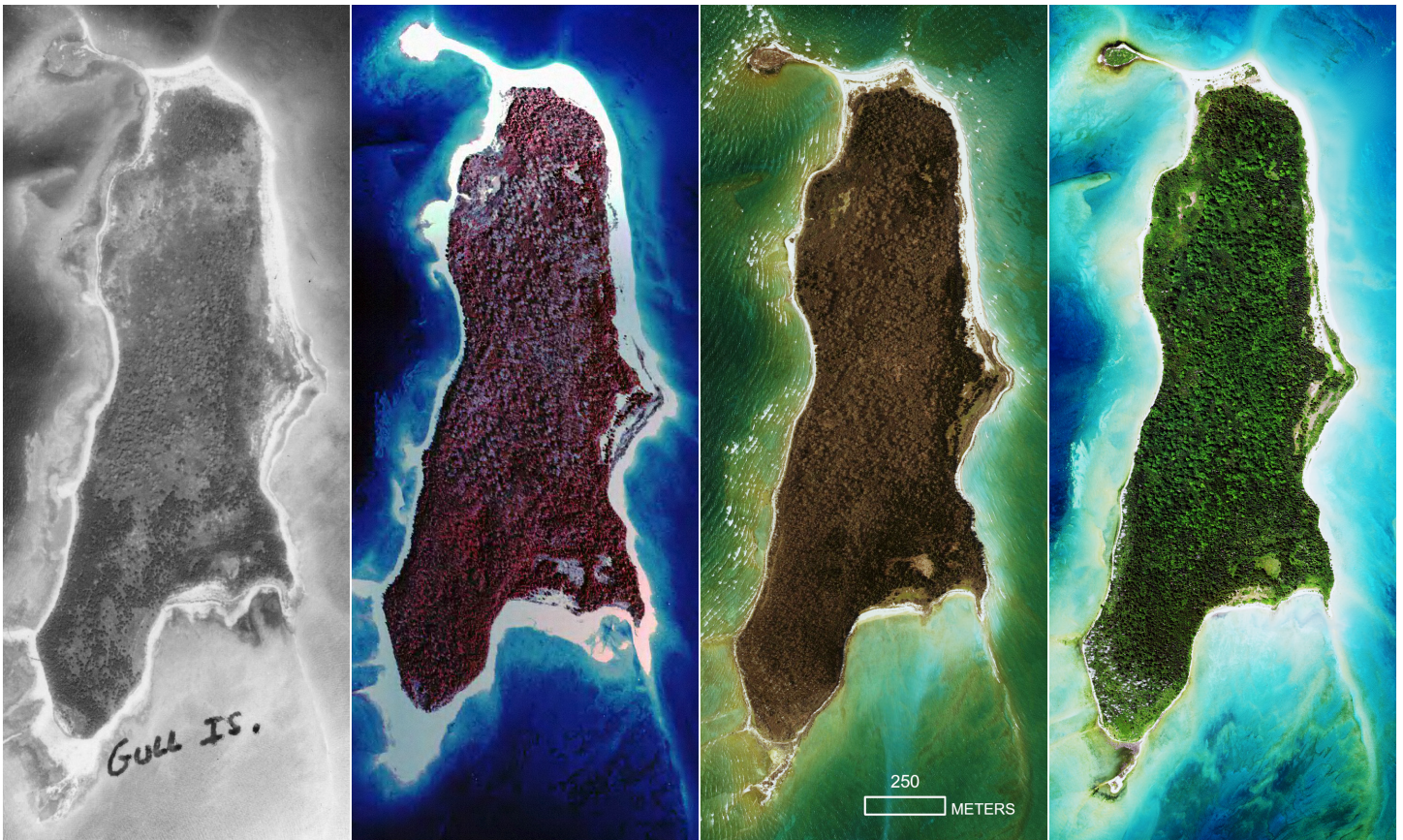


Figure 2. Imagery used to prioritize survey effort on Gull Island. From left to right: historical black-and-white imagery (1939), color infrared imagery (1998), recent true color leaf-off imagery (2017), and recent true color leaf-on imagery (2018) (USDA 1939, USDA 1998, State of Michigan 2017, USDA 2018).

imagery (2017-2018), recent true color leaf-on imagery (2018-2020), topographic maps, digital elevation models, and hillshade (a grayscale 3D representation of the terrain surface) (Figures 2 and 3). The preliminary delineation of natural community types across the island helped focus subsequent surveys of high-quality natural communities as well as invasive species and rare plant surveys. The MNFI natural community classification system was used as the classification framework (Kost et al. 2007, Cohen et al. 2015, Cohen et al. 2020).

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

Field Survey

A qualitative, plotless sampling design was employed to survey natural communities on the NWR islands. For every island, MNFI ecologists evaluated each natural community type that was delineated during the GIS analysis described above and each natural community type polygon was ground-truthed through meander surveys. The meander survey covered a representative sample of each polygon, and involved investigating typical and unique aerial signatures, traversing topographic variation, and visiting noticeable vegetation zones and soil moisture types. A Samsung Tablet in tracking mode was used during the meander surveys to create a record of routes taken within the surveyed natural community polygons. Prioritized communities (rare community types and high-quality examples of any community type) received more survey effort than common and degraded communities. According to Natural Heritage Methodology, if a site meets defined requirements for ecological condition, landscape context, and size of the area of interest (MNFI 1988) it is categorized as a high-quality example of that specific natural community type, entered into MNFI's database as an element occurrence, and given a letter rank. Ecological field surveys were conducted during the growing season to evaluate the condition and classification of the sites.

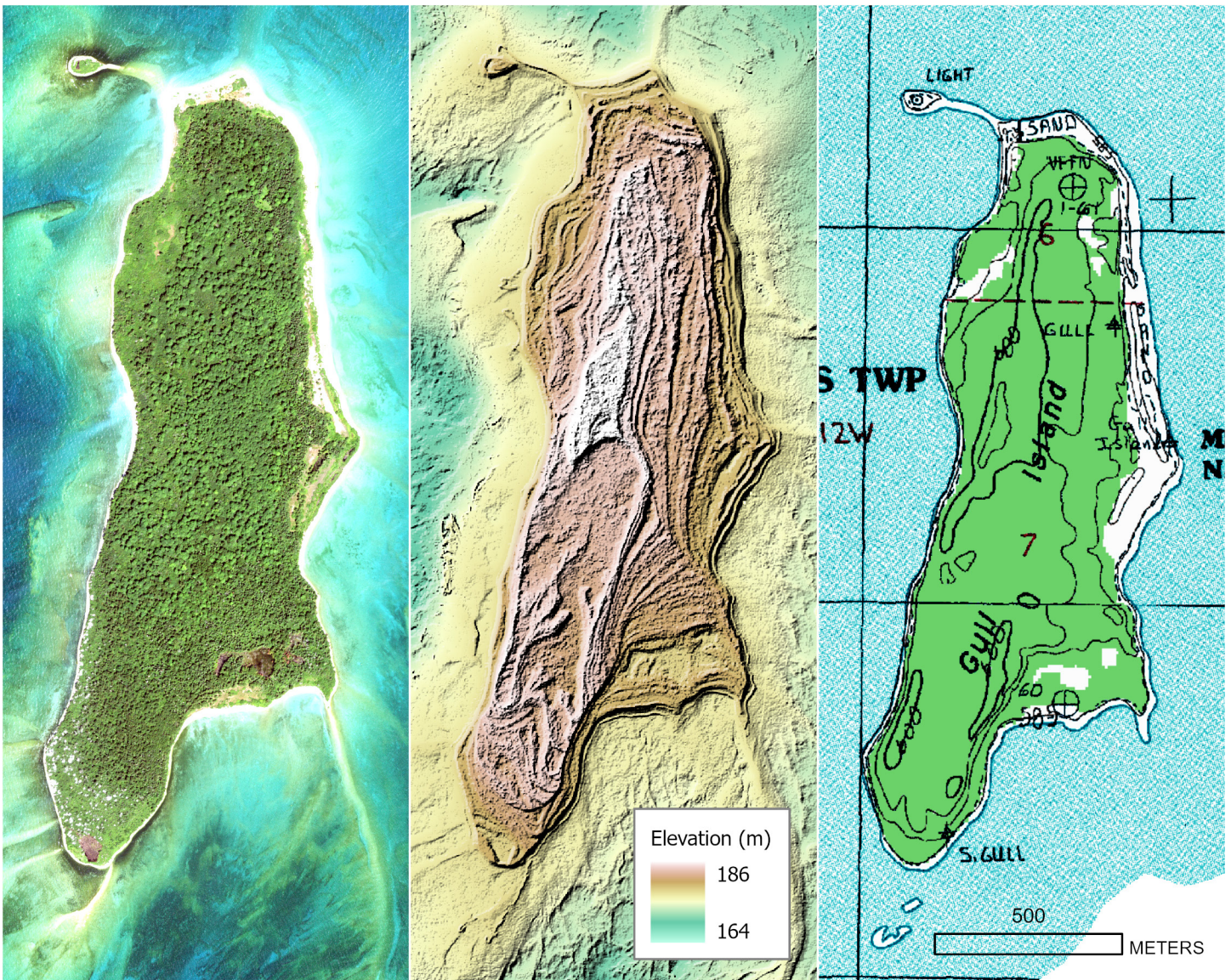


Figure 3. Spatial data layers and imagery used to prioritize survey effort on Gull Island. From left to right: recent true color leaf-on imagery (2020), elevation with shaded relief, and topographic map (USDA 2020, USGS 2016, USGS 2022).

Global / State Conservation Status Rank Combination	Ecological Integrity Assessment Rank			
	A Excellent Integrity	B Good Integrity	C Fair Integrity	D Poor Integrity
G1S1, G2S1, GNR51, GUS1				
G2S2, GNR52, G3S1, G3S2, GUS2				
GUS3, GNR53, G3S3, G4S1, G4S2, G5S1, G5S2, any SNR				
G4S3, G4S4, G5S3, G5S4, G5S5, GNR54, GNR55, GUS4, GUS5				
Red Shading = Natural Community Survey Targets				

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

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., ditching, trails, pollutants, and logging)
- h) evaluating potential threats to ecological integrity (i.e., invasive plant species, pests, diseases, deer herbivory) with an emphasis on recording geospatial locations of invasive plant infestations
- i) ground-truthing aerial photographic interpretation using GPS (Garmin units and Samsung Tablets were utilized)
- j) taking digital photos and GPS points at significant locations
- k) surveying adjacent lands when possible to assess landscape context
- l) evaluating the natural community classification and mapped ecological boundaries
- m) determining the ecological integrity of mapped high-quality natural communities by assigning element occurrence ranks
- n) noting management needs and restoration opportunities

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 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 on Gull Island that are listed in "Plants used by the Great Lakes Ojibwa" (Meeker et al. 1993). These culturally significant plants are also indexed to natural community type (Appendix 3.2).

In addition to these natural community surveys, MNFI conducted rare plant and invasive species mapping on Gull Island in 2022. Data gathered from this survey effort was also used to inform the documentation and description of high-quality natural communities on Gull Island. For details on the 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 develop the ecological integrity rank, with higher scores for higher-ranked element occurrences. The rarity index was developed 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 developed by calculating the average of an invasive threat severity index and a treatment feasibility index. The threat severity index was developed using knowledge of impacts of invasive plant species to natural community types and site-specific information gained during surveys on invasive infestations. Higher scores for the threat severity index correspond to

increased degradation due to invasive infestation. The treatment feasibility index was derived by assigning a score to each natural community element occurrence based on the ease of treating the invasive species recorded within that site. Higher scores for the treatment feasibility index correspond to a greater likelihood of successful treatment and control of targeted invasive species. The threat severity index and treatment feasibility index were assigned based on professional judgement and familiarity with species, systems, and ecological regions. Each index was scored on a scale of 0 to 5. For each natural community element occurrence, the sum of the scores for the ecological integrity index, rarity index, and invasive index was calculated to sort the natural community element occurrences by their stewardship prioritization score (Figure 5). The stewardship prioritization for the natural community element occurrences is presented in the **Stewardship Prioritization Results** section.

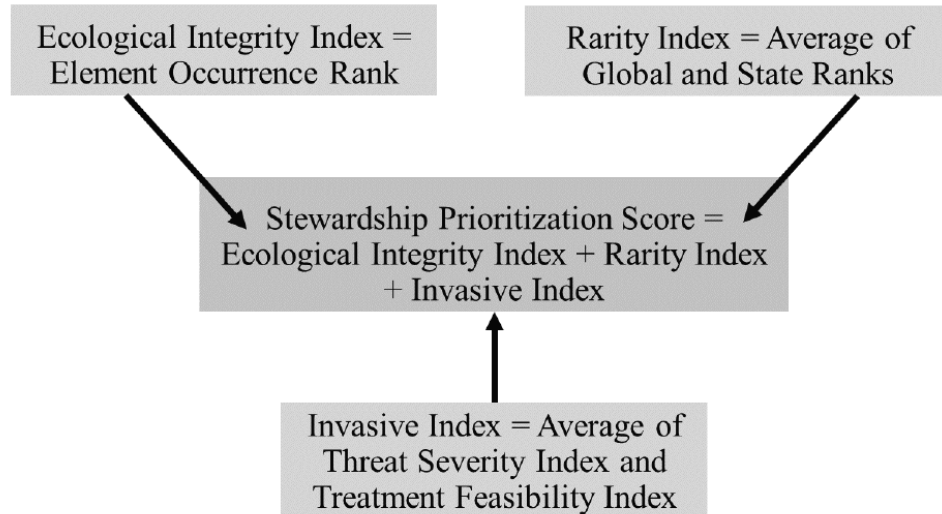


Figure 5. The stewardship prioritization score is the sum of the ecological integrity index, rarity index, and invasive index. This prioritization scoring was derived to help focus finite resources for biodiversity stewardship.



For each high-quality natural community element occurrence, surveyors compiled comprehensive plant species list. Gull Island limestone cobble shore (left) and sand and gravel beach (right). Photos by Joshua G. Cohen.

Survey Results

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

Four high-quality natural communities occur on Gull Island including boreal forest, limestone cobble shore, mesic northern forest, and sand and gravel beach. Table 1 lists the visited sites, their element occurrence ranks, and their acreage. Mapped natural community boundaries are provided for each natural community element occurrence in Figure 6. The following site summaries detail threats and management recommendations for each of the four natural community element occurrences visited in 2022 organized alphabetically by community type. Appendix 3 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

Table 1. Natural community element occurrences (EOs) surveyed in 2022 on Gull Island. EO rank abbreviations are as follows: C, fair estimated viability.

Community Type	EO ID	Acreage	EO RANK
Boreal Forest	26263	45	C
Limestone Cobble Shore	26265	5	C
Mesic Northern Forest	26262	92	C
Sand and Gravel Beach	26264	29	C



Gull Island, limestone cobble shore. Photo by Bill Parsons, Little Traverse Bay Bands of Odawa Indians Natural Resource Department.



Figure 6. Natural community element occurrences on Gull Island.

SITE SUMMARIES

1. Gull Island - Boreal Forest

Natural Community Type: Boreal Forest

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

Element Occurrence Rank: C

Size: 45 acres

Location: Gull Island, Seney National Wildlife Refuge, Lake Michigan

Element Occurrence Identification Number: 26263

Site Description: Boreal forest on Gull Island occurs on gently rolling former sandy shoreline along the eastern shore. The soils are characterized by shallow (5-10 cm), acidic (pH 5.5) organics overlying fine-textured alkaline (pH 8.0) sands. Boreal forest intergrades locally with mesic northern forest along the interior margin of the boreal forest.

Gull Island's position in northern Lake Michigan makes it subject to frequent storm events. Windthrow is common within the boreal forest, which is characterized by high volumes of coarse woody debris. The boreal forest is young and subject to frequent turnover. A 34 cm northern white-cedar (*Thuja occidentalis*) was cored and estimated to be over 63 years old (53 growth rings counted). A 41.5 cm white pine (*Pinus strobus*) snag with fire charring was found within the boreal forest suggesting that the boreal forest was impacted by wildfire. While deer are absent from the island, the vegetation of the boreal forest has been impacted by snowshoe-hare browse on shrubs and tree seedlings.

The boreal forest is dominated by northern white-cedar and balsam fir (*Abies balsamea*) with paper birch (*Betula papyrifera*) as a canopy associate. Canopy coverage ranges from 55 to 75% with some areas of the forest closer to the shoreline having more open canopy where blowdown is more prevalent. Canopy trees typically range in diameter from 10 to 20 cm. The understory layer is patchy to dense (25-45%) with balsam fir and choke cherry (*Prunus virginiana*). The low shrub layer is patchy (10-20%) and dominated by yew (*Taxus canadensis*) with occasional mountain-ash (*Sorbus decora*). The prevalence of yew in the boreal forest and adjacent mesic northern forest indicates the absence of deer on Gull Island. The ground cover is patchy (10-20%) with feathermosses locally dominant and characteristic species including gay-wings



Gull Island boreal forest. Photo by Tyler J. Bassett.



Gull Island boreal forest delineated in yellow on 2017 aerial imagery.

(*Polygala paucifolia*), cow-parsnip (*Heracleum maximum*), Canada mayflower (*Maianthemum canadense*), and common trillium (*Trillium grandiflorum*).

The Gull Island boreal forest was surveyed May 24th and August 9th, 2022. Ninety plant species were documented with 81 native species and 9 non-native species (Appendix 2.1). The total FQI was 38.9.

Threats: Species composition and vegetative structure of the boreal forest on Gull Island have been influenced by windthrow and wildfire. Non-native species are infrequent and include bull thistle (*Cirsium vulgare*), hound's-tongue (*Cynoglossum officinale*), orange hawkweed (*Hieracium aurantiacum*), common St. John's-wort (*Hypericum perforatum*), catnip (*Nepeta cataria*), bittersweet nightshade (*Solanum dulcamara*), common dandelion (*Taraxacum officinale*), Tatarian honeysuckle (*Lonicera tatarica*), and common mullein (*Verbascum thapsus*).

Management Recommendations: The main management recommendations are to allow natural processes to operate unhindered, retain an intact buffer of natural communities surrounding the boreal forest, control the invasive species (especially Tatarian honeysuckle), and monitor control efforts. The Tatarian honeysuckle currently occurs at low densities and can be readily controlled with prompt action. The density of understory vegetation within the interior of the island necessitates vigilant monitoring to detect additional patches of honeysuckle that may become established.



Gay-wings (*Polygala paucifolia*) and Canada mayflower (*Maianthemum canadense*) are prevalent in the herbaceous layer of the boreal forest. Photo by Tyler J. Bassett.



Although rare within the boreal forest, the presence of robust round-leaved orchid (*Platanthera orbiculata*) is an indicator that Gull Island has not been impacted by deer browse pressure. Photo by Tyler J. Bassett.

2. Gull Island - Limestone Cobble Shore

Natural Community Type: Limestone Cobble Shore

Rank: G2G3 S3, imperiled to vulnerable globally and vulnerable within the state

Element Occurrence Rank: C

Size: 5 acres

Location: Gull Island, Seney National Wildlife Refuge, Lake Michigan

Element Occurrence Identification Number: 26265

Site Description: Over a mile of limestone cobble shore occurs along the western, southern, and southeastern shoreline of Gull Island. The limestone cobble shore ranges from 5 to 10 meters wide. The western shore of Gull Island is exposed to 36 miles of Lake Michigan and the eastern shore is exposed to 7 miles of open Lake Michigan to the east. The shorelines are both subject to high energy disturbance in the form of frequent storms, high wave activity, and ice scour. This frequent disturbance contributes to the absence of soil accumulation and vegetative establishment along the shore. Limestone cobble shore is characterized by both a low diversity of plant species and low levels of plant cover. The limestone cobble shore has been impacted by five years of high Great Lakes water levels (from 2016 through 2020), reducing the extent of limestone cobble shore. High water levels have resulted in the die back of trees and shrubs within the limestone cobble shore. In addition, high water levels have also likely reduced the overall cover of herbaceous plants.

Wet gravelly, alkaline (pH 8.0) sands mixed with organics occur between and beneath the cobble. Rocks along this stretch of shoreline range from small cobble to large boulders and the underlying substrate is limestone cobble and bedrock. Surficial cobble includes a mix dominated by limestone with granite, basalts, and fossils also present. Along the western shoreline, a low ledge of conglomerate backs the limestone cobble shore. Along the southern portion of the island, double-crested cormorants are nesting in the forest adjacent to the limestone cobble shore and have generated open canopy conditions and numerous snags within this disturbed block of forest.



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



Gull Island limestone cobble shore delineated in yellow on 2017 aerial imagery.

Vegetation within the limestone cobble shore is absent to sparse. Where vegetation has become established, it occurs between cobbles and along the upper margin of the shore. Vegetation was likely especially sparse in 2022 since surveys were conducted following five years of high Great Lakes water levels (2016 through 2020). Scattered trees and shrubs occur rarely along the upper margins of the limestone cobble shore and include northern white-cedar (*Thuja occidentalis*), white spruce (*Picea glauca*), paper birch (*Betula papyrifera*), pin cherry (*Prunus pensylvanica*), choke cherry (*P. virginiana*), red-berried elder (*Sambucus racemosa*), ninebark (*Physocarpus opulifolius*), red-osier dogwood (*Cornus sericea*), and wild red raspberry (*Rubus strigosus*). A high percentage of these woody species have died recently following the high-water levels. The sparse ground cover includes wild columbine (*Aquilegia canadensis*), herb Robert (*Geranium robertianum*), spotted touch-me-not (*Impatiens capensis*), common milkweed (*Asclepias syriaca*), fireweed (*Chamaenerion angustifolium*), wild strawberry (*Fragaria virginiana*), starry false Solomon-seal (*Maianthemum stellatum*), poison-ivy (*Toxicodendron radicans*), and stinging nettle (*Urtica dioica*).

The Gull Island limestone cobble shore was surveyed May 24th and August 9th, 2022. Forty-three plant species were documented with 25 native species and 18 non-native species (Appendix 2.2). The total FQI was 11.1.

Threats: Species composition and structure are patterned by natural processes. Numerous non-native species were documented along the limestone cobble shore including spotted knapweed (*Centaurea stoebe*), Canada thistle (*Cirsium arvense*), bull thistle (*C. vulgare*), poison-hemlock (*Conium maculatum*), hound's-tongue (*Cynoglossum officinale*), false buckwheat (*Fallopia convolvulus*), common St. John's-wort (*Hypericum perforatum*), motherwort (*Leonurus cardiaca*), catnip (*Nepeta cataria*), lady's-thumb (*Persicaria maculosa*), Canada bluegrass (*Poa compressa*), mossy stonecrop (*Sedum acre*), bladder campion (*Silene vulgaris*), bitter-sweet nightshade (*Solanum dulcamara*), perennial sow-thistle (*Sonchus arvensis*), common dandelion (*Taraxacum officinale*), and common mullein (*Verbascum thapsus*).

Management Recommendations: The main management recommendation is to control and monitor invasive species along the shoreline. We recommend focusing control efforts within the limestone cobble shore on poison-hemlock and spotted knapweed since they are high-priority targets for control or eradication. Though spotted knapweed is abundant on the sand and gravel beach it is still sparse on the limestone cobble shore.



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

3. Gull Island - Mesic Northern Forest

Natural Community Type: Mesic Northern Forest

Rank: G4 S3, apparently secure globally and vulnerable within the state

Element Occurrence Rank: C

Size: 92 acres

Location: Gull Island, Seney National Wildlife Refuge, Lake Michigan

Element Occurrence Identification Number: 26262

Site Description: Mesic northern forest on Gull Island occurs on gently rolling terrain in the interior of the island. Mesic northern forest intergrades locally with boreal forest, which occurs primarily along the eastern side of the island.

Gull Island's position in northern Lake Michigan makes it subject to frequent storm events. Windthrow is common within the mesic northern forest, which is characterized by low volumes of coarse woody debris. Several large diameter downed logs were noted within the forest. The mesic northern forest is young and subject to frequent turnover. A 36.4 cm sugar maple (*Acer saccharum*) was cored and estimated to be over 83 years old. The soils are characterized by a shallow (5 cm), acidic (pH 5.5) mull humus overlying fine- to medium-textured sands that are also acidic (pH 5.5).

The mesic northern forest is dominated by sugar maple with canopy associates including northern white-cedar (*Thuja occidentalis*), paper birch (*Betula papyrifera*), and black cherry (*Prunus serotina*). Canopy coverage typically ranges from 75 to 85% with some areas of the forest closer to shoreline having more open canopy where blowdown is more prevalent. Canopy trees typically range in diameter from 25 to 45 cm with some scattered sugar maple reaching greater than 60 cm. The understory layer is dense (80-100%) and overwhelmingly dominated by yew (*Taxus canadensis*) with associates



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



Gull Island mesic northern forest delineated in yellow on 2017 aerial imagery.

including choke cherry (*Prunus virginiana*), mountain maple (*Acer spicatum*), and red-berried elder (*Sambucus racemosa*) as well as sugar maple and northern white-cedar saplings. The prevalence of yew, which is frequently 6 to 12 feet tall, indicates the absence of deer on Gull Island. The low shrub layer is also dense (75-100%) and dominated by yew with associates including Canadian fly honeysuckle (*Lonicera canadensis*), choke cherry, and sugar maple seedlings. The dense shrub layer results in a sparse to patchy ground cover (15-25%) with characteristic species including common trillium (*Trillium grandiflorum*), cow-parsnip (*Heracleum maximum*), Canada mayflower (*Maianthemum canadense*), starry false Solomon-seal (*M. stellatum*), sharp-lobed hepatica (*Hepatica acutiloba*), early meadow-rue (*Thalictrum dioicum*), woodferns (*Dryopteris* spp.), wild leek (*Allium tricoccum*), running ground-pine (*Lycopodium clavatum*), and Canada violet (*Viola canadensis*). The proliferation of common trillium in localized patches can be attributed to a lack of deer on the island.

The Gull Island mesic northern forest was surveyed May 24th and August 9th, 2022. Fifty-six native plant species were documented. No invasive species were documented during the course of the surveys (Appendix 2.3). The total FQI was 34.4.

Threats: Species composition and vegetative structure of the mesic northern forest on Gull Island are influenced by gap-phase dynamics. No threats were documented within the mesic northern forest.

Management Recommendations: The main management recommendations are to allow natural processes to operate unhindered, retain an intact buffer of natural communities surrounding the mesic northern forest, and monitor for invasive species.



Common trillium (*Trillium grandiflorum*) and yew (*Taxus canadensis*) are respectively dominant in the ground cover and shrub layer of the mesic northern forest. Photo by Tyler J. Bassett.

4. Gull Island - Sand and Gravel Beach

Natural Community Type: Sand and Gravel Beach

Rank: G3? S3, vulnerable throughout range

Element Occurrence Rank: C

Size: 29 acres

Location: Gull Island, Seney National Wildlife Refuge, Lake Michigan

Element Occurrence Identification Number: 26264

Site Description: Over two miles of sand and gravel beach occur on the eastern, northern, and northwestern shores of Gull Island. Along the eastern shore, sand and gravel beach is backed by low foredune. The sand and gravel beach ranges from 10 to 30 meters wide. The eastern shore of Gull Island is exposed to 7 miles of open Lake Michigan to the east and the western shore is exposed to 36 miles of Lake Michigan. The shorelines are both subject to high energy disturbance in the form of frequent storms, high wave activity, and ice scour. This frequent disturbance contributes to the absence of soil accumulation and vegetative establishment along the shore. Sand and gravel beach is characterized by both a low diversity of plant species and low levels of plant cover (<1%). A wide variety of plants can develop at the inland margin of sand and gravel beaches, but few establish and persist on the active beach, where there is often intense wind and wave action, resulting in almost constantly moving sand. The dynamic nature of open sand and gravel beaches greatly inhibits soil development. Storm waves and winter ice typically prevent permanent vegetation establishment and soil development. Vegetation was likely especially sparse in 2022 since surveys were conducted following five years of high Great Lakes water levels (from 2016 through 2020). Sands along this beach are alkaline (pH 8.0) and medium-textured. Gravel and cobble occur intermixed with the medium-textured sands along this stretch of beach. As noted above, the sand and gravel beach along the eastern shore is backed by low foredune. Floristic composition of the foredune is similar to that of the sand and gravel beach but is characterized by greater vegetative cover and higher floristic diversity.



Gull Island sand and gravel beach. Photo by Joshua G. Cohen.



Gull Island sand and gravel beach delineated in yellow on 2017 aerial imagery.

Vegetation within the sand and gravel beach is sparse to absent. Where vegetation has become established, it occurs along the upper margin of the shore. Scattered trees and shrubs (<1%) along the upper margins of the sand and gravel beach include paper birch (*Betula papyrifera*) and red-osier dogwood (*Cornus sericea*). Low foredune backing the sand and gravel beach along the eastern shore of the island is characterized by dense shrub cover (50-60%) with red-osier dogwood, sand cherry (*Prunus pumila*), and choke cherry (*P. virginiana*). Ground cover within the low foredune is patchy to dense (40-60%) with characteristic species including poison-ivy (*Toxicodendron radicans*), wormwood (*Artemisia campestris*), yarrow (*Achillea millefolium*), starry false Solomon-seal (*Maianthemum stellatum*), and Canada mayflower (*M. canadense*). These species also occur infrequently along the upper margin of the sand and gravel beach.

The Gull Island sand and gravel beach was surveyed May 24th and August 9th, 2022. Seventy-nine plant species were documented with 59 native species and 20 non-native species (Appendix 2.4). The total FQI was 26.7.

Threats: Species composition and community structure are patterned by natural processes. Non-native species recorded in the low foredune and along the margin of the sand and gravel beach include spotted knapweed (*Centaurea stoebe*), Canada thistle (*Cirsium arvense*), bull thistle (*C. vulgare*), poison-hemlock (*Conium maculatum*), common St. John's-wort (*Hypericum perforatum*), common burdock (*Arctium minus*), yellow rocket (*Barbarea vulgaris*), hound's-tongue (*Cynoglossum officinale*), tansy mustard (*Descurainia pinnata*), ox-eye daisy (*Leucanthemum vulgare*), catnip (*Nepeta cataria*), wild parsnip (*Pastinaca sativa*), curly dock (*Rumex crispus*), bittersweet nightshade (*Solanum dulcamara*), common dandelion (*Taraxacum officinale*), Canada bluegrass (*Poa compressa*), mossy stonecrop (*Sedum acre*), sweetbrier (*Rosa rubiginosa*), and common mullein (*Verbascum thapsus*). Spotted knapweed and mossy stonecrop are locally abundant to dominant in some areas, especially in the swale behind the foredune along the northeastern and northern shore of the island.

Management Recommendations: The main management recommendation is to control and monitor invasive species along the shoreline. We recommend focusing control efforts within the sand and gravel beach on spotted knapweed, poison-hemlock, and wild parsnip since these are high priority targets for control or eradication. Though sweetbrier is generally not considered a pernicious invasive, an incipient invasion detected along the southeast coast of the island should be eradicated. Its strongly armed stems allow it to escape herbivory and become locally dominant (Michigan Flora Online 2011).



Gull Island sand and gravel beach. Photo by Joshua G. Cohen.

Stewardship Prioritization Results and Discussion

The stewardship prioritization scores for each natural community element occurrence on Gull Island are presented in Table 2. We sorted the element occurrences by their stewardship prioritization scores and assigned them a medium (≥ 9 and < 10 ; yellow) or low (< 9 ; blue) stewardship priority. No high (≥ 10) scores were assigned on Gull Island. The highest ranking natural community element occurrences on Gull Island are the limestone cobble shore and sand and gravel beach, which received medium stewardship prioritization scores. The boreal forest and mesic northern forest received low priority scores. Compared to natural community element occurrences found on other islands in the National Wildlife Refuge (Table 3) and other islands within the Beaver Island Archipelago (Cohen 2017), these are relatively low priority scores reflecting the low integrity ranking of the element occurrences on Gull Island, the prevalence of invasive plants along the shoreline, and the low feasibility of successfully treating invasives given the high level of disturbance along the shoreline of Gull Island.

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, 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 and to adjust future stewardship prioritization.

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

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
26265	Limestone Cobble Shore	Gull Island (Lake Michigan)	C	3	G2G3	3.5	S3	3	3.25	3	3	3	9.25
26264	Sand and Gravel Beach	Gull Island (Lake Michigan)	C	3	G3?	3	S3	3	3	3	3	3	9
26263	Boreal Forest	Gull Island (Lake Michigan)	C	3	GU	3	S3	3	3	2	2	2	8
26262	Mesic Northern Forest	Gull Island (Lake Michigan)	C	3	G4	2	S3	3	2.5	0	NA	0	5.5



Given the low integrity of the natural community types on Gull Island, the prevalence of invasive plants along the shoreline systems, and the low feasibility of successfully treating these invasive infestations, we suggest that invasive species treatment is a low stewardship priority in comparison to other National Wildlife Refuge islands and also other islands within the Beaver Island Archipelago. Photo by Bill Parsons, Little Traverse Bay Bands of Odawa Indians Natural Resource Department.

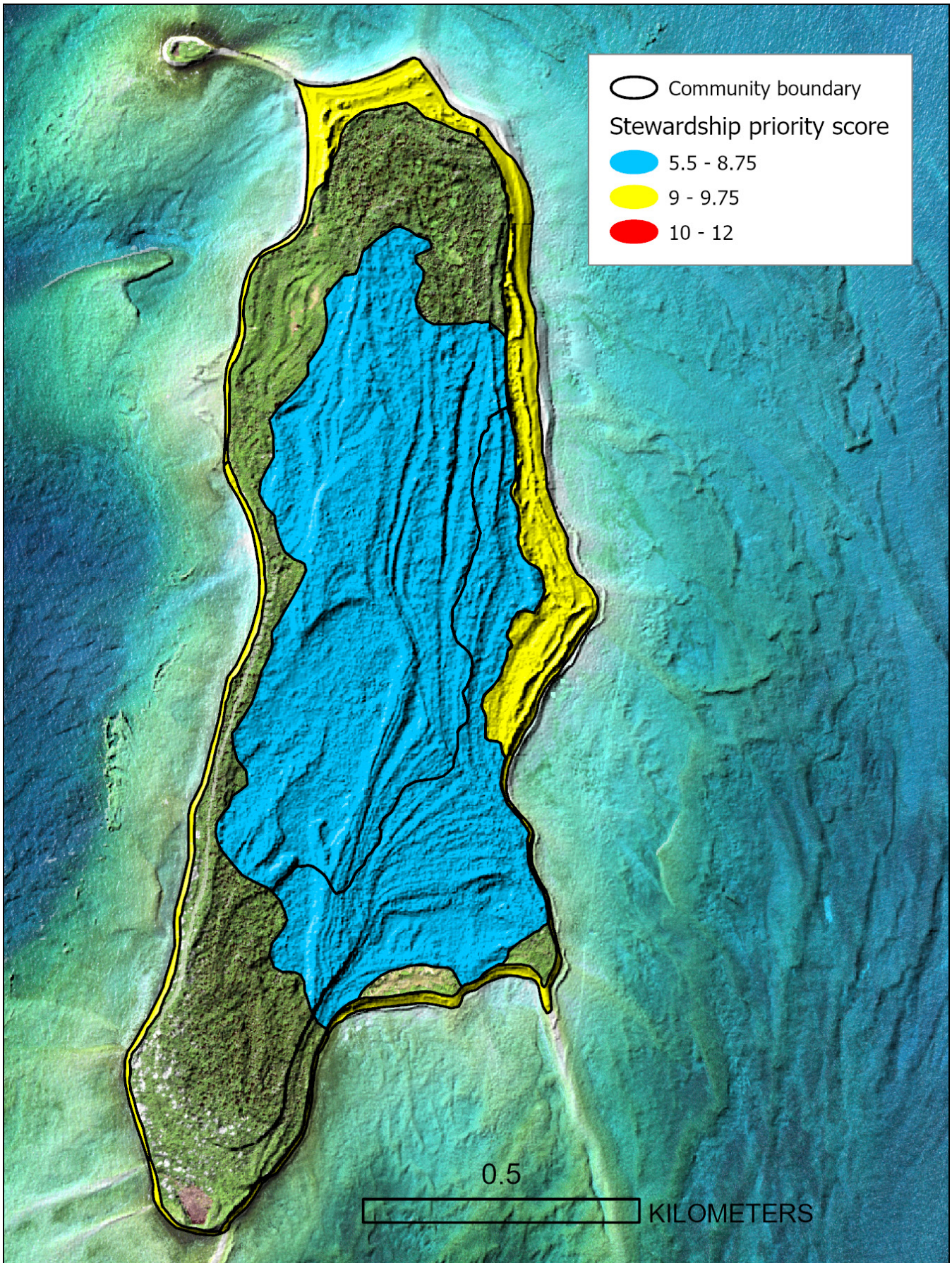


Figure 7. Stewardship prioritization for natural community element occurrences on Gull Island. Element occurrences are displayed by their stewardship prioritization scores and assigned a medium (yellow) or low (blue) stewardship priority.

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 Gull Island natural community EOs (underlined and in bold) ranked 33rd, 38th, 55th, and 64th out of the 66 natural community EOs.

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

Conclusion

Through this project we evaluated the ecological integrity of high-quality natural communities on Gull Island. We documented four new element occurrences including boreal forest, limestone cobble shore, mesic northern forest, and sand and gravel beach. This report provides site-based assessments of these four 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

island-wide 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, if invasive species control efforts are to be enacted on Gull Island, we recommend focusing control efforts on reducing poison-hemlock and spotted knapweed in the limestone cobble shore; poison-hemlock, spotted knapweed, sweetbrier, and wild parsnip in the sand and gravel beach; and Tatarian honeysuckle in the boreal forest.



Spotted knapweed infestation along the Gull Island sand and gravel beach. If invasive species control efforts are to be enacted on Gull Island, we recommend focusing control efforts on reducing spotted knapweed, poison-hemlock, sweetbrier, and wild parsnip in the sand and gravel beach; spotted knapweed and poison-hemlock in the limestone cobble shore; and Tatarian honeysuckle in the boreal forest. Photo by Tyler J. Bassett.

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Gull Island mesic northern forest. Photo by Bill Parsons, Little Traverse Bay Bands of Odawa Indians Natural Resource Department.

Appendix 1 - Global and State Element Ranking Criteria

GLOBAL RANKS

- G1** = critically imperiled: at very high risk of extinction due to extreme rarity (often 5 or fewer occurrences), very steep declines, or other factors.
- G2** = imperiled: at high risk of extinction due to very restricted range, very few occurrences (often 20 or fewer), steep declines, or other factors.
- G3** = vulnerable: at moderate risk of extinction due to a restricted range, relatively few occurrences (often 80 or fewer), recent and widespread declines, or other factors.
- G4** = apparently secure: uncommon but not rare; some cause for long-term concern due to declines or other factors.
- G5** = secure: common; widespread.
- GNR** = Global rank not yet assessed. Unranked.
- GU** = currently unrankable due to lack of information or due to substantially conflicting information about status or trends.
- GX** = eliminated: eliminated throughout its range, with no restoration potential due to extinction of dominant or characteristic species.
- G?** = incomplete data.

STATE RANKS

- S1** = critically imperiled in the state because of extreme rarity (often 5 or fewer occurrences) or because of some factor(s) such as very steep declines making it especially vulnerable to extirpation from the state.
- S2** = imperiled in the state because of rarity due to very restricted range, very few occurrences (often 20 or fewer), steep declines, or other factors making it very vulnerable to extirpation from the state.
- S3** = vulnerable in the state due to a restricted range, relatively few occurrences (often 80 or fewer), recent and widespread declines, or other factors making it vulnerable to extirpation.
- S4** = uncommon but not rare; some cause for long-term concern due to declines or other factors.
- S5** = common and widespread in the state.
- SNR** = State rank not yet assessed. Unranked.
- SX** = community is presumed to be extirpated from the state. Not located despite intensive searches of historical sites and other appropriate habitat, and virtually no likelihood that it will be rediscovered.
- S?** = incomplete data.

Appendix 2 - Floristic Quality Assessments

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

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

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

Appendix 2.1. Gull Island Boreal Forest FQA

Conservatism-Based Metrics:

Total Mean C:	4.1
Native Mean C:	4.6
Total FQI:	38.9
Native FQI:	41.4
Adjusted FQI:	43.6
% C value 0:	11.1
% C value 1-3:	22.2
% C value 4-6:	56.7
% C value 7-10:	10
Native Tree Mean C:	3.8
Native Shrub Mean C:	4.7
Native Herbaceous Mean C:	4.7

Species Richness:

Total Species:	90	
Native Species:	81	90.00%
Non-native Species:	9	10.00%

Species Wetness:

Mean Wetness:	1.8
Native Mean Wetness:	1.6

Physiognomy Metrics:

Tree:	9	10.00%
Shrub:	17	18.90%
Vine:	5	5.60%
Forb:	45	50.00%
Grass:	1	1.10%
Sedge:	2	2.20%
Rush:	0	0%
Fern:	11	12.20%
Bryophyte:	0	0%

Duration Metrics:

Annual:	1	1.10%
Perennial:	82	91.10%
Biennial:	7	7.80%
Native Annual:	1	1.10%
Native Perennial:	76	84.40%
Native Biennial:	4	4.40%

Appendix 2.1. Gull 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 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>Actaea pachypoda</i>	dolls-eyes	ACTPAC	native	7	5
<i>Agrimonia gryposepala</i>	tall agrimony	AGRGRY	native	2	3
<i>Aquilegia canadensis</i>	wild columbine	AQUCAN	native	5	3
<i>Aralia nudicaulis</i>	wild sarsaparilla	ARANUD	native	5	3
<i>Aralia racemosa</i>	spikenard	ARARAC	native	8	3
<i>Arisaema triphyllum</i>	jack-in-the-pulpit	ARITRI	native	5	0
<i>Athyrium filix-femina</i>	lady fern	ATHFIL	native	4	0
<i>Betula papyrifera</i>	paper birch	BETPAP	native	2	3
<i>Boechnera grahamii</i>	rock cress	BOEGRA	native	6	3
<i>Botrypus virginianus</i>	rattlesnake fern	BOTVIR	native	5	3
<i>Carex bebbii</i>	sedge	CXBEBB	native	4	-5
<i>Carex pedunculata</i>	sedge	CXPEDU	native	5	3
<i>Celastrus scandens</i>	american bittersweet	CELSCA	native	3	3
<i>Chimaphila umbellata</i>	pipsissewa	CHIUMB	native	8	5
<i>Cirsium vulgare</i>	bull thistle	CIRVUL	non-native	0	3
<i>Clintonia borealis</i>	bluebead-lily; corn-lily	CLIBOR	native	5	0
<i>Corallorhiza striata</i>	striped coral-root	CORSTR	native	6	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>Corylus cornuta</i>	beaked hazelnut	CORCOR	native	5	3
<i>Cynoglossum officinale</i>	hounds-tongue	CYNOFF	non-native	0	5
<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 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>Fragaria virginiana</i>	wild strawberry	FRAVIR	native	2	3
<i>Galium triflorum</i>	fragrant bedstraw	GALTRR	native	4	3
<i>Gaultheria procumbens</i>	wintergreen	GAUPRO	native	5	3
<i>Goodyera oblongifolia</i>	menzies rattlesnake plantain	GOOBL	native	8	3
<i>Gymnocarpium dryopteris</i>	oak fern	GYMDRY	native	5	3
<i>Hackelia deflexa</i>	stickseed	HACDEF	native	2	5
<i>Heracleum maximum</i>	cow-parsnip	HERMAX	native	3	-3
<i>Hieracium aurantiacum</i>	orange hawkweed	HIEAUR	non-native	0	5
<i>Huperzia lucidula</i>	shining clubmoss	HUPLUC	native	5	0
<i>Hypericum perforatum</i>	common st. johns-wort	HYPPER	non-native	0	5
<i>Lactuca biennis</i>	tall blue lettuce	LACBIE	native	2	0
<i>Lactuca canadensis</i>	tall lettuce	LACCAN	native	2	3

Appendix 2.1. Gull Island Boreal Forest FQA (continued)

Scientific Name	Common Name	Acronym	Native?	C	W
<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 tatarica</i>	tartarian honeysuckle	LONTAT	non-native	0	3
<i>Lycopodium clavatum</i>	running ground-pine	LYCCLA	native	4	0
<i>Lycopus americanus</i>	common water horehound	LYCAME	native	2	-5
<i>Maianthemum canadense</i>	canada mayflower	MAICAN	native	4	3
<i>Maianthemum stellatum</i>	starry false solomon-seal	MAISTE	native	5	0
<i>Melampyrum lineare</i>	cow-wheat	MELLIN	native	6	3
<i>Mitella nuda</i>	naked miterwort	MITNUD	native	8	-3
<i>Nepeta cataria</i>	catnip	NEPCAT	non-native	0	3
<i>Orthilia secunda</i>	one-sided pyrola	ORTSEC	native	7	0
<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
<i>Platanthera orbiculata</i>	round-leaved orchid	PLAORB	native	10	0
<i>Polygala paucifolia</i>	gay-wings	POLPAU	native	7	3
<i>Polygonatum pubescens</i>	downy solomon seal	POLPUB	native	5	5
<i>Polypodium virginianum</i>	common polypody	POLVIR	native	8	5
<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>Ribes triste</i>	swamp red currant	RIBTRI	native	6	-5
<i>Rubus pubescens</i>	dwarf raspberry	RUBPUB	native	4	-3
<i>Sambucus racemosa</i>	red-berried elder	SAMRAC	native	3	3
<i>Solanum dulcamara</i>	bittersweet nightshade	SOLDUL	non-native	0	0
<i>Solidago flexicaulis</i>	zigzag goldenrod	SOLFLE	native	6	3
<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>Thalictrum dioicum</i>	early meadow-rue	THADIO	native	6	3
<i>Thuja occidentalis</i>	arbor vitae	THUOCC	native	4	-3
<i>Toxicodendron radicans</i>	poison-ivy	TOXRAD	native	2	0
<i>Trientalis borealis</i>	star-flower	TRIBOR	native	5	0
<i>Trillium grandiflorum</i>	common trillium	TRIGRA	native	5	3
<i>Urtica dioica</i>	stinging nettle	URTDIO	native	1	0
<i>Verbascum thapsus</i>	common mullein	VERTHA	non-native	0	5
<i>Viburnum trilobum</i>	american highbush-cranberry	VIBTRI	native	5	-3
<i>Viola blanda</i>	sweet white violet	VIOLBLA	native	5	-3
<i>Viola labradorica</i>	dog violet	VIOLAB	native	3	0
<i>Viola pubescens</i>	yellow violet	VIOPUB	native	4	3
<i>Viola renifolia</i>	kidney-leaved violet	VIOREN	native	6	-3

Appendix 2.2. Gull Island Limestone Cobble Shore FQA

Conservatism-Based Metrics:

Total Mean C:	1.7
Native Mean C:	2.9
Total FQI:	11.1
Native FQI:	14.5
Adjusted FQI:	22.1
% C value 0:	41.9
% C value 1-3:	41.9
% C value 4-6:	16.3
% C value 7-10:	0
Native Tree Mean C:	3.2
Native Shrub Mean C:	3.4
Native Herbaceous Mean C:	2.5

Species Richness:

Total Species:	43	
Native Species:	25	58.10%
Non-native Species:	18	41.90%

Species Wetness:

Mean Wetness:	1.6
Native Mean Wetness:	0.5

Physiognomy Metrics:

Tree:	5	11.60%
Shrub:	7	16.30%
Vine:	4	9.30%
Forb:	26	60.50%
Grass:	1	2.30%
Sedge:	0	0.00%
Rush:	0	0%
Fern:	0	0.00%
Bryophyte:	0	0%

Duration Metrics:

Annual:	6	14.00%
Perennial:	32	74.40%
Biennial:	5	11.60%
Native Annual:	3	7.00%
Native Perennial:	22	51.20%
Native Biennial:	0	0.00%

Appendix 2.2. Gull Island Limestone Cobble Shore FQA (continued)

Scientific Name	Common Name	Acronym	Native?	C	W
<i>Aquilegia canadensis</i>	wild columbine	AQUCAN	native	5	3
<i>Asclepias syriaca</i>	common milkweed	ASCSYR	native	1	5
<i>Betula papyrifera</i>	paper birch	BETPAP	native	2	3
<i>Celastrus scandens</i>	american bittersweet	CELSCA	native	3	3
<i>Centaurea stoebe</i>	spotted knapweed	CENSTO	non-native	0	5
<i>Chamerion angustifolium</i>	fireweed	CHAANG	native	3	0
<i>Cirsium arvense</i>	canada thistle	CIRARV	non-native	0	3
<i>Cirsium vulgare</i>	bull thistle	CIRVUL	non-native	0	3
<i>Conium maculatum</i>	poison-hemlock	CONMAC	non-native	0	-3
<i>Cornus sericea</i>	red-osier	CORSER	native	2	-3
<i>Cynoglossum officinale</i>	hounds-tongue	CYNOFF	non-native	0	5
<i>Descurainia pinnata</i>	tansy mustard	DESPIN	non-native	0	5
<i>Epilobium ciliatum</i>	willow-herb	EPICIL	native	3	-3
<i>Fallopia convolvulus</i>	false buckwheat	FALCON	non-native	0	3
<i>Fragaria virginiana</i>	wild strawberry	FRAVIR	native	2	3
<i>Geranium robertianum</i>	herb robert	GERROB	native	3	3
<i>Hypericum perforatum</i>	common st. johns-wort	HYPPER	non-native	0	5
<i>Impatiens capensis</i>	spotted touch-me-not	IMPCAP	native	2	-3
<i>Leonurus cardiaca</i>	motherwort	LEOCAR	non-native	0	5
<i>Maianthemum stellatum</i>	starry false solomon-seal	MAISTE	native	5	0
<i>Nepeta cataria</i>	catnip	NEPCAT	non-native	0	3
<i>Persicaria maculosa</i>	ladys-thumb	PERMAC	non-native	0	0
<i>Physocarpus opulifolius</i>	ninebark	PHYOPU	native	4	-3
<i>Picea glauca</i>	white spruce	PICGLA	native	3	3
<i>Poa compressa</i>	canada bluegrass	POACOM	non-native	0	3
<i>Prunus pensylvanica</i>	pin cherry	PRUPEN	native	3	3
<i>Prunus virginiana</i>	choke cherry	PRUVIR	native	2	3
<i>Ribes triste</i>	swamp red currant	RIBTRI	native	6	-5
<i>Rubus strigosus</i>	wild red raspberry	RUBSTR	native	2	0
<i>Rumex triangulivalvis</i>	dock	RUMTRI	native	1	0
<i>Sambucus racemosa</i>	red-berried elder	SAMRAC	native	3	3
<i>Sedum acre</i>	mossy stonecrop	SEDACR	non-native	0	5
<i>Silene vulgaris</i>	bladder campion	SILVUL	non-native	0	5
<i>Solanum dulcamara</i>	bittersweet nightshade	SOLDUL	non-native	0	0
<i>Solanum ptychanthum</i>	black nightshade	SOLPTY	native	1	3
<i>Sonchus arvensis</i>	perennial sow-thistle	SONARV	non-native	0	3
<i>Sorbus americana</i>	american mountain-ash	SORAME	native	4	0
<i>Taraxacum officinale</i>	common dandelion	TAROFF	non-native	0	3
<i>Thuja occidentalis</i>	arbor vitae	THUOCC	native	4	-3
<i>Toxicodendron radicans</i>	poison-ivy	TOXRAD	native	2	0
<i>Urtica dioica</i>	stinging nettle	URTDIO	native	1	0
<i>Verbascum thapsus</i>	common mullein	VERTHA	non-native	0	5
<i>Viburnum trilobum</i>	american highbush-cranberry	VIBTRI	native	5	-3

Appendix 2.3. Gull Island Mesic Northern Forest FQA

Conservatism-Based Metrics:

Total Mean C:	4.6
Native Mean C:	4.6
Total FQI:	34.4
Native FQI:	34.4
Adjusted FQI:	46
% C value 0:	0
% C value 1-3:	23.2
% C value 4-6:	66.1
% C value 7-10:	10.7
Native Tree Mean C:	3.8
Native Shrub Mean C:	4.3
Native Herbaceous Mean C:	4.8

Species Richness:

Total Species:	56	
Native Species:	56	100.00%
Non-native Species:	0	0.00%

Species Wetness:

Mean Wetness:	2
Native Mean Wetness:	2

Physiognomy Metrics:

Tree:	8	14.30%
Shrub:	7	12.50%
Vine:	3	5.40%
Forb:	27	48.20%
Grass:	2	3.60%
Sedge:	1	1.80%
Rush:	0	0%
Fern:	8	14.30%
Bryophyte:	0	0%

Duration Metrics:

Annual:	1	1.80%
Perennial:	55	98.20%
Biennial:	0	0.00%
Native Annual:	1	1.80%
Native Perennial:	55	98.20%
Native Biennial:	0	0.00%

Appendix 2.3. Gull Island Mesic Northern Forest FQA (continued)

Scientific Name	Common Name	Acronym	Native?	C	W
<i>Acer pensylvanicum</i>	striped maple	ACEPEN	native	5	3
<i>Acer saccharum</i>	sugar maple	ACESAU	native	5	3
<i>Acer spicatum</i>	mountain maple	ACESPI	native	5	3
<i>Actaea pachypoda</i>	dolls-eyes	ACTPAC	native	7	5
<i>Allium tricoccum</i>	wild leek	ALLTRI	native	5	3
<i>Aquilegia canadensis</i>	wild columbine	AQUCAN	native	5	3
<i>Aralia nudicaulis</i>	wild sarsaparilla	ARANUD	native	5	3
<i>Arisaema triphyllum</i>	jack-in-the-pulpit	ARITRI	native	5	0
<i>Betula papyrifera</i>	paper birch	BETPAP	native	2	3
<i>Botrypus virginianus</i>	rattlesnake fern	BOTVIR	native	5	3
<i>Carex arctata</i>	sedge	CXARTT	native	3	5
<i>Caulophyllum thalictroides</i>	blue cohosh	CAUTHA	native	5	5
<i>Circaea alpina</i>	small enchanters-nightshade	CIRALP	native	4	-3
<i>Circaea canadensis</i>	enchanters-nightshade	CIRCAN	native	2	3
<i>Clintonia borealis</i>	bluebead-lily; corn-lily	CLIBOR	native	5	0
<i>Cornus rugosa</i>	round-leaved dogwood	CORRUG	native	6	5
<i>Corylus cornuta</i>	beaked hazelnut	CORCOR	native	5	3
<i>Dendrolycopodium dendroideum</i>	tree clubmoss	DENDEN	native	5	3
<i>Dicentra cucullaria</i>	dutchmans-breeches	DICCUC	native	7	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>Eurybia macrophylla</i>	big-leaved aster	EURMAC	native	4	5
<i>Fallopia cili nodis</i>	fringed false buckwheat	FALCIL	native	3	5
<i>Festuca subverticillata</i>	nodding fescue	FESSUB	native	5	3
<i>Hepatica acutiloba</i>	sharp-lobed hepatica	HEPACU	native	8	5
<i>Heracleum maximum</i>	cow-parsnip	HERMAX	native	3	-3
<i>Huperzia lucidula</i>	shining clubmoss	HUPLUC	native	5	0
<i>Lonicera canadensis</i>	canadian fly honeysuckle	LONCAN	native	5	3
<i>Lonicera dioica</i>	red honeysuckle	LONDIO	native	5	3
<i>Lycopodium clavatum</i>	running ground-pine	LYCCLA	native	4	0
<i>Maianthemum canadense</i>	canada mayflower	MAICAN	native	4	3
<i>Maianthemum racemosum</i>	false spikenard	MAIRAC	native	5	3
<i>Maianthemum stellatum</i>	starry false solomon-seal	MAISTE	native	5	0
<i>Milium effusum</i>	wood millet	MILEFF	native	8	3
<i>Polygala paucifolia</i>	gay-wings	POLPAU	native	7	3
<i>Polygonatum pubescens</i>	downy solomon seal	POLPUB	native	5	5
<i>Polypodium virginianum</i>	common polypody	POLVIR	native	8	5
<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>Ranunculus sceleratus</i>	cursed crowfoot	RANSCE	native	1	-5
<i>Ribes cynosbati</i>	prickly or wild gooseberry	RIBCYN	native	4	3
<i>Sambucus racemosa</i>	red-berried elder	SAMRAC	native	3	3
<i>Sanguinaria canadensis</i>	bloodroot	SANCAA	native	5	3

Appendix 2.3. Gull Island Mesic Northern Forest FQA (continued)

Scientific Name	Common Name	Acronym	Native?	C	W
<i>Sorbus americana</i>	american mountain-ash	SORAME	native	4	0
<i>Taxus canadensis</i>	yew	TAXCAN	native	5	3
<i>Thalictrum dasycarpum</i>	purple meadow-rue	THADAS	native	3	-3
<i>Thalictrum dioicum</i>	early meadow-rue	THADIO	native	6	3
<i>Thuja occidentalis</i>	arbor vitae	THUOCC	native	4	-3
<i>Toxicodendron radicans</i>	poison-ivy	TOXRAD	native	2	0
<i>Trientalis borealis</i>	star-flower	TRIBOR	native	5	0
<i>Trillium grandiflorum</i>	common trillium	TRIGRA	native	5	3
<i>Urtica dioica</i>	stinging nettle	URTDIO	native	1	0
<i>Viola blanda</i>	sweet white violet	VIOBLA	native	5	-3
<i>Viola canadensis</i>	canada violet	VIOCAN	native	5	3

Appendix 2.4. Gull Island Sand and Gravel Beach FQA

Conservatism-Based Metrics:

Total Mean C:	3
Native Mean C:	4
Total FQI:	26.7
Native FQI:	30.7
Adjusted FQI:	34.6
% C value 0:	27.8
% C value 1-3:	31.6
% C value 4-6:	30.4
% C value 7-10:	10.1
Native Tree Mean C:	2.7
Native Shrub Mean C:	4.4
Native Herbaceous Mean C:	4.1

Species Richness:

Total Species:	79
Native Species:	59 74.70%
Non-native Species:	20 25.30%

Species Wetness:

Mean Wetness:	1.8
Native Mean Wetness:	1.4

Physiognomy Metrics:

Tree:	6	7.60%
Shrub:	16	20.30%
Vine:	4	5.10%
Forb:	46	58.20%
Grass:	3	3.80%
Sedge:	1	1.30%
Rush:	2	3%
Fern:	1	1.30%
Bryophyte:	0	0%

Duration Metrics:

Annual:	6	7.60%
Perennial:	58	73.40%
Biennial:	15	19.00%
Native Annual:	4	5.10%
Native Perennial:	48	60.80%
Native Biennial:	7	8.90%

Appendix 2.4. Gull Island Sand and Gravel Beach FQA (continued)

Scientific Name	Common Name	Acronym	Native?	C	W
<i>Achillea millefolium</i>	yarrow	ACHMIL	native	1	3
<i>Agrimonia gryposepala</i>	tall agrimony	AGRGRY	native	2	3
<i>Anemone cylindrica</i>	thimbleweed	ANECYL	native	6	5
<i>Anticlea elegans</i>	white camas	ANTELE	native	10	-3
<i>Aquilegia canadensis</i>	wild columbine	AQUCAN	native	5	3
<i>Arabidopsis lyrata</i>	sand cress	ARALYR	native	7	3
<i>Arabis pycnocarpa</i>	hairy rock cress	ARAPYC	native	6	3
<i>Arctium minus</i>	common burdock	ARCMIN	non-native	0	3
<i>Arctostaphylos uva-ursi</i>	bearberry	ARCUVA	native	8	5
<i>Artemisia campestris</i>	wormwood	ARTCAM	native	5	5
<i>Asclepias syriaca</i>	common milkweed	ASCSYR	native	1	5
<i>Barbarea vulgaris</i>	yellow rocket	BARVUL	non-native	0	0
<i>Betula papyrifera</i>	paper birch	BETPAP	native	2	3
<i>Boechera grahamii</i>	rock cress	BOEGRA	native	6	3
<i>Cakile edentula</i>	sea-rocket	CAKEDE	native	5	3
<i>Campanula rotundifolia</i>	harebell	CAMROT	native	6	3
<i>Carex bebbii</i>	sedge	CXBEBB	native	4	-5
<i>Celastrus scandens</i>	american bittersweet	CELSCA	native	3	3
<i>Centaurea stoebe</i>	spotted knapweed	CENSTO	non-native	0	5
<i>Cirsium arvense</i>	canada thistle	CIRARV	non-native	0	3
<i>Cirsium vulgare</i>	bull thistle	CIRVUL	non-native	0	3
<i>Clinopodium vulgare</i>	wild-basil	CLIVUL	native	3	5
<i>Conium maculatum</i>	poison-hemlock	CONMAC	non-native	0	-3
<i>Conyza canadensis</i>	horseweed	CONCAN	native	0	3
<i>Cornus amomum</i>	silky dogwood	CORAMO	native	2	-3
<i>Cornus rugosa</i>	round-leaved dogwood	CORRUG	native	6	5
<i>Cornus sericea</i>	red-osier	CORSER	native	2	-3
<i>Corydalis aurea</i>	golden corydalis	CORAUR	native	5	5
<i>Cynoglossum officinale</i>	hounds-tongue	CYNOFF	non-native	0	5
<i>Descurainia pinnata</i>	tansy mustard	DESPIN	non-native	0	5
<i>Diervilla lonicera</i>	bush-honeysuckle	DIELON	native	4	5
<i>Elymus canadensis</i>	canada wild rye	ELYCAN	native	5	3
<i>Fragaria virginiana</i>	wild strawberry	FRAVIR	native	2	3
<i>Fraxinus pennsylvanica</i>	red ash	FRAPEN	native	2	-3
<i>Galium triflorum</i>	fragrant bedstraw	GALTRR	native	4	3
<i>Hypericum perforatum</i>	common st. johns-wort	HYPPER	non-native	0	5
<i>Juncus balticus</i>	rush	JUNBAL	native	4	-5
<i>Juncus nodosus</i>	joint rush	JUNNOD	native	5	-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>Lathyrus japonicus</i>	beach pea	LATJAP	native	10	3
<i>Leucanthemum vulgare</i>	ox-eye daisy	LEUVUL	non-native	0	5
<i>Lycopus americanus</i>	common water horehound	LYCAME	native	2	-5
<i>Maianthemum canadense</i>	canada mayflower	MAICAN	native	4	3
<i>Maianthemum stellatum</i>	starry false solomon-seal	MAISTE	native	5	0

Appendix 2.4. Gull Island Sand and Gravel Beach FQA (continued)

Scientific Name	Common Name	Acronym	Native?	C	W
<i>Nepeta cataria</i>	catnip	NEPCAT	non-native	0	3
<i>Oenothera biennis</i>	common evening-primrose	OENBIE	native	2	3
<i>Pastinaca sativa</i>	wild parsnip	PASSAT	non-native	0	5
<i>Physocarpus opulifolius</i>	ninebark	PHYOPU	native	4	-3
<i>Picea glauca</i>	white spruce	PICGLA	native	3	3
<i>Poa compressa</i>	canada bluegrass	POACOM	non-native	0	3
<i>Poa palustris</i>	fowl meadow grass	POAPAS	native	3	-3
<i>Polygala paucifolia</i>	gay-wings	POLPAU	native	7	3
<i>Populus balsamifera</i>	balsam poplar	POPBAL	native	2	-3
<i>Potentilla anserina</i>	silverweed	POTANS	native	5	-3
<i>Prunus pensylvanica</i>	pin cherry	PRUPEN	native	3	3
<i>Prunus pumila</i>	sand cherry	PRUPUM	native	8	5
<i>Prunus virginiana</i>	choke cherry	PRUVIR	native	2	3
<i>Pteridium aquilinum</i>	bracken fern	PTEAQU	native	0	3
<i>Ranunculus sceleratus</i>	cursed crowfoot	RANSCE	native	1	-5
<i>Rhus typhina</i>	staghorn sumac	RHUTYP	native	2	3
<i>Rosa acicularis</i>	wild rose	ROSACI	native	4	3
<i>Rosa blanda</i>	wild rose	ROSBLA	native	3	3
<i>Rosa rubiginosa</i>	sweetbrier	ROSRUB	non-native	0	3
<i>Rubus strigosus</i>	wild red raspberry	RUBSTR	native	2	0
<i>Rumex crispus</i>	curly dock	RUMCRI	non-native	0	0
<i>Sedum acre</i>	mossy stonecrop	SEDACR	non-native	0	5
<i>Silene antirrhina</i>	sleepy catchfly	SILANT	native	2	5
<i>Solanum dulcamara</i>	bittersweet nightshade	SOLDUL	non-native	0	0
<i>Solidago simplex</i>	gillmans goldenrod	SOLSIM	native	10	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>Toxicodendron radicans</i>	poison-ivy	TOXRAD	native	2	0
<i>Urtica dioica</i>	stinging nettle	URTDIO	native	1	0
<i>Verbascum thapsus</i>	common mullein	VERTHA	non-native	0	5
<i>Verbena hastata</i>	blue vervain	VERHAS	native	4	-3
<i>Viola arvensis</i>	field pansy	VIOARV	non-native	0	5

Appendix 3 - Ojibwe Names for Plants Observed on Gull Island

This appendix includes a crosswalk between Ojibwe names, scientific names, and common English names for all species observed on Gull Island that are listed in “Plants used by the Great Lakes Ojibwa” (Meeker et al. 1993). The crosswalk constitutes Appendix 3.1. In addition, in Appendix 3.2 we list the observed plants by their Ojibwe names indexed by the natural community types where they were recorded on Gull 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 (29; 27%). We indicate whether or not a plant has been restored. Note that we do not reproduce accents (diacritical marks) for names included only under a phonetic name in Meeker et al. (1993) and this may affect pronunciation (for example, some “s” = “zh”). Multiple scientific names separated by semi-colons indicate closely related species we have crosswalked to a single Ojibwe name. The first scientific name listed is the species listed in Meeker et al. (1993). If Meeker et al. (1993) lists a synonym or only includes a closely related species, then the scientific name used in Meeker et al. (1993) is listed in parentheses (*different but closely related species). Page numbers within the crosswalk indicate the page in Meeker et al. (1993) where the plant is referenced.

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

Ojibwe Name	Restored	Page	Scientific Name	English Name
(g)odotaagaans	Yes	318	<i>Clintonia borealis</i>	bluebead-lily; corn-lily
(g)odotaagaans; ?ziiginise; ziiginish€	Yes	35	<i>Campanula rotundifolia</i>	harebell
(gi)chi-mazaan; wiisagibag, -oon; wiisagijibik	Yes	96	<i>Arctium minus</i>	common burdock
(gi)chi-mazaanashk	Yes	103	<i>Cirsium vulgare</i>	bull thistle
(gi)chi-okaadaak; nezhikewang; okaadaak	Yes	274	<i>Aralia racemosa</i>	spikenard
?bebaamaabiig; okaaadaak; waaboozojibik	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
aandegopin	Yes	174	<i>Lycopus americanus; Lycopus uniflorus (*L. asper)</i>	common water horehound
aginiiminagaawanzh	Yes	225	<i>Rosa blanda</i>	wild rose
agongosimin, -ag	Yes	217	<i>Melampyrum lineare</i>	cow-wheat
agongosimin, -an, -ag	Yes	326	<i>Maianthemum canadense</i>	canada mayflower
agongosimizh (plant); agongosimin, -an (berry); agongosi(wi)jibik; ginebigwashk	Yes	260	<i>Maianthemum racemosum (Smilacina racemosa)</i>	false spikenard
ah-o-je-mahg (adjimag)	No	333	<i>Sorbus americana; Sorbus decora</i>	american mountain-ash
ajidamoowaanow	Yes	262	<i>Solidago flexicaulis</i>	zigzag goldenrod
ajidamoowaanow; waabigwan	Yes	93	<i>Achillea millefolium</i>	yarrow
aniibimin, -an (berry); aniibiminagaawashk (plant)	Yes	351	<i>Viburnum trilobum (V. opulus)</i>	american highbush-cranberry
animikiibag	Yes	135	<i>Toxicodendron radicans</i>	poison-ivy
animozid	Yes	291	<i>Hepatica acutiloba</i>	sharp-lobed hepatica
aninaandag, -oog; ininaandag, -oog; bigiwaandag, -oog; zhinbog, --g; zhingobaaandag, -oog; zhingob bigiwaandag	Yes	313	<i>Abies balsamea</i>	balsam fir
aninaatig, -oog	Yes	270	<i>Acer saccharum</i>	sugar maple
anungokauh	No	56	<i>Maianthemum stellatum (Smilacina stellata)</i>	starry false solomons-seal
apaakozigan; miskwaabiimag	Yes	18	<i>Arctostaphylos uva-ursi</i>	bearberry
apakway; apakweshk; apakweshkway; nabagashk	Yes	152	<i>Typha latifolia</i>	broad-leaved cat-tail
asa/isaweminagaawanzh (plant); asa/isawemin (berry)	Yes	256	<i>Prunus virginiana</i>	choke cherry
azaadi(i); maanzaadi(i)	Yes	328	<i>Populus balsamifera</i>	balsam poplar
baakwaanaatig; baakwaanimizh	Yes	28	<i>Rhus typhina</i>	staghorn sumac
bagaan, -ag; bagaanens; bagaanimizh; bagaanak	Yes	243	<i>Corylus cornuta</i>	beaked hazelnut
bagwaji-zhi/agaagawanzh, -iig; zhi/agaagawanzh, -iig; zhi/agaagawanzhiins	Yes	272	<i>Allium tricoccum</i>	wild leek
bawa'iminaan; gozigwaakomin, -ag	Yes	329	<i>Prunus pensylvanica</i>	pin cherry
bezhigojibik	Yes	281	<i>Caulophyllum thalictroides</i>	blue cohosh
bibigwewanashk, -oon	Yes	167	<i>Heracleum maximum (H. lanatum)</i>	cow-parsnip

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

Ojibwe Name	Restored	Page	Scientific Name	English Name
biimaakwad; manidoo-biimaakwad	Yes	36	<i>Celastrus scandens</i>	american bittersweet
cigona ' gan	No	250	<i>Dendrolycopodium obscurum</i> ; <i>D. dendroideum</i> (* <i>Lycopodium o.</i>)	ground-pine
doodooshaaboo	Yes	361	<i>Lactuca biennis</i>	tall blue lettuce
doodooshaaboojiibik; mindimooyenh	Yes	134	<i>Taraxacum officinale</i>	common dandelion
gaagigebag	Yes	209	<i>Chimaphila umbellata</i>	pipsissewa
gaanda'igwaasoning ezhinaagwak	Yes	206	<i>Anemone cylindrica</i>	thimbleweed
gaawaandag; gaawaandagwaatig; mina'ig; wadab; zesegaandag	Yes	327	<i>Picea glauca</i>	white spruce
gaazha/igensibag; (gi)chi-namewashk	Yes	115	<i>Nepeta cataria</i>	catnip
giboodiyegwaazon	Yes	37	<i>Corydalis aurea</i>	golden corydalis
gickensine ' namukuk	Yes	240	<i>Botrypus virginianus</i> (<i>Botrychium virginianum</i>)	rattlesnake fern
giizhigaandagizi; ogaawa/inzh	Yes	43	<i>Juniperus communis</i>	common or ground juniper
giizhik, -ag; gizhikens, -ag; giizhikenh	Yes	387	<i>Thuja occidentalis</i>	arbor vitae
ginoozhewashk; ozawijiibik; zhiiwibag	Yes	127	<i>Rumex crispus</i>	curly dock
ini ' niwin ' dibige ' gun'; baushkindjibgwaun	No	308	<i>Trillium grandiflorum</i>	common trillium
ininiwa/inzh; zhaabozigan	Yes	99	<i>Asclepias syriaca</i>	common milkweed
kauwe-sabu-min; me ' skwacabo ' minuk	No	257	<i>Ribes cynosbati</i>	prickly or wild gooseberry
main 'gamuna 'tig; anigomiji ' minaga 'wunj	No	59	<i>Symphoricarpos albus var. albus</i>	snowberry
maskwi ' widzhi ' wiko 'kok	No	312	<i>Viola canadensis</i>	canada violet
mazaan; mazaanaatig	Yes	373	<i>Urtica dioica</i>	stinging nettle
mazaanashk	Yes	102	<i>Cirsium arvense</i>	canada thistle
meskojiibikak; meskwijiibikak; miskojiibik; miskwijiibik	Yes	306	<i>Sanguinaria canadensis</i>	bloodroot
migiziibag; migiziwibag; naemgosibag	Yes	237	<i>Eurybia macrophylla</i> (<i>Aster macrophyllus</i>)	big-leaved aster
miishijiiminagaawanzh, iig (plant); miishijiimin -ag (berry); zhaaboomin	Yes	385	<i>Ribes triste</i>	swamp red currant
miskominagaawanzh; miskwiminagaawanzh; miskomin, -ag; miskimin, -ag	Yes	125	<i>Rubus strigosus</i> (<i>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
moosewijiibik	Yes	34	<i>Artemisia campestris</i>	wormwood
moozomizh	Yes	314	<i>Acer pensylvanicum</i>	striped maple
naaniibide'oodegin	Yes	303	<i>Polygonatum pubescens</i>	downy solomon seal
nawo 'buguk; wunukibugauh	No	336	<i>Trientalis borealis</i>	star-flower
ne 'bagandag ' ; pebamabid-singup	No	335	<i>Taxus canadensis</i>	yew
neezhodaeyun	No	325	<i>Linnaea borealis</i>	twinflower
nookwezigan	Yes	71	<i>Erigeron strigosus</i> ; <i>E. annuus</i>	daisy fleabane
ode'immin, -an; ode'imminijiibik	Yes	109	<i>Fragaria virginiana</i>	wild strawberry

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

Ojibwe Name	Restored	Page	Scientific Name	English Name
ode'iminiijibik; zhakaagomin; zhaashaagomin; zhaashaagominens	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
ogitebagoons	Yes	269	<i>Viola pubescens</i>	yellow violet
ojidimo miskishmandamin	No	38	<i>Dicentra cucullaria</i>	dutchmans-breeches
ookwemizh (plant); ookwemin (berry)	Yes	255	<i>Prunus serotina</i>	wild black cherry
ozaawashkojibik	Yes	360	<i>Impatiens capensis</i>	spotted touch-me-not
ozagadigom	Yes	295	<i>Osmorhiza claytonii</i>	hairy sweet-cicely
ozhaashijibik; ozhaashijibikens; zhooshkijibik	Yes	106	<i>Chamerion angustifolium</i> (<i>Epilobium a.</i>)	fireweed
papshkisiganak; papskatciksi 'gana 'tig	Yes	305	<i>Sambucus racemosa</i>	red-berried elder
pigwe 'wunusk	No	118	<i>Pastinaca sativa</i>	wild parsnip
sabankuk	No	215	<i>Lonicera dioica</i>	red honeysuckle
sewa 'komin	No	50	<i>Prunus pumila</i>	sand cherry
skizgu-min	No	331	<i>Rubus pubescens</i>	dwarf raspberry
tcatcabonu 'ksik; zheebaunkudohnse	No	182	<i>Scutellaria galericulata</i>	marsh skullcap
tikizidgeebikohnse	Yes	24	<i>Polygala paucifolia</i>	gay-wings
waabigwan	Yes	104	<i>Conyza canadensis</i>	horseweed
wapkadak; weekizigun	Yes	271	<i>Actaea pachypoda (A. alba)</i>	dolls-eyes
wewai 'bugug	Yes	338	<i>Viola labradorica (V. conspersa)</i>	dog violet
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
zaesikanibowin	No	92	<i>Anticlea elegans (Zigadenus e.)</i>	white camas
zhaashaagobiimag	Yes	315	<i>Acer spicatum</i>	mountain maple
zhaashaagomin	Yes	275	<i>Arisaema triphyllum</i>	jack-in-the-pulpit
zhawaseshkoohnse	No	186	<i>Verbena hastata</i>	blue vervain
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 (Lycopodium</i> <i>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 (Polygonum</i> <i>persicaria)</i>	ladys thumb
No name given (<i>R. sceleratus</i>)	No	180	<i>Ranunculus sceleratus</i>	cursed crowfoot
No name given (<i>S. ptychanthum</i>)	No	130	<i>Solanum ptychanthum (*Solanum</i> <i>nigrum)</i>	black nightshade
No name given (<i>T. dasycarpum</i>)	No	185	<i>Thalictrum dasycarpum</i>	purple meadow-rue

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

Ojibwe Name	Scientific Name	English Name	Boreal	Limestone	Mesic	Sand and
			Forest	Cobble Shore	Northern Forest	Gravel Beach
(g)odotaagaans	<i>Clintonia borealis</i>	bluebead-lily; corn-lily	X		X	
(g)odotaagaans; ?ziiginise; ziiginish€	<i>Campanula rotundifolia</i>	harebell				X
(gi)chi-mazaan; wiisagibag, -oon; wiisagijiibik	<i>Arctium minus</i>	common burdock				X
(gi)chi-mazaanashk	<i>Cirsium vulgare</i>	bull thistle	X	X		X
(gi)chi-okaadaak; nezhikewang; okaadaak	<i>Aralia racemosa</i>	spikenard	X			
?bebaamaabiig; okaadaak; waaboozojiibik	<i>Aralia nudicaulis</i>	wild sarsaparilla	X		X	
a 'sawan; ana ' ganuck; nokomi ' skinun	<i>Athyrium filix-femina</i>	lady fern				
aagimaak	<i>Fraxinus pennsylvanica</i>	red ash				X
aandegopin	<i>Lycopus americanus; Lycopus uniflorus (*L. asper)</i>	common water horehound	X			X
aginiiminagaawanzh	<i>Rosa blanda</i>	wild rose				X
agongosimin, -ag	<i>Melampyrum lineare</i>	cow-wheat	X			
agongosimin, -an, -ag	<i>Maianthemum canadense</i>	canada mayflower	X		X	X
agongosimizh (plant); agongosimin, -an (berry); agongosi(wi)jiibik; ginebigwashk	<i>Maianthemum racemosum (Smilacina racemosa)</i>	false spikenard			X	
ah-o-je-mahg (adjimag)	<i>Sorbus americana; Sorbus decora</i>	american mountain-ash	X	X	X	
ajidamoowaanow	<i>Solidago flexicaulis</i>	zigzag goldenrod	X			
ajidamoowaanow; waabigwan	<i>Achillea millefolium</i>	yarrow	X			X
aniibimin, -an (berry); aniibiminagaawashk (plant)	<i>Viburnum trilobum (V. opulus)</i>	american highbush-cranberry	X	X		
animikiibag	<i>Toxicodendron radicans</i>	poison-ivy	X		X	X
animozid	<i>Hepatica acutiloba</i>	sharp-lobed hepatica			X	
aninaandag, -oog; ininaandag, -oog; bigiwaandag, -oog; zhinbog, -g; zhingobaaandag, -oog; zhingob bigiwaandag	<i>Abies balsamea</i>	balsam fir	X			
aninaatig, -oog	<i>Acer saccharum</i>	sugar maple	X		X	
anungokauh	<i>Maianthemum stellatum (Smilacina stellata)</i>	starry false solomons-seal	X	X	X	X
apaakozigan; miskwaabiimag	<i>Arctostaphylos uva-ursi</i>	bearberry				X
apakway; apakweshk; apakweshkway; nabagashk	<i>Typha latifolia</i>	broad-leaved cat-tail				
asa/isaweminagaawanzh (plant); asa/isawemin (berry)	<i>Prunus virginiana</i>	choke cherry	X	X	X	X
azaadi(i); maanazaadi(i)	<i>Populus balsamifera</i>	balsam poplar				X
baakwaanaatig; baakwaanimizh	<i>Rhus typhina</i>	staghorn sumac				X
bagaan, -ag; bagaanens; bagaanimizh; bagaanak	<i>Corylus cornuta</i>	beaked hazelnut	X		X	
bagwaji-zhi/agaagawanzh, -iig; zhi/agaagawanzh, -iig; zhi/agaagawanzhiins	<i>Allium tricoccum</i>	wild leek			X	
bawa'iminaan; gozigwaakomin, -ag	<i>Prunus pensylvanica</i>	pin cherry	X	X	X	X
bezhigojiibik	<i>Caulophyllum thalictroides</i>	blue cohosh			X	
bibigwewanashk, -oon	<i>Heracleum maximum (H. lanatum)</i>	cow-parsnip	X		X	
biimaakwad; manidoo-biimaakwad	<i>Celastrus scandens</i>	american bittersweet		X		X
cigona ' gan	<i>Dendrolycopodium obscurum; D. dendroideum (*Lycopodium o.)</i>	ground-pine	X		X	
doodooshaaboo	<i>Lactuca biennis</i>	tall blue lettuce	X			X

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

Ojibwe Name	Scientific Name	English Name	Boreal	Limestone	Mesic	Sand and
			Forest	Cobble Shore	Northern Forest	Gravel Beach
doodooshaaboojiibik; mindimooyenh	<i>Taraxacum officinale</i>	common dandelion	X	X		X
gaagigebag	<i>Chimaphila umbellata</i>	pipsissewa				
gaanda'igwaasoning ezhinaagwak	<i>Anemone cylindrica</i>	thimbleweed				X
gaawaandag; gaawaandagwaatig; mina'ig; wadab; zesegaandag	<i>Picea glauca</i>	white spruce		X		
gaazha/igensibag; (gi)chi-namewashk	<i>Nepeta cataria</i>	catnip	X	X		X
giboodiyegwaazon	<i>Corydalis aurea</i>	golden corydalis				X
gickensine ' namukuk	<i>Botrypus virginianus (Botrychium virginianum)</i>	rattlesnake fern	X		X	
giizhigaandagizi; ogaawa/inzh	<i>Juniperus communis</i>	common or ground juniper				X
giizhik, -ag; gizhikens, -ag; giizhikenh	<i>Thuja occidentalis</i>	arbor vitae	X	X		X
ginoozhewashk; ozawijiibik; zhiiwibag	<i>Rumex crispus</i>	curly dock				X
ini ' niwin ' dibige ' gun'; baushkindjibgwaun	<i>Trillium grandiflorum</i>	common trillium	X		X	
ininiwa/inzh; zhaabozigan	<i>Asclepias syriaca</i>	common milkweed		X		X
kauwe-sabu-min; me ' skwacabo ' minuk	<i>Ribes cynosbati</i>	prickly or wild gooseberry			X	
main 'gamuna 'tig; anigomiji ' minaga 'wunj	<i>Symphoricarpos albus var. albus</i>	snowberry	X			
maskwi ' widzhi ' wiko 'kok	<i>Viola canadensis</i>	canada violet			X	
mazaan; mazaanaatig	<i>Urtica dioica</i>	stinging nettle	X	X	X	X
mazaanashk	<i>Cirsium arvense</i>	canada thistle		X		X
meskojiibikak; meskwijiibikak; miskojiibik; miskwijiibik	<i>Sanguinaria canadensis</i>	bloodroot			X	
migiziibag; migiziwibag; naemgosibag	<i>Eurybia macrophylla (Aster macrophyllus)</i>	big-leaved aster	X		X	
miishijiiminagaawanzh, iig (plant); miishijiimin -ag (berry); zhaaboomin	<i>Ribes triste</i>	swamp red currant	X	X		
miskominagaawanzh; miskwiminagaawanzh; miskomin, -ag; miskimin, -ag	<i>Rubus strigosus (R. idaeus)</i>	wild red raspberry		X		X
miskoobimizh; miskwaabiimizh	<i>Cornus sericea</i>	red-osier	X	X		X
miskwazi-wusk	<i>Physocarpus opulifolius</i>	Rosaceae	X	X		X
misudidjeebik	<i>Aquilegia canadensis</i>	wild columbine	X	X	X	X
moosewijiibik	<i>Artemisia campestris</i>	wormwood				X
moozomizh	<i>Acer pensylvanicum</i>	striped maple	X		X	
naaniibide'oodegin	<i>Polygonatum pubescens</i>	downy solomon seal	X		X	
nawo 'buguk; wunukibugauh	<i>Trientalis borealis</i>	star-flower	X		X	
ne ' bagandag ' ; pebamabid-singup	<i>Taxus canadensis</i>	yew	X		X	
neezhodaeyun	<i>Linnaea borealis</i>	twinflower	X			
nookwezigan	<i>Erigeron strigosus; E. annuus</i>	daisy fleabane				
ode'immin, -an; ode'iminiijiibik	<i>Fragaria virginiana</i>	wild strawberry	X	X		X
ode'iminiijiibik; zhakaagomin; zhaashaagomin;	<i>Cornus canadensis</i>	bunchberry	X		X	
odjici ' gomin	<i>Lactuca canadensis</i>	tall lettuce	X			
oginiiminagaawanzh	<i>Rosa acicularis</i>	wild rose				X
ogitebagoons	<i>Viola pubescens</i>	yellow violet	X			
ojidimo miskishmandaumin	<i>Dicentra cucullaria</i>	dutchmans-breeches			X	
ookwemizh (plant); ookwemin (berry)	<i>Prunus serotina</i>	wild black cherry			X	
ozaawashkojiibik	<i>Impatiens capensis</i>	spotted touch-me-not		X		
ozagadigom	<i>Osmorhiza claytonii</i>	hairy sweet-cicely	X			

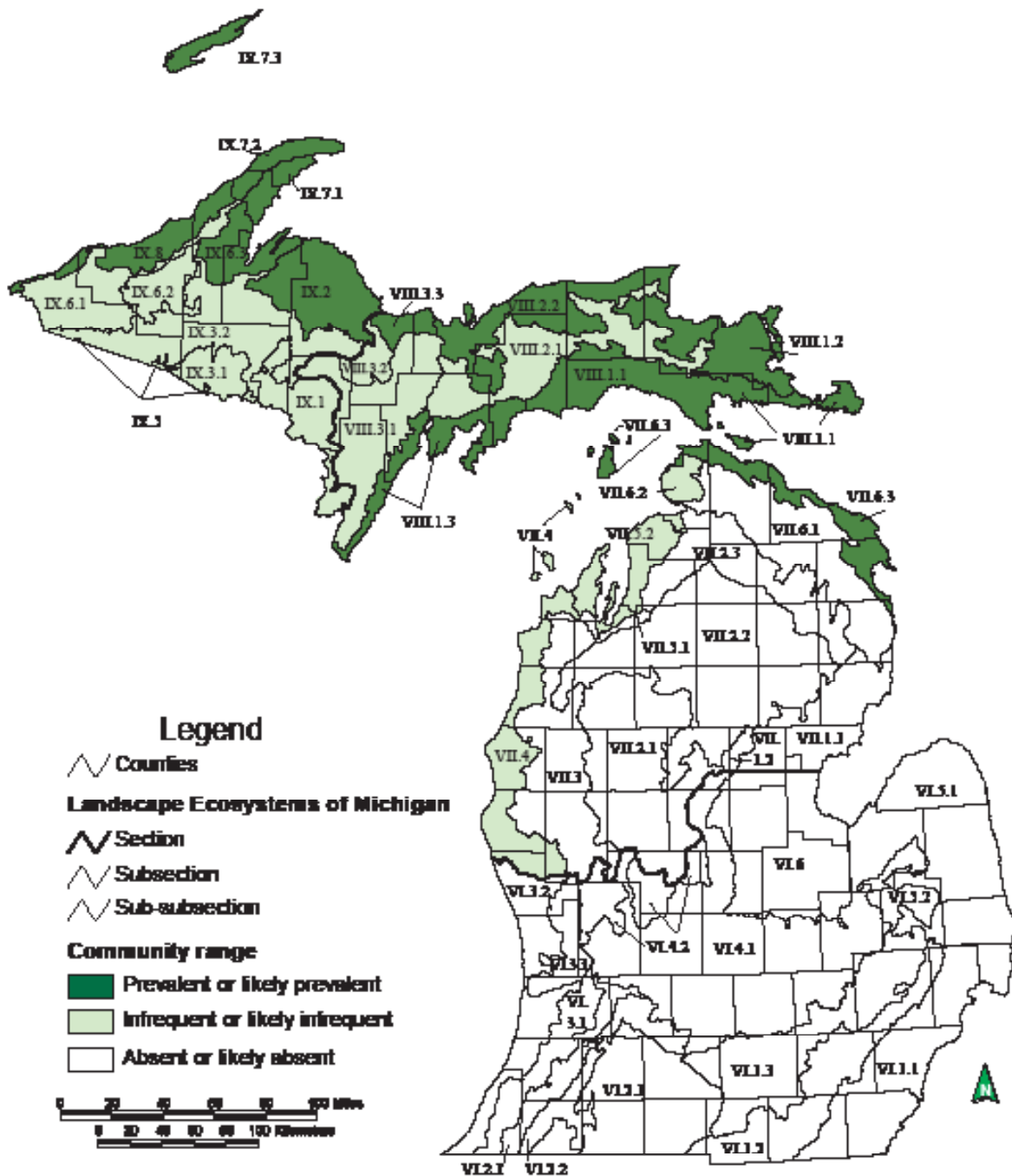
Appendix 3.2. Ojibwe plant names indexed by natural community type.

Ojibwe Name	Scientific Name	English Name	Natural Community Type			
			Boreal Forest	Limestone Cobble Shore	Mesic Northern Forest	Sand and Gravel Beach
ozhaashijiibik; ozhaashijiibikens; zhooshkijiibik	<i>Chamerion angustifolium</i> (<i>Epilobium a.</i>)	fireweed		X		
papshkisiganak; papskatciksi ' gana 'tig	<i>Sambucus racemosa</i>	red-berried elder	X	X	X	X
pigwe 'wunusk	<i>Pastinaca sativa</i>	wild parsnip				X
sabankuk	<i>Lonicera dioica</i>	red honeysuckle	X		X	
sewa 'komin	<i>Prunus pumila</i>	sand cherry				X
skizgu-min	<i>Rubus pubescens</i>	dwarf raspberry	X			
tcatcabonu ' ksik; zheebaunkudohse	<i>Scutellaria galericulata</i>	marsh skullcap				
tikizidgeebikohse	<i>Polygala paucifolia</i>	gay-wings			X	X
waabigwan	<i>Conyza canadensis</i>	horseweed				X
wapakadak; weekizigun	<i>Actaea pachypoda (A. alba)</i>	dolls-eyes	X		X	
wewai ' bugug	<i>Viola labradorica (V. conspersa)</i>	dog violet	X			
wezauskwagmik; osawa ' skanet wiigwaas, -an, -ag; wiigwaasaatig; wiigwaasi-	<i>Diervilla lonicera</i>	bush-honeysuckle				X

Appendix 4- Natural Community Overviews and Distribution Maps

BOREAL FOREST

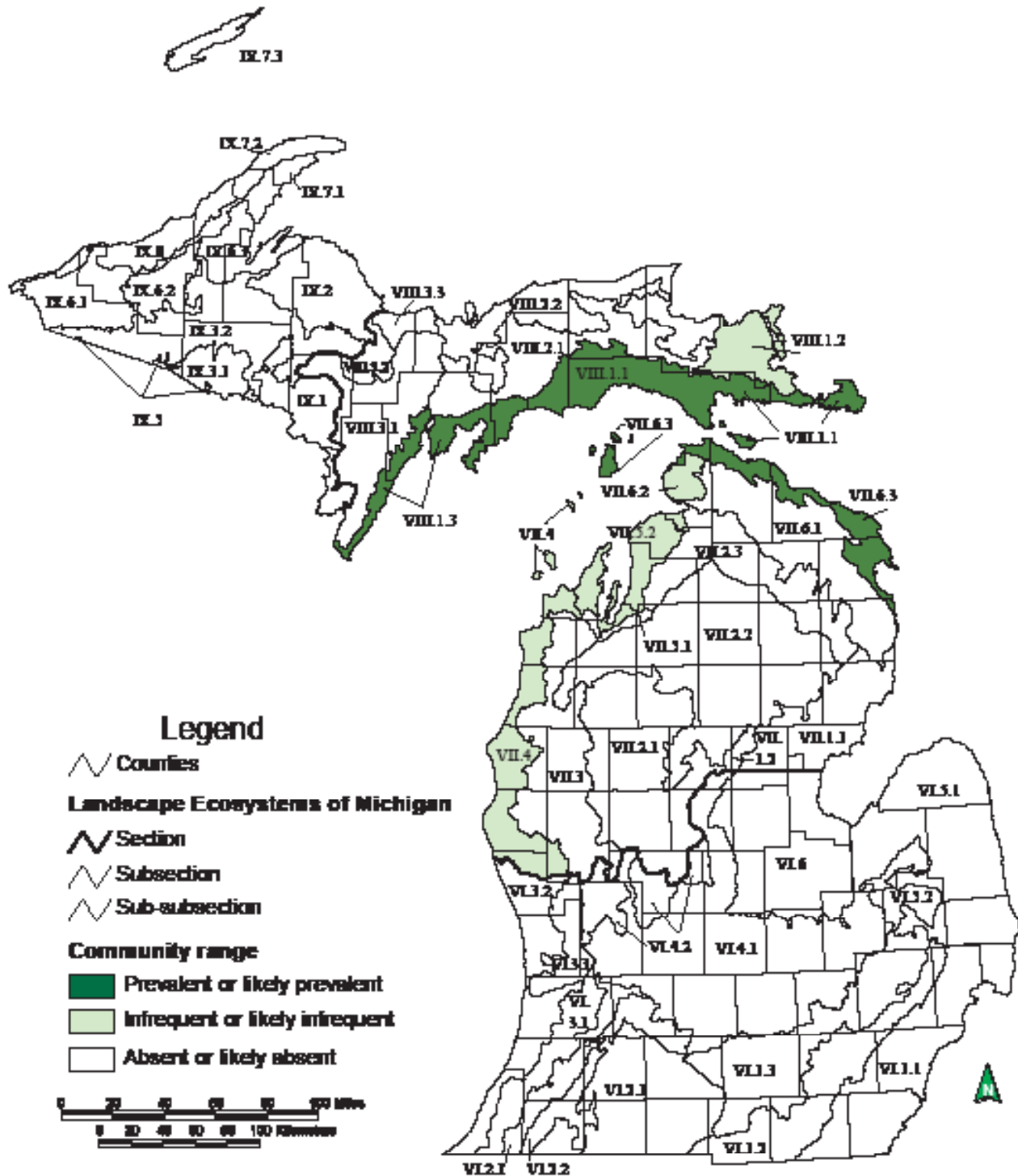
Overview: Boreal forest is a conifer or conifer-hardwood forest type occurring on moist to dry sites characterized by species dominant in the Canadian boreal forest. It typically occupies upland sites along shores of the Great Lakes, on islands in the Great Lakes, and locally inland. The community occurs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

LIMESTONE COBBLE SHORE

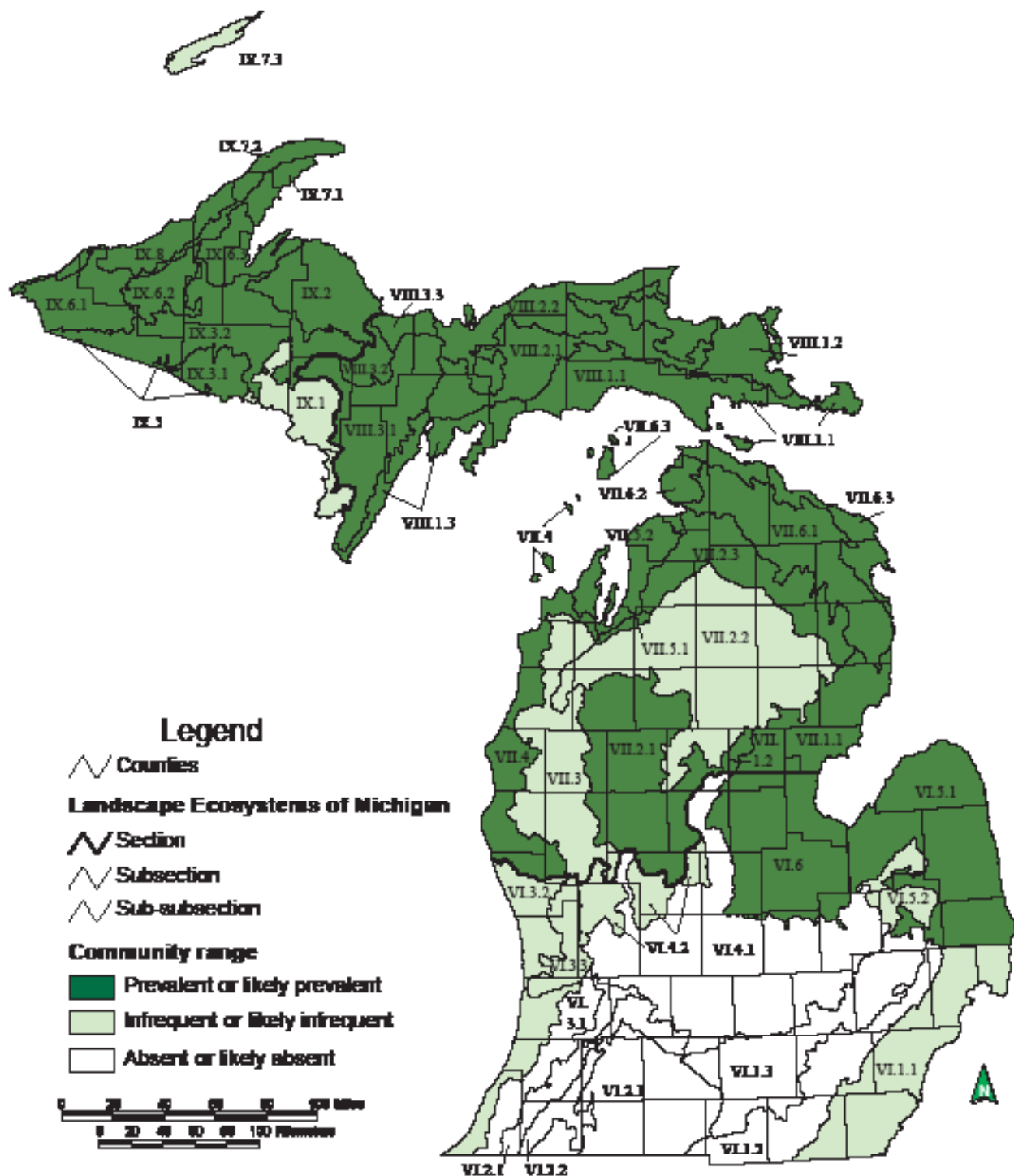
Overview: Limestone cobble shore occurs along gently sloping shorelines of Lake Michigan and Lake Huron. The community is studded with cobbles and boulders and is frequently inundated by storms and periods of high water. Limestone cobble shore is typically sparsely vegetated, because cobbles cover most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



Map 2. Distribution of limestone cobble shore in Michigan (Albert et al. 2008).

MESIC NORTHERN FOREST

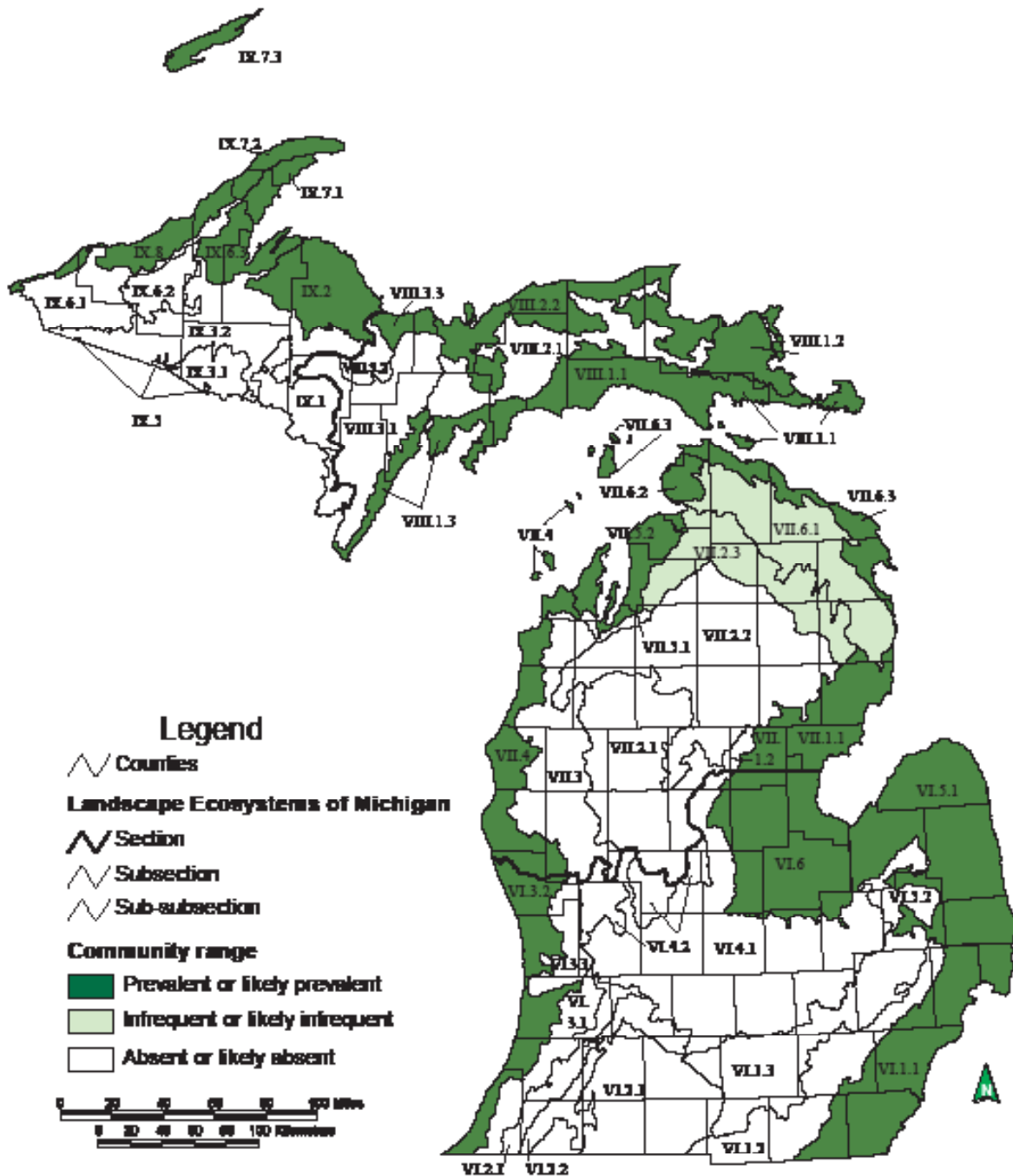
Overview: Mesic northern forest is a forest type of moist to dry-mesic sites lying mostly north of the climatic tension zone, characterized by the dominance of northern hardwoods, particularly sugar maple (*Acer saccharum*) and American beech (*Fagus grandifolia*). Conifers such as hemlock (*Tsuga canadensis*) and white pine (*Pinus strobus*) are frequently important canopy associates. This community type breaks into two broad classes: northern hardwood forest and hemlock-hardwood forest. It is primarily found on coarse-textured ground and end moraines, and soils are typically loamy sand to sandy loam. The natural disturbance regime is characterized by gap-phase dynamics; frequent, small windthrow gaps allow for the regeneration of the shade-tolerant canopy species. Catastrophic windthrow occurs infrequently with several generations of trees passing between large-scale, severe disturbance events. Historically, mesic northern forest occurred as a matrix system, dominating vast areas of mesic uplands in the Great Lakes region. These forests were multi-generational, with old-growth conditions lasting many centuries (Kost et al. 2007, Cohen et al. 2015).



Map 3. Distribution of mesic northern forest in Michigan (Albert et al. 2008).

SAND AND GRAVEL BEACH

Overview: Sand and gravel beaches occur along the shorelines of the Great Lakes and on some of Michigan's larger inland lakes, where wind, waves, and winter ice cause the shoreline to be too unstable to support aquatic vegetation. Because of the high levels of disturbance, these beaches are typically quite open, with sand and gravel sediments and little or no vegetation. Sand and gravel beach is characterized by both a low diversity of plant species and low levels of plant cover (<1%). A wide variety of plants can develop at the inland margin of sand and gravel beaches, but few establish and persist on the active beach, where there is often intense wind and wave action, resulting in almost constantly moving sand. The dynamic nature of open sand and gravel beaches greatly inhibits soil development. Uprooted trees or driftwood accumulate on the beach, fostering localized sand accretion and often vegetation establishment. Finer organic material also builds up seasonally on beaches, and can include plant debris, algae, and dead lake or wetland organisms. These aggregations can be large, greatly increasing the nutrient availability and changing the sediment characteristics of the beach, although these changes are often temporary due to the dynamics of the shoreline environment. Storm waves and winter ice typically prevent permanent vegetation establishment and soil development (Kost et al. 2007, Cohen et al. 2015).



Map 4. Distribution of sand and gravel beach in Michigan (Albert et al. 2008).