Invasive Plant Management Plan for Detroit Island in Horicon-Green Bay National Wildlife Refuge

Great Lakes Region

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On the cover :
Hairy rock cress (*Arabis pycnocarpa*) on limestone lakeshore cliff of Detroit Island, Green Bay National Wildlife Refuge. Photograph: Tyler J Bassett, July 15, 2021

Summary

Invasive species management is a major priority of National Wildlife Refuge (NWR) System of the United States Fish and Wildlife Service (USFWS). More than 2.5 million acres of National Wildlife Refuge System lands are infested with invasive species, of which about 10% have been treated. Recent success stories include Midway Atoll National Wildlife Refuge eradicating 99% of invasive *Verbesina encelioides* (golden crownbeard) to the benefit of the endangered short-tailed albatross and other native seabirds and plants (USFWS 2013).

Invasive species management on any refuge requires baseline information about the invasive species present and conservation assets that they threaten. Invasive species management in refuges is prioritized and conducted on a sub-refuge area-invasive species basis. A plan for treatment must be developed which includes Specific, Measurable, Achievable, Results-oriented, and Time-bound objectives (SMART). This includes not only goals and instructions for treatment but for ongoing monitoring, data collection, and record-keeping. These objectives must be consistent with the principles of the multi-pronged approach of integrated pest management.

The Green Bay NWR consists of several islands of Lake Michigan called the Grand Traverse Islands, linking Wisconsin's Door Peninsula to Michigan's Garden Peninsula. The Refuge provides roosting habitat for the little brown bat, nesting and stopover habitat for many bird species such as the bald eagle, black-crowned night-heron, and Caspian tern, and supports a diversity of state special concern plants species such as climbing fumitory, white camas, and low calamint (Salas et al. 2017, Bassett et al. 2022, Cohen et al. 2022).

In support of Green Bay NWR's Habitat Management Plan and Comprehensive Conservation Plan, this Invasive Plan Management Plan (IPMP) is meant to guide invasive plant species management and monitoring, using the principals of integrated pest management, on Detroit Island. The Refuge owns and manages most of the island's southernmost 60.7 ha (150 ac), while the north half and some parcels in the south are privately owned. This mix of private and federally owned land presents challenges to protecting conservation assets not seen on the other islands of Green Bay NWR. The content and structure of this plan follow *The Land Manager's Guide to Developing an Invasive Plant Management Plan* (USFWS Cal-IPC 2018).

This IPMP provides field methods and data management procedures to facilitate monitoring surveys for conservation assets and invasive species, treatment objectives and actions, and treatment effectiveness monitoring. Data gathered by these methods should contribute to an adaptive management strategy based on this IPMP. Adapting management strategies based on new information will prompt the flexibility needed to combat the complex challenge of invasive plant management (Lowell et al. 2014).

Acknowledgments

We thank the authors of the framework used to guide this Invasive Plant Management Plan (USFWS Cal-IPC 2018). We are grateful to Michigan Natural Features Inventory (MNFI) staff who contributed to this project: Helen Enander for providing maps, Elizabeth Haber for feedback on this report and Jesse Lincoln for his contributions to the project design, plfanning, and surveys on other islands. We thank US Fish and Wildlife Service Region 3 sponsors Richard King and Joshua Booker. We thank the staff at Horicon National Wildlife Refuge, particularly Bill Peterson and Sadie O'Dell. We are grateful to Matt Chansler and the Michigan State University Herbarium for assistance with plant identification and accepting voucher specimens. We thank Claire Peterson of the Michigan Invasive Species Information Network (MISIN) for providing records of invasive species observations. We thank the Detroit Island Landowners Association for use of their dock and trails to gain access to the National Wildlife Refuge lands.

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Chapter 1: Introduction

Plan Purpose and Need

Humans have been moving plants to new habitats for millennia. Shortly after Europeans began to colonize North America, many European plants began to naturalize on the continent such as dandelion (*Taraxacum officinale*), common plantain (*Plantago major*), and white clover (*Trifolium repens*; Mack 2003). Today, people continue to introduce non-native plants at a rapid rate through activities such as gardening, shipping, recreation, and travel (Reichard and White 2001, van Kleunen et al. 2018). Some introduced plants establish and naturalize in a relatively harmless fashion, while others become so problematic as to be called invasive.

Invasive species negatively affect biodiversity. In a global meta-analysis of animal and plant species, invasive species presence was associated with a 21% decrease in species richness (Crystal-Ornelas and Lockwood 2020). Approximately 42% of federally threatened and endangered species are vulnerable primarily due to invasive species (Pimentel et al. 2005). An abundant invasive species can even drive a related native species to extinction through hybridization and introgression (Levin et al. 1996).

Invasive plants can cause ecological harm to other species. Invasive plants such as spotted knapweed (*Centaurea stoebe* ssp. *micranthos*) release allelopathic chemicals that directly suppress the growth of native plants (Thorpe et al. 2009). Other invasive plants, such as garlic mustard (*Alliaria petiolata*), chemically suppress mycorrhizae which form mutualisms with native plants (Stinson et al. 2006). Invasive species can also affect animal communities by altering relative species abundances and decreasing habitat heterogeneity (Ceradini and Chalfoun 2017).

Invasive species can alter entire ecosystems by changing the amount of available nutrients such as nitrogen and carbon. A global meta-analysis found that invaded ecosystems had 40% and 133% higher levels of aboveground nitrogen and carbon, respectively (Liao et al. 2007). Cumulative impacts of invasive species cause an estimated $120 billion in environmental damage annually in the United States (Pimentel et al. 2005, Lockwood et al. 2013).

The impact of invasive species was recognized by the US federal government in President Obama's *Executive Order 13751: Safeguarding the Nation from the Impacts of Invasive Species* and in the Department of Interior's *Invasive Species Strategic Plan for the years 2021 – 2025* (US DOI 2021). These documents call to prevent the introduction of new invasive species and to manage established invasive species. This is also consistent with the conservation, management, and restoration components of the mission of the National Wildlife Refuge (NWR) System.

With time and resources being scarce, a comprehensive, selective, and adaptive approach is needed to combat invasive plant species. Integrated pest management (IPM) uses multiple approaches to eliminate, manage, or prevent plant invasion (USFWS Cal-IPC 2018). It recognizes that emerging invasions can be reversed through early detection and rapid response (EDRR) and future invasions prevented through monitoring. For species that are not eradicable, it adopts a management strategy that depends on the availability of resources, the extent to which

the target species is detrimental, and the value of the resources of concern that the target species threatens. Strategies may include reducing cover of the target species, containing it to its current range, preventing its spread into high-quality natural communities, or electing not to manage for an invasive species. IPM has been successfully employed, for example, to reduce invasive common reed (*Phragmites australis* ssp. *australis*) to less than ¼ of its peak cover on Beaver Island in Lake Michigan (Higman et al. 2019).

Islands are more susceptible to the impacts of invasive species than mainland areas (Lonsdale 1999), and the negative relationship between invasion and species richness is especially high on islands (Pysek et al. 2011). However, islands are often small/isolated enough that eradication can be successful if troublesome species are detected early in the invasion process (USDI 2021).

Islands in fresh waterbodies are globally rare. The Great Lakes has the largest collection of freshwater islands in the world, with 32,000 islands. These islands are home to precious cultural resources, regionally endemic species such as dwarf lake iris (*Iris lacustris*), and rare natural communities such as limestone cobble shore (Cohen et al. 2015). They also provide habitat for colonial nesting birds, stopover land for migratory bird species, and spawning ground for fish in offshore shoals (Henson et al. 2010).

Here we present an Invasive Plant Management Plan (IPMP) for the federally owned portion of Detroit Island, approximately 150 ac (61 ha) on the southern portion of the island which are a part of Green Bay NWR. Detroit Island as a whole is a 637 ac (258 ha) island in Lake Michigan located south of the town of Washington on Washington Island in Door County, Wisconsin, USA, with the northern portion and a few parcels in the south owned privately, by the State of Wisconsin, or Door County Land Trust. We share results of recent botanical and ecological surveys on the federally owned lands, a prioritization of invasive species and areas for treatment, a watch list of potential future invaders, management objectives and strategies, and recommendations for ongoing monitoring and evaluation.

This IPMP provides field methods and data management procedures to facilitate monitoring surveys for conservation assets and invasive species, treatment objectives and actions, and treatment effectiveness monitoring. Data gathered by these methods should contribute to an adaptive management strategy based on this IPMP. Adapting management strategies based on new information will prompt the flexibility needed to combat the complex challenge of invasive plant management (Lowell et al. 2014).

Spatial Scope and Setting

Detroit Island (45.32°N, 86.91°W in Door County, Wisconsin, USA) is part of the Grand Traverse Islands, which run between Wisconsin's Door Peninsula and Michigan's Garden Peninsula (Figure 1). The island chain is part of the Niagara Escarpment, a rock formation extending in an arc from Wisconsin to New York that is made of limestone and dolomite formed from calcium carbonate deposited by coral reefs in the Silurian Age (Albert et al. 1995). The Grand Traverse Island chain is cherished for its diversity of animals, plants, and cultural artifacts such as shipwrecks, lighthouses, and archaeological sites of Native American settlements. (Bacon 2016, Judziewicz 2001). The flora of this island chain has been in development since

about 10,000 BP when post-glacial water levels in the Great Lakes receded enough for its land to be exposed (Forzley et al. 1993).

Detroit Island is approximately 4 mi (6 km) long by 0.6 mi (1 km) at its widest point (Figure 1). It covers 637 ac (258 ha), but Green Bay NWR manages only 150 ac (61 ha) on the southern portion of the island. Detroit Island is comprised of a mixture of publicly and privately owned lands. Several parcels in the northern half of the island are administered by the Wisconsin Department of Natural Resources as the Grand Traverse Island State Park and Door County Land Trust as a portion of the Detroit Harbor Nature Preserve. The rest of the parcels on Detroit Island are privately owned, including a private dock, several managed dirt roads, and several seasonal homes in the northern half of the island.

The bedrock underlying the ground surface on Detroit Island is Silurian dolomite. Dolomite is a variant of limestone, but it consists of mainly magnesium calcium carbonate instead of calcite and aragonite, and it is more resistant to erosion (Albert et al. 1995). There are no interior bodies of water. The interior of the federal lands contains few cliff escarpments 3 to 10 ft (1 to 3 m) high (Cohen et al. 2022). The rest of the interior is recognizable as mesic forest degraded, impacted from disturbances like high deer browse and logging, which started in the area around 1840s and continue more recently in a more selective capacity (Fuller 1927, Judziewicz 2001). Most of the shoreline on federal land is limestone cobble shore / Great Lakes alkaline rockshore [9.8 ac (4 ha)] with small, intermittent sections of limestone bedrock lakeshore / Great Lakes alkaline rockshore [3.2 ac (1.3 ha)], limestone lakeshore cliff / moist cliff [0.3 ac (0.1 ha)], and sand and gravel beach / Great Lakes beach [0.1 ac (0.04 ha)]. The greater amount of vegetation persisting along the eastern shore suggests that there is less energy and wave activity on the eastern shore than the western shore. Other than the cliff communities, the topographic relief on the southern portion of the island is gentle with the highest elevation on federal land greater than 610 ft (186 m). The northern portion of the island has much steeper topography and a maximum elevation of 663 ft (202 m), 82 ft (25m) above Lake Michigan.

Biological explorations in the Grand Traverse Islands began later than many other such expeditions, starting in 1889 (Judziewicz 2001). On Detroit Island, there were six botanical expeditions where plant collections were made prior to the 2021 surveys, with the earliest in July 1971 and latest in September 1998 (Judziewicz 2001). These surveys documented 340 plant species across the entirety of the island, including 7 currently listed Wisconsin listed species: climbing fumitory (*Adlumia fungosa*), elk sedge (*Carex garberi*), low calamint (*Clinopodium glabrum* syn. *C. arkansanum*), rock whitlow-grass (*Draba arabisans*), dwarf lake iris, bird's-eye primrose (*Primula mistassinica*), and Gillman's goldenrod (*Solidago simplex* var. *gillmanii*).

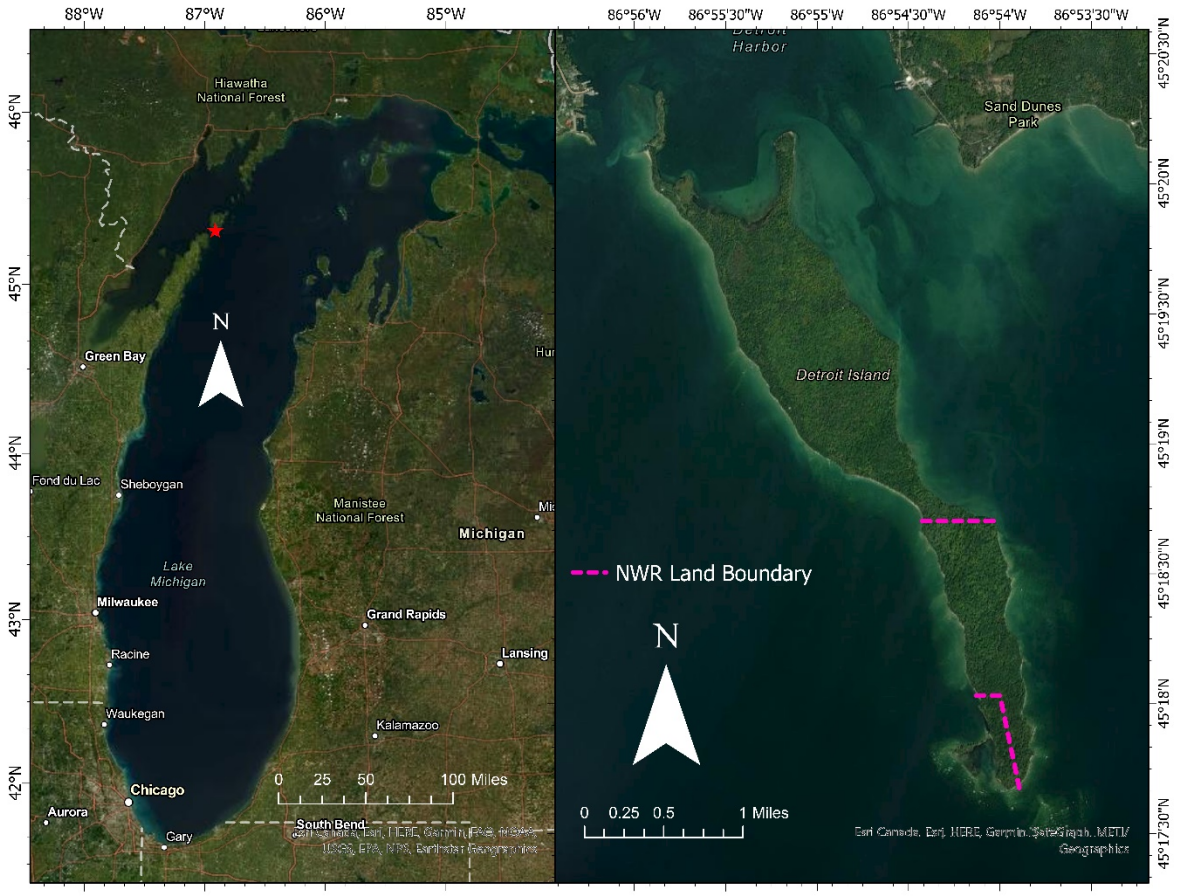

Figure 1. Detroit Island (right) is located in northern Lake Michigan, USA (left). The pink dashed line represents the boundary between NWR- and non-federally owned parcels. The red star in the left pane represents the location of Detroit Island in Lake Michigan, USA.

Conservation Assets

With the surveys of 2021 restricted to federal lands, the richest communities described by Judziewicz (2001) were not visited. High-quality natural communities covered approximately 9% of federal land on Detroit Island with the majority of the land occupied by disturbed mesic forest. Most of the shoreline on federal land is limestone cobble shore / Great Lakes alkaline rockshore [9.8 ac (4 ha)] with small, intermittent sections of limestone bedrock lakeshore / Great Lakes alkaline rockshore [3.2 ac (1.3 ha)], limestone lakeshore cliff / moist cliff [0.3 ac (0.1 ha)], and sand and gravel beach / Great Lakes beach [0.1 ac (0.04 ha)]. There are small areas of limestone cliff / dry cliff within the disturbed mesic forest [0.7 ac (0.3 ha)]. The majority of listed plant occurrences were found in or near the high-quality areas (Figure 2).

Seven currently listed plant species were documented on Detroit Island prior to 2021 surveys including one federally threated species (Table 1). Climbing fumitory was observed within a previously mapped element occurrence (EO) [redacted] (EO ID 9902; Figure 2, Figure 3). Twenty-three individuals including one fertile “climber” were observed (Bassett et al. 2022). Low calamint was found within a previously mapped EO across

five polygons [redacted] (EO ID 14402) [redacted] (EO ID 5668). One to one hundred and eight-four individuals were found within each polygon.

Surveyors failed to find rock whitlow-grass after an exhaustive search [redacted] on federal lands (EO ID 13501). Several of the records of listed species were partially or entirely on non-federal land, so the entire documented area wasn't surveyed for elk sedge (EO ID 4752, 12829), dwarf lake iris, bird's eye primrose (EO ID 17582), and Gillman's goldenrod. Suitable habitat on federal lands were surveyed, but the species were not found.

During the 2021 surveys two previously undocumented Wisconsin special concern species were observed on Detroit Island: white camas (*Anticlea elegans*) and Laurentian bladder fern (*Cystopteris laurentiana*; Figure 3; Bassett et al. 2022). There were 40 individuals of white camas across five polygons, three within meters of each other [redacted] Two to twelve individuals were flowering in each polygon. Surveyors found four polygons of Laurentian bladder fern scattered [redacted].

Troublesome invasive species occur in or near all these communities. They are also encroaching on some of the places where rare plants and animals occur. Strategies to control these invasive species are discussed in Chapters 3 and 4.

Table 1. Element occurrences (EOs) for rare native species and natural communities Natural community classifications for Michigan and Wisconsin are listed in the Element column. EO ID is a unique identifier assigned to each EO in Wisconsin's Natural Heritage Database. New EO have EO ID to be determined (TBD). NatureServe Natural Heritage EO ranks are briefly described as follows: A = excellent viability, B = good viability, C = fair viability, D = poor viability, E = verified extent, F = failed to find. Combination of letter ranks represent intermediate ranking. State and global status ranks for natural communities are explained in Table 2. UNK = unknown. NA = not applicable

Element	Common name	EO ID	EO Rank	Last Observed	State Status	Global Status
Adlumia fungosa	Climbing fumitory	9902	D	2021	Special concern	G4
Anticlea elegans	White camas	TBD	TBD	2021	Special concern	G5T4T5
Carex garberi	Elk Sedge	4752	C/F[1]	1998	Threatened	G5
Carex garberi	Elk Sedge	12829	H	1979	Threatened	G5
Clinopodium glabrum	Low calamint	5568	C	2021	Special concern	G5
Clinopodium glabrum	Low calamint	14402	AB	2021	Special concern	G5
Cystopteris laurentiana	Laurentian bladder fern	TBD	TBD	2021	Special concern	G3
Draba arabisans	Rock whitlow-grass	13501	F	1998	Special concern	G4G5
Iris lacustris	Dwarf lake iris	V0207 790WI S[2,3]	UNK[2]	1998	Threatened (Both federal and state)	G3
Primula mistassinica	Bird's-eye primrose	17582	B/F[1]	1998	Special concern	G5
Solidago simplex var. *gillmanii*	Gillman's goldenrod	v0208 798WI S [2,3]	UNK[2]	1998	Threatened	G5T3?
Limestone bedrock shore / Great Lakes Alkaline Rockshore	NA	24374	BC	2021	S2	G3
Limestone cliff / Dry cliff	NA	24373	BC	2021	S2	G4G5
Limestone cobble shore / Great Lakes alkaline Rockshore	NA	24375	BC	2021	S3	G2G3
Limestone lakeshore cliff / Moist cliff	NA	24372	B	2021	S1	G4G5
Sand and gravel beach / Great Lakes beach	NA	24387	BC	2021	S3	G4

[1] Did not survey portion on private property; Failed to find on federal land.
[2] Catalog number for specimen documentation on Detroit Island (Judziewicz 2001), since no EO ID was supplied by Wisconsin Natural Heritage Program to MNFI, likely due to its presence on non-federal land. Specimen collection date was listed as last observation
[3] Survey was not conducted in the EO area documented, because it was documented on non-federal property. Suitable habitat on federal land was surveyed.

Table 2. Explanation of state and global status ranks for natural communities (verbatim from NatureServe Biotics): https://help.natureserve.org/biotics/content/record_management/Element_Files/Element_Tracking/ETRACK_Definitions_of_Heritage_Conservation_Status_Ranks.htm

Status	Description	Explanation
S1	Critically Imperiled	At very high risk of extirpation in the jurisdiction due to very restricted range, very few populations or occurrences, very steep declines, severe threats, or other factors.
S2	Imperiled	At high risk of extirpation in the jurisdiction due to restricted range, few populations or occurrences, steep declines, severe threats, or other factors.
S3	Vulnerable	At moderate risk of extirpation in the jurisdiction due to a fairly restricted range, relatively few populations or occurrences, recent and widespread declines, threats, or other factors.
S4	Apparently secure	At a fairly low risk of extirpation in the jurisdiction due to an extensive range and/or many populations or occurrences, but with possible cause for some concern as a result of local recent declines, threats, or other factors.
S5	Secure	At very low or no risk of extirpation in the jurisdiction due to a very extensive range, abundant populations or occurrences, with little to no concern from declines or threats.
G1	Critically Imperiled	At very high risk of extinction or elimination due to very restricted range, very few populations or occurrences, very steep declines, very severe threats, or other factors.
G2	Imperiled	At high risk of extinction or elimination due to restricted range, few populations or occurrences, steep declines, severe threats, or other factors.
G3	Vulnerable	At moderate risk of extinction or elimination due to a fairly restricted range, relatively few populations or occurrences, recent and widespread declines, threats, or other factors.
G4	Apparently secure	At fairly low risk of extinction or elimination due to an extensive range and/or many populations or occurrences, but with possible cause for some concern as a result of local recent declines, threats, or other factors.
G5	Secure	At very low risk or extinction or elimination due toi a very extensive range, abundant populations or occurrences, and little to no concern from declines or threats.
GU	Unrankable	Currently unrankable due to lack of information or due to substantially conflicting information about status or trends. NOTE: Whenever possible (when the range of uncertainty is three consecutive ranks or less), a range rank (e.g., G2G3) should be used to delineate the limits (range) of uncertainty.
?	Inexact numeric rank	Denotes inexact numeric rank; this should not be used with any of the Variant Global Conservation Status Ranks or GX or GH.

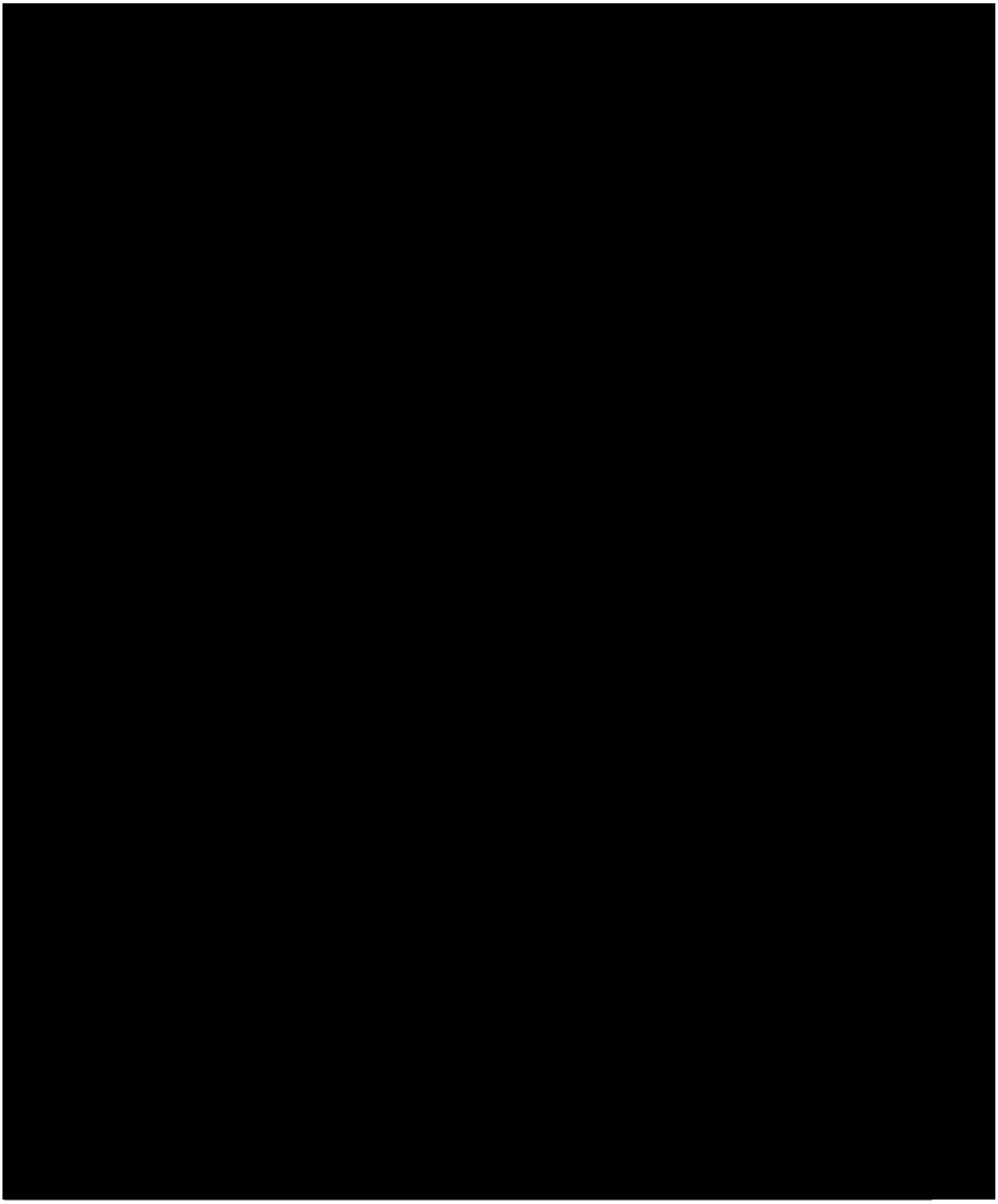

Figure 2. Rare plant and natural community element occurrences (EOs) on Detroit Island. All occurrences were observed in 2021. Older records not surveyed or failed to find in 2021 are not mapped here.

Figure 3. Rare plant species on Detroit Island. Top left: climbing fumitory (*Adlumia fungosa*) [redacted] (Photo: Tyler J Bassett, July 15, 2021). Top right: white camas (*Anticlea elegans*) [redacted] (Photo: Tyler J Bassett, July 13, 2021). Bottom: Low calamint (*Clinopodium glabrum*) [redacted] (bottom left photo: Tyler J Bassett, July 15, 2021; bottom right photo: Scott M Warner, July 15, 2021).

Conservation Goals

This plan supports the following Refuge System goals cited in the comprehensive conservation plan (Lenz et al. 2013):

- Conserve a diversity of fish, wildlife, and plants and their habitats, including species that are endangered or threatened with becoming endangered.
- Develop and maintain a network of habitats for migratory birds, anadromous and interjurisdictional fish, and marine mammal populations that is strategically distributed and carefully managed to meet important life history needs of these species across their ranges.
- Conserve those ecosystems, plant communities, wetlands of national or international significance, and landscapes and seascapes that are unique, rare, declining, or underrepresented in existing protection efforts.

This plan also supports the following objectives specific to Green Bay NWR from the Habitat Management Plan (Salas et al. 2017):

- Maintain quality of northern mesic forest
- Maintain quality of limestone cobble shore / Great Lakes alkaline rockshore

We also advocate for maintaining the quality of the three additional natural communities on Detroit Island (Table 1; Figure 2):

- Limestone cliff / dry cliff
- Limestone lakeshore cliff / moist cliff
- Sand and gravel beach / Great Lakes beach

Considering the mixed ownership on Detroit Island, it may be necessary to work with other landowners to effectively combat invasive species to protect conservation assets. Although private lands were not included in the 2021 surveys, from reports from other naturalists, most notably Judziewicz (2001) we know there were quality habitats in both the northern and southern non-federal parcels and several listed species / natural communities were observed there in 1998: bird's eye primrose, dwarf lake iris, elk sedge, Gillman's goldenrod, and limestone bedrock lakeshore / Great Lakes alkaline rockshore.

Specific, Measurable, Achievable, Results-oriented, and Time-bound (SMART) objectives are laid out in Chapter 4.

History of Invasive Plant Management

No history of invasive plant management has occurred on Detroit Island since its acquisition into the NWR. Other landowners may have engaged in some treatment or management activities. Although not an invasive plant, white-tailed deer (*Odocoileus virginiana*) browse was mentioned as a threat to the mesic forests, particularly spring ephemerals, of Detroit Island in Judziewicz 2001.

Regulatory Context

Refuge staff and partners contracted for treatment should be familiar with relevant local, state, and federal regulations pertaining to the management action they are perusing.

Herbicides should be used with caution in consideration of nearby plants, wetlands, wind conditions, forecasted rain, and human health. All herbicide labels should be thoroughly understood, and the specific herbicide should be permitted in the State for the use desired. When working near wetlands/water, permits from the Wisconsin Department of Natural Resources may be required. Refuge authorities also require pesticide use proposals through their Pesticide Use Proposal System before any chemical treatments. Herbicide applicators should have the appropriate certification. Detailed best management practices are in Cal-IPC (2015). More details can be found in *Regional Protocol Framework for Rare and Invasive Plant Monitoring on Great Lakes Islands* (2021c) and *Draft Site-specific Protocol for Vegetation Surveys on Great Lakes Islands, Green Bay and Gravel Island National Wildlife Refuges* (2021a).

Chapter 2: Methods

This chapter identifies the who, what, why, and how in the development of this IPMP for Detroit Island, Green Bay NWR. The IPMP was developed using the best available information and processes. This chapter describes processes that were used to gather information and make decisions about areas, species, strategies, and activities to focus on and employ.

Project Team

The Project Team was comprised of members working on developing the IPMP [Rachel Hackett (MNFI), Scott Warner (MNFI)], United States Fish and Wildlife Service (USFWS) staff members who were decision makers [Richard King, Joshua Booker, Bill Peterson], and USFWS staff members who will be implementing the plan [Bill Peterson, Sadie O'Dell, Francis Gercz, Joel Vos, Jon Krapfl].

Internal and External Communication, Outreach, and Engagement

The IPMP team met and communicated throughout the planning, fieldwork, and reporting processes via virtual meetings, emails, electronic chat, MS Teams, and in-person meetings. Varying levels of involvement were required at different stages. The IPMP lead authors also maintained communication with other MNFI staff members who conducted the most recent surveys on Detroit Island. Additionally, communication was made with the local area conservationist Samantha Koyen, Door County Soil & Water Conservation Department (SWCD). Door County SWCD is a project partner who will conduct invasive plant treatment in the State of Wisconsin islands in the Grand Traverse Islands of the Green Bay NWR.

Information Gathering

Information was gathered from Horicon Complex NWR Staff, the Michigan Natural Heritage Database, botanical and ecological surveys conducted in 2021 (Bassett et al. 2022, Cohen et al. 2022), and online digital data sources [e.g., ArcGIS Online (AGOL) Great Lakes – Invasives and Photopoints, iNaturalist, Midwest Invasive Species Information Network (MISIN)]. The nomenclature of plant species follows Integrated Taxonomic Information System (ITIS, https://www.itis.gov).

Element Occurrence Records

The Wisconsin Natural Heritage Database contains EOs of rare and listed species and natural communities. MNFI made a request for records located on federal lands on Detroit Island from the Wisconsin Natural Heritage Program, a program of Wisconsin Department of Natural Resources (Table 1). These records were used to plan a visit to the island during the optimal detection period. A more detailed description of the use of this information to inform vegetative and ecological surveys on Detroit Island can be found in *Regional Protocol Framework for Rare and Invasive Plant Monitoring on Great Lakes Islands* (2021c) and *Draft Site-specific Protocol for Vegetation Surveys on Great Lakes Islands, Green Bay and Gravel Island National Wildlife Refuges* (2021a).

When a rare species was encountered while doing field surveys, information about the observation was documented as requested by the Wisconsin Natural Heritage Program. An annual report of all rare and listed species observations, failed to find surveys, and new occurrences was submitted to Wisconsin Natural Heritage Program for review and incorporation

into the Wisconsin Natural Heritage Database (Bassett 2021). US Fish and Wildlife Service was supplied a copy of this report via Microsoft Teams.

Vegetation surveys

Vegetation surveys were conducted to inform both the management of invasive species threats and the prioritization of high-quality species and communities for protection or management. Detroit Island was visited July 15, 2021. Protocols described in *Regional Protocol Framework for Rare and Invasive Plant Monitoring on Great Lakes Islands* (2021c) and *Draft Site-specific Protocol for Vegetation Surveys on Great Lakes Islands, Green Bay and Gravel Island National Wildlife Refuges* (2021a) and summarized here were followed in 2021.

Surveyors planned meander survey routes to adequately cover each natural community on the island. Meanders were designed to include known records of rare and listed plant species and possible micro-habitats or areas of non-homogenous habitat detectable from an inspection of aerial imagery, topographical maps, and prior observations. Possible micro-habitats encountered while in the field were also explored. The perimeter of the island and invasive species pathways such as docks and known anthropogenic disturbances (e.g., ruins, trails) were also included in vegetation surveys.

GPS data were collected in the field to map locations of rare species, rare and/or high quality natural communities, and invasive species. Non-native species that were locally naturalized and relatively innocuous (e.g., dandelion, hawkweed) were not mapped but included on species lists in the communities they invaded.

ArcGIS Online USFWS invasive species related data collection and management

Information gathered on invasive plant species populations during the 2021 surveys was synthesized and transcribed into the US Fish and Wildlife Service's ArcGIS Online (AGOL) feature layers for Region 3 plant and weed observations based on the type of geometry most suited to represent the population (i.e., point, line, polygon; Esri 2022b). Description of the data included in the Feature Layers can be found in Appendix 1.

Much of the data were collected and recorded in the field via ArcGIS Collector in an AGOL Web Map called Great Lakes – Invasives and Photopoints generated by USFWS data manager for the project (Esri 2020, Esri 2022b). Some data were transcribed out of the field using the same ArcGIS Collector app and Web Map. Detailed instructions for adding features to the Web Map are included in Appendix 2.

Features to document invasive species treatment and monitor its efficacy are also within the USFWS AGOL Great Lakes – Invasives and Photopoints Web Map. There are multiple feature layers to house the different management treatment types (e.g., chemical, mechanical). Like with invasive species populations, invasive species treatment areas should be mapped in the appropriate management feature layer in the program ArcGIS Collector: for example, pesticide applications should be documented with the Region # Management Actions Chemical Plant Feature.

Documentation and monitoring of treatment efficacy should be conducted with Photo Survey Points as described in *Regional Protocol Framework for Rare and Invasive Plant Monitoring on Great Lakes Islands* (2021c) and *Draft Site-specific Protocol for Vegetation Surveys on Great Lakes Islands, Green Bay and Gravel Island National Wildlife Refuges* (2021a) and summarized here: Photo points should be strategically placed in mapped invasive species communities to capture a visual representation of the cover and density of the target species. The number of photo points needed will vary, but a minimum of three points for each treatment area is expected. These points will be visited on multiple occasions: at least once prior to treatment (i.e., pre-treatment) and one or more visits post-treatment depending on treatment method(s) and logistical constraints. Detailed instructions on adding features to the Web Map are included in Appendix 2.

Prioritization of Species and Management Areas

Natural community areas and invasive species were ranked using the Invasive Plant Inventory and Early Detection Prioritization Tool (IPIEDPT). This tool was developed by the USFWS Inventory and Monitoring Initiative (Region 8) and Utah State University (USFWS 2016).

Invasive species prioritization

To prioritize invasive plant species using the IPIEDPT, we needed to develop lists of invasive species present in each area and likely invaders from surrounding areas. Invasive species observed during the 2021 surveys were used to populate the list. To increase the practical application of the list, the likely invader list was expanded to include invasive species observed on nearby islands as gathered from 2021 surveys (Bassett et al. 2022).

Using the IPIEDPT, species were scored using categorical ranks adhering to rubrics developed by IPIEDPT (USFWS 2016). The ranked factors fell into four categories, with one category having multiple factors:

- Invasiveness ranking (weighted 0.2)
- Invasive species status and habitat suitability (weighted 0.4)
    - Species proximity
    - Current species abundance
    - Habitat suitability
- Ecological impacts (weighted 0.3)
- Legal mandates – Noxious or other regulatory designation (weighted 0.1)

For invasiveness ranking, the NatureServe ranking system was used if available. If the IPIEDPT did not have a NatureServe invasiveness ranking for a species, primary research, expert opinion and invasiveness ranking of that species from previous MNFI projects were used (Cohen et al. 2019). Species proximity and current abundance were derived from data gathered during the 2021 surveys (Cohen et al. 2022). Habitat suitability rank was determined using local field guides and expert opinion. Ecological impact rank was determined using expert opinion and invasiveness ranking of that species from previous MNFI projects (Cohen et al. 2019). Legal mandates were reviewed as listed on the United States Department of Agriculture's [USDA's] PLANTS Database (https://plants.sc.egov.usda.gov/home/).

As the species of bush honeysuckle (*Lonicera* sp.) observed on the island all have the same NatureServe rankings and not managed differently, they are pooled together for the purpose of the IPIEDPT.

Prioritization across Detroit, Plum, Poverty, and St. Martin Islands

Although some of the input between the IPIEDPT area prioritization tool and MNFI's Stewardship Prioritization were the same, the Stewardship Prioritization scores differ in that more emphasis was placed on the natural communities in a global and state context, value was placed on the quality of the natural community, and individual invasive species presence, spread, and density were taken into consideration. For the Stewardship Prioritization, there were three indices informed by numerous factors:

- Ecological integrity index
    - EO rank
- Rarity index
    - Global rank of natural community
    - State rank of natural community
- Invasive index
    - Invasive threat severity
        - Site-specific information on infestations
        - Habit and history of invasive plant species in a natural community type
    - Treatment feasibility

The natural communities ranked as higher quality habitat had a higher ecological integrity index. The rarity index was the mean of the global and state rankings of the natural community types, with rarer communities having higher scores. The invasive index was the mean of the invasive threat severity and treatment feasibility. Experts ranked the invasive threat severity based on the 1) site-specific information gathered during the 2021 surveys on the species, spread, density, and location of invasive species infestations in the area and 2) knowledge of the impacts of present invasive species in that natural community type. A natural community with increased degradation due to invasive species infestations would have a higher score. The treatment feasibility index was a rank score assigned based on treatment ease and success of the invasive species present in the natural community. The sum of the three indices produced the stewardship prioritization score.

Area prioritization

Natural communities on the island were categorized using the scheme in *A Field Guide to the Natural Communities of Michigan* (Cohen et al. 2015), which concentrates on the dominant species composition, soils, hydrology, and geography of the community, and cross-walked to equivalent Wisconsin Natural Community types (Epstein 2017). Information gathered by ecologists during the 2021 surveys was used to differentiate natural community areas and identify areas of high quality and good representation of those communities on the State-level (USFWS 2021b, Cohen et al. 2022). On Detroit Island one area of significant anthropogenic disturbance was separated from natural communities: disturbed mesic forest.

Using the IPIEDPT, areas were scored using categorical ranks adhering to rubrics developed by IPIEDPT (USFWS 2016). The ranked factors fell into three categories, each with multiple factors:

- Area description (weighted 0.4)
    - Ecological integrity
    - Innate resistance to invasion
    - Importance to Federal or State-listed species
    - Importance to other priority natural resources of conservation
- Invasion risk (weighted 0.3)
    - Relative to terrestrial pathways
    - Relative to aquatic pathways
    - Relative to transport vectors
    - Relative to anthropogenic disturbances
- Invasive plant status (weighted 0.3)
    - Relative to most recent inventory and monitoring event
    - Relative to overall infestation level
    - Number of invasive plant species present in area

The scores of each category were averaged (mean), weighed, then the three category scores were summed to derive the total score for the area. IPIEDPT default weights were used for each category.

For area description factors, categorical rankings were determined using 2021 ecological survey data and notes, NatureServe-MNFI resilience rankings of the natural community, NatureServe-MNFI biodiversity rankings of the natural community, NatureServe-MNFI state rarity score of natural community in Michigan, and expert opinion (Cohen et al. 2019, Cohen et al. 2022). For invasion risk factors, categorical rankings were determined using 2021 ecological survey data and notes; geospatial variables of proximity to shoreline and presence of trails, roads, and human structures; evidence of past logging; and expert opinion (Cohen et al. 2022). For invasive plant status factors, categorical rankings were determined using the invasive species population data described in Chapter 2: Methods – Information Gathering. All areas had been comprehensively monitored within the last five years. Opinions on the highest value natural areas during the 2021 surveys were shared in virtual meetings among MNFI, USFWS, Green Bay NWR, and Door County SWCD, and applied as expert opinion where applicable.

Link area-species

Using the IPIEDPT, the link between each area and invasive species was also classified using the species presence, status and distribution, and habitat suitability in that area. These rankings were derived from data gathered from the 2021 surveys and expert opinion (Cohen et al. 2022). All three factors were equally weighed and added to the overall species score.

Identifying Management Strategies

Management strategies were identified from integrated pest management and adaptive management literature and protocols. Strategies are broad and may be changed or adapted as new

information is learned (Table 3). Multiple strategies may be suggested for the same management area per invasives species or the same invasive species over different management areas.

Table 3. Management terminology used to describe management strategies.

Strategy	Description
Early Detection/Rapid Response (EDRR)	Surveillance technique to monitor and treat emerging pest infestations.
Monitoring	Ongoing surveillance and documentation of infested or non-infested areas for pest populations at a regular frequency.
Eradication	Population is small and isolated enough that complete eradication of all plants and reproductive propagules is possible with little chance of reintroduction.
Elimination/Zero Density	Population is of high enough priority or small enough size to eliminate from a designated area, but reintroduction is likely from surrounding areas or vectors.
Outlier Control	When populations are present as large infestations, the first priority is to eliminate small outlier populations away from the larger infestation.
Perimeter Control	When populations are present as large infestations, once outlier populations have been eliminated, management focus switches to control around the perimeter of the larger infestation moving from the fringes towards the center.
Sustained Control	The species is so widespread that elimination is unlikely due to population size and pressure of continual reintroduction from neighboring areas. Control areas would most likely focus on specific high priority areas impacted from the species with a long-term commitment expected.

Chapter 3: Invasive Plant Priority Species and Areas

Observed and potential invasive species on Detroit Island were divided into three categories: Priority 1, Priority 2, and Priority 3 (Table 4). Priority 1 species were observed on the island and pose a significant threat to natural communities and rare species (Figure 4, Figure 5). Management is likely to result in significant positive outcomes. Three species were classified as Priority 1 (Table 5).

Priority 2 species were not observed on Detroit in 2021 but have been seen in nearby regions and would pose a significant threat if found on Detroit Island. Thirty-one species were classified as Priority 2 (Table 6). EDRR is recommended strategy for species in this category.

Priority 3 species were considered naturalized on Detroit and nearby islands (Table 5; Figure 4, Figure 5). These species are difficult to detect in their first year and produce copious wind- or animal-dispersed seed. Their capacity to outcompete native plants in natural communities is limited. Four species were classified as Priority 3. Management strategies such as outlier control would be difficult to achieve for these species given the remote island setting.

Table 4. Description of prioritization categories given to observed and potential invasive plant species on Detroit Island.

Category	Description
Priority 1	Present and prioritized: The species was observed in 2021, poses significant threats to natural communities and rare species, and is potentially eradicable or controllable.
Priority 2	Watch list: The species has been observed in at least one nearby county and would pose a significant threat to natural communities and rare species if found on Detroit Island.
Priority 3	Present but not prioritized: The species is often considered invasive and was observed in 2021 but has thoroughly naturalized on Detroit and nearby islands and poses a relatively low threat to rare species and high-quality communities.

Table 5. Categorization of invasive species observed in 2021 according to their invasibility and manageability. Priority 1 and Priority 3 are defined in Table 4. The breakdown of IPIEDPT Total Score can be found in Appendix 3.

Scientific Name ITIS	Common Name	Category	IPIEDPT Total Score
Alliaria petiolata	Garlic mustard	Priority 1	9.40
Berberis thunbergia	Japanese barberry	Priority 1	9.00
Lonicera spp.	Bush honeysuckles	Priority 1	8.47
Cerastium fontanum ssp. *vulgare*	Common mouse-ear chickweed	Priority 3	3.90
Cirsium palustre	European marsh thistle	Priority 3	6.77
Cirsium vulgare	Bull thistle	Priority 3	6.77
Cynoglossum officinale	Houndstongue	Priority 3	6.77
Dactylis glomerata	Orchardgrass	Priority 3	4.10
Elymus repens	Quackgrass	Priority 3	5.70
Epipactus helleborine	Helleborine	Priority 3	4.97
Erysimum cheiranthoides	Wormseed wallflower	Priority 3	4.90
Fallopia convolvulus	Black bindweed	Priority 3	3.70
Hieracium caespitosum	Yellow hawkweed	Priority 3	4.10
Hypericum perforatum	Common St. John's-wort	Priority 3	4.37
Leonurus cardiaca	Motherwort	Priority 3	4.10
Nepeta cataria	Cat-nip	Priority 3	3.57
Persicaria maculosa	Spotted ladysthumb	Priority 3	4.10
Phleum pratense	Common timothy	Priority 3	4.90
Poa compressa	Canada bluegrass	Priority 3	4.10
Poa pratensis	Kentucky bluegrass	Priority 3	3.43
Rumex obtusifolius	Bitter dock	Priority 3	4.10
Sedum acre	Goldmoss stonecrop	Priority 3	4.37
Silene latifolia	Bladder campion	Priority 3	4.10
Solanum dulcamara	Bittersweet nightshade	Priority 3	4.90
Taraxacum officinale	Dandelion	Priority 3	3.57
Tragopogon pratensis	Jack-go-to-bed-at-noon	Priority 3	4.30
Verbascum thapsus	Common mullein	Priority 3	4.37

A brief discussion of the management and ecology of each Priority 1 species follows. The Priority 2 species watch list is also presented. Priority 1 species were mapped when observed (Figure 4).

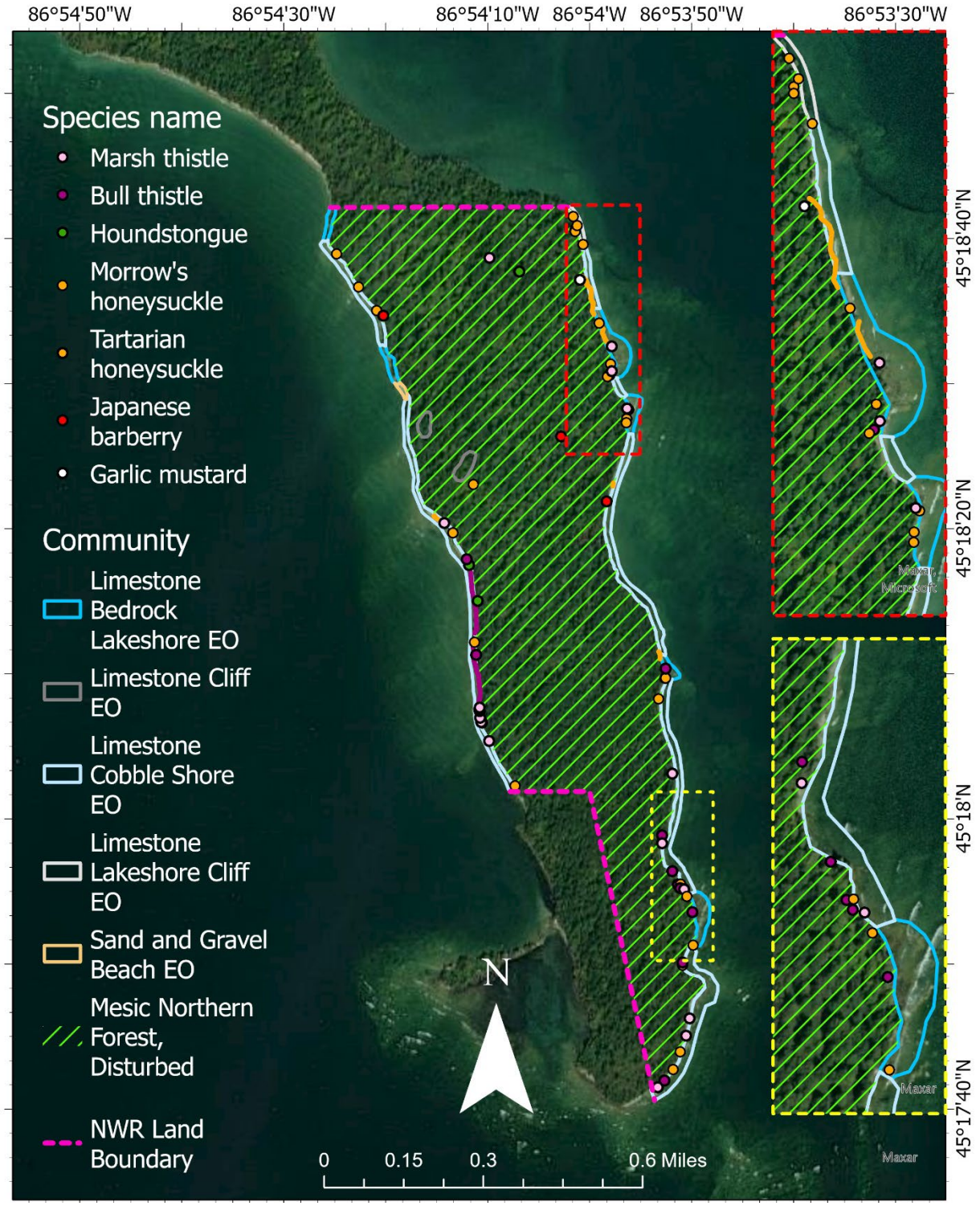

Figure 4. Invasive species data taken on Detroit Island and delineation of natural communities and anthropogenic areas. The colored panels in the upper-right are higher resolution views of the like-colored rectangles on the main map. Abbreviations: 'EO' = element occurrence.

Figure 5. Invasive plant species on Detroit Island. Clockwise from upper left: Bush honeysuckle (Lonicera morrowii) and Tyler Bassett, photo taken on St. Martin Island by Rachel Hackett on June 2, 2021, garlic mustard (Alliaria petiolata), photo taken on Betsey River Valley State Trail, Benzie County, Michigan, by Rachel Hackett on May 24, 2021; houndstongue (Cynoglossum officinale) and marsh thistle (Cirsium palustre), photos taken on Plum Island by Tyler Bassett on July 12, 2021. The upper photos are Priority 1 species and the lower photos are Priority 3 species (Table 4, Table 5).

Species Descriptions and Priorities

Priority 1: Present Aggressive Species

GARLIC MUSTARD (*ALLIARIA PETIOLATA*)

Garlic mustard is a biennial herb that was first brought to the United States by European colonizers to use in cooking and medicine (Czarapata 2005). It was first collected in Wisconsin, USA, on the lakeshore of Lake Park in Milwaukee in June 1938 (Wisconsin State Herbarium 2022). It is now present throughout the state where it thrives in disturbed forested habitats, as well as more natural settings where its invasive tendencies displace native vegetation, especially spring ephemerals and tree seedlings (Wisconsin State Herbarium 2022, Reznicek et al. 2011). Garlic mustard releases antifungal chemicals into the soil that disrupt symbiosis between native plant species and mycorrhizal fungi, which suppresses native plant growth. It is a restricted species in Wisconsin.

Species description: Garlic mustard is a biennial herb of the mustard family (Brassicaceae). In its first year, it is a basal rosette of one to several scallop-edged, round to kidney shaped leaves. In its second year, a stalk up to 4 ft (1.2 m) is produced with alternate scalloped, round to triangular shaped leaves with no leaf stems (i.e., petioles). In April or May of its second year, garlic mustard will produce small, white flowers with four petals usually at the top of the stalk, but occasionally where the leaf meets the stem. Garlic mustard flowers until June (Figure 5). Seeds are produced in slender capsules from flower stems (i.e., peduncles) and are viable within days of initial flowering. Hundreds of seeds are produced per plant. Seeds are typically dispersed in July and August after the plant dies. Seeds can hitchhike on animals and clothing or travel by water. Seeds can remain viable for at least seven years (Czarapata 2005). Roots of garlic mustard have a strong garlic scent when damaged.

The garlic odor of damaged roots is the easiest way to distinguish first year garlic mustard rosettes from similar leaved native violets (*Viola* spp.) and non-native creeping Charlie (*Glechoma hederacea*). Garlic mustard has been mistaken with a few other early blooming, white flowered species: toothworts (*Cardamine* spp.) and sweet-cicely (*Osmorhiza* spp.). Garlic mustard has simple leaves, unlike the compound leaves of sweet-cicely and some toothworts. Simple-leaved toothworts can be distinguished from garlic mustard by leaf shape and lack of root odor.

Habitat: Disturbed and shaded areas, roadsides, savannas, bases of large trees, mesic forests, floodplain forests, and swamps (Czarapata 2005, Reznicek et al. 2011)

Current status in landscape: One patch approximately 6 ft^2 (0.6 m^2) was observed in the disturbed mesic forest less than 100 ft (30 m) west from limestone cobble lakeshore / Great Lakes alkaline rockshore (Figure 4).

Management: Any management action will need to be repeated several times a year for many years for effective control because of the viability of the seeds and ease of seed-spread. Many hand-pull garlic mustard in the early spring before seed set, although it may be pulled before flowering anytime the soil is not frozen. Plants may also be cut at their base after the flower stalks have elongated but before flowers have opened, but this method has mixed results

(Czarapata 2005). If plants are flowering, stalks should be removed in plastic bags and properly disposed of or burned.

Controlled burns in fall or early spring have been used to treat garlic mustard in fire-adapted habitats (e.g., savanna). Three to five consecutive years of burning are recommended for this method. Follow-up to control survivors with hand-pulling, propane torch, or chemical control (Czarapata 2005).

Chemical control methods include spring foliar application of glyphosate, triclopyr, or 2,4-D amine, but repeated treatments are necessary. After the first chemical treatment, new seedlings will emerge with vigor. As the season progresses, it can become difficult to avoid non-target species in with foliar treatments. Some preemergent controls with corn gluten have shown promise for treatment (Czarapata 2005).

JAPANESE BARBERRY (*BERBERIS THUNBERGIA*)

Japanese barberry is a popular cultivated shrub. It is prized for hedges and the fall/winter color provided by its red berries. It was first collected as a wild plant in Wisconsin in 1936 (Wisconsin State Herbarium 2022). It is now present throughout the state where it thrives in disturbed habitats, as well as more natural settings where its invasive tendencies displace native vegetation (Wisconsin State Herbarium 2022, Reznicek et al. 2011).

Species description: Japanese barberry has simple, alternate elliptic-to-obovate leaves with smooth margins. It is a spiny, often low-growing shrub, but vigorous individuals can reach a height of about 6 ft (2 m). The small cream-colored flowers bloom in May and mature into small egg-shaped red berries by late summer. Berries not dispersed by birds may persist on the plant into the winter. Japanese barberry can reproduce not only by seed but by creeping roots and branches; the branches root when they touch the ground (Czarapata 2005).

Habitat: Forests, swamps, fields, and dunes (Reznicek et al. 2011).

Current status in landscape: Three patches of Japanese barberry were observed: one within 50 ft (15 m) of the east coast of limestone cobble lakeshore / Great Lakes alkaline rockshore, one within 50 ft (15 m) of the west coast of limestone cobble lakeshore / Great Lakes alkaline rockshore, and one within the interior disturbed mesic forest (Figure 4). The largest patch of 20 ft^2 (2 m^2) was near the west coast. The other two patches were 4 ft^2 (0.4 m^2).

Management: Like many invasive species, Japanese barberry leafs out earlier than native plants, making spring a good season for detection. The plant can be pulled or dug out, but all roots must be removed. In disturbed open habitats, such as trails and areas surrounding structures, mowing may be effective after large plants are removed. Plants can be cut at the base in winter or spring. Triclopyr formulated for use with penetrating oil can be used on cut stumps and as a basal bark treatment. Glyphosate applied to cut stumps may also work. Resprouts should be treated with glyphosate (Czarapata 2005).

BUSH HONEYSUCKLES (*LONICERA* SPP.)

Invasive bush honeysuckles are allelopathic shrubs (Bauer et al 2012) that have been established in Michigan since at least the 1890s. They have become terrible pests, readily spreading via avian fruit dispersal, and establishing not only in disturbed areas but also high-quality natural communities in which they can form dense thickets to the exclusion of native vegetation (Reznicek et al. 2011). Spring ephemerals are particularly affected by the shade these invasive species cast when they leaf-out earlier than native vegetation (Czarapata 2005).

Species description: Bush honeysuckles are woody, deciduous shrubs that can reach 15 ft (4.5 m) tall (Figure 5). Their leaves are opposite, oval, and without small hairs on the outer edge (i.e., margin) of the leaf. Flowers are white to pink and bloom along the leaf axils. Fruits are red to orange berries that contain many seeds.

Bush honeysuckles can be distinguished from similar, native honeysuckles by their hollow pith in branches 2 years or older; native honeysuckles have a solid pith (Reznicek et al. 2011). Non-native honeysuckles also leaf-out before almost all native species and retain their leaves longer, extending their reliable detection period from April or May to November (Borland et al. 2015).

Habitat: Roadsides, thickets, banks, shores, and forests (Reznicek et al. 2011).

Current status in landscape: Bush honeysuckle was mapped at over 30 locations in the NWR lands on Detroit Island (Figure 4). The majority of these locations were within 100 ft (30 m) of the lakeshore, but one occurrence of 16 ft^2 (1.5 m^2) was near the Laurentian bladder fern and limestone cliff / dry cliff EOs. More bush honeysuckle is likely scattered about the NWR portions of the island. The occurrences were mapped as *Lonicera* sp., as treatment for the species does not differ among non-native bush honeysuckle species and not all individuals were observed during a time when the species were distinguishable. On this island, the occurrences identified to species represented morrow honeysuckle (*L. morrowi*) and Tatarian honeysuckle (*L. tatarica*).

Management: Effective treatments include hand-pulling (remove all roots), foliar spray, stump-cutting plus herbicide, and basal bark treatment (spray bottom 18 in (46 cm) of stems; Borland et al. 2015). Pulled plants or cut stems can re-root if discarded on the soil (Czarapata 2005), so proper disposal of plant fragments should be ensured. Treatment must be continued for 3 to 5 years until the seedbank is depleted (Czarapata 2005).

Priority 2: Watch List

The focus for Detroit Island invasive species watch list is on moderately to highly invasive species that are known from nearby islands, Delta County, Michigan, Door County, Wisconsin, and other counties in the immediate vicinity (Table 6). The list was not limited by the regional Great Lakes islands watch list in the *Regional Protocol Framework for Rare and Invasive Plant Monitoring on Great Lakes Islands* (USFWS 2021c). Species occurrences were compiled from the following databases: Michigan Flora Online, Online Virtual Flora of Wisconsin, Michigan Invasive Species Information Network, and iNaturalist. Priority 2 species observed on islands in Green Bay NWR were included in the IPIEDPT.

Table 6. Watch list of invasive species that have been observed near Detroit Island, Door County, Wisconsin, USA. Abbreviations: iNat = iNaturalist, Co. = County, I. = Island, MISIN = Midwest Invasive Species Information Network, MNFI = Michigan Natural Features Inventory, WIS = Wisconsin State Herbarium. Counties: Brown Co., WI; Delta Co., MI; Door Co., WI.

Scientific name	Common name	Source and year of most recent observation	Location
Acer platanoides	Norway maple	iNat 2020 (https://www.inaturalist.org/observations/53771341)	Door Co.
Ailanthus altissima	Tree of Heaven	WIS 1977 (Catalog #: v0329267WIS)	Door Co.
Celastrus orbiculatus	Oriental bittersweet	MISIN 2020	Delta Co.
Centaurea stoebe	Spotted knapweed	Bassett et al. 2022, Cohen et al. 2022	Plum I., Poverty I., St. Martin I.
Cirsium arvense	Canada thistle	Bassett et al. 2022, Cohen et al. 2022	Plum I., Poverty I., St. Martin I.
Dipsacus fullonum	Wild teasel	WIS 2000 (Catalog #: UWGB35359)	Brown Co.
Dipsacus laciniatus	Cut-leaf teasel	iNat 2020 (https://www.inaturalist.org/observations/54274873)	Door Co.
Elaeagnus umbellata	Autumn olive	Bassett et al. 2022, Cohen et al. 2022	St. Martin I., Delta Co.
Epilobium hirsutum	Great hairy willow-herb	iNat 2021 (https://www.inaturalist.org/observations/90580693)	Door Co.
Euphorbia esula	Leafy spurge	Bassett et al. 2022, Cohen et al. 2022	St. Martin I., Rocky I.
Fallopia japonica	Japanese knotweed	iNat 2021 (https://www.inaturalist.org/observations/94607207)	Delta Co.
Frangula alnus	Glossy buckthorn	iNat 2021 (https://www.inaturalist.org/observations/97788402)	Delta Co.
Hesperis matronalis	Dame's rocket	Bassett et al. 2022, Cohen et al. 2022	Plum I.
Iris pseudoacorus	Yellow iris	iNat 2021 (https://www.inaturalist.org/observations/83344012)	Delta Co.
Lysimachia nummularia	Moneywort	iNat 2021 (https://www.inaturalist.org/observations/97786520)	Delta Co.
Lythrum salicaria	Purple loosestrife	Bassett et al. 2022, Cohen et al. 2022	Plum I.
Melilotus albus	White sweet-clover	Bassett et al. 2022, Cohen et al. 2022	Poverty I., Hog I.
Melilotus officinalis	Yellow sweet-clover	iNat 2021 (https://www.inaturalist.org/observations/85598750)	Door Co.
Morus alba	White mulberry	iNat 2020 (https://www.inaturalist.org/observations/48336723)	Door Co.
Myriophyllum spicatum	Eurasian water-milfoil	MISIN 2019	Delta Co.
Pastinaca sativa	Wild parsnip	Bassett et al. 2022, Cohen et al. 2022	Plum I., Poverty I., Rocky I., St. Martin I.

Scientific name	Common name	Source and year of most recent observation	Location
Phalaris arundinacea	Reed canary grass	Bassett et al. 2022, Cohen et al. 2022	Plum I., Poverty I., Rocky I., St. Martin I.
Phragmites australis ssp. *australis*	Invasive common reed	Bassett et al. 2022, Cohen et al. 2022	Poverty I., St. Martin I.
Pinus sylvestris	Scotch pine	iNat 2021 (https://www.inaturalist.org/observations/95590492)	Door Co.
Populus alba	White poplar	Bassett et al. 2022, Cohen et al. 2022	St. Martin I.
Rhamnus cathartica	Common buckthorn	iNat 2021 (https://www.inaturalist.org/observations/98069022)	Door Co.
Robinia pseudoacacia	Black locust	iNat 2020 (https://www.inaturalist.org/observations/62369578)	Door Co.
Rosa multiflora	Multiflora rose	Bassett et al. 2022, Cohen et al. 2022	Plum I.
Typha spp.[4]	Cat-tail species	Bassett et al. 2022, Cohen et al. 2022	Plum I., Poverty I., St. Martin I.
Vinca minor	Lesser periwinkle	iNat 2021 (https://www.inaturalist.org/observations/94772911)	Door Co.
Vincetoxicum nigrum	Black swallow-wort	iNat 2017 (https://www.inaturalist.org/observations/8092705)	Door Co.

Area Priorities among Detroit, Plum, Poverty, and St. Martin Islands

Detroit Island had five of the natural community EOs throughout Detroit, Plum, Poverty, and St. Martin Islands (Cohen et al. 2022). Of the EOs among the four islands, Detroit had 1 community ranking in the high stewardship tier, 1 community ranking in the medium stewardship tier, and 3 ranked in the low stewardship tier (Table 7). Other high tier EOs were on Poverty and St. Martin Islands. The EOs of the high tier were ranked higher quality (i.e., ecological integrity index) and had greater threat from invasive species based on the habit of the species in that natural community and treatment feasibility at their 2021 infestation severity than those EOs of medium and low tiers (i.e., invasive index). Poverty Island boreal forest (EO ID 7488) was considered particularly vulnerable to invasive species considering the fire in 2016 increasing the opportunity for invasive establishment including the present invasive common reed in disturbed areas (Cohen et al. 2022).

Detroit Island's limestone bedrock lakeshore / Great Lakes alkaline rockshore (EO ID 24374) was ranked in the high stewardship tier with a stewardship prioritization score of 10 (Figure 2; Table 7). The combination of needing to protect the high-quality habitat, the natural community rarity, and feasibility of successful treatment of the invasive species present pushed this community into the highest tier. This EO was habitat for two listed species, and several invasive species threaten the community in surrounding habitat.

Detroit Island's Limestone cobble shore / Great Lakes alkaline rockshore (EO ID 24375) was ranked in the medium tier. It was of higher quality, imperiled at the state level, and contained a moderate level of infestation with species that have a likelihood of successful treatment.

[4] Includes *Typha angustifolia* and *T. x glauca*

Detroit Island's limestone lakeshore cliff / moist cliff (EO ID 24372), limestone cliff / dry cliff (EO ID 24373), and sand and gravel beach / Great Lakes beach (EO ID 24373) ranked in the low stewardship tier. The two cliff communities were of medium quality and not of global or state rarity. The sand and gravel beach / Great Lakes beach ranked lowest because no invasive species were detected. For more details on each communities see the Area Descriptions and Priorities on the following pages.

Table 7. MNFI stewardship prioritization scores for natural community EOs across Detroit, Plum, Poverty, and St. Martin Islands in Green Bay NWR. Higher scores indicate a higher stewardship priority. "EO ID" refers to a unique identifier in a State Natural Heritage Database. The Stewardship Prioritization Score is the sum of the three bolded indices (i.e., Ecological Integrity Index, Rarity Index, Invasive Index) to which the other scores contribute. Element occurrences are sorted by their MNFI stewardship prioritization scores and assigned a high (red), medium (yellow), or low (blue) stewardship priority. Anthropogenic areas were not ranked using the MNFI Stewardship prioritization score. Detroit Island natural community EOs are bolded. The MNFI Stewardship Prioritization is abridged from Cohen et al. 2022.

Island	Area	EO ID	Ecological Integrity Index	Global Rank Score	State Rank Score	Rarity Index	Invasive Threat Severity Score	Treatment Feasibility	Invasive Index	Stewardship Prioritization Score
Poverty	Boreal forest	7488	4	3	3	3	3	4	3.5	**10.5**
Poverty	Limestone bedrock lakeshore	4159	4.5	3	4	3.5	2	3	2.5	**10.5**
Detroit	**Limestone bedrock lakeshore / Great Lakes alkaline rockshore**	**24374**	**4**	**3**	**4**	**3.5**	**2**	**3**	**2.5**	**10**
Poverty	Limestone lakeshore cliff	1437	5	1.5	4	2.75	2	2.5	2.25	**10**
St. Martin	Limestone lakeshore cliff	24348	5	1.5	4	2.75	2	3	2.5	**10**
Detroit	**Limestone cobble shore / Great Lakes alkaline rockshore**	**24375**	**3.5**	**3**	**4**	**3.5**	**2**	**3**	**2.5**	**9.5**
St. Martin	Limestone cliff	24350	4	1.5	4	2.75	2	3	2.5	**9.25**
St. Martin	Limestone cobble shore	24353	4	3.5	3	3.25	1	3	2	**9.25**
Plum	Great Lakes marsh	24367	3	2	4	3	3	3	3	**9**
St. Martin	Mesic northern forest	24349	3.5	2	3	2.5	3	3	3	**9**
St. Martin	Boreal forest north	24351	4	3	3	3	1	2	1.5	**8.5**
St. Martin	Boreal forest south	24351	4	3	3	3	1	2	1.5	**8.5**
Plum	Limestone cobble shore	24370	3	3	4	3.5	2	2	2	**8.5**
Detroit	**Limestone lakeshore cliff / moist cliff**	**24372**	**3.5**	**3**	**2**	**2.5**	**2**	**3**	**2.5**	**8.5**
Plum	Limestone lakeshore cliff	24368	3	3	2	2.5	4	2	3	**8.5**
St. Martin	Northern hardwood swamp	24352	3	2	3	2.5	3	3	3	**8.5**
Plum	Mesic northern forest	24369	2	2	3	2.5	5	2	3.5	**8**
Detroit	**Limestone cliff / dry cliff**	**24373**	**3.5**	**1.5**	**1**	**1.25**	**2**	**3**	**2.5**	**7.25**
Detroit	**Sand and gravel beach / Great Lakes beach**	**24387**	**3.5**	**3**	**4**	**3.5**	**0**	**---**	**0**	**7**

Area Descriptions and Priorities

Natural communities were classified based on *A Field Guides to the Natural Communities of Michigan* (Cohen et al. 2015) and cross-walked to equivalent classifications of Wisconsin Natural Community types (Epstein 2017).

IPIEDPT scored the five natural community areas above the disturbed mesic northern forest (Table 8). The relative score of each natural community area is different from MNFI's Stewardship Prioritization ranking (Table 7; Cohen et al. 2022). The biggest point of contention is the sand and gravel beach / Great Lakes beach, ranked highest on Detroit Island by IPIEDPT while ranked lowest in MNFI's Stewardship Prioritization. The different purpose of the two tools lends to our understanding of the difference between the two rankings: IPIEDPT was built primarily as a monitoring prioritization while MNFI's Stewardship Prioritization was meant to focus land management and protection. Since the beach had no invasive species present, it was ranked high for monitoring with IPIEDPT while the lack of invasive species lowered it priority for management. The IPIEDPT ranked the limestone bedrock lakeshore / Great Lakes alkaline rockshore low, because of its invasive status, while the MNFI Stewardship Prioritization ranked it high for its high quality and the feasibility of treating the specific invasives present. IPIEDPT does not take the individual species present into account with its tool, only the total number of invasive species and overall infestation level.

Each area is described in more detail in the following pages. Management recommendations are discussed in Chapter 4.

Table 8. IPIEDPT area prioritization scores for Detroit Island. Higher scores indicate a higher priority. Natural community classification for the area are listed with Michigan classification first and Wisconsin classification second (Cohen et al. 2015, Epstein 2017).

Area	Description Score	Risk Score	Status Score	Total Score
Sand and gravel beach / Great Lakes beach	1.7	1.8	2.1	5.6
Limestone lakeshore cliff / moist cliff	1.4	1.8	1.4	4.6
Limestone cliff / dry cliff	1.4	1.5	1.5	4.4
Limestone cobble shore / Great Lakes alkaline rockshore	1.7	1.8	0.9	4.4
Limestone bedrock lakeshore / Great Lakes alkaline rockshore	1.8	1.8	0.5	4.1
Disturbed mesic northern forest	1.6	1.5	0.3	3.4

Limestone Bedrock Lakeshore / Great Lakes Alkaline Rockshore (EO ID 24374)

Limestone bedrock lakeshore / Great Lakes alkaline rockshore is a state-imperiled community that occurs in only Door County in Wisconsin (WDNR 2015). It is comprised of ancient limestone pavement occurring along Great Lakes shores, also called alvar pavement and limestone pavement lakeshore. Vegetation is limited to cracks, joints, and depressions in the bedrock (Figure 6). Trees are generally limited to the inland edge. Characteristic plants include low calamint, silverweed (*Potentilla anserina*), Baltic rush (*Juncus balticus* ssp. *littoralis*), Kalm's St. John's wort (*Hypericum kalmianum*), balsam ragwort (*Packera paupercula*), Ohio goldenrod (*Solidago ohioensis*), white camas, northern white cedar (*Thuja occidentalis*), paper birch (*Betula papyrifera*), balsam poplar (*Populus balsamifera*), and shrubby cinquefoil (*Dasiphora fruticosa*). Fluctuating water levels make for a dynamic flora. The pH of what little soil can develop tends to be mildly alkaline. Exposure to storms, wind, ice, fluctuating water levels, and desiccating conditions make for a harsh environment (Cohen et al. 2015).

Figure 6. Limestone bedrock lakeshore on Detroit Island, Green Bay National Wildlife Refuge. Photo: Joshua G Cohen, July 15, 2022.

Sensitive resources: [redacted]

Important biotic factors: The sparse vegetation was characterized by herbaceous plants such as low calamint, silverweed, herb Robert (*Geranium robertianum*), touch-me-not (*Impatiens capensis*), wild strawberry (*Fragaria virginiana*), beak-rush (*Rhynchospora capillacea*), and water smartweed (*Persicaria amphibia*). Trees and shrubs, generally restricted to the inland edge, cracks, and crevices, included northern white cedar, green ash (*Fraxinus pennsylvanica*), basswood (*Tilia americana*), chokecherry (*Prunus virginiana*), red elderberry (*Sambucus racemosa*), wild red raspberry (*Rubus sachalinensis var. sachalinensis*), and currants (*Ribes* spp.). Recent high-water years have led to the dieback of both woody and herbaceous vegetation. Occasional splash pools support aquatic vegetation. Red algae were present, slowly dissolving the limestone substrate that creates the splash pools.

Important abiotic factors: The limestone bedrock lakeshore grades intermittently with limestone cobble shore locally along the eastern and western shoreline of Detroit Island (Figure 2). When placed in a line, limestone bedrock lakeshore is approximately 0.3 mi (500 m), but the longest continuous segment on federal lands is only 722 ft (220 m). The inland edge of the bedrock is bordered by disturbed mesic forest. The extent of the bedrock lakeshore fluctuates interannually. Consecutive high-water years in the Great Lakes from 2016 through 2020 made the shoreline relatively narrow in 2021. Soils are shallow, alkaline organics restricted to cracks, crevices, and depressions.

Identified vectors and pathways: Occasional visitors will find it relatively easy to walk along the bedrock lakeshore. The position along the lake makes this community vulnerable to the washup of invasive-plant propagules.

Invasive plant status: Twelve non-native species were present in total, with woody species likely along the border with the disturbed mesic forest. One Priority 1 invasive species was present along the border with the mesic forest: bush honeysuckle (Bassett et al. 2022). Bush honeysuckle was found for 164 ft (50 m) and another patch of 9 ft^2 (0.8 m^2) along the east shore in the northern part of the federal lands and a 16 ft^2 (1.5 m^2) patch in the southeast. Canada bluegrass (*Poa compressa*) is locally common while other non-native species were occasional. Only marsh thistle (*Cirsium palustre*) among Priority 3 species was mapped.

The most likely new invaders of this area include one other Priority 1 species and nine Priority 2 species that scored greater than 20 due to suitable habitat and/or proximity in adjacent areas/nearby islands (Table 9):

- Japanese barberry
- Spotted knapweed
- Canada thistle (*Cirsium arvense)*
- Autumn olive (*Elaeagnus umbellata*)
- Purple loosestrife (*Lythrum salicaria*)
- White sweet-clover (*Melilotus albus*)
- Invasive common reed
- Wild parsnip (*Pastinaca sativa*)
- Narrow-leaf cat-tail (*Typha angustifolia*)

Table 9. IPIEDPT area-species link scores for the limestone bedrock lakeshore / Great Lakes alkaline rockshore. Species with a non-zero "Status Score" were observed in the area during the 2021 surveys (Cohen et al. 2022). Priority 1 species that had present status in the area were bolded. As bush honeysuckle (*Lonicera* sp.) observed on the island all have the same NatureServe rankings, they are pooled together in the table. Appendix 3, Table 3-3 lists all area-species links by species, and it lists additional common names.

Common Name	Scientific Name ITIS	Presence Score	Status Score	Habitat Score	Total Score	Species Score	Overall Score
Wormseed wallflower	*Erysimum cheiranthoides*	10	7	10	27	4.9	31.9
Common timothy	*Phleum pratense*	10	7	10	27	4.9	31.9
Bittersweet nightshade, woody nightshade	*Solanum dulcamara*	10	7	10	27	4.9	31.9
Marsh thistle	*Cirsium palustre*	10	5	10	25	6.8	31.8
Goldmoss stonecrop	*Sedum acre*	10	7	10	27	4.4	31.4
Flannel plant, common mullein	*Verbascum thapsus*	10	7	10	27	4.4	31.4
Common mouse-ear chickweed	*Cerastium fontanum* ssp. *vulgare*	10	7	10	27	3.9	30.9
Bush honeysuckle	***Lonicera* spp.**	**10**	**1**	**10**	**21**	**8.5**	**29.5**
Bull thistle	*Cirsium vulgare*	10	0	10	20	6.8	26.8
Houndstongue	*Cynoglossum officinale*	10	0	10	20	6.8	26.8
Common St. John's wort	*Hypericum perforatum*	10	7	5	22	4.4	26.4
Canada bluegrass	*Poa compressa*	10	7	5	22	4.1	26.1
Bitter dock, broadleaf dock	*Rumex obtusifolius*	10	7	5	22	4.1	26.1
Quackgrass	*Elymus repens*	10	0	10	20	5.7	25.7
Black bindweed, wild buckwheat	*Fallopia convolvulus*	10	7	5	22	3.7	25.7
Butter and eggs	*Linaria vulgaris*	10	1	10	21	4.4	25.4
Jack-go-to-bed-at-noon	*Tragopogon pratensis*	10	0	10	20	4.3	24.3
Purple loosestrife	*Lythrum salicaria*	5	0	10	15	9.1	24.1
Spotted ladysthumb, ladysthumb	*Persicaria maculosa*	10	0	10	20	4.1	24.1
Common reed	*Phragmites australis* ssp. *australis*	5	0	10	15	9.1	24.1
White campion	*Silene latifolia*	10	0	10	20	4.1	24.1
Spotted knapweed	*Centaurea stoebe* ssp. *micranthos*	5	0	10	15	9.0	24.0
Narrow-leaf cat-tail	*Typha angustifolia*	5	0	10	15	9.0	24.0
Cat-nip	*Nepeta cataria*	10	0	10	20	3.6	23.6
Dandelion	*Taraxacum officinale*	10	0	10	20	3.6	23.6
Kentucky bluegrass	*Poa pratensis*	10	0	10	20	3.4	23.4
Canada thistle	*Cirsium arvense*	5	0	10	15	7.6	22.6
Wild parsnip	*Pastinaca sativa*	5	0	10	15	7.3	22.3
Garden valerian, common valerian	*Valeriana officinalis*	5	0	10	15	7.3	22.3
White sweet-clover	*Melilotus albus*	5	0	10	15	6.3	21.3

Common Name	Scientific Name ITIS	Presence Score	Status Score	Habitat Score	Total Score	Species Score	Overall Score
Autumn-olive	*Elaeagnus umbellata*	5	0	10	15	6.1	21.1
Smallflower hairy willow herb	*Epilobium parviflorum*	5	0	10	15	5.3	20.3
Lesser burdock	*Arctium minus*	5	0	10	15	5.1	20.1
Common hempnettle	*Galeopsis tetrahit*	5	0	10	15	5.1	20.1
Japanese barberry	*Berberis thunbergii*	10	0	1	11	9.0	20.0
Redtop	*Agrostis gigantea*	5	0	10	15	4.9	19.9
Orange hawkweed	*Hieracium aurantiacum*	5	0	10	15	4.5	19.5
Black medick	*Medicago lupulina*	5	0	10	15	4.5	19.5
Soapwort, bouncing bet	*Saponaria officinalis*	5	0	10	15	4.5	19.5
Meadow fescue	*Schedonorus pratensis*	5	0	10	15	4.5	19.5
Red clover	*Trifolium pratense*	5	0	10	15	4.5	19.5
Thyme-leaf speedwell	*Veronica serpyllifolia*	5	0	10	15	4.5	19.5
Garlic mustard	*Alliaria petiolata*	10	0	0	10	9.4	19.4
Orchard grass	*Dactylis glomerata*	10	0	5	15	4.1	19.1
Yellow hawkweed	*Hieracium caespitosum*	10	0	5	15	4.1	19.1
Motherwort	*Leonurus cardiaca*	10	0	5	15	4.1	19.1
Tall buttercup	*Ranunculus acris*	5	0	10	15	4.1	19.1
Bladder campion	*Silene vulgaris*	5	0	10	15	4.1	19.1
Reed canary grass	*Phalaris arundinacea*	5	0	5	10	9.1	19.1
Ox-eye daisy	*Leucanthemum vulgare*	5	0	10	15	4.0	19.0
Annual bluegrass	*Poa annua*	5	0	10	15	3.6	18.6
Leafy spurge	*Euphorbia esula*	5	0	5	10	8.1	18.1
Multiflora rose	*Rosa multiflora*	5	0	5	10	7.3	17.3
Helleborine	*Epipactis helleborine*	10	0	1	11	5.0	16.0
Erect hedge parsley	*Torilis japonica*	5	0	5	10	5.9	15.9
Queen Anne's lace	*Daucus carota*	5	0	5	10	5.1	15.1
European cranberry-bush	*Viburnum opulus*	5	0	5	10	5.1	15.1
Common gypsy-weed	*Veronica officinalis*	5	0	5	10	4.9	14.9
Proso millet	*Panicum miliaceum*	5	0	5	10	3.9	13.9
Dame's rocket	*Hesperis matronalis*	5	0	1	6	7.7	13.7
Wood bluegrass	*Poa nemoralis*	5	0	5	10	3.6	13.6
White poplar	*Populus alba*	5	0	1	6	6.5	12.5
Scotch mist	*Galium sylvaticum*	5	0	1	6	4.1	10.1
Norway spruce	*Picea abies*	5	0	1	6	4.1	10.1
Strawberry clover	*Trifolium fragiferum*	5	0	1	6	3.6	9.6

Limestone Cliff / dry Cliff (EO ID 24373)

Limestone cliff is a state-imperiled community in Michigan consisting of inland vertical to near-vertical exposures of limestone bedrock (Cohen et al. 2015), while dry cliff classification in Wisconsin is considered apparently secure, but also comprises other rock types like sandstone (Epstein 2017). Dry cliffs are more common in the "driftless area" of southwestern Wisconsin. In Michigan the limestone cliff community is limited to six counties, found along the Niagara Escarpment, and is typically near the Great Lakes shorelines at the margin of boreal or mesic northern forest. Vascular vegetation is sparse, with less than 25% coverage, though lichens and non-vascular plants can be locally abundant. Vascular plants occur mostly in ledges and cracks and at the base of the cliff. The upper ledge tends to be forested with trees such as sugar maple (*Acer saccharum*), northern white cedar, and balsam fir (*Abies balsamifera*; Figure 7). Continuous erosion restricts soil development to cracks and cliff bases. Threats to limestone cliffs include logging of adjacent uplands and associated soil erosion, excessive foot traffic on the upper edge, rock climbing, and invasive plants (Kost et al. 2007, Cohen et al. 2015, Cohen et al. 2020).

Figure 7. Limestone cliff on Detroit Island, Green Bay National Wildlife Refuge. Photo: Joshua G Cohen, July 15, 2022.

Sensitive resources: [redacted]

[redacted]

Important biotic factors: The vegetation is sparse. Herbaceous vegetation included common polypody (*Polypodium virginianum*), alpine enchanter's nightshade (*Circaea alpina*), herb Robert, hairy sweet-cicely (*Osmorhiza claytonii*), fringed false buckwheat (*Fallopia cilinodis*), wild sarsaparilla (*Aralia nudicaulis*), wild leek (*Allium tricoccum*), jack-in-the-pulpit (*Arisaema triphyllum*), cow-parsnip (*Heracleum sphondylium* ssp. *montanum*), and blue cohosh (*Caulophyllum thalictroides*). Shrubs included red elderberry, beaked hazelnut (*Corylus cornuta*), chokecherry, wild red raspberry, and thimbleberry (*Rubus parviflorus*). Trees scattered along the lip and on ledges and crevices included sugar maple, northern white cedar, and paper birch. One white cedar 7.7 in (19.6 cm) in diameter was aged to be over 33 years old.

Important abiotic factors: The natural community on Detroit Island consists of two mapped polygons covering 0.7 ac (0.3 ha), surrounded by disturbed mesic northern forest (Figure 2). The cliffs are west facing AND relatively short, with heights ranging from 3 to 10 ft (1 to 3 m). Soils accumulating in cracks, on ledges, and around tree trunks are thin, fine-textured alkaline organics (Cohen et al. 2022).

Identified vectors and pathways: Occasional human and animal visitors may travel along the cliffs as vegetation can be sparse. Such traffic can promote invasives species spread across the island.

Gaps in communities adjacent to limestone cliff / dry cliff change microhabitats and may increase pathways for invasive plant species. American beech (*Fagus grandifolia*) is a component of the canopy in the surrounding disturbed mesic northern forest, and its status is threatened by beech bark disease. Beech bark disease was first observed in Door County, Wisconsin, in September 2009 and has since spread westward and southward with noticeable mortality occurring in Door County.

Invasive plant status: Five non-native species were present in total. One Priority 1 species was found infrequently on the limestone cliff / dry cliff: bush honeysuckle. The patch was approximately 16 ft^2 (1.5 m^2) between two polygons of Laurentian bladder ferns. Canada bluegrass was locally common (Bassett et al. 2022, Cohen et al. 2022).

The most likely new invaders of this area include two Priority 1 species and seven Priority 2 species that scored greater than 20 due to suitable habitat and/or proximity in adjacent areas/nearby islands (Table 10).

- Garlic mustard
- Japanese barberry
- Spotted knapweed
- Autumn olive
- Dame's rocket (*Hesperis matronalis*)
- Erect hedge-parsley (*Torilis japonica)*
- Multiflora rose (*Rosa multiflora)*
- Leafy spurge (*Euphorbia esula*)

Table 10. IPIEDPT area-species link scores for the limestone cliff / dry cliff area. Species with a non-zero "Status Score" were observed in the area during the 2021 surveys (Cohen et al. 2022). Priority 1 species that had present status in the area were bolded. As bush honeysuckle (*Lonicera* sp.) observed on the island all have the same NatureServe rankings, they are pooled together in the table. Appendix 3, Table 3-3 lists all area-species links by species, and it lists additional common names.

Common Name	Scientific Name ITIS	Presence Score	Status Score	Habitat Score	Total Score	Species Score	Overall Score
Bush honeysuckle	***Lonicera* sp.**	**10**	**5**	**10**	**25**	**8.5**	**33.5**
Canada bluegrass	*Poa compressa*	10	7	10	27	4.1	31.1
Kentucky bluegrass	*Poa pratensis*	10	7	10	27	3.4	30.4
Garlic mustard	*Alliaria petiolata*	10	0	10	20	9.4	29.4
Marsh thistle	*Cirsium palustre*	10	0	10	20	6.8	26.8
Bull thistle	*Cirsium vulgare*	10	0	10	20	6.8	26.8
Houndstongue	*Cynoglossum officinale*	10	0	10	20	6.8	26.8
Motherwort	*Leonurus cardiaca*	10	7	5	22	4.1	26.1
Cat-nip	*Nepeta cataria*	10	7	5	22	3.6	25.6
Bittersweet nightshade, woody nightshade	*Solanum dulcamara*	10	0	10	20	4.9	24.9
Goldmoss stonecrop	*Sedum acre*	10	0	10	20	4.4	24.4
Flannel plant, common mullein	*Verbascum thapsus*	10	0	10	20	4.4	24.4
Jack-go-to-bed-at-noon	*Tragopogon pratensis*	10	0	10	20	4.3	24.3
White campion	*Silene latifolia*	10	0	10	20	4.1	24.1
Spotted knapweed	*Centaurea stoebe* ssp. *micranthos*	5	0	10	15	9.0	24.0
Common mouse-ear chickweed	*Cerastium fontanum* ssp. *vulgare*	10	0	10	20	3.9	23.9
Dandelion	*Taraxacum officinale*	10	0	10	20	3.6	23.6
Leafy spurge	*Euphorbia esula*	5	0	10	15	8.1	23.1
Dame's rocket	*Hesperis matronalis*	5	0	10	15	7.7	22.7
Multiflora rose	*Rosa multiflora*	5	0	10	15	7.3	22.3
Garden valerian, common valerian	*Valeriana officinalis*	5	0	10	15	7.3	22.3
Autumn-olive	*Elaeagnus umbellata*	5	0	10	15	6.1	21.1
Erect hedge parsley	*Torilis japonica*	5	0	10	15	5.9	20.9
Quackgrass	*Elymus repens*	10	0	5	15	5.7	20.7
Lesser burdock	*Arctium minus*	5	0	10	15	5.1	20.1
Common hempnettle	*Galeopsis tetrahit*	5	0	10	15	5.1	20.1
Japanese barberry	*Berberis thunbergii*	10	0	1	11	9.0	20.0
Helleborine	*Epipactis helleborine*	10	0	5	15	5.0	20.0
Redtop	*Agrostis gigantea*	5	0	10	15	4.9	19.9
Common timothy	*Phleum pratense*	10	0	5	15	4.9	19.9
Common gypsy-weed	*Veronica officinalis*	5	0	10	15	4.9	19.9
Orange hawkweed	*Hieracium aurantiacum*	5	0	10	15	4.5	19.5

Common Name	Scientific Name ITIS	Presence Score	Status Score	Habitat Score	Total Score	Species Score	Overall Score
Soapwort, bouncing bet	*Saponaria officinalis*	5	0	10	15	4.5	19.5
Thyme-leaf speedwell	*Veronica serpyllifolia*	5	0	10	15	4.5	19.5
Orchard grass	*Dactylis glomerata*	10	0	5	15	4.1	19.1
Scotch mist	*Galium sylvaticum*	5	0	10	15	4.1	19.1
Spotted ladysthumb, ladysthumb	*Persicaria maculosa*	10	0	5	15	4.1	19.1
Tall buttercup	*Ranunculus acris*	5	0	10	15	4.1	19.1
Bitter dock, broadleaf dock	*Rumex obtusifolius*	10	0	5	15	4.1	19.1
Black bindweed, wild buckwheat	*Fallopia convolvulus*	10	0	5	15	3.7	18.7
Wood bluegrass	*Poa nemoralis*	5	0	10	15	3.6	18.6
Canada thistle	*Cirsium arvense*	5	0	5	10	7.6	17.6
Wild parsnip	*Pastinaca sativa*	5	0	5	10	7.3	17.3
Wormseed wallflower	*Erysimum cheiranthoides*	10	0	1	11	4.9	15.9
Common St. John's wort	*Hypericum perforatum*	10	0	1	11	4.4	15.4
Butter and eggs	*Linaria vulgaris*	10	0	1	11	4.4	15.4
Queen Anne's lace	*Daucus carota*	5	0	5	10	5.1	15.1
Yellow hawkweed	*Hieracium caespitosum*	10	0	1	11	4.1	15.1
Purple loosestrife	*Lythrum salicaria*	5	0	1	6	9.1	15.1
Common reed	*Phragmites australis* ssp. *australis*	5	0	1	6	9.1	15.1
European cranberry-bush	*Viburnum opulus*	5	0	5	10	5.1	15.1
Reed canary grass	*Phalaris arundinacea*	5	0	1	6	9.1	15.1
Black medick	*Medicago lupulina*	5	0	5	10	4.5	14.5
Meadow fescue	*Schedonorus pratensis*	5	0	5	10	4.5	14.5
Red clover	*Trifolium pratense*	5	0	5	10	4.5	14.5
Bladder campion	*Silene vulgaris*	5	0	5	10	4.1	14.1
Narrow-leaf cat-tail	*Typha angustifolia*	5	0	0	5	9.0	14.0
Annual bluegrass	*Poa annua*	5	0	5	10	3.6	13.6
White poplar	*Populus alba*	5	0	1	6	6.5	12.5
White sweet-clover	*Melilotus albus*	5	0	1	6	6.3	12.3
Smallflower hairy willow herb	*Epilobium parviflorum*	5	0	1	6	5.3	11.3
Norway spruce	*Picea abies*	5	0	1	6	4.1	10.1
Ox-eye daisy	*Leucanthemum vulgare*	5	0	1	6	4.0	10.0
Proso millet	*Panicum miliaceum*	5	0	1	6	3.9	9.9
Strawberry clover	*Trifolium fragiferum*	5	0	1	6	3.6	9.6

Limestone Cobble Shore / Great Lakes Alkaline Rockshore (EO ID 24375)

Limestone cobble shore / Great Lakes alkaline rockshore is a state-imperiled community that occurs in only Door County in Wisconsin (WDNR 2015). 'Cobble' refers to the size of the limestone pieces. which are larger than gravel but smaller than boulders. Limestone cobble shore communities occur on islands and on the mainland along the Niagara Escarpment. Vegetation is sparse and varies with water levels (Figure 8). It consists of herbs and scattered shrubs along the open shore and is often backed by a thicket of trees and shrubs such as northern white cedar, paper birch, quaking aspen (*Populus trembuloides*), white spruce, soapberry (*Shepherdia canadensis*), tag alder (*Alnus incana*), and shrubby cinquefoil (Cohen et al. 2015). Threats to limestone cobble shore include unauthorized off-road vehicle recreation and invasive plant species (Kost et al. 2007, Cohen et al. 2020).

Figure 8. Limestone cobble shore on Detroit Island, Green Bay National Wildlife Refuge. Photo: Scott M Warner, July 15, 2021.

Sensitive resources: [redacted]

Important biotic factors: Vegetation is absent to sparse, mostly limited to between cobbles and near the upper margin of shore. It was likely denser before the recent consecutive highwater years (2016 to 2020). The eastern shore supported greater amounts of vegetation, suggesting that higher wind and wave activity occurred on the western shore (Cohen et al. 2022). Characteristic herbaceous vegetation included silverweed, herb Robert, wild sarsaparilla, white camas, and harebell (*Campanula rotundifolia*). The upper margins are scattered trees and shrubs: northern white cedar, green ash, American elm (*Ulmus americana*), mountain-ash (*Sorbus decora*), red elderberry, chokecherry, ninebark (*Physocarpus opulifolius*) and wild red raspberry. One 7 in (17.8 cm) diameter white cedar was aged at 114 years old.

Important abiotic factors: The limestone cobble shore EO occupies 9.8 ac (4 ha) along both eastern and western shores of Detroit Island (Figure 2). It grades intermittently into small stretches of limestone bedrock lakeshore. Cobbles dominate the surface, providing little substrate for plant growth. Between cobbles, the soil is wet, alkaline, gravelly sand mixed with organics. Wind, waves, ice, and fluctuating water levels make for a harsh, unstable environment. Occasionally, the cobbles grade into small lengths of limestone bedrock lakeshore (Cohen et al. 2022).

Identified vectors and pathways: The position along the lake makes this community vulnerable to shore invaders. Deer and human visitors are likely to walk along the shore and bring seeds of invasives on gear, hair, and clothing.

Invasive plant status: Twelve non-native species were present in total, with woody species likely along the border with the disturbed mesic forest. One Priority 1 invasive species was present along the border with the disturbed mesic forest: bush honeysuckle (Bassett et al. 2022). One the east side of the island, stretches of 33 ft (10 m), 79 ft (24 m), and 436 ft (133 m) were mapped along with patches of 24 ft^2 (2 m^2), 36 ft^2 (3 m^2), and 100 ft^2 (9 m^2). On the west side one stretch of 38 m was mapped with five patches ranging from 1 to 9 ft^2 (0.1 to 1 m^2) and one patch of 25 ft^2 (2 m^2; Figure 4). Canada bluegrass was found locally common near white camas on the eastern shore (Cohen et al. 2022). Only thistles (*Cirsium* sp.) and houndstongue (*Cynoglossum officinale*) among Priority 3 species were mapped.

The most likely new invaders of this area include one Priority 1 species and seven Priority 2 species that scored greater than 20 due to suitable habitat and/or proximity in adjacent areas/nearby islands (Table 11).

- Japanese barberry
- Spotted knapweed
- Autumn olive
- White sweet-clover
- Wild parsnip
- Invasive common reed

- Purple loosestrife
- Narrow-leaf cat-tail

Table 11. IPIEDPT area-species link scores for the limestone cobble shore area / Great Lakes alkaline rockshore. Species with a non-zero "Status Score" were observed in the area during the 2021 surveys (Cohen et al. 2022). Priority 1 species that had present status in the area were bolded. As bush honeysuckle (*Lonicera* sp.) observed on the island all have the same NatureServe rankings, they are pooled together in the table. Appendix 3, Table 3-3 lists all area-species links by species, and it lists additional common names.

Common Name	Scientific Name ITIS	Presence Score	Status Score	Habitat Score	Total Score	Species Score	Overall Score
Quackgrass	*Elymus repens*	10	7	10	27	5.7	32.7
Flannel plant, common mullein	*Verbascum thapsus*	10	7	10	27	4.4	31.4
Spotted ladysthumb, ladysthumb	*Persicaria maculosa*	10	7	10	27	4.1	31.1
White campion	*Silene latifolia*	10	7	10	27	4.1	31.1
Cat-nip	*Nepeta cataria*	10	7	10	27	3.6	30.6
Bush honeysuckle	***Lonicera* sp.**	**10**	**1**	**10**	**21**	**8.5**	**29.5**
Marsh thistle	*Cirsium palustre*	10	1	10	21	6.8	27.8
Bull thistle	*Cirsium vulgare*	10	1	10	21	6.8	27.8
Houndstongue	*Cynoglossum officinale*	10	0	10	20	6.8	26.8
Common St. John's wort	*Hypericum perforatum*	10	7	5	22	4.4	26.4
Yellow hawkweed	*Hieracium caespitosum*	10	7	5	22	4.1	26.1
Canada bluegrass	*Poa compressa*	10	7	5	22	4.1	26.1
Butter and eggs	*Linaria vulgaris*	10	1	10	21	4.4	25.4
Wormseed wallflower	*Erysimum cheiranthoides*	10	0	10	20	4.9	24.9
Common timothy	*Phleum pratense*	10	0	10	20	4.9	24.9
Bittersweet nightshade	*Solanum dulcamara*	10	0	10	20	4.9	24.9
Goldmoss stonecrop	*Sedum acre*	10	0	10	20	4.4	24.4
Jack-go-to-bed-at-noon	*Tragopogon pratensis*	10	0	10	20	4.3	24.3
Purple loosestrife	*Lythrum salicaria*	5	0	10	15	9.1	24.1
Common reed	*Phragmites australis* ssp. *australis*	5	0	10	15	9.1	24.1
Spotted knapweed	*Centaurea stoebe* ssp. *micranthos*	5	0	10	15	9.0	24.0
Narrow-leaf cat-tail	*Typha angustifolia*	5	0	10	15	9.0	24.0
Dandelion	*Taraxacum officinale*	10	0	10	20	3.6	23.6
Kentucky bluegrass	*Poa pratensis*	10	0	10	20	3.4	23.4
Canada thistle	*Cirsium arvense*	5	0	10	15	7.6	22.6
Wild parsnip	*Pastinaca sativa*	5	0	10	15	7.3	22.3
Common valerian	*Valeriana officinalis*	5	0	10	15	7.3	22.3
White sweet-clover	*Melilotus albus*	5	0	10	15	6.3	21.3
Autumn-olive	*Elaeagnus umbellata*	5	0	10	15	6.1	21.1
Smallflower hairy willow herb	*Epilobium parviflorum*	5	0	10	15	5.3	20.3

Common Name	Scientific Name ITIS	Presence Score	Status Score	Habitat Score	Total Score	Species Score	Overall Score
Lesser burdock	*Arctium minus*	5	0	10	15	5.1	20.1
Common hempnettle	*Galeopsis tetrahit*	5	0	10	15	5.1	20.1
Japanese barberry	*Berberis thunbergii*	10	0	1	11	9.0	20.0
Redtop	*Agrostis gigantea*	5	0	10	15	4.9	19.9
Orange hawkweed	*Hieracium aurantiacum*	5	0	10	15	4.5	19.5
Black medick	*Medicago lupulina*	5	0	10	15	4.5	19.5
Soapwort, bouncing bet	*Saponaria officinalis*	5	0	10	15	4.5	19.5
Meadow fescue	*Schedonorus pratensis*	5	0	10	15	4.5	19.5
Red clover	*Trifolium pratense*	5	0	10	15	4.5	19.5
Thyme-leaf speedwell	*Veronica serpyllifolia*	5	0	10	15	4.5	19.5
Garlic mustard	*Alliaria petiolata*	10	0	0	10	9.4	19.4
Orchard grass	*Dactylis glomerata*	10	0	5	15	4.1	19.1
Motherwort	*Leonurus cardiaca*	10	0	5	15	4.1	19.1
Tall buttercup	*Ranunculus acris*	5	0	10	15	4.1	19.1
Bitter dock, broadleaf dock	*Rumex obtusifolius*	10	0	5	15	4.1	19.1
Reed canary grass	*Phalaris arundinacea*	5	0	5	10	9.1	19.1
Ox-eye daisy	*Leucanthemum vulgare*	5	0	10	15	4.0	19.0
Common mouse-ear chickweed	*Cerastium fontanum* ssp. *vulgare*	5	0	10	15	3.9	18.9
Black bindweed, wild buckwheat	*Fallopia convolvulus*	10	0	5	15	3.7	18.7
Annual bluegrass	*Poa annua*	5	0	10	15	3.6	18.6
Leafy spurge	*Euphorbia esula*	5	0	5	10	8.1	18.1
Multiflora rose	*Rosa multiflora*	5	0	5	10	7.3	17.3
Helleborine	*Epipactis helleborine*	10	0	1	11	5.0	16.0
Erect hedge parsley	*Torilis japonica*	5	0	5	10	5.9	15.9
Queen Anne's lace	*Daucus carota*	5	0	5	10	5.1	15.1
European cranberry-bush	*Viburnum opulus*	5	0	5	10	5.1	15.1
Common gypsy-weed	*Veronica officinalis*	5	0	5	10	4.9	14.9
Bladder campion	*Silene vulgaris*	5	0	5	10	4.1	14.1
Proso millet	*Panicum miliaceum*	5	0	5	10	3.9	13.9
Dame's rocket	*Hesperis matronalis*	5	0	1	6	7.7	13.7
Wood bluegrass	*Poa nemoralis*	5	0	5	10	3.6	13.6
White poplar	*Populus alba*	5	0	1	6	6.5	12.5
Scotch mist	*Galium sylvaticum*	5	0	1	6	4.1	10.1
Norway spruce	*Picea abies*	5	0	1	6	4.1	10.1
Strawberry clover	*Trifolium fragiferum*	5	0	1	6	3.6	9.6

Limestone Lakeshore Cliff / moist Cliff (EO ID 24372)

Limestone lakeshore cliff from Michigan's natural community classification system is made up of vertical exposures of limestone along the Great Lakes (Cohen et al. 2015). In Wisconsin, this community is placed in the moist cliff category, which contains both lakeside and inland cliffs, and occurs throughout most of the state (WDNR 2015). Their sparse soils are exposed to desiccating wind, ice, and sun. Substrate is periodically lost when weathering sloughs off bedrock. These stressful and unstable conditions support a sparse vascular plant assemblage, though the ridge top may be forested with species such as red oak (*Quercus rubra*), sugar maple, northern white cedar, balsam fir, and paper birch (Figure 9). In Wisconsin, moist cliff is apparently secure (WDNR 2015), but the limestone lakeshore cliff community is considered critically imperiled in Michigan (Cohen et al. 2015). This disagreement between the classifications is likely due to the Wisconsin classification including cliffs not on the Great Lakes. Threats to limestone lakeshore cliffs include shoreline development, logging of adjacent uplands and associated soil erosion, excessive foot traffic along upper edge, rock climbing, and invasive plants (Kost et al. 2007, Cohen et al. 2020).

Figure 9. Limestone Lakeshore Cliff on Detroit Island, Green Bay National Wildlife Refuge. Photo: Joshua G Cohen, July 15, 2022.

Sensitive resources: [redacted]

Important biotic factors: Vegetation is sparse, generally limited to flat, exposed bedrock, and cracks, ledges, and joints in the cliff face. Vegetation was sparse but includes harebell, herb Robert, wild columbine (*Aquilegia canadensis*), false spikenard (*Maianthemum racemosum*), wild strawberry, and common polypody. Mosses are locally common. Stunted and scattered northern white cedar and sugar maples occurred along lip and on ledges and crevices (Cohen et al. 2022).

Important abiotic factors: There are stretches of limestone lakeshore cliff / moist cliff along both shorelines of Detroit Island, but only a small area of 0.3 ac (0.1 ha) occurs on federal lands in the northeast section of the property. The cliffs are low, ranging from 6.5 to 16.4 ft (2 to 5 m) tall. Soils are very shallow, fine-textured, and alkaline that accumulate on ledges, crevices and at the base of tree boles. Thin soils, cold winter temperatures, and desiccating winds make for harsh conditions (Cohen et al. 2022). Thin soil leads to frequent windthrow of canopy trees in this community (Cohen et al. 2015).

Identified vectors and pathways: The position along the lake makes this community vulnerable to shore invaders. Deer and human visitors are likely to walk along the ridge and bring seeds of invasives on gear, hair, and clothing.

Invasive plant status: Six non-native species were present in total. One Priority 1 invasive species was present along the border with the disturbed mesic forest: bush honeysuckle (*Lonicera* sp.; Bassett et al. 2022). Five patches ranging from 1 to 40 ft^2 (0.1 to 4 m^2) were mapped near the cliffs. Canada bluegrass and cat-nip (*Nepeta cataria*) were locally common.

The most likely new invaders of this area include one Priority 1 species and six Priority 2 species that scored greater than 20 due to suitable habitat and/or proximity in adjacent areas/nearby islands (Table 12):

- Japanese barberry
- Spotted knapweed
- Autumn olive
- Purple loosestrife
- White sweet-clover
- Wild parsnip
- Invasive common reed
- Narrow-leaf cat-tail

Table 12. IPIEDPT area-species link scores for the limestone lakeshore cliff area / moist cliff. Species with a non-zero "Status Score" were observed in the area during the 2021 surveys (Cohen et al. 2022). Priority 1 species that had present status in the area were bolded. As bush honeysuckle (*Lonicera* sp.) observed on the island all have the same NatureServe rankings, they are pooled together in the table. Appendix 3, Table 3-3 lists all area-species links by species, and it lists additional common names.

Common Name	Scientific Name ITIS	Presence Score	Status Score	Habitat Score	Total Score	Species Score	Overall Score
Canada bluegrass	*Poa compressa*	10	7	10	27	4.1	31.1
Common mouse-ear chickweed	*Cerastium fontanum* ssp. *vulgare*	10	7	10	27	3.9	30.9
Cat-nip	*Nepeta cataria*	10	7	10	27	3.6	30.6
Dandelion	*Taraxacum officinale*	10	7	10	27	3.6	30.6
Kentucky bluegrass	*Poa pratensis*	10	7	10	27	3.4	30.4
Bush honeysuckle	***Lonicera* sp.**	**10**	**1**	**10**	**21**	**8.5**	**29.5**
Marsh thistle	*Cirsium palustre*	10	0	10	20	6.8	26.8
Bull thistle	*Cirsium vulgare*	10	0	10	20	6.8	26.8
Houndstongue	*Cynoglossum officinale*	10	0	10	20	6.8	26.8
Quackgrass	*Elymus repens*	10	0	10	20	5.7	25.7
Wormseed wallflower	*Erysimum cheiranthoides*	10	0	10	20	4.9	24.9
Common timothy	*Phleum pratense*	10	0	10	20	4.9	24.9
Bittersweet nightshade, woody nightshade	*Solanum dulcamara*	10	0	10	20	4.9	24.9
Butter and eggs	*Linaria vulgaris*	10	0	10	20	4.4	24.4
Goldmoss stonecrop	*Sedum acre*	10	0	10	20	4.4	24.4
Flannel plant, common mullein	*Verbascum thapsus*	10	0	10	20	4.4	24.4
Jack-go-to-bed-at-noon	*Tragopogon pratensis*	10	0	10	20	4.3	24.3
Purple loosestrife	*Lythrum salicaria*	5	0	10	15	9.1	24.1
Spotted ladysthumb, ladysthumb	*Persicaria maculosa*	10	0	10	20	4.1	24.1
Common reed	*Phragmites australis* ssp. *australis*	5	0	10	15	9.1	24.1
White campion	*Silene latifolia*	10	0	10	20	4.1	24.1
Spotted knapweed	*Centaurea stoebe* ssp. *micranthos*	5	0	10	15	9.0	24.0
Narrow-leaf cat-tail	*Typha angustifolia*	5	0	10	15	9.0	24.0
Canada thistle	*Cirsium arvense*	5	0	10	15	7.6	22.6
Wild parsnip	*Pastinaca sativa*	5	0	10	15	7.3	22.3
Common valerian	*Valeriana officinalis*	5	0	10	15	7.3	22.3
White sweet-clover	*Melilotus albus*	5	0	10	15	6.3	21.3
Autumn-olive	*Elaeagnus umbellata*	5	0	10	15	6.1	21.1
Smallflower hairy willow herb	*Epilobium parviflorum*	5	0	10	15	5.3	20.3
Lesser burdock	*Arctium minus*	5	0	10	15	5.1	20.1
Common hempnettle	*Galeopsis tetrahit*	5	0	10	15	5.1	20.1
Japanese barberry	*Berberis thunbergii*	10	0	1	11	9.0	20.0

Common Name	Scientific Name ITIS	Presence Score	Status Score	Habitat Score	Total Score	Species Score	Overall Score
Redtop	*Agrostis gigantea*	5	0	10	15	4.9	19.9
Orange hawkweed	*Hieracium aurantiacum*	5	0	10	15	4.5	19.5
Black medick	*Medicago lupulina*	5	0	10	15	4.5	19.5
Soapwort, bouncing bet	*Saponaria officinalis*	5	0	10	15	4.5	19.5
Meadow fescue	*Schedonorus pratensis*	5	0	10	15	4.5	19.5
Red clover	*Trifolium pratense*	5	0	10	15	4.5	19.5
Thyme-leaf speedwell	*Veronica serpyllifolia*	5	0	10	15	4.5	19.5
Garlic mustard	*Alliaria petiolata*	10	0	0	10	9.4	19.4
Common St. John's wort	*Hypericum perforatum*	10	0	5	15	4.4	19.4
Orchard grass	*Dactylis glomerata*	10	0	5	15	4.1	19.1
Yellow hawkweed	*Hieracium caespitosum*	10	0	5	15	4.1	19.1
Motherwort	*Leonurus cardiaca*	10	0	5	15	4.1	19.1
Tall buttercup	*Ranunculus acris*	5	0	10	15	4.1	19.1
Bitter dock, broadleaf dock	*Rumex obtusifolius*	10	0	5	15	4.1	19.1
Bladder campion	*Silene vulgaris*	5	0	10	15	4.1	19.1
Reed canary grass	*Phalaris arundinacea*	5	0	5	10	9.1	19.1
Ox-eye daisy	*Leucanthemum vulgare*	5	0	10	15	4.0	19.0
Black bindweed, wild buckwheat	*Fallopia convolvulus*	10	0	5	15	3.7	18.7
Annual bluegrass	*Poa annua*	5	0	10	15	3.6	18.6
Leafy spurge	*Euphorbia esula*	5	0	5	10	8.1	18.1
Multiflora rose	*Rosa multiflora*	5	0	5	10	7.3	17.3
Helleborine	*Epipactis helleborine*	10	0	1	11	5.0	16.0
Erect hedge parsley	*Torilis japonica*	5	0	5	10	5.9	15.9
Queen Anne's lace	*Daucus carota*	5	0	5	10	5.1	15.1
European cranberry-bush	*Viburnum opulus*	5	0	5	10	5.1	15.1
Common gypsy-weed	*Veronica officinalis*	5	0	5	10	4.9	14.9
Proso millet	*Panicum miliaceum*	5	0	5	10	3.9	13.9
Dame's rocket	*Hesperis matronalis*	5	0	1	6	7.7	13.7
Wood bluegrass	*Poa nemoralis*	5	0	5	10	3.6	13.6
White poplar	*Populus alba*	5	0	1	6	6.5	12.5
Scotch mist	*Galium sylvaticum*	5	0	1	6	4.1	10.1
Norway spruce	*Picea abies*	5	0	1	6	4.1	10.1
Strawberry clover	*Trifolium fragiferum*	5	0	1	6	3.6	9.6

Sand and Gravel Beach / Great Lakes Beach (EO ID 24387)

Sand and gravel beach / Great Lakes beach is considered imperiled in Wisconsin and vulnerable in Michigan (Cohen et al. 2015, WDNR 2015). It occurs along the margins of the Great Lakes where regular disturbance of wind, waves, and ice maintain an open beach with sparse vegetation (Figure 10). Characteristic vegetation includes seaside spurge (*Euphorbia polygonifolia*), American sea-rocket (*Cakile edentula*), silverweed, Baltic rush, and water horehound (*Lycopus americanus*). These areas are important for migrating and resident birds to forage, rest, and breed (WDNR 2015).

Figure 10. Sand and gravel beech on Detroit Island, Green Bay National Wildlife Refuge. Photo: Joshua G Cohen, July 15, 2022.

Sensitive resources: [redacted]

Important biotic factors: Vegetation along the beach ranges from abundant to sparse. Scattered trees along the upper margin of the beach include northern white cedar, paper birch, and green ash. High Great Lakes water levels (2016 to 2020) have drowned much of the woody vegetation growing within and near the sand and gravel beach and likely reduced the overall herbaceous cover as well (Cohen et al. 2022).

Important abiotic factors: The sand and gravel beach / Great Lakes beach on the western shoreline of Detroit Island ranges from 20 to 40 ft (6 to 12 m) wide. The portion on federal lands stretches only 164 ft (50 m), but longer stretches can be seen on non-federal lands. The sand is alkaline and medium-textured with gravel and cobble intermixed. High Great Lakes water levels (from 2016 through 2020) have impacted both abiotic and biotic factors (e.g., substrate deposition/erosion, plant growth; Cohen et al. 2022).

Identified vectors and pathways: Foot and off-road vehicle (ORV) traffic along the beach is a pathway for spread of invasive species. The position along the lake makes this community vulnerable to shore invaders.

Invasive plant status: No invasive species were noted during the 2021 surveys (Bassett et al. 2022, Cohen et al. 2022).

The most likely new invaders of this area include two Priority 1 species and nine Priority 2 species that scored greater than 20 due to suitable habitat and/or proximity in adjacent areas/nearby islands (Table 13):

- Japanese barberry
- Canada thistle
- Spotted knapweed
- Autumn olive
- Leafy spurge
- Dame's rocket
- Bush honeysuckle
- Purple loosestrife
- White sweet-clover
- Wild parsnip
- Invasive common reed

Table 13. IPIEDPT area-species link scores for the sand and gravel beach / Great Lakes beach area. Species with a non-zero "Status Score" were observed in the area during the 2021 surveys (Cohen et al. 2022). Priority 1 species that had present status in the area were bolded. As bush honeysuckle (*Lonicera* sp.) observed on the island all have the same NatureServe rankings, they are pooled together in the table. Appendix 3, Table 3-3 lists all area-species links by species, and it lists additional common names.

Common Name	Scientific Name ITIS	Presence Score	Status Score	Habitat Score	Total Score	Species Score	Overall Score
Bush honeysuckle	*Lonicera* sp.	10	0	10	20	8.5	28.5
Marsh thistle	*Cirsium palustre*	10	0	10	20	6.8	26.8
Bull thistle	*Cirsium vulgare*	10	0	10	20	6.8	26.8
Houndstongue	*Cynoglossum officinale*	10	0	10	20	6.8	26.8
Quackgrass	*Elymus repens*	10	0	10	20	5.7	25.7
Wormseed wallflower	*Erysimum cheiranthoides*	10	0	10	20	4.9	24.9
Bittersweet nightshade, woody nightshade	*Solanum dulcamara*	10	0	10	20	4.9	24.9
Common St. John's wort	*Hypericum perforatum*	10	0	10	20	4.4	24.4
Butter and eggs	*Linaria vulgaris*	10	0	10	20	4.4	24.4
Goldmoss stonecrop	*Sedum acre*	10	0	10	20	4.4	24.4
Flannel plant, common mullein	*Verbascum thapsus*	10	0	10	20	4.4	24.4
Jack-go-to-bed-at-noon	*Tragopogon pratensis*	10	0	10	20	4.3	24.3
Purple loosestrife	*Lythrum salicaria*	5	0	10	15	9.1	24.1
Spotted ladysthumb, ladysthumb	*Persicaria maculosa*	10	0	10	20	4.1	24.1
Common reed	*Phragmites australis* ssp. *australis*	5	0	10	15	9.1	24.1
White campion	*Silene latifolia*	10	0	10	20	4.1	24.1
Japanese barberry	*Berberis thunbergii*	10	0	5	15	9.0	24.0
Spotted knapweed	*Centaurea stoebe* ssp. *micranthos*	5	0	10	15	9.0	24.0
Narrow-leaf cat-tail	*Typha angustifolia*	5	0	10	15	9.0	24.0
Common mouse-ear chickweed	*Cerastium fontanum* ssp. *vulgare*	10	0	10	20	3.9	23.9
Cat-nip	*Nepeta cataria*	10	0	10	20	3.6	23.6
Leafy spurge	*Euphorbia esula*	5	0	10	15	8.1	23.1
Dame's rocket	*Hesperis matronalis*	5	0	10	15	7.7	22.7
Canada thistle	*Cirsium arvense*	5	0	10	15	7.6	22.6
Wild parsnip	*Pastinaca sativa*	5	0	10	15	7.3	22.3
White sweet-clover	*Melilotus albus*	5	0	10	15	6.3	21.3
Autumn-olive	*Elaeagnus umbellata*	5	0	10	15	6.1	21.1
Smallflower hairy willow herb	*Epilobium parviflorum*	5	0	10	15	5.3	20.3
Lesser burdock	*Arctium minus*	5	0	10	15	5.1	20.1
Common hempnettle	*Galeopsis tetrahit*	5	0	10	15	5.1	20.1
Redtop	*Agrostis gigantea*	5	0	10	15	4.9	19.9
Common timothy	*Phleum pratense*	10	0	5	15	4.9	19.9

Common Name	Scientific Name ITIS	Presence Score	Status Score	Habitat Score	Total Score	Species Score	Overall Score
Orange hawkweed	*Hieracium aurantiacum*	5	0	10	15	4.5	19.5
Soapwort, bouncing bet	*Saponaria officinalis*	5	0	10	15	4.5	19.5
Meadow fescue	*Schedonorus pratensis*	5	0	10	15	4.5	19.5
Red clover	*Trifolium pratense*	5	0	10	15	4.5	19.5
Garlic mustard	*Alliaria petiolata*	10	0	0	10	9.4	19.4
Orchard grass	*Dactylis glomerata*	10	0	5	15	4.1	19.1
Yellow hawkweed	*Hieracium caespitosum*	10	0	5	15	4.1	19.1
Motherwort	*Leonurus cardiaca*	10	0	5	15	4.1	19.1
Bitter dock, broadleaf dock	*Rumex obtusifolius*	10	0	5	15	4.1	19.1
Bladder campion	*Silene vulgaris*	5	0	10	15	4.1	19.1
Reed canary grass	*Phalaris arundinacea*	5	0	5	10	9.1	19.1
Ox-eye daisy	*Leucanthemum vulgare*	5	0	10	15	4.0	19.0
Black bindweed, wild buckwheat	*Fallopia convolvulus*	10	0	5	15	3.7	18.7
Dandelion	*Taraxacum officinale*	10	0	5	15	3.6	18.6
Multiflora rose	*Rosa multiflora*	5	0	5	10	7.3	17.3
Common valerian	*Valeriana officinalis*	5	0	5	10	7.3	17.3
White poplar	*Populus alba*	5	0	5	10	6.5	16.5
Helleborine	*Epipactis helleborine*	10	0	1	11	5.0	16.0
Erect hedge parsley	*Torilis japonica*	5	0	5	10	5.9	15.9
Queen Anne's lace	*Daucus carota*	5	0	5	10	5.1	15.1
European cranberry-bush	*Viburnum opulus*	5	0	5	10	5.1	15.1
Black medick	*Medicago lupulina*	5	0	5	10	4.5	14.5
Canada bluegrass	*Poa compressa*	5	0	5	10	4.1	14.1
Tall buttercup	*Ranunculus acris*	5	0	5	10	4.1	14.1
Proso millet	*Panicum miliaceum*	5	0	5	10	3.9	13.9
Annual bluegrass	*Poa annua*	5	0	5	10	3.6	13.6
Wood bluegrass	*Poa nemoralis*	5	0	5	10	3.6	13.6
Kentucky bluegrass	*Poa pratensis*	5	0	5	10	3.4	13.4
Common gypsy-weed	*Veronica officinalis*	5	0	1	6	4.9	10.9
Thyme-leaf speedwell	*Veronica serpyllifolia*	5	0	1	6	4.5	10.5
Scotch mist	*Galium sylvaticum*	5	0	1	6	4.1	10.1
Norway spruce	*Picea abies*	5	0	1	6	4.1	10.1
Strawberry clover	*Trifolium fragiferum*	5	0	1	6	3.6	9.6

Disturbed Mesic Northern Forest / Northern Mesic Forest

Mesic northern forest is a hardwood or hardwood-conifer forest dominated by trees such as sugar maple and American beech with frequent yellow birch (*Betula alleghaniensis*), basswood, red oak, hemlock (*Tsuga canadensis*), white pine (*Pinus strobus*), and in wetter areas, northern white cedar (Cohen et al. 2015). Natural disturbances in mesic northern forests include frequent but small-scale windthrow events. There is little evidence that fires were prominent or frequent. Mesic forests once covered most of the mesic uplands in the Great Lakes region, but most have been thoroughly logged at least once in the last 200 years (Cohen 2000). More novel threats to remnant and secondary growth mesic forests include non-native insects or a combination of insect-fungus invasions: emerald ash borer (*Agrilus planipennis*), hemlock wooly adelgid (*Adelges tsugae*), beech bark disease, and bumper years of the caterpillar spongy moth (*Lymantria dispar dispar*, formerly known as gypsy moth). These disturbances create larger and more frequent canopy gaps changing the microhabitats underneath.

This forest most closely resembles a mesic northern forest community, but the degree of anthropogenic disturbance has altered its state so it is difficult to recognize. Most of the forest is in a successional period, but even as it proceeds to a forest with more mature canopy and long-lived canopy species, it may not resemble a defined natural community as existed prior to European colonization and mass logging efforts. The ground cover and topography has been altered by previous logging events.

Sensitive resources: Although not considered a high quality habitat itself, the disturbed forest does border and surround several natural communities of EO quality (Figure 4). Near the limestone cliff / dry cliff, [redacted] (Bassett 2021).

Important biotic factors: Forested and logged areas resembling succeeding fields contained 84 plant species, including 16 non-native species. On Detroit Island, the canopy of the more intact portion is dominated by sugar maple with a diverse array of associates such as American beech, basswood, paper birch and northern white cedar. Larger trees were over 110 years old. Canopy beech trees have been impacted by beech bark disease. The understory is sparse to patchy with beaked hazelnut, mountain maple (*Acer spicatum*), and non-native bush honeysuckle. Ground cover was dense with characteristic species including stinging nettle (*Urtica dioica*), cow parsnip, alpine enchanter's nightshade, broad-leaf enchanter's nightshade (*Circaea canadensis*), herb Robert, jack-in-the-pulpit, yellow violet (*Viola pubescens*), wild sarsaparilla, and doll's-eyes (*Actaea pachypoda*). Low volumes of coarse woody debris littered the forest floor (Josh Cohen, Tyler Bassett, Scott Warner, *personal observation*).

Important abiotic factors: The topography is flat to gently rolling. The soils are shallow [8 in (20 cm)] sandy loams over limestone cobble and bedrock. Cut stumps and old logging roads occurred throughout (Josh Cohen, Tyler Bassett, Scott Warner, *personal observation*).

Identified vectors and pathways: Old logging roads provide avenues for human and animal visitors to transport invasive species propagules throughout the island. Additional biotic threats come from beech bark disease, earthworms, and caterpillar browse (Cohen et al. 2022).

Invasive plant status: Sixteen non-native species were present in total. All three Priority 1 invasive species of Detroit Island were present: garlic mustard, Japanese barberry, and bush honeysuckle (Figure 4). Garlic mustard was found in a small 6 ft^2 (0.6 m^2) patch. Japanese barberry was found in patches ranging from 4 to 20 ft^2 (0.4 to 2 m^2). Bush honeysuckle was found mostly along the edges of the disturbed mesic forest, but there were several patches mapped in the interior.

The most likely new invaders of this area include six Priority 2 species that scored greater than 20 due to suitable habitat and/or proximity in adjacent areas/nearby islands (Table 14):

- Canada thistle
- Dame's rocket
- Purple loosestrife
- Wild parsnip
- Erect hedge parsley
- Multiflora rose

Table 14. IPIEDPT area-species link scores for the mesic northern forest area. Species with a non-zero "Status Score" were observed in the area during the 2021 surveys (Cohen et al. 2022). Priority 1 species that had present status in area were bolded. As bush honeysuckle (*Lonicera* sp.) observed on the island all have the same NatureServe rankings, they are pooled together in the table. Appendix 3, Table 3-3 lists all area-species links by species, and it lists additional common names.

Common Name	Scientific Name ITIS	Presence Score	Status Score	Habitat Score	Total Score	Species Score	Overall Score
Garlic mustard	***Alliaria petiolata***	**10**	**10**	**10**	**30**	**9.4**	**39.4**
Houndstongue	*Cynoglossum officinale*	10	10	10	30	6.8	36.8
Japanese barberry	***Berberis thunbergii***	**10**	**5**	**10**	**25**	**9.0**	**34.0**
Helleborine	*Epipactis helleborine*	10	7	10	27	5.0	32.0
Bull thistle	*Cirsium vulgare*	10	5	10	25	6.8	31.8
Canada bluegrass	*Poa compressa*	10	7	10	27	4.1	31.1
Common mouse-ear chickweed	*Cerastium fontanum* ssp. *vulgare*	10	7	10	27	3.9	30.9
Kentucky bluegrass	*Poa pratensis*	10	7	10	27	3.4	30.4
Bush honeysuckle	***Lonicera* sp.**	**10**	**1**	**10**	**21**	**8.5**	**29.5**
Common St. John's wort	*Hypericum perforatum*	10	10	5	25	4.4	29.4
Quackgrass	*Elymus repens*	10	7	5	22	5.7	27.7
Common timothy	*Phleum pratense*	10	7	5	22	4.9	26.9
Marsh thistle	*Cirsium palustre*	10	0	10	20	6.8	26.8
Jack-go-to-bed-at-noon	*Tragopogon pratensis*	10	7	5	22	4.3	26.3
Orchard grass	*Dactylis glomerata*	10	7	5	22	4.1	26.1
Motherwort	*Leonurus cardiaca*	10	7	5	22	4.1	26.1
Cat-nip	*Nepeta cataria*	10	7	5	22	3.6	25.6
Bittersweet nightshade, woody nightshade	*Solanum dulcamara*	10	0	10	20	4.9	24.9
Flannel plant, common mullein	*Verbascum thapsus*	10	0	10	20	4.4	24.4
Purple loosestrife	*Lythrum salicaria*	5	0	10	15	9.1	24.1
Dandelion	*Taraxacum officinale*	10	0	10	20	3.6	23.6
Dame's rocket	*Hesperis matronalis*	5	0	10	15	7.7	22.7
Canada thistle	*Cirsium arvense*	5	0	10	15	7.6	22.6
Wild parsnip	*Pastinaca sativa*	5	0	10	15	7.3	22.3
Multiflora rose	*Rosa multiflora*	5	0	10	15	7.3	22.3
Garden valerian, common valerian	*Valeriana officinalis*	5	0	10	15	7.3	22.3
Autumn-olive	*Elaeagnus umbellata*	5	0	10	15	6.1	21.1
Erect hedge parsley	*Torilis japonica*	5	0	10	15	5.9	20.9
Lesser burdock	*Arctium minus*	5	0	10	15	5.1	20.1
Common hempnettle	*Galeopsis tetrahit*	5	0	10	15	5.1	20.1
Redtop	*Agrostis gigantea*	5	0	10	15	4.9	19.9
Common gypsy-weed	*Veronica officinalis*	5	0	10	15	4.9	19.9

Common Name	Scientific Name ITIS	Presence Score	Status Score	Habitat Score	Total Score	Species Score	Overall Score
Orange hawkweed	*Hieracium aurantiacum*	5	0	10	15	4.5	19.5
Soapwort, bouncing bet	*Saponaria officinalis*	5	0	10	15	4.5	19.5
Meadow fescue	*Schedonorus pratensis*	5	0	10	15	4.5	19.5
Red clover	*Trifolium pratense*	5	0	10	15	4.5	19.5
Thyme-leaf speedwell	*Veronica serpyllifolia*	5	0	10	15	4.5	19.5
Butter and eggs	*Linaria vulgaris*	10	0	5	15	4.4	19.4
Scotch mist	*Galium sylvaticum*	5	0	10	15	4.1	19.1
Spotted ladysthumb, ladysthumb	*Persicaria maculosa*	10	0	5	15	4.1	19.1
Reed canary grass	*Phalaris arundinacea*	5	0	5	10	9.1	19.1
Tall buttercup	*Ranunculus acris*	5	0	10	15	4.1	19.1
Bitter dock, broadleaf dock	*Rumex obtusifolius*	10	0	5	15	4.1	19.1
White campion	*Silene latifolia*	10	0	5	15	4.1	19.1
Wood bluegrass	*Poa nemoralis*	5	0	10	15	3.6	18.6
White poplar	*Populus alba*	5	0	5	10	6.5	16.5
Wormseed wallflower	*Erysimum cheiranthoides*	10	0	1	11	4.9	15.9
Goldmoss stonecrop	*Sedum acre*	10	0	1	11	4.4	15.4
Queen Anne's lace	*Daucus carota*	5	0	5	10	5.1	15.1
Yellow hawkweed	*Hieracium caespitosum*	10	0	1	11	4.1	15.1
Common reed	*Phragmites australis* ssp. *australis*	5	0	1	6	9.1	15.1
European cranberry-bush	*Viburnum opulus*	5	0	5	10	5.1	15.1
Spotted knapweed	*Centaurea stoebe* ssp. *micranthos*	5	0	1	6	9.0	15.0
Narrow-leaf cat-tail	*Typha angustifolia*	5	0	1	6	9.0	15.0
Black bindweed, wild buckwheat	*Fallopia convolvulus*	10	0	1	11	3.7	14.7
Black medick	*Medicago lupulina*	5	0	5	10	4.5	14.5
Leafy spurge	*Euphorbia esula*	5	0	1	6	8.1	14.1
Bladder campion	*Silene vulgaris*	5	0	5	10	4.1	14.1
Ox-eye daisy	*Leucanthemum vulgare*	5	0	5	10	4.0	14.0
Annual bluegrass	*Poa annua*	5	0	5	10	3.6	13.6
White sweet-clover	*Melilotus albus*	5	0	1	6	6.3	12.3
Smallflower hairy willow herb	*Epilobium parviflorum*	5	0	1	6	5.3	11.3
Norway spruce	*Picea abies*	5	0	1	6	4.1	10.1
Proso millet	*Panicum miliaceum*	5	0	1	6	3.9	9.9
Strawberry clover	*Trifolium fragiferum*	5	0	1	6	3.6	9.6

Chapter 4: Work Plan

This section will propose management objectives and compile and summarize management actions best suited for the island areas as related to the invasive species documented on the island as discussed in Chapter 3. Management objectives were written to be measurable, yet flexible to the needs and limitations of treatment on remote islands. Each management action will include a management strategy (Table 3), species targeted, location, and timing recommendations, and be related to a management objective.

Invasive Plant Management Objectives

- Elimination of 1 of 3 Priority 1 species within five years.
- Elimination of 2 of 3 Priority 1 species within ten years
- Plan treatment of newly observed Priority 2 species or unprioritized invasive species within 2 years of observation
- Reduce 25% of each population of Priority 1 and 3 species within 330 ft (100 m) of extant rare plant EOs within fifteen years

Management Strategies and Action

Ongoing actions

- Regular *monitoring* of shoreline communities for new occurrences of invasives plant species, especially the sand and gravel beach / Great Lakes beach
- Work with other landowners on island to develop set management threshold and develop action plan for deer population on island. *Monitor* population regularly and initiate management efforts when approaching threshold.
- Work with other landowners on island to manage Priority 1 and monitor for Priority 2 species along coastal communities

Actions to be initiated within five years

- *Elimination* of garlic mustard in disturbed mesic forest. Eradication declared after monitoring efforts fail to find the species spanning ten years.
- *Elimination* of Japanese barberry from disturbed mesic forest. Eradication declared after monitoring efforts fail to find the species spanning five years.
- *Sustained control* of bush honeysuckle within 330 ft (100 m) of Laurentian bladder fern, climbing fumitory, and limestone cliff / dry cliff EOs.

Actions to be initiated within ten years

- *Sustained control* of bush honeysuckle within 330 ft (100 m) of rare plant EOs in coastal communities.
- *Sustained control* of Priority 3 species within 330 ft (100 m) of Laurentian bladder fern, climbing fumitory, and limestone cliff / dry cliff EOs.

Best Management Practices for Avoiding Non-Target Effects

Best management practices (BMPs) describe efforts to initiate before, during, and after treatment to minimize negative effects on conservation assets (Table 1; Figure 2) and other resources. BMPs differ relative to the area, invasive species, and conservation assets involved and their

relation among each other. Preparation and knowledge are the best weapons in this effort. The recommended practices are:

1. Those treating invasive species and monitoring treatment efforts should have skills and resources to identify Priority 1, Priority 2, and rare species found on the island
2. When possible, mark and maintain a buffer area around conservation assets
3. When treatment is occurring near conservation assets, efforts are planned prior to treatment to protect populations such as
    a. covering asset with barrier, like buckets or tarp, while treatment is occurring,
    b. bagging and preventing propagule spread of invasive species as soon as possible after treatment
    c. using treatment tools, methods, or additives that reduce fine-scale, non-target exposure and damage
    d. timing treatment to avoid non-target exposure to treatment

Chapter 5: Monitoring and Evaluation

Monitoring and Evaluation

Follow-up treatment is necessary for all Priority 1 species due to viability of reproductive propagules and other strategies (e.g., resprouting) after treatment. Initial and follow-up treatments for any species should be documented with the appropriate feature type in the layer R3 Management Actions in the USFWS AGOL Feature layers.

A species will be considered eliminated/zero density when it is first undetected in a follow-up survey. It will be considered eradicated when it is undetected for upwards of three years depending on the viability of that species' reproductive propagules (e.g., six years for invasive common reed, four for wild parsnip). At this point the species will move from the Priority 1 treatment list to the Priority 2 watch list for the island. The natural community EOs, roads/trails, and shoreline should be monitored with regular frequency.

Progress in invasive species treatment will be monitored through USFWS AGOL Feature Layers, specifically the Plant Invasive Location, Plant [Treatment], and Photo Point Survey feature layers. These layers collect data relevant to monitoring, treatment, and treatment efficacy respectively. Methods are described in Chapter 2 and directions to contribute to these layers can be found in Appendix 2.

Adaptation

An adaptive management strategy is a framework for dealing with complex environmental management problems. Adaptive management strategies stress the importance of symbiotic planning, management actions, experimentation, knowledge acquisition, and learning in the face of uncertain outcomes and changes (Lowell et al. 2014). To make informed and applicable management decisions, these schedules, management objectives, and management actions should be reviewed after each treatment and monitoring event for adaptation needs based on new information derived from those events (Lowell et al. 2014; Figure 11).

Both a treatment and monitoring schedule should be planned and budgeted based on the management objectives and proposed actions. Treatment and monitoring can occur during the same visit if time and personnel are budgeted accordingly. In Figure 11, this IPMP is the "Plan" at the top of the Adaptive management cycle, a treatment is "Act", a monitoring event is "Monitor", and a revisit of the management objectives, actions, and schedules with information gathered from the "Act" and "Monitor" and from novel research, experiments, and technology is "Evaluate".

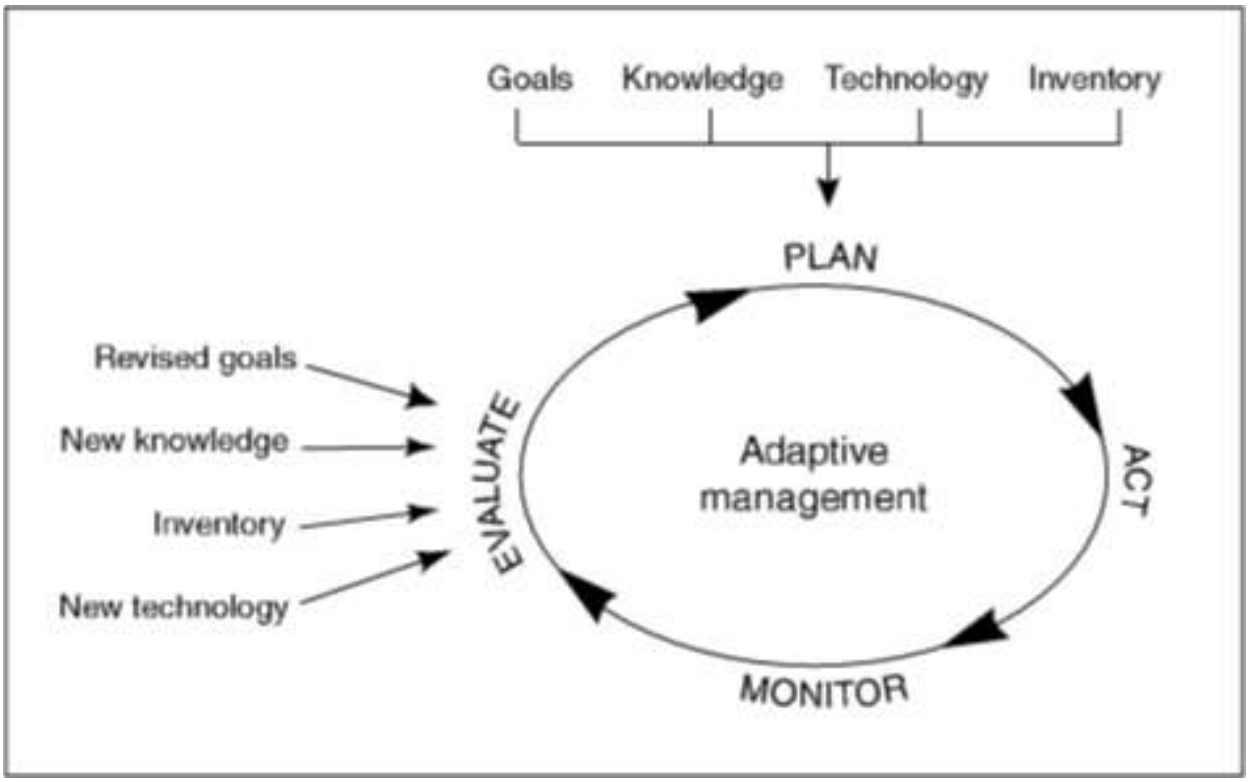

Figure 11. The adaptive management cycle. Figure reproduced from USDA USDI (1994) and Lowell et al. (2014).

Monitoring

Regular monitoring should occur to monitor treatment efficacy, detect new or newly spreading invasive species, and check the status of known rare species and communities. Monitoring effort may need to be adjusted among years due to resource and logistical constraints. Suggested monitoring tasks for each level of effort are described in Table 15. When any island visit is planned, the top four monitoring tasks should be conducted. The amount of time and personnel available for a visit can guide which additional monitoring tasks, if any, are to be conducted. Note: given the remoteness of the island, a team of at least two persons working together is recommended for safety.

Table 15. List of monitoring tasks categorized as belonging in a minimal, lower, medium, high, or highest monitoring effort. Monitoring tasks of highest priority are included in lower monitoring efforts. Priorities may change as a result of new information derived from monitoring and treatment efforts. An estimate of time for a team of two staff needed to survey is listed below each monitoring effort. Day(s) is abbreviated "d".

Monitoring Task	Monitoring Effort				
	Minimal (0.5 d)	Low (0.5-1 d)	Medium (1 d)	High (2 - 3 d)	Highest (3 – 5 d)
Treatment efficacy photo points	X	X	X	X	X
Invasive species survey on western shore	X	X	X	X	X
Invasive species survey on eastern shore	X	X	X	X	X
Rare species occurrences of low calamint and white camas	X	X	X	X	X
Invasive species survey in limestone cliff / dry cliff EO		X	X	X	X
Rare species occurrences of climbing fumitory, Laurentian bladder fern		X	X	X	X
Invasive species survey in disturbed mesic northern forest			X	X	X
Rare species survey for new occurrences in natural community EOs				X	X
Rare species survey for new occurrences in disturbed mesic northern forest				X	X
Invasive species survey in coastal communities of non-federal lands					X
Invasive species survey in all natural communities of non-federal lands					X
Rare species survey for new occurrences coastal communities of non-federal lands					X
Rare species survey in all natural communities of non-federal lands					X

A monitoring schedule including desired effort should be planned and budgeted (Table 16). This schedule should be flexible enough to adapt the IPMP plan based on evaluation of new data acquired after treatment and/or monitoring (Figure 11). Greater intensity monitoring efforts should be conducted when 1) resources allow, 2) the span between more intensive survey efforts is five years or more, and 3) after a new or spreading invasive species is observed during a monitoring or treatment event. Observation of a new or spreading invasive species will require modifications to management objectives/actions, monitoring prioritizations, and the effort schedule. Following a new observation, the monitoring effort should be revisited and more frequent surveys scheduled for the following years. If the new observation occurred during a treatment of minimal-, low-, or medium-level monitoring effort, a high-level or highest-level monitoring effort should be scheduled within the following two years. If the new observation occurred during a high- or highest-level monitoring effort, the monitoring effort for the following years can be less (Table 16).

Table 16. Several examples of scheduled monitoring efforts for 16 years. Base schedule A is minimal effort each year with medium effort once every 5 years and a high effort every 15 years. Base schedule B is low effort every three years with high effort after 3 lows efforts. Base schedule C is monitoring every 5 years alternating between high and low efforts. The apostrophe (') represents an adaptation to a monitoring schedule based on the discovery of a new or spreading invasive species and which year it was found.

	Example Schedule of Monitoring Effort					
Year	A	A'	B	B'	C	C'
1	Minimal	Minimal	Low	Low	High	High
2	Minimal	Minimal				
3	Minimal	Minimal				
4	Minimal	Minimal	Low	Low '		
5	Medium	Medium		High		
6	Minimal	Minimal		Minimal	Low	Low
7	Minimal	Minimal '	Low	Low		
8	Minimal	High				
9	Minimal	Minimal				
10	Medium	Medium	High	Low		
11	Minimal	Minimal			High	High '
12	Minimal	Medium				Minimal
13	Minimal	Minimal	Low	Low		Minimal
14	Minimal	Minimal				
15	Highest	Medium				
16	Minimal	Minimal	Low	High	Low	High

Treatment

All treatments should undergo the treatment and permitting process and then be recorded in the appropriate USFWS AGOL Region 3 treatment feature layer (e.g., Plant Chemical Use). These layers are engineered to house relevant data and multiple treatments of the same area, if needed.

All treatment areas should undergo monitoring for treatment efficacy using the USFWS AGOL Photo Points Survey feature layer. Protocols described in *Regional Protocol Framework for Rare and Invasive Plant Monitoring on Great Lakes Islands* (2021c) and *Draft Site-specific Protocol for Vegetation Surveys on Great Lakes Islands, Green Bay and Gravel Island National Wildlife Refuges* (2021a) and summarized here should be followed:

The treatment area is photographed before and after treatment. The number, orientation, and spacing of photographs within the treatment area will vary, but the photographs should be collected at surveyor discretion with the goal of collecting enough photos to accurately capture a visual representation of the cover and density of target plants. The GPS locations of the pre-treatment photographs will be revisited post-treatment. Any new photographs taken at the photo point will be submitted via the USFWS AGOL Photo Point Survey feature layer as a related table to the pre-treatment photo. This will allow for easier monitoring of qualitative treatment efficacy.

Following treatment or monitoring years, the management objectives and actions should be revisited and reevaluated based on the new information gathered. The treatment or monitoring plan may need to be adapted. Adaptive management practices allow for more flexibility in decision making and account for uncertainty and variability in the plan (Lowell et al. 2014).

Data Management

Invasives species populations, treatments, and treatment efficacy data will be collected via USFWS AGOL Web Map like Great Lakes – Invasives and Photo Points as described in Chapter 2 (Esri 2022b). The accessibility and flexibility of AGOL tools allow for easy sharing among partners and almost instant synching of new or updated data. These data are managed by regional USFWS staff. For more information on layer metadata, see Appendix 1. For more information on using ArcGIS Collector to record data, see Appendix 2.

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Appendix 1. Meta data for data collection forms

Digital data forms were used to collect and compile data where appropriate for field surveys conducted to collect critical background information for the IPMP. To collect information for rare species occurrences (i.e., element occurrences), surveyors used MNFI's public "MNFI Rare Species Form" via Survey123 Field App (Table 1-1). Entries were quality controlled by MNFI staff prior to addition to Michigan's Natural Heritage database.

To collect information for invasive species occurrences for 2021 surveys, surveyors used a map generated and deposited in USFWS AGOL group called "Great Lakes – Invasives and Photopoints" via ArcGIS Collector App (Esri 2020). This map contained several Feature Layers that could have entries added. Each Feature Layer in "Great Lakes – Invasives and Photopoints" is described below in tables 1-1 to 1-5.

For all tables, "Display name" is the name used in surveys and most correspondence. All data layers will auto-generate many fields including username, created date, last edited date, and unique global ID.

Table 1-1. Description of metadata collected for MNFI Rare Species Form via Survey123. This form contains only one layer. Data collected automatically by device that is hidden from the surveyor was not included in the metadata table (e.g., GPS location)

Display Name	Definitions and Values	Example	Required
Survey Date & Time	Date and time in local time zone. Generated by device	5/8/2016, 8:01 am	X
Observer/s	Full name(s) of observers	Rachel Hackett	X
Affiliation	Group which the observer ascribes to	MNFI	
Email	Observer email address to which to address follow-up questions	hackett5@msu.edu	X
Survey Type	Select best description of what type of survey, if any was conducted to find organism.	Camera Trap	
General Location	Name of location, park, closest waterway, street name, etc. to describe locality of observation	Mayberry State Park	X
Latitude read-only	Display of latitude collected by device	45.3789542	
Longitude read-only	Display of longitude collected by device	86.5468732	
Manual Distance	If GPS was read from a separate device, enter a numerical estimate of accuracy of coordinates.	25	
Manual Distance Unit	Units of the above accuracy estimate	Meters	
Add Photo	Add up to 4 photographs taken by device		
Audio Recording	Make an audio recording to support identification		
Search Type	Select how to search for the species observed: by element or by taxonomy	Element	X
Species Type	Select whether the species observed is an Animal or Plant	Plant	X
Search by	Select whether to search for species by Scientific Name, Common Name, Genus, Family, or Order	Scientific name	X
Higher Class Unit	If Search Type of 'Taxonomy' was selected, select genus, family, or order of organism	Pinguicula	
Species	If Search Type of 'Element' was selected, select the species name of the organism	Butterwort	X

Display Name	Definitions and Values	Example	Required
Location Use Class	For animal species, select whether there is evidence of breeding (e.g., breeding plumage, songs)	Not applicable	
Scientific Name	Display of scientific name based on species selected	Pinguicula vulgaris	
Common Name	Display of common name based on species selected	Butterwort	
Subnational Rank	Display of State/subnational rank of species based on NatureServe ranking calculator	S3	
EO Track Status	Display of what is ranked about species	Track all extant and selected historical EOs	
Number of adults/individuals observed	For animal species, enter number of adults observed	2	
Number of juveniles observed	For animal species, enter the number of juveniles observed	0	
Estimate or actual count?	For animal species, indicate whether the count of adults and juveniles is an estimate or exact count	Actual	
Evidence Type	For animal species, select from list what is the basis of the observation	Photographed	
Notes	For animal species, list anything more of note about the observation (e.g., size, sex, behavior, identification notes)	It sounded like a Cooper's Hawk, but looked small. Caught a sparrow.	
Number of individuals observed	For plant species, enter the number of individuals observed	20	
Estimate or actual count?	For plant species, indicate whether the count of individuals is an estimate or exact count	Estimate	
Abundance	For plant species, indicate the qualitative abundance of the species in the area using the DAFOR scale	Occasional	
Percent of plants in flower	For plant species, estimate the percentage of plants in flower	10	
Percent of plants in fruit	For plant species, estimate the percentage of plants in fruit	0	
Apparent vigor	For plant species, rate the health of the plant or population	Good	
Notes	For plant species, list anything more of note about the observation (e.g., size, distribution pattern, unique features, identification notes)	Clumped near Sphagnum mounds. Leaf herbivory	
Associated Species	For plant species, list any other plant species that grow with the observed species in the habitat	Sphagnum moss, Cladium mariscoides, Juncus, Thuja occidentalis, Arctostraphylos uva-ursi, Triantha glutinosa, Utricularia cornuta.	
Habitat Description	Description of area in which the organism was observed	Found in coastal fen near pooling water.	
Disturbance	Description or list of possible disturbance to the population (e.g., invasive species, pollution, hydrology)	Unmarked trail splits population. Frangula alnus encroaching in area	
Overall site quality	Rating of overall quality of the site	Good	

Table 1-2. Description of layers and metadata collected for USFWS Photo Point Survey AGOL Feature Layer. The Photo_Point layer describes the location of the photo point. The Obs_Event is a table related to Photo_Point layer that describes each observation event where photos are taken at the photo point. One photo point can have many observation events. Data collected automatically by the device that is hidden from the surveyor was not included in the metadata table (e.g., GPS location). This layer is often used to document invasive treatment efficacy over time.

Layer	Display Name	Definitions and Values	Example	Required
Photo_Point	Photo_ID	Unique label to indicate refuge, island, and target species of the photo taken	GBY_StMartin_PHAU_3	X
Photo_Point	Photo_Direction	Azimuth	140	X
Photo_Point	Comments	Additional relevant notes about the photo point location	captures half of the total infestation	
Obs_Event	Photo_Obs_ID	Unique label to indicate refuge, island, and target species of the photo taken (same as Photo_Point/Photo_ID). Generated automatically from Photo_ID	GBY_StMartin_PHAU_3	X
Obs_Event	Date	Date of observation event	5/7/2018	X
Obs_Event	Comments	Additional relevant notes about photo point observation event	6 months post-treatment	
Obs_Event	Photos and Files	Photographs taken for observation event		

Table 1-3. Description of layers and metadata collected for USFWS Plant Invasive Location AGOL Feature Layer. There are three separate feature layer with the same metadata for mapping invasive species as a point, line, or polygon. Each feature layer contains only one layer/table. Data collect automatically by device that is hidden from the surveyor was not included in the metadata table (e.g., GPS location)

Display Name	Definitions and Values	Example	Required
Observer Name	Full names of surveyors	Josh Cohen; Jesse Lincoln	X
Observer Type	Affiliation of surveyors	University	
First Observation Date	Date-time of observation	07/21/2021, 4:45 PM	X
Select species	Accepted common name of invasive plant species	Leafy spurge	X
Growth Stage of Target	Current plant phenology of the majority of documented infestation	Pre-seed	
Approx. infestation area (sq. ft)	Estimate of area occupied by invasive plant species in square feet	55	X (if a point or line)
% of area infested	Percentage cover of invasive plant species inside occupied area	20%	X (if a polygon)
% of infestation that is under control, if applicable	What proportion of infestation is dead or dying from treatment	0%	
Funding Source	how was data collection funded	MNFI co-op grant	
General notes and comments	Additional relevant notes about invasive species population	near hiking trail	

Table 1-4. Description of layers and metadata collected for USFWS Plant Chemical AGOL Feature Layer. There are three separate feature layers with the same metadata for mapping invasive species as a point, line, or polygon. Each feature layer contains only one layer/table. Data collected automatically by the device that is hidden from the surveyor was not included in the metadata table (e.g., GPS location)

Display Name	Definitions and Values	Example	Required
Operator Name	Full name of applicator	John Doe	X
Operator Type	Affiliation of applicator	Contractor-Private	
Start Date	Start date of chemical treatment	10/3/2021	X
End Date (if different)	For multiday efforts, this is the end date of treatment	10/4/2021	
Pesticide Use Permit Number	Pesticide Use Permit number	R3-21-31540-005	
Application Method	Type of chemical application	Foliar	
Application Equipment	type of equipment used to apply herbicide	backpack sprayer	
Total person Hours	Time spent (hours only) used to estimate treatment costs for reporting	2	
Approx area treat (sq. ft.)	Estimate of area treated in square feet	55	X (if a point or line)
Chemical 1 Trade Name	Enter the trade name of primary chemical. Long list, start typing to filter choices. If not found, please enter Other (see comments) and add it in the Comments field	Rodeo	X
Chemical 1 Concentration (number)	quantity or percentage of primary chemical in tank mix	3	
Chemical 1 Concentration (units)	measurement unit of primary chemical concentration	% solution	
Chemical 2 Trade Name	Enter the trade name of primary chemical. Long list, start typing to filter choices. If not found, please enter Other (see comments) and add it in the Comments field	Imazapyr 2 SL	
Chemical 2 Concentration (number)	quantity or percentage of primary chemical in tank mix	2	
Chemical 2 Concentration (units)	measurement unit of primary chemical concentration	% solution	
Quantity of solution applied	amount of herbicide used	0.5	X
Units for Quantity	units for amount of herbicide used	gallons	X
Primary Target Species	Primary target species. Long list, start typing common name or scientific name to filter list	purple loosestrife	X
Growth Stage of Target	Growth stage of the Primary Target Species	flowering	
Air Temperature	Degrees in Fahrenheit	82	
% Cloud Cover	number 0 to 100. Approximate % cloud cover	25	
Wind Direction	Direction the wind is coming from	North	
Est. wind speed	Wind speed in miles per hour (MPH)	10	
% chance of rain in next 72 hours	number 0 to 100. Determined from weather predictions	35	
% humidity during application	number 0 to 100. Approximate humidity	40	

Display Name	Definitions and Values	Example	Required
Fire Funded Treatment	Yes or No	No	
Funding Source	how was data collection funded	MNFI co-op grant	
General notes and comments	Any further comment, including info on fields that you selected Other (see comments) on above. 1500 character limit	Likely did not treat all plants. Very difficult to see with reed canary and other grasses in the way	

Table 1-5. Description of layers and metadata collected for USFWS Plant Chemical Search AGOL Feature Layer. There are three separate feature layers with the same metadata for mapping invasive species as a point, line, or polygon. Each feature layer contains only one layer/table. Data collected automatically by the device that is hidden from the surveyor was not included in the metadata table (e.g., GPS location)

Display Name	Definitions and Values	Example	Required
Primary Target Species	Primary target species. Long list, start typing common name or scientific name to filter list	European frog-bit	X
Search Date	Date of search effort	9/2/2021	X
Search Method	ATV/UTV, on foot, car or truck, other	Other	X
Relative Search Intensity	Incidental, Exhaustive, Formal Inventory, or Other (provide in Comment field)	Incidental	X
Approximate Search Width	for linear searches, search area width in feet	100	X for lines
Participant Names	Full name(s) of searchers	Jane Doe, John Doe	X
Fire Funded Treatment	Yes or No	No	
Funding Source	How was data collection funded	station funds	
General notes and comments	Any further comment, including info on fields that you selected Other (see comments) on above. 1500 character limit	visual search by airboat	

Appendix 2: Documenting Invasive Species to USFWS AGOL Features using ArcGIS Collector App

The USFWS Project Data Manager creates ArcGIS Online (AGOL) groups on a project-by-project basis to grant access of feature layers to data contributors. A contributor to these feature layers must have an AGOL organizational user account and be invited to the group by the Data Manager. This project had access to layers for "Plant Invasion Location", "Plant Chemical", and "Photo Point Survey". Other projects may be granted access to additional or different feature layers.

Feature layers are named for the type of data they contain (e.g., plant observation, treatment type) and the geometric shape (i.e., point, line, polygon) of the data within the feature like "Plant Invasive Location – Point". The data requirements and additional data fields remain the same per type of data regardless of shape (Appendix 1). There are two ways new data can be added to feature layers: 1) new records can be created, and 2) new data can be added to an existing feature record via a related table. Adding data to existing feature records via a related table is meant to group location revisit and retreatment data together to facilitate the appearance of trends. This action is most common in relation to treatment efficacy monitoring with the Photo Point Survey feature layer. Table 2-1 describes examples of desired actions of a data contributor with new data, the most appropriate feature layer, and required data of that feature layer.

Table 2-1. Action to feature layer guide. The "Action" column describes what the user wants to do with the new information they've gathered. The "Feature Layer" directs them to the appropriate feature layer and related table. Brackets […] indicate that the title of the feature layer may change based on the item in the bracket. For existing records that need new data added, the feature layer is named before the slash (/) and the related table where the new data is added is listed after the slash (/).

Action	Feature Layer [5]	Required data to enter by user
Create new invasive species infestation record as a point	Plant Invasive Location – Point	Observer Name, First Observation Date, Select species
Create new invasive species infestation record as a line	Plant Invasive Location – Line	Observer Name, First Observation Date, Select species
Create new invasive species infestation record as a polygon	Plant Invasive Location – Polygon	Observer Name, First Observation Date, Select species
Add new monitoring information to *existing* invasive species infestation record	Plant Invasive Location – [Shape] / Table – Plant Monitoring	Monitoring Date, % Control, Assessment Method
Create new chemical treatment area	Plant Chemical – [Shape]	Operator Name, Start Date, Chemical1 Trade Name, Chemical2 Trade Name, Primary Target Species,
Create new mechanical treatment area	Plant Mechanical – [Shape]	Operator Name, Start Date, Action Type
Add new information to *existing* invasive species treatment record	Plant [Treatment Type] – [Shape] / Table - Plant Monitoring	Monitoring Date, % Control, Assessment Method
Create new photo point for treatment area	Photo Point Survey	Photo_ID, Photo_Direction
Add new photo to *existing* photo point	Photo Point Survey / Obs_Event	Date, Take/Attach photo

[5] Feature Layer Names may differ slightly to user based on naming in AGOL Group/Map by USFWS Data manager

The following procedure describes the preparation and procedure to follow to collect data and map features offline in the field to AGOL features such as "Plant Invasive Location - Point", "Photo Point Survey", and various invasive species management feature layers using ArcGIS Collector app (Esri 2020, Esri 2022b). Fields/data collected for each feature layer will differ. You must have an AGOL username from an organization and be granted access to a AGOL group with the feature layers or map you are contributing to in order to use the features mentioned here.

Element 1: Before entering the field…

These steps require connection to mobile data or wi-fi

1. Download ArcGIS Collector App
    a. Go to your device's Store App
    b. Search for "ArcGIS Collector"
    c. Download app
    d. Warning: ESRI is no longer updating the ArcGIS Collector App beyond 2020 in their conversion to ESRI FieldMaps App (Esri 2022a). At the time of this report, the FieldMaps app did not yet have all of the capabilities needed to collect data for these layers
2. Add offline maps
    a. Open ArcGIS Collector App on your device
    b. Sign in using your AGOL username associated with the USFWS group that contains the Feature Layers and Maps you wish to access in the field
    c. On the home page, select the Group with the Map you wish to download for offline use
    d. Select the Map from the Group
    e. Tap the three dot menu in the upper right
    f. Selected "Add Offline Area"
    g. Here you have two feature to select: 1) the map area, 2) the map detail.
    h. Using two fingers to zoom in and out of the map on the device. Fit the box to the area you want to download
    i. Tap on the blue word after "Level of detail" (e.g., Room, Building, City). Select the level of detail you want for your map. The finest detail settings are near the top of the list.
        i. If the area you wanted to download did not fit within the box, you can decrease the "Level of detail". This will increase the size of the box
        ii. If you do not want a courser "Level of detail" to get a map of your entire area of interest, you may want to download several maps of finer detail (e.g., Big Charity Island North, Big Charity Island South)
    j. When you have the map area and level of detail you, tap "Download Area"
    k. Once the map is downloaded, it should be listed as "On device"
    l. Tap the three dot menu to the right of your new map
    m. Select "Rename area"
    n. Type in your name for the map.
    o. Tap "OK"
3. Sync map before entering the field

a. If significant time has passed between when you downloaded the map for offline use and the time you are heading to field to use it, you may want to Sync the map to get the most up to date version
b. Open ArcGIS Collector App on your device
c. Sign in using your AGOL username associated with the USFWS group that contains the Feature Layers and Maps you wish to access in the field
d. On the home page, select the Group with the Map you wish to download for offline use
e. Select the Map from the Group
f. Your map should be listed here
g. Tap the three dot menu to the right of your new map
h. Select "Sync"
i. Under the map name, the most recent "Sync" date will be listed

Element 2: In the field…

These steps may be completed in "Airplane" mode with "Location" on and "Wi-Fi" off

1. Add records to offline Map Feature Layers
    a. Open ArcGIS Collector App on your device
    b. On the home page, select the Group with the Map you wish to download for offline use
    c. You should see all the Maps you downloaded in a list
    d. Tap on the Map you wish to add records to
    e. Find your location
        i. If in the field with "Location" on, you can center your location using the target button in the right. If there is not a dot in the center of the target, your location may not be on or your may not be on the map
        ii. If you want to select the location manually, zoom into the location and try to center the map at the point as best you can

    f. Tap the blue "+" icon in the bottom right
    g. Because of inherent uncertainty, your location could be anywhere within the circle surrounding the "+" on the map. Use two fingers to adjust the size of the uncertain circle and where the "+" on the map is located.

    h. Select the Feature Layer for which you want to add a record
    i. Complete the feature record.
    j. Tap "update point" if you have altered the location
    k. To add record, tap the check mark in the upper right when finished.
    l. To discard record, tap the "x" in the upper left when finished
2. To edit or add observation to existing record
    a. Zoom into the record feature on the map
    b. Tap on the feature record you wish to edit
    c. Several feature records may be listed, select the one you wish to edit
        i. Tap the pencil icon to edit the feature
            1. Edit the fields need
        ii. Tap the chain link to add an observation or other linked table
            1. Tab the blue "Add" button

2. Add date, comments, and take/attach photographs

iii. To save changes, tap the check mark in the upper right

iv. To discard changes, tap the "x" in the upper left

Element 3: After returning from the field…

These steps require connection to mobile data or wi-fi

1. Sync field collected or edited data with AGOL Map
    a. Tap the three dot menu to the right of your new map
    b. Select "Sync"
    c. Under the map name, the most recent "Sync" date will be listed
    d. Now your added/edited data is visible on AGOL Map to all members
2. Delete a feature record
    a. Open ArcGIS Collector App on your device
    b. Sign in using your AGOL username associated with the USFWS group that contains the Feature Layers and Maps you wish to access in the field
    c. On the home page, select the Group with the Map you wish to download for offline use
    d. Select the Map from the Group
    e. Select the offline map with the feature record you need to delete
    f. Tap and select the feature
    g. Search for a "Record Status" or similar field.
        i. If feature has such a field, select "Delete record" from list of options
    h. If feature does not have such a field, add a "Delete record" note to the "Comment" field To save changes, tap the check mark in the upper right
    i. To discard changes, tap the "x" in the upper left
    j. Follow the directions to "1. Sync field collected or edited data with AGOL Map" above
    k. The feature record may still appear on the Map for some time until data manager deletes the record.

Appendix 3. IPIEDPT Reports

Natural community areas and invasive species were ranked using the Invasive Plant Inventory and Early Detection Prioritization Tool (IPIEDPT). This tool was developed by the USFWS Inventory and Monitoring Initiative (Region 8) and Utah State University (USFWS 2016). The original objective of this tool was to identify areas for plant surveys and monitoring. In this IPMP it was used to identify potential threats and watch list species for each island area. For more details on species scores and ranking see Chapter 2: Prioritization of Species and Management Areas.

When prioritizing areas among the four surveyed Green Bay NWR islands (i.e., Detroit, Plum, Poverty, St. Martin), the IPIEDPT area prioritization results were not used. The emphasis on invasive species monitoring was evident when areas that had little to no invasive species present were ranked in the highest tier. Instead MNFI deferred to a "Stewardship Prioritization" matrix (See Chapter 2: Prioritization of Species and Management Areas; Cohen et al. 2022).

Although the results were not used, we included a description of the IPIEDPT ranked factors for area prioritization and the results here (Table 1-1). The ranked factors fell into three categories, each with multiple factors:

- Area description (weighted 0.4)
    - Ecological integrity
    - Innate resistance to invasion
    - Importance to Federal or State-listed species
    - Importance to other priority natural resources of conservation
- Invasion risk (weighted 0.3)
    - Relative to terrestrial pathways
    - Relative to aquatic pathways
    - Relative to transport vectors
    - Relative to anthropogenic disturbances
- Invasive plant status (weighted 0.3)
    - Relative to most recent inventory and monitoring event
    - Relative to overall infestation level
    - Number of invasive plant species present in area

The scores of each category were averaged (mean), weighed, then the three category scores were summed to derive the total score for the area. IPIEDPT default weights were used for each category.

For area description factors, categorical rankings were determined using 2021 ecological survey data and notes, NatureServe-MNFI resilience rankings of the natural community, NatureServe-MNFI biodiversity rankings of the natural community, NatureServe-MNFI state rarity score of natural community in Michigan, and expert opinion (Cohen et al. 2019, Cohen et al. 2022). For invasion risk factors, categorical rankings were determined using 2021 ecological survey data and notes; geospatial variables of proximity to shoreline and presence of trails, roads, human structures; evidence of past logging, and expert opinion (Cohen et al. 2022). For invasive plant status factors, categorical rankings were determined using the invasives species population data

described in Chapter 2: Methods – Information Gathering. All areas had been comprehensively monitored within the last five years. Opinions on the highest value natural areas during the 2021 surveys were shared in virtual meetings among MNFI, USFWS, Green Bay NWR, and Door County SWCD, and applied as expert opinion where applicable.

Table 3-1. IPIEDPT area prioritization scores for Green Bay NWR. St. Martin Island areas are bolded. MNFI Stewardship Score Sum was included for comparison (Cohen et al. 2022).

Island	Area	EO ID	EO Rank	Description Score	Risk Score	Status Score	Total Score	MNFI Stewardship Score Sum
Detroit	**Sand and gravel beach / Great Lakes beach**	**24387**	**BC**	**1.7**	**1.8**	**2.1**	**5.6**	**7**
Plum	Great Lakes marsh / emergent marsh	24367	C	2.8	1.8	0.5	**5.1**	**9**
St. Martin	Limestone cliff	24350	B	1.8	1.2	1.8	**4.8**	**9.25**
St. Martin	Limestone lakeshore cliff	24348	A	1.8	1.2	1.8	**4.8**	**10**
St. Martin	Limestone cobble shore	24353	B	1.7	1.2	1.8	**4.7**	**9.25**
Detroit	**Limestone lakeshore cliff / moist cliff**	**24372**	**BC**	**1.4**	**1.8**	**1.4**	**4.6**	**8.5**
Detroit	**Limestone cliff / dry cliff**	**24373**	**BC**	**1.4**	**1.5**	**1.5**	**4.4**	**7.25**
Detroit	**Limestone cobble shore / Great Lakes alkaline rockshore**	**24375**	**BC**	**1.7**	**1.8**	**0.9**	**4.4**	**9.5**
Detroit	**Limestone bedrock lakeshore / Great Lakes alkaline rockshore**	**24374**	**B**	**1.8**	**1.8**	**0.5**	**4.1**	**10**
Plum	Mesic northern forest	24369	D	2.3	1.5	0.3	**4.1**	**8**
St. Martin	Mesic northern forest	24349	BC	2.7	0.9	0.5	**4.1**	**9**
Plum	Limestone cobble shore / Great Lakes alkaline rockshore	24370	C	1.3	1.8	0.9	**4.0**	**8.5**
Poverty	Limestone bedrock lakeshore	4159	AB	2.5	0.9	0.5	**3.9**	**10.5**
Poverty	Limestone lakeshore cliff	1437	A	2.1	0.9	0.9	**3.9**	**10**
Plum	Limestone lakeshore cliff / moist cliff	24368	C	1.4	1.8	0.5	**3.7**	**8.5**
Detroit	**Disturbed mesic northern forest**	**---**	**---**	**1.6**	**1.5**	**0.3**	**3.4**	**---**
St. Martin	Lighthouse	---	---	1.1	1.8	0.3	**3.2**	---
St. Martin	South dock	---	---	1.1	1.8	0.3	**3.2**	---
St. Martin	Northern hardwood swamp	24352	C	1.3	0.9	0.9	**3.1**	**8.5**
Plum	Disturbed boreal forest	---	---	1.1	1.5	0.3	**2.9**	---
St. Martin	Boreal forest north	24351	B	1.3	0.9	0.5	**2.7**	**8.5**
St. Martin	Boreal forest south	24351	B	1.3	0.9	0.5	**2.7**	**8.5**
Poverty	Boreal forest	7488	B	1.3	0.4	0.5	**2.2**	**10.5**

Table 3-2. IPIEDPT species prioritization scores. As bush honeysuckle (*Lonicera* sp.) observed on the island all have the same NatureServe rankings, they are pooled together in the table.

Scientific Name ITIS	Common Name	ITIS TSN	USDA Symbol	Invasiveness Score	Status Score	Impacts Score	Legal Score	Total Score
Agrostis gigantea	redtop, black bent, water bentgrass	40414	AGGI2	0.6	4	0.3	0	4.9
Alliaria petiolata	garlic mustard, garlic-mustard	184481	ALPE4	1.4	4	3	1	9.4
Arctium minus	lesser burdock, lesser burrdock, burdock, small burdock, smaller burdock, bardane, beggar's button, common burdock, wild burdock, wild rhubarb	36546	ARMI2	0.2	4	0.9	0	5.1
Berberis thunbergii	Japanese barberry	18835	BETH	1.4	3.6	3	1	9
Centaurea stoebe ssp. *micranthos*	spotted knapweed	780711	CEST8	1.4	3.6	3	1	9
Cerastium fontanum ssp. *vulgare*	common mouse-ear chickweed, big chickweed, mouseear chickweed	523831	CEFOV2	0	3.6	0.3	0	3.9
Cirsium arvense	Canada thistle, Canadian thistle, Californian thistle, creeping thistle, field thistle	36335	CIAR4	1.4	3.07	2.1	1	7.57
Cirsium palustre	marsh thistle	36394	CIPA6	0.6	3.07	2.1	1	6.77
Cirsium vulgare	bull thistle, common thistle, spear thistle	36428	CIVU	0.6	3.07	2.1	1	6.77
Cynoglossum officinale	houndstongue, gypsy-flower, common houndstongue, hound's tongue, gypsyflower	31890	CYOF	0.6	3.07	2.1	1	6.77
Dactylis glomerata	cocksfoot, orchardgrass, orchard grass	193446	DAGL	0.2	3.6	0.3	0	4.1
Daucus carota	bird's nest, wild carrot, Queen Anne's lace	29477	DACA6	0.2	3.6	0.3	1	5.1
Elaeagnus umbellata	oleaster, autumn olive, autumn-olive	27776	ELUM	0.2	4	0.9	1	6.1
Elymus repens	quackgrass	512839	ELRE4	1.4	4	0.3	0	5.7
Epilobium parviflorum	Smallflower hairy willow herb	27321	EPPA5	1	4	0.3	0	5.3
Epipactis helleborine	broadleaf helleborine, helleborine	43482	EPHE	0.6	3.07	0.3	1	4.97
Erysimum cheiranthoides	Wormseed wallflower	22933	ERCH9	1	3.6	0.3	0	4.9
Euphorbia esula	spurge, wolf's milk, wolf's-milk, leafy spurge	28064	EUES	1.4	3.6	2.1	1	8.1
Fallopia convolvulus	black bindweed, wild buckwheat	513511	POCO10	0.2	3.2	0.3	0	3.7
Galeopsis tetrahit	bristlestem hempnettle, brittle-stem hemp-nettle, common hempnettle	32499	GATE2	0.2	3.6	0.3	1	5.1
Galium sylvaticum	Scotch mist	34930	GASY	0.2	3.6	0.3	0	4.1

Scientific Name ITIS	Common Name	ITIS TSN	USDA Symbol	Invasiveness Score	Status Score	Impacts Score	Legal Score	Total Score
Hesperis matronalis	dame's rocket, dames violet, mother-of-the-evening, dames rocket, damesrocket	23138	HEMA3	0.6	4	2.1	1	7.7
Hieracium aurantiacum	orange hawkweed	37697	HIAU	0.6	3.6	0.3	0	4.5
Hieracium caespitosum	meadow hawkweed, yellow hawkweed	503009	HICA10	0.2	3.6	0.3	0	4.1
Hypericum perforatum	St. John's wort, common St. John's wort, Klamathweed, Klamath weed, St. Johnswort, common St. Johnswort	21454	HYPE	1.4	2.67	0.3	0	4.37
Leonurus cardiaca	Motherwort	32548	LECA2	0.2	3.6	0.3	0	4.1
Leucanthemum vulgare	oxeye daisy, oxeye-daisy, oxeyedaisy, ox-eye daisy	37903	LEVU	0.6	3.07	0.3	0	3.97
Linaria vulgaris	butter and eggs, greater butter-and-eggs, yellow toadflax, flaxweed, Jacob's ladder, ramsted, wild snapdragon	33216	LIVU2	1	3.07	0.3	0	4.37
Lonicera sp.	bella honeysuckle, whitebell honeysuckle, Bell's honeysuckle, show fly honeysuckle	35286	LONIC	1.4	3.07	3	1	8.47
Lythrum salicaria	purple lythrum, rainbow weed, spiked loosetrife, purple loosestrife	27079	LYSA2	2	4	2.1	1	9.1
Medicago lupulina	black medick, black medic clover, black medic, hop clover, hop medic, nonesuch, yellow trefoil	503721	MELU	0.2	4	0.3	0	4.5
Melilotus albus	Bokhara-clover, honey-clover, white melilot, white sweet-clover	516979	MEALA2	0.2	4	2.1	0	6.3
Nepeta cataria	Cat-nip	32623	NECA2	0.2	3.07	0.3	0	3.57
Panicum miliaceum	Proso millet	792496	PAMI2	0	3.6	0.3	0	3.9
Pastinaca sativa	wild parsnip	29795	PASA2	0.2	4	2.1	1	7.3
Persicaria maculosa	spotted ladysthumb, ladysthumb	823821	POPE3	0.2	3.6	0.3	0	4.1
Phalaris arundinacea	reed canary grass, reed canarygrass	41335	PHAR3	2	3.07	3	1	9.07
Phleum pratense	common timothy, timothy	41062	PHPR3	1	3.6	0.3	0	4.9
Phragmites australis ssp. *australis*	common reed	41072	PHAU7	2	4	2.1	1	9.1
Picea abies	Norway spruce	183289	PIAB	0.2	3.6	0.3	0	4.1
Poa annua	annual blue grass, walkgrass, annual bluegrass	41107	POAN	0.2	3.07	0.3	0	3.57
Poa compressa	Canada bluegrass, flat-stem blue grass	41082	POCO	1	2.8	0.3	0	4.1

Scientific Name ITIS	Common Name	ITIS TSN	USDA Symbol	Invasiveness Score	Status Score	Impacts Score	Legal Score	Total Score
Poa nemoralis	Wood bluegrass	41146	PONE	0.2	3.07	0.3	0	3.57
Poa pratensis	Kentucky bluegrass	41088	POPR	1	2.13	0.3	0	3.43
Populus alba	white poplar	22451	POAL7	1	3.6	0.9	1	6.5
Ranunculus acris	meadow buttercup, tall buttercup	18583	RAAC3	0.2	3.6	0.3	0	4.1
Rosa multiflora	multiflora rose	24833	ROMU	0.6	3.6	2.1	1	7.3
Rumex obtusifolius	bluntleaf dock, bitter dock, broadleaf dock	20939	RUOB	0.2	3.6	0.3	0	4.1
Saponaria officinalis	soapwort, bouncingbet, bouncingbet soapweed, bouncing bet, sweet Betty	20039	SAOF4	0.2	4	0.3	0	4.5
Schedonorus pratensis	Meadow fescue	784877	SCPR4	0.2	4	0.3	0	4.5
Sedum acre	Goldmoss stonecrop	24105	SECA	1	3.07	0.3	0	4.37
Silene latifolia	blader campion, bladder-campion, white campion	565517	SILA21	0.2	3.6	0.3	0	4.1
Silene vulgaris	bladder silene, maiden's-tears, bladder campion, cowbell, maiden's tears, rattleweed, maidenstears	20142	SIVU	0.2	3.6	0.3	0	4.1
Solanum dulcamara	climbing nightshade, bitter nightshade, bittersweet nightshade, blue nightshade, European bittersweet, fellenwort, woody nightshade	30414	SODU	0.2	2.8	0.9	1	4.9
Taraxacum officinale	common dandelion, blowball, faceclock, dandelion	36213	TAOF	0.2	3.07	0.3	0	3.57
Torilis japonica	Erect hedge parsley	29895	TOJA	1	3.6	0.3	1	5.9
Tragopogon pratensis	Jack-go-to-bed-at-noon	38569	TRPR	0	4	0.3	0	4.3
Trifolium fragiferum	Strawberry clover	26251	TRFR2	0.2	3.07	0.3	0	3.57
Trifolium pratense	red clover	26313	TRPR2	0.2	4	0.3	0	4.5
Typha angustifolia	narrowleaf cattail, narrow-leaf cat-tail	42325	TYAN	1.4	3.6	3	1	9
Valeriana officinalis	garden heliotrope, garden valerian, common valerian	35363	VAOF	0.2	4	2.1	1	7.3
Verbascum thapsus	big taper, flannel plant, velvet dock, velvet plant, woolly mullein, flannel mullein, great mullein, mullein, common mullein	33394	VETH	1	3.07	0.3	0	4.37
Veronica officinalis	Common gypsy-weed	33398	VEOF2	1	3.6	0.3	0	4.9
Veronica serpyllifolia	Thyme-leaf speedwell	33423	VESE	0.2	4	0.3	0	4.5
Viburnum opulus	European cranberry-bush	35270	VIOP	0.6	3.6	0.9	0	5.1

Table 3-3. IPIEDPT area-species link scores for Detroit Island, sorted by species. Table 9 to Table 14 list scores for each area. As bush honeysuckle (*Lonicera* sp.) observed on the island all have the same NatureServe rankings, they are pooled together in the table. Great Lakes is abbreviated "G.L."

areaID	speciesID	Area	Scientific Name ITIS	Presence Score	Status Score	Habitat Score	Total Score	Species Score	Overall Score
72	1	Limestone bedrock lakeshore / G.L. alkaline rockshore	*Agrostis gigantea*	5	0	10	15	4.9	19.9
73	1	Limestone cliff / dry cliff	*Agrostis gigantea*	5	0	10	15	4.9	19.9
74	1	Limestone cobble shore / G.L. alkaline rockshore	*Agrostis gigantea*	5	0	10	15	4.9	19.9
75	1	Limestone lakeshore cliff / moist cliff	*Agrostis gigantea*	5	0	10	15	4.9	19.9
76	1	Disturbed mesic northern forest	*Agrostis gigantea*	5	0	10	15	4.9	19.9
77	1	Sand and gravel beach / G.L. beach	*Agrostis gigantea*	5	0	10	15	4.9	19.9
72	65	Limestone bedrock lakeshore / G.L. alkaline rockshore	*Alliaria petiolata*	10	0	0	10	9.4	19.4
73	65	Limestone cliff / dry cliff	*Alliaria petiolata*	10	0	10	20	9.4	29.4
74	65	Limestone cobble shore / G.L. alkaline rockshore	*Alliaria petiolata*	10	0	0	10	9.4	19.4
75	65	Limestone lakeshore cliff / moist cliff	*Alliaria petiolata*	10	0	0	10	9.4	19.4
76	65	Disturbed mesic northern forest	*Alliaria petiolata*	10	10	10	30	9.4	39.4
77	65	Sand and gravel beach / G.L. beach	*Alliaria petiolata*	10	0	0	10	9.4	19.4
72	2	Limestone bedrock lakeshore / G.L. alkaline rockshore	*Arctium minus*	5	0	10	15	5.1	20.1
73	2	Limestone cliff / dry cliff	*Arctium minus*	5	0	10	15	5.1	20.1
74	2	Limestone cobble shore / G.L. alkaline rockshore	*Arctium minus*	5	0	10	15	5.1	20.1
75	2	Limestone lakeshore cliff / moist cliff	*Arctium minus*	5	0	10	15	5.1	20.1
76	2	Disturbed mesic northern forest	*Arctium minus*	5	0	10	15	5.1	20.1
77	2	Sand and gravel beach / G.L. beach	*Arctium minus*	5	0	10	15	5.1	20.1
72	3	Limestone bedrock lakeshore / G.L. alkaline rockshore	*Berberis thunbergii*	10	0	1	11	9	20
73	3	Limestone cliff / dry cliff	*Berberis thunbergii*	10	0	1	11	9	20
74	3	Limestone cobble shore / G.L. alkaline rockshore	*Berberis thunbergii*	10	0	1	11	9	20
75	3	Limestone lakeshore cliff / moist cliff	*Berberis thunbergii*	10	0	1	11	9	20
76	3	Disturbed mesic northern forest	*Berberis thunbergii*	10	5	10	25	9	34
77	3	Sand and gravel beach / G.L. beach	*Berberis thunbergii*	10	0	5	15	9	24

areaID	speciesID	Area	Scientific Name ITIS	Presence Score	Status Score	Habitat Score	Total Score	Species Score	Overall Score
72	4	Limestone bedrock lakeshore / G.L. alkaline rockshore	*Centaurea stoebe* ssp. *micranthos*	5	0	10	15	9	24
73	4	Limestone cliff / dry cliff	*Centaurea stoebe* ssp. *micranthos*	5	0	10	15	9	24
74	4	Limestone cobble shore / G.L. alkaline rockshore	*Centaurea stoebe* ssp. *micranthos*	5	0	10	15	9	24
75	4	Limestone lakeshore cliff / moist cliff	*Centaurea stoebe* ssp. *micranthos*	5	0	10	15	9	24
76	4	Disturbed mesic northern forest	*Centaurea stoebe* ssp. *micranthos*	5	0	1	6	9	15
77	4	Sand and gravel beach / G.L. beach	*Centaurea stoebe* ssp. *micranthos*	5	0	10	15	9	24
72	5	Limestone bedrock lakeshore / G.L. alkaline rockshore	*Cerastium fontanum* ssp. *vulgare*	10	7	10	27	3.9	30.9
73	5	Limestone cliff / dry cliff	*Cerastium fontanum* ssp. *vulgare*	10	0	10	20	3.9	23.9
74	5	Limestone cobble shore / G.L. alkaline rockshore	*Cerastium fontanum* ssp. *vulgare*	5	0	10	15	3.9	18.9
75	5	Limestone lakeshore cliff / moist cliff	*Cerastium fontanum* ssp. *vulgare*	10	7	10	27	3.9	30.9
76	5	Disturbed mesic northern forest	*Cerastium fontanum* ssp. *vulgare*	10	7	10	27	3.9	30.9
77	5	Sand and gravel beach / G.L. beach	*Cerastium fontanum* ssp. *vulgare*	10	0	10	20	3.9	23.9
72	6	Limestone bedrock lakeshore / G.L. alkaline rockshore	*Cirsium arvense*	5	0	10	15	7.57	22.57
73	6	Limestone cliff / dry cliff	*Cirsium arvense*	5	0	5	10	7.57	17.57
74	6	Limestone cobble shore / G.L. alkaline rockshore	*Cirsium arvense*	5	0	10	15	7.57	22.57
75	6	Limestone lakeshore cliff / moist cliff	*Cirsium arvense*	5	0	10	15	7.57	22.57
76	6	Disturbed mesic northern forest	*Cirsium arvense*	5	0	10	15	7.57	22.57
77	6	Sand and gravel beach / G.L. beach	*Cirsium arvense*	5	0	10	15	7.57	22.57
72	7	Limestone bedrock lakeshore / G.L. alkaline rockshore	*Cirsium palustre*	10	5	10	25	6.77	31.77
73	7	Limestone cliff / dry cliff	*Cirsium palustre*	10	0	10	20	6.77	26.77
74	7	Limestone cobble shore / G.L. alkaline rockshore	*Cirsium palustre*	10	1	10	21	6.77	27.77
75	7	Limestone lakeshore cliff / moist cliff	*Cirsium palustre*	10	0	10	20	6.77	26.77
76	7	Disturbed mesic northern forest	*Cirsium palustre*	10	0	10	20	6.77	26.77
77	7	Sand and gravel beach / G.L. beach	*Cirsium palustre*	10	0	10	20	6.77	26.77
72	8	Limestone bedrock lakeshore / G.L. alkaline rockshore	*Cirsium vulgare*	10	0	10	20	6.77	26.77

areaID	speciesID	Area	Scientific Name ITIS	Presence Score	Status Score	Habitat Score	Total Score	Species Score	Overall Score
73	8	Limestone cliff / dry cliff	*Cirsium vulgare*	10	0	10	20	6.77	26.77
74	8	Limestone cobble shore / G.L. alkaline rockshore	*Cirsium vulgare*	10	1	10	21	6.77	27.77
75	8	Limestone lakeshore cliff / moist cliff	*Cirsium vulgare*	10	0	10	20	6.77	26.77
76	8	Disturbed mesic northern forest	*Cirsium vulgare*	10	5	10	25	6.77	31.77
77	8	Sand and gravel beach / G.L. beach	*Cirsium vulgare*	10	0	10	20	6.77	26.77
72	9	Limestone bedrock lakeshore / G.L. alkaline rockshore	*Cynoglossum officinale*	10	0	10	20	6.77	26.77
73	9	Limestone cliff / dry cliff	*Cynoglossum officinale*	10	0	10	20	6.77	26.77
74	9	Limestone cobble shore / G.L. alkaline rockshore	*Cynoglossum officinale*	10	0	10	20	6.77	26.77
75	9	Limestone lakeshore cliff / moist cliff	*Cynoglossum officinale*	10	0	10	20	6.77	26.77
76	9	Disturbed mesic northern forest	*Cynoglossum officinale*	10	10	10	30	6.77	36.77
77	9	Sand and gravel beach / G.L. beach	*Cynoglossum officinale*	10	0	10	20	6.77	26.77
72	10	Limestone bedrock lakeshore / G.L. alkaline rockshore	*Dactylis glomerata*	10	0	5	15	4.1	19.1
73	10	Limestone cliff / dry cliff	*Dactylis glomerata*	10	0	5	15	4.1	19.1
74	10	Limestone cobble shore / G.L. alkaline rockshore	*Dactylis glomerata*	10	0	5	15	4.1	19.1
75	10	Limestone lakeshore cliff / moist cliff	*Dactylis glomerata*	10	0	5	15	4.1	19.1
76	10	Disturbed mesic northern forest	*Dactylis glomerata*	10	7	5	22	4.1	26.1
77	10	Sand and gravel beach / G.L. beach	*Dactylis glomerata*	10	0	5	15	4.1	19.1
72	11	Limestone bedrock lakeshore / G.L. alkaline rockshore	*Daucus carota*	5	0	5	10	5.1	15.1
73	11	Limestone cliff / dry cliff	*Daucus carota*	5	0	5	10	5.1	15.1
74	11	Limestone cobble shore / G.L. alkaline rockshore	*Daucus carota*	5	0	5	10	5.1	15.1
75	11	Limestone lakeshore cliff / moist cliff	*Daucus carota*	5	0	5	10	5.1	15.1
76	11	Disturbed mesic northern forest	*Daucus carota*	5	0	5	10	5.1	15.1
77	11	Sand and gravel beach / G.L. beach	*Daucus carota*	5	0	5	10	5.1	15.1
72	12	Limestone bedrock lakeshore / G.L. alkaline rockshore	*Elaeagnus umbellata*	5	0	10	15	6.1	21.1
73	12	Limestone cliff / dry cliff	*Elaeagnus umbellata*	5	0	10	15	6.1	21.1
74	12	Limestone cobble shore / G.L. alkaline rockshore	*Elaeagnus umbellata*	5	0	10	15	6.1	21.1

areaID	speciesID	Area	Scientific Name ITIS	Presence Score	Status Score	Habitat Score	Total Score	Species Score	Overall Score
75	12	Limestone lakeshore cliff / moist cliff	*Elaeagnus umbellata*	5	0	10	15	6.1	21.1
76	12	Disturbed mesic northern forest	*Elaeagnus umbellata*	5	0	10	15	6.1	21.1
77	12	Sand and gravel beach / G.L. beach	*Elaeagnus umbellata*	5	0	10	15	6.1	21.1
72	13	Limestone bedrock lakeshore / G.L. alkaline rockshore	*Elymus repens*	10	0	10	20	5.7	25.7
73	13	Limestone cliff / dry cliff	*Elymus repens*	10	0	5	15	5.7	20.7
74	13	Limestone cobble shore / G.L. alkaline rockshore	*Elymus repens*	10	7	10	27	5.7	32.7
75	13	Limestone lakeshore cliff / moist cliff	*Elymus repens*	10	0	10	20	5.7	25.7
76	13	Disturbed mesic northern forest	*Elymus repens*	10	7	5	22	5.7	27.7
77	13	Sand and gravel beach / G.L. beach	*Elymus repens*	10	0	10	20	5.7	25.7
72	14	Limestone bedrock lakeshore / G.L. alkaline rockshore	*Epilobium parviflorum*	5	0	10	15	5.3	20.3
73	14	Limestone cliff / dry cliff	*Epilobium parviflorum*	5	0	1	6	5.3	11.3
74	14	Limestone cobble shore / G.L. alkaline rockshore	*Epilobium parviflorum*	5	0	10	15	5.3	20.3
75	14	Limestone lakeshore cliff / moist cliff	*Epilobium parviflorum*	5	0	10	15	5.3	20.3
76	14	Disturbed mesic northern forest	*Epilobium parviflorum*	5	0	1	6	5.3	11.3
77	14	Sand and gravel beach / G.L. beach	*Epilobium parviflorum*	5	0	10	15	5.3	20.3
72	15	Limestone bedrock lakeshore / G.L. alkaline rockshore	*Epipactis helleborine*	10	0	1	11	4.97	15.97
73	15	Limestone cliff / dry cliff	*Epipactis helleborine*	10	0	5	15	4.97	19.97
74	15	Limestone cobble shore / G.L. alkaline rockshore	*Epipactis helleborine*	10	0	1	11	4.97	15.97
75	15	Limestone lakeshore cliff / moist cliff	*Epipactis helleborine*	10	0	1	11	4.97	15.97
76	15	Disturbed mesic northern forest	*Epipactis helleborine*	10	7	10	27	4.97	31.97
77	15	Sand and gravel beach / G.L. beach	*Epipactis helleborine*	10	0	1	11	4.97	15.97
72	16	Limestone bedrock lakeshore / G.L. alkaline rockshore	*Erysimum cheiranthoides*	10	7	10	27	4.9	31.9
73	16	Limestone cliff / dry cliff	*Erysimum cheiranthoides*	10	0	1	11	4.9	15.9
74	16	Limestone cobble shore / G.L. alkaline rockshore	*Erysimum cheiranthoides*	10	0	10	20	4.9	24.9
75	16	Limestone lakeshore cliff / moist cliff	*Erysimum cheiranthoides*	10	0	10	20	4.9	24.9
76	16	Disturbed mesic northern forest	*Erysimum cheiranthoides*	10	0	1	11	4.9	15.9

areaID	speciesID	Area	Scientific Name ITIS	Presence Score	Status Score	Habitat Score	Total Score	Species Score	Overall Score
77	16	Sand and gravel beach / G.L. beach	*Erysimum cheiranthoides*	10	0	10	20	4.9	24.9
72	17	Limestone bedrock lakeshore / G.L. alkaline rockshore	*Euphorbia esula*	5	0	5	10	8.1	18.1
73	17	Limestone cliff / dry cliff	*Euphorbia esula*	5	0	10	15	8.1	23.1
74	17	Limestone cobble shore / G.L. alkaline rockshore	*Euphorbia esula*	5	0	5	10	8.1	18.1
75	17	Limestone lakeshore cliff / moist cliff	*Euphorbia esula*	5	0	5	10	8.1	18.1
76	17	Disturbed mesic northern forest	*Euphorbia esula*	5	0	1	6	8.1	14.1
77	17	Sand and gravel beach / G.L. beach	*Euphorbia esula*	5	0	10	15	8.1	23.1
72	18	Limestone bedrock lakeshore / G.L. alkaline rockshore	*Fallopia convolvulus*	10	7	5	22	3.7	25.7
73	18	Limestone cliff / dry cliff	*Fallopia convolvulus*	10	0	5	15	3.7	18.7
74	18	Limestone cobble shore / G.L. alkaline rockshore	*Fallopia convolvulus*	10	0	5	15	3.7	18.7
75	18	Limestone lakeshore cliff / moist cliff	*Fallopia convolvulus*	10	0	5	15	3.7	18.7
76	18	Disturbed mesic northern forest	*Fallopia convolvulus*	10	0	1	11	3.7	14.7
77	18	Sand and gravel beach / G.L. beach	*Fallopia convolvulus*	10	0	5	15	3.7	18.7
72	19	Limestone bedrock lakeshore / G.L. alkaline rockshore	*Galeopsis tetrahit*	5	0	10	15	5.1	20.1
73	19	Limestone cliff / dry cliff	*Galeopsis tetrahit*	5	0	10	15	5.1	20.1
74	19	Limestone cobble shore / G.L. alkaline rockshore	*Galeopsis tetrahit*	5	0	10	15	5.1	20.1
75	19	Limestone lakeshore cliff / moist cliff	*Galeopsis tetrahit*	5	0	10	15	5.1	20.1
76	19	Disturbed mesic northern forest	*Galeopsis tetrahit*	5	0	10	15	5.1	20.1
77	19	Sand and gravel beach / G.L. beach	*Galeopsis tetrahit*	5	0	10	15	5.1	20.1
72	20	Limestone bedrock lakeshore / G.L. alkaline rockshore	*Galium sylvaticum*	5	0	1	6	4.1	10.1
73	20	Limestone cliff / dry cliff	*Galium sylvaticum*	5	0	10	15	4.1	19.1
74	20	Limestone cobble shore / G.L. alkaline rockshore	*Galium sylvaticum*	5	0	1	6	4.1	10.1
75	20	Limestone lakeshore cliff / moist cliff	*Galium sylvaticum*	5	0	1	6	4.1	10.1
76	20	Disturbed mesic northern forest	*Galium sylvaticum*	5	0	10	15	4.1	19.1
77	20	Sand and gravel beach / G.L. beach	*Galium sylvaticum*	5	0	1	6	4.1	10.1
72	21	Limestone bedrock lakeshore / G.L. alkaline rockshore	*Hesperis matronalis*	5	0	1	6	7.7	13.7

areaID	speciesID	Area	Scientific Name ITIS	Presence Score	Status Score	Habitat Score	Total Score	Species Score	Overall Score
73	21	Limestone cliff / dry cliff	*Hesperis matronalis*	5	0	10	15	7.7	22.7
74	21	Limestone cobble shore / G.L. alkaline rockshore	*Hesperis matronalis*	5	0	1	6	7.7	13.7
75	21	Limestone lakeshore cliff / moist cliff	*Hesperis matronalis*	5	0	1	6	7.7	13.7
76	21	Disturbed mesic northern forest	*Hesperis matronalis*	5	0	10	15	7.7	22.7
77	21	Sand and gravel beach / G.L. beach	*Hesperis matronalis*	5	0	10	15	7.7	22.7
72	22	Limestone bedrock lakeshore / G.L. alkaline rockshore	*Hieracium aurantiacum*	5	0	10	15	4.5	19.5
73	22	Limestone cliff / dry cliff	*Hieracium aurantiacum*	5	0	10	15	4.5	19.5
74	22	Limestone cobble shore / G.L. alkaline rockshore	*Hieracium aurantiacum*	5	0	10	15	4.5	19.5
75	22	Limestone lakeshore cliff / moist cliff	*Hieracium aurantiacum*	5	0	10	15	4.5	19.5
76	22	Disturbed mesic northern forest	*Hieracium aurantiacum*	5	0	10	15	4.5	19.5
77	22	Sand and gravel beach / G.L. beach	*Hieracium aurantiacum*	5	0	10	15	4.5	19.5
72	23	Limestone bedrock lakeshore / G.L. alkaline rockshore	*Hieracium caespitosum*	10	0	5	15	4.1	19.1
73	23	Limestone cliff / dry cliff	*Hieracium caespitosum*	10	0	1	11	4.1	15.1
74	23	Limestone cobble shore / G.L. alkaline rockshore	*Hieracium caespitosum*	10	7	5	22	4.1	26.1
75	23	Limestone lakeshore cliff / moist cliff	*Hieracium caespitosum*	10	0	5	15	4.1	19.1
76	23	Disturbed mesic northern forest	*Hieracium caespitosum*	10	0	1	11	4.1	15.1
77	23	Sand and gravel beach / G.L. beach	*Hieracium caespitosum*	10	0	5	15	4.1	19.1
72	24	Limestone bedrock lakeshore / G.L. alkaline rockshore	*Hypericum perforatum*	10	7	5	22	4.37	26.37
73	24	Limestone cliff / dry cliff	*Hypericum perforatum*	10	0	1	11	4.37	15.37
74	24	Limestone cobble shore / G.L. alkaline rockshore	*Hypericum perforatum*	10	7	5	22	4.37	26.37
75	24	Limestone lakeshore cliff / moist cliff	*Hypericum perforatum*	10	0	5	15	4.37	19.37
76	24	Disturbed mesic northern forest	*Hypericum perforatum*	10	10	5	25	4.37	29.37
77	24	Sand and gravel beach / G.L. beach	*Hypericum perforatum*	10	0	10	20	4.37	24.37
72	25	Limestone bedrock lakeshore / G.L. alkaline rockshore	*Leonurus cardiaca*	10	0	5	15	4.1	19.1
73	25	Limestone cliff / dry cliff	*Leonurus cardiaca*	10	7	5	22	4.1	26.1
74	25	Limestone cobble shore / G.L. alkaline rockshore	*Leonurus cardiaca*	10	0	5	15	4.1	19.1

areaID	speciesID	Area	Scientific Name ITIS	Presence Score	Status Score	Habitat Score	Total Score	Species Score	Overall Score
75	25	Limestone lakeshore cliff / moist cliff	*Leonurus cardiaca*	10	0	5	15	4.1	19.1
76	25	Disturbed mesic northern forest	*Leonurus cardiaca*	10	7	5	22	4.1	26.1
77	25	Sand and gravel beach / G.L. beach	*Leonurus cardiaca*	10	0	5	15	4.1	19.1
72	26	Limestone bedrock lakeshore / G.L. alkaline rockshore	*Leucanthemum vulgare*	5	0	10	15	3.97	18.97
73	26	Limestone cliff / dry cliff	*Leucanthemum vulgare*	5	0	1	6	3.97	9.97
74	26	Limestone cobble shore / G.L. alkaline rockshore	*Leucanthemum vulgare*	5	0	10	15	3.97	18.97
75	26	Limestone lakeshore cliff / moist cliff	*Leucanthemum vulgare*	5	0	10	15	3.97	18.97
76	26	Disturbed mesic northern forest	*Leucanthemum vulgare*	5	0	5	10	3.97	13.97
77	26	Sand and gravel beach / G.L. beach	*Leucanthemum vulgare*	5	0	10	15	3.97	18.97
72	27	Limestone bedrock lakeshore / G.L. alkaline rockshore	*Linaria vulgaris*	10	1	10	21	4.37	25.37
73	27	Limestone cliff / dry cliff	*Linaria vulgaris*	10	0	1	11	4.37	15.37
74	27	Limestone cobble shore / G.L. alkaline rockshore	*Linaria vulgaris*	10	1	10	21	4.37	25.37
75	27	Limestone lakeshore cliff / moist cliff	*Linaria vulgaris*	10	0	10	20	4.37	24.37
76	27	Disturbed mesic northern forest	*Linaria vulgaris*	10	0	5	15	4.37	19.37
77	27	Sand and gravel beach / G.L. beach	*Linaria vulgaris*	10	0	10	20	4.37	24.37
72	28	Limestone bedrock lakeshore / G.L. alkaline rockshore	*Lonicera* sp.	10	1	10	21	8.47	29.47
73	28	Limestone cliff / dry cliff	*Lonicera* sp.	10	5	10	25	8.47	33.47
74	28	Limestone cobble shore / G.L. alkaline rockshore	*Lonicera* sp.	10	1	10	21	8.47	29.47
75	28	Limestone lakeshore cliff / moist cliff	*Lonicera* sp.	10	1	10	21	8.47	29.47
76	28	Disturbed mesic northern forest	*Lonicera* sp.	10	1	10	21	8.47	29.47
77	28	Sand and gravel beach / G.L. beach	*Lonicera* sp.	10	0	10	20	8.47	28.47
72	29	Limestone bedrock lakeshore / G.L. alkaline rockshore	*Lythrum salicaria*	5	0	10	15	9.1	24.1
73	29	Limestone cliff / dry cliff	*Lythrum salicaria*	5	0	1	6	9.1	15.1
74	29	Limestone cobble shore / G.L. alkaline rockshore	*Lythrum salicaria*	5	0	10	15	9.1	24.1
75	29	Limestone lakeshore cliff / moist cliff	*Lythrum salicaria*	5	0	10	15	9.1	24.1
76	29	Disturbed mesic northern forest	*Lythrum salicaria*	5	0	10	15	9.1	24.1

areaID	speciesID	Area	Scientific Name ITIS	Presence Score	Status Score	Habitat Score	Total Score	Species Score	Overall Score
77	29	Sand and gravel beach / G.L. beach	*Lythrum salicaria*	5	0	10	15	9.1	24.1
72	30	Limestone bedrock lakeshore / G.L. alkaline rockshore	*Medicago lupulina*	5	0	10	15	4.5	19.5
73	30	Limestone cliff / dry cliff	*Medicago lupulina*	5	0	5	10	4.5	14.5
74	30	Limestone cobble shore / G.L. alkaline rockshore	*Medicago lupulina*	5	0	10	15	4.5	19.5
75	30	Limestone lakeshore cliff / moist cliff	*Medicago lupulina*	5	0	10	15	4.5	19.5
76	30	Disturbed mesic northern forest	*Medicago lupulina*	5	0	5	10	4.5	14.5
77	30	Sand and gravel beach / G.L. beach	*Medicago lupulina*	5	0	5	10	4.5	14.5
72	31	Limestone bedrock lakeshore / G.L. alkaline rockshore	*Melilotus albus*	5	0	10	15	6.3	21.3
73	31	Limestone cliff / dry cliff	*Melilotus albus*	5	0	1	6	6.3	12.3
74	31	Limestone cobble shore / G.L. alkaline rockshore	*Melilotus albus*	5	0	10	15	6.3	21.3
75	31	Limestone lakeshore cliff / moist cliff	*Melilotus albus*	5	0	10	15	6.3	21.3
76	31	Disturbed mesic northern forest	*Melilotus albus*	5	0	1	6	6.3	12.3
77	31	Sand and gravel beach / G.L. beach	*Melilotus albus*	5	0	10	15	6.3	21.3
72	32	Limestone bedrock lakeshore / G.L. alkaline rockshore	*Nepeta cataria*	10	0	10	20	3.57	23.57
73	32	Limestone cliff / dry cliff	*Nepeta cataria*	10	7	5	22	3.57	25.57
74	32	Limestone cobble shore / G.L. alkaline rockshore	*Nepeta cataria*	10	7	10	27	3.57	30.57
75	32	Limestone lakeshore cliff / moist cliff	*Nepeta cataria*	10	7	10	27	3.57	30.57
76	32	Disturbed mesic northern forest	*Nepeta cataria*	10	7	5	22	3.57	25.57
77	32	Sand and gravel beach / G.L. beach	*Nepeta cataria*	10	0	10	20	3.57	23.57
72	33	Limestone bedrock lakeshore / G.L. alkaline rockshore	*Panicum miliaceum*	5	0	5	10	3.9	13.9
73	33	Limestone cliff / dry cliff	*Panicum miliaceum*	5	0	1	6	3.9	9.9
74	33	Limestone cobble shore / G.L. alkaline rockshore	*Panicum miliaceum*	5	0	5	10	3.9	13.9
75	33	Limestone lakeshore cliff / moist cliff	*Panicum miliaceum*	5	0	5	10	3.9	13.9
76	33	Disturbed mesic northern forest	*Panicum miliaceum*	5	0	1	6	3.9	9.9
77	33	Sand and gravel beach / G.L. beach	*Panicum miliaceum*	5	0	5	10	3.9	13.9
72	34	Limestone bedrock lakeshore / G.L. alkaline rockshore	*Pastinaca sativa*	5	0	10	15	7.3	22.3

areaID	speciesID	Area	Scientific Name ITIS	Presence Score	Status Score	Habitat Score	Total Score	Species Score	Overall Score
73	34	Limestone cliff / dry cliff	*Pastinaca sativa*	5	0	5	10	7.3	17.3
74	34	Limestone cobble shore / G.L. alkaline rockshore	*Pastinaca sativa*	5	0	10	15	7.3	22.3
75	34	Limestone lakeshore cliff / moist cliff	*Pastinaca sativa*	5	0	10	15	7.3	22.3
76	34	Disturbed mesic northern forest	*Pastinaca sativa*	5	0	10	15	7.3	22.3
77	34	Sand and gravel beach / G.L. beach	*Pastinaca sativa*	5	0	10	15	7.3	22.3
72	35	Limestone bedrock lakeshore / G.L. alkaline rockshore	*Persicaria maculosa*	10	0	10	20	4.1	24.1
73	35	Limestone cliff / dry cliff	*Persicaria maculosa*	10	0	5	15	4.1	19.1
74	35	Limestone cobble shore / G.L. alkaline rockshore	*Persicaria maculosa*	10	7	10	27	4.1	31.1
75	35	Limestone lakeshore cliff / moist cliff	*Persicaria maculosa*	10	0	10	20	4.1	24.1
76	35	Disturbed mesic northern forest	*Persicaria maculosa*	10	0	5	15	4.1	19.1
77	35	Sand and gravel beach / G.L. beach	*Persicaria maculosa*	10	0	10	20	4.1	24.1
72	36	Limestone bedrock lakeshore / G.L. alkaline rockshore	*Phalaris arundinacea*	5	0	5	10	9.07	19.07
73	36	Limestone cliff / dry cliff	*Phalaris arundinacea*	5	0	1	6	9.07	15.07
74	36	Limestone cobble shore / G.L. alkaline rockshore	*Phalaris arundinacea*	5	0	5	10	9.07	19.07
75	36	Limestone lakeshore cliff / moist cliff	*Phalaris arundinacea*	5	0	5	10	9.07	19.07
76	36	Disturbed mesic northern forest	*Phalaris arundinacea*	5	0	5	10	9.07	19.07
77	36	Sand and gravel beach / G.L. beach	*Phalaris arundinacea*	5	0	5	10	9.07	19.07
72	37	Limestone bedrock lakeshore / G.L. alkaline rockshore	*Phleum pratense*	10	7	10	27	4.9	31.9
73	37	Limestone cliff / dry cliff	*Phleum pratense*	10	0	5	15	4.9	19.9
74	37	Limestone cobble shore / G.L. alkaline rockshore	*Phleum pratense*	10	0	10	20	4.9	24.9
75	37	Limestone lakeshore cliff / moist cliff	*Phleum pratense*	10	0	10	20	4.9	24.9
76	37	Disturbed mesic northern forest	*Phleum pratense*	10	7	5	22	4.9	26.9
77	37	Sand and gravel beach / G.L. beach	*Phleum pratense*	10	0	5	15	4.9	19.9
72	38	Limestone bedrock lakeshore / G.L. alkaline rockshore	*Phragmites australis* ssp. *australis*	5	0	10	15	9.1	24.1
73	38	Limestone cliff / dry cliff	*Phragmites australis* ssp. *australis*	5	0	1	6	9.1	15.1
74	38	Limestone cobble shore / G.L. alkaline rockshore	*Phragmites australis* ssp. *australis*	5	0	10	15	9.1	24.1

areaID	speciesID	Area	Scientific Name ITIS	Presence Score	Status Score	Habitat Score	Total Score	Species Score	Overall Score
75	38	Limestone lakeshore cliff / moist cliff	*Phragmites australis* ssp. *australis*	5	0	10	15	9.1	24.1
76	38	Disturbed mesic northern forest	*Phragmites australis* ssp. *australis*	5	0	1	6	9.1	15.1
77	38	Sand and gravel beach / G.L. beach	*Phragmites australis* ssp. *australis*	5	0	10	15	9.1	24.1
72	39	Limestone bedrock lakeshore / G.L. alkaline rockshore	*Picea abies*	5	0	1	6	4.1	10.1
73	39	Limestone cliff / dry cliff	*Picea abies*	5	0	1	6	4.1	10.1
74	39	Limestone cobble shore / G.L. alkaline rockshore	*Picea abies*	5	0	1	6	4.1	10.1
75	39	Limestone lakeshore cliff / moist cliff	*Picea abies*	5	0	1	6	4.1	10.1
76	39	Disturbed mesic northern forest	*Picea abies*	5	0	1	6	4.1	10.1
77	39	Sand and gravel beach / G.L. beach	*Picea abies*	5	0	1	6	4.1	10.1
72	40	Limestone bedrock lakeshore / G.L. alkaline rockshore	*Poa annua*	5	0	10	15	3.57	18.57
73	40	Limestone cliff / dry cliff	*Poa annua*	5	0	5	10	3.57	13.57
74	40	Limestone cobble shore / G.L. alkaline rockshore	*Poa annua*	5	0	10	15	3.57	18.57
75	40	Limestone lakeshore cliff / moist cliff	*Poa annua*	5	0	10	15	3.57	18.57
76	40	Disturbed mesic northern forest	*Poa annua*	5	0	5	10	3.57	13.57
77	40	Sand and gravel beach / G.L. beach	*Poa annua*	5	0	5	10	3.57	13.57
72	41	Limestone bedrock lakeshore / G.L. alkaline rockshore	*Poa compressa*	10	7	5	22	4.1	26.1
73	41	Limestone cliff / dry cliff	*Poa compressa*	10	7	10	27	4.1	31.1
74	41	Limestone cobble shore / G.L. alkaline rockshore	*Poa compressa*	10	7	5	22	4.1	26.1
75	41	Limestone lakeshore cliff / moist cliff	*Poa compressa*	10	7	10	27	4.1	31.1
76	41	Disturbed mesic northern forest	*Poa compressa*	10	7	10	27	4.1	31.1
77	41	Sand and gravel beach / G.L. beach	*Poa compressa*	5	0	5	10	4.1	14.1
72	42	Limestone bedrock lakeshore / G.L. alkaline rockshore	*Poa nemoralis*	5	0	5	10	3.57	13.57
73	42	Limestone cliff / dry cliff	*Poa nemoralis*	5	0	10	15	3.57	18.57
74	42	Limestone cobble shore / G.L. alkaline rockshore	*Poa nemoralis*	5	0	5	10	3.57	13.57
75	42	Limestone lakeshore cliff / moist cliff	*Poa nemoralis*	5	0	5	10	3.57	13.57
76	42	Disturbed mesic northern forest	*Poa nemoralis*	5	0	10	15	3.57	18.57

areaID	speciesID	Area	Scientific Name ITIS	Presence Score	Status Score	Habitat Score	Total Score	Species Score	Overall Score
77	42	Sand and gravel beach / G.L. beach	*Poa nemoralis*	5	0	5	10	3.57	13.57
72	43	Limestone bedrock lakeshore / G.L. alkaline rockshore	*Poa pratensis*	10	0	10	20	3.43	23.43
73	43	Limestone cliff / dry cliff	*Poa pratensis*	10	7	10	27	3.43	30.43
74	43	Limestone cobble shore / G.L. alkaline rockshore	*Poa pratensis*	10	0	10	20	3.43	23.43
75	43	Limestone lakeshore cliff / moist cliff	*Poa pratensis*	10	7	10	27	3.43	30.43
76	43	Disturbed mesic northern forest	*Poa pratensis*	10	7	10	27	3.43	30.43
77	43	Sand and gravel beach / G.L. beach	*Poa pratensis*	5	0	5	22	3.43	13.43
72	44	Limestone bedrock lakeshore / G.L. alkaline rockshore	*Populus alba*	5	0	1	6	6.5	12.5
73	44	Limestone cliff / dry cliff	*Populus alba*	5	0	1	6	6.5	12.5
74	44	Limestone cobble shore / G.L. alkaline rockshore	*Populus alba*	5	0	1	6	6.5	12.5
75	44	Limestone lakeshore cliff / moist cliff	*Populus alba*	5	0	1	6	6.5	12.5
76	44	Disturbed mesic northern forest	*Populus alba*	5	0	5	10	6.5	16.5
77	44	Sand and gravel beach / G.L. beach	*Populus alba*	5	0	5	10	6.5	16.5
72	45	Limestone bedrock lakeshore / G.L. alkaline rockshore	*Ranunculus acris*	5	0	10	15	4.1	19.1
73	45	Limestone cliff / dry cliff	*Ranunculus acris*	5	0	10	15	4.1	19.1
74	45	Limestone cobble shore / G.L. alkaline rockshore	*Ranunculus acris*	5	0	10	15	4.1	19.1
75	45	Limestone lakeshore cliff / moist cliff	*Ranunculus acris*	5	0	10	15	4.1	19.1
76	45	Disturbed mesic northern forest	*Ranunculus acris*	5	0	10	15	4.1	19.1
77	45	Sand and gravel beach / G.L. beach	*Ranunculus acris*	5	0	5	10	4.1	14.1
72	46	Limestone bedrock lakeshore / G.L. alkaline rockshore	*Rosa multiflora*	5	0	5	10	7.3	17.3
73	46	Limestone cliff / dry cliff	*Rosa multiflora*	5	0	10	15	7.3	22.3
74	46	Limestone cobble shore / G.L. alkaline rockshore	*Rosa multiflora*	5	0	5	10	7.3	17.3
75	46	Limestone lakeshore cliff / moist cliff	*Rosa multiflora*	5	0	5	10	7.3	17.3
76	46	Disturbed mesic northern forest	*Rosa multiflora*	5	0	10	15	7.3	22.3
77	46	Sand and gravel beach / G.L. beach	*Rosa multiflora*	5	0	5	10	7.3	17.3
72	47	Limestone bedrock lakeshore / G.L. alkaline rockshore	*Rumex obtusifolius*	10	7	5	22	4.1	26.1

areaID	speciesID	Area	Scientific Name ITIS	Presence Score	Status Score	Habitat Score	Total Score	Species Score	Overall Score
73	47	Limestone cliff / dry cliff	*Rumex obtusifolius*	10	0	5	15	4.1	19.1
74	47	Limestone cobble shore / G.L. alkaline rockshore	*Rumex obtusifolius*	10	0	5	15	4.1	19.1
75	47	Limestone lakeshore cliff / moist cliff	*Rumex obtusifolius*	10	0	5	15	4.1	19.1
76	47	Disturbed mesic northern forest	*Rumex obtusifolius*	10	0	5	15	4.1	19.1
77	47	Sand and gravel beach / G.L. beach	*Rumex obtusifolius*	10	0	5	15	4.1	19.1
72	48	Limestone bedrock lakeshore / G.L. alkaline rockshore	*Saponaria officinalis*	5	0	10	15	4.5	19.5
73	48	Limestone cliff / dry cliff	*Saponaria officinalis*	5	0	10	15	4.5	19.5
74	48	Limestone cobble shore / G.L. alkaline rockshore	*Saponaria officinalis*	5	0	10	15	4.5	19.5
75	48	Limestone lakeshore cliff / moist cliff	*Saponaria officinalis*	5	0	10	15	4.5	19.5
76	48	Disturbed mesic northern forest	*Saponaria officinalis*	5	0	10	15	4.5	19.5
77	48	Sand and gravel beach / G.L. beach	*Saponaria officinalis*	5	0	10	15	4.5	19.5
72	49	Limestone bedrock lakeshore / G.L. alkaline rockshore	*Schedonorus pratensis*	5	0	10	15	4.5	19.5
73	49	Limestone cliff / dry cliff	*Schedonorus pratensis*	5	0	5	10	4.5	14.5
74	49	Limestone cobble shore / G.L. alkaline rockshore	*Schedonorus pratensis*	5	0	10	15	4.5	19.5
75	49	Limestone lakeshore cliff / moist cliff	*Schedonorus pratensis*	5	0	10	15	4.5	19.5
76	49	Disturbed mesic northern forest	*Schedonorus pratensis*	5	0	10	15	4.5	19.5
77	49	Sand and gravel beach / G.L. beach	*Schedonorus pratensis*	5	0	10	15	4.5	19.5
72	50	Limestone bedrock lakeshore / G.L. alkaline rockshore	*Sedum acre*	10	7	10	27	4.37	31.37
73	50	Limestone cliff / dry cliff	*Sedum acre*	10	0	10	20	4.37	24.37
74	50	Limestone cobble shore / G.L. alkaline rockshore	*Sedum acre*	10	0	10	20	4.37	24.37
75	50	Limestone lakeshore cliff / moist cliff	*Sedum acre*	10	0	10	20	4.37	24.37
76	50	Disturbed mesic northern forest	*Sedum acre*	10	0	1	11	4.37	15.37
77	50	Sand and gravel beach / G.L. beach	*Sedum acre*	10	0	10	20	4.37	24.37
72	51	Limestone bedrock lakeshore / G.L. alkaline rockshore	*Silene latifolia*	10	0	10	20	4.1	24.1
73	51	Limestone cliff / dry cliff	*Silene latifolia*	10	0	10	20	4.1	24.1
74	51	Limestone cobble shore / G.L. alkaline rockshore	*Silene latifolia*	10	7	10	27	4.1	31.1

areaID	speciesID	Area	Scientific Name ITIS	Presence Score	Status Score	Habitat Score	Total Score	Species Score	Overall Score
75	51	Limestone lakeshore cliff / moist cliff	*Silene latifolia*	10	0	10	20	4.1	24.1
76	51	Disturbed mesic northern forest	*Silene latifolia*	10	0	5	15	4.1	19.1
77	51	Sand and gravel beach / G.L. beach	*Silene latifolia*	10	0	10	20	4.1	24.1
72	52	Limestone bedrock lakeshore / G.L. alkaline rockshore	*Silene vulgaris*	5	0	10	15	4.1	19.1
73	52	Limestone cliff / dry cliff	*Silene vulgaris*	5	0	5	10	4.1	14.1
74	52	Limestone cobble shore / G.L. alkaline rockshore	*Silene vulgaris*	5	0	5	10	4.1	14.1
75	52	Limestone lakeshore cliff / moist cliff	*Silene vulgaris*	5	0	10	15	4.1	19.1
76	52	Disturbed mesic northern forest	*Silene vulgaris*	5	0	5	10	4.1	14.1
77	52	Sand and gravel beach / G.L. beach	*Silene vulgaris*	5	0	10	15	4.1	19.1
72	53	Limestone bedrock lakeshore / G.L. alkaline rockshore	*Solanum dulcamara*	10	7	10	27	4.9	31.9
73	53	Limestone cliff / dry cliff	*Solanum dulcamara*	10	0	10	20	4.9	24.9
74	53	Limestone cobble shore / G.L. alkaline rockshore	*Solanum dulcamara*	10	0	10	20	4.9	24.9
75	53	Limestone lakeshore cliff / moist cliff	*Solanum dulcamara*	10	0	10	20	4.9	24.9
76	53	Disturbed mesic northern forest	*Solanum dulcamara*	10	0	10	20	4.9	24.9
77	53	Sand and gravel beach / G.L. beach	*Solanum dulcamara*	10	0	10	20	4.9	24.9
72	54	Limestone bedrock lakeshore / G.L. alkaline rockshore	*Taraxacum officinale*	10	0	10	20	3.57	23.57
73	54	Limestone cliff / dry cliff	*Taraxacum officinale*	10	0	10	20	3.57	23.57
74	54	Limestone cobble shore / G.L. alkaline rockshore	*Taraxacum officinale*	10	0	10	20	3.57	23.57
75	54	Limestone lakeshore cliff / moist cliff	*Taraxacum officinale*	10	7	10	27	3.57	30.57
76	54	Disturbed mesic northern forest	*Taraxacum officinale*	10	0	10	20	3.57	23.57
77	54	Sand and gravel beach / G.L. beach	*Taraxacum officinale*	10	0	5	15	3.57	18.57
72	55	Limestone bedrock lakeshore / G.L. alkaline rockshore	*Torilis japonica*	5	0	5	10	5.9	15.9
73	55	Limestone cliff / dry cliff	*Torilis japonica*	5	0	10	15	5.9	20.9
74	55	Limestone cobble shore / G.L. alkaline rockshore	*Torilis japonica*	5	0	5	10	5.9	15.9
75	55	Limestone lakeshore cliff / moist cliff	*Torilis japonica*	5	0	5	10	5.9	15.9
76	55	Disturbed mesic northern forest	*Torilis japonica*	5	0	10	15	5.9	20.9

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77	55	Sand and gravel beach / G.L. beach	*Torilis japonica*	5	0	5	10	5.9	15.9
72	56	Limestone bedrock lakeshore / G.L. alkaline rockshore	*Tragopogon pratensis*	10	0	10	20	4.3	24.3
73	56	Limestone cliff / dry cliff	*Tragopogon pratensis*	10	0	10	20	4.3	24.3
74	56	Limestone cobble shore / G.L. alkaline rockshore	*Tragopogon pratensis*	10	0	10	20	4.3	24.3
75	56	Limestone lakeshore cliff / moist cliff	*Tragopogon pratensis*	10	0	10	20	4.3	24.3
76	56	Disturbed mesic northern forest	*Tragopogon pratensis*	10	7	5	22	4.3	26.3
77	56	Sand and gravel beach / G.L. beach	*Tragopogon pratensis*	10	0	10	20	4.3	24.3
72	57	Limestone bedrock lakeshore / G.L. alkaline rockshore	*Trifolium fragiferum*	5	0	1	6	3.57	9.57
73	57	Limestone cliff / dry cliff	*Trifolium fragiferum*	5	0	1	6	3.57	9.57
74	57	Limestone cobble shore / G.L. alkaline rockshore	*Trifolium fragiferum*	5	0	1	6	3.57	9.57
75	57	Limestone lakeshore cliff / moist cliff	*Trifolium fragiferum*	5	0	1	6	3.57	9.57
76	57	Disturbed mesic northern forest	*Trifolium fragiferum*	5	0	1	6	3.57	9.57
77	57	Sand and gravel beach / G.L. beach	*Trifolium fragiferum*	5	0	1	6	3.57	9.57
72	58	Limestone bedrock lakeshore / G.L. alkaline rockshore	*Trifolium pratense*	5	0	10	15	4.5	19.5
73	58	Limestone cliff / dry cliff	*Trifolium pratense*	5	0	5	10	4.5	14.5
74	58	Limestone cobble shore / G.L. alkaline rockshore	*Trifolium pratense*	5	0	10	15	4.5	19.5
75	58	Limestone lakeshore cliff / moist cliff	*Trifolium pratense*	5	0	10	15	4.5	19.5
76	58	Disturbed mesic northern forest	*Trifolium pratense*	5	0	10	15	4.5	19.5
77	58	Sand and gravel beach / G.L. beach	*Trifolium pratense*	5	0	10	15	4.5	19.5
72	59	Limestone bedrock lakeshore / G.L. alkaline rockshore	*Typha angustifolia*	5	0	10	15	9	24
73	59	Limestone cliff / dry cliff	*Typha angustifolia*	5	0	0	5	9	14
74	59	Limestone cobble shore / G.L. alkaline rockshore	*Typha angustifolia*	5	0	10	15	9	24
75	59	Limestone lakeshore cliff / moist cliff	*Typha angustifolia*	5	0	10	15	9	24
76	59	Disturbed mesic northern forest	*Typha angustifolia*	5	0	1	6	9	15
77	59	Sand and gravel beach / G.L. beach	*Typha angustifolia*	5	0	10	15	9	24
72	60	Limestone bedrock lakeshore / G.L. alkaline rockshore	*Valeriana officinalis*	5	0	10	15	7.3	22.3

areaID	speciesID	Area	Scientific Name ITIS	Presence Score	Status Score	Habitat Score	Total Score	Species Score	Overall Score
73	60	Limestone cliff / dry cliff	*Valeriana officinalis*	5	0	10	15	7.3	22.3
74	60	Limestone cobble shore / G.L. alkaline rockshore	*Valeriana officinalis*	5	0	10	15	7.3	22.3
75	60	Limestone lakeshore cliff / moist cliff	*Valeriana officinalis*	5	0	10	15	7.3	22.3
76	60	Disturbed mesic northern forest	*Valeriana officinalis*	5	0	10	15	7.3	22.3
77	60	Sand and gravel beach / G.L. beach	*Valeriana officinalis*	5	0	5	10	7.3	17.3
72	61	Limestone bedrock lakeshore / G.L. alkaline rockshore	*Verbascum thapsus*	10	7	10	27	4.37	31.37
73	61	Limestone cliff / dry cliff	*Verbascum thapsus*	10	0	10	20	4.37	24.37
74	61	Limestone cobble shore / G.L. alkaline rockshore	*Verbascum thapsus*	10	7	10	27	4.37	31.37
75	61	Limestone lakeshore cliff / moist cliff	*Verbascum thapsus*	10	0	10	20	4.37	24.37
76	61	Disturbed mesic northern forest	*Verbascum thapsus*	10	0	10	20	4.37	24.37
77	61	Sand and gravel beach / G.L. beach	*Verbascum thapsus*	10	0	10	20	4.37	24.37
72	62	Limestone bedrock lakeshore / G.L. alkaline rockshore	*Veronica officinalis*	5	0	5	10	4.9	14.9
73	62	Limestone cliff / dry cliff	*Veronica officinalis*	5	0	10	15	4.9	19.9
74	62	Limestone cobble shore / G.L. alkaline rockshore	*Veronica officinalis*	5	0	5	10	4.9	14.9
75	62	Limestone lakeshore cliff / moist cliff	*Veronica officinalis*	5	0	5	10	4.9	14.9
76	62	Disturbed mesic northern forest	*Veronica officinalis*	5	0	10	15	4.9	19.9
77	62	Sand and gravel beach / G.L. beach	*Veronica officinalis*	5	0	1	6	4.9	10.9
72	63	Limestone bedrock lakeshore / G.L. alkaline rockshore	*Veronica serpyllifolia*	5	0	10	15	4.5	19.5
73	63	Limestone cliff / dry cliff	*Veronica serpyllifolia*	5	0	10	15	4.5	19.5
74	63	Limestone cobble shore / G.L. alkaline rockshore	*Veronica serpyllifolia*	5	0	10	15	4.5	19.5
75	63	Limestone lakeshore cliff / moist cliff	*Veronica serpyllifolia*	5	0	10	15	4.5	19.5
76	63	Disturbed mesic northern forest	*Veronica serpyllifolia*	5	0	10	15	4.5	19.5
77	63	Sand and gravel beach / G.L. beach	*Veronica serpyllifolia*	5	0	1	6	4.5	10.5
72	64	Limestone bedrock lakeshore / G.L. alkaline rockshore	*Viburnum opulus*	5	0	5	10	5.1	15.1
73	64	Limestone cliff / dry cliff	*Viburnum opulus*	5	0	5	10	5.1	15.1
74	64	Limestone cobble shore / G.L. alkaline rockshore	*Viburnum opulus*	5	0	5	10	5.1	15.1

areaID	speciesID	Area	Scientific Name ITIS	Presence Score	Status Score	Habitat Score	Total Score	Species Score	Overall Score
75	64	Limestone lakeshore cliff / moist cliff	*Viburnum opulus*	5	0	5	10	5.1	15.1
76	64	Disturbed mesic northern forest	*Viburnum opulus*	5	0	5	10	5.1	15.1
77	64	Sand and gravel beach / G.L. beach	*Viburnum opulus*	5	0	5	10	5.1	15.1