

# **Invasive Plant Management Plan for St. Martin Island in Horicon-Green Bay National Wildlife Refuge**

*Great Lakes Region*



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**On the cover :**

Limestone cobble shoreline of St Martin Island, Green Bay National Wildlife Refuge.

Photograph: Jesse Lincoln, June 3, 2021



## Summary

Invasive species management is a major priority of National Wildlife Refuge 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 National Wildlife Refuge 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 and federally endangered plants such as dwarf lake iris, Laurentian fragile fern, and climbing fumitory (Salas et al. 2017, Cohen et al. 2022).

In support of Green Bay National Wildlife Refuge's Habitat Management Plan and Comprehensive Conservation Plan, this Invasive Plant Management Plan (IPMP) is meant to guide invasive plant species management and monitoring, using the principals of integrated pest management, on St. Martin Island. St Martin is the largest island on the refuge, and the most habitat- and species-diverse, hosting six high-quality natural community occurrences, one listed animal, and six listed plants. These conservation assets are threatened by a diversity of invasive species, several of them quite aggressive, including invasive common reed, reed canary grass, narrow-leaved cat-tail, bush honeysuckle, and wild parsnip. 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, and Elizabeth Haber for feedback on this report. We thank the Little Traverse Bay Band of Odawa Indians Natural Resources Department for collaboration on surveys and logistical support, particularly Bill Parsons and Noah Jansen. We thank U.S. 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.

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# Narrative

## 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*) 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 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 St. Martin Island, a 523 ha island in Lake Michigan located 15 km southwest of the Garden Peninsula in the State of Michigan for Horicon-Green Bay NWR Complex staff. The island is part of the Green Bay NWR. We share results of recent botanical and ecological surveys, 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***

St. Martin Island (45°30'N, 86°46'W in Delta County, Michigan, 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, Judziwicz 2001). St. Martin Island's flora 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).

St Martin Island is about 3 km long by 2 km wide and covers 1300 acres. On its eastern and western shores, it has sheer cliffs up to 80 ft high. Other than coastal cliffs, its topographic relief

is gentle. Its highest point is 302 ft (92 m) above Lake Michigan. The bedrock underlying the ground surface on St. Martin Island is dolomite. Dolomite is a variant of limestone, but it consists of more 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 contains occasional cliff escarpments 3 to 7 ft high (Judziewicz et al. 2016). There was an old-growth mesic forest on St. Martin Island until at least 1926 (Fuller 1927), but this was subsequently logged, and the island's forest is now second- or third-growth. Parts of the island have excellent displays of spring ephemerals (Judziewicz 2001). Until 2013, the entire island was privately owned, still evidenced by dilapidated structures near the dock in the southwest, a small cemetery in the interior, and a network of old roads and trails. There was a fishing village established in the 19<sup>th</sup> century which supported a 100-person population before its abandonment in 1900 (Judziewicz 2001).

Historically, the island has been thoroughly botanized. Limited collecting expeditions in 1926, 1969, and 1989–1990 accumulated a record of nearly 200 plant species (Judziewicz 2001), and this number grew to 405 after ownership of most of the island transferred to The Nature Conservancy in 2013/2014, which allowed a thorough collecting expedition (Judziewicz et al. 2016). These and other expeditions documented the following rare plants: climbing fumitory (*Adlumia fungosa*), dwarf lake iris, rock whitlow-grass (*Draba arabisans*), ashy whitlow-grass (*D. cana*), Laurentian fragile fern (*Cystopteris laurentiana*), and calypso orchid (*Calypso bulbosa*). The interior of the island has been reported as forest, primarily mesic hardwood forest, but also contains sections of coniferous and mixed forest and a wetland complex of vernal pools and green-ash swamp; this forested wetland occurs in the Little Traverse Bay Band of Odawa Indians (LTBBOI) property in the northeast (Judziewicz et al. 2016; Figure 2). The shoreline consists of limestone dolomite cliffs, limestone dolomite cobble shore, and a bit of sandy beach with a small sand dune (Judziewicz et al. 2016).



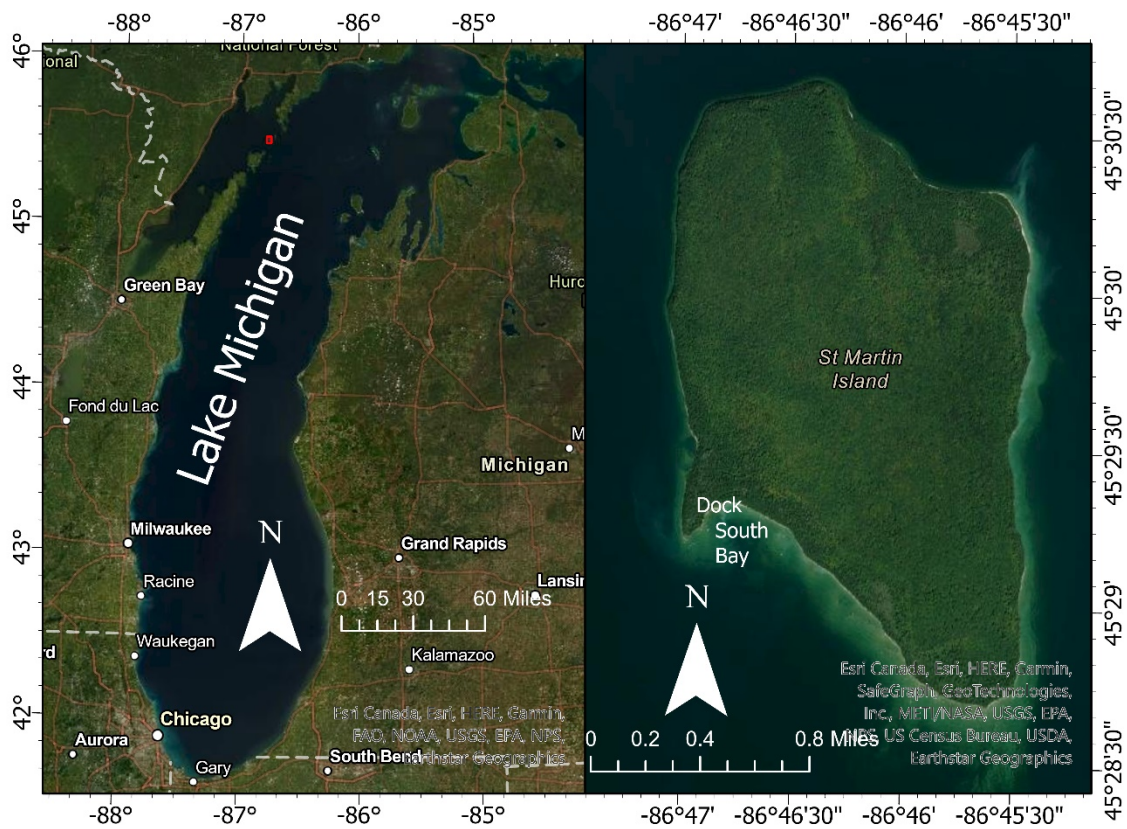


Figure 1. St. Martin Island (right) is located in northern Lake Michigan, USA (left). The red rectangle in the left pane represents the extent of the right pane.



Figure 2. Land ownership on St. Martin Island. Land purchased by The Nature Conservancy in 2013 and 2014 was donated to the United States Fish and Wildlife Service (USFWS). A parcel in the northeast is still owned by the Little Traverse Bay Band of Odawa Indians. This figure is reproduced from Salas et al. (2017).

### Conservation Assets

Our botanical and ecological surveys corroborate the findings of Judziewicz et al. (2016), despite some semantic differences arising from differences in classification systems across states (Bassett et al. 2022, Cohen et al. 2022). We found the island to be rich in rare animals, plants, and natural communities (Table 1). Bald eagles (*Haliaeetus leucocephalus*) have been nesting on the island since at least 2002. The most recent observation (July 29, 2021) was during Michigan Natural Features Inventory (MNFI) 2021 surveys: a juvenile in a nest in a basswood tree (*Tilia americana*) in an opening adjacent to the mesic northern forest (Table 1). St. Martin Island is in the Boreal Hardwood Transition Bald Eagle management unit, which saw the highest increases in new and occupied nests in the United States during the time period from 2009-2019 (USFWS 2020).

Five state-listed plant species and one federal- and state-listed species were known from the island prior to the 2021 surveys. All listed species were observed in the 2021 surveys except for the calypso orchid, which has not been seen since 1961 (Bassett et al. 2022; Table 1; Figure 3). Judziewicz et al. (2016) hypothesize that deer-browse and climate change are to blame for its

extirpation. One of the two occurrences of the federally listed dwarf lake iris has not been observed in recent surveys (Judziewicz et al. 2016, Bassett et al. 2022, Cohen et al. 2022). This occurrence is based on an observation stated in an article by A.M. Fuller published in 1927 and is believed to be extirpated (Judziewicz et al. 2016). One of our rediscoveries was of an old record, rock whitlow grass, which was not previously reported since 1990. This species was uncommon [REDACTED] (Figure 4). A new ram's-head lady-slipper (*Cypripedium arietinum*) record was discovered, [REDACTED] (Bassett et al. 2022; Figure 3, Figure 4).

High-quality natural communities cover about 55% of the island (Figure 3, Figure 5). Mesic northern forest occupies about 40%, covering 530 acres and containing showy displays of spring ephemerals (Figure 5, Figure 6). Boreal forest and northern hardwood swamp are also present at 119 and 7 acres respectively. Covering about half of the shoreline in a narrow strip is limestone cobble shore, occupying 15 total acres. State-critically-imperiled limestone lakeshore cliff covers approximately the other half of the shoreline for a total of 42 acres. Imperiled on a state-wide scale, limestone cliff occupies 7 acres of the interior.

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 Chapter 3.

Table 1. Element occurrence (EO) for rare native species and natural communities. EO ID is a unique identifier assigned to each EO in Michigan Natural Heritage Database. 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. NA = not applicable.

Element	Common name	EO ID	EO Rank	Last Observed	State Status	Global Status
<i>Adlumia fungosa</i>	Climbing fumitory	8054	A	2021	Special concern	G4
<i>Calypso bulbosa</i>	Calypso	15499	F	1961	Threatened	G5
<i>Cypripedium arietinum</i>	Ram's head lady-slipper	24441	C	2021	Special concern	G3
<i>Cystopteris laurentiana</i>	Laurentian fragile fern	24389	CD	2021	Special concern	G3
<i>Cystopteris laurentiana</i>	Laurentian fragile fern	24390	B	2021	Special concern	G3
<i>Draba arabisans</i>	Rock whitlow-grass	13792	CD	2021	Special concern	G4
<i>Draba cana</i>	Ashy whitlow-grass	24391	CD	2021	Threatened	G5
<i>Haliaeetus leucocephalus</i>	Bald eagle	14287	E	2021	Special concern	G5
<i>Iris lacustris</i>	Dwarf lake iris	23699	F	1926	Threatened (Both federal and state)	G3
<i>Iris lacustris</i>	Dwarf lake iris	23701	D	2021	Threatened (Both federal and state)	G3

Element	Common name	EO ID	EO Rank	Last Observed	State Status	Global Status
Boreal forest <sup>1</sup>	NA	24351	B	2021	S3	GU
Limestone cliff	NA	24350	B	2021	S2	G4G5
Limestone cobble shore <sup>1</sup>	NA	24353	B	2021	S3	G2G3
Limestone lakeshore cliff	NA	24348	A	2021	S1	G4G5
Mesic northern forest	NA	24349	BC	2021	S3	G4
Northern hardwood swamp <sup>2</sup>	NA	24352	C	2021	S3	G4

Table 2. Explanation of state and global status ranks for natural communities (taken verbatim from NatureServe Biotics Help):  
[https://help.natureserve.org/biotics/content/record\\_management/Element\\_Files/Element\\_Tracking/ETRA\\_CK\\_Definitions\\_of\\_Heritage\\_Conservation\\_Status\\_Ranks.htm](https://help.natureserve.org/biotics/content/record_management/Element_Files/Element_Tracking/ETRA_CK_Definitions_of_Heritage_Conservation_Status_Ranks.htm)

Status	Description	Explanation
<b>S1</b>	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.
<b>S2</b>	Imperiled	At high risk of extirpation in the jurisdiction due to restricted range, few populations or occurrences, steep declines, severe threats, or other factors.
<b>S3</b>	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.
<b>S4</b>	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.
<b>S5</b>	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.
<b>G1</b>	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.
<b>G2</b>	Imperiled	At high risk of extinction or elimination due to restricted range, few populations or occurrences, steep declines, severe threats, or other factors.
<b>G3</b>	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.
<b>G4</b>	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.
<b>G5</b>	Secure	At very low risk of extinction or elimination due to a very extensive range, abundant populations or occurrences, and little to no concern from declines or threats.
<b>GU</b>	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.

<sup>1</sup> This area is located partially on land owned by LTBBOI

<sup>2</sup> The majority of this area is on land owned by LTBBOI, but considering its relationship and geographical proximity to federally owned lands on St. Martin Island, it was ranked and included in discussions







Figure 4. Rare plant species on St. Martin Island. Clockwise from top: rock whitlow-grass (*Draba arabisans*; photo: Jesse Lincoln, June 4, 2021), ram's-head lady-slipper (*Cypripedium arietinum*; Lincoln, June 2021), dwarf lake iris (*Iris lacustris*; Joshua Cohen, June 3, 2021), ashy whitlow-grass (*Draba cana*; Lincoln, June 2, 2021).





Figure 5. Spring flora in the high-quality mesic northern forest on St. Martin Island. Left: woodland phlox (*Phlox divaricata*). Right: yellow lady-slipper (*Cypripedium parviflorum*). Photos: Jesse Lincoln, June 2, 2021.



Figure 6. High-quality natural communities on St. Martin Island. Clockwise from upper left: limestone lakeshore cliff (photo: Jesse Lincoln, June 4, 2021), mesic northern forest (Joshua Cohen, June 2, 2021), limestone cobble shore (Lincoln, June 2, 2021), limestone cliff (Cohen, June 3, 2021), and boreal forest (Cohen, June 2, 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<sup>1</sup>

We also advocate for maintaining the quality of the four additional natural communities on St. Martin Island (Table 1; Figure 3):

- Boreal forest <sup>1</sup>
- Limestone cliff
- Limestone lakeshore cliff
- Northern hardwood swamp<sup>2</sup>.

The majority of the northern hardwood swamp and portions of the boreal forest and limestone cobble lakeshore are located on land owned by LTBBOI, but considering its relationship, geographical proximity to federally owned lands on St. Martin Island, and the presence of invasive species within it, these areas were ranked and included in discussions. Any management actions in the areas on LTBBOI land should be made in accordance with the LTBBOI.

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

### **History of Invasive Plant Management**

According to the GIS layer Islands\_Invasive\_Species.gdb provided by the United State Fish and Wildlife Service (USFWS), large amounts of purple loosestrife (*Lythrum salicaria*), invasive common reed, and reed canary grass (*Phalaris arundinacea*) were mapped in 2016 and 2017 near the dock and along the limestone cobble shore of St. Martin Island's south coast. Much of this invasion was treated in 2017 (Figure 7). Subsequent highwater years further contributed to the decline of these invasive species such that none of these three species were detected on the government-owned portion of the island in 2021, although reed canary grass and invasive common reed were found on LTBBOI land in the northeast (Figure 9).



Although not an invasive plant, management of white-tailed deer (*Odocoileus virginiana*) in 2013 has led to a rebound of once sparse native plants in recent years. Deer were introduced to St. Martin Island in the last few decades (Salas et al. 2017). Though a native species to Michigan, white-tailed deer become a nuisance at high density, over-browsing their preferred vegetation, like Canada yew (*Taxus canadensis*). Reports from 1926 – 2006 noted the forest floor of the island was covered with Canada yew. In 2013, the island's deer population was significantly reduced through a culling effort arranged by The Nature Conservancy (Sadie O'Dell, *pers. comm.*). When surveyed in 2014, virtually no Canada yew remained, and the forest understory was generally sparse except for herbs such as houndstongue (*Cynoglossum boreale*), the bur-like fruit of which sticks to deer fur (Judziewicz et al. 2016). Our 2021 surveys revealed that the understory had recovered to a large extent, supporting a diverse spring flora and vigorous plant growth (Bassett et al. 2022, Cohen et al. 2022; Figure 5, Figure 8). Limited recovery was observed with Canada yew due to herbivory directly or indirectly from a caterpillar, possibly saddled prominent (*Heterocampa guttivitta*), which had an outbreak on St. Martin Island in 2014 (Rush and Allen 1987, Sadie O'Dell *personal communication*).

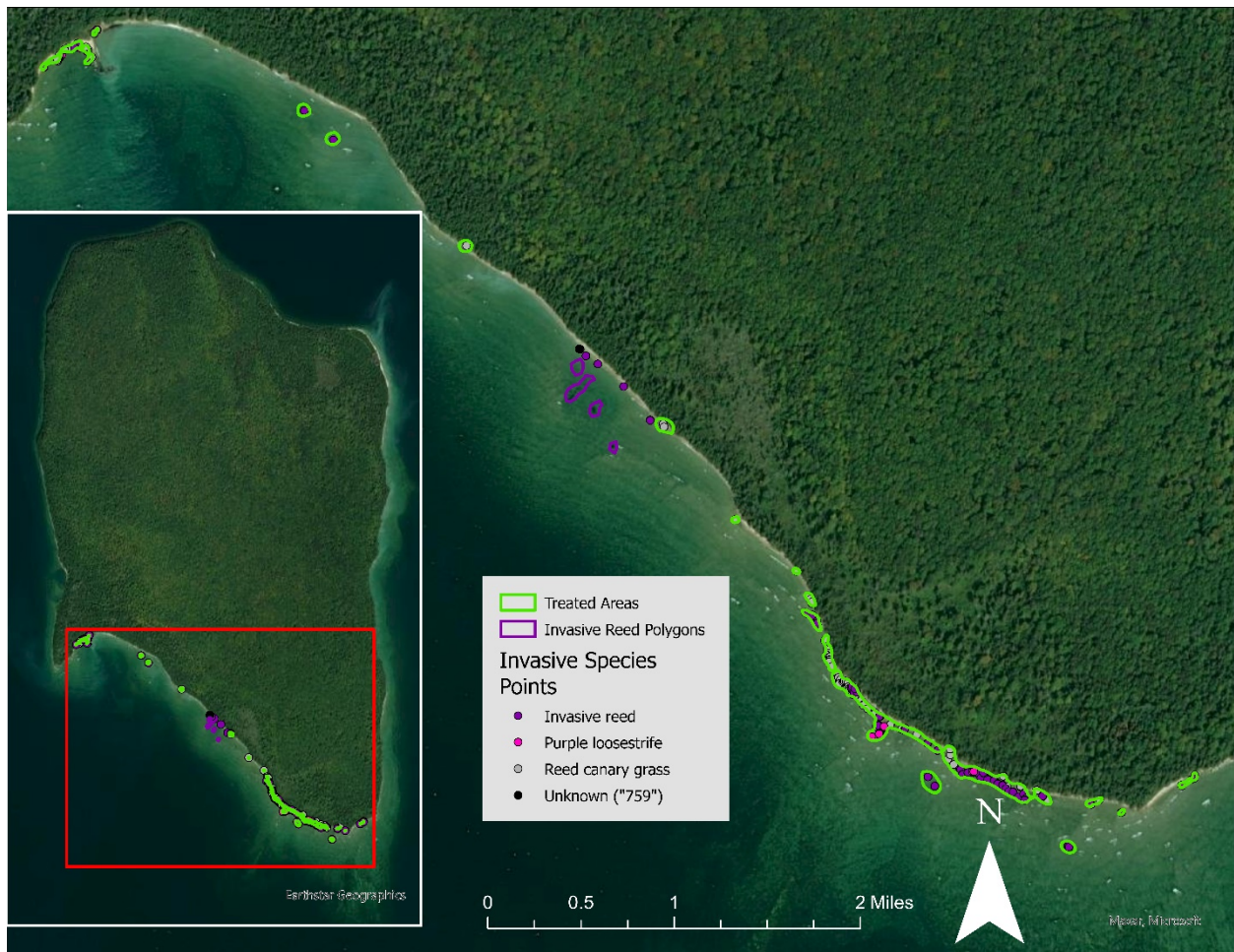


Figure 7. Invasive species mapped in 2016 – 2017 and treated in 2017.





Figure 8. After a 2013 deer cull, the once sparse forest understory of St. Martin Island has recovered to a large extent, supporting ample spring ephemerals and vigorous plant growth. Photo by Joshua Cohen, June 2, 2021.

### **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 Michigan Department of Environment, Great Lakes, and Energy (formerly Michigan Department of Environmental Quality) 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 St. Martin 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 by members working on developing the IPMP [Scott Warner (MNFI), Rachel Hackett (MNFI)], 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. External communication was established between other MNFI staff members who conducted the most recent surveys on St. Martin Island (Tyler Bassett, Josh Cohen, Rachel Hackett, Jesse Lincoln, Scott Warner) and LTBBOI Natural Resource Department staff (Bill Parsons, Noah Jansen), who partnered with and accompanied MNFI staff on their surveys and own property on St. Martin Island. Communication was also fostered with the local area Cooperative Invasive Species Management Area (CISMA): Elise Desjarlais, Lake-2-Lake CISMA. Lake-2-Lake CISMA is a project partner who will conduct invasive plant treatment in the State of Michigan 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 Michigan Natural Heritage Database contains Element Occurrences (EO) of rare and listed species and natural communities. These records were mined for those located on St. Martin Island and used to plan survey visits to the island during appropriate detection periods (Table 1). A more detailed description of the use of this information to inform vegetative and ecological surveys on St. Martin 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 via MNFI's public Survey123 form: MNFI Rare Species Form. The form was designed to collect information on Michigan's endangered, threatened, and special



concern species (Appendix 1). All observations are reviewed by MNFI staff before being transcribed into the Michigan Natural Heritage Database. U.S. Fish and Wildlife Service has a subscription to access the database via a web interface or ArcGIS Server Feature. For more information about Michigan's Natural Heritage Database, contact the MNFI Data Manager at [mnfi@msu.edu](mailto:mnfi@msu.edu).

### *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. St. Martin Island was visited twice over the growing season in 2021: the first visit occurred from June 2 to June 4 and the second visit from July 28 to July 29. 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 was 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.

Most 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 about feature layers and data collection via AGOL 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) for comparison within the island. This tool was developed by the USFWS Inventory and Monitoring Initiative (Region 8) and Utah State University (USFWS 2016) and designed to highlight invasive plant monitoring priorities and watch list species.

For treatment prioritization across Green Bay NWR islands of Detroit, Plum, Poverty, and St. Martin, the IPIEDPT tool was not used. The tool's emphasis on invasive species monitoring was evident: areas that had little to no invasive species present were ranked in the highest tier (Appendix 3, Table 1-1). In its stead, we present the "Stewardship Prioritization" matrix generated for the natural community report for Green Bay NWR (Cohen et al. 2022).

### ***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 was used (Cohen et al. 2019). Species proximity and current abundance were derived from data gathered during the 2021 surveys (Bassett et al. 2022, 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 US Department of Agriculture'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 evaluated 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 within St. Martin Island*

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. 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). For IPMP purposes, discontinuous polygons of the same natural community were considered separate natural community areas if they had differing levels of invasion or mechanisms for invasion (e.g., boreal forest near the old lighthouse/railroad and boreal forest with wild parsnip in the southwest). On St. Martin Island two areas of significant anthropogenic disturbance harbored unique invasive species and were included as separate areas in IPIEDPT: St. Martin lighthouse and St. Martin south dock.

The IPIEDPT has a method to score area prioritization using categorical ranks adhering to rubrics developed by IPIEDPT (USFWS 2016). The IPIEDPT tool itself was developed with a focus on prioritization of plant surveys and monitoring, not treatment. 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, Horicon NWR Complex, and Lake-2-Lake Cisma, 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.

<b>Strategy</b>	<b>Description</b>
Early Detection/Rapid Response (EDRR)	Surveillance technique to monitor and treat emerging pest infestations.
Monitoring	On-going 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 re-introduction.
Elimination/Zero Density	Population is of high enough priority or small enough size to eliminate from a designated area, but re-introduction 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 St. Martin 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 9, Figure 10).

Management is likely to result in significant positive outcomes. Nine species were classified as Priority 1 (Table 5). Two woody species were placed in Priority 1 category despite IPIEDPT scores closer in value to Priority 3 species: Autumn olive (*Elaeagnus umbellata*) and white poplar (*Populus alba*). MNFI believes these species pose a significant risk to the island ecosystem and should be treated while their infestation is relatively small. The single individual of autumn olive observed was pulled in the field in 2021, but since it was present, it was placed in the Priority 1 list instead of Priority 2.

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

Priority 3 species were considered naturalized on St. Martin and nearby islands (Table 5; Figure 9, Figure 10). 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 St. Martin 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 St. Martin Island.
Priority 3	Present but not prioritized: The species is often considered invasive and was observed in 2021 but has thoroughly naturalized on St. Martin 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. Non-native species that have been widely and long-naturalized in the region such as dandelion (*Taraxacum officinale*) were not considered. 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
<i>Centaurea stoebe</i> ssp. <i>micranthos</i>	Spotted knapweed	Priority 1	9.00
<i>Elaeagnus umbellata</i>	Autumn olive	Priority 1	6.10
<i>Euphorbia esula</i>	Leafy spurge	Priority 1	8.10
<i>Lonicera</i> spp.	Bush honeysuckles	Priority 1	8.47
<i>Pastinaca sativa</i>	Wild parsnip	Priority 1	7.30
<i>Phalaris arundinacea</i>	Reed canary grass	Priority 1	9.07
<i>Phragmites australis</i> ssp. <i>australis</i>	Invasive common reed	Priority 1	9.10
<i>Populus alba</i>	White poplar	Priority 1	6.50
<i>Typha angustifolia</i>	Narrow-leaved cat-tail	Priority 1	9.00
<i>Cirsium arvense</i>	Canada thistle	Priority 3	7.57
<i>Cirsium palustre</i>	European marsh thistle	Priority 3	6.77
<i>Cirsium vulgare</i>	Bull thistle	Priority 3	6.77
<i>Cynoglossum officinale</i>	Houndstongue	Priority 3	6.77

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 9).



Figure 9. Invasive species data taken on St. Martin 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. Note that the only multi-polygon community EO broken into more than one area was boreal forest. Abbreviations: 'BF' = boreal forest, 'EO' = element occurrence.





Figure 10. Invasive plant species on St. Martin Island. Clockwise from upper left: marsh thistle (*Cirsium palustre*), houndstongue (*Cynoglossum officinale*), leafy spurge (*Euphorbia esula*), and bush honeysuckle (*Lonicera morrowi*). The upper photos are Priority 3 species and the lower photos are Priority 1 species (Table 4, Table 5). Photos by Rachel Hackett, June 2–3, 2021.

## **Species Descriptions and Priorities**

### **Priority 1: Present Aggressive Species**

#### **SPOTTED KNAPWEED (*CENTAUREA STOEBE* SSP. *MICRANTHOS*)**

Spotted knapweed was not collected in Michigan until 1911, yet it has since become a terrible invasive plant in open upland habitats throughout the state (Reznicek et al. 2011), including relatively undisturbed natural areas (Czarapata 2005). In North America, this Eurasian allelopathic biennial first became a serious pest in the rangelands of the West. In Montana, USA, its annual economic impact has been estimated at a cost of \$42 million a year (Czarapata 2005).

**Species description:** Spotted knapweed is a forb with basal rosette and flowering stage. Although considered a biennial, the basal rosette stage may last one to four years. It can be distinguished from other similar species by the combination of its deeply pinnatifid or bipinnatifid divided stem leaves and the blackened, fringed tips on the end of the green modified leaves (i.e., phyllaries) that form a cup (i.e., involucre) under the less than 3 cm broad flowerhead. Each mature plant flowers for several days as early as late June and as late as September, which makes this the easiest time window for detection. A seasoned naturalist can identify basal rosettes during most of the summer growing season. Seeds are dispersed by wind twenty days after the end of flowering. Spotted knapweed is viable in the seedbank for nine years (Czarapata 2005).

**Habitat:** Disturbed, open, upland sites (Reznicek et al. 2011).

**Current status in landscape:** Fortunately, spotted knapweed was mapped at only one location on St. Martin Island, in the southwest near the dock (Figure 9). This was a relatively small patch (Bassett et al. 2022).

**Management:** Digging or hand-pulling can be successful when the ground is moist. Some people experience skin reactions when handling this plant, so gloves should be worn. It is essential to remove the entire root system and to remove the excised plant from the site. The soil should be loosened before pulling to prevent root breakage, as even a small root fragment left in the soil can resprout to form a new plant. Uprooting often exposes seed that will later germinate. Annual control measures will likely be necessary for several years (Czarapata 2005). Spotted knapweed is viable in the seedbank for nine years (Czarapata 2005).

For large infestations, chemical treatment may be inappropriate because of non-target effects. An area 10 to 15 ft (3 to 4.5 m) beyond the invasion zone must be treated to control roots and seeds. This would not be justified in the intact natural communities. Several insects have showed promise as biological control agents in the Midwest (Czarapata 2005). Care must be taken when weighing a decision for biological control, as introducing a new species into an island ecosystem can have unintended consequences (e.g., Ortega *et al.* 2004).

### AUTUMN OLIVE (*ELAEAGNUS UMBELLATA*)

Autumn olive was not reported as naturalized in Michigan until 1939, yet it has since become a terrible pest throughout the Lower Peninsula and is now spreading in the Upper Peninsula (Reznicek et al. 2011). It is an aggressive competitor that can displace native plants and further disrupt communities by its ability to fix nitrogen and alter soil nutrient levels (Czarapata 2005).

**Species description:** Autumn olive is a shrub that grows to a height of 6 to 20 ft (2 to 6 m). The leaves are small, simple, untoothed, alternately arranged, and oval to elliptic in shape. The leaf undersides, young stems, and the small bright-red fleshy fruit are covered with conspicuous silver dots, a key diagnostic trait. The fragrant white four-petaled flowers droop down in pairs, flower in May or June, and have a long floral tube. Autumn olive produces copious fruits, which are spread easily via animal dispersal (Czarapata 2005). Their distinctive leaves, fruits, and flowers make them unlikely to be confused with anything but Russian olive (*E. angustifolia*), also invasive, but not yet known from any counties near St. Martin Island.

**Habitat:** Very versatile, but perhaps most frequently along roadsides, in forests, and in fields (Reznicek et al. 2011).

**Current status in landscape:** Only one plant was observed on the island, a small individual that that was removed by the surveyor. This was in the north, on the edge of the mesic northern forest and limestone cliff EOs (Bassett et al. 2022).

**Management:** Hand pulling is best done in spring when the ground is moist and the entire root system can be removed to prevent resprouting. Given the early stage of invasion on St. Martin, this will likely be an effective way to control any additional individuals that are revealed through vigilant monitoring. Cutting or burning this species results in vigorous resprouting unless chemicals are applied. Several chemical treatment options are available, with glyphosate or triclopyr with penetrating oil being the most common used for cut stump treatments. Respouts even after chemical treatment are not unusual and should be cut and chemically treated again. (Czarapata 2005).

LEAFY SPURGE (*EUPHORBIA ESULA*, SYNONYM *E. VIRGATA*)

Leafy spurge is a prohibited noxious weed in Michigan (Borland et al. 2015) where it was first collected in 1855. It has since spread to most of the state, sometimes carpeting large open areas (Reznicek et al. 2011). It spreads easily via horizontal roots and has colonized huge areas in western North America causing extensive ecological and economic damage (Czarapata 2005). It is imperative to eradicate this species early on the invasion curve (Harvey and Mazzotti 2014). Its sap is a human health risk that causes blistering and possibly blindness in sensitive humans and it is toxic to cattle and horses (Czarapata 2005).

**Species description:** Leafy spurge is a perennial forb with linear to lance shaped, bluish-green leaves 1 to 4 in (2.5 to 10.2 cm) in length. This species produces a milky sap when any part of the plant is damaged. Its flowers have no petals or sepals, but instead have modified yellow-green leaves (i.e., bracts) around small yellow-green flowers. Bloom time lasts from May to August, when it is easiest to detect and identify. Leafy spurge produces three-parted capsules with ballistic dispersal that can launch seeds to distances up to 20 ft (6 m) away. Seeds can remain viable in the soil for up to eight years. Its taproot can be up to 15 ft (4.5 m) deep (Borland et al. 2015). Leafy spurge reproduces and disperses aggressively both via seed and vegetative fragments including stems, root buds, and roots.

**Habitat:** Disturbed, open, upland sites, such as roadsides, railroads, and fields (Reznicek et al. 2011; Figure 10).

**Current status in landscape:** On St. Martin, it was found only in two patches, in the northeast of St. Martin Island on LTBOOI land near the lighthouse and near the dock (Bassett et al. 2022; Figure 9, Figure 10). While not in high-quality natural communities, they pose an immediate risk to the nearby limestone cobble shore, northern hardwood swamp, and boreal forest community EOs.

**Management:** The aggressive spread of this plant makes monitoring and EDRR particularly important. Mechanical removal should not be attempted. A failed effort to remove the deep and spreading root system can stimulate further growth and spread.

For small infestations, chemical treatment is the best option. Imazapic is a selective herbicide that works on leafy spurge, but it can leach through sandy soils into groundwater. Nonselective 2,4-D amine plus glyphosate are recommended, but due to persistent rhizomes and seedbank, follow-up treatment is needed for 3 to 4 years.

Some biocontrol agents have shown promise as treatment: the leafy spurge gall midge (*Spurgia esulae*) and flea beetles (*Aphthona* spp.; Czarapata 2005, Lym 2005). After treatment, vigilant surveillance should continue for 5 to 10 years; seeds remain viable for up to eight years. Early spring is a good time to survey for this species because the plants leaf out early (Borland et al. 2015).

### 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. Their leaves are opposite, oval, without small hairs on the outer edge (i.e., margin) of the leaf. Flowers are white to pink and bloom along the leaf axils (Figure 10). 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 eight locations from the north half of St. Martin Island, some occurring within or near quality mesic forest, boreal forest, and northern hardwood swamp (Bassett et al. 2022; Figure 9, Figure 10). More bush honeysuckle is likely scattered about the island, particularly along roads and trails. 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 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).

### WILD PARSNIP (*PASTINACA SATIVA*)

Wild parsnip is a biennial that was first collected in Michigan in 1871; since then it has established throughout the state. It is found mostly on shores, roadsides, and anthropogenic openings but it also invades thickets and open forests (Reznicek et al. 2011). Wild parsnip spreads in slow waves at first and then begins to spread rapidly. Extreme caution should be used when treating this plant. All aboveground plant parts contain sap that can cause intense burns, rashes, and blistering on skin when exposed to sunlight.

**Species description:** Wild parsnip is a biennial forb with a basal rosette and flowering stage. It has coarsely toothed compound leaves that clasp around a grooved stem. The flowers are small, yellow, and arranged in flat umbels 2 to 6 in (5 to 15.25 cm) broad. The seeds can remain viable for four years (Czarapata 2005). Seeds are flattened, ridged, and oval. Seeds attach easily to passing animals, but can also be moved by wind and water, as well as by roadside mowing equipment. Seeds can remain viable in the soil for up to 4 years. The easiest detection period is from June to mid-July when the showy yellow flowers are in bloom (Czarapata 2005).

**Habitat:** Roadsides, fields, clearings, shores, thickets, and open forests (Reznicek et al. 2011).

**Current status in landscape:** One occurrence was spotted on St. Martin Island, in the southwest within the boreal forest EO (Bassett et al. 2022; Figure 9, Figure 10).

**Management:** Plants can be uprooted when the soil is moist. Alternatively, the root should be cut 1 to 2 in (2.5 to 5 cm) below ground level to prevent resprouting. Removal is best done before seed has begun to set. If not, seed heads must be bagged and destroyed in a secure location (Czarapata 2005).

Larger populations can be cut at ground level with a power brush-cutter. Chemical treatment is also effective: Glyphosate or metsulfuron-methyl plus a surfactant, or triclopyr formulated for use with water and 2,4-D amine are commonly used as foliar sprays (Czarapata 2005). Follow-up monitoring and treatment will be necessary.



### REED CANARY GRASS (*PHALARIS ARUNDINACEA*)

Reed canary grass is a native element of our flora, yet invasive strains have been introduced from Europe. The native and invasive strains are morphologically indistinct. The latter is becoming a serious pest in wetland habitats, forming dense monocultures (Reznicek et al. 2011).

**Species description:** Reed canary grass is a perennial grass that reaches 2 to 7 ft tall (0.5 to 2 m). Its leaves are 0.25 to 0.75 in (0.6 to 2 cm) wide and up to 10 in (25.5 cm) long. It blooms from May to mid-June and its flowers change color from green to purple to beige over time. Seeds ripen in late June. Reed canary grass can be difficult to distinguish from other grasses for those unfamiliar with local wetland grasses, especially blue-joint grass (*Calamagrostis canadensis*). Reed canary grass is easiest to detect from May through July when it has flowers and fruits. Reed canary grass reproduces by seed and vegetatively through rhizomes.

**Habitat:** Marshes, wet shores, borders of streams and ponds, ditches, and sparse forests (Reznicek et al. 2011).

**Current status in landscape:** All occurrences should be considered invasive on St. Martin Island. A patchy population was found over an area between 1000 ft<sup>2</sup> and 20,000 ft<sup>2</sup> in the northern hardwood swamp owned by the LTBOI (Bassett et al. 2022; Figure 3, Figure 9).

**Management:** Reed canary grass can be difficult to eradicate because of its prodigious seedbank and thick fibrous root mass by which it spreads. Chemical treatments have been successful in controlling large patches in late summer or fall (Borland et al. 2015). It can also be treated in the spring, as this species' leaf-out is earlier than many other species and can be managed when many native plants are still dormant (Czarapata 2005). Monitoring and follow-up treatment is required for 5 to 10 years (Borland et al. 2015).

### INVASIVE COMMON REED (*PHRAGMITES AUSTRALIS* SSP. *AUSTRALIS*)

Invasive common reed has formed large, dense monocultures to the near-total exclusion of other vegetation in wetlands throughout Michigan, particularly the Saginaw Bay area. Preventing further spread in northern Michigan is critical, especially in quality natural wetlands.

**Species description:** Invasive common reed is a perennial grass that can reach heights of 15 ft (4.5 m) with bluish-green leaves up to 1.5 in (3.8 cm) wide. Leaf sheaths remain tight on culms even after senescence. Flowers bloom from July to September. Invasive common reed can spread via fragments, rhizomes, root runners, and rarely by seed. It forms a thick system of rhizomes that can persist for 3 to 6 years (Borland et al. 2015). Stands at least 1 year old can often be detected any time of year from their tall dead stalks persisting from the previous year. New stands or those whose dead stalks were destroyed over winter are easiest to detect after June. The height and density of the species distinguishes it from most other plants.

Invasive common reed can be easily confused with the native reed *P. australis* ssp. *americanus*. Morphological distinction is subtle but reliable: stand density, stem color, fungus presence on the stem, leaf color, leaf sheath tightness on the stem, length of ligule, and length of glumes. The following sources will assist in the distinction:

- *Phragmites australis* species description and photographs, Reznicek et al. 2011, <https://michiganflora.net/species.aspx?id=2184>
- Identifying Native vs. Invasive Phragmites, Etienne Herrick, <https://www.greatlakesphragmites.net/blog/20180830-native-vs-invasive/>
- Phragmites—Native or Not?, MNFI, <https://mnfi.anr.msu.edu/pdfs/phragmites-native-non-native.pdf>
- Common Reed Plant Guide, United States Department of Agriculture (USDA), [https://plants.usda.gov/DocumentLibrary/plantguide/pdf/pg\\_phau7.pdf](https://plants.usda.gov/DocumentLibrary/plantguide/pdf/pg_phau7.pdf)
- Native vs. Invasive, Ontario Phragmites Working Group, <https://www.opwg.ca/phragmites/native-vs-invasive/>

**Habitat:** Marshes, ditches, swales, swamps, fens, and wet shores, including in standing water wet shores.

**Current status in landscape:** Invasive common reed has been mapped on the southern coast of St. Martin Island in the recent past, but treatment in 2017 followed by consecutive highwater years in 2019 and 2020 appear to have naturally eliminated the shoreline population. Mature plants are still extant in the northern hardwood swamp owned by the LTBOI (Bassett et al. 2022; Figure 2, Figure 9). The patch noted by LTBOI personnel was less than 1000 ft<sup>2</sup>, and its density was described as patchy.

**Management:** Mechanical treatment alone is ineffective. Cutting in early August can be effective in small infestations, if the new growth that resprouts from the cut stems is treated with glyphosate using a wick applicator. Alternatively, stems can be cut near the ground in July or August followed by the immediate dripping of glyphosate. Follow-up treatment will be required for at least the lifespan of the rhizomes, 3 – 6 years (Czarapata 2005).

### NARROW-LEAVED CAT-TAIL (*TYPHA ANGUSTIFOLIA*)

Narrow-leaved cat-tail is a perennial and obligate wetland plant. It was first collected in Michigan in 1877. Since then it has taken over many disturbed wetlands and can become problematic in quality natural communities (Reznicek et al. 2011).

**Species description:** Long leaves stretch from the base, approximately 0.25 to 0.75 in wide (0.6 to 2 cm). It flowers from June to July and flowers are borne in a velvety brown reproductive structure called a spike with a gap of at least 1 in (2.5 cm) separating the female flowers on the bottom from the male flowers on top. The seeds of narrow-leaved cat-tail can remain viable for 100 years (Borland et al. 2015). Narrow-leaved cat-tail spreads via seeds and rhizomes (Czarapata 2005).

Michigan has two species of cat-tail (*Typha* sp.): narrow-leaved cat-tail and broad-leaved cat-tail (*T. latifolia*). The most distinguishing feature between the two species is the gap between female and male flowers in native broad-leaved cat-tail is absent or is less than 1 in (2 cm). The species are difficult to distinguish outside of the flowering season. Substantial overlap in the width of leaves [0.5 to 1 in (1.25 to 2.5 cm) of broad-leaved cat-tail] and the fruiting structure make intermediate individuals of both species indeterminable based on size alone.

Hybridization between the two species produces hybrid cat-tail (*T. × glauca*) and further vexes identification (Reznicek et al. 2011). Both narrow-leaved and hybrid cat-tail have invasive tendencies, particularly the latter. Hybrid cat-tail is mostly sterile but also spreads via rhizomes. (Czarapata 2005). Misidentifications are frequent even among trained naturalists. We recommend considering both narrow-leaved and hybrid cat-tail a severe threat to wetland communities.

**Habitat:** Almost any wet habitat (Reznicek et al. 2011).

**Current status in landscape:** Invasive cat-tail identified as *T. angustifolia* was seen in the northern hardwood swamp owned by the LTBOI (Bassett et al. 2022; Figure 9). The three patches described from that community were each less than 1000 ft<sup>2</sup>. Density ranged from patchy to dense to monoculture.

**Management:** The most effective treatments for this species have been glyphosate applied in mid- to late-summer with a wick, boom, or hand-spray applicator, followed by cutting and removing dead stems a week later. Annual follow-up treatments will be necessary for a few years as the root system continues to produce new shoots. The 100-year viability of seeds and ongoing possibility of new emigrants necessitates vigilant annual monitoring (Czarapata 2005).

### WHITE POPLAR (*POPULUS ALBA*)

White poplar was first collected in Michigan in 1896 and is now present across most of the state. It was formerly a popular landscaping tree and can spread by suckers to form thickets along roads, at old homesites, in fields, and even invading forests (Reznicek et al. 2011).

**Species description:** White poplar is an upland tree with distinct mature leaves that have five or fewer irregular lobes and densely felted white pubescence. Young big-tooth aspen (*Populus grandidentata*) leaves can have white to gray pubescence, but it does not persist on mature leaves. Like most poplars, white poplar can form large stands that represent a single cloned individual from underground suckers.

**Habitat:** Disturbed upland sites such as roadsides, old homesites, and fields, particularly sandy soil, and also spreading into forests (Reznicek et al. 2011).

**Current status in landscape:** A single patch was spotted on St. Martin Island, on LTBBOI property in the northeast (Bassett et al. 2022; Figure 9). A large clone, roughly one third of an acre in extent, is growing next to the lighthouse keeper's quarters. This location is near part of the boreal forest and limestone cobble shore EOs.

**Management:** Mechanical treatment alone is not usually sufficient treatment, as mechanical treatment promotes suckering. A combined mechanical and chemical treatment is recommended. Stems less than 2 in (5 cm) in diameter should be cut, while larger stems should be girdled. Treatment while the plant is dormant is ideal when combining mechanical treatment with bark or cut-surface chemical treatment (e.g., Triclopyr) to lessen damage to nontarget species. During active growth after leaf expansion, glyphosate is effective as a foliar spray and on cut stumps and girdles. Cutting close to the ground between June and August reduces suckering. All cut stems must be treated (Czarapata 2005, Glass 1992). Yearly recutting of stems is necessary. Follow-up is necessary after a few weeks to ensure that bark has not grown back over the girdle.

## Priority 2: Watch List

The focus for St. Martin 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 St. Martin Island, Delta County, Michigan, 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.

<b>Scientific name</b>	<b>Common name</b>	<b>Source and year of most recent observation</b>	<b>Location</b>
<i>Acer platanoides</i>	Norway maple	iNat 2020 ( <a href="https://www.inaturalist.org/observations/53771341">inaturalist.org/observations/53771341</a> )	Door Co.
<i>Ailanthus altissima</i>	Tree of heaven	WIS 1977 (Catalog #: v0329267WIS)	Door Co.
<i>Alliaria petiolata</i>	Garlic mustard	Bassett et al. 2022, Cohen et al. 2022	Detroit I., Door Co.
<i>Berberis thunbergii</i>	Japanese barberry	Bassett et al. 2022, Cohen et al. 2022	Detroit I. and Plum I., Door Co.
<i>Celastrus orbiculatus</i>	Oriental bittersweet	MISIN 2020	Delta Co.
<i>Dipsacus fullonum</i>	Wild teasel	WIS 2000 (Catalog #: UWGB35359)	Brown Co.
<i>Dipsacus laciniatus</i>	Cut-leaf teasel	iNat 2020 ( <a href="https://www.inaturalist.org/observations/54274873">https://www.inaturalist.org/observations/54274873</a> )	Door Co.
<i>Epilobium hirsutum</i>	Great hairy willow-herb	iNat 2021 ( <a href="https://www.inaturalist.org/observations/90580693">https://www.inaturalist.org/observations/90580693</a> )	Door Co.
<i>Fallopia japonica</i>	Japanese knotweed	iNat 2021 ( <a href="https://www.inaturalist.org/observations/94607207">https://www.inaturalist.org/observations/94607207</a> )	Delta Co.
<i>Frangula alnus</i>	Glossy buckthorn	iNat 2021 ( <a href="https://www.inaturalist.org/observations/97788402">https://www.inaturalist.org/observations/97788402</a> )	Delta Co.
<i>Hesperis matronalis</i>	Dame's rocket	Bassett et al. 2022, Cohen et al. 2022	Plum I., Door Co.
<i>Iris pseudoacorus</i>	Yellow iris	iNat 2021 ( <a href="https://www.inaturalist.org/observations/83344012">https://www.inaturalist.org/observations/83344012</a> )	Delta Co.
<i>Lysimachia nummularia</i>	Moneywort	iNat 2021 ( <a href="https://www.inaturalist.org/observations/97786520">https://www.inaturalist.org/observations/97786520</a> )	Delta Co.
<i>Lythrum salicaria</i>	Purple loosestrife	Bassett et al. 2022, Cohen et al. 2022	Plum I.
<i>Melilotus albus</i>	White sweet-clover	Bassett et al. 2022, Cohen et al. 2022	Hog I., Poverty I., Door Co.; Rocky I., Delta Co.
<i>Melilotus officinalis</i>	Yellow sweet-clover	iNat 2021 ( <a href="https://www.inaturalist.org/observations/85598750">https://www.inaturalist.org/observations/85598750</a> )	Door Co.
<i>Morus alba</i>	White mulberry	iNat 2020 ( <a href="https://www.inaturalist.org/observations/48336723">https://www.inaturalist.org/observations/48336723</a> )	Door Co.
<i>Myriophyllum spicatum</i>	Eurasian water-milfoil	MISIN 2019	Delta Co.
<i>Pinus sylvestris</i>	Scotch pine	iNat 2021 ( <a href="https://www.inaturalist.org/observations/95590492">https://www.inaturalist.org/observations/95590492</a> )	Door Co.
<i>Rhamnus cathartica</i>	Common buckthorn	iNat 2021 ( <a href="https://www.inaturalist.org/observations/98069022">https://www.inaturalist.org/observations/98069022</a> )	Door Co.

<b>Scientific name</b>	<b>Common name</b>	<b>Source and year of most recent observation</b>	<b>Location</b>
<i>Robinia pseudoacacia</i>	Black locust	iNat 2020 ( <a href="https://www.inaturalist.org/observations/62369578">https://www.inaturalist.org/observations/62369578</a> )	Door Co.
<i>Rosa multiflora</i>	Multiflora rose	Bassett et al. 2022, Cohen et al. 2022	Plum I., Door Co.
<i>Torilis japonica</i>	Erect hedge-parsley	Bassett et al. 2022, Cohen et al. 2022	Plum I. Door Co.
<i>Vinca minor</i>	Lesser periwinkle	iNat 2021 ( <a href="https://www.inaturalist.org/observations/94772911">https://www.inaturalist.org/observations/94772911</a> )	Door Co.
<i>Vincetoxicum nigrum</i>	Black swallow-wort	iNat 2017 ( <a href="https://www.inaturalist.org/observations/8092705">https://www.inaturalist.org/observations/8092705</a> )	Door Co.

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

St. Martin Island had the highest number (6) of natural community EOs among Detroit, Plum, Poverty, and St. Martin Islands (Cohen et al. 2022). Of the EOs among the four islands, St. Martin had 1 community ranking in the high stewardship tier, 3 communities ranking in the medium stewardship tier, and 2 ranked in the low stewardship tier (Table 7). Other high tier EOs were on Poverty and Detroit 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).

St. Martin's limestone lakeshore cliff (EO ID 24348) was ranked in the high stewardship tier with a stewardship prioritization score of 10 (Figure 3; Table 7). The combination of needing to protect the high-quality habitat 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, two invasive species and several invasive species threaten the community in surrounding habitat (See Area Descriptions on the following pages).

The St. Martin EOs in the medium tier are typically higher quality, at vulnerable or imperiled at the state level, and contain a moderate level of infestation with species that have a likelihood of successful treatment. The northern hardwood swamp (EO ID 24352) ranked in the low tier because of its overall lower quality and numerous invasive species that would require multiple treatments. The boreal forest (EO ID 24351) ranked in the low tier because it has relatively few easily treatable invasive species and as a natural community is ranked only vulnerable at the state and global levels.



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. EOs 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. St. Martin 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	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
<b>St. Martin</b>	<b>Limestone lakeshore cliff</b>	<b>24348</b>	<b>5</b>	<b>1.5</b>	<b>4</b>	<b>2.75</b>	<b>2</b>	<b>3</b>	<b>2.5</b>	<b>10</b>
Detroit	Limestone cobble shore	24375	3.5	3	4	3.5	2	3	2.5	9.5
<b>St. Martin</b>	<b>Limestone cliff</b>	<b>24350</b>	<b>4</b>	<b>1.5</b>	<b>4</b>	<b>2.75</b>	<b>2</b>	<b>3</b>	<b>2.5</b>	<b>9.25</b>
<b>St. Martin</b>	<b>Limestone cobble shore</b>	<b>24353</b>	<b>4</b>	<b>3.5</b>	<b>3</b>	<b>3.25</b>	<b>1</b>	<b>3</b>	<b>2</b>	<b>9.25</b>
Plum	Great Lakes marsh	24367	3	2	4	3	3	3	3	9
<b>St. Martin</b>	<b>Mesic northern forest</b>	<b>24349</b>	<b>3.5</b>	<b>2</b>	<b>3</b>	<b>2.5</b>	<b>3</b>	<b>3</b>	<b>3</b>	<b>9</b>
<b>St. Martin</b>	<b>Boreal forest north</b>	<b>24351</b>	<b>4</b>	<b>3</b>	<b>3</b>	<b>3</b>	<b>1</b>	<b>2</b>	<b>1.5</b>	<b>8.5</b>
<b>St. Martin</b>	<b>Boreal forest south</b>	<b>24351</b>	<b>4</b>	<b>3</b>	<b>3</b>	<b>3</b>	<b>1</b>	<b>2</b>	<b>1.5</b>	<b>8.5</b>
Plum	Limestone cobble shore	24370	3	3	4	3.5	2	2	2	8.5
Detroit	Limestone lakeshore 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
<b>St. Martin</b>	<b>Northern hardwood swamp<sup>1</sup></b>	<b>24352</b>	<b>3</b>	<b>2</b>	<b>3</b>	<b>2.5</b>	<b>3</b>	<b>3</b>	<b>3</b>	<b>8.5</b>
Plum	Mesic northern forest	24369	2	2	3	2.5	5	2	3.5	8
Detroit	Limestone cliff	24373	3.5	1.5	1	1.25	2	3	2.5	7.25
Detroit	Sand and gravel beach	24387	3.5	3	4	3.5	0	---	0	7

### Area Descriptions and Priorities

Without taking into account which invasive species were present in each area, IPIEDPT scored four natural community areas above the others: limestone cliff, limestone cobble shore, limestone lakeshore cliff, and mesic northern forest (Table 8). This mostly aligns with the expert opinion of MNFI. Each area is described briefly. Management recommendations are discussed in Chapter 4.

Table 8. IPIEDPT area prioritization scores for St. Martin Island. Higher scores indicate a higher priority.

Area	Description Score	Risk Score	Status Score	Total Score
Limestone cliff	1.8	1.2	1.8	4.8
Limestone lakeshore cliff	1.8	1.2	1.8	4.8
Limestone cobble shore <sup>1</sup>	1.7	1.2	1.8	4.7
Mesic northern forest	2.7	0.9	0.5	4.1
South dock	1.1	1.8	0.3	3.2
Lighthouse <sup>2</sup>	1.1	1.8	0.3	3.2
Northern hardwood swamp <sup>2</sup>	1.3	0.9	0.9	3.1
Boreal forest south	1.3	0.9	0.5	2.7
Boreal forest north <sup>1</sup>	1.3	0.9	0.5	2.7

#### *Boreal Forest South (EO ID 24351)*

Boreal forest is a conifer or conifer-hardwood forest occurring on a variety of substrates including sand dunes, glacial lakeplains, and thin soil over bedrock or cobble. The canopy is dominated by northern white cedar (*Thuja occidentalis*), white spruce (*Picea glauca*), and balsam fir (*Abies balsamea*). Boreal forests that are influenced by their proximity to the Great Lakes have high levels of windthrow and climatic conditions with low summer temperatures, high levels of humidity, snowfall, and summer fog. Fires and insects infrequently cause natural disturbance that add diversity and influence microhabitats in the community. Historical logging practices targeting northern white cedar and other conifers favored the conversion of boreal forest to early-successional forests dominated by deciduous species (Figure 11). Threats to boreal forests include logging, shoreline development, and deer browse (Cohen 2007, Cohen et al. 2015).



Figure 11. Boreal forest south area with evidence of past logging on St. Martin Island, Green Bay National Wildlife Refuge. Photo by Joshua Cohen, June 2, 2021.

#### **Sensitive resources:**

[REDACTED]

Understory and groundcover species, including sapling recruitment, are sensitive to over browsing by deer.

**Important biotic factors:** The boreal forest EO on St. Martin Island is dominated by white cedar, several individuals of which were cored, and their minimum estimated age ranged from 104 – 178 years. Canopy associates include balsam fir, quaking aspen (*Populus tremuloides*), and paper birch (*Betula papyrifera*), with occasional red pine (*Pinus resinosa*). Canopy trees' diameter at breast height (DBH) is typically 12 to 20 in (30 to 50 cm). The sub-canopy layers are sparse to patchy except in areas of high windthrow. Following a 2013 deer cull, the formerly over-browsed understory was observed in 2021 to be recovering. It supported vigorous plant growth and limited amounts of Canada yew, though the yew is also threatened by caterpillar browse. Bald eagle and peregrine falcon (*Falco peregrinus*) were observed during the survey of this natural community (Cohen et al. 2022).

**Important abiotic factors:** Boreal forest on St. Martin Island occurs in a band along the shore, including between lakeshore cliff terraces. The boreal forest EO in its entirety consists of four polygons totaling 119 acres. The boreal forest south area consists of two polygons totaling about half that acreage (Figure 3). The soil consists of a shallow acidic organic layer overlying alkaline loam overlying limestone cobble and bedrock. Evidence of fire was observed locally (Cohen et al. 2022).

**Identified vectors and pathways:** The boreal forest south area is adjacent to the south dock area including a camping area with remnants of permanent dwellings. The south dock is the only dock currently suitable for use, thus is an avenue for invasion. Occasional visitors may travel along several old roads and trails that run through the area, the largest of which traverse from the south dock to the lighthouse (Figure 9). These trails support a high proportion of the current invasive plant species, and their ease of access promotes the transport of new species via animals (e.g., human, deer) across the island. The boreal forest south is also very near Lake Michigan itself with only the limestone cobble shore between. Higher lake levels and high wave action days wash debris including invasive species reproductive parts into the natural community.

**Invasive plant status:** The Priority 1 species wild parsnip was present in a 100 ft<sup>2</sup> patch. Eleven other non-native species were present. They were often located along the old roads and trails with the exception of marsh thistle (*Cirsium palustre*) and bittersweet nightshade (*Solanum dulcamara*). Marsh thistle was found off-trail and mapped when encountered (Bassett et al. 2022).

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

- Garlic mustard (*Allaria petiolata*)
- Japanese barberry (*Berberis thunbergii*)
- Spotted knapweed
- Autumn olive
- Dame's rocket (*Hesperis matronalis*)
- Bush honeysuckle
- Reed canary grass
- Invasive common reed
- Multiflora rose (*Rosa multiflora*)
- Erect hedge parsley (*Torilis japonica*)
- Narrow-leaved cat-tail



Table 9. IPIEDPT area-species link scores for the boreal forest south 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 are 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
Houndstongue	<i>Cynoglossum officinale</i>	10	10	10	30	6.77	36.8
Marsh thistle	<i>Cirsium palustre</i>	10	7	10	27	6.77	33.8
Helleborine	<i>Epipactis helleborine</i>	10	7	10	27	4.97	32.0
Bittersweet nightshade, woody nightshade	<i>Solanum dulcamara</i>	10	7	10	27	4.9	31.9
Common gypsy-weed	<i>Veronica officinalis</i>	10	7	10	27	4.9	31.9
Orange hawkweed	<i>Hieracium aurantiacum</i>	10	7	10	27	4.5	31.5
Dandelion	<i>Taraxacum officinale</i>	10	7	10	27	3.57	30.6
Canada bluegrass	<i>Poa compressa</i>	10	5	10	25	4.1	29.1
Wood bluegrass	<i>Poa nemoralis</i>	10	5	10	25	3.57	28.6
Bush honeysuckle	<i>Lonicera</i> sp.	10	0	10	20	8.47	28.5
Canada thistle	<i>Cirsium arvense</i>	10	0	10	20	7.57	27.6
<b>Wild parsnip</b>	<b><i>Pastinaca sativa</i></b>	<b>10</b>	<b>5</b>	<b>5</b>	<b>20</b>	<b>7.3</b>	<b>27.3</b>
Common timothy	<i>Phleum pratense</i>	10	7	5	22	4.9	26.9
Red clover	<i>Trifolium pratense</i>	10	7	5	22	4.5	26.5
Autumn-olive	<i>Elaeagnus umbellata</i>	10	0	10	20	6.1	26.1
Lesser burdock	<i>Arctium minus</i>	10	0	10	20	5.1	25.1
Garlic mustard	<i>Alliaria petiolata</i>	5	0	10	15	9.4	24.4
Scotch mist	<i>Galium sylvaticum</i>	10	0	10	20	4.1	24.1
Reed canary grass	<i>Phalaris arundinacea</i>	10	0	5	15	9.07	24.1
Japanese barberry	<i>Berberis thunbergii</i>	5	0	10	15	9	24.0
Kentucky bluegrass	<i>Poa pratensis</i>	10	0	10	20	3.43	23.4
Dame's rocket	<i>Hesperis matronalis</i>	5	0	10	15	7.7	22.7
Multiflora rose	<i>Rosa multiflora</i>	5	0	10	15	7.3	22.3
Bull thistle	<i>Cirsium vulgare</i>	5	0	10	15	6.77	21.8
Erect hedge parsley	<i>Torilis japonica</i>	5	0	10	15	5.9	20.9
Common reed	<i>Phragmites australis</i> ssp. <i>australis</i>	10	0	1	11	9.1	20.1
Spotted knapweed	<i>Centaurea stoebe</i> ssp. <i>micranthos</i>	10	0	1	11	9	20.0
Narrow-leaved cat-tail	<i>Typha angustifolia</i>	10	0	1	11	9	20.0
Redtop	<i>Agrostis gigantea</i>	5	0	10	15	4.9	19.9
Soapwort, bouncing bet	<i>Saponaria officinalis</i>	5	0	10	15	4.5	19.5
Thyme-leaf speedwell	<i>Veronica serpyllifolia</i>	5	0	10	15	4.5	19.5
Flannel plant, common mullein	<i>Verbascum thapsus</i>	10	0	5	15	4.37	19.4

Common Name	Scientific Name ITIS	Presence Score	Status Score	Habitat Score	Total Score	Species Score	Overall Score
Jack-go-to-bed-at-noon	<i>Tragopogon pratensis</i>	5	0	10	15	4.3	19.3
Leafy spurge	<i>Euphorbia esula</i>	10	0	1	11	8.1	19.1
Tall buttercup	<i>Ranunculus acris</i>	10	0	5	15	4.1	19.1
Common mouse-ear chickweed	<i>Cerastium fontanum ssp. vulgare</i>	5	0	10	15	3.9	18.9
Annual bluegrass	<i>Poa annua</i>	10	0	5	15	3.57	18.6
White poplar	<i>Populus alba</i>	10	0	1	11	6.5	17.5
Garden valerian, common valerian	<i>Valeriana officinalis</i>	5	0	5	10	7.3	17.3
Quackgrass	<i>Elymus repens</i>	5	0	5	10	5.7	15.7
Goldmoss stonecrop	<i>Sedum acre</i>	10	0	1	11	4.37	15.4
Queen Anne's lace	<i>Daucus carota</i>	5	0	5	10	5.1	15.1
Purple loosestrife	<i>Lythrum salicaria</i>	5	0	1	6	9.1	15.1
European cranberry-bush	<i>Viburnum opulus</i>	5	0	5	10	5.1	15.1
Black bindweed, wild buckwheat	<i>Fallopia convolvulus</i>	10	0	1	11	3.7	14.7
Meadow fescue	<i>Schedonorus pratensis</i>	5	0	5	10	4.5	14.5
Orchard grass	<i>Dactylis glomerata</i>	5	0	5	10	4.1	14.1
Bitter dock, broadleaf dock	<i>Rumex obtusifolius</i>	5	0	5	10	4.1	14.1
White campion	<i>Silene latifolia</i>	5	0	5	10	4.1	14.1
Bladder campion	<i>Silene vulgaris</i>	5	0	5	10	4.1	14.1
Ox-eye daisy	<i>Leucanthemum vulgare</i>	5	0	5	10	3.97	14.0
White sweet-clover	<i>Melilotus albus</i>	5	0	1	6	6.3	12.3
Smallflower hairy willow herb	<i>Epilobium parviflorum</i>	5	0	1	6	5.3	11.3
Common hempnettle	<i>Galeopsis tetrahit</i>	5	0	1	6	5.1	11.1
Wormseed wallflower	<i>Erysimum cheiranthoides</i>	5	0	1	6	4.9	10.9
Black medick	<i>Medicago lupulina</i>	5	0	1	6	4.5	10.5
Common St. John's wort	<i>Hypericum perforatum</i>	5	0	1	6	4.37	10.4
Butter and eggs	<i>Linaria vulgaris</i>	5	0	1	6	4.37	10.4
Yellow hawkweed	<i>Hieracium caespitosum</i>	5	0	1	6	4.1	10.1
Motherwort	<i>Leonurus cardiaca</i>	5	0	1	6	4.1	10.1
Spotted ladythumb, ladythumb	<i>Persicaria maculosa</i>	5	0	1	6	4.1	10.1
Norway spruce	<i>Picea abies</i>	5	0	1	6	4.1	10.1
Proso millet	<i>Panicum miliaceum</i>	5	0	1	6	3.9	9.9
Cat-nip	<i>Nepeta cataria</i>	5	0	1	6	3.57	9.6
Strawberry clover	<i>Trifolium fragiferum</i>	5	0	1	6	3.57	9.6

### *Boreal Forest North (EO ID 24351)*

Boreal forest is a conifer or conifer-hardwood forest occurring on a variety of substrates including sand dunes, glacial lakeplains, and thin soil over bedrock or cobble. The canopy is dominated by northern white cedar, white spruce, and balsam fir. Boreal forests that are influenced by their proximity to the Great Lakes have high levels of windthrow and climatic conditions with low summer temperatures, high levels of humidity, snowfall, and summer fog (Figure 12). Fires and insects infrequently cause natural disturbance that add diversity and influence microhabitats in the community. Historical logging practices targeting northern white cedar and other conifers favored the conversion of boreal forest to early-successional forests dominated by deciduous species. Threats to boreal forests include logging, shoreline development, and deer browse (Cohen 2007, Cohen et al. 2015).

The area is located partially on land owned by LTBBOI (Figure 2). Any management actions on LTBBOI portion of this area should be made in accordance with the LTBBOI.



Figure 12. Boreal forest north area on St. Martin Island, Green Bay National Wildlife Refuge. Photo by Joshua Cohen, June 2, 2021.

**Sensitive resources:**



Understory and groundcover species, including sapling recruitment, are sensitive to over browsing by deer.

**Important biotic factors:** The boreal forest EO on St. Martin Island is dominated by northern white cedar, several individuals of which were cored, and their minimum estimated age ranged from 104 to 178 years. Canopy associates include balsam fir, quaking aspen, and paper birch, with red pine occasional. Canopy trees' DBH is typically 12 to 20 in (30 – 50 cm). The sub-canopy layers are sparse to patchy except in areas of high windthrow. Following a 2013 deer cull, the formerly over-browsed understory was observed in 2021 to be recovering. It supported vigorous plant growth and limited amounts of Canada yew, though the yew is also threatened by caterpillar browse. Bald eagle and peregrine falcon were observed during the survey (Cohen et al. 2022).

**Important abiotic factors:** Boreal forest on St. Martin Island occurs in a band along the shore, including between lakeshore cliff terraces. The boreal forest EO in its entirety consists of four polygons totaling 119 acres. The boreal forest north area consists of two polygons totaling about half that acreage (Figure 3). The soil consists of a shallow acidic organic layer overlying alkaline loam overlying limestone cobble and bedrock. Evidence of fire was observed locally (Cohen et al. 2022).

**Identified vectors and pathways:** The boreal forest north area is adjacent to the disturbed lighthouse area. The boreal forest north is also very near Lake Michigan itself with only the limestone cobble shore between. Higher lake levels and high wave action days wash debris including invasive species fragments or propagules into the natural community. Occasional visitors may travel along several old roads and trails that run through the area, the largest of which are from the south dock to the lighthouse. These trails support a high proportion of the current invasive plant species, and their ease of access promotes the transport of new species via animals (e.g., human, deer) across the island.

**Invasive plant status:** No Priority 1 species were present. Eleven Priority 3 species were present. They were often located along the old roads and trails with the exception of marsh thistle and bittersweet nightshade. Marsh thistle was found off-trail and mapped when encountered (Bassett et al. 2022).

The most likely new invaders of this area include eight Priority 1 species and five Priority 2 species that scored greater than 20 due to suitable habitat and/or proximity in adjacent areas/nearby islands (Table 10). Additionally, white poplar is included despite scoring under 20 due to its proximity to the boreal forest north area, near the lighthouse.

- Garlic mustard
- Japanese barberry
- Spotted knapweed
- Autumn olive
- Dame's rocket
- Bush honeysuckle
- Wild parsnip
- Reed canary grass
- Invasive common reed
- White poplar
- Multiflora rose
- Erect hedge parsley
- Narrow-leaved cat-tail



Table 10. IPIEDPT area-species link scores for the boreal forest north 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
Canada thistle	<i>Cirsium arvense</i>	10	10	10	30	7.57	37.6
Helleborine	<i>Epipactis helleborine</i>	10	7	10	27	4.97	32.0
Bittersweet nightshade, woody nightshade	<i>Solanum dulcamara</i>	10	7	10	27	4.9	31.9
Common gypsy-weed	<i>Veronica officinalis</i>	10	7	10	27	4.9	31.9
Houndstongue	<i>Cynoglossum officinale</i>	10	5	10	25	6.77	31.8
Orange hawkweed	<i>Hieracium aurantiacum</i>	10	7	10	27	4.5	31.5
Canada bluegrass	<i>Poa compressa</i>	10	7	10	27	4.1	31.1
Dandelion	<i>Taraxacum officinale</i>	10	7	10	27	3.57	30.6
Wood bluegrass	<i>Poa nemoralis</i>	10	5	10	25	3.57	28.6
Bush honeysuckle	<i>Lonicera</i> sp.	10	0	10	20	8.47	28.5
Common timothy	<i>Phleum pratense</i>	10	7	5	22	4.9	26.9
Marsh thistle	<i>Cirsium palustre</i>	10	0	10	20	6.77	26.8
Bull thistle	<i>Cirsium vulgare</i>	10	0	10	20	6.77	26.8
Red clover	<i>Trifolium pratense</i>	10	7	5	22	4.5	26.5
Autumn-olive	<i>Elaeagnus umbellata</i>	10	0	10	20	6.1	26.1
Lesser burdock	<i>Arctium minus</i>	10	0	10	20	5.1	25.1
Garlic mustard	<i>Alliaria petiolata</i>	5	0	10	15	9.4	24.4
Scotch mist	<i>Galium sylvaticum</i>	10	0	10	20	4.1	24.1
Reed canary grass	<i>Phalaris arundinacea</i>	10	0	5	15	9.07	24.1
Japanese barberry	<i>Berberis thunbergii</i>	5	0	10	15	9	24.0
Kentucky bluegrass	<i>Poa pratensis</i>	10	0	10	20	3.43	23.4
Dame's rocket	<i>Hesperis matronalis</i>	5	0	10	15	7.7	22.7
Wild parsnip	<i>Pastinaca sativa</i>	10	0	5	15	7.3	22.3
Multiflora rose	<i>Rosa multiflora</i>	5	0	10	15	7.3	22.3
Erect hedge parsley	<i>Torilis japonica</i>	5	0	10	15	5.9	20.9
Common reed	<i>Phragmites australis</i> ssp. <i>australis</i>	10	0	1	11	9.1	20.1
Spotted knapweed	<i>Centaurea stoebe</i> ssp. <i>micranthos</i>	10	0	1	11	9	20.0
Narrow-leaved cat-tail	<i>Typha angustifolia</i>	10	0	1	11	9	20.0
Redtop	<i>Agrostis gigantea</i>	5	0	10	15	4.9	19.9
Thyme-leaf speedwell	<i>Veronica serpyllifolia</i>	5	0	10	15	4.5	19.5
Flannel plant, common mullein	<i>Verbascum thapsus</i>	10	0	5	15	4.37	19.4
Leafy spurge	<i>Euphorbia esula</i>	10	0	1	11	8.1	19.1

Common Name	Scientific Name ITIS	Presence Score	Status Score	Habitat Score	Total Score	Species Score	Overall Score
Tall buttercup	<i>Ranunculus acris</i>	10	0	5	15	4.1	19.1
Common mouse-ear chickweed	<i>Cerastium fontanum</i> ssp. <i>vulgare</i>	5	0	10	15	3.9	18.9
Annual bluegrass	<i>Poa annua</i>	10	0	5	15	3.57	18.6
White poplar	<i>Populus alba</i>	10	0	1	11	6.5	17.5
Garden valerian, common valerian	<i>Valeriana officinalis</i>	5	0	5	10	7.3	17.3
Quackgrass	<i>Elymus repens</i>	5	0	5	10	5.7	15.7
Goldmoss stonecrop	<i>Sedum acre</i>	10	0	1	11	4.37	15.4
Queen Anne's lace	<i>Daucus carota</i>	5	0	5	10	5.1	15.1
Purple loosestrife	<i>Lythrum salicaria</i>	5	0	1	6	9.1	15.1
European cranberry-bush	<i>Viburnum opulus</i>	5	0	5	10	5.1	15.1
Black bindweed, wild buckwheat	<i>Fallopia convolvulus</i>	10	0	1	11	3.7	14.7
Soapwort, bouncing bet	<i>Saponaria officinalis</i>	5	0	5	10	4.5	14.5
Meadow fescue	<i>Schedonorus pratensis</i>	5	0	5	10	4.5	14.5
Jack-go-to-bed-at-noon	<i>Tragopogon pratensis</i>	5	0	5	10	4.3	14.3
Orchard grass	<i>Dactylis glomerata</i>	5	0	5	10	4.1	14.1
Bitter dock, broadleaf dock	<i>Rumex obtusifolius</i>	5	0	5	10	4.1	14.1
White campion	<i>Silene latifolia</i>	5	0	5	10	4.1	14.1
Bladder campion	<i>Silene vulgaris</i>	5	0	5	10	4.1	14.1
Ox-eye daisy	<i>Leucanthemum vulgare</i>	5	0	5	10	3.97	14.0
White sweet-clover	<i>Melilotus albus</i>	5	0	1	6	6.3	12.3
Smallflower hairy willow herb	<i>Epilobium parviflorum</i>	5	0	1	6	5.3	11.3
Common hempenettle	<i>Galeopsis tetrahit</i>	5	0	1	6	5.1	11.1
Wormseed wallflower	<i>Erysimum cheiranthoides</i>	5	0	1	6	4.9	10.9
Black medick	<i>Medicago lupulina</i>	5	0	1	6	4.5	10.5
Common St. John's wort	<i>Hypericum perforatum</i>	5	0	1	6	4.37	10.4
Butter and eggs	<i>Linaria vulgaris</i>	5	0	1	6	4.37	10.4
Yellow hawkweed	<i>Hieracium caespitosum</i>	5	0	1	6	4.1	10.1
Motherwort	<i>Leonurus cardiaca</i>	5	0	1	6	4.1	10.1
Spotted ladythumb, ladythumb	<i>Persicaria maculosa</i>	5	0	1	6	4.1	10.1
Norway spruce	<i>Picea abies</i>	5	0	1	6	4.1	10.1
Proso millet	<i>Panicum miliaceum</i>	5	0	1	6	3.9	9.9
Cat-nip	<i>Nepeta cataria</i>	5	0	1	6	3.57	9.6
Strawberry clover	<i>Trifolium fragiferum</i>	5	0	1	6	3.57	9.6



### *Limestone Cliff (EO ID 24350)*

Limestone cliff is a state-imperiled community consisting of inland vertical to near-vertical exposures of limestone bedrock. 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*), white cedar, and balsam fir (Figure 13). This community is likely limited to six counties in northern Michigan, found along the Niagara Escarpment, and is typically near the Great Lakes shorelines at the margin of boreal or mesic northern forest. 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 13. Limestone cliff on St. Martin Island, Green Bay National Wildlife Refuge. Photo by Joshua Cohen, June 3, 2021.

### **Sensitive resources:**

**Important biotic factors:** The cliff serves as a refuge for deer-preferred species such as northern white cedar and Canada yew (Cohen et al. 2022).

**Important abiotic factors:** The natural community on St. Martin Island consists of five mapped polygons covering seven acres, surrounded by boreal, mesic northern, and disturbed forest. The cliffs are relatively short, with heights ranging from 5 to 20 ft (2 to 6 m). Soils accumulating in cracks, on ledges, at the cliff bases, and around tree trunks are thin alkaline organics.

**Identified vectors and pathways:** Occasional visitors may travel along several old roads and trails that pass near the limestone cliff. These trails support a high proportion of the current invasive plant species, and their ease of access promotes the transport of new species via animals (e.g., human, deer) across the island.

Gaps in communities adjacent to limestone cliffs change microhabitats and may increase pathways for invasive plant species. In the surrounding mesic northern forest, beech bark disease has killed 10% of canopy American beech (*Fagus grandifolia*), and scale is present on 60% of canopy beech. Canopy white ash (*Fraxinus americana*) in that forest is likely to be affected by emerald ash borer (*Agrilus planipennis*; Cohen et al. 2022).

**Invasive plant status:** The only invasives observed in this community were the Priority 3 species bittersweet nightshade and wood bluegrass (*Poa nemoralis*), which were occasional and locally common, respectively. Portions of the cliffs are adjacent to significant windthrow areas, which have resulted in additional light, desiccation, and a niche for the Priority 3 species wood bluegrass to exploit (Bassett et al. 2022).

The most likely new invaders of this area include three Priority 1 species and three Priority 2 species that scored greater than 20 due to suitable habitat and/or proximity in adjacent areas/nearby islands (Table 11). Wetland or shade-intolerant species with no habitat affinity for limestone cliffs occurring within forests are excluded from the list.

- Autumn olive
- Dame's rocket
- Bush honeysuckle
- White sweet-clover (*Melilotus albus*)
- Reed canary grass
- Erect hedge-parsley



Table 11. IPIEDPT area-species link scores for the limestone 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
Bittersweet nightshade, woody nightshade	<i>Solanum dulcamara</i>	10	7	10	27	4.9	31.9
Narrow-leaved cat-tail	<i>Typha angustifolia</i>	10	0	10	20	9	29.0
Wood bluegrass	<i>Poa nemoralis</i>	10	5	10	25	3.57	28.6
Bush honeysuckle	<i>Lonicera</i> sp.	10	0	10	20	8.47	28.5
Canada thistle	<i>Cirsium arvense</i>	10	0	10	20	7.57	27.6
Marsh thistle	<i>Cirsium palustre</i>	10	0	10	20	6.77	26.8
Bull thistle	<i>Cirsium vulgare</i>	10	0	10	20	6.77	26.8
Houndstongue	<i>Cynoglossum officinale</i>	10	0	10	20	6.77	26.8
Autumn-olive	<i>Elaeagnus umbellata</i>	10	0	10	20	6.1	26.1
Erect hedge parsley	<i>Torilis japonica</i>	10	0	10	20	5.9	25.9
Lesser burdock	<i>Arctium minus</i>	10	0	10	20	5.1	25.1
Orange hawkweed	<i>Hieracium aurantiacum</i>	10	0	10	20	4.5	24.5
Scotch mist	<i>Galium sylvaticum</i>	10	0	10	20	4.1	24.1
Canada bluegrass	<i>Poa compressa</i>	10	0	10	20	4.1	24.1
Tall buttercup	<i>Ranunculus acris</i>	10	0	10	20	4.1	24.1
Kentucky bluegrass	<i>Poa pratensis</i>	10	0	10	20	3.43	23.4
Dame's rocket	<i>Hesperis matronalis</i>	5	0	10	15	7.7	22.7
White sweet-clover	<i>Melilotus albus</i>	5	0	10	15	6.3	21.3
Common hempnettle	<i>Galeopsis tetrahit</i>	5	0	10	15	5.1	20.1
Reed canary grass	<i>Phalaris arundinacea</i>	10	0	1	11	9.07	20.1
Common reed	<i>Phragmites australis</i> ssp. <i>australis</i>	10	0	1	11	9.1	20.1
Spotted knapweed	<i>Centaurea stoebe</i> ssp. <i>micranthos</i>	10	0	1	11	9	20.0
Helleborine	<i>Epipactis helleborine</i>	10	0	5	15	4.97	20.0
Wormseed wallflower	<i>Erysimum cheiranthoides</i>	5	0	10	15	4.9	19.9
Common gypsy-weed	<i>Veronica officinalis</i>	10	0	5	15	4.9	19.9
Red clover	<i>Trifolium pratense</i>	10	0	5	15	4.5	19.5
Thyme-leaf speedwell	<i>Veronica serpyllifolia</i>	5	0	10	15	4.5	19.5
Butter and eggs	<i>Linaria vulgaris</i>	5	0	10	15	4.37	19.4
Flannel plant, common mullein	<i>Verbascum thapsus</i>	10	0	5	15	4.37	19.4
Leafy spurge	<i>Euphorbia esula</i>	10	0	1	11	8.1	19.1
Spotted ladythumb, ladythumb	<i>Persicaria maculosa</i>	5	0	10	15	4.1	19.1
Common mouse-ear chickweed	<i>Cerastium fontanum</i> ssp. <i>vulgare</i>	5	0	10	15	3.9	18.9

Common Name	Scientific Name ITIS	Presence Score	Status Score	Habitat Score	Total Score	Species Score	Overall Score
Cat-nip	<i>Nepeta cataria</i>	5	0	10	15	3.57	18.6
Annual bluegrass	<i>Poa annua</i>	10	0	5	15	3.57	18.6
Wild parsnip	<i>Pastinaca sativa</i>	10	0	1	11	7.3	18.3
White poplar	<i>Populus alba</i>	10	0	1	11	6.5	17.5
Multiflora rose	<i>Rosa multiflora</i>	5	0	5	10	7.3	17.3
Garden valerian, common valerian	<i>Valeriana officinalis</i>	5	0	5	10	7.3	17.3
Common timothy	<i>Phleum pratense</i>	10	0	1	11	4.9	15.9
Quackgrass	<i>Elymus repens</i>	5	0	5	10	5.7	15.7
Goldmoss stonecrop	<i>Sedum acre</i>	10	0	1	11	4.37	15.4
Queen Anne's lace	<i>Daucus carota</i>	5	0	5	10	5.1	15.1
Purple loosestrife	<i>Lythrum salicaria</i>	5	0	1	6	9.1	15.1
European cranberry-bush	<i>Viburnum opulus</i>	5	0	5	10	5.1	15.1
Japanese barberry	<i>Berberis thunbergii</i>	5	0	1	6	9	15.0
Redtop	<i>Agrostis gigantea</i>	5	0	5	10	4.9	14.9
Black bindweed, wild buckwheat	<i>Fallopia convolvulus</i>	10	0	1	11	3.7	14.7
Soapwort, bouncing bet	<i>Saponaria officinalis</i>	5	0	5	10	4.5	14.5
Meadow fescue	<i>Schedonorus pratensis</i>	5	0	5	10	4.5	14.5
Garlic mustard	<i>Alliaria petiolata</i>	5	0	0	5	9.4	14.4
Orchard grass	<i>Dactylis glomerata</i>	5	0	5	10	4.1	14.1
Bitter dock, broadleaf dock	<i>Rumex obtusifolius</i>	5	0	5	10	4.1	14.1
White campion	<i>Silene latifolia</i>	5	0	5	10	4.1	14.1
Bladder campion	<i>Silene vulgaris</i>	5	0	5	10	4.1	14.1
Ox-eye daisy	<i>Leucanthemum vulgare</i>	5	0	5	10	3.97	14.0
Smallflower hairy willow herb	<i>Epilobium parviflorum</i>	5	0	1	6	5.3	11.3
Black medick	<i>Medicago lupulina</i>	5	0	1	6	4.5	10.5
Common St. John's wort	<i>Hypericum perforatum</i>	5	0	1	6	4.37	10.4
Jack-go-to-bed-at-noon	<i>Tragopogon pratensis</i>	5	0	1	6	4.3	10.3
Yellow hawkweed	<i>Hieracium caespitosum</i>	5	0	1	6	4.1	10.1
Motherwort	<i>Leonurus cardiaca</i>	5	0	1	6	4.1	10.1
Norway spruce	<i>Picea abies</i>	5	0	1	6	4.1	10.1
Proso millet	<i>Panicum miliaceum</i>	5	0	1	6	3.9	9.9
Strawberry clover	<i>Trifolium fragiferum</i>	5	0	1	6	3.57	9.6
Dandelion	<i>Taraxacum officinale</i>	0	0	0	0	3.57	3.6

#### *Limestone Cobble Shore*<sup>1</sup> (EO ID 24353)

Limestone cobble shore is a state-vulnerable community that occurs in just eight counties of northern Michigan. ‘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 14). 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, white spruce, soapberry (*Shepherdia canadensis*), tag alder (*Alnus incana*), and shrubby cinquefoil (*Dasiphora fruticosa*; 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).

The area is located partially on land owned by LTBBOI (Figure 2). Any management actions on LTBBOI portion of this area should be made in accordance with the LTBBOI.



Figure 14. Limestone cobble shore on St. Martin Island, Green Bay National Wildlife Refuge. Photo by Joshua Cohen, June 3, 2021.

**Sensitive resources:**



**Important biotic factors:** Vegetation is sparse, mostly limited to cracks between cobbles. It was likely denser before the recent consecutive highwater years. Along the upper margins are scattered trees and shrubs: northern white cedar, red elderberry (*Sambucus racemosa*), green ash (*Fraxinus pennsylvanica*), quaking aspen, paper birch, and red osier dogwood (*Cornus sericea*). Many trees have been killed by the recent high water (Cohen et al. 2022).

**Important abiotic factors:** The limestone cobble shore EO is currently narrow, 10 to 15 ft (3 to 5 m) in width and occupies 15 acres along the southern and northeastern shores. 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. The shore is accessible by a network of old trails. Deer and human visitors are likely to walk along the ridge and bring seeds of invasives on gear, hair, and clothing.

**Invasive plant status:** The only invasives observed in this community were Priority 3 species: mossy stonecrop (*Sedum acre*), bittersweet nightshade, and dandelion (Bassett et al. 2022). In 2017, large patches of purple loosestrife, reed canary grass, and invasive reed were documented. Much of the invaded area was treated, and subsequent highwater years further contributed to an absence of these invasive species by 2021.

The most likely new invaders of this area include nine Priority 1 species and two Priority 2 species that scored greater than 20 due to suitable habitat and/or proximity in adjacent areas/nearby islands (Table 12). Additionally, white poplar is included despite scoring under 20 due to its proximity to the limestone cobble shore, near the lighthouse.

- Spotted knapweed
- Autumn olive
- Leafy spurge
- Bush honeysuckle
- Purple loosestrife
- White sweet-clover
- Wild parsnip
- Invasive common reed
- Reed canary grass
- White poplar
- Narrow-leaved cat-tail



Table 12. IPIEDPT area-species link scores for the limestone cobble shore 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. 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
Bittersweet nightshade	<i>Solanum dulcamara</i>	10	10	10	30	4.9	34.9
Goldmoss stonecrop	<i>Sedum acre</i>	10	7	10	27	4.37	31.4
Dandelion	<i>Taraxacum officinale</i>	10	7	10	27	3.57	30.6
Common reed	<i>Phragmites australis</i> ssp. <i>australis</i>	10	0	10	20	9.1	29.1
Spotted knapweed	<i>Centaurea stoebe</i> ssp. <i>micranthos</i>	10	0	10	20	9	29.0
Narrow-leaved cat-tail	<i>Typha angustifolia</i>	10	0	10	20	9	29.0
Bush honeysuckle	<i>Lonicera</i> sp.	10	0	10	20	8.47	28.5
Canada thistle	<i>Cirsium arvense</i>	10	0	10	20	7.57	27.6
Wild parsnip	<i>Pastinaca sativa</i>	10	0	10	20	7.3	27.3
Marsh thistle	<i>Cirsium palustre</i>	10	0	10	20	6.77	26.8
Bull thistle	<i>Cirsium vulgare</i>	10	0	10	20	6.77	26.8
Houndstongue	<i>Cynoglossum officinale</i>	10	0	10	20	6.77	26.8
Autumn-olive	<i>Elaeagnus umbellata</i>	10	0	10	20	6.1	26.1
Lesser burdock	<i>Arctium minus</i>	10	0	10	20	5.1	25.1
Common timothy	<i>Phleum pratense</i>	10	0	10	20	4.9	24.9
Orange hawkweed	<i>Hieracium aurantiacum</i>	10	0	10	20	4.5	24.5
Red clover	<i>Trifolium pratense</i>	10	0	10	20	4.5	24.5
Flannel plant, common mullein	<i>Verbascum thapsus</i>	10	0	10	20	4.37	24.4
Purple loosestrife	<i>Lythrum salicaria</i>	5	0	10	15	9.1	24.1
Reed canary grass	<i>Phalaris arundinacea</i>	10	0	5	15	9.07	24.1
Tall buttercup	<i>Ranunculus acris</i>	10	0	10	20	4.1	24.1
Annual bluegrass	<i>Poa annua</i>	10	0	10	20	3.57	23.6
Kentucky bluegrass	<i>Poa pratensis</i>	10	0	10	20	3.43	23.4
Leafy spurge	<i>Euphorbia esula</i>	10	0	5	15	8.1	23.1
Common valerian	<i>Valeriana officinalis</i>	5	0	10	15	7.3	22.3
White sweet-clover	<i>Melilotus albus</i>	5	0	10	15	6.3	21.3
Quackgrass	<i>Elymus repens</i>	5	0	10	15	5.7	20.7
Smallflower hairy willow herb	<i>Epilobium parviflorum</i>	5	0	10	15	5.3	20.3
Common hempnettle	<i>Galeopsis tetrahit</i>	5	0	10	15	5.1	20.1
Redtop	<i>Agrostis gigantea</i>	5	0	10	15	4.9	19.9
Wormseed wallflower	<i>Erysimum cheiranthoides</i>	5	0	10	15	4.9	19.9
Common gypsy-weed	<i>Veronica officinalis</i>	10	0	5	15	4.9	19.9
Black medick	<i>Medicago lupulina</i>	5	0	10	15	4.5	19.5
Soapwort, bouncing bet	<i>Saponaria officinalis</i>	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
Meadow fescue	<i>Schedonorus pratensis</i>	5	0	10	15	4.5	19.5
Thyme-leaf speedwell	<i>Veronica serpyllifolia</i>	5	0	10	15	4.5	19.5
Butter and eggs	<i>Linaria vulgaris</i>	5	0	10	15	4.37	19.4
Jack-go-to-bed-at-noon	<i>Tragopogon pratensis</i>	5	0	10	15	4.3	19.3
Spotted ladythumb, ladythumb	<i>Persicaria maculosa</i>	5	0	10	15	4.1	19.1
Canada bluegrass	<i>Poa compressa</i>	10	0	5	15	4.1	19.1
White campion	<i>Silene latifolia</i>	5	0	10	15	4.1	19.1
Bladder campion	<i>Silene vulgaris</i>	5	0	10	15	4.1	19.1
Ox-eye daisy	<i>Leucanthemum vulgare</i>	5	0	10	15	3.97	19.0
Common mouse-ear chickweed	<i>Cerastium fontanum</i> ssp. <i>vulgare</i>	5	0	10	15	3.9	18.9
Black bindweed, wild buckwheat	<i>Fallopia convolvulus</i>	10	0	5	15	3.7	18.7
Cat-nip	<i>Nepeta cataria</i>	5	0	10	15	3.57	18.6
Wood bluegrass	<i>Poa nemoralis</i>	10	0	5	15	3.57	18.6
White poplar	<i>Populus alba</i>	10	0	1	11	6.5	17.5
Multiflora rose	<i>Rosa multiflora</i>	5	0	5	10	7.3	17.3
Helleborine	<i>Epipactis helleborine</i>	10	0	1	11	4.97	16.0
Erect hedge parsley	<i>Torilis japonica</i>	5	0	5	10	5.9	15.9
Queen Anne's lace	<i>Daucus carota</i>	5	0	5	10	5.1	15.1
Scotch mist	<i>Galium sylvaticum</i>	10	0	1	11	4.1	15.1
European cranberry-bush	<i>Viburnum opulus</i>	5	0	5	10	5.1	15.1
Japanese barberry	<i>Berberis thunbergii</i>	5	0	1	6	9	15.0
Garlic mustard	<i>Alliaria petiolata</i>	5	0	0	5	9.4	14.4
Common St. John's wort	<i>Hypericum perforatum</i>	5	0	5	10	4.37	14.4
Orchard grass	<i>Dactylis glomerata</i>	5	0	5	10	4.1	14.1
Yellow hawkweed	<i>Hieracium caespitosum</i>	5	0	5	10	4.1	14.1
Motherwort	<i>Leonurus cardiaca</i>	5	0	5	10	4.1	14.1
Bitter dock, broadleaf dock	<i>Rumex obtusifolius</i>	5	0	5	10	4.1	14.1
Proso millet	<i>Panicum miliaceum</i>	5	0	5	10	3.9	13.9
Dame's rocket	<i>Hesperis matronalis</i>	5	0	1	6	7.7	13.7
Norway spruce	<i>Picea abies</i>	5	0	1	6	4.1	10.1
Strawberry clover	<i>Trifolium fragiferum</i>	5	0	1	6	3.57	9.6



#### *Limestone Lakeshore Cliff (EO ID 24348)*

Limestone lakeshore cliff is made up of vertical exposures of limestone along the Great Lakes (Figure 15). 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. This community is critically imperiled at the state level, occurring along the Niagara Escarpment in just three Michigan counties (Cohen et al. 2015). 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 15. Limestone lakeshore cliff on St. Martin Island, Green Bay National Wildlife Refuge. Photo by Joshua Cohen, July 28, 2021.

#### **Sensitive resources:**

[REDACTED]

**Important biotic factors:** Vegetation is sparse, generally limited to cracks, ledges, and talus at the cliff base, and forested terraces between cliffs. Mosses, lichens, and liverworts are locally

common. The cliff serves as a refuge for deer-preferred species such as white cedar and Canada yew (Cohen et al. 2022). Northern white cedar growing in cracks along the cliff face were cored and the oldest estimated to be at least 289 years old (Cohen et al. 2022). Even older trees may be present, as some white cedar of the Niagara Escarpment have been documented to live for up to 1900 years (Kelly and Larson 2007).

**Important abiotic factors:** Soils are very shallow and alkaline. The community occupies 42 acres along two miles of the northwest and east shores and locally intergrades with limestone cobble shore and small patches of limestone bedrock lakeshore. The cliffs are generally 10 to 40 ft (3 to 12 m) tall and occasionally up to 70 ft (21 m). The cliffs are often two-tiered with a 50 to 100 ft (15 to 30 m) terrace of boreal forest separating the tiers. 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:** The only invasives observed were Priority 3 plants bittersweet nightshade and wood bluegrass, which were occasional and locally common, respectively (Bassett et al. 2022).

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

- Spotted knapweed
- Autumn olive
- Bush honeysuckle
- Purple loosestrife
- White sweet-clover
- Wild parsnip
- Invasive common reed
- Reed canary grass
- Narrow-leaved cat-tail



Table 13. IPIEDPT area-species link scores for the limestone lakeshore 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
Bittersweet nightshade, woody nightshade	<i>Solanum dulcamara</i>	10	7	10	27	4.9	31.9
Common reed	<i>Phragmites australis</i> ssp. <i>australis</i>	10	0	10	20	9.1	29.1
Spotted knapweed	<i>Centaurea stoebe</i> ssp. <i>micranthos</i>	10	0	10	20	9	29.0
Wood bluegrass	<i>Poa nemoralis</i>	10	5	10	25	3.57	28.6
Bush honeysuckle	<i>Lonicera</i> sp.	10	0	10	20	8.47	28.5
Canada thistle	<i>Cirsium arvense</i>	10	0	10	20	7.57	27.6
Wild parsnip	<i>Pastinaca sativa</i>	10	0	10	20	7.3	27.3
Marsh thistle	<i>Cirsium palustre</i>	10	0	10	20	6.77	26.8
Bull thistle	<i>Cirsium vulgare</i>	10	0	10	20	6.77	26.8
Houndstongue	<i>Cynoglossum officinale</i>	10	0	10	20	6.77	26.8
Autumn-olive	<i>Elaeagnus umbellata</i>	10	0	10	20	6.1	26.1
Lesser burdock	<i>Arctium minus</i>	10	0	10	20	5.1	25.1
Common timothy	<i>Phleum pratense</i>	10	0	10	20	4.9	24.9
Orange hawkweed	<i>Hieracium aurantiacum</i>	10	0	10	20	4.5	24.5
Goldmoss stonecrop	<i>Sedum acre</i>	10	0	10	20	4.37	24.4
Purple loosestrife	<i>Lythrum salicaria</i>	5	0	10	15	9.1	24.1
Canada bluegrass	<i>Poa compressa</i>	10	0	10	20	4.1	24.1
Tall buttercup	<i>Ranunculus acris</i>	10	0	10	20	4.1	24.1
Narrow-leaved cat-tail	<i>Typha angustifolia</i>	10	0	5	15	9	24.0
Annual bluegrass	<i>Poa annua</i>	10	0	10	20	3.57	23.6
Dandelion	<i>Taraxacum officinale</i>	10	0	10	20	3.57	23.6
Kentucky bluegrass	<i>Poa pratensis</i>	10	0	10	20	3.43	23.4
Leafy spurge	<i>Euphorbia esula</i>	10	0	5	15	8.1	23.1
Common valerian	<i>Valeriana officinalis</i>	5	0	10	15	7.3	22.3
White sweet-clover	<i>Melilotus albus</i>	5	0	10	15	6.3	21.3
Quackgrass	<i>Elymus repens</i>	5	0	10	15	5.7	20.7
Smallflower hairy willow herb	<i>Epilobium parviflorum</i>	5	0	10	15	5.3	20.3
Common hempnettle	<i>Galeopsis tetrahit</i>	5	0	10	15	5.1	20.1
Reed canary grass	<i>Phalaris arundinacea</i>	10	0	1	11	9.07	20.1
Redtop	<i>Agrostis gigantea</i>	5	0	10	15	4.9	19.9
Wormseed wallflower	<i>Erysimum cheiranthoides</i>	5	0	10	15	4.9	19.9
Common gypsy-weed	<i>Veronica officinalis</i>	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
Black medick	<i>Medicago lupulina</i>	5	0	10	15	4.5	19.5
Red clover	<i>Trifolium pratense</i>	10	0	5	15	4.5	19.5
Thyme-leaf speedwell	<i>Veronica serpyllifolia</i>	5	0	10	15	4.5	19.5
Butter and eggs	<i>Linaria vulgaris</i>	5	0	10	15	4.37	19.4
Flannel plant, common mullein	<i>Verbascum thapsus</i>	10	0	5	15	4.37	19.4
Spotted ladythumb, ladythumb	<i>Persicaria maculosa</i>	5	0	10	15	4.1	19.1
Bladder campion	<i>Silene vulgaris</i>	5	0	10	15	4.1	19.1
Ox-eye daisy	<i>Leucanthemum vulgare</i>	5	0	10	15	3.97	19.0
Common mouse-ear chickweed	<i>Cerastium fontanum</i> ssp. <i>vulgare</i>	5	0	10	15	3.9	18.9
Black bindweed, wild buckwheat	<i>Fallopia convolvulus</i>	10	0	5	15	3.7	18.7
Cat-nip	<i>Nepeta cataria</i>	5	0	10	15	3.57	18.6
White poplar	<i>Populus alba</i>	10	0	1	11	6.5	17.5
Multiflora rose	<i>Rosa multiflora</i>	5	0	5	10	7.3	17.3
Helleborine	<i>Epipactis helleborine</i>	10	0	1	11	4.97	16.0
Erect hedge parsley	<i>Torilis japonica</i>	5	0	5	10	5.9	15.9
Queen Anne's lace	<i>Daucus carota</i>	5	0	5	10	5.1	15.1
Scotch mist	<i>Galium sylvaticum</i>	10	0	1	11	4.1	15.1
European cranberry-bush	<i>Viburnum opulus</i>	5	0	5	10	5.1	15.1
Japanese barberry	<i>Berberis thunbergii</i>	5	0	1	6	9	15.0
Soapwort, bouncing bet	<i>Saponaria officinalis</i>	5	0	5	10	4.5	14.5
Meadow fescue	<i>Schedonorus pratensis</i>	5	0	5	10	4.5	14.5
Garlic mustard	<i>Alliaria petiolata</i>	5	0	0	5	9.4	14.4
Common St. John's wort	<i>Hypericum perforatum</i>	5	0	5	10	4.37	14.4
Jack-go-to-bed-at-noon	<i>Tragopogon pratensis</i>	5	0	5	10	4.3	14.3
Orchard grass	<i>Dactylis glomerata</i>	5	0	5	10	4.1	14.1
Yellow hawkweed	<i>Hieracium caespitosum</i>	5	0	5	10	4.1	14.1
Motherwort	<i>Leonurus cardiaca</i>	5	0	5	10	4.1	14.1
Bitter dock, broadleaf dock	<i>Rumex obtusifolius</i>	5	0	5	10	4.1	14.1
White campion	<i>Silene latifolia</i>	5	0	5	10	4.1	14.1
Proso millet	<i>Panicum miliaceum</i>	5	0	5	10	3.9	13.9
Dame's rocket	<i>Hesperis matronalis</i>	5	0	1	6	7.7	13.7
Norway spruce	<i>Picea abies</i>	5	0	1	6	4.1	10.1
Strawberry clover	<i>Trifolium fragiferum</i>	5	0	1	6	3.57	9.6



### *Mesic Northern Forest (EO ID 24349)*

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; Figure 16). 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, 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.



Figure 16. Mesic northern forest with old hunting blind on St. Martin Island, Green Bay National Wildlife Refuge. Photo by Joshua Cohen, June 2, 2021.

### **Sensitive resources:**

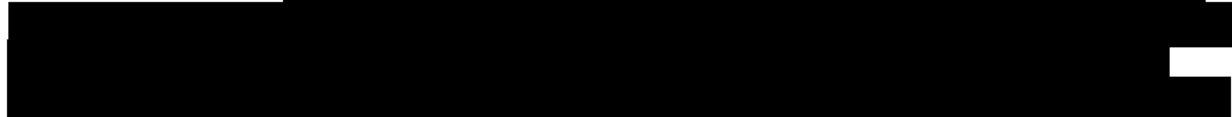






Figure 17. Bald eagle nest with juvenile [REDACTED] mesic northern forest EO on St. Martin Island, Green Bay National Wildlife Refuge. Photo by Scott Warner, July 29, 2021.

**Important biotic factors:** On St. Martin Island, the canopy is dominated by sugar maple with a diverse array of associates such as red oak, beech, basswood, white ash, and occasionally northern white cedar. Canopy trees are generally 14 to 20 in (35 to 50 cm) in DBH and occasionally 24 to 31 in (60 to 80 cm). Several cored trees were estimated to be over 100 years old and two were over 200. The forest is recovering from over-browse after a 2013 deer cull. Emerald ash borer has not yet affected canopy white ash, though it was observed in the northern hardwood swamp.

**Important abiotic factors:** Historically, mesic northern forest underwent relatively little disturbance, with old-growth conditions persisting for centuries between rare catastrophic fire or windthrow events (Cohen et al. 2015). St. Martin was selectively logged in the past. The mesic northern forest EO on the island currently occupies 530 acres but could expand as the surrounding forest benefits from invasive species management and maturation. Scattered limestone boulders provide potential habitat for rare plants. Pit and mound topography and variability in the thickness of the soil layer over the limestone substrate also provide habitat heterogeneity (Cohen et al. 2022). Old hunting blinds are found across the island's uplands (Bassett et al. 2022).



**Identified vectors and pathways:** Occasional visitors may travel along several old roads and trails that run adjacent to the area, the largest of which are from the south dock to the lighthouse. These trails support a high proportion of the current invasive plant species, and their ease of access promotes the transport of new species via animals (e.g., human, deer) across the island. These trails bisect this mesic northern forest EO (See *Disturbed Forest*). Additional biotic threats come from beech bark disease, earthworms, and caterpillar browse on Canada yew (Cohen et al. 2022).

Part of the EO in the north of the island is near the limestone cobble shore and could be affected by shore invasions. Beech bark disease has killed 10% of canopy beech, and scale is present on 60% of canopy beech (Cohen et al. 2022). Tree mortality from beech bark disease and emerald ash borer is expected to create gaps that could be exploited by invasives.

**Invasive plant status:** Priority 1 invasive species present were the woody shrubs autumn olive and bush honeysuckle. Only a few individuals were found, and most were young and pulled when encountered as indicated in the data point collected in the USFWS AGOL Invasive Plant Feature Layer (Bassett et al. 2022). Seventeen other non-native species were present. They were often located along the old roads and trails with the exception of thistles (*Cirsium* spp.) and bittersweet nightshade. Thistles were found off-trail and mapped when encountered.

The most likely new invaders of this area include three other Priority 1 species and five Priority 2 species that scored greater than 20 due to suitable habitat and/or proximity in adjacent areas/nearby islands (Table 14):

- Garlic mustard
- Invasive common reed
- Reed canary grass
- Wild parsnip
- Dame's rocket
- Erect hedge parsley
- Japanese barberry
- 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
<b>Bush honeysuckle</b>	<b><i>Lonicera</i> sp.</b>	10	10	10	30	8.47	38.5
<b>Autumn-olive</b>	<b><i>Elaeagnus umbellata</i></b>	10	10	10	30	6.1	36.1
Marsh thistle	<i>Cirsium palustre</i>	10	7	10	27	6.77	33.8
Bull thistle	<i>Cirsium vulgare</i>	10	7	10	27	6.77	33.8
Canada thistle	<i>Cirsium arvense</i>	10	5	10	25	7.57	32.6
Helleborine	<i>Epipactis helleborine</i>	10	7	10	27	4.97	32.0
Common gypsy-weed	<i>Veronica officinalis</i>	10	7	10	27	4.9	31.9
Houndstongue	<i>Cynoglossum officinale</i>	10	5	10	25	6.77	31.8
Flannel plant, common mullein	<i>Verbascum thapsus</i>	10	7	10	27	4.37	31.4
Scotch mist	<i>Galium sylvaticum</i>	10	7	10	27	4.1	31.1
Canada bluegrass	<i>Poa compressa</i>	10	7	10	27	4.1	31.1
Dandelion	<i>Taraxacum officinale</i>	10	7	10	27	3.57	30.6
Kentucky bluegrass	<i>Poa pratensis</i>	10	7	10	27	3.43	30.4
Lesser burdock	<i>Arctium minus</i>	10	5	10	25	5.1	30.1
Bittersweet nightshade, woody nightshade	<i>Solanum dulcamara</i>	10	5	10	25	4.9	29.9
Common reed	<i>Phragmites australis</i> ssp. <i>australis</i>	10	0	10	20	9.1	29.1
Wood bluegrass	<i>Poa nemoralis</i>	10	5	10	25	3.57	28.6
Tall buttercup	<i>Ranunculus acris</i>	10	7	5	22	4.1	26.1
Annual bluegrass	<i>Poa annua</i>	10	7	5	22	3.57	25.6
Black bindweed, wild buckwheat	<i>Fallopia convolvulus</i>	10	10	1	21	3.7	24.7
Orange hawkweed	<i>Hieracium aurantiacum</i>	10	0	10	20	4.5	24.5
Garlic mustard	<i>Alliaria petiolata</i>	5	0	10	15	9.4	24.4
Reed canary grass	<i>Phalaris arundinacea</i>	10	0	5	15	9.07	24.1
Japanese barberry	<i>Berberis thunbergii</i>	5	0	10	15	9	24.0
Dame's rocket	<i>Hesperis matronalis</i>	5	0	10	15	7.7	22.7
Wild parsnip	<i>Pastinaca sativa</i>	10	0	5	15	7.3	22.3
Multiflora rose	<i>Rosa multiflora</i>	5	0	10	15	7.3	22.3
Erect hedge parsley	<i>Torilis japonica</i>	5	0	10	15	5.9	20.9
Spotted knapweed	<i>Centaurea stoebe</i> ssp. <i>micranthos</i>	10	0	1	11	9	20.0
Narrow-leaved cat-tail	<i>Typha angustifolia</i>	10	0	1	11	9	20.0
Redtop	<i>Agrostis gigantea</i>	5	0	10	15	4.9	19.9
Common timothy	<i>Phleum pratense</i>	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
Red clover	<i>Trifolium pratense</i>	10	0	5	15	4.5	19.5
Thyme-leaf speedwell	<i>Veronica serpyllifolia</i>	5	0	10	15	4.5	19.5
Leafy spurge	<i>Euphorbia esula</i>	10	0	1	11	8.1	19.1
Common mouse-ear chickweed	<i>Cerastium fontanum</i> ssp. <i>vulgare</i>	5	0	10	15	3.9	18.9
White poplar	<i>Populus alba</i>	10	0	1	11	6.5	17.5
Garden valerian, common valerian	<i>Valeriana officinalis</i>	5	0	5	10	7.3	17.3
Quackgrass	<i>Elymus repens</i>	5	0	5	10	5.7	15.7
Goldmoss stonecrop	<i>Sedum acre</i>	10	0	1	11	4.37	15.4
Queen Anne's lace	<i>Daucus carota</i>	5	0	5	10	5.1	15.1
Purple loosestrife	<i>Lythrum salicaria</i>	5	0	1	6	9.1	15.1
European cranberry-bush	<i>Viburnum opulus</i>	5	0	5	10	5.1	15.1
Soapwort, bouncing bet	<i>Saponaria officinalis</i>	5	0	5	10	4.5	14.5
Meadow fescue	<i>Schedonorus pratensis</i>	5	0	5	10	4.5	14.5
Jack-go-to-bed-at-noon	<i>Tragopogon pratensis</i>	5	0	5	10	4.3	14.3
Orchard grass	<i>Dactylis glomerata</i>	5	0	5	10	4.1	14.1
Bitter dock, broadleaf dock	<i>Rumex obtusifolius</i>	5	0	5	10	4.1	14.1
White campion	<i>Silene latifolia</i>	5	0	5	10	4.1	14.1
Bladder campion	<i>Silene vulgaris</i>	5	0	5	10	4.1	14.1
Ox-eye daisy	<i>Leucanthemum vulgare</i>	5	0	5	10	3.97	14.0
White sweet-clover	<i>Melilotus albus</i>	5	0	1	6	6.3	12.3
Smallflower hairy willow herb	<i>Epilobium parviflorum</i>	5	0	1	6	5.3	11.3
Common hempnettle	<i>Galeopsis tetrahit</i>	5	0	1	6	5.1	11.1
Wormseed wallflower	<i>Erysimum cheiranthoides</i>	5	0	1	6	4.9	10.9
Black medick	<i>Medicago lupulina</i>	5	0	1	6	4.5	10.5
Common St. John's wort	<i>Hypericum perforatum</i>	5	0	1	6	4.37	10.4
Butter and eggs	<i>Linaria vulgaris</i>	5	0	1	6	4.37	10.4
Yellow hawkweed	<i>Hieracium caespitosum</i>	5	0	1	6	4.1	10.1
Motherwort	<i>Leonurus cardiaca</i>	5	0	1	6	4.1	10.1
Spotted ladythumb, ladythumb	<i>Persicaria maculosa</i>	5	0	1	6	4.1	10.1
Norway spruce	<i>Picea abies</i>	5	0	1	6	4.1	10.1
Proso millet	<i>Panicum miliaceum</i>	5	0	1	6	3.9	9.9
Cat-nip	<i>Nepeta cataria</i>	5	0	1	6	3.57	9.6
Strawberry clover	<i>Trifolium fragiferum</i>	5	0	1	6	3.57	9.6



#### *Northern Hardwood Swamp (EO ID 24352)*

Northern hardwood swamps are seasonally inundated peatlands dominated by black ash (*Fraxinus nigra*) with other canopy associates including green ash, silver maple (*Acer saccharinum*), American elm (*Ulmus americana*), yellow birch, balsam fir, and northern white cedar. They occur in depressions, over groundwater seeps, and in low areas near rivers, lakes, and wetlands. Canopy composition is governed by flooding frequency and the extent to which surface water is stagnant, with stagnant water favoring black ash and moving water favoring other species (Cohen et al. 2015). Threats to northern hardwood swamps include hydrological alterations (e.g., drainage for agriculture), sedimentation of logging or construction, significant alterations of flooding amount, nutrients, and flooding frequency as a result of anthropogenic development, and invasive species (Kost et al. 2007, Cohen et al. 2020). The spread of the invasive species emerald ash borer has changed the canopy once dominated by black ash and community of northern hardwood swamps (Figure 18).



Figure 18. Northern hardwood swamp on St. Martin Island, Green Bay National Wildlife Refuge. Photo by Joshua Cohen, June 3, 2021.

The majority of this area is on land owned by LTBBOI (Figure 2), but considering its relationship and geographical proximity to federally owned lands on St. Martin Island, it was ranked and included in discussions. Any management actions on LTBBOI land should be made in accordance with the LTBBOI.



**Sensitive resources:**

**Important biotic factors:** Wood duck (*Aix sponsa*) is prevalent in the swamp. Emerald ash borer is affecting 25% of canopy ash (Cohen et al. 2022).

**Important abiotic factors:** The seven-acre hardwood swamp on St. Martin occurs in a small depression in the northeast (Figure 3). Its soil consists of inundated shallow organic substrate overlying alkaline sandy clay. Water depths range from 1 to 2 ft (30 to 60 cm; Cohen et al. 2022).

**Identified vectors and pathways:** Occasional visitors may travel along old roads and trails that run near the area. These trails support a high proportion of the island's invasive plant species, and their ease of access promotes the transport of new species via animals (e.g., human, deer) across the island. The swamp is relatively close to the lighthouse and shore and could be impacted by invasive species associated with these areas. Emerald ash borer has created gaps that could continue to be exploited by invasives.

**Invasive plant status:** Priority 1 invasive species present were reed canary grass, narrow-leaved cat-tail, and invasive common reed (Figure 9). Reed canary grass and cat-tail were patchy in the area observed, the former occupying an area of less than 1000 ft<sup>2</sup> and the latter over an area of 1000 to 20,000 ft<sup>2</sup>. Cat-tail occupied three patches, each less than 1000 ft<sup>2</sup>, and its density ranged from patchy to dense to monoculture. One Priority 2 species, bittersweet nightshade, was observed (Bassett et al. 2022).

The most likely new invaders of this area include two other Priority 1 species and five Priority 2 species that scored greater than 20 due to suitable habitat and/or proximity in adjacent areas/nearby islands (Table 15). Priority 2 species purple loosestrife scored relatively low but is still included because it was known from St. Martin before likely being eliminated due to recent highwater years and is still present on nearby Plum Island. Upland or shade-intolerant species with no habitat affinity for swamps are excluded from the list.

- Garlic mustard
- Japanese barberry
- Autumn olive
- Bush honeysuckle
- Multiflora rose
- Erect hedge-parsley
- Purple loosestrife

Table 15. IPIEDPT area-species link scores for the northern hardwood swamp 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
<b>Common reed</b>	<b><i>Phragmites australis</i> ssp. <i>australis</i></b>	10	7	10	27	9.1	36.1
<b>Reed canary grass</b>	<b><i>Phalaris arundinacea</i></b>	10	5	10	25	9.07	34.1
Bittersweet nightshade, woody nightshade	<i>Solanum dulcamara</i>	10	7	10	27	4.9	31.9
<b>Narrow-leaved cat-tail</b>	<b><i>Typha angustifolia</i></b>	10	1	10	21	9	30.0
Bush honeysuckle	<i>Lonicera</i> sp.	10	0	10	20	8.47	28.5
Canada thistle	<i>Cirsium arvense</i>	10	0	10	20	7.57	27.6
Bull thistle	<i>Cirsium vulgare</i>	10	0	10	20	6.77	26.8
Houndstongue	<i>Cynoglossum officinale</i>	10	0	10	20	6.77	26.8
Autumn-olive	<i>Elaeagnus umbellata</i>	10	0	10	20	6.1	26.1
Lesser burdock	<i>Arctium minus</i>	10	0	10	20	5.1	25.1
Common gypsy-weed	<i>Veronica officinalis</i>	10	0	10	20	4.9	24.9
Orange hawkweed	<i>Hieracium aurantiacum</i>	10	0	10	20	4.5	24.5
Garlic mustard	<i>Alliaria petiolata</i>	5	0	10	15	9.4	24.4
Tall buttercup	<i>Ranunculus acris</i>	10	0	10	20	4.1	24.1
Japanese barberry	<i>Berberis thunbergii</i>	5	0	10	15	9	24.0
Wild parsnip	<i>Pastinaca sativa</i>	10	0	5	15	7.3	22.3
Marsh thistle	<i>Cirsium palustre</i>	5	0	10	15	6.77	21.8
White poplar	<i>Populus alba</i>	10	0	5	15	6.5	21.5
Erect hedge parsley	<i>Torilis japonica</i>	5	0	10	15	5.9	20.9
Smallflower hairy willow herb	<i>Epilobium parviflorum</i>	5	0	10	15	5.3	20.3
Common hempnettle	<i>Galeopsis tetrahit</i>	5	0	10	15	5.1	20.1
Spotted knapweed	<i>Centaurea stoebe</i> ssp. <i>micranthos</i>	10	0	1	11	9	20.0
Helleborine	<i>Epipactis helleborine</i>	10	0	5	15	4.97	20.0
Redtop	<i>Agrostis gigantea</i>	5	0	10	15	4.9	19.9
Common timothy	<i>Phleum pratense</i>	10	0	5	15	4.9	19.9
Red clover	<i>Trifolium pratense</i>	10	0	5	15	4.5	19.5
Thyme-leaf speedwell	<i>Veronica serpyllifolia</i>	5	0	10	15	4.5	19.5
Flannel plant, common mullein	<i>Verbascum thapsus</i>	10	0	5	15	4.37	19.4
Leafy spurge	<i>Euphorbia esula</i>	10	0	1	11	8.1	19.1
Scotch mist	<i>Galium sylvaticum</i>	10	0	5	15	4.1	19.1
Canada bluegrass	<i>Poa compressa</i>	10	0	5	15	4.1	19.1
Bitter dock, broadleaf dock	<i>Rumex obtusifolius</i>	5	0	10	15	4.1	19.1

Common Name	Scientific Name ITIS	Presence Score	Status Score	Habitat Score	Total Score	Species Score	Overall Score
Common mouse-ear chickweed	<i>Cerastium fontanum ssp. vulgare</i>	5	0	10	15	3.9	18.9
Annual bluegrass	<i>Poa annua</i>	10	0	5	15	3.57	18.6
Kentucky bluegrass	<i>Poa pratensis</i>	10	0	5	15	3.43	18.4
Dame's rocket	<i>Hesperis matronalis</i>	5	0	5	10	7.7	17.7
Multiflora rose	<i>Rosa multiflora</i>	5	0	5	10	7.3	17.3
Garden valerian, common valerian	<i>Valeriana officinalis</i>	5	0	5	10	7.3	17.3
Quackgrass	<i>Elymus repens</i>	5	0	5	10	5.7	15.7
Goldmoss stonecrop	<i>Sedum acre</i>	10	0	1	11	4.37	15.4
Queen Anne's lace	<i>Daucus carota</i>	5	0	5	10	5.1	15.1
Purple loosestrife	<i>Lythrum salicaria</i>	5	0	1	6	9.1	15.1
European cranberry-bush	<i>Viburnum opulus</i>	5	0	5	10	5.1	15.1
Black bindweed, wild buckwheat	<i>Fallopia convolvulus</i>	10	0	1	11	3.7	14.7
Wood bluegrass	<i>Poa nemoralis</i>	10	0	1	11	3.57	14.6
Soapwort, bouncing bet	<i>Saponaria officinalis</i>	5	0	5	10	4.5	14.5
Meadow fescue	<i>Schedonorus pratensis</i>	5	0	5	10	4.5	14.5
Jack-go-to-bed-at-noon	<i>Tragopogon pratensis</i>	5	0	5	10	4.3	14.3
Orchard grass	<i>Dactylis glomerata</i>	5	0	5	10	4.1	14.1
Spotted ladythumb, ladythumb	<i>Persicaria maculosa</i>	5	0	5	10	4.1	14.1
White campion	<i>Silene latifolia</i>	5	0	5	10	4.1	14.1
White sweet-clover	<i>Melilotus albus</i>	5	0	1	6	6.3	12.3
Wormseed wallflower	<i>Erysimum cheiranthoides</i>	5	0	1	6	4.9	10.9
Black medick	<i>Medicago lupulina</i>	5	0	1	6	4.5	10.5
Common St. John's wort	<i>Hypericum perforatum</i>	5	0	1	6	4.37	10.4
Butter and eggs	<i>Linaria vulgaris</i>	5	0	1	6	4.37	10.4
Yellow hawkweed	<i>Hieracium caespitosum</i>	5	0	1	6	4.1	10.1
Motherwort	<i>Leonurus cardiaca</i>	5	0	1	6	4.1	10.1
Norway spruce	<i>Picea abies</i>	5	0	1	6	4.1	10.1
Bladder campion	<i>Silene vulgaris</i>	5	0	1	6	4.1	10.1
Ox-eye daisy	<i>Leucanthemum vulgare</i>	5	0	1	6	3.97	10.0
Proso millet	<i>Panicum miliaceum</i>	5	0	1	6	3.9	9.9
Cat-nip	<i>Nepeta cataria</i>	5	0	1	6	3.57	9.6
Dandelion	<i>Taraxacum officinale</i>	5	0	1	6	3.57	9.6
Strawberry clover	<i>Trifolium fragiferum</i>	5	0	1	6	3.57	9.6

### *South Dock*

The south dock is an area with heavy anthropogenic disturbance and human-made structures. The dock is located in South Bay at the southeast (of the island and flanked by limestone cobble shore. It is backed by boreal forest and an extensive old camp.

### **Sensitive resources:**

**Identified vectors and pathways:** A prominent trail connects the south dock to the lighthouse and also branches into many other trails. Visitors may bring invasive species on their boat, clothing, and gear. One party was observed to be docking at this location when we arrived on July 26, 2021. The area's location along the shoreline also makes it vulnerable to shore invasion without human vectors.

**Invasive plant status:** This is a highly disturbed anthropogenic community. Priority 1 invasive species were mapped but a comprehensive plant list was not made for this area. Spotted knapweed was found only at this site. The area was included in the IPIEDPT to help guide management directives for this species. Many other non-native, Priority 3 species were observed here and at the nearby camp (Bassett et al. 2022).

The most likely new invaders of this area include six other Priority 1 species and four Priority 2 species that scored greater than 20 due to suitable habitat and/or proximity in adjacent areas/nearby islands (Table 16). Purple loosestrife was considered Priority 2 because it was not observed in 2021, however before the recent highwater years it was known from the south shore of St. Martin Island.

- Autumn olive
- Purple loosestrife
- Wild parsnip
- Reed canary grass
- Invasive common reed
- White sweet-clover
- White poplar
- Multiflora rose
- Erect hedge-parsley
- Narrow-leaved cat-tail



Table 16. IPIEDPT area-species link scores for the south dock 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
<b>Spotted knapweed</b>	<b><i>Centaurea stoebe</i> ssp. <i>micranthos</i></b>	10	1	10	21	9	30.0
Common reed	<i>Phragmites australis</i> ssp. <i>australis</i>	10	0	10	20	9.1	29.1
Narrow-leaved cat-tail	<i>Typha angustifolia</i>	10	0	10	20	9	29.0
Bush honeysuckle	<i>Lonicera</i> sp.	10	0	10	20	8.47	28.5
Leafy spurge	<i>Euphorbia esula</i>	10	0	10	20	8.1	28.1
Canada thistle	<i>Cirsium arvense</i>	10	0	10	20	7.57	27.6
Wild parsnip	<i>Pastinaca sativa</i>	10	0	10	20	7.3	27.3
Marsh thistle	<i>Cirsium palustre</i>	10	0	10	20	6.77	26.8
Bull thistle	<i>Cirsium vulgare</i>	10	0	10	20	6.77	26.8
Houndstongue	<i>Cynoglossum officinale</i>	10	0	10	20	6.77	26.8
Autumn-olive	<i>Elaeagnus umbellata</i>	10	0	10	20	6.1	26.1
Lesser burdock	<i>Arctium minus</i>	10	0	10	20	5.1	25.1
Common timothy	<i>Phleum pratense</i>	10	0	10	20	4.9	24.9
Bittersweet nightshade, woody nightshade	<i>Solanum dulcamara</i>	10	0	10	20	4.9	24.9
Red clover	<i>Trifolium pratense</i>	10	0	10	20	4.5	24.5
Goldmoss stonecrop	<i>Sedum acre</i>	10	0	10	20	4.37	24.4
Flannel plant, common mullein	<i>Verbascum thapsus</i>	10	0	10	20	4.37	24.4
Purple loosestrife	<i>Lythrum salicaria</i>	5	0	10	15	9.1	24.1
Reed canary grass	<i>Phalaris arundinacea</i>	10	0	5	15	9.07	24.1
Canada bluegrass	<i>Poa compressa</i>	10	0	10	20	4.1	24.1
Tall buttercup	<i>Ranunculus acris</i>	10	0	10	20	4.1	24.1
Annual bluegrass	<i>Poa annua</i>	10	0	10	20	3.57	23.6
Kentucky bluegrass	<i>Poa pratensis</i>	10	0	10	20	3.43	23.4
Multiflora rose	<i>Rosa multiflora</i>	5	0	10	15	7.3	22.3
Garden valerian, common valerian	<i>Valeriana officinalis</i>	5	0	10	15	7.3	22.3
White poplar	<i>Populus alba</i>	10	0	5	15	6.5	21.5
White sweet-clover	<i>Melilotus albus</i>	5	0	10	15	6.3	21.3
Erect hedge parsley	<i>Torilis japonica</i>	5	0	10	15	5.9	20.9
Quackgrass	<i>Elymus repens</i>	5	0	10	15	5.7	20.7
Smallflower hairy willow herb	<i>Epilobium parviflorum</i>	5	0	10	15	5.3	20.3
Queen Anne's lace	<i>Daucus carota</i>	5	0	10	15	5.1	20.1
Common hemnettle	<i>Galeopsis tetrahit</i>	5	0	10	15	5.1	20.1

Common Name	Scientific Name ITIS	Presence Score	Status Score	Habitat Score	Total Score	Species Score	Overall Score
European cranberry-bush	<i>Viburnum opulus</i>	5	0	10	15	5.1	20.1
Redtop	<i>Agrostis gigantea</i>	5	0	10	15	4.9	19.9
Wormseed wallflower	<i>Erysimum cheiranthoides</i>	5	0	10	15	4.9	19.9
Common gypsy-weed	<i>Veronica officinalis</i>	10	0	5	15	4.9	19.9
Orange hawkweed	<i>Hieracium aurantiacum</i>	5	0	10	15	4.5	19.5
Black medick	<i>Medicago lupulina</i>	5	0	10	15	4.5	19.5
Soapwort, bouncing bet	<i>Saponaria officinalis</i>	5	0	10	15	4.5	19.5
Meadow fescue	<i>Schedonorus pratensis</i>	5	0	10	15	4.5	19.5
Thyme-leaf speedwell	<i>Veronica serpyllifolia</i>	5	0	10	15	4.5	19.5
Garlic mustard	<i>Alliaria petiolata</i>	5	0	5	10	9.4	19.4
Common St. John's wort	<i>Hypericum perforatum</i>	5	0	10	15	4.37	19.4
Butter and eggs	<i>Linaria vulgaris</i>	5	0	10	15	4.37	19.4
Jack-go-to-bed-at-noon	<i>Tragopogon pratensis</i>	5	0	10	15	4.3	19.3
Orchard grass	<i>Dactylis glomerata</i>	5	0	10	15	4.1	19.1
Yellow hawkweed	<i>Hieracium caespitosum</i>	5	0	10	15	4.1	19.1
Spotted ladythumb, ladythumb	<i>Persicaria maculosa</i>	5	0	10	15	4.1	19.1
Bitter dock, broadleaf dock	<i>Rumex obtusifolius</i>	5	0	10	15	4.1	19.1
White campion	<i>Silene latifolia</i>	5	0	10	15	4.1	19.1
Bladder campion	<i>Silene vulgaris</i>	5	0	10	15	4.1	19.1
Japanese barberry	<i>Berberis thunbergii</i>	5	0	5	10	9	19.0
Ox-eye daisy	<i>Leucanthemum vulgare</i>	5	0	10	15	3.97	19.0
Common mouse-ear chickweed	<i>Cerastium fontanum</i> ssp. <i>vulgare</i>	5	0	10	15	3.9	18.9
Cat-nip	<i>Nepeta cataria</i>	5	0	10	15	3.57	18.6
Dandelion	<i>Taraxacum officinale</i>	5	0	10	15	3.57	18.6
Strawberry clover	<i>Trifolium fragiferum</i>	5	0	10	15	3.57	18.6
Helleborine	<i>Epipactis helleborine</i>	10	0	1	11	4.97	16.0
Scotch mist	<i>Galium sylvaticum</i>	10	0	1	11	4.1	15.1
Black bindweed, wild buckwheat	<i>Fallopia convolvulus</i>	10	0	1	11	3.7	14.7
Wood bluegrass	<i>Poa nemoralis</i>	10	0	1	11	3.57	14.6
Motherwort	<i>Leonurus cardiaca</i>	5	0	5	10	4.1	14.1
Norway spruce	<i>Picea abies</i>	5	0	5	10	4.1	14.1
Proso millet	<i>Panicum miliaceum</i>	5	0	5	10	3.9	13.9
Dame's rocket	<i>Hesperis matronalis</i>	5	0	1	6	7.7	13.7

### *Lighthouse*

The lighthouse area is composed of anthropogenic disturbance and human-made structures including remnants of a short railroad line and an old, unusable dock. The lighthouse and associated structures are found in a sparsely treed area in the northeast of the island adjacent to the limestone cobble shore EO (Figure 9).

The majority of this area is on land owned by LTBBOI (Figure 2) but considering its relationship and geographical proximity to federally owned lands on St. Martin Island, it was ranked and included in discussions. Any management actions on LTBBOI land should be made in accordance with the LTBBOI.

**Sensitive resources:** The lighthouse is adjacent to the limestone cobble shore, and near the boreal forest north and northern hardwood swamp EOs. [REDACTED]

**Identified vectors and pathways:** A prominent trail connects the lighthouse to the northeast dock and the rest of the island's road/trail network. Visitors may bring invasive species on their clothing/gear. The area's proximity to Lake Michigan makes it vulnerable to shore invaders.

**Invasive plant status:** This is a highly disturbed anthropogenic community. Priority 1 invasive species were mapped but a comprehensive plant list was not made for this area. Two Priority 1 invasive species were found at only this site and along the nearby trail. The area was included in the IPIEDPT to help guide management directives for those two species. Leafy spurge was observed at the lighthouse and along the trail leading to the north dock (Figure 9, Figure 10). A dense white poplar clone occupying roughly one third of an acre and visible from aerial imagery is located at the southeast corner of the lighthouse keeper's quarters. Many other non-native, Priority 3 species were observed but not recorded (Bassett et al. 2022).

The most likely new invaders of this area include seven other Priority 1 species and four Priority 2 species that scored greater than 20 due to suitable habitat and/or proximity in adjacent areas/nearby islands (Table 17):

- Spotted knapweed
- Autumn olive
- Bush honeysuckle
- Purple loosestrife
- White sweet-clover
- Wild parsnip
- Reed canary grass
- Invasive common reed
- Multiflora rose
- Erect hedge-parsley
- Narrow-leaved cat-tail

Table 17. IPIEDPT area-species link scores for the lighthouse area. Species with a non-zero “Status Score” were observed in the area during the 2021 surveys. 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
Leafy spurge	<i>Euphorbia esula</i>	10	5	10	25	8.1	33.1
White poplar	<i>Populus alba</i>	10	5	10	25	6.5	31.5
Common reed	<i>Phragmites australis</i> ssp. <i>australis</i>	10	0	10	20	9.1	29.1
Spotted knapweed	<i>Centaurea stoebe</i> ssp. <i>micranthos</i>	10	0	10	20	9	29.0
Narrow-leaved cat-tail	<i>Typha angustifolia</i>	10	0	10	20	9	29.0
Bush honeysuckle	<i>Lonicera</i> sp.	10	0	10	20	8.47	28.5
Canada thistle	<i>Cirsium arvense</i>	10	0	10	20	7.57	27.6
Wild parsnip	<i>Pastinaca sativa</i>	10	0	10	20	7.3	27.3
Marsh thistle	<i>Cirsium palustre</i>	10	0	10	20	6.77	26.8
Houndstongue	<i>Cynoglossum officinale</i>	10	0	10	20	6.77	26.8
Autumn-olive	<i>Elaeagnus umbellata</i>	10	0	10	20	6.1	26.1
Lesser burdock	<i>Arctium minus</i>	10	0	10	20	5.1	25.1
Common timothy	<i>Phleum pratense</i>	10	0	10	20	4.9	24.9
Bittersweet nightshade, woody nightshade	<i>Solanum dulcamara</i>	10	0	10	20	4.9	24.9
Orange hawkweed	<i>Hieracium aurantiacum</i>	10	0	10	20	4.5	24.5
Red clover	<i>Trifolium pratense</i>	10	0	10	20	4.5	24.5
Goldmoss stonecrop	<i>Sedum acre</i>	10	0	10	20	4.37	24.4
Flannel plant, common mullein	<i>Verbascum thapsus</i>	10	0	10	20	4.37	24.4
Purple loosestrife	<i>Lythrum salicaria</i>	5	0	10	15	9.1	24.1
Reed canary grass	<i>Phalaris arundinacea</i>	10	0	5	15	9.07	24.1
Canada bluegrass	<i>Poa compressa</i>	10	0	10	20	4.1	24.1
Tall buttercup	<i>Ranunculus acris</i>	10	0	10	20	4.1	24.1
Annual bluegrass	<i>Poa annua</i>	10	0	10	20	3.57	23.6
Wood bluegrass	<i>Poa nemoralis</i>	10	0	10	20	3.57	23.6
Dandelion	<i>Taraxacum officinale</i>	10	0	10	20	3.57	23.6
Kentucky bluegrass	<i>Poa pratensis</i>	10	0	10	20	3.43	23.4
Multiflora rose	<i>Rosa multiflora</i>	5	0	10	15	7.3	22.3
Garden valerian, common valerian	<i>Valeriana officinalis</i>	5	0	10	15	7.3	22.3
Bull thistle	<i>Cirsium vulgare</i>	5	0	10	15	6.77	21.8
White sweet-clover	<i>Melilotus albus</i>	5	0	10	15	6.3	21.3
Erect hedge parsley	<i>Torilis japonica</i>	5	0	10	15	5.9	20.9
Quackgrass	<i>Elymus repens</i>	5	0	10	15	5.7	20.7



Common Name	Scientific Name ITIS	Presence Score	Status Score	Habitat Score	Total Score	Species Score	Overall Score
Smallflower hairy willow herb	<i>Epilobium parviflorum</i>	5	0	10	15	5.3	20.3
Queen Anne's lace	<i>Daucus carota</i>	5	0	10	15	5.1	20.1
Common hempnettle	<i>Galeopsis tetrahit</i>	5	0	10	15	5.1	20.1
European cranberry-bush	<i>Viburnum opulus</i>	5	0	10	15	5.1	20.1
Redtop	<i>Agrostis gigantea</i>	5	0	10	15	4.9	19.9
Wormseed wallflower	<i>Erysimum cheiranthoides</i>	5	0	10	15	4.9	19.9
Black medick	<i>Medicago lupulina</i>	5	0	10	15	4.5	19.5
Soapwort, bouncing bet	<i>Saponaria officinalis</i>	5	0	10	15	4.5	19.5
Meadow fescue	<i>Schedonorus pratensis</i>	5	0	10	15	4.5	19.5
Thyme-leaf speedwell	<i>Veronica serpyllifolia</i>	5	0	10	15	4.5	19.5
Garlic mustard	<i>Alliaria petiolata</i>	5	0	5	10	9.4	19.4
Common St. John's wort	<i>Hypericum perforatum</i>	5	0	10	15	4.37	19.4
Butter and eggs	<i>Linaria vulgaris</i>	5	0	10	15	4.37	19.4
Jack-go-to-bed-at-noon	<i>Tragopogon pratensis</i>	5	0	10	15	4.3	19.3
Orchard grass	<i>Dactylis glomerata</i>	5	0	10	15	4.1	19.1
Yellow hawkweed	<i>Hieracium caespitosum</i>	5	0	10	15	4.1	19.1
Spotted ladythumb, ladythumb	<i>Persicaria maculosa</i>	5	0	10	15	4.1	19.1
Bitter dock, broadleaf dock	<i>Rumex obtusifolius</i>	5	0	10	15	4.1	19.1
White campion	<i>Silene latifolia</i>	5	0	10	15	4.1	19.1
Bladder campion	<i>Silene vulgaris</i>	5	0	10	15	4.1	19.1
Japanese barberry	<i>Berberis thunbergii</i>	5	0	5	10	9	19.0
Ox-eye daisy	<i>Leucanthemum vulgare</i>	5	0	10	15	3.97	19.0
Common mouse-ear chickweed	<i>Cerastium fontanum</i> ssp. <i>vulgare</i>	5	0	10	15	3.9	18.9
Black bindweed, wild buckwheat	<i>Fallopia convolvulus</i>	10	0	5	15	3.7	18.7
Cat-nip	<i>Nepeta cataria</i>	5	0	10	15	3.57	18.6
Strawberry clover	<i>Trifolium fragiferum</i>	5	0	10	15	3.57	18.6
Helleborine	<i>Epipactis helleborine</i>	10	0	1	11	4.97	16.0
Scotch mist	<i>Galium sylvaticum</i>	10	0	1	11	4.1	15.1
Common gypsy-weed	<i>Veronica officinalis</i>	5	0	5	10	4.9	14.9
Motherwort	<i>Leonurus cardiaca</i>	5	0	5	10	4.1	14.1
Norway spruce	<i>Picea abies</i>	5	0	5	10	4.1	14.1
Proso millet	<i>Panicum miliaceum</i>	5	0	5	10	3.9	13.9
Dame's rocket	<i>Hesperis matronalis</i>	5	0	1	6	7.7	13.7

### ***Disturbed Forest***

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 9).

**Identified vectors and pathways:** Occasional visitors may travel along several old roads and trails that run through the area, the largest of which are from the south dock to the lighthouse. These trails support a high proportion of the current invasive plant species, and their ease of access promotes the transport of new species via animals (e.g., human, deer) across the island.

**Invasive plant status:** As a highly disturbed anthropogenic community, Priority 1 invasive species were mapped (Figure 9), but a comprehensive plant list was not made. Mapped invasive species included (Bassett et al. 2022):

- Canada thistle
- Marsh thistle
- Bull thistle
- Houndstongue
- Morrow's honeysuckle (*Lonicera morrowii*)
- Tartarian honeysuckle

## 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.

### ***Invasive Plant Management Objectives***

- Elimination of 3 of 9 Priority 1 species within five years
- Elimination of 6 of 9 Priority 1 species within ten years
- Eradication of 5 of 9 Priority 1 species within fifteen 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 100 m of extant dwarf lake iris and ram's head lady-slipper EOs within fifteen years
- Reduce 25% of bittersweet nightshade population within 100 m of climbing fumitory EOs within fifteen years

### ***Management Strategies and Activities***

#### Ongoing actions

- Regular *monitoring* of shoreline communities for new occurrences of invasives plant species, especially the southern limestone cobble shore that borders dwarf lake iris and ram's head lady-slipper EOs.
- Set management threshold and continue development on "Nuisance Deer Control Plan" for deer population on island (Salas et al. 2017). *Monitor* population regularly and initiate management efforts when approaching threshold.

#### Actions to be initiated within five years

- *Elimination* of wild parsnip in boreal forest south. Declare eradication after monitoring efforts fail to find species span five years.
- *Elimination* of autumn olive and bush honeysuckle from mesic northern forest and disturbed forest. Declare eradication after monitoring efforts fail to find species span five years.
- *Elimination* of reed canary grass, narrow-leaved cat-tail, and invasive common reed from northern hardwood swamp. The infestations are located on property owned by LTBBOI, but action is needed to protect surrounding communities on federal land. Any management actions in the areas on LTBBOI land should made in accordance with the LTBBOI. Declare eradication after monitoring efforts fail to find species span ten years.
- *Elimination* of spotted knapweed near south dock. Declare eradication after monitoring efforts fail to find species span ten years.
- *Perimeter control to elimination* of leafy spurge near lighthouse. The infestations are located on property owned by LTBBOI, but action is needed to protect surrounding communities on federal land. Any management actions in the areas on LTBBOI land should made in accordance with the LTBBOI. Declare eradication after monitoring efforts fail to find species span ten years.

- *Sustained control* of wood bluegrass within 100 m of Laurentian fragile fern, rock whitlow-grass, and ashy whitlow-grass EOs in limestone cliff and limestone lakeshore cliff.

Actions to be initiated within ten years

- *Elimination* of white poplar near lighthouse. The infestations are located on property owned by LTBBOI, but action is needed to protect surrounding communities on federal land. Any management actions in the areas on LTBBOI land should be made in accordance with the LTBBOI. Declare eradication after monitoring efforts fail to find species span five years.
- *Sustained control* of houndstongue, thistle, helleborine, and bittersweet nightshade within 100 m of dwarf lake iris and ram's head lady-slipper EOs in boreal forest south.
- *Sustained control* of bittersweet nightshade within 100 m of climbing fumitory EOs in boreal forest north, and limestone cobble shore.
- *Sustained control* of bittersweet nightshade within 100 m of limestone cliff EO.

### **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 3) 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 19).

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 19, 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”.

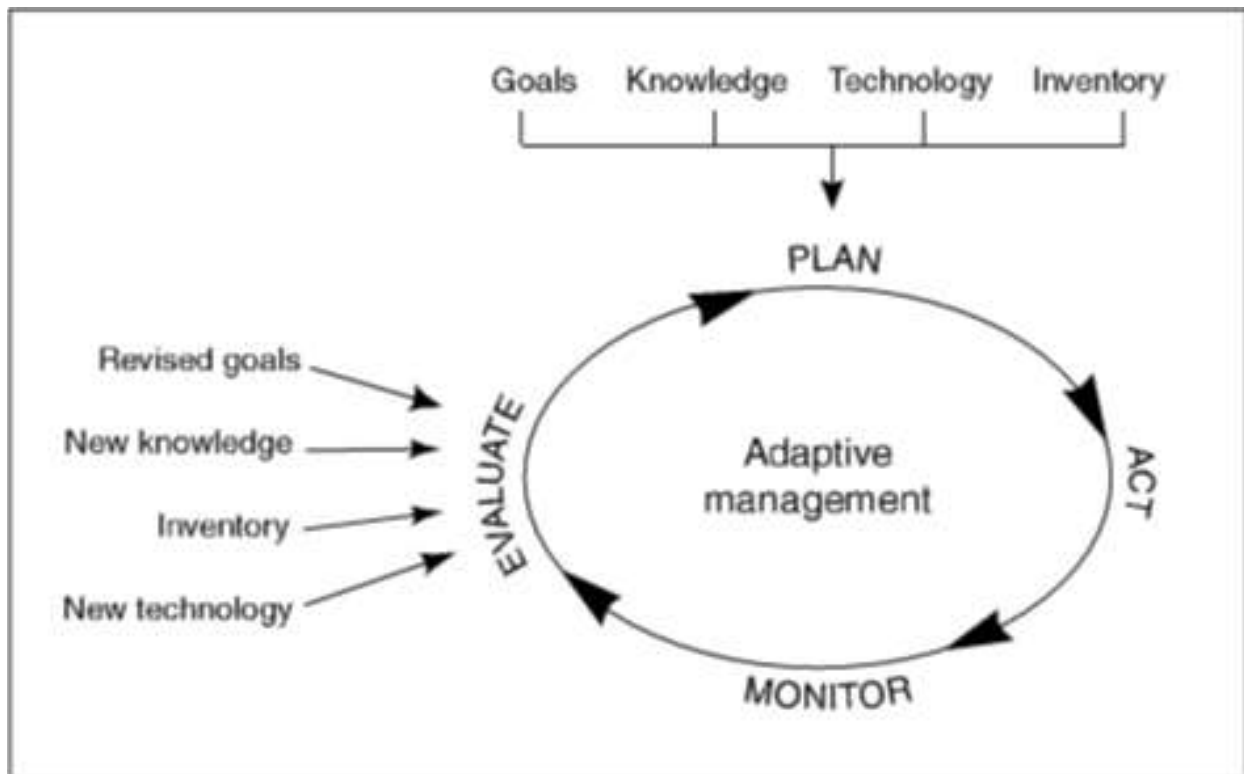


Figure 19. The adaptive management cycle. Figure reproduced from USDA USDI (1994) and Lowell et al. (2014).

### *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 18. When any island visit is planned, the top three 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 18. 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 on St. Martin Island is listed below each monitoring effort. Day(s) is abbreviated “d”.

Monitoring Task	Monitoring Effort				
	Minimal (1 d)	Low (1 – 2 d)	Medium (3 d)	High (4 d)	Highest (5 – 7 d)
Treatment efficacy photo points	X	X	X	X	X
Invasive species survey on southern shoreline	X	X	X	X	X
Rare species occurrences of dwarf lake iris, ram's head lady-slipper and Laurentian fragile fern	X	X	X	X	X
Invasive species survey on perimeter of island, south dock area, and lighthouse area <sup>3</sup> , including main trail between south dock and lighthouse		X	X	X	X
Rare species occurrences of climbing fumitory, rock whitlow-grass, ashy whitlow-grass		X	X	X	X
Invasive species in limestone cobble shore, limestone cliff, limestone lakeshore cliff			X	X	X
Invasive species survey in mesic northern forest EO			X	X	X
Invasive species survey in northern hardwood swamp <sup>3</sup>				X	X
Invasive species survey in boreal forest				X	X
Rare species survey for new occurrences in limestone cobble shore, limestone cliff, limestone lakeshore cliff				X	X
Invasive species survey in all island communities <sup>3</sup>					X
Rare species survey for new occurrences in mesic northern forest EO					X
Rare species survey for new occurrences in boreal forest					X
Rare species survey in all island communities <sup>3</sup>					X

A monitoring schedule including desired effort should be planned and budgeted (Table 19). This schedule should be flexible to adapt the IPMP based evaluation of new data acquired after treatment and/or monitoring (Figure 19). 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 19).

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<sup>3</sup> With permission from LTBOI as they own property in the northeast including the lighthouse area and northern hardwood swamp

Table 19. 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 low 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.

Year	Example Schedule of Monitoring Effort					
	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. Working with AGOL feature layers is described in Appendix 2.

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 accounts 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. Metadata 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	<a href="mailto:hackett5@msu.edu">hackett5@msu.edu</a>	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	<i>Pinguicula vulgaris</i>	
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, Arctostaphylos 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 Related Data 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 <sup>4</sup>	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 <i>existing</i> 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 <i>existing</i> 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 <i>existing</i> photo point	Photo Point Survey / Obs_Event	Date, Take/Attach photo

<sup>4</sup> 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 the USFWS 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 offline
  - 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. Select “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 want, 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 offline
- 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 of interest
  - 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 on the right. If there is not a dot in the center of the target, your device’s location may not be on or you may not be within the map extent
    - 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 uncertainty 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. Open ArcGIS Collector App on your device
  - b. On the home page, select the Group with the Map with the record feature of interest
  - c. You should see all the Maps you downloaded in a list
  - d. Tap on the Map with the record feature of interest
  - e. Zoom into the record feature of interest on the map
  - f. Tap on the feature record of interest
  - g. Several feature records may be listed, select the one you wish to edit



- i. To edit
  1. Tap the pencil icon at the bottom of the screen to edit the feature
  2. Edit the fields need
- ii. To add new data (e.g., revisit data):
  1. Scroll down the record to the section marked “Related”
  2. Tap the chain link to add an observation or other linked table (e.g., Table – Plant Monitoring, Table – Obs\_Event)
  3. Tap the blue “Add” button
  4. Add new data to fields
- 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. 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
  - c. On the home page, select the Group with the Map you wish to sync
  - d. Tap the three dot menu to the right of the map you wish to sync
  - e. Select “Sync”
  - f. Under the map name, the most recent “Sync” date will be listed
  - g. 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
  - c. On the home page, select the Group with the Map that has the features you wish to delete
  - d. Select the map with the feature record you need to delete
  - e. Tap and select the feature
  - f. Search for a “Record Status” or similar field
    - i. If feature has such a field, select “Delete record” from list of options
  - g. If feature does not have such a field, add a “Delete record” note to the “Comment” field
  - h. 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, Horicon NWR Complex, and Lake-2-Lake CISMA, 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
<b>St. Martin</b>	<b>Limestone cliff</b>	<b>24350</b>	<b>B</b>	<b>1.8</b>	<b>1.2</b>	<b>1.8</b>	<b>4.8</b>	<b>9.25</b>
<b>St. Martin</b>	<b>Limestone lakeshore cliff</b>	<b>24348</b>	<b>A</b>	<b>1.8</b>	<b>1.2</b>	<b>1.8</b>	<b>4.8</b>	<b>10</b>
<b>St. Martin</b>	<b>Limestone cobble shore<sup>1</sup></b>	<b>24353</b>	<b>B</b>	<b>1.7</b>	<b>1.2</b>	<b>1.8</b>	<b>4.7</b>	<b>9.25</b>
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
<b>St. Martin</b>	<b>Mesic northern forest</b>	<b>24349</b>	<b>BC</b>	<b>2.7</b>	<b>0.9</b>	<b>0.5</b>	<b>4.1</b>	<b>9</b>
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	---
<b>St. Martin</b>	<b>Lighthouse<sup>2</sup></b>	---	---	<b>1.1</b>	<b>1.8</b>	<b>0.3</b>	<b>3.2</b>	---
<b>St. Martin</b>	<b>South dock</b>	---	---	<b>1.1</b>	<b>1.8</b>	<b>0.3</b>	<b>3.2</b>	---
<b>St. Martin</b>	<b>Northern hardwood swamp<sup>2</sup></b>	<b>24352</b>	<b>C</b>	<b>1.3</b>	<b>0.9</b>	<b>0.9</b>	<b>3.1</b>	<b>8.5</b>
Plum	Disturbed boreal forest	---	---	1.1	1.5	0.3	2.9	---
<b>St. Martin</b>	<b>Boreal forest north<sup>1</sup></b>	<b>24351</b>	<b>B</b>	<b>1.3</b>	<b>0.9</b>	<b>0.5</b>	<b>2.7</b>	<b>8.5</b>
<b>St. Martin</b>	<b>Boreal forest south</b>	<b>24351</b>	<b>B</b>	<b>1.3</b>	<b>0.9</b>	<b>0.5</b>	<b>2.7</b>	<b>8.5</b>
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
<i>Agrostis gigantea</i>	redtop, black bent, water bentgrass	40414	AGGI2	0.6	4	0.3	0	4.9
<i>Alliaria petiolata</i>	garlic mustard, garlic-mustard	184481	ALPE4	1.4	4	3	1	9.4
<i>Arctium minus</i>	lesser burdock, burdock, burdock, small burdock, smaller burdock, bardane, beggar's button, common burdock, wild burdock, wild rhubarb	36546	ARM12	0.2	4	0.9	0	5.1
<i>Berberis thunbergii</i>	Japanese barberry	18835	BETH	1.4	3.6	3	1	9
<i>Centaurea stoebe</i> ssp. <i>micranthos</i>	spotted knapweed	780711	CEST8	1.4	3.6	3	1	9
<i>Cerastium fontanum</i> ssp. <i>vulgare</i>	common mouse-ear chickweed, big chickweed, mouseear chickweed	523831	CEFOV2	0	3.6	0.3	0	3.9
<i>Cirsium arvense</i>	Canada thistle, Canadian thistle, Californian thistle, creeping thistle, field thistle	36335	CIAR4	1.4	3.07	2.1	1	7.57
<i>Cirsium palustre</i>	marsh thistle	36394	CIPA6	0.6	3.07	2.1	1	6.77
<i>Cirsium vulgare</i>	bull thistle, common thistle, spear thistle	36428	CIVU	0.6	3.07	2.1	1	6.77
<i>Cynoglossum officinale</i>	houndstongue, gypsy-flower, common houndstongue, hound's tongue, gypsyflower	31890	CYOF	0.6	3.07	2.1	1	6.77
<i>Dactylis glomerata</i>	cocksfoot, orchardgrass, orchard grass	193446	DAGL	0.2	3.6	0.3	0	4.1
<i>Daucus carota</i>	bird's nest, wild carrot, Queen Anne's lace	29477	DACA6	0.2	3.6	0.3	1	5.1
<i>Elaeagnus umbellata</i>	oleaster, autumn olive, autumn-olive	27776	ELUM	0.2	4	0.9	1	6.1
<i>Elymus repens</i>	quackgrass	512839	ELRE4	1.4	4	0.3	0	5.7
<i>Epilobium parviflorum</i>	Smallflower hairy willow herb	27321	EPPA5	1	4	0.3	0	5.3
<i>Epipactis helleborine</i>	broadleaf helleborine, helleborine	43482	EPHE	0.6	3.07	0.3	1	4.97
<i>Erysimum cheiranthoides</i>	Wormseed wallflower	22933	ERCH9	1	3.6	0.3	0	4.9
<i>Euphorbia esula</i>	spurge, wolf's milk, wolf's-milk, leafy spurge	28064	EUES	1.4	3.6	2.1	1	8.1
<i>Fallopia convolvulus</i>	black bindweed, wild buckwheat	513511	POCO10	0.2	3.2	0.3	0	3.7
<i>Galeopsis tetrahit</i>	bristliestem hempnettle, brittle-stem hemp-nettle, common hempnettle	32499	GATE2	0.2	3.6	0.3	1	5.1
<i>Galium sylvaticum</i>	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
<i>Hesperis matronalis</i>	dame's rocket, dames violet, mother-of-the-evening, dames rocket, damesrocket	23138	HEMA3	0.6	4	2.1	1	7.7
<i>Hieracium aurantiacum</i>	orange hawkweed	37697	HIAU	0.6	3.6	0.3	0	4.5
<i>Hieracium caespitosum</i>	meadow hawkweed, yellow hawkweed	503009	HICA10	0.2	3.6	0.3	0	4.1
<i>Hypericum perforatum</i>	St. John's wort, common St. John's wort, Klamath weed, St. Johnswort, common St. Johnswort	21454	HYPE	1.4	2.67	0.3	0	4.37
<i>Leonurus cardiaca</i>	Motherwort	32548	LECA2	0.2	3.6	0.3	0	4.1
<i>Leucanthemum vulgare</i>	oxeye daisy, oxeye-daisy, oxeyedaisy, ox-eye daisy	37903	LEVU	0.6	3.07	0.3	0	3.97
<i>Linaria vulgaris</i>	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
<i>Lonicera</i> sp.	bush honeysuckle	35286	LONIC	1.4	3.07	3	1	8.47
<i>Lythrum salicaria</i>	purple lythrum, rainbow weed, spiked loosetrife, purple loosestrife	27079	LYSA2	2	4	2.1	1	9.1
<i>Medicago lupulina</i>	black medick, black medic clover, black medic, hop clover, hop medic, nonesuch, yellow trefoil	503721	MELU	0.2	4	0.3	0	4.5
<i>Melilotus albus</i>	Bokhara-clover, honey-clover, white melilot, white sweet-clover	516979	MEALA2	0.2	4	2.1	0	6.3
<i>Nepeta cataria</i>	Cat-nip	32623	NECA2	0.2	3.07	0.3	0	3.57
<i>Panicum miliaceum</i>	Proso millet	792496	PAMI2	0	3.6	0.3	0	3.9
<i>Pastinaca sativa</i>	wild parsnip	29795	PASA2	0.2	4	2.1	1	7.3
<i>Persicaria maculosa</i>	spotted ladythumb, ladythumb	823821	POPE3	0.2	3.6	0.3	0	4.1
<i>Phalaris arundinacea</i>	reed canary grass, reed canarygrass	41335	PHAR3	2	3.07	3	1	9.07
<i>Phleum pratense</i>	common timothy, timothy	41062	PHPR3	1	3.6	0.3	0	4.9
<i>Phragmites australis</i> ssp. <i>australis</i>	common reed	41072	PHAU7	2	4	2.1	1	9.1
<i>Picea abies</i>	Norway spruce	183289	PIAB	0.2	3.6	0.3	0	4.1
<i>Poa annua</i>	annual blue grass, walkgrass, annual bluegrass	41107	POAN	0.2	3.07	0.3	0	3.57
<i>Poa compressa</i>	Canada bluegrass, flat-stem blue grass	41082	POCO	1	2.8	0.3	0	4.1
<i>Poa nemoralis</i>	Wood bluegrass	41146	PONE	0.2	3.07	0.3	0	3.57

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

Table 3-3. IPIEDPT area-species link scores for St. Martin Island, sorted by species. Table 9 to Table 17 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.

areaID	speciesID	Area	Scientific Name ITIS	Presence Score	Status Score	Habitat Score	Total Score	Species Score	Overall Score
86	1	Boreal forest south	<i>Agrostis gigantea</i>	5	0	10	15	4.9	19.9
87	1	Boreal forest north <sup>1</sup>	<i>Agrostis gigantea</i>	5	0	10	15	4.9	19.9
88	1	Limestone cliff	<i>Agrostis gigantea</i>	5	0	5	10	4.9	14.9
89	1	Limestone cobble shore <sup>1</sup>	<i>Agrostis gigantea</i>	5	0	10	15	4.9	19.9
90	1	Limestone lakeshore cliff	<i>Agrostis gigantea</i>	5	0	10	15	4.9	19.9
91	1	Mesic northern forest	<i>Agrostis gigantea</i>	5	0	10	15	4.9	19.9
92	1	Northern hardwood swamp <sup>2</sup>	<i>Agrostis gigantea</i>	5	0	10	15	4.9	19.9
93	1	South dock	<i>Agrostis gigantea</i>	5	0	10	15	4.9	19.9
94	1	Lighthouse <sup>2</sup>	<i>Agrostis gigantea</i>	5	0	10	15	4.9	19.9
86	65	Boreal forest south	<i>Alliaria petiolata</i>	5	0	10	15	9.4	24.4
87	65	Boreal forest north <sup>1</sup>	<i>Alliaria petiolata</i>	5	0	10	15	9.4	24.4
88	65	Limestone cliff	<i>Alliaria petiolata</i>	5	0	0	5	9.4	14.4
89	65	Limestone cobble shore <sup>1</sup>	<i>Alliaria petiolata</i>	5	0	0	5	9.4	14.4
90	65	Limestone lakeshore cliff	<i>Alliaria petiolata</i>	5	0	0	5	9.4	14.4
91	65	Mesic northern forest	<i>Alliaria petiolata</i>	5	0	10	15	9.4	24.4
92	65	Northern hardwood swamp <sup>2</sup>	<i>Alliaria petiolata</i>	5	0	10	15	9.4	24.4
93	65	South dock	<i>Alliaria petiolata</i>	5	0	5	10	9.4	19.4
94	65	Lighthouse <sup>2</sup>	<i>Alliaria petiolata</i>	5	0	5	10	9.4	19.4
86	2	Boreal forest south	<i>Arctium minus</i>	10	0	10	20	5.1	25.1
87	2	Boreal forest north <sup>1</sup>	<i>Arctium minus</i>	10	0	10	20	5.1	25.1
88	2	Limestone cliff	<i>Arctium minus</i>	10	0	10	20	5.1	25.1
89	2	Limestone cobble shore <sup>1</sup>	<i>Arctium minus</i>	10	0	10	20	5.1	25.1
90	2	Limestone lakeshore cliff	<i>Arctium minus</i>	10	0	10	20	5.1	25.1
91	2	Mesic northern forest	<i>Arctium minus</i>	10	5	10	25	5.1	30.1
92	2	Northern hardwood swamp <sup>2</sup>	<i>Arctium minus</i>	10	0	10	20	5.1	25.1
93	2	South dock	<i>Arctium minus</i>	10	0	10	20	5.1	25.1
94	2	Lighthouse <sup>2</sup>	<i>Arctium minus</i>	10	0	10	20	5.1	25.1
86	3	Boreal forest south	<i>Berberis thunbergii</i>	5	0	10	15	9	24.0
87	3	Boreal forest north <sup>1</sup>	<i>Berberis thunbergii</i>	5	0	10	15	9	24.0
88	3	Limestone cliff	<i>Berberis thunbergii</i>	5	0	1	6	9	15.0
89	3	Limestone cobble shore <sup>1</sup>	<i>Berberis thunbergii</i>	5	0	1	6	9	15.0
90	3	Limestone lakeshore cliff	<i>Berberis thunbergii</i>	5	0	1	6	9	15.0
91	3	Mesic northern forest	<i>Berberis thunbergii</i>	5	0	10	15	9	24.0
92	3	Northern hardwood swamp <sup>2</sup>	<i>Berberis thunbergii</i>	5	0	10	15	9	24.0

areaID	speciesID	Area	Scientific Name ITIS	Presence Score	Status Score	Habitat Score	Total Score	Species Score	Overall Score
93	3	South dock	<i>Berberis thunbergii</i>	5	0	5	10	9	19.0
94	3	Lighthouse <sup>2</sup>	<i>Berberis thunbergii</i>	5	0	5	10	9	19.0
86	4	Boreal forest south	<i>Centaurea stoebe</i> ssp. <i>micranthos</i>	10	0	1	11	9	20.0
87	4	Boreal forest north <sup>1</sup>	<i>Centaurea stoebe</i> ssp. <i>micranthos</i>	10	0	1	11	9	20.0
88	4	Limestone cliff	<i>Centaurea stoebe</i> ssp. <i>micranthos</i>	10	0	1	11	9	20.0
89	4	Limestone cobble shore <sup>1</sup>	<i>Centaurea stoebe</i> ssp. <i>micranthos</i>	10	0	10	20	9	29.0
90	4	Limestone lakeshore cliff	<i>Centaurea stoebe</i> ssp. <i>micranthos</i>	10	0	10	20	9	29.0
91	4	Mesic northern forest	<i>Centaurea stoebe</i> ssp. <i>micranthos</i>	10	0	1	11	9	20.0
92	4	Northern hardwood swamp <sup>2</sup>	<i>Centaurea stoebe</i> ssp. <i>micranthos</i>	10	0	1	11	9	20.0
93	4	South dock	<i>Centaurea stoebe</i> ssp. <i>micranthos</i>	10	1	10	21	9	30.0
94	4	Lighthouse <sup>2</sup>	<i>Centaurea stoebe</i> ssp. <i>micranthos</i>	10	0	10	20	9	29.0
86	5	Boreal forest south	<i>Cerastium fontanum</i> ssp. <i>vulgare</i>	5	0	10	15	3.9	18.9
87	5	Boreal forest north <sup>1</sup>	<i>Cerastium fontanum</i> ssp. <i>vulgare</i>	5	0	10	15	3.9	18.9
88	5	Limestone cliff	<i>Cerastium fontanum</i> ssp. <i>vulgare</i>	5	0	10	15	3.9	18.9
89	5	Limestone cobble shore <sup>1</sup>	<i>Cerastium fontanum</i> ssp. <i>vulgare</i>	5	0	10	15	3.9	18.9
90	5	Limestone lakeshore cliff	<i>Cerastium fontanum</i> ssp. <i>vulgare</i>	5	0	10	15	3.9	18.9
91	5	Mesic northern forest	<i>Cerastium fontanum</i> ssp. <i>vulgare</i>	5	0	10	15	3.9	18.9
92	5	Northern hardwood swamp <sup>2</sup>	<i>Cerastium fontanum</i> ssp. <i>vulgare</i>	5	0	10	15	3.9	18.9
93	5	South dock	<i>Cerastium fontanum</i> ssp. <i>vulgare</i>	5	0	10	15	3.9	18.9
94	5	Lighthouse <sup>2</sup>	<i>Cerastium fontanum</i> ssp. <i>vulgare</i>	5	0	10	15	3.9	18.9
86	6	Boreal forest south	<i>Cirsium arvense</i>	10	0	10	20	7.57	27.6
87	6	Boreal forest north <sup>1</sup>	<i>Cirsium arvense</i>	10	10	10	30	7.57	37.6
88	6	Limestone cliff	<i>Cirsium arvense</i>	10	0	10	20	7.57	27.6
89	6	Limestone cobble shore <sup>1</sup>	<i>Cirsium arvense</i>	10	0	10	20	7.57	27.6
90	6	Limestone lakeshore cliff	<i>Cirsium arvense</i>	10	0	10	20	7.57	27.6
91	6	Mesic northern forest	<i>Cirsium arvense</i>	10	5	10	25	7.57	32.6
92	6	Northern hardwood swamp <sup>2</sup>	<i>Cirsium arvense</i>	10	0	10	20	7.57	27.6
93	6	South dock	<i>Cirsium arvense</i>	10	0	10	20	7.57	27.6
94	6	Lighthouse <sup>2</sup>	<i>Cirsium arvense</i>	10	0	10	20	7.57	27.6
86	7	Boreal forest south	<i>Cirsium palustre</i>	10	7	10	27	6.77	33.8



areaID	speciesID	Area	Scientific Name ITIS	Presence Score	Status Score	Habitat Score	Total Score	Species Score	Overall Score
87	7	Boreal forest north <sup>1</sup>	<i>Cirsium palustre</i>	10	0	10	20	6.77	26.8
88	7	Limestone cliff	<i>Cirsium palustre</i>	10	0	10	20	6.77	26.8
89	7	Limestone cobble shore <sup>1</sup>	<i>Cirsium palustre</i>	10	0	10	20	6.77	26.8
90	7	Limestone lakeshore cliff	<i>Cirsium palustre</i>	10	0	10	20	6.77	26.8
91	7	Mesic northern forest	<i>Cirsium palustre</i>	10	7	10	27	6.77	33.8
92	7	Northern hardwood swamp <sup>2</sup>	<i>Cirsium palustre</i>	5	0	10	15	6.77	21.8
93	7	South dock	<i>Cirsium palustre</i>	10	0	10	20	6.77	26.8
94	7	Lighthouse <sup>2</sup>	<i>Cirsium palustre</i>	10	0	10	20	6.77	26.8
86	8	Boreal forest south	<i>Cirsium vulgare</i>	5	0	10	15	6.77	21.8
87	8	Boreal forest north <sup>1</sup>	<i>Cirsium vulgare</i>	10	0	10	20	6.77	26.8
88	8	Limestone cliff	<i>Cirsium vulgare</i>	10	0	10	20	6.77	26.8
89	8	Limestone cobble shore <sup>1</sup>	<i>Cirsium vulgare</i>	10	0	10	20	6.77	26.8
90	8	Limestone lakeshore cliff	<i>Cirsium vulgare</i>	10	0	10	20	6.77	26.8
91	8	Mesic northern forest	<i>Cirsium vulgare</i>	10	7	10	27	6.77	33.8
92	8	Northern hardwood swamp <sup>2</sup>	<i>Cirsium vulgare</i>	10	0	10	20	6.77	26.8
93	8	South dock	<i>Cirsium vulgare</i>	10	0	10	20	6.77	26.8
94	8	Lighthouse <sup>2</sup>	<i>Cirsium vulgare</i>	5	0	10	15	6.77	21.8
86	9	Boreal forest south	<i>Cynoglossum officinale</i>	10	10	10	30	6.77	36.8
87	9	Boreal forest north <sup>1</sup>	<i>Cynoglossum officinale</i>	10	5	10	25	6.77	31.8
88	9	Limestone cliff	<i>Cynoglossum officinale</i>	10	0	10	20	6.77	26.8
89	9	Limestone cobble shore <sup>1</sup>	<i>Cynoglossum officinale</i>	10	0	10	20	6.77	26.8
90	9	Limestone lakeshore cliff	<i>Cynoglossum officinale</i>	10	0	10	20	6.77	26.8
91	9	Mesic northern forest	<i>Cynoglossum officinale</i>	10	5	10	25	6.77	31.8
92	9	Northern hardwood swamp <sup>2</sup>	<i>Cynoglossum officinale</i>	10	0	10	20	6.77	26.8
93	9	South dock	<i>Cynoglossum officinale</i>	10	0	10	20	6.77	26.8
94	9	Lighthouse <sup>2</sup>	<i>Cynoglossum officinale</i>	10	0	10	20	6.77	26.8
86	10	Boreal forest south	<i>Dactylis glomerata</i>	5	0	5	10	4.1	14.1
87	10	Boreal forest north <sup>1</sup>	<i>Dactylis glomerata</i>	5	0	5	10	4.1	14.1
88	10	Limestone cliff	<i>Dactylis glomerata</i>	5	0	5	10	4.1	14.1
89	10	Limestone cobble shore <sup>1</sup>	<i>Dactylis glomerata</i>	5	0	5	10	4.1	14.1
90	10	Limestone lakeshore cliff	<i>Dactylis glomerata</i>	5	0	5	10	4.1	14.1
91	10	Mesic northern forest	<i>Dactylis glomerata</i>	5	0	5	10	4.1	14.1
92	10	Northern hardwood swamp <sup>2</sup>	<i>Dactylis glomerata</i>	5	0	5	10	4.1	14.1
93	10	South dock	<i>Dactylis glomerata</i>	5	0	10	15	4.1	19.1
94	10	Lighthouse <sup>2</sup>	<i>Dactylis glomerata</i>	5	0	10	15	4.1	19.1
86	11	Boreal forest south	<i>Daucus carota</i>	5	0	5	10	5.1	15.1
87	11	Boreal forest north <sup>1</sup>	<i>Daucus carota</i>	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
88	11	Limestone cliff	<i>Daucus carota</i>	5	0	5	10	5.1	15.1
89	11	Limestone cobble shore <sup>1</sup>	<i>Daucus carota</i>	5	0	5	10	5.1	15.1
90	11	Limestone lakeshore cliff	<i>Daucus carota</i>	5	0	5	10	5.1	15.1
91	11	Mesic northern forest	<i>Daucus carota</i>	5	0	5	10	5.1	15.1
92	11	Northern hardwood swamp <sup>2</sup>	<i>Daucus carota</i>	5	0	5	10	5.1	15.1
93	11	South dock	<i>Daucus carota</i>	5	0	10	15	5.1	20.1
94	11	Lighthouse <sup>2</sup>	<i>Daucus carota</i>	5	0	10	15	5.1	20.1
86	12	Boreal forest south	<i>Elaeagnus umbellata</i>	10	0	10	20	6.1	26.1
87	12	Boreal forest north <sup>1</sup>	<i>Elaeagnus umbellata</i>	10	0	10	20	6.1	26.1
88	12	Limestone cliff	<i>Elaeagnus umbellata</i>	10	0	10	20	6.1	26.1
89	12	Limestone cobble shore <sup>1</sup>	<i>Elaeagnus umbellata</i>	10	0	10	20	6.1	26.1
90	12	Limestone lakeshore cliff	<i>Elaeagnus umbellata</i>	10	0	10	20	6.1	26.1
91	12	Mesic northern forest	<i>Elaeagnus umbellata</i>	10	10	10	30	6.1	36.1
92	12	Northern hardwood swamp <sup>2</sup>	<i>Elaeagnus umbellata</i>	10	0	10	20	6.1	26.1
93	12	South dock	<i>Elaeagnus umbellata</i>	10	0	10	20	6.1	26.1
94	12	Lighthouse <sup>2</sup>	<i>Elaeagnus umbellata</i>	10	0	10	20	6.1	26.1
86	13	Boreal forest south	<i>Elymus repens</i>	5	0	5	10	5.7	15.7
87	13	Boreal forest north <sup>1</sup>	<i>Elymus repens</i>	5	0	5	10	5.7	15.7
88	13	Limestone cliff	<i>Elymus repens</i>	5	0	5	10	5.7	15.7
89	13	Limestone cobble shore <sup>1</sup>	<i>Elymus repens</i>	5	0	10	15	5.7	20.7
90	13	Limestone lakeshore cliff	<i>Elymus repens</i>	5	0	10	15	5.7	20.7
91	13	Mesic northern forest	<i>Elymus repens</i>	5	0	5	10	5.7	15.7
92	13	Northern hardwood swamp <sup>2</sup>	<i>Elymus repens</i>	5	0	5	10	5.7	15.7
93	13	South dock	<i>Elymus repens</i>	5	0	10	15	5.7	20.7
94	13	Lighthouse <sup>2</sup>	<i>Elymus repens</i>	5	0	10	15	5.7	20.7
86	14	Boreal forest south	<i>Epilobium parviflorum</i>	5	0	1	6	5.3	11.3
87	14	Boreal forest north <sup>1</sup>	<i>Epilobium parviflorum</i>	5	0	1	6	5.3	11.3
88	14	Limestone cliff	<i>Epilobium parviflorum</i>	5	0	1	6	5.3	11.3
89	14	Limestone cobble shore <sup>1</sup>	<i>Epilobium parviflorum</i>	5	0	10	15	5.3	20.3
90	14	Limestone lakeshore cliff	<i>Epilobium parviflorum</i>	5	0	10	15	5.3	20.3
91	14	Mesic northern forest	<i>Epilobium parviflorum</i>	5	0	1	6	5.3	11.3
92	14	Northern hardwood swamp <sup>2</sup>	<i>Epilobium parviflorum</i>	5	0	10	15	5.3	20.3
93	14	South dock	<i>Epilobium parviflorum</i>	5	0	10	15	5.3	20.3
94	14	Lighthouse <sup>2</sup>	<i>Epilobium parviflorum</i>	5	0	10	15	5.3	20.3
86	15	Boreal forest south	<i>Epipactis helleborine</i>	10	7	10	27	4.97	32.0
87	15	Boreal forest north <sup>1</sup>	<i>Epipactis helleborine</i>	10	7	10	27	4.97	32.0
88	15	Limestone cliff	<i>Epipactis helleborine</i>	10	0	5	15	4.97	20.0

areaID	speciesID	Area	Scientific Name ITIS	Presence Score	Status Score	Habitat Score	Total Score	Species Score	Overall Score
89	15	Limestone cobble shore <sup>1</sup>	<i>Epipactis helleborine</i>	10	0	1	11	4.97	16.0
90	15	Limestone lakeshore cliff	<i>Epipactis helleborine</i>	10	0	1	11	4.97	16.0
91	15	Mesic northern forest	<i>Epipactis helleborine</i>	10	7	10	27	4.97	32.0
92	15	Northern hardwood swamp <sup>2</sup>	<i>Epipactis helleborine</i>	10	0	5	15	4.97	20.0
93	15	South dock	<i>Epipactis helleborine</i>	10	0	1	11	4.97	16.0
94	15	Lighthouse <sup>2</sup>	<i>Epipactis helleborine</i>	10	0	1	11	4.97	16.0
86	16	Boreal forest south	<i>Erysimum cheiranthoides</i>	5	0	1	6	4.9	10.9
87	16	Boreal forest north <sup>1</sup>	<i>Erysimum cheiranthoides</i>	5	0	1	6	4.9	10.9
88	16	Limestone cliff	<i>Erysimum cheiranthoides</i>	5	0	10	15	4.9	19.9
89	16	Limestone cobble shore <sup>1</sup>	<i>Erysimum cheiranthoides</i>	5	0	10	15	4.9	19.9
90	16	Limestone lakeshore cliff	<i>Erysimum cheiranthoides</i>	5	0	10	15	4.9	19.9
91	16	Mesic northern forest	<i>Erysimum cheiranthoides</i>	5	0	1	6	4.9	10.9
92	16	Northern hardwood swamp <sup>2</sup>	<i>Erysimum cheiranthoides</i>	5	0	1	6	4.9	10.9
93	16	South dock	<i>Erysimum cheiranthoides</i>	5	0	10	15	4.9	19.9
94	16	Lighthouse <sup>2</sup>	<i>Erysimum cheiranthoides</i>	5	0	10	15	4.9	19.9
86	17	Boreal forest south	<i>Euphorbia esula</i>	10	0	1	11	8.1	19.1
87	17	Boreal forest north <sup>1</sup>	<i>Euphorbia esula</i>	10	0	1	11	8.1	19.1
88	17	Limestone cliff	<i>Euphorbia esula</i>	10	0	1	11	8.1	19.1
89	17	Limestone cobble shore <sup>1</sup>	<i>Euphorbia esula</i>	10	0	5	15	8.1	23.1
90	17	Limestone lakeshore cliff	<i>Euphorbia esula</i>	10	0	5	15	8.1	23.1
91	17	Mesic northern forest	<i>Euphorbia esula</i>	10	0	1	11	8.1	19.1
92	17	Northern hardwood swamp <sup>2</sup>	<i>Euphorbia esula</i>	10	0	1	11	8.1	19.1
93	17	South dock	<i>Euphorbia esula</i>	10	0	10	20	8.1	28.1
94	17	Lighthouse <sup>2</sup>	<i>Euphorbia esula</i>	10	5	10	25	8.1	33.1
86	18	Boreal forest south	<i>Fallopia convolvulus</i>	10	0	1	11	3.7	14.7
87	18	Boreal forest north <sup>1</sup>	<i>Fallopia convolvulus</i>	10	0	1	11	3.7	14.7
88	18	Limestone cliff	<i>Fallopia convolvulus</i>	10	0	1	11	3.7	14.7
89	18	Limestone cobble shore <sup>1</sup>	<i>Fallopia convolvulus</i>	10	0	5	15	3.7	18.7
90	18	Limestone lakeshore cliff	<i>Fallopia convolvulus</i>	10	0	5	15	3.7	18.7
91	18	Mesic northern forest	<i>Fallopia convolvulus</i>	10	10	1	21	3.7	24.7
92	18	Northern hardwood swamp <sup>2</sup>	<i>Fallopia convolvulus</i>	10	0	1	11	3.7	14.7
93	18	South dock	<i>Fallopia convolvulus</i>	10	0	1	11	3.7	14.7
94	18	Lighthouse <sup>2</sup>	<i>Fallopia convolvulus</i>	10	0	5	15	3.7	18.7
86	19	Boreal forest south	<i>Galeopsis tetrahit</i>	5	0	1	6	5.1	11.1

areaID	speciesID	Area	Scientific Name ITIS	Presence Score	Status Score	Habitat Score	Total Score	Species Score	Overall Score
87	19	Boreal forest north <sup>1</sup>	<i>Galeopsis tetrahit</i>	5	0	1	6	5.1	11.1
88	19	Limestone cliff	<i>Galeopsis tetrahit</i>	5	0	10	15	5.1	20.1
89	19	Limestone cobble shore <sup>1</sup>	<i>Galeopsis tetrahit</i>	5	0	10	15	5.1	20.1
90	19	Limestone lakeshore cliff	<i>Galeopsis tetrahit</i>	5	0	10	15	5.1	20.1
91	19	Mesic northern forest	<i>Galeopsis tetrahit</i>	5	0	1	6	5.1	11.1
92	19	Northern hardwood swamp <sup>2</sup>	<i>Galeopsis tetrahit</i>	5	0	10	15	5.1	20.1
93	19	South dock	<i>Galeopsis tetrahit</i>	5	0	10	15	5.1	20.1
94	19	Lighthouse <sup>2</sup>	<i>Galeopsis tetrahit</i>	5	0	10	15	5.1	20.1
86	20	Boreal forest south	<i>Galium sylvaticum</i>	10	0	10	20	4.1	24.1
87	20	Boreal forest north <sup>1</sup>	<i>Galium sylvaticum</i>	10	0	10	20	4.1	24.1
88	20	Limestone cliff	<i>Galium sylvaticum</i>	10	0	10	20	4.1	24.1
89	20	Limestone cobble shore <sup>1</sup>	<i>Galium sylvaticum</i>	10	0	1	11	4.1	15.1
90	20	Limestone lakeshore cliff	<i>Galium sylvaticum</i>	10	0	1	11	4.1	15.1
91	20	Mesic northern forest	<i>Galium sylvaticum</i>	10	7	10	27	4.1	31.1
92	20	Northern hardwood swamp <sup>2</sup>	<i>Galium sylvaticum</i>	10	0	5	15	4.1	19.1
93	20	South dock	<i>Galium sylvaticum</i>	10	0	1	11	4.1	15.1
94	20	Lighthouse <sup>2</sup>	<i>Galium sylvaticum</i>	10	0	1	11	4.1	15.1
86	21	Boreal forest south	<i>Hesperis matronalis</i>	5	0	10	15	7.7	22.7
87	21	Boreal forest north <sup>1</sup>	<i>Hesperis matronalis</i>	5	0	10	15	7.7	22.7
88	21	Limestone cliff	<i>Hesperis matronalis</i>	5	0	10	15	7.7	22.7
89	21	Limestone cobble shore <sup>1</sup>	<i>Hesperis matronalis</i>	5	0	1	6	7.7	13.7
90	21	Limestone lakeshore cliff	<i>Hesperis matronalis</i>	5	0	1	6	7.7	13.7
91	21	Mesic northern forest	<i>Hesperis matronalis</i>	5	0	10	15	7.7	22.7
92	21	Northern hardwood swamp <sup>2</sup>	<i>Hesperis matronalis</i>	5	0	5	10	7.7	17.7
93	21	South dock	<i>Hesperis matronalis</i>	5	0	1	6	7.7	13.7
94	21	Lighthouse <sup>2</sup>	<i>Hesperis matronalis</i>	5	0	1	6	7.7	13.7
86	22	Boreal forest south	<i>Hieracium aurantiacum</i>	10	7	10	27	4.5	31.5
87	22	Boreal forest north <sup>1</sup>	<i>Hieracium aurantiacum</i>	10	7	10	27	4.5	31.5
88	22	Limestone cliff	<i>Hieracium aurantiacum</i>	10	0	10	20	4.5	24.5
89	22	Limestone cobble shore <sup>1</sup>	<i>Hieracium aurantiacum</i>	10	0	10	20	4.5	24.5
90	22	Limestone lakeshore cliff	<i>Hieracium aurantiacum</i>	10	0	10	20	4.5	24.5
91	22	Mesic northern forest	<i>Hieracium aurantiacum</i>	10	0	10	20	4.5	24.5
92	22	Northern hardwood swamp <sup>2</sup>	<i>Hieracium aurantiacum</i>	10	0	10	20	4.5	24.5
93	22	South dock	<i>Hieracium aurantiacum</i>	5	0	10	15	4.5	19.5
94	22	Lighthouse <sup>2</sup>	<i>Hieracium aurantiacum</i>	10	0	10	20	4.5	24.5
86	23	Boreal forest south	<i>Hieracium caespitosum</i>	5	0	1	6	4.1	10.1
87	23	Boreal forest north <sup>1</sup>	<i>Hieracium caespitosum</i>	5	0	1	6	4.1	10.1

areaID	speciesID	Area	Scientific Name ITIS	Presence Score	Status Score	Habitat Score	Total Score	Species Score	Overall Score
88	23	Limestone cliff	<i>Hieracium caespitosum</i>	5	0	1	6	4.1	10.1
89	23	Limestone cobble shore <sup>1</sup>	<i>Hieracium caespitosum</i>	5	0	5	10	4.1	14.1
90	23	Limestone lakeshore cliff	<i>Hieracium caespitosum</i>	5	0	5	10	4.1	14.1
91	23	Mesic northern forest	<i>Hieracium caespitosum</i>	5	0	1	6	4.1	10.1
92	23	Northern hardwood swamp <sup>2</sup>	<i>Hieracium caespitosum</i>	5	0	1	6	4.1	10.1
93	23	South dock	<i>Hieracium caespitosum</i>	5	0	10	15	4.1	19.1
94	23	Lighthouse <sup>2</sup>	<i>Hieracium caespitosum</i>	5	0	10	15	4.1	19.1
86	24	Boreal forest south	<i>Hypericum perforatum</i>	5	0	1	6	4.37	10.4
87	24	Boreal forest north <sup>1</sup>	<i>Hypericum perforatum</i>	5	0	1	6	4.37	10.4
88	24	Limestone cliff	<i>Hypericum perforatum</i>	5	0	1	6	4.37	10.4
89	24	Limestone cobble shore <sup>1</sup>	<i>Hypericum perforatum</i>	5	0	5	10	4.37	14.4
90	24	Limestone lakeshore cliff	<i>Hypericum perforatum</i>	5	0	5	10	4.37	14.4
91	24	Mesic northern forest	<i>Hypericum perforatum</i>	5	0	1	6	4.37	10.4
92	24	Northern hardwood swamp <sup>2</sup>	<i>Hypericum perforatum</i>	5	0	1	6	4.37	10.4
93	24	South dock	<i>Hypericum perforatum</i>	5	0	10	15	4.37	19.4
94	24	Lighthouse <sup>2</sup>	<i>Hypericum perforatum</i>	5	0	10	15	4.37	19.4
86	25	Boreal forest south	<i>Leonurus cardiaca</i>	5	0	1	6	4.1	10.1
87	25	Boreal forest north <sup>1</sup>	<i>Leonurus cardiaca</i>	5	0	1	6	4.1	10.1
88	25	Limestone cliff	<i>Leonurus cardiaca</i>	5	0	1	6	4.1	10.1
89	25	Limestone cobble shore <sup>1</sup>	<i>Leonurus cardiaca</i>	5	0	5	10	4.1	14.1
90	25	Limestone lakeshore cliff	<i>Leonurus cardiaca</i>	5	0	5	10	4.1	14.1
91	25	Mesic northern forest	<i>Leonurus cardiaca</i>	5	0	1	6	4.1	10.1
92	25	Northern hardwood swamp <sup>2</sup>	<i>Leonurus cardiaca</i>	5	0	1	6	4.1	10.1
93	25	South dock	<i>Leonurus cardiaca</i>	5	0	5	10	4.1	14.1
94	25	Lighthouse <sup>2</sup>	<i>Leonurus cardiaca</i>	5	0	5	10	4.1	14.1
86	26	Boreal forest south	<i>Leucanthemum vulgare</i>	5	0	5	10	3.97	14.0
87	26	Boreal forest north <sup>1</sup>	<i>Leucanthemum vulgare</i>	5	0	5	10	3.97	14.0
88	26	Limestone cliff	<i>Leucanthemum vulgare</i>	5	0	5	10	3.97	14.0
89	26	Limestone cobble shore <sup>1</sup>	<i>Leucanthemum vulgare</i>	5	0	10	15	3.97	19.0
90	26	Limestone lakeshore cliff	<i>Leucanthemum vulgare</i>	5	0	10	15	3.97	19.0
91	26	Mesic northern forest	<i>Leucanthemum vulgare</i>	5	0	5	10	3.97	14.0
92	26	Northern hardwood swamp <sup>2</sup>	<i>Leucanthemum vulgare</i>	5	0	1	6	3.97	10.0
93	26	South dock	<i>Leucanthemum vulgare</i>	5	0	10	15	3.97	19.0
94	26	Lighthouse <sup>2</sup>	<i>Leucanthemum vulgare</i>	5	0	10	15	3.97	19.0
86	27	Boreal forest south	<i>Linaria vulgaris</i>	5	0	1	6	4.37	10.4
87	27	Boreal forest north <sup>1</sup>	<i>Linaria vulgaris</i>	5	0	1	6	4.37	10.4
88	27	Limestone cliff	<i>Linaria vulgaris</i>	5	0	10	15	4.37	19.4



areaID	speciesID	Area	Scientific Name ITIS	Presence Score	Status Score	Habitat Score	Total Score	Species Score	Overall Score
89	27	Limestone cobble shore <sup>1</sup>	<i>Linaria vulgaris</i>	5	0	10	15	4.37	19.4
90	27	Limestone lakeshore cliff	<i>Linaria vulgaris</i>	5	0	10	15	4.37	19.4
91	27	Mesic northern forest	<i>Linaria vulgaris</i>	5	0	1	6	4.37	10.4
92	27	Northern hardwood swamp <sup>2</sup>	<i>Linaria vulgaris</i>	5	0	1	6	4.37	10.4
93	27	South dock	<i>Linaria vulgaris</i>	5	0	10	15	4.37	19.4
94	27	Lighthouse <sup>2</sup>	<i>Linaria vulgaris</i>	5	0	10	15	4.37	19.4
86	28	Boreal forest south	<i>Lonicera</i> sp.	10	0	10	20	8.47	28.5
87	28	Boreal forest north <sup>1</sup>	<i>Lonicera</i> sp.	10	0	10	20	8.47	28.5
88	28	Limestone cliff	<i>Lonicera</i> sp.	10	0	10	20	8.47	28.5
89	28	Limestone cobble shore <sup>1</sup>	<i>Lonicera</i> sp.	10	0	10	20	8.47	28.5
90	28	Limestone lakeshore cliff	<i>Lonicera</i> sp.	10	0	10	20	8.47	28.5
91	28	Mesic northern forest	<i>Lonicera</i> sp.	10	10	10	30	8.47	38.5
92	28	Northern hardwood swamp <sup>2</sup>	<i>Lonicera</i> sp.	10	0	10	20	8.47	28.5
93	28	South dock	<i>Lonicera</i> sp.	10	0	10	20	8.47	28.5
94	28	Lighthouse <sup>2</sup>	<i>Lonicera</i> sp.	10	0	10	20	8.47	28.5
86	29	Boreal forest south	<i>Lythrum salicaria</i>	5	0	1	6	9.1	15.1
87	29	Boreal forest north <sup>1</sup>	<i>Lythrum salicaria</i>	5	0	1	6	9.1	15.1
88	29	Limestone cliff	<i>Lythrum salicaria</i>	5	0	1	6	9.1	15.1
89	29	Limestone cobble shore <sup>1</sup>	<i>Lythrum salicaria</i>	5	0	10	15	9.1	24.1
90	29	Limestone lakeshore cliff	<i>Lythrum salicaria</i>	5	0	10	15	9.1	24.1
91	29	Mesic northern forest	<i>Lythrum salicaria</i>	5	0	1	6	9.1	15.1
92	29	Northern hardwood swamp <sup>2</sup>	<i>Lythrum salicaria</i>	5	0	1	6	9.1	15.1
93	29	South dock	<i>Lythrum salicaria</i>	5	0	10	15	9.1	24.1
94	29	Lighthouse <sup>2</sup>	<i>Lythrum salicaria</i>	5	0	10	15	9.1	24.1
86	30	Boreal forest south	<i>Medicago lupulina</i>	5	0	1	6	4.5	10.5
87	30	Boreal forest north <sup>1</sup>	<i>Medicago lupulina</i>	5	0	1	6	4.5	10.5
88	30	Limestone cliff	<i>Medicago lupulina</i>	5	0	1	6	4.5	10.5
89	30	Limestone cobble shore <sup>1</sup>	<i>Medicago lupulina</i>	5	0	10	15	4.5	19.5
90	30	Limestone lakeshore cliff	<i>Medicago lupulina</i>	5	0	10	15	4.5	19.5
91	30	Mesic northern forest	<i>Medicago lupulina</i>	5	0	1	6	4.5	10.5
92	30	Northern hardwood swamp <sup>2</sup>	<i>Medicago lupulina</i>	5	0	1	6	4.5	10.5
93	30	South dock	<i>Medicago lupulina</i>	5	0	10	15	4.5	19.5
94	30	Lighthouse <sup>2</sup>	<i>Medicago lupulina</i>	5	0	10	15	4.5	19.5
86	31	Boreal forest south	<i>Melilotus albus</i>	5	0	1	6	6.3	12.3
87	31	Boreal forest north <sup>1</sup>	<i>Melilotus albus</i>	5	0	1	6	6.3	12.3
88	31	Limestone cliff	<i>Melilotus albus</i>	5	0	10	15	6.3	21.3
89	31	Limestone cobble shore <sup>1</sup>	<i>Melilotus albus</i>	5	0	10	15	6.3	21.3

areaID	speciesID	Area	Scientific Name ITIS	Presence Score	Status Score	Habitat Score	Total Score	Species Score	Overall Score
90	31	Limestone lakeshore cliff	<i>Melilotus albus</i>	5	0	10	15	6.3	21.3
91	31	Mesic northern forest	<i>Melilotus albus</i>	5	0	1	6	6.3	12.3
92	31	Northern hardwood swamp <sup>2</sup>	<i>Melilotus albus</i>	5	0	1	6	6.3	12.3
93	31	South dock	<i>Melilotus albus</i>	5	0	10	15	6.3	21.3
94	31	Lighthouse <sup>2</sup>	<i>Melilotus albus</i>	5	0	10	15	6.3	21.3
86	32	Boreal forest south	<i>Nepeta cataria</i>	5	0	1	6	3.57	9.6
87	32	Boreal forest north <sup>1</sup>	<i>Nepeta cataria</i>	5	0	1	6	3.57	9.6
88	32	Limestone cliff	<i>Nepeta cataria</i>	5	0	10	15	3.57	18.6
89	32	Limestone cobble shore <sup>1</sup>	<i>Nepeta cataria</i>	5	0	10	15	3.57	18.6
90	32	Limestone lakeshore cliff	<i>Nepeta cataria</i>	5	0	10	15	3.57	18.6
91	32	Mesic northern forest	<i>Nepeta cataria</i>	5	0	1	6	3.57	9.6
92	32	Northern hardwood swamp <sup>2</sup>	<i>Nepeta cataria</i>	5	0	1	6	3.57	9.6
93	32	South dock	<i>Nepeta cataria</i>	5	0	10	15	3.57	18.6
94	32	Lighthouse <sup>2</sup>	<i>Nepeta cataria</i>	5	0	10	15	3.57	18.6
86	33	Boreal forest south	<i>Panicum miliaceum</i>	5	0	1	6	3.9	9.9
87	33	Boreal forest north <sup>1</sup>	<i>Panicum miliaceum</i>	5	0	1	6	3.9	9.9
88	33	Limestone cliff	<i>Panicum miliaceum</i>	5	0	1	6	3.9	9.9
89	33	Limestone cobble shore <sup>1</sup>	<i>Panicum miliaceum</i>	5	0	5	10	3.9	13.9
90	33	Limestone lakeshore cliff	<i>Panicum miliaceum</i>	5	0	5	10	3.9	13.9
91	33	Mesic northern forest	<i>Panicum miliaceum</i>	5	0	1	6	3.9	9.9
92	33	Northern hardwood swamp <sup>2</sup>	<i>Panicum miliaceum</i>	5	0	1	6	3.9	9.9
93	33	South dock	<i>Panicum miliaceum</i>	5	0	5	10	3.9	13.9
94	33	Lighthouse <sup>2</sup>	<i>Panicum miliaceum</i>	5	0	5	10	3.9	13.9
86	34	Boreal forest south	<i>Pastinaca sativa</i>	10	5	5	20	7.3	27.3
87	34	Boreal forest north <sup>1</sup>	<i>Pastinaca sativa</i>	10	0	5	15	7.3	22.3
88	34	Limestone cliff	<i>Pastinaca sativa</i>	10	0	1	11	7.3	18.3
89	34	Limestone cobble shore <sup>1</sup>	<i>Pastinaca sativa</i>	10	0	10	20	7.3	27.3
90	34	Limestone lakeshore cliff	<i>Pastinaca sativa</i>	10	0	10	20	7.3	27.3
91	34	Mesic northern forest	<i>Pastinaca sativa</i>	10	0	5	15	7.3	22.3
92	34	Northern hardwood swamp <sup>2</sup>	<i>Pastinaca sativa</i>	10	0	5	15	7.3	22.3
93	34	South dock	<i>Pastinaca sativa</i>	10	0	10	20	7.3	27.3
94	34	Lighthouse <sup>2</sup>	<i>Pastinaca sativa</i>	10	0	10	20	7.3	27.3
86	35	Boreal forest south	<i>Persicaria maculosa</i>	5	0	1	6	4.1	10.1
87	35	Boreal forest north <sup>1</sup>	<i>Persicaria maculosa</i>	5	0	1	6	4.1	10.1
88	35	Limestone cliff	<i>Persicaria maculosa</i>	5	0	10	15	4.1	19.1
89	35	Limestone cobble shore <sup>1</sup>	<i>Persicaria maculosa</i>	5	0	10	15	4.1	19.1
90	35	Limestone lakeshore cliff	<i>Persicaria maculosa</i>	5	0	10	15	4.1	19.1

areaID	speciesID	Area	Scientific Name ITIS	Presence Score	Status Score	Habitat Score	Total Score	Species Score	Overall Score
91	35	Mesic northern forest	<i>Persicaria maculosa</i>	5	0	1	6	4.1	10.1
92	35	Northern hardwood swamp <sup>2</sup>	<i>Persicaria maculosa</i>	5	0	5	10	4.1	14.1
93	35	South dock	<i>Persicaria maculosa</i>	5	0	10	15	4.1	19.1
94	35	Lighthouse <sup>2</sup>	<i>Persicaria maculosa</i>	5	0	10	15	4.1	19.1
86	36	Boreal forest south	<i>Phalaris arundinacea</i>	10	0	5	15	9.07	24.1
87	36	Boreal forest north <sup>1</sup>	<i>Phalaris arundinacea</i>	10	0	5	15	9.07	24.1
88	36	Limestone cliff	<i>Phalaris arundinacea</i>	10	0	1	11	9.07	20.1
89	36	Limestone cobble shore <sup>1</sup>	<i>Phalaris arundinacea</i>	10	0	5	15	9.07	24.1
90	36	Limestone lakeshore cliff	<i>Phalaris arundinacea</i>	10	0	1	11	9.07	20.1
91	36	Mesic northern forest	<i>Phalaris arundinacea</i>	10	0	5	15	9.07	24.1
92	36	Northern hardwood swamp <sup>2</sup>	<i>Phalaris arundinacea</i>	10	5	10	25	9.07	34.1
93	36	South dock	<i>Phalaris arundinacea</i>	10	0	5	15	9.07	24.1
94	36	Lighthouse <sup>2</sup>	<i>Phalaris arundinacea</i>	10	0	5	15	9.07	24.1
86	37	Boreal forest south	<i>Phleum pratense</i>	10	7	5	22	4.9	26.9
87	37	Boreal forest north <sup>1</sup>	<i>Phleum pratense</i>	10	7	5	22	4.9	26.9
88	37	Limestone cliff	<i>Phleum pratense</i>	10	0	1	11	4.9	15.9
89	37	Limestone cobble shore <sup>1</sup>	<i>Phleum pratense</i>	10	0	10	20	4.9	24.9
90	37	Limestone lakeshore cliff	<i>Phleum pratense</i>	10	0	10	20	4.9	24.9
91	37	Mesic northern forest	<i>Phleum pratense</i>	10	0	5	15	4.9	19.9
92	37	Northern hardwood swamp <sup>2</sup>	<i>Phleum pratense</i>	10	0	5	15	4.9	19.9
93	37	South dock	<i>Phleum pratense</i>	10	0	10	20	4.9	24.9
94	37	Lighthouse <sup>2</sup>	<i>Phleum pratense</i>	10	0	10	20	4.9	24.9
86	38	Boreal forest south	<i>Phragmites australis</i> ssp. <i>australis</i>	10	0	1	11	9.1	20.1
87	38	Boreal forest north <sup>1</sup>	<i>Phragmites australis</i> ssp. <i>australis</i>	10	0	1	11	9.1	20.1
88	38	Limestone cliff	<i>Phragmites australis</i> ssp. <i>australis</i>	10	0	1	11	9.1	20.1
89	38	Limestone cobble shore <sup>1</sup>	<i>Phragmites australis</i> ssp. <i>australis</i>	10	0	10	20	9.1	29.1
90	38	Limestone lakeshore cliff	<i>Phragmites australis</i> ssp. <i>australis</i>	10	0	10	20	9.1	29.1
91	38	Mesic northern forest	<i>Phragmites australis</i> ssp. <i>australis</i>	10	0	10	20	9.1	29.1
92	38	Northern hardwood swamp <sup>2</sup>	<i>Phragmites australis</i> ssp. <i>australis</i>	10	7	10	27	9.1	36.1
93	38	South dock	<i>Phragmites australis</i> ssp. <i>australis</i>	10	0	10	20	9.1	29.1
94	38	Lighthouse <sup>2</sup>	<i>Phragmites australis</i> ssp. <i>australis</i>	10	0	10	20	9.1	29.1
86	39	Boreal forest south	<i>Picea abies</i>	5	0	1	6	4.1	10.1
87	39	Boreal forest north <sup>1</sup>	<i>Picea abies</i>	5	0	1	6	4.1	10.1
88	39	Limestone cliff	<i>Picea abies</i>	5	0	1	6	4.1	10.1

areaID	speciesID	Area	Scientific Name ITIS	Presence Score	Status Score	Habitat Score	Total Score	Species Score	Overall Score
89	39	Limestone cobble shore <sup>1</sup>	<i>Picea abies</i>	5	0	1	6	4.1	10.1
90	39	Limestone lakeshore cliff	<i>Picea abies</i>	5	0	1	6	4.1	10.1
91	39	Mesic northern forest	<i>Picea abies</i>	5	0	1	6	4.1	10.1
92	39	Northern hardwood swamp <sup>2</sup>	<i>Picea abies</i>	5	0	1	6	4.1	10.1
93	39	South dock	<i>Picea abies</i>	5	0	5	10	4.1	14.1
94	39	Lighthouse <sup>2</sup>	<i>Picea abies</i>	5	0	5	10	4.1	14.1
86	40	Boreal forest south	<i>Poa annua</i>	10	0	5	15	3.57	18.6
87	40	Boreal forest north <sup>1</sup>	<i>Poa annua</i>	10	0	5	15	3.57	18.6
88	40	Limestone cliff	<i>Poa annua</i>	10	0	5	15	3.57	18.6
89	40	Limestone cobble shore <sup>1</sup>	<i>Poa annua</i>	10	0	10	20	3.57	23.6
90	40	Limestone lakeshore cliff	<i>Poa annua</i>	10	0	10	20	3.57	23.6
91	40	Mesic northern forest	<i>Poa annua</i>	10	7	5	22	3.57	25.6
92	40	Northern hardwood swamp <sup>2</sup>	<i>Poa annua</i>	10	0	5	15	3.57	18.6
93	40	South dock	<i>Poa annua</i>	10	0	10	20	3.57	23.6
94	40	Lighthouse <sup>2</sup>	<i>Poa annua</i>	10	0	10	20	3.57	23.6
86	41	Boreal forest south	<i>Poa compressa</i>	10	5	10	25	4.1	29.1
87	41	Boreal forest north <sup>1</sup>	<i>Poa compressa</i>	10	7	10	27	4.1	31.1
88	41	Limestone cliff	<i>Poa compressa</i>	10	0	10	20	4.1	24.1
89	41	Limestone cobble shore <sup>1</sup>	<i>Poa compressa</i>	10	0	5	15	4.1	19.1
90	41	Limestone lakeshore cliff	<i>Poa compressa</i>	10	0	10	20	4.1	24.1
91	41	Mesic northern forest	<i>Poa compressa</i>	10	7	10	27	4.1	31.1
92	41	Northern hardwood swamp <sup>2</sup>	<i>Poa compressa</i>	10	0	5	15	4.1	19.1
93	41	South dock	<i>Poa compressa</i>	10	0	10	20	4.1	24.1
94	41	Lighthouse <sup>2</sup>	<i>Poa compressa</i>	10	0	10	20	4.1	24.1
86	42	Boreal forest south	<i>Poa nemoralis</i>	10	5	10	25	3.57	28.6
87	42	Boreal forest north <sup>1</sup>	<i>Poa nemoralis</i>	10	5	10	25	3.57	28.6
88	42	Limestone cliff	<i>Poa nemoralis</i>	10	5	10	25	3.57	28.6
89	42	Limestone cobble shore <sup>1</sup>	<i>Poa nemoralis</i>	10	0	5	15	3.57	18.6
90	42	Limestone lakeshore cliff	<i>Poa nemoralis</i>	10	5	10	25	3.57	28.6
91	42	Mesic northern forest	<i>Poa nemoralis</i>	10	5	10	25	3.57	28.6
92	42	Northern hardwood swamp <sup>2</sup>	<i>Poa nemoralis</i>	10	0	1	11	3.57	14.6
93	42	South dock	<i>Poa nemoralis</i>	10	0	1	11	3.57	14.6
94	42	Lighthouse <sup>2</sup>	<i>Poa nemoralis</i>	10	0	10	20	3.57	23.6
86	43	Boreal forest south	<i>Poa pratensis</i>	10	0	10	20	3.43	23.4
87	43	Boreal forest north <sup>1</sup>	<i>Poa pratensis</i>	10	0	10	20	3.43	23.4
88	43	Limestone cliff	<i>Poa pratensis</i>	10	0	10	20	3.43	23.4
89	43	Limestone cobble shore <sup>1</sup>	<i>Poa pratensis</i>	10	0	10	20	3.43	23.4

areaID	speciesID	Area	Scientific Name ITIS	Presence Score	Status Score	Habitat Score	Total Score	Species Score	Overall Score
90	43	Limestone lakeshore cliff	<i>Poa pratensis</i>	10	0	10	20	3.43	23.4
91	43	Mesic northern forest	<i>Poa pratensis</i>	10	7	10	27	3.43	30.4
92	43	Northern hardwood swamp <sup>2</sup>	<i>Poa pratensis</i>	10	0	5	15	3.43	18.4
93	43	South dock	<i>Poa pratensis</i>	10	0	10	20	3.43	23.4
94	43	Lighthouse <sup>2</sup>	<i>Poa pratensis</i>	10	0	10	20	3.43	23.4
86	44	Boreal forest south	<i>Populus alba</i>	10	0	1	11	6.5	17.5
87	44	Boreal forest north <sup>1</sup>	<i>Populus alba</i>	10	0	1	11	6.5	17.5
88	44	Limestone cliff	<i>Populus alba</i>	10	0	1	11	6.5	17.5
89	44	Limestone cobble shore <sup>1</sup>	<i>Populus alba</i>	10	0	1	11	6.5	17.5
90	44	Limestone lakeshore cliff	<i>Populus alba</i>	10	0	1	11	6.5	17.5
91	44	Mesic northern forest	<i>Populus alba</i>	10	0	1	11	6.5	17.5
92	44	Northern hardwood swamp <sup>2</sup>	<i>Populus alba</i>	10	0	5	15	6.5	21.5
93	44	South dock	<i>Populus alba</i>	10	0	5	15	6.5	21.5
94	44	Lighthouse <sup>2</sup>	<i>Populus alba</i>	10	5	10	25	6.5	31.5
86	45	Boreal forest south	<i>Ranunculus acris</i>	10	0	5	15	4.1	19.1
87	45	Boreal forest north <sup>1</sup>	<i>Ranunculus acris</i>	10	0	5	15	4.1	19.1
88	45	Limestone cliff	<i>Ranunculus acris</i>	10	0	10	20	4.1	24.1
89	45	Limestone cobble shore <sup>1</sup>	<i>Ranunculus acris</i>	10	0	10	20	4.1	24.1
90	45	Limestone lakeshore cliff	<i>Ranunculus acris</i>	10	0	10	20	4.1	24.1
91	45	Mesic northern forest	<i>Ranunculus acris</i>	10	7	5	22	4.1	26.1
92	45	Northern hardwood swamp <sup>2</sup>	<i>Ranunculus acris</i>	10	0	10	20	4.1	24.1
93	45	South dock	<i>Ranunculus acris</i>	10	0	10	20	4.1	24.1
94	45	Lighthouse <sup>2</sup>	<i>Ranunculus acris</i>	10	0	10	20	4.1	24.1
86	46	Boreal forest south	<i>Rosa multiflora</i>	5	0	10	15	7.3	22.3
87	46	Boreal forest north <sup>1</sup>	<i>Rosa multiflora</i>	5	0	10	15	7.3	22.3
88	46	Limestone cliff	<i>Rosa multiflora</i>	5	0	5	10	7.3	17.3
89	46	Limestone cobble shore <sup>1</sup>	<i>Rosa multiflora</i>	5	0	5	10	7.3	17.3
90	46	Limestone lakeshore cliff	<i>Rosa multiflora</i>	5	0	5	10	7.3	17.3
91	46	Mesic northern forest	<i>Rosa multiflora</i>	5	0	10	15	7.3	22.3
92	46	Northern hardwood swamp <sup>2</sup>	<i>Rosa multiflora</i>	5	0	5	10	7.3	17.3
93	46	South dock	<i>Rosa multiflora</i>	5	0	10	15	7.3	22.3
94	46	Lighthouse <sup>2</sup>	<i>Rosa multiflora</i>	5	0	10	15	7.3	22.3
86	47	Boreal forest south	<i>Rumex obtusifolius</i>	5	0	5	10	4.1	14.1
87	47	Boreal forest north <sup>1</sup>	<i>Rumex obtusifolius</i>	5	0	5	10	4.1	14.1
88	47	Limestone cliff	<i>Rumex obtusifolius</i>	5	0	5	10	4.1	14.1
89	47	Limestone cobble shore <sup>1</sup>	<i>Rumex obtusifolius</i>	5	0	5	10	4.1	14.1
90	47	Limestone lakeshore cliff	<i>Rumex obtusifolius</i>	5	0	5	10	4.1	14.1



areaID	speciesID	Area	Scientific Name ITIS	Presence Score	Status Score	Habitat Score	Total Score	Species Score	Overall Score
91	47	Mesic northern forest	<i>Rumex obtusifolius</i>	5	0	5	10	4.1	14.1
92	47	Northern hardwood swamp <sup>2</sup>	<i>Rumex obtusifolius</i>	5	0	10	15	4.1	19.1
93	47	South dock	<i>Rumex obtusifolius</i>	5	0	10	15	4.1	19.1
94	47	Lighthouse <sup>2</sup>	<i>Rumex obtusifolius</i>	5	0	10	15	4.1	19.1
86	48	Boreal forest south	<i>Saponaria officinalis</i>	5	0	10	15	4.5	19.5
87	48	Boreal forest north <sup>1</sup>	<i>Saponaria officinalis</i>	5	0	5	10	4.5	14.5
88	48	Limestone cliff	<i>Saponaria officinalis</i>	5	0	5	10	4.5	14.5
89	48	Limestone cobble shore <sup>1</sup>	<i>Saponaria officinalis</i>	5	0	10	15	4.5	19.5
90	48	Limestone lakeshore cliff	<i>Saponaria officinalis</i>	5	0	5	10	4.5	14.5
91	48	Mesic northern forest	<i>Saponaria officinalis</i>	5	0	5	10	4.5	14.5
92	48	Northern hardwood swamp <sup>2</sup>	<i>Saponaria officinalis</i>	5	0	5	10	4.5	14.5
93	48	South dock	<i>Saponaria officinalis</i>	5	0	10	15	4.5	19.5
94	48	Lighthouse <sup>2</sup>	<i>Saponaria officinalis</i>	5	0	10	15	4.5	19.5
86	49	Boreal forest south	<i>Schedonorus pratensis</i>	5	0	5	10	4.5	14.5
87	49	Boreal forest north <sup>1</sup>	<i>Schedonorus pratensis</i>	5	0	5	10	4.5	14.5
88	49	Limestone cliff	<i>Schedonorus pratensis</i>	5	0	5	10	4.5	14.5
89	49	Limestone cobble shore <sup>1</sup>	<i>Schedonorus pratensis</i>	5	0	10	15	4.5	19.5
90	49	Limestone lakeshore cliff	<i>Schedonorus pratensis</i>	5	0	5	10	4.5	14.5
91	49	Mesic northern forest	<i>Schedonorus pratensis</i>	5	0	5	10	4.5	14.5
92	49	Northern hardwood swamp <sup>2</sup>	<i>Schedonorus pratensis</i>	5	0	5	10	4.5	14.5
93	49	South dock	<i>Schedonorus pratensis</i>	5	0	10	15	4.5	19.5
94	49	Lighthouse <sup>2</sup>	<i>Schedonorus pratensis</i>	5	0	10	15	4.5	19.5
86	50	Boreal forest south	<i>Sedum acre</i>	10	0	1	11	4.37	15.4
87	50	Boreal forest north <sup>1</sup>	<i>Sedum acre</i>	10	0	1	11	4.37	15.4
88	50	Limestone cliff	<i>Sedum acre</i>	10	0	1	11	4.37	15.4
89	50	Limestone cobble shore <sup>1</sup>	<i>Sedum acre</i>	10	7	10	27	4.37	31.4
90	50	Limestone lakeshore cliff	<i>Sedum acre</i>	10	0	10	20	4.37	24.4
91	50	Mesic northern forest	<i>Sedum acre</i>	10	0	1	11	4.37	15.4
92	50	Northern hardwood swamp <sup>2</sup>	<i>Sedum acre</i>	10	0	1	11	4.37	15.4
93	50	South dock	<i>Sedum acre</i>	10	0	10	20	4.37	24.4
94	50	Lighthouse <sup>2</sup>	<i>Sedum acre</i>	10	0	10	20	4.37	24.4
86	51	Boreal forest south	<i>Silene latifolia</i>	5	0	5	10	4.1	14.1
87	51	Boreal forest north <sup>1</sup>	<i>Silene latifolia</i>	5	0	5	10	4.1	14.1
88	51	Limestone cliff	<i>Silene latifolia</i>	5	0	5	10	4.1	14.1
89	51	Limestone cobble shore <sup>1</sup>	<i>Silene latifolia</i>	5	0	10	15	4.1	19.1
90	51	Limestone lakeshore cliff	<i>Silene latifolia</i>	5	0	5	10	4.1	14.1
91	51	Mesic northern forest	<i>Silene latifolia</i>	5	0	5	10	4.1	14.1

areaID	speciesID	Area	Scientific Name ITIS	Presence Score	Status Score	Habitat Score	Total Score	Species Score	Overall Score
92	51	Northern hardwood swamp <sup>2</sup>	<i>Silene latifolia</i>	5	0	5	10	4.1	14.1
93	51	South dock	<i>Silene latifolia</i>	5	0	10	15	4.1	19.1
94	51	Lighthouse <sup>2</sup>	<i>Silene latifolia</i>	5	0	10	15	4.1	19.1
86	52	Boreal forest south	<i>Silene vulgaris</i>	5	0	5	10	4.1	14.1
87	52	Boreal forest north <sup>1</sup>	<i>Silene vulgaris</i>	5	0	5	10	4.1	14.1
88	52	Limestone cliff	<i>Silene vulgaris</i>	5	0	5	10	4.1	14.1
89	52	Limestone cobble shore <sup>1</sup>	<i>Silene vulgaris</i>	5	0	10	15	4.1	19.1
90	52	Limestone lakeshore cliff	<i>Silene vulgaris</i>	5	0	10	15	4.1	19.1
91	52	Mesic northern forest	<i>Silene vulgaris</i>	5	0	5	10	4.1	14.1
92	52	Northern hardwood swamp <sup>2</sup>	<i>Silene vulgaris</i>	5	0	1	6	4.1	10.1
93	52	South dock	<i>Silene vulgaris</i>	5	0	10	15	4.1	19.1
94	52	Lighthouse <sup>2</sup>	<i>Silene vulgaris</i>	5	0	10	15	4.1	19.1
86	53	Boreal forest south	<i>Solanum dulcamara</i>	10	7	10	27	4.9	31.9
87	53	Boreal forest north <sup>1</sup>	<i>Solanum dulcamara</i>	10	7	10	27	4.9	31.9
88	53	Limestone cliff	<i>Solanum dulcamara</i>	10	7	10	27	4.9	31.9
89	53	Limestone cobble shore <sup>1</sup>	<i>Solanum dulcamara</i>	10	10	10	30	4.9	34.9
90	53	Limestone lakeshore cliff	<i>Solanum dulcamara</i>	10	7	10	27	4.9	31.9
91	53	Mesic northern forest	<i>Solanum dulcamara</i>	10	5	10	25	4.9	29.9
92	53	Northern hardwood swamp <sup>2</sup>	<i>Solanum dulcamara</i>	10	7	10	27	4.9	31.9
93	53	South dock	<i>Solanum dulcamara</i>	10	0	10	20	4.9	24.9
94	53	Lighthouse <sup>2</sup>	<i>Solanum dulcamara</i>	10	0	10	20	4.9	24.9
86	54	Boreal forest south	<i>Taraxacum officinale</i>	10	7	10	27	3.57	30.6
87	54	Boreal forest north <sup>1</sup>	<i>Taraxacum officinale</i>	10	7	10	27	3.57	30.6
88	54	Limestone cliff	<i>Taraxacum officinale</i>	0	0	0	0	3.57	3.6
89	54	Limestone cobble shore <sup>1</sup>	<i>Taraxacum officinale</i>	10	7	10	27	3.57	30.6
90	54	Limestone lakeshore cliff	<i>Taraxacum officinale</i>	10	0	10	20	3.57	23.6
91	54	Mesic northern forest	<i>Taraxacum officinale</i>	10	7	10	27	3.57	30.6
92	54	Northern hardwood swamp <sup>2</sup>	<i>Taraxacum officinale</i>	5	0	1	6	3.57	9.6
93	54	South dock	<i>Taraxacum officinale</i>	5	0	10	15	3.57	18.6
94	54	Lighthouse <sup>2</sup>	<i>Taraxacum officinale</i>	10	0	10	20	3.57	23.6
86	55	Boreal forest south	<i>Torilis japonica</i>	5	0	10	15	5.9	20.9
87	55	Boreal forest north <sup>1</sup>	<i>Torilis japonica</i>	5	0	10	15	5.9	20.9
88	55	Limestone cliff	<i>Torilis japonica</i>	10	0	10	20	5.9	25.9
89	55	Limestone cobble shore <sup>1</sup>	<i>Torilis japonica</i>	5	0	5	10	5.9	15.9
90	55	Limestone lakeshore cliff	<i>Torilis japonica</i>	5	0	5	10	5.9	15.9
91	55	Mesic northern forest	<i>Torilis japonica</i>	5	0	10	15	5.9	20.9
92	55	Northern hardwood swamp <sup>2</sup>	<i>Torilis japonica</i>	5	0	10	15	5.9	20.9

areaID	speciesID	Area	Scientific Name ITIS	Presence Score	Status Score	Habitat Score	Total Score	Species Score	Overall Score
93	55	South dock	<i>Torilis japonica</i>	5	0	10	15	5.9	20.9
94	55	Lighthouse <sup>2</sup>	<i>Torilis japonica</i>	5	0	10	15	5.9	20.9
86	56	Boreal forest south	<i>Tragopogon pratensis</i>	5	0	10	15	4.3	19.3
87	56	Boreal forest north <sup>1</sup>	<i>Tragopogon pratensis</i>	5	0	5	10	4.3	14.3
88	56	Limestone cliff	<i>Tragopogon pratensis</i>	5	0	1	6	4.3	10.3
89	56	Limestone cobble shore <sup>1</sup>	<i>Tragopogon pratensis</i>	5	0	10	15	4.3	19.3
90	56	Limestone lakeshore cliff	<i>Tragopogon pratensis</i>	5	0	5	10	4.3	14.3
91	56	Mesic northern forest	<i>Tragopogon pratensis</i>	5	0	5	10	4.3	14.3
92	56	Northern hardwood swamp <sup>2</sup>	<i>Tragopogon pratensis</i>	5	0	5	10	4.3	14.3
93	56	South dock	<i>Tragopogon pratensis</i>	5	0	10	15	4.3	19.3
94	56	Lighthouse <sup>2</sup>	<i>Tragopogon pratensis</i>	5	0	10	15	4.3	19.3
86	57	Boreal forest south	<i>Trifolium fragiferum</i>	5	0	1	6	3.57	9.6
87	57	Boreal forest north <sup>1</sup>	<i>Trifolium fragiferum</i>	5	0	1	6	3.57	9.6
88	57	Limestone cliff	<i>Trifolium fragiferum</i>	5	0	1	6	3.57	9.6
89	57	Limestone cobble shore <sup>1</sup>	<i>Trifolium fragiferum</i>	5	0	1	6	3.57	9.6
90	57	Limestone lakeshore cliff	<i>Trifolium fragiferum</i>	5	0	1	6	3.57	9.6
91	57	Mesic northern forest	<i>Trifolium fragiferum</i>	5	0	1	6	3.57	9.6
92	57	Northern hardwood swamp <sup>2</sup>	<i>Trifolium fragiferum</i>	5	0	1	6	3.57	9.6
93	57	South dock	<i>Trifolium fragiferum</i>	5	0	10	15	3.57	18.6
94	57	Lighthouse <sup>2</sup>	<i>Trifolium fragiferum</i>	5	0	10	15	3.57	18.6
86	58	Boreal forest south	<i>Trifolium pratense</i>	10	7	5	22	4.5	26.5
87	58	Boreal forest north <sup>1</sup>	<i>Trifolium pratense</i>	10	7	5	22	4.5	26.5
88	58	Limestone cliff	<i>Trifolium pratense</i>	10	0	5	15	4.5	19.5
89	58	Limestone cobble shore <sup>1</sup>	<i>Trifolium pratense</i>	10	0	10	20	4.5	24.5
90	58	Limestone lakeshore cliff	<i>Trifolium pratense</i>	10	0	5	15	4.5	19.5
91	58	Mesic northern forest	<i>Trifolium pratense</i>	10	0	5	15	4.5	19.5
92	58	Northern hardwood swamp <sup>2</sup>	<i>Trifolium pratense</i>	10	0	5	15	4.5	19.5
93	58	South dock	<i>Trifolium pratense</i>	10	0	10	20	4.5	24.5
94	58	Lighthouse <sup>2</sup>	<i>Trifolium pratense</i>	10	0	10	20	4.5	24.5
86	59	Boreal forest south	<i>Typha angustifolia</i>	10	0	1	11	9	20.0
87	59	Boreal forest north <sup>1</sup>	<i>Typha angustifolia</i>	10	0	1	11	9	20.0
88	59	Limestone cliff	<i>Typha angustifolia</i>	10	0	10	20	9	29.0
89	59	Limestone cobble shore <sup>1</sup>	<i>Typha angustifolia</i>	10	0	10	20	9	29.0
90	59	Limestone lakeshore cliff	<i>Typha angustifolia</i>	10	0	5	15	9	24.0
91	59	Mesic northern forest	<i>Typha angustifolia</i>	10	0	1	11	9	20.0
92	59	Northern hardwood swamp <sup>2</sup>	<i>Typha angustifolia</i>	10	1	10	21	9	30.0
93	59	South dock	<i>Typha angustifolia</i>	10	0	10	20	9	29.0

areaID	speciesID	Area	Scientific Name ITIS	Presence Score	Status Score	Habitat Score	Total Score	Species Score	Overall Score
94	59	Lighthouse <sup>2</sup>	<i>Typha angustifolia</i>	10	0	10	20	9	29.0
86	60	Boreal forest south	<i>Valeriana officinalis</i>	5	0	5	10	7.3	17.3
87	60	Boreal forest north <sup>1</sup>	<i>Valeriana officinalis</i>	5	0	5	10	7.3	17.3
88	60	Limestone cliff	<i>Valeriana officinalis</i>	5	0	5	10	7.3	17.3
89	60	Limestone cobble shore <sup>1</sup>	<i>Valeriana officinalis</i>	5	0	10	15	7.3	22.3
90	60	Limestone lakeshore cliff	<i>Valeriana officinalis</i>	5	0	10	15	7.3	22.3
91	60	Mesic northern forest	<i>Valeriana officinalis</i>	5	0	5	10	7.3	17.3
92	60	Northern hardwood swamp <sup>2</sup>	<i>Valeriana officinalis</i>	5	0	5	10	7.3	17.3
93	60	South dock	<i>Valeriana officinalis</i>	5	0	10	15	7.3	22.3
94	60	Lighthouse <sup>2</sup>	<i>Valeriana officinalis</i>	5	0	10	15	7.3	22.3
86	61	Boreal forest south	<i>Verbascum thapsus</i>	10	0	5	15	4.37	19.4
87	61	Boreal forest north <sup>1</sup>	<i>Verbascum thapsus</i>	10	0	5	15	4.37	19.4
88	61	Limestone cliff	<i>Verbascum thapsus</i>	10	0	5	15	4.37	19.4
89	61	Limestone cobble shore <sup>1</sup>	<i>Verbascum thapsus</i>	10	0	10	20	4.37	24.4
90	61	Limestone lakeshore cliff	<i>Verbascum thapsus</i>	10	0	5	15	4.37	19.4
91	61	Mesic northern forest	<i>Verbascum thapsus</i>	10	7	10	27	4.37	31.4
92	61	Northern hardwood swamp <sup>2</sup>	<i>Verbascum thapsus</i>	10	0	5	15	4.37	19.4
93	61	South dock	<i>Verbascum thapsus</i>	10	0	10	20	4.37	24.4
94	61	Lighthouse <sup>2</sup>	<i>Verbascum thapsus</i>	10	0	10	20	4.37	24.4
86	62	Boreal forest south	<i>Veronica officinalis</i>	10	7	10	27	4.9	31.9
87	62	Boreal forest north <sup>1</sup>	<i>Veronica officinalis</i>	10	7	10	27	4.9	31.9
88	62	Limestone cliff	<i>Veronica officinalis</i>	10	0	5	15	4.9	19.9
89	62	Limestone cobble shore <sup>1</sup>	<i>Veronica officinalis</i>	10	0	5	15	4.9	19.9
90	62	Limestone lakeshore cliff	<i>Veronica officinalis</i>	10	0	5	15	4.9	19.9
91	62	Mesic northern forest	<i>Veronica officinalis</i>	10	7	10	27	4.9	31.9
92	62	Northern hardwood swamp <sup>2</sup>	<i>Veronica officinalis</i>	10	0	10	20	4.9	24.9
93	62	South dock	<i>Veronica officinalis</i>	10	0	5	15	4.9	19.9
94	62	Lighthouse <sup>2</sup>	<i>Veronica officinalis</i>	5	0	5	10	4.9	14.9
86	63	Boreal forest south	<i>Veronica serpyllifolia</i>	5	0	10	15	4.5	19.5
87	63	Boreal forest north <sup>1</sup>	<i>Veronica serpyllifolia</i>	5	0	10	15	4.5	19.5
88	63	Limestone cliff	<i>Veronica serpyllifolia</i>	5	0	10	15	4.5	19.5
89	63	Limestone cobble shore <sup>1</sup>	<i>Veronica serpyllifolia</i>	5	0	10	15	4.5	19.5
90	63	Limestone lakeshore cliff	<i>Veronica serpyllifolia</i>	5	0	10	15	4.5	19.5
91	63	Mesic northern forest	<i>Veronica serpyllifolia</i>	5	0	10	15	4.5	19.5
92	63	Northern hardwood swamp <sup>2</sup>	<i>Veronica serpyllifolia</i>	5	0	10	15	4.5	19.5
93	63	South dock	<i>Veronica serpyllifolia</i>	5	0	10	15	4.5	19.5
94	63	Lighthouse <sup>2</sup>	<i>Veronica serpyllifolia</i>	5	0	10	15	4.5	19.5

areaID	speciesID	Area	Scientific Name ITIS	Presence Score	Status Score	Habitat Score	Total Score	Species Score	Overall Score
86	64	Boreal forest south	<i>Viburnum opulus</i>	5	0	5	10	5.1	15.1
87	64	Boreal forest north <sup>1</sup>	<i>Viburnum opulus</i>	5	0	5	10	5.1	15.1
88	64	Limestone cliff	<i>Viburnum opulus</i>	5	0	5	10	5.1	15.1
89	64	Limestone cobble shore <sup>1</sup>	<i>Viburnum opulus</i>	5	0	5	10	5.1	15.1
90	64	Limestone lakeshore cliff	<i>Viburnum opulus</i>	5	0	5	10	5.1	15.1
91	64	Mesic northern forest	<i>Viburnum opulus</i>	5	0	5	10	5.1	15.1
92	64	Northern hardwood swamp <sup>2</sup>	<i>Viburnum opulus</i>	5	0	5	10	5.1	15.1
93	64	South dock	<i>Viburnum opulus</i>	5	0	10	15	5.1	20.1
94	64	Lighthouse <sup>2</sup>	<i>Viburnum opulus</i>	5	0	10	15	5.1	20.1



