Preserving the Legacy of Michigan's Great Lakes Islands

A Planning Framework and Island Database for Invasive Species Action

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Submitted by:

Michigan Natural Features Inventory

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Some things to know about Michigan's Great Lakes Islands

Island travelers can detach from the frantic pace of life and immerse themselves in the isolation, beauty and simpler lifestyle as if taking a step back in time.

The Great Lakes contain the largest body of fresh water on Earth and boast the largest collection of freshwater islands in the world. They support a globally significant group of diverse flora, fauna, and natural communities that were able to colonize islands or persist on islands following isolation from the mainland.

With the increasing rate of global change, islands represent some of the most fragile and vulnerable resources on the planet

Of all the element occurrences currently reported throughout Michigan, approximately 9.6% are on Michigan's Great Lakes islands. Considering these islands consist of only approximately 1% of the entire area of Michigan, this is highly significant disproportionality.

92% of the colonial waterbirds counted in the 4th decadal survey was observed on islands; this is noteworthy!

Information regarding the distribution of invasive species, their direct impacts as well as impacts of varying management actions on colonial waterbirds are lacking—gathering these data is of utmost importance.

Very few spatial resources met the criteria for ready mobilization and entirely new intermediate datasets were created as part of this project.

Data from aggregators such as GBIF, BISON, and Ecoengine are not rigorously confirmed, and locational accuracy is wide-ranging.

Except for the MISIN data, spatial data for invasive species are a one-shot glimpse in time and will need to be re-queried to acquire the most current data from each source.

Spatial biological and ecological assets are far more available than spatial data that represents social and economic assets.

Many people involved in invasive management know much more about priority invasive species than about Michigan's native systems and requests are mounting for assistance in identifying priority sites, particularly native natural communities.

Michigan has grown by leaps and bounds regarding understanding and framing invasive species action. It is an opportune time to build upon the current wave of activity and innovation and dedicate energy and resources to address invasive species that threaten one of Michigan's greatest treasures – its Great Lakes Islands.

Abbreviations and Accessing Resources

List of Abbreviations

AIS	Aquatic Invasive Species
BISON	Biodiversity Information Serving Our Nation
CABI	Centre for Agriculture and Bioscience International
CARL	Conservation and Recreation Lands
CISMA	Cooperative Invasive Species Management Area
C-CAP	Coastal Change Analysis Program
CWB's	Colonial Water Birds
Ecoengine	Holos Berkeley Ecoinformatics Engine
EDDMapS	Early Detection Distribution Mapping System
EDR	Early Detection and Rapid Response
EGLE	Energy, Great Lakes and the Environment
EO	Element Occurrence
GISD	Global Invasive Species Database
GLAHF	Great Lakes Aquatic Habitat Framework
GLANSIS	Great Lakes Aquatic Nuisance Species Information System
GLCWCI	Great Lakes Coastal Wetland Consortium Inventory
GLEAM	Great Lakes Environmental Assessment and Mapping Project
GNIS	Geographic Names Information System
GSA	Goodyear Spawning Atlas
ICUN	International Union for Conservation of Nature
CABI ISC	CABI Invasive Species Compendium
LTTB	Little Bay Bands of Odawa Indians
MDEQ	Michigan Department of Environmental Quality
MDNR	Michigan Department of Natural Resources
MDOT	Michigan Department of Transportation
MiFI	State Michigan Vegetative Mapping System
MISC	Michigan Invasive Species Coalition
MISIN	Midwest Invasive Species Information Network
MIPC	Michigan Invasive Plant Council
MNFI	Michigan Natural Features Inventory
MDARD	Michigan Department of Agriculture and Rural Development
NAS	Non-indigenous Aquatic Species
NLCD	National Land Cover Dataset
NOAA	National Oceanic and Atmospheric Administration
NPS	National Park Service
PADUS	Protected Areas Database of the U.S.
RC&D	Resource Conservation and Development
SOM	State of Michigan
TIS	Terrestrial Invasive Species
TNC	The Nature Conservancy
USACE	U.S. Army Corps of Engineers
USFWS	United States Fish and Wildlife Service
USGS	U.S. Geological Survey

Accessing Resources Identified with Links

There are many web links throughout this document. Sometimes these links fail when directly clicking on them within the document. It may be necessary to copy these and paste them into your browser to access them. Also, web sites often change over time. Typing the key words of the resources into a google (or other) search engine, will often guide you to the source or to an archive of the resource.

Acknowledgements

This project would not have been possible without the leadership, support and encouragement of many colleagues. We would like to thank Matt Preisser for shining a light on the extraordinary groundwork that has been laid for the conservation of Michigan's Great Lakes Islands, through several decades of research. He has championed the rekindling and expansion of these efforts by gathering baseline data to unite stakeholders across a common island challenge and a leading threat to island integrity: the impacts of invasive species. We deeply appreciate the vision and leadership provided by Christie Deloria in coordinating landscape-scale restoration and conservation of our coastal resources as well as her helpful guidance and support of this project. We offer profound thanks to the other members of our Steering Committee: Christina Baugher, Karen Boase, Seth Herbst, Kevin Walters, Sarah LeSage, Greg Norwood, and Sue Tangora, for their keen interest, insight and support. We have learned from them all during the course of the project as well as through many prior years of collaboration. Similarly, we have benefited from the expertise of other members of the Invasive Species Core and EDR Teams, including John Bedford, Amy Derosier, Joanne Foreman, Anne Garwood, Bill Keiper, Tom Owen, Nick Popoff and Ryan Wheeler. We applaud the CISMAs for their remarkable work throughout the state and are grateful to Nick Cassel for engaging with us to test the *Island Database* to inform planning for Les Cheneaux Islands. It is a privilege to work alongside such passionate and dedicated professionals.

We are grateful to the members of the Northern Lake Michigan Island Collaborative who are leading the way towards sustainable integration of the ecological, social and economic assets of the Beaver Archipelago, especially Pam Grassmick, Jennifer Fettinger and Pat Lederle who have provided dynamic leadership. The groundbreaking research of Judy Soule, Dave Ewert et al., , Karen Vigmostad, Francesca Cuthbert, Bonnie Henson et al. has been invaluable and has deepened our understanding of island values and the critical importance of island conservation. We would also like to thank the USFWS Coastal Program, Little Traverse Bay Bands of Odawa, and the Little Traverse Conservancy whose funding and enthusiasm have enabled us to explore many of Michigan's Great Lakes islands. Our many MNFI colleagues, both past and current, including Josh Cohen, Dave Cuthrell, Yu Man Lee, John Paskus, Mike Penskar, Brian Klatt, Nancy Toben and Ashley Adkins, working together provide a strong collaborative foundation for all of our work, both scientific and administrative, and we thank them all. We appreciate the assistance provided by Noah Jansen and Amanda Klain for various aspects of our investigations. We hope that one day there will be an overwhelming demand for convening an Island Summit to celebrate the enduring successes in stemming the tide of invasive species and increasing the resiliency of our Great Lakes islands.

Executive Summary

The Great Lakes contain the largest body of fresh water on Earth and the largest collection of freshwater islands in the world. They support a globally significant group of flora, fauna, and natural communities, including critically important habitat for colonial waterbird, nesting stopover sites for migratory birds including waterfowl, shorebirds, landbirds and waterbirds as well as critical fish spawning and nursery areas. They face the certain and increasing threat of invasion by non-native species. Due to their size and isolation, many of Michigan's islands are currently less impacted by invasions than on the mainland, yet for these same reasons they are also more vulnerable to them. This report describes a comprehensive effort to gather existing data on Michigan's Great Lakes Islands to create a spatial database of island attributes and an associated references and resources for use in planning and implementing actions to address invasive species.

We reviewed grey and peer-reviewed literature; reports, papers and planning documents and spatial and non-spatial data sets related to Michigan's Great Lakes islands, island biogeography and invasive species. We captured relevant non-spatial information using a Zotero reference management software and exported and converted it to a searchable statewide depository for island information, hosted on Michigan Natural Features Inventory's (MNFI's) website. We identified a list of 93 high priority invasive species within 13 taxa either present or with potential to invade the Great Lakes and compiled an Excel spreadsheet with modes of dispersal for each.

We identified four existing sources of island spatial data and evaluated 178 spatially explicit resources for island geopolitical/geo-physical, ecological, cultural and socio-economic attributes as well as special designations and invasive species characteristics. Additionally, we evaluated 23 secondary resources representing invasive species vectors. Each resource was screened and carefully managed to augment our existing island datasets to produce the most complete and accurate (in location and name) baseline dataset possible of individual Michigan Great Lakes islands.

We reviewed and compiled examples of methods used to prioritize conservation assets and invasive species and examples of case studies of invasive species efforts that have achieved some success. We developed a planning framework and template for action and conducted a pilot-test with the Three Shores Cooperative Invasive Species Management Area (CISMA) in the eastern Upper Peninsula. Summaries of these findings are provided in separate reports. We also identified data and knowledge gaps that need to be addressed over time and identified priority actions for moving forward systematically to address invasive species on Michigan's Great Lakes islands.

A solid foundation has been laid for targeted and strategic invasive species action in Michigan through the pivotal work by key Federal and State agencies and CISMA's across the state. Considerable data has been gathered on Michigan's Great Lakes islands to inform invasive species action, especially with regard to ecological assets in the coastal zone, but survey coverage is uneven and important gaps remain. Less information is available on cultural and socioeconomic assets and how to represent them spatially in order to better integrate them with ecological attributes. Invasive species inventories are spotty, and some data gathered are not reported or spatially mapped. A systematic approach for gathering additional data over time and improving interoperability of data sets is needed. Natural community surveys on North and South Fox islands and Isle Royale are clear

inventory priorities, however, further effort is needed to undertake a more current and comprehensive prioritization of other inventory priorities.

The *Island Database* provides the most current collection of information on Michigan's Great Lakes islands assets to date, and these data can be systematically evaluated along with other island features of importance to identify core areas with the highest potential for long-term resilience. The core areas can be overlaid with important cultural and economic features, invasive species distributions and dispersal pathways to provide the spatial framework for decision-making. These data can be used alongside the accompanying *Guidebook for Planning Invasive Species Action,* to select and implement priority vector-based, species-based and site-based actions.

Ideally, the *Island Database* will become a "living", dynamically updated island spatial dataset, however, many factors limit this today. We encourage user participation in setting this agenda, by exploring the currently available data, contributing data, and providing feedback on and how the database can be improved to better inform decision making.

Top Priorities for Michigan's Great Lakes Islands and Invasive Species

Improving Knowledge of the Status of Island Assets

- Ramp up the spatialization of cultural and socio-economic assets.
- Continue to expand systematic surveys of islands for natural features.
- Re-score islands for determining other priority inventory needs**.**

Improving Knowledge of Invasive Species Distributions on Islands

- Establish mechanisms for streaming real-time invasive species distribution data into the *Island Database.*
- Mine and gather additional spatial data for priority invasive species on islands.
- Encourage the use of the Midwest Invasive Species Information Network (MISIN) mapping and reporting system by islanders.

Invasive Species Prevention

- Post signage and outreach materials at strategic entry points and high public use areas.
- Establish inspection protocols at entry points for islands.
- Conduct boat landing educational blitzes at appropriate locations on islands.

Early Detection and Response/Vector Management

- Establish and implement detection-monitoring protocols at likely entry points and hot spots.
- Establish one or more well-trained strike teams and operational protocols.
- Identify and map all island vectors.

Control

- Conduct systematic shoreline surveys for phragmites and implement prioritized control.
- Inventory funded projects that address invasive species to avoid duplication of effort.
- Use the Island Database to overlay existing data to develop an action plan.

Monitoring Treatments

- Develop and use practical treatment-monitoring protocols for control efforts on islands.
- Use the MISIN treatment tracking or other similar tracking system for all treatments.

Technology

- Equip and train CISMA coordinators to use spatial data tools

Education and Outreach

- Identify and publicize the top 5-10 species for islands within each CISMA
- Conduct training on Michigan's native ecosystems and most vulnerable species
- Establish and provide training on decontamination protocols

Funding

- Initiate a campaign to identify funding sources for address invasive action on islands.

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Introduction

Michigan's Great Lakes Islands

The Great Lakes are remarkable in that they contain the largest body of fresh water on Earth and boast the largest collection of freshwater islands in the world! Great Lakes islands support a globally significant group of diverse flora, fauna, and natural communities that were able to colonize islands or persist on islands following isolation from the mainland. The result is a distinctive island biota with many endemic or rare species with unique genetics. In fact, islands support a disproportionate number of rare species when compared with the mainland. Great Lakes Islands provide essential habitat for colonial nesting waterbirds with refuge from predators and abundant food resources in the surrounding waters. In addition, they provide critically important stopover sites for migratory birds including waterfowl, shorebirds, landbirds and waterbirds as well as critical fish spawning and nursery areas.

Islands have played a great role in our nation's history and have significant cultural and historic value, including the role they played as strategic outposts during wars. Some islands have provided important economic resources to people through forest products, fisheries and other industries. Michigan's islands also hold a certain degree of fascination and attraction for people and have long been a favorite travel destination. Island travelers can detach from the frantic pace of life and immerse themselves in the isolation, beauty and simpler lifestyle as if taking a step back in time. There are opportunities for exploration and recreation, that are increasingly providing the foundation for island tourism. Over 20 islands in the U.S. Great Lakes host communities of people, typically a mix of year-round and seasonal residents and visitors. Island communities, although distinct in character, history and geography share special adaptations to island life as well as common challenges of access to services, support of diversified economies, changing demographics and management of natural, cultural and historical resources (Great Lakes Islands Alliance 2019).

In the 1990s, there was a growing emphasis and body of study on the biological conservation of Great Lakes islands. Soule (1993), in the last known assessment specifically of Michigan's GL islands, recognized that "management policy based on an island-by-island, case-by-case approach can potentially result in degradation of the entire array of islands..." and that "islands must be considered as *a single, irreplaceable resource* and *protected as a whole* if the high value of this natural heritage is to be maintained." Henson et al. (2010) produced a comprehensive spatial database of Great Lakes islands and described their biodiversity values, threats and conservation status. Using an ecologically based analysis they identified the islands and island complexes within the Great Lakes that are the highest priority for conservation action. The hope was that the information in their report would help inform Great Lakes island management and land-use decision making and contribute to the growing global appreciation of Great Lakes biodiversity. Unfortunately, islands have largely fallen off the radar in most management and research discussions either due to lack of awareness, coordination, resources or commitment. The Northern Lake Michigan Islands Collaborative is an exception and provides an excellent model for implementing a coordinated response to invasive species prevention, early detection and strategic control.

Cuthbert et al. (2007) identified two key factors which may play a disproportionately important role in buffering islands from some types of change or rates of change. Islands, especially small ones, are

relatively isolated from the mainland and have microclimates that are modified by the Great Lakes. If temperatures of Great Lakes waters change more slowly than temperatures of the land this may serve to provide a temporary refugia for many species. They also suggest that the isolation of islands may reduce nonanthropogenic dispersal of species when compared to the mainland resulting in a relatively low richness of biota and possibly higher biotic integrity if introduced species don't reach the islands. In addition, human activity which can be a vector for invasive species dispersal is often relatively low due to the expense and logistics of extractive industries such as timber. Thus, islands may provide refuge for species sensitive to climate change and should be conserved to protect these unique species and natural communities.

"Environmentally, islands are noted for their unique fauna and flora which are particularly vulnerable to disturbance and destruction by human activities…. With the increasing rate of global change, islands represent some of the most fragile and vulnerable resources on the planet" (United Nations Environmental Programme 2019).

Our aim is to refocus attention on Great Lakes islands and provide the framework and key tools necessary to manage and conserve these valuable resources.

Invasive species – A Leading Threat to Biodiversity Globally

Invasion by non-native species is one of the most serious threats to biodiversity globally and Michigan's islands are no exception. Due to their size and isolation, many of Michigan's islands are currently less impacted by invasions than on the mainland, yet for these same reasons they are also more vulnerable to them when they arrive. Due to increased global grade, the rate of dispersal of species beyond their natural ranges has increased dramatically. A subset of these species escape, establish in the wild and become invasive, threatening "biodiversity, natural resources, economic development, human health and ecosystem services, such as water resources, nutrient cycles and erosion" (IUCN 2018). Islands are particularly vulnerable to these impacts because of the unique ecological assets they harbor, their reduced ability to buffer impacts due to their size, their lack of exposure to some predators and other pests, and, for inhabited islands communities, their reliance on a steady supply of products coming from elsewhere.

Over the past decade Michigan has advanced exponentially regarding invasive species documentation, management, research, funding and capacity for strategic action. Core teams have been assembled across state agency departments and divisions to focus on aquatic and terrestrial invasive species (AIS, TIS). These include staff from Energy, Great Lakes, and the Environment (EGLE; formerly MDEQ), Michigan Department of Natural Resources (MDNR), Michigan Department of Agricultural and Rural Development (MDARD) and Michigan Department of Transportation (MDOT). Well-vetted statewide AIS and TIS plans have been developed and are currently being implemented. Together, the Core Teams manage the Michigan Invasive Species Grant Program (MISGP) which disseminates funding devoted to strategic invasive species planning, action and research. The program is now in its 6th cycle of funding, with up to $3.6 million in grant funds available annually (MISGP Website, accessed June 20, 2019).

The Midwest Invasive Species Information Network (MISIN) was created for collecting spatial data on the distribution and abundance of priority invasive species and for tracking treatment efforts. It also serves as a hub for collecting and disseminating invasive species information and provides a

platform for dialogue and engagement among practitioners. Cooperative Invasive Species Management Areas (CISMAs) comprised of groups of non-profit and government agencies, businesses and volunteers, have expanded to cover the entire state and are implementing strategic action. The Michigan Invasive Species Coalition (MISC) was created as a guiding body for the CISMAs and holds an annual conference that brings CISMA Coordinators together for dialogue and learning.

Michigan has a long history of island research, revealing a tremendous wealth of biological, cultural and socio-economic assets noted above. With the immediate and increasing threat of invasive species, studying them is not enough. Dedicated and focused efforts to prevent and minimize invasive species impacts on islands are urgently needed. There is a short window of time in which deliberate, prioritized action to stem the invasion of new species, and minimize the impacts of established species can make a tangible difference. If action is delayed, costs will escalate, and successful intervention will become much more difficult, and, in some cases, impossible. **It is an opportune time to build upon the momentum of Michigan's current wave of activity and innovation in invasion science and dedicate energy and resources to address those species that threaten one of the state's greatest treasures – its Great Lakes Islands.**

This study was conducted to gather baseline data on the biological, cultural, and socio-economic assets of Michigan's Great Lakes Islands, the distribution and abundance of invasive species that threaten them, and invasive species planning and management resources that are available to address them. These data are intended to inform the development of a systematic, prioritized approach that builds upon current knowledge, to prevent, manage and mitigate invasion species impacts on Michigan's island resources. These data will be assessed to identify data and research gaps that need to be addressed to improve decision-making and management effectiveness. Project deliverables include this summary report; a searchable bibliography of island and invasive species information, a spatial database for Michigan's islands that can be used for querying and prioritizing; examples of prioritization schemes; some useful case studies, a guidebook for action with a template for management; and a summary of a pilot test of the database and the template that was conducted with the Three Shores CISMA for Les Cheneaux Islands in the eastern Upper Peninsula.

Organization of Report

This report provides an introduction to Michigan's Great Lakes islands and why this project was undertaken, followed by a concise review of the methods utilized. The results and discussion sections provide a summary of our findings on the biological, cultural, and socio-economic assets of the islands and the spatial and non-spatial data gathered during the study. The conclusion section weaves these findings together and highlights top priorities for action based upon current knowledge.

The report does not go into detail on specific sites, priorities or actions; instead four separate documents are provided with the report that provide relevant examples of useful background information and work being accomplished. *Examples of Prioritization Schemes* provides examples of criteria that have been used for prioritizing and ranking island assets and invasive species action. Examples of successful or instructive invasive species management efforts are provided in *Case Studies of Invasive Species Success Stories.* A *Guidebook for Planning Invasive Species Action*

includes a discussion on priority invasive species, key planning principles and resources, a template for action and examples of actions that can be taken. Finally, *Planning for Invasive Species Action on Les Cheneaux Islands* describes a pilot study with the Three Shores CISMA to utilize data gathered from this study for decision-making and implementing action on Les Cheneaux Islands. To reinforce the importance of the less commonly accoladed aspects of successful invasive species management—vision and leadership, coordination and communication, partnerships, policies and procedures, data management and organization capacity—we highlight these documents and associate them with tenets below.

Prioritization Schemes: Look before you leap; you wouldn't spend your *own* money on that.

Case Studies: Get out of your box and talk; there's good stuff to learn from and share.

Guidebook for Action: -Save money; don't reinvent the wheel.

Planning for Invasive Species Action on Les Cheneaux Islands: Move forward strategically; don't succumb to data or monitoring paralysis.

Methods

Work with Island Invasives Steering Committee for Guidance

In addition to the project sponsor, the U.S. Fish and Wildlife Service's Great Lakes Coastal Program, a project steering/advisory committee was convened with the assistance of Matt Preisser from the Michigan Department of Environment, Great Lakes, and Energy (EGLE), formerly of the Michigan Office of the Great Lakes. In addition to Mr. Preisser, this committee was comprised of seven program experts from EGLE's Water Resources Division (including the state's AIS Program Coordinator and Coastal Management Program habitat expert) and Michigan Department of Natural Resources' Forest Resources, Parks, Fisheries and Wildlife (including the state's TIS Program Coordinator) Divisions. We met with the steering committee at the onset of the project and several times throughout the project to share what we had gathered, seek guidance on moving forward, and ensure that the results will be relevant and useful for both federal and state program needs.

Identification and compilation of non-spatial data sources relevant to islands, invasive species and climate change resiliency

We reviewed grey and peer-reviewed literature, the many reports, papers and planning documents provided by DEQ, and spatial and non-spatial data sets, relating to Michigan's Great Lakes islands, island biogeography and invasive species. We scoured the web, accessed relevant databases, queried Michigan's CISMAs and selected island contacts and drew upon our own extensive experience with Michigan's native ecosystems and invasive species, for additional relevant resources. Our focus was on gathering any information that provided relevant baseline data and planning templates and processes for guiding strategic management of invasive species on Great Lakes Islands. Because we anticipated finding an abundance of information, we undertook a "quick gather" assessment of what resources were available, compiled an overview summary, and met with the steering committee for

guidance on how to proceed with a deeper investigation. We met with the steering committee again for additional guidance as we moved forward.

Management of digital information and creation of a searchable bibliography

We identified an application, Zotero, which is a free and open-source reference management software to assist in managing the bibliographic data and related research materials that we identified during our search. This tool was designed to collect, organize, cite, and share research. We created an Island Invasive Project Group with a login and password so that various team members could access and add to the "Island Invasive Library" that we created. As we found articles and reports pertaining to the ecological, cultural and economic values of Michigan Great Lakes islands and invasive species, we entered the information into the Zotero Library manually or by using the Zotero Connector tool in our browser which automatically imports articles and associated information. Zotero captures metadata associated with each article or report including item type; publication; author; title; url; isbn; abstract; date; publisher and other relevant fields. We added manual keyword tags for each article that did not have automatic tags created by the author or authors.

We exported the Zotero Library; "Island Invasives" into an Excel spreadsheet for easy sorting and searching. In order to create a searchable bibliography using key words identified in the manual tags, the Excel spreadsheet was converted into an HTML table and placed into a standalone web page that uses the JQuery JavaScript library and the DataTables JavaScript plugin to provide the sorting and basic text searching ability. This searchable bibliography was placed on Michigan Natural Features Inventory website and is included here: https://mnfi.anr.msu.edu/island-invasives/bibliography.htm

We also exported the information from the "Island Invasives" Library into a bibliography format resulting in a list of references which is included in this report (Appendix 1)., We collected many of the articles and reports cited in the library as PDFs, and these are included in a separate folder with file names as author, date, title.

Identification and Assessment of Vectors and Pathways for Invasive Species

We identified a list of 93 high priority invasive species within 13 taxa that are either present or have potential to invade the Great Lakes. These taxa include algae, annelids, bacteria, birds, bryozoa, crustaceans, fish, fungi, insects, mammals, mollusks, plants and viruses. We then compiled a list of vector categories representing different modes of activity including commercial and recreational fishing, human activity and commerce, natural forces, host vector organisms, commercial and recreational transportation, aquaculture, aquaria, game farming and gardens. Finally, we organized this information into an excel spreadsheet in which we indicated potential modes of dispersal for each of the 93 invasive species.

Genesis of a Baseline Island Spatial Dataset

Four existing sources of island spatial data were identified. The State of Michigan (SOM) and the Michigan Department of Natural Resources (MDNR) island datasets, were identified but these did not contain metadata and it is unclear how they were created. In 2010 the Ontario Ministry of Natural Resources, Natural Heritage Information Centre, Nature Conservancy of Canada, and The Nature Conservancy (henceforth the NHIC) published an international dataset of the Great Lakes islands. This dataset combined Canadian data with National Oceanic and Atmospheric Administration (NOAA) shoreline data, adding missing islands from Ontario parks, the Environment Canada Shoreline Sensitivity Atlas and NOAA Electronic Navigation Charts. The Great Lakes

Aquatic Habitat Framework (GLAHF) in 2014 produced another international Great Lakes island dataset as part of creating a high-resolution shoreline layer for the Great Lakes. In addition to Ontario data, they employed the USGS National Hydrography Dataset (NHD) at 1:24,000 and in some areas manually added polygons.

The table below illustrates the heterogeneity of the four existing island datasets (to the geography of Michigan for the Great Lakes datasets). Our goal was to leverage existing island datasets and other available data to produce the most complete and accurate (in location and name) baseline dataset possible of individual Michigan Great Lakes islands.

Table 1. Comparison of four island spatial data layers

Data Source	Named islands	Total islands	Total area (ac)
SOM	338	1684	424,002
MDNR	308	1866	419,592
NHIC	326*	2442**	426,385
GLAHF	NA	1330	430,348

* Features consisted of islands, island complexes, and partial islands

** The definition of island included point data of reefs, rocks, shoals and other navigational hazards

The existing datasets were visually reviewed over current aerial imagery and USGS 1:24000 digital topographic maps. In some areas there was significant disagreement as shown in the figure on the next page. The question of how to define an island is a dilemma that has been solved by varied methods, presumably for differing objectives. Depending on water levels, fragments of land are connected or disjunct (the purple vs white polygons on the right side of the figure may be illustrating this). The NHIC dataset (yellow) has mapped very tiny polygons in the lower left corner. The two large red polygons at the bottom of the image aren't even islands but they are on the state line which may have instigated their inclusion. Also, locational discontinuities are apparent such as between the yellow and purple rectangular polygons on the lower left.

Figure 1. Islands near Monroe County, SE Michigan, illustrating discrepancies in spatial data.

Ancillary dataset identification

Based on our objective of assembling the current state of geospatial knowledge about Michigan's Great Lakes islands, we discovered and evaluated 178 spatially explicit resources for island geopolitical/geophysical, ecological, cultural, socio-economic attributes, special designations and invasive species characteristics. Additionally, we evaluated 23 secondary resources representing invasive species vectors. Each resource was screened for applicability, quality and scope.

Ancillary data management and processing

Many steps are required to ensure gathered data are accurate and should be made available to users. Commonly required steps include the following:

- Review metadata for each dataset (if available).
- View the data in GIS.
- Quality control the data:
  - check locational accuracy against known controls
  - check subject accuracy and completeness against other data sources (if possible)
  - check that attributes are within reasonable ranges
  - check that the date reflects the currency of the subject information
- Determine whether the dataset will provide unique information and is of suitable quality or can be used with caveats.
- Process acceptable data (may not always include all the following):
  - re-project dataset to Michigan Georef NAD83 meters
  - subset data to the geographic extent of the project
  - store in a file geodatabase, and check/repair feature class geometry
  - document the date, data source, information contribution, file name and storage location in a metadata spreadsheet
  - remove columns that are deemed extraneous
  - remove records that don't meet requirements (e.g. unverified invasive species observations)
  - determine whether qualitative or quantitative attribution is appropriate
  - determine the data relationship (1:1 or 1:M)
  - assess whether intermediate data processing (e.g. merge with other data representing the same subject) is warranted
  - determine the appropriate technique to tag islands with the data – intersect, spatial join (with or without a tolerance distance), tabulate area or zonal statistics for raster data
  - consolidate data if needed (e.g. many occurrence records for a single species on an island need to be consolidated into one record in order to determine species richness)
  - evaluate geoprocessing results against original data, examine islands that did not receive attributes, track number of islands receiving attributes in data spreadsheet

Assessing and Summarizing Relevant Findings

These spatial and non-data gathered were reviewed in their entirety to identify key, known island characteristics and state of the art planning and processes regarding invasive species management. We queried the database to extract examples of data layers that are of general interest or of immediate importance for decision-making and included them in the report body or in the appendices or accompanying documents previously described. With the abundance of available data

gathered, the summary of island characteristics presented here is, of necessity, only the tip of the iceberg. There are dozens of possible queries that can be made. This is precisely why the database was created—to gather the multitude of island data and organize it so that users can query it based on their own needs.

We used these spatial and non-spatial data to develop a planning framework and *Template for Action* and pilot-tested it with the Three Shores CISMA in the eastern Upper Peninsula. We drew upon these compiled data, our learnings from the pilot study and our own professional experience to refine the template and develop a guidebook of possible actions that can be used alongside it. The guidebook includes actions that have been widely or occasionally implemented or suggested by others. We also identified data and knowledge gaps that need to be addressed over time and identified priority actions for moving forward with a systematic approach to addressing invasive species management on Michigan's islands.

Results

Steering Committee Meetings

We held three formal meetings with the steering committee and had conversations with individual committee members during the project. In addition, the project sponsor provided a set of questions for input which we refined and e-mailed to committee members. These interactions are summarized below.

Meeting 1: We introduced the project, its purpose and the need for this work, and introduced the project team. We asked the committee to consider what information would help them make better decisions in their professional capacity as funders, policy-makers, researchers, managers, practitioners or citizens, and to communicate that to us throughout the project.

Meeting 2: We presented and discussed our initial quick-gather of island information and sought input from the committee. Committee members were excited about the amount of data gathered, but recognized it was overwhelming and that we would need to narrow our focus.

Meeting 3: We demonstrated the spatial database and template of key steps for planning and implementing invasive species action, assessing outcomes, adapting management and contributing knowledge to the conservation community. We acknowledged that we were cognizant of the large amount of data and were seeking ways to make it more manageable. There was general agreement that the data was useful, and the template of key steps was good, but it was still overwhelming, and the spatial database needed testing. There was also feedback that the outline of key steps was biased towards site-based management, at the expense of vector- and species-based approaches. The suggestion was made to refine, and pilot test the use of the template and database with the Three Shores CISMA, focusing on Les Cheneaux islands. This would both test their applicability and usability and narrow our scope to a practical application.

Individual input provided by members of the committee:

Several additional key points were made by individual committee members including: a) the need for a data layer showing all boat launches and related vectors on the islands, b) the need to emphasize the social component of invasive species management, and c) the suggestion that we

define up front an overarching goal of protecting biodiversity. As a result of these interactions, we reframed our *Template for Action* to more explicitly consider vector-based, species-based and site-based approaches. We refined the database and made it accessible via a password protected web mapping application on ArcGis Online to the Three Shores CISMA Coordinator, Nick Cassel. We also provided Nick access to MNFI's element occurrence data for the Les Cheneaux region, as well as invasive species and potential vector spatial data. We met with him to walk through the template and show him how to use the database. We queried him about the challenges and successes he has had as a CISMA Coordinator to help inform our deliverables. We acknowledge the social component necessary for successful action, but also note the need for growth in this arena. Much of the available data on islands assets is biodiversity-focused and we provide key examples of prioritizing action based on the identification of elements of biodiversity as conservation targets; however, it was not our task to define management goals for the state or others, rather to gather data that could be assembled queried, and organized as needed based upon the user's own needs.

Summary of Non-spatial Data Sources

Identification, Compilation and Management of Non-spatial Data Sources

Our search for articles, reports and planning documents relevant to islands, invasive species and climate change resiliency resulted in the compilation of 256 references which we organized into a searchable bibliography. This information was used to identify additional datasets which we incorporated into the island spatial dataset. It can also be used to guide future planning and inform research and management efforts. We hope that this resource can evolve over time with the contribution of new items in the future.

Summary of Spatial Database Sources, Attributes and Data

Creation of a Baseline Island Spatial Dataset

Four existing sources of island spatial data were identified, as described in the methods section. The table below illustrates the heterogeneity of the four existing island datasets (to the geography of Michigan for the Great Lakes datasets). The bottom row is the subsequent baseline island dataset we built for this project. Our goal was to leverage existing island datasets and other available data to produce the most complete and accurate (in location and name) baseline dataset possible of individual Michigan Great Lakes islands. A list of data sources is provided in Appendix 2 and a list of data attributes that were collected is included in Appendix 3.

Table 2. The MNFI Island Database compared with previous island datasets.

Data Source	Named islands	Total islands	Total area (ac)
SOM	338	1684	424,002
MDNR	308	1866	419,592
NHIC	326*	2442**	426,385
GLAHF	NA	1330	430,348
MNFI (The *Island Database*)	440	1709	427,635

* Features consisted of islands, island complexes, and partial islands

** The definition of island included point data of reefs, rocks, shoals and other navigational hazards

After extensive visual inspection, the NHIC dataset seemed to be the best choice to serve as our starting point. However large islands in this dataset (Drummond, St Martin, Channel Island, Harsens Island) were split into two or more pieces. Also, there were very small polygons created from buffered points of navigational hazards (rocks or shoals). The metadata for the Michigan *Island Database* includes the detailed steps we followed to build our island dataset. In short, we converted the island complexes into individual island features, merged the split islands, removed 701 tiny polygons that originated from navigational hazard points, repositioned approximately 50 polygons, digitized 35 additional islands, and added 87 names to existing island polygons. Our baseline island spatial dataset consists of 1709 island features with 440 named islands.

Ancillary datasets

Based on our objective of assembling the current state of geospatial knowledge about Michigan's Great Lakes islands, we discovered and evaluated 178 spatially explicit resources for island geopolitical/geophysical, ecological, cultural, socio-economic attributes, special designations and invasive species characteristics. Additionally, we evaluated 23 secondary resources representing invasive species vectors. Each resource was screened for applicability, quality and scope. We identified 112 resources that we could use to create 189 island attributes.

Very few spatial resources met the criteria for ready mobilization as described in the data gap summaries in the results section. Additionally, entirely new intermediate datasets were created as part of this project as shown in the table below.

We created a spatial dataset of Cuthbert's 4th Decadal Great Lakes Colonial Waterbird Survey (Cuthbert and Wires 2013) sites, species composition, and nest estimates from the report pages. The report also identifies sites that are Colonial Waterbird Priority Sites, Common Tern Priority Sites, and Marsh Tern Priority Sites and we added those attributes to the dataset.

Table 3. Intermediate tables and datasets created for this project.

Type of Information	Type of data
Rare species and high-quality natural communities	Related table
Historic sites	Related table
Management plan(s)	Related table
Invasive species	Related table
CISMA summary statistics of islands and biodiversity	Table
Points from Cuthbert's 4th decadal Great Lakes Colonial Waterbird Survey	Dataset
Watch list invasive species county presence for the greater Great Lakes basin	Datasets (28)

We created a consolidated land ownership dataset from multiple, sometimes conflicting and individually incomplete sources. Variation was resolved and digitizing errors were repaired as much as possible. Our dataset is likely still missing some non-governmental organization land and probably local and county land because these entities do not all have spatial data.

We created one invasive species dataset from six different sources, resolving differences in scientific and common names, verification status, and handling differences in locational accuracy and data formats. These include the Midwest Invasive Species Information network (MISIN), Non-indigenous Aquatic Species (NAS), Great Lakes Aquatic Non-indigenous Species Information System (GLANSIS), Early Detection & Distribution Mapping System (EDDMapS - Michigan Department of Natural Resources (MDNR) Forest Health dataset, and distribution of various invasive species data gathered for projects conducted by MNFI prior to the creation of the MISIN.

For each Michigan watch list invasive species (State of Michigan 2018), we produced a county range dataset for the greater Great Lakes states using the combined invasive species dataset. Some invasive species records from EDDMapS lacked spatial coordinates but did list the county and state where the invasive species was found. We also integrated those records into our county range datasets. Michigan's watch list species are listed in the Priority Invasive Species Section of this report and Appendix 4 includes the set of range maps for the Greater Great Lakes states.

We re-digitized approximately 386 Natural Heritage Database element occurrences (EOs) (MNFI 2019) in the Isle Royale area. They were the sole remaining area in Michigan that had not been re-digitized since the MNFI Natural Heritage Database was converted from latitude longitude locations with an estimated locational uncertainty into a spatial database. By analyzing the original field survey form, which sometimes included hand-drawn maps, the spatial location of the element could typically be more accurately represented. This intermediate step was done to increase the accuracy of the overlay of EO's and the 457 islands in the Isle Royale complex.

Islands were given quantitative (e.g. great blue heron count, rare species count, coastal wetland acres) or qualitative attributes (e.g. Designated USFS Wilderness Area, Motorcycle Designated trail, Oil/Gas Extraction) as appropriate to the ancillary dataset. Most of the attributes have a 1:1 relationship with an island, but four have a 1:M (1 to many) relationship by way of related tables in the geodatabase (historic sites, unique invasive species, unique rare species and natural communities, master plans).

Summary of Island Spatial Data

Number of Island features (island or island groups) and sizes
The table below summarizes the total number of island features and named islands in the project dataset and their total acreage and shoreline miles. It also lists the 14 largest islands which make up 90% of the total island area.

Table 4. Number of island features and named islands.

Totals	Total Acres	Total Shoreline miles
1709 islands	427,685	1537
440 named islands	425,950	1323
These fourteen islands below make up 90% of total island area ordered from largest to smallest.		
1. Channel Island (Isle Royale)	6. North Manitou Island	11. Grosse Isle
2. Drummond Island	7. Grand Island	12. Garden Island
3. Beaver Island	8. Neebish Island	13. Marquette Island
4. Sugar Island	9. Harsens Island	14. High Island
5. Bois Blanc Island	10. South Manitou Island	

The graph below is the histogram of the log of island area in acres. A value of 0 on the x axis represents an area of 1 acre. Island area is negatively skewed, with most islands less than 1 acre in size. According to Wyman et al. 2018 islands as small as 0.5 hectares may be used by colonial waterbirds, but double-crested cormorants (who nest with other birds) can use less area. The importance of these small islands has not been quantified, but they are likely most vulnerable to changing water levels and extreme events that are forecast for the future.

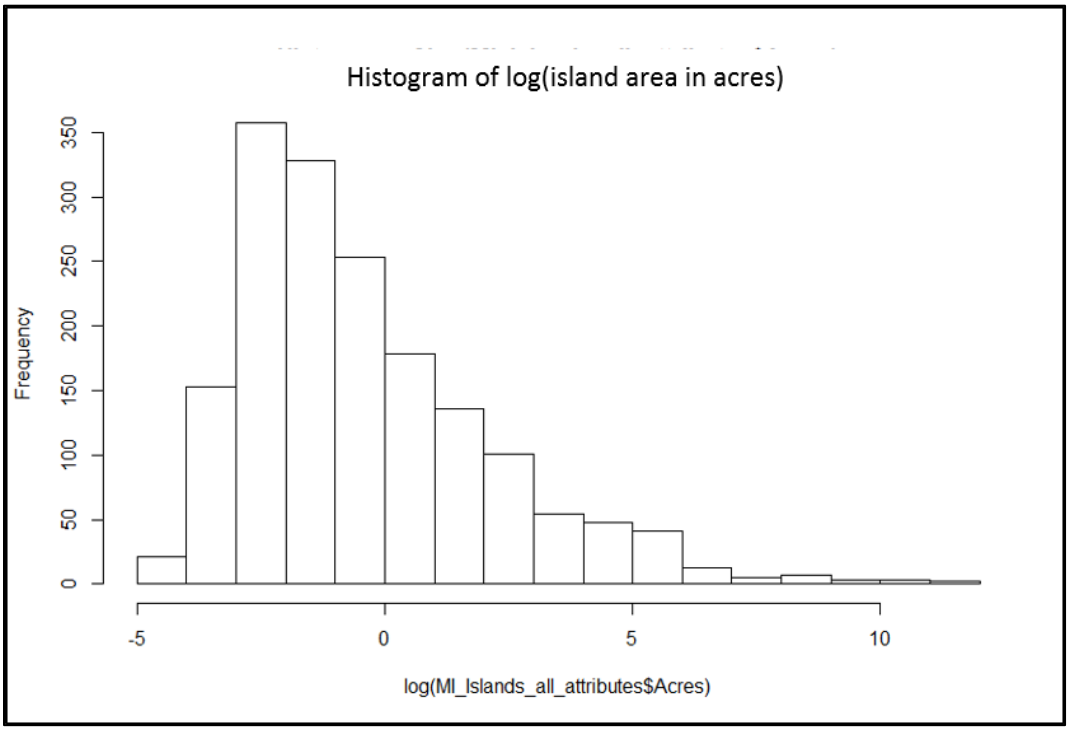

Figure 2. Histogram of the log of island area showing most islands are less than one acre in size.

Summary of Islands in the Great Lakes and Selected Geopolitical Characteristics

The number of islands in each Great Lake, their percentage of the total number of islands and their total island acreage is shown below, followed by a list of several available geopolitical characteristics of interest.

Table 5. Summary of island numbers and area by waterbody.

Waterbody	Number of Islands	% of Total Number	% of Total Island Acres
Lake Superior	900	53%	4.8%
Lake Huron	514	30%	28.6%
Lake Michigan	113	7%	18.1%
Georgian Bay	95	6%	0.6%
Lake St. Clair	56	3%	4.6%
Lake Erie	31	2%	0.4%

Table 6. Summary of selected island geopolitical characteristics.

Summary of Selected Geopolitical Characteristics	
County with greatest number of islands	Chippewa
County with greatest island area	Keweenaw
Percent of counties with no islands	(57/83) 68%
Highest number of islands in a twp. (Houghton Twp.)	334
Second highest number of islands in a twp. (Sugar Island Twp.)	197
Third highest number of islands in a twp. (Drummond Twp.)	131
Number of islands where township not designated	87
Number of islands with master plan(s)	80
Number of islands with permanent residents	16
Number of islands have a connection to mainland (bridge/road)	44
Number of islands with a school	7
Maximum distance to mainland (an unnamed island)	26.6 miles
Mean distance to mainland (CA or MI)	5.6 miles
Mean distance to land (CA or MI island or mainland)	147 meters
Number of islands < 2 meters above current water level*	1356

*Army Corps of Engineers March 2018 water level
*10-meter digital elevation model

Ownership Data

Island ownership data was combined from Conservation and Recreation Lands 2017, Tribal Lands layer from the DNR, Land Conservancy internal data and Protected Areas Database 1.4 (USGS 2016). These data are approximate because the ownership databases have some conflicting information, and all are incomplete. However, they provide critical baseline information that can be used for decision-making and prioritizing action; these data will be in constant evolution. The table below summarizes available data, showing the number of island acres in majority ownership categories and total number of islands in non-private ownership categories. A total of 747 islands are 100% non-privately owned (the non-private ownership categories aren't exclusive, so this total is not the sum of the last column in the table below). The largest privately-owned island is Big Saint Martin Island in Lake Huron, which encompasses 821 acres.

Table 7. Island area summarized by ownership category.

Majority Owner	Island (ac)		Non-private* Ownership Category	Number of Islands
State	195,452		NGO**	36
Federal	178,252		Public land**	705
NGO	39,239		State Park	55
Local	5,062		State Game Area	177
Tribe	430		University presence	4
County	404		*public land includes both state park and state game areas	
Private - Easement	171		**likely incomplete: not all NGO's have spatial data; islands can have public land, NGO and University presence.	
Private	8,674			

Natural Heritage Database (NHD) Element Occurrence (EO) Data

The table below displays the number of unique EO's, federally listed and Great Lakes endemic species and natural communities. *Of all the EO's currently reported throughout Michigan, approximately 9.6% are on Michigan's Great Lakes islands. Considering these islands consist of only approximately 1% of the entire area of Michigan, this disproportionate distribution is highly significant.* Also, these data only represent occurrences for islands that have been surveyed to date. Systematic surveys of rare and endemic species, and high-quality natural communities have not been conducted throughout the islands and undoubtedly more occurrences will be documented. Currently 898 islands have at least one occurrence of a rare species or high-quality natural community and 69 islands have federally listed plants or animals. The high representation of biodiversity elements on Michigan's Great Lakes islands underscore the need for dedicated resources for inventory and strategic action to fortify them against the impacts of invasive species. *Of the 1,970 EOs that occur on islands, it was surprising that 1,339 or 68% have not been surveyed in the last 20 years.*

Table 8. Number of unique rare species or natural community types on islands.

Category	Unique Species or Communities on Islands
Rare animals (E, T, SC)	106
Federally listed animals	12
Great Lakes endemic animals	7
Rare Plants (E, T, SC)	150
Federally listed animals	5
Great Lakes endemic plants	4
Natural communities (NC)	38
Great Lakes endemic NC's	10

*****~9.6% of the MNFI NHD records are on Great Lakes islands, while the islands comprise only ~1**%** of the total area of Michigan.

A list of rare species on Michigan's Great Lakes Islands is found in Appendix 5 and a list of the high-quality natural communities is in Appendix 6. Appendix 7 provides a list of definitions of Global and State ranks and Federal, State status.

Colonial Waterbirds (CWB's), Migratory Bird Stopover Habitat and Fish Spawning Data

The tables and discussion below summarize data on CWBs, migratory stopover and fish spawning habitat for three taxonomic groups that are heavily reliant on island resources. We show these data together here, since these elements of biodiversity are repeatedly cited in Great Lakes Planning documents and literature as the most critically reliant on Great Lakes island habitats. During the time of this study, we were able to gather quite detailed information on CWBs and migratory bird stopover habitat, however, we acknowledge that there is a large body of fish literature that is not fully captured here. It would be useful to mine additional data sources on the status of fish habitat associated with Great Lakes islands to augment the *Island Database*.

Table 9. CWB presence and priority designations, migratory bird stopover habitat and fish spawning data.

Category	Number of Islands/Acres
Some documented colonial waterbird presence*	307
Quantitative data of colonial waterbirds by species**	106
Designated as a Colonial Waterbird Priority Site***	38
Designated as a Common Tern Priority Site***	6
Designated as a Marsh Tern Priority Site***	16
Waterfowl habitat****	715 acres
Shorebird habitat****	207 acres
Landbird habitat****	2,217 acres
Fish spawning locations*****	All islands 1709
Range in number of spawning fish species per island*****	1-36

*Data source CWB presence: MNFI, Cuthbert, BISON

**Quantitative data: Cuthbert's 4th Decadal CWB Survey (1-38,001 birds)

***Priority Site Designations: Cuthbert's 4th Decadal CWB Survey

****Stopover Habitat: TNC Stopover model. Did not include Lake Superior; the resolution of data (30 m raster) missed many smaller islands

***** Goodyear Fish Spawning Atlas, IFR Spawning Update from GLAHF, MNFI

Colonial Waterbirds

Colonial waterbirds are recognized as a significant and unique biological resource in the Great Lakes ecosystem with close to a million nesting in the U.S. Great Lakes annually. The U.S. Fish and Wildlife Service and the Canadian Wildlife Service have conducted four census efforts for colonial waterbirds in the Great Lakes region, beginning in the mid-1970's, to gather information on their distribution and population trends to inform their conservation and management. In addition, coastal and nearshore areas in the Great Lakes, provide globally important stopover sites for all groups of migratory birds including waterfowl, shorebirds, landbirds (raptors and songbirds) and waterbirds. Many of the coastal aquatic and terrestrial landscapes in the Great Lakes that once supported

migrating birds have been degraded or lost, yet the region still supports hundreds of millions of migrants during both spring and fall migration (Ewert et al. 2012).

During the breeding seasons of 2007-2009, Cuthbert and Wires (2013) surveyed shorelines and islands in the U.S. Great Lakes and their connecting waters to gather information on estimates of the number and distribution of breeding pairs of colonial waterbirds. They compared these data to population estimates from previous census efforts dating back to the 1970's and used the Wires and Cuthbert (2001) prioritization method to identify the most important waterbird colony sites in the U.S. Great Lakes. The estimates of number and distribution compiled by Cuthbert and Wires are shown in the table below.

Table 10. Colonial waterbird quantitative data by waterbody (Cuthbert and Wires 2007-2009 survey data)

Water-body	No islands	Island min area (ac)	Island avg area (ac)	Sum AWPE	Sum DCCO	Sum GBHE	Sum GREG	Sum BCNH	Sum HERG	Sum CATE	Sum COTE	Sum BLTE	Sum FOTE	Sum RBGU	CWB Total
Georgian Bay	3	0.87	24	0	108	37	0	6	112	28	0	0	0	2427	2718
Erie	1	274	274	0	0	2	0	250	0	0	0	0	0	0	252
Huron	19	0.58	38	0	4866	210	443	319	5794	289	26	0	0	61904	73851
Michigan	27	1.00	363	17	22161	100	15	71	9351	778	104	0	0	56521	89118
Superior	54	0.06	625	0	1522	158	0	3	3253	0	452	0	0	5824	11212
St. Clair	3	80	1058	0	0	194	0	0	0	0	0	32	16	0	242

Abbreviations: AWPE=American White Pelican, DCCO=Double-crested Cormorant, GBHE=Great Blue Heron, GREG=Great Egret, BCNH=Black-crowned Night-Heron, HERG=Herring Gull, CATE=Caspian Tern, COTE=Common Tern, BLTE=Black Tern, FOTE=Forster's Tern, RBGU=Ring-billed Gull, CWB=Colonial Waterbird

Cuthbert and Wires (2013) recommend transitioning from the complete decadal count of CWBs to more frequent, less intensive surveys including 1) monitoring a subset of important sites for the general colonial waterbird group and Common Terns, and 2) monitoring of all sites used by marsh terns due to significant declines in these species. They suggest documenting the extent of non-native phragmites invasion of coastal areas utilized by marsh terns to determine the how it may have impacted their numbers. This would inform where and how restoration activities could be the most helpful. They also recommend tracking and sharing information regarding landscape scale changes that may affect colonial waterbird populations in the future. Understanding how factors such as climate change, water level change, cormorant control, gull control, land use change, spread of invasive species, disease outbreaks and oil spills impact colonial waterbirds, are needed to inform conservation efforts. Developing effective ways of delivering historical and future monitoring data to the bird conservation and restoration community is a priority.

Using our *Island Database* (Michigan data only), we calculated that *92% of the colonial waterbirds counted in the 4th decadal survey was observed on islands; this is noteworthy!* The U.S. Fish and

Wildlife Service has sponsored Great Lakes waterbird surveys in previous years and it is expected that they will continue to support these efforts in the future. More widespread knowledge of threats and priority areas will help target the best use of these funds. Information regarding the distribution of invasive species, their direct impacts, and the impacts of varying management actions on CWB's, are lacking—gathering these data is of utmost importance. Our work with partners over the last decade, on islands of the Beaver Archipelago, in the Grand Traverse Bay region, and throughout the Upper Peninsula, have demonstrated both a significant presence of invasive phragmites and its successful management through early detection and response. These successes should to be expanded throughout Michigan's Great Lakes islands to ensure the protection of CWB populations.

Migratory Bird Stopover Habitat

Ewert et al (2012) identified and scored attributes of areas that serve as important stopover sites for migratory birds near the Great Lakes shorelines, and then used these attributes, to map potential stopover habitats across the basin. Their results demonstrate that the most intact landscapes provide the most suitable stopover habitat when contrasted with more highly altered landscapes. The maps provided by this research indicate that stopover habitat for landbirds is currently most available along and near the northern shorelines of Lakes Michigan and Huron and the eastern portion of Lake Ontario and in shortest supply in southern Ontario along Lakes Huron, Erie, and Ontario and connecting waters. Models developed by Ewert et al (2012) indicate quite a bit of overlap between stopover habitat for shorebirds and waterfowl and that waterfowl stopover habitat occurs in the many bays around the Great Lakes and connecting waters between the Great Lakes (e.g. St. Mary's River, Detroit River and Niagara River). Plans include disseminating this information more widely through outreach materials and they have created a web portal that provides data access for analytical applications: https://lccnetwork.org/resource/great-lakes-migratory-bird-stopover-portal

Fish Spawning Habitat

Fish spawning data was available from the GLAHF and consisted of data mostly from the Goodyear Spawning Atlas (Goodyear et al. 1982) plus more recently published spawning locations (Institute for Fisheries Research 2011). An island's spawning territory was determined to be a five-mile buffer of the island (Goodyear et al. 1982) and the number of unique fish species spawning within an island's territory was tallied. All islands have at least one fish species documented spawning within their nearshore habitat.

Landcover, Streams and Lakes

Land cover data is derived from satellite imagery and in raster format, generally with a pixel size of 30 m (900 m^2). The area of 714 islands is less than that of one pixel. One rule of thumb when using raster data is that the smallest object appropriate to resolve should be at least 4 pixels in area. Using this rule, 607 islands (36%) met the criteria. Seven of those islands (Round Island in Lake Michigan; Manitou, Grand, Granite, Lighthouse, and Cattle Island in Lake Superior) were outside the spatial extent of the most recent land cover dataset for Michigan, the C-CAP Regional Landcover (NOAA 2016). Landcover for those seven came from the National Landcover Dataset (USGS 2011). Land-cover illustrates an issue common to all ancillary data that is in raster format (e.g. stopover habitat, resilience, elevation). The small area of most of the islands precludes the use of raster ancillary data.

Table 11. Overall island landcover class proportions; islands with hydrologic features.

Landcover Type, Stream, Lake	%/Number of Islands
Deciduous forest*	25%
Forested Wetland*	19%
Evergreen Forest*	16%
Mixed Forest*	13%
Non-forested Wetland*	9%
Open Water*	5%
Shrubland*	3%
Presence of a river or stream**	29
Presence of an inland lake**	36

*NOAA C-Cap 2016 land cover and USGS NLCD 2011 Landcover
**Michigan Framework v17a hydrology

USFWS Midwest Regional Coastal Program Focal Species and Focus Areas

The USFWS Midwest Regional Coastal Program developed a strategic work plan for 2017-2021 using surrogate species as its foundation (Boyer et al. 2017). They refined their Coastal Program focus areas by intersecting the distribution of coastal surrogate species with locations of important migratory bird stopover habitat and identifying hotspots of overlap. The surrogate species and focus areas are shown below. The Green Bay and Urban Opportunity Focus Areas are outside of the scope of Michigan's Great Lakes islands but are included here for reference.

Table 12. Focus areas and focal species defined by the USFWS Midwest Regional Coastal Program.

Focus Areas Focal Species	Saginaw Bay	Straights of Mackinac	W. Lake Erie- Lake St. Clair	W. Lake Superior	Green Bay	Urban Oppor-tunity Area
Black Tern	X	X	X		X	
Blue-winged Teal	X	X	X	X	X	
Brook Trout		X		X		
Canada Warbler	X	X	X	X	X	X
Common Tern	X	X	X	X	X	X
Dwarf lake iris		X			X	
Hine's Emerald Dragonfly		X			X	
Lake Sturgeon	X	X	X	X	X	X
Houghton's goldenrod	X		X		X	X
Monarch	X	X		X	X	X
Piping Plover			X			

The focal species were selected based on an extensive vetting process to identify species, that if protected, would serve to protect a host of other important species and natural processes. We queried the *Island Database* to quantify their presence throughout Michigan's Great Lakes islands. Data

sources for black and common tern presence were the Cuthbert and Wires surveys (2013) and the MNFI Natural Heritage database. Brook trout presence was ascertained with the MDNR fish atlas and the Lake Michigan brook trout collection from Great Lakes Geographic Information System. Blue-winged teal and Canada warbler locations were selectively obtained from BISON. Dwarf lake iris and Houghton's goldenrod presence relied only on the MNFI database. Hine's emerald dragonfly and piping plover presence came both from the MNFI database and USFWS Critical Habitat data. Lake sturgeon data came from MNFI database, the DNR fish atlas, and the Goodyear spawning atlas. Finally, monarch butterfly data was accessed from GBIF and Ecoengine.

Data from aggregators such as GBIF, BISON, and Ecoengine are not rigorously confirmed, and locational accuracy is wide-ranging. We screened the locations from those sources by data provider, coordinate uncertainty estimates if available, and expert opinion. The results summarized below indicate that 303 islands potentially have at least one focal species present. Beaver Island has the highest number (8) of focal species potentially present, however, it has received greater survey attention than many other islands due to the presence of the Central Michigan University Biological Station, which has an active research and education program. These data are shown in the table below.

Table 13. Number of islands with potential for at least one focal species.

Potential USFWS Focal Species Presence Category	Number of Islands
Potentially have at least 1 focal species	303
Most focal species potentially found on 1 island (Beaver Island)	8
Islands within a USFWS Focus Area	491

Special Designations

Numerous sources were queried for special designation status based upon input from the steering committee. These included many state sources; federal sources from the Protected Areas Database of the U.S., National Parks Service, U.S. Geological Survey, U.S. Environmental Protection Agency, U.S. Forest Service, U.S. Fish and Wildlife Service, and National Oceanic and Atmospheric Administration Marine Protected Areas Database. Other designations were obtained from Audubon Important Bird Areas, RAMSAR Wetlands of International Importance, and the USFWS Midwest Region Coastal Program Focus Area Plan. The number of dedication categories and number of islands with at least one of them is displayed below and all the designation categories are compiled in Appendix 8.

Table 14. Islands with special designations.

Designation Category	Number of islands with at Least One Designation of Specified Category
19 State designations	329
15 Federal designations	1175
3 Other designations	654

Cultural Designations

Many Great Lakes islands have a rich history and cultural value that is difficult to quantify with spatial data. Significant tribal sites are particularly absent from our ancillary data. We were able to identify islands with archaeology sites, shipwrecks nearby, wild rice (*Zizania*), lighthouses, and historic markers. The table below lists number of islands having a resource, but we suspect the data for the first four may be incomplete.

Table 15. Cultural resources and islands.

Cultural Resource	Number of islands
Islands that contain an archaeology site	642
Islands within 250 meters of a shipwreck	17
Islands that have wild rice presence	8
Islands that have a lighthouse	31
Number of islands that have a total of 48 State historic markers	11
Number of islands that have a total of 85 National Register of Historic Places designations	51

Socio-economic Features Tied to Potential Vectors

The following island features identified as potential vectors for dispersal of invasive species were available for our spatial data set. These were obtained through the Michigan Framework v17a, DNR trails layer, LIAA.org water trail layer, other state data layers, and the Army Core of Engineers harbors data. The existence of a connection by a ferry to the mainland and possibly other islands was attributed manually by visual inspection and checked against a list of ferry services on the MDOT web site. These vectors can be considered along with our overall vector assessment of likely dispersal modes for the 93 species we considered (Appendix 9).

Table 16. Number of islands with potential vectors for invasive species dispersal.

Feature/Vector	Number of Islands
Islands with roads (density 0 – 30 mi/mi2)	45
Islands with state trails other than water trails	13
Islands with a water trail within 100 meters	597
Islands with a BAS, ACE Harbor or MDOT port	16
Islands with a marina	21
Islands with an airport	10
Islands with ferry service	16
Islands with a connection to mainland (bridge/road)	44
Islands with some shoreline modification (docks, groins)	89

Other spatial data that represent potential vectors are listed below, however; they don't intersect currently with islands and could not be included in the *Island Database*.

Table 17. Additional vectors represented by spatial data.

Additional Spatial Vectors
Great Lakes vessel tracklines and density from automatic identification system (AIS)
Aquaculture locations
Minnow dealer locations
State and Federal fish hatcheries

Invasive Species

We were able to gather spatial distribution data from the MISN, NAS, GLANSIS, and EDDMapS. Except for the MISIN data, these data are a one-shot glimpse in time and will need to be re-queried to acquire the most current data from each source. This is not a quick or seamless process as described in detail below in the section on *Data Gaps.* In addition, we queried selected island personnel to determine if they had any other invasive species distribution data or knowledge that is not currently in the MISIN or any other publicly viewable database. The results of these queries indicate that there are indeed other sources of data that could be mined to improve the cumulative distribution maps for invasive species. It is likely that this is the case for many funded restoration projects already completed or currently on-going.

The table below provides some general summary statistics from the currently available invasive species distribution data for Michigan's Great Lakes islands (as of March 1, 2019). Despite the data gaps noted above, the accumulation of these data is a remarkable achievement and these data are growing rapidly. This is in large part due to the deliberate requirement of MISGP-funded projects to enter their data into the MISIN. But there is also a growing awareness of the importance of reporting occurrence data by stakeholders throughout the Great Lakes. These data are enabling practitioners to make better decisions, demonstrate what is working and what is not, and improve the focus of future work.

Table 18. Known invasive species distribution data on islands.

Invasive Species Category	Number of Islands or Species Count
Islands with an invasive species mapped	206
Range of number of unique invasive species on an island	0-43
Islands with at least one MI watchlist invasive species	43
Number of different MI watchlist species currently mapped on islands	6
Islands with a high (top 100) AIS risk for plants, inverts or fish (TNC 2018)	143
Number of unique invasive species on islands overall	164
Number of islands that are part of at least one master plan; note that not all plans mention invasive species	80

Summary of CISMA Data

Nine CISMAs (out of 21 total) contain Great Lakes islands within their purview as shown on the next page. We summarized the island dataset by CISMA for number and size characteristics of the

islands; ecological characteristics of islands including stream/river length, lake area, coastal wetland area, mean spawning species; MNFI EO numbers, rare species richness, natural community type richness, Great Blue Heron Rookery, Federally listed species and endemics counts; and the number of unique invasive species present on islands within the CISMA.

The nine CISMAs average 190 islands each with a range of 9-637 islands (Northwest Michigan CISMA, Three Shores CISMA respectively). Three Shores CISMA has the highest total area of islands (169,090 ac), almost 40% of all island area.

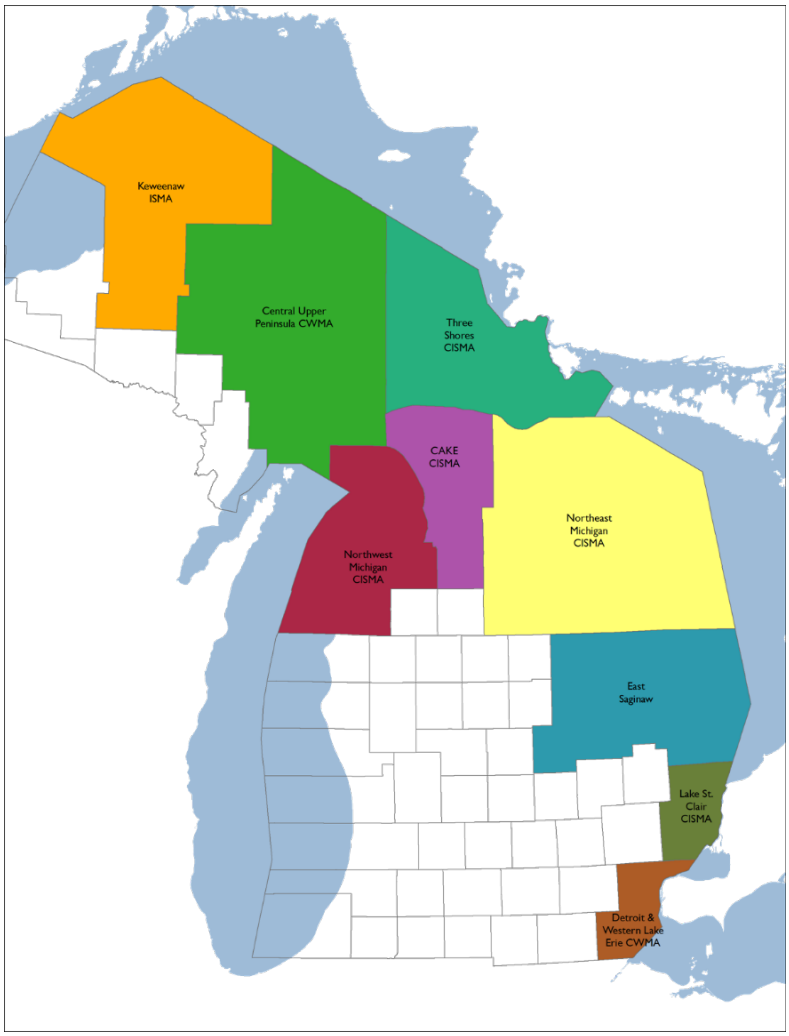

Figure 3. Michigan CISMA's with Great Lakes islands.

Keweenaw ISMA islands contain over 176 miles of river/stream and almost 9000 acres of lakes, far greater than any other CISMA. They also contain the maximum number of EOs (702) and unique rare plant species (82), the plant species richness being almost twice that of the next highest CISMA. Three Shores CISMA islands list 49 unique rare animal species, followed closely by Detroit & Western Lake Erie CWMA with 44. Twenty-one natural community types are documented within the Three Shores CISMA islands, followed by the CAKE CISMA islands with 19. CAKE CISMA

islands also has the highest number of Great Lakes endemics at 14. CISMAs in southern Michigan show the highest number of fish spawning species with Lake St. Clair CISMA islands and Detroit & Western Lake Erie CWMA islands averaging 32 and 29 species respectively. Detroit & Western Lake Erie CWMA islands have the highest number of unique invasive species with 85 species documented. A summary of the CISMAs associated with islands is provided in Appendix 10.

Spatial Data Gaps

There are many potential limitations to the currently available spatial data relating to islands and invasive species that are summarized below. These do not necessarily preclude action; in fact, they *must not* preclude action if we are to make a difference for Michigan's Great Lakes islands. However, these gaps need to be acknowledged up front in order to move forward in the most strategic fashion possible and so that solutions can be targeted and realized over time. Key data limitations that we identified are discussed below. These follow the categories from Island Conservation (2018).

Data processing barriers limiting interoperability

An ideal product from this project would be a "living", dynamically updated island spatial dataset. As of today, many factors limit our ability to create this dataset. Spatially, data come in many different projections, datums, or geographic coordinate systems and scales which can impact consistency among datasets. Errors in coordinates or representational uncertainty in spatial location complicates the effectiveness and accuracy of matching data with island polygons as most data are not already tagged by island.

Geographic-based barriers aren't the only concern. Subject-based barriers are also prevalent. Often no single dataset is the definitive source for the subject. A single-subject attribute can be represented by different data formats (e.g. point, polygon, raster). Taxonomic barriers prevented the easy merger of invasive species data sources because scientific and/or common names were not consistent among sources. Incomplete or inconsistent land ownership in several datasets required an intermediate processing step to resolve these issues. Live-data access barriers will need to be addressed before our ideal product can be possible.

Of specific importance for this project, only one source of Great Lakes invasive species location data (MISIN) is available as a regularly updated web service. Most of the other invasive species data sources require time-consuming web queries and downloads, usually of comma-delimited text files. NAS does have real-time data that is accessible via an application programming interface (API), however it does not return spatial data (JSON, rather than GeoJSON), is difficult to merge with other data sources and takes some skill to employ. Web services have become more common in recent years, but most of the ancillary data sources used in our product were not available as web services.

Data mobilization barriers

Many resources that we would have liked to include are not in spatial format, but rather in reports, web pages, or journal articles. We compiled these resources into a searchable bibliography. The 256 articles documented can be searched using the title, publication date, author or keyword in order to identify relevant resources. This bibliography can be updated to include additional articles and publications. Metadata, information about date, scale, quality, and sources of spatial data, while now

a requirement of federal government data, were still lacking for many of our ancillary datasets. This limits the immediate use of the dataset and the information we can communicate to others. Accessibility of datasets can also be a barrier. Data in MNFI's Natural Heritage Database are sensitive and not publicly available, therefore limiting the immediate availability of information and analyses for others. Some datasets are not available online and tracking down the holder of the data can be very time-consuming, e.g., GLEAM data (Allan et al. 2015) including marinas, boating access sites, and docks.

Geographic data gaps

Data collection is generally uneven across land ownership categories. Public land typically has more information than private land and larger or populated islands generally have more data available. Small islands or those far from the mainland are excluded from many analyses because their area is below the resolution of raster data, e.g., (landcover or digital elevation models), or they are located outside of the extent of a specific dataset (e.g., some national datasets).

Data subject gaps

Cultural data gaps include important cultural areas, tribal resources and historical data. Some of these data are also sensitive and therefore may not be publicly available. Ecological gaps across all islands consist of plant/animal species data not tracked by MNFI (e.g. USFWS focal species, migratory birds), islands that have not been surveyed for rare species or natural communities, nearshore environment characteristics (e.g. substrate, bedrock, wave exposure, bathymetry), shoreline conditions and classification, and data on destructive species (e.g. deer, racoon). Socio-economic data gaps include tourism or island seasonal visitation and population, birding sites, special events, and hunting and fishing. Invasive species vector data gaps include dredging and habitat fragmentation at the scale of most small islands.

Priority Invasive Species for Michigan's Great lakes Islands

Compilation of existing data

Global attention has been focused on identifying the highest threat invasive species that are likely to invade areas of interest. It is important to prioritize those species that pose the greatest risk to values specified in a planning area, so that available resources can be used efficiently and effectively to protect the most important assets—there are never enough resources to accomplish everything. Risk assessment is an active arena of research and application in the Great Lakes region and Michigan is no exception. While there is no single approved list of priority invasive species, there are lists of watch list species, prohibited and restricted species and noxious weeds; the latter two have legal standing. There are many other lists that are generally agreed upon by stakeholders, but do not necessarily have legal status or that may have legal status in one or more states but not in others and have varying levels of enforcement (see, for example, the Wisconsin Department of Natural Resources Invasive Species Rule - NR 40 (WDNR 2009; Appendix 11). A summary of various lists for the Midwest Region is provided on the Midwest Invasive Plant Network website (MIPN last updated June 2019; Appendix 12. While this list is not restricted to the Great Lakes basin, it is useful as a comparison between Great Lakes states and may also be useful for pin-pointing regional priorities within the Great Lakes. We note that there are often disagreements regarding certain species, sometimes vehement ones, but caution against getting caught up in species-specific turmoil at the expense of the big picture and instead recommend moving forward as strategically as possible on those things that matter the most.

Because Michigan's Great Lakes islands span the entire Great Lakes basin it seems prudent to consider all high impact species recognized regionally so they are on the radar and don't come as a surprise, and to capitalize on the extensive regional and national expertise that has gone into identifying them. Individual decisions about the species most likely to invade an area of interest can be determined by the planning team for a given area. Invasive species management occurs at multiple scales and over different time spans and priorities will differ accordingly. Early detection species for the Great Lakes region, such as Asian carp, are not likely to be the highest priority on Beaver Island, for example. Of more immediate concern there, is to ensure the eradication of the only known occurrence of garlic mustard (*Alliaria petiolata*) and the sustained control of invasive phragmites, both of which have been a resounding success. However, Asian carp should still be on their radar for the future, due to the presence of suitable habitat and the anticipated impacts.

A species such as water hyacinth (*Eicchornia crassipes*), considered to be one of the top 100 worst invaders in the world (GISD, 2019) may not be an immediate concern on Beaver Island or other Michigan islands today, but could be in the future due to changes in climate. The goal is to try to capture the universe of species that have a high likelihood of establishment once they arrive or whose potential impacts are high, and establishment is likely under future climate scenarios. Action in the short-term can focus on high impact species that are already established or have the potential to arrive soon, while maintaining a long-term awareness of future potential invaders. Species can always be removed from a list if they are determined at some point not to pose a significant risk or high likelihood of establishment. Several examples of prioritizing invasive species are provided in the accompanying *Examples of Prioritization Scheme* document.

We compiled and reviewed existing data from the abundant resources available regarding invasive species of risk to the Great Lakes region and to Michigan's islands. Primary sources included the EGLE, MDNR, MDARD, MISIN, MIPN, Non-indigenous Aquatic Species (NAS), GLANSIS, WDNR, Global Invasive Species Database (GISD), CABI Compendium of Invasive Species, NatureServe, Early Detection and Distribution and Mapping System (EDDMapS), and Invasive.org. Four lists for Michigan's islands are summarized below. The first two are official approved lists with legal status; the third is the State of Michigan Watch List. The fourth, is an unofficial working list of species that we identified were recognized regionally to be of some concern for Michigan's Great Lakes islands.

Michigan's Prohibited and Restricted Species List

Species on this list are legally designated by the State of Michigan as either prohibited or restricted. These species are unlawful to possess, introduce, import, sell or offer for sale as a live organism, except under certain circumstances. The plants, fragments, seeds or a hybrid or genetically engineered variant are specifically prohibited. Prohibited species are not widely distributed in the state and safe and effect management or control techniques are not available for many of them. Restricted species are already established in Michigan, but management and some control practices are known for most of them. Both prohibited and restricted species are known to have significant impacts to the economy, environment or to human health. While this list is highly informative, it is not by any means a definitive list of the species that pose the greatest risk to Michigan and its islands. There are many other species established in Michigan that pose similarly significant or even greater risks but are not yet on this list for various reasons. The Prohibited and Restricted lists were

established through Michigan's Natural Resources Environmental Protection Act (Part 413) of Act 451 and can be amended by Invasive Species Orders.
https://www.michigan.gov/documents/mdard/Michigan_Prohibited_and_Restricted_Weeds_641413_7.pdf

Table 19. Michigan's prohibited plant species.

Scientific Name	Common Name	Other Designation
	Algae	
Cylindrospermopsis racibarskii	cylindro	
	Terrestrial/Wetland Plants	
*Fallopia japonica***	Japanese knotweed	
Heracleum mantegazzianum	giant hogweed	
	Aquatic Plants	
*Egeria densa**	Brazilian elodea	Watch List
Hydrilla verticillata	hydrilla	Watch List
Hydrocharis morsus-ranae	European frog-bit	Watch List
Lagarosiphon major	African oxygen weed	
*Myriophyllum aquaticum****	parrot-feather water-milfoil	Watch List
Nymphoides peltata	yellow floating heart	Watch List
Salvinia molesta, auriculata, biloba, or *herzogii*	giant salvinia	
Stratiotes aloides	water soldier	Watch List
*Trapa natans****	water chestnut	Watch List

*Synonyms: *Elodea densa, Anacharis densa, and Philotria densa*; **includes hybrids with *Fallopia sachalinensis* known as *Fallopia* x *bohemica;* ***Synonyms: *M. brasiliensis*, *M. brasiliense*, *M. proserpinacoides* and *Enydria aquatica*

Table 20. Michigan's restricted plant species.

Scientific Name	Common Name	Other Designation
	Terrestrial Plants	
Elaeagnus umbellata	autumn olive	
Lythrum salicaria	purple loosestrife	
Phragmites australis	(non-native) phragmites	
	Aquatic Plants	
Butomus umbellata	flowering rush	
Myriophyllum spicatum	Eurasian water-milfoil	
Potamogeton crispus	curly leaf pondweed	

Table 21. Michigan's prohibited animal species.

Scientific Name	Common Name	Other Designation
	Birds	
Streptopelia decaocto	Eurasian collared dove	
	Crustaceans	
Dikerogammarus villosus	killer shrimp	
Procambarus clarkii	red swamp crayfish	Watch List
Cherax destructor	yabby crayfish	
	Fish	
Apollonia melanostomus	round goby	
Channa argus	northern snakehead	Watch List
Ctenopharyngodon idella	grass carp (fertile)	Watch List
Gymnocephalus cernuus	Eurasion ruffe	
Hypophthalmichthys molitrix	silver carp	Watch List
Hypophthalmichthys nobilis	bighead carp	Watch List
Leuciscus idus	ide	
Mylopharyngodon piceus	black carp	Watch List
Proterorhinus semilunaris	tubenose goby	
Pseudorasbora parva	stone moroko (topmouth gudeon)	
Rhodeus sericeus	bitterling	
Sander lucioperca	zander (pike-perch)	
Scardinius erythrophthalmus	rudd	
Silurus glanis	wels catfish	
Tinca tinca	tench	
	Insects	
Anoplophora glabripennis	Asian longhorned beetle	Watch List
Adelges piceae	balsam woolly adelgid	
Agrilus planipennis	emerald ash borer	
	Mammals	
Myocastor coypus	nutria	Watch List
Sus scrofa	feral swine	
	Mollusks	
Candidula intersecta	wrinkled dune snail	
Cantareus aspersa	Brown/common garden snail	
Hygromia cinctella	girdled snail	
Lissachatina fulica	giant African snail	
Monacha cartusiana	Carthusian snail	
Xerolenta obvia	heath snail	
Potamopyrgus antipodarum	New Zealand mudsnail	Watch List

Table 22. Michigan's restricted animal species.

Scientific Name	Common Name	Other Desigation
Dreissena polymorpha	zebra mussel	
Dreissena rostriformis bugensis	quagga mussel	
Misgurnus anguillicaudatus	Japanese weatherfish	
Orconectes rusticus	rusty crayfish	

Michigan's Prohibited Noxious Weed List

This list focuses on species that are of primary impact to agriculture. Prohibited noxious weed seeds cannot be contaminants in seed offered for sale, including any sold under an older scientific name (synonym). Restricted noxious weed seeds must not be found in quantities greater than one seed per 2000 in agricultural seed offered for sale, including any sold under an older scientific name (synonym). Some of these species also pose a risk to native ecosystems, such as spotted knapweed (*Centaurea stoebe*) and Canada thistle (*Cirsium arvense*), and some are on the Prohibited and Restricted list. We captured these and others that are impacting native ecosystems in a more comprehensive working list of priority invasive species described below, following the description of Michigan Watch List Species. Michigan's list of noxious weeds is provided in Appendix 13.

Michigan's Watch List Species

Species on the State of Michigan's Watch List have been identified as posing an immediate or potential threat to Michigan's economy, environment or human health in accordance with the definition provided in the National Invasive Species legislation adopted during the Clinton administration. These species have only a limited distribution in Michigan or have not yet been confirmed in the wild here. These are species that Michigan hopes to prevent from ever arriving in Michigan or to respond to effectively to eradicate or stop from spreading into new areas. https://www.michigan.gov/invasives/0,5664,7-324-68002_74188---,00.html

Table 23. Michigan's watch list species.

Scientific Name	Common Name	Other Designation
Tree pests and diseases		
Anoplophora glabripennis	Asian long-horn beetle	Prohibited
Adelges tsugae	Hemlock Woolly Adelgid	
Adelges piceae	Balsam Woolly Adelgid	Prohibited
Pityophthorus juglandis + Geosmithia morbida	Thousand Canker Disease	
Mammals		
Mycorcastor coypus	Nutria	Prohibited
Fish & Other Aquatic Species		
Channa argus	Northern Snakehead	Prohibited
Ctenopharyngodon idella	Carp - Grass	Prohibited
Hypophthalmichthys molitrix	Carp - Silver	Prohibited
Hypophthalmichthys nobilis	Carp - Bighead	Prohibited
Mylopharyngodon piceus	Carp - Black	Prohibited

Table 23. Watch List Continued

Scientific Name	Common Name	Other Designation
Potamopyrgus antipodarum	New Zealand Mud Snail	Prohibited
Procambarus clarkia	Red-swamp crayfish	Prohibited
Insects		
Lycorma delicatula	Spotted lanternfly	
Terrestrial Plants		
Achyranthes japonica	Japanese Chaff flower	
Carex kobomugi	Asiatic sand sedge	
*Dioscorea oppostifolia**	Chinese yam	
Impatiens glandulifera	Himalayan balsam	
Microstegium vimineum	Japanese stiltgrass	
Persicaria perfoliate	mile-a-minute weed	
Pueraria montana var. *lobata*	kudzu	
Aquatic Plants		
Egeria densa	Brazilian Elodea	Prohibited
Eichhornia crassipes	water hyacinth	
Hydrilla verticillata	hydrilla	Prohibited
Hydrocharis morsus-ranae	European frog-bit	Prohibited
Marsilea quadrifolia	European water-clover	
Myriophyllum aquaticum	parrot-feather water-milfoil	Prohibited
Nymphoides peltate	yellow floating heart	Prohibited
Pistia stratioites	water lettuce	
Trapa natans	water chestnut	Prohibited

*Some taxonomic uncertainty
**tree diseases list the scientific name for the pathogen or fungus associated with the disease

Working List of Priority Invasive Species in the Great Lakes Region

We originally identified 93 species of concern for Michigan's Great Lakes islands focused primarily on species with high impacts that are not well established in the Great Lakes or are on the lists noted above. After considering this list and our knowledge of islands where we have conducted some invasive species distribution mapping, we added 78 additional medium to high impact species to this list. These additional species are already common in many places on the mainland, but may either be absent, or uncommon on many of Michigan's islands and therefore may be considered prevention or early detection and response species there. The *Island Database* can be queried to determine if there are known, mapped occurrences for any of these species in the user's area of interest and these can be compared against the vector analysis (Appendix 9) and available descriptive information on the biology and impact level for each. These species can then be organized into action categories, like the A-D list categories used in *Meeting the Challenge of Invasive Species: A Framework for Action* (Higman & Campbell 2009). These categories correspond to 1) prevention, 2) early detection and response, 3) asset-based control and 4) gather more information action categories. We modified these categories slightly here, by splitting the asset-based control category into species into those

that are mostly local and those that are widespread. Assessing each species to rank their impact level was beyond the scope of this project, however, this would be a highly useful product.

Table 24. Action categories.

A-E List Action Categories	
A List Species:	Medium to high threat; not present in area; implement strategic prevention measures.
B List Species:	Medium to high threat; mostly isolated occurrences; treat wherever found, if success is likely and adequate resources are available.
C List Species:	Medium to high threat; mostly local—found in some areas but not others; designate areas for eradication, containment or control; EDR where uncommon; contain or control where common if success is likely and adequate resources are available.
D List Species:	Medium to high threat; widespread; no action required; may choose to control based on site assets and management goals, and if success is likely and adequate resources are available.
E List Species:	More information required: Is it truly invasive with big impacts? Are effective control techniques known? May choose to control based on site assets and management goals if success is likely and adequate resources are available. Could monitor for spread or perhaps implement a research project in collaboration with experts.

This is a simple, yet highly effective framework for sorting out information for decision-making, when overwhelmed by all the possible species that need to be addressed and the many actions that can be taken. Local knowledge should be incorporated in the area of consideration and the species assigned to action categories refined accordingly. These categories can be used to capitalize on actions that address multiple species at the same time. We emphasize that we did not conduct any risk-analyses ourselves to develop this list, rather we pulled from the abundant information already available. The list is clearly not fixed in stone and will evolve over time, but it provides a starting point from which to improve on over time. The working list is provided in Appendix 14.

Vectors and Pathways

Extensive work has also been undertaken globally to identify how invasive species are transported to new areas and their pathways of spread. Michigan's AIS Management Plan (2013) exemplifies this vector approach, with three primary goals focused on prevention and early detection and response. Virtually every plan we reviewed includes prevention and EDR and many planning documents emphasize these activities over containment, control and restoration, because they are considered the most cost-effective approaches to mitigating invasive species impacts. We discuss the critical importance of identifying high value places on the landscape to compliment these approaches in the following section. We reviewed 93 species on our working list of priority invasive species and categorized their likely vectors. The general categories shown below were examined and sub-categories were determined within each (Appendix 9).

Table 25. Overarching vector categories.

Overarching Vector Categories	
Food/Fishing - Commercial	Host Vector Organisms
Food/Fishing - Recreational	Transportation/Commercial/Trade
Human activity & Commerce	Transportation - Recreational
Natural Forces	Aquaculture/Aquaria/Game farms/Gardens

Islands, Invasive Species and Climate Change Resiliency

There is mounting evidence that climate change factors will exacerbate invasions of non-native species by increasing range expansions and the superior competitiveness of invasive species. The impacts of a changing climate and island resilience will vary depending upon intrinsic factors such as island area and configuration, topography, soils, age and ecological complexity as well as extrinsic factors such as natural disasters, magnitude and rate of climatic interactions, regional character, local human influences and socioeconomic factors (Harter et al. 2015 and Reaser et al. 2007). Invasive species simplify systems and reduce resiliency of natural systems and are a significant threat to biodiversity and ecosystem integrity. Islands of low biodiversity and community complexity are most vulnerable due to climate change disruptions of ecological interactions.

Climate change resilience and invasive species management should be considered simultaneously in island conservation planning. Identifying, maintaining and fortifying intact natural systems on islands is one of the best-known strategies for increasing resilience to climate change. Courchamp et al. (2014) emphasize that the removal of invasive species from islands is one of the most powerful tools for preventing extinctions and restoring ecosystems. Furthermore, Lipton et al (2018) in the Fourth National Climate Assessment, emphasize that focusing on prevention, eradication and control of invasive species and implementing early detection and response (EDR) is an adaptation strategy that helps maintain healthy ecosystems and biodiversity, thereby increasing the resistance and resiliency of natural systems to climate change.

Lipton et al (2018) assert that the best adaptive strategies are flexible, consider the emerging and interactive impacts of climate and other stressors and are coordinated across local and landscape scales. In addition, they suggest that new technologies and novel approaches to both invasive species management and adapting to climate change could reduce negative impacts. Falk (2016) promotes the “resilience ecology” approach which emphasizes combined strategies of enhancing resistance (e.g. survival and persistence), and reorganization (allowing new suites of species to colonize an area that may be more adaptive under new conditions) and facilitating geographic migration of species.

Conclusions and Recommended Priorities

A solid foundation has been laid for targeted and strategic invasive species action in Michigan through the pivotal work by key Federal and State agencies. Key funders are working to direct resources towards planning, management and monitoring in the most important places, and towards areas of research with the most information needs. CISMAs cover the entire state and are working

through regional cross-jurisdictional partnerships, and the MISC is providing overarching guidance, information and tools and education to empower them.

Considerable data has been gathered on Michigan's Great Lakes islands to inform invasive species action, especially with regard to ecological assets in the coastal zone, but survey coverage is uneven and important gaps remain. Less information is available on cultural and socioeconomic assets and how to represent them spatially in order to better integrate them with ecological attributes. With the exception of some of the islands in the Beaver archipelago, invasive species inventories are spotty, and some data gathered are not reported or spatially. mapped. There are issues with data mobilization and operability that need to be resolved. A systematic approach for gathering additional data over time and improving interoperability of data sets is needed. Yet there are numerous case studies and ample data available to act on; and in fact, it is urgent that we do so.

Several clear inventory priorities identified by MNFI include updating and expanding previous natural community surveys on North and South Fox islands and "de novo" natural community surveys on Isle Royale. MNFI ecologists have delineated priority survey areas for these three islands. Surprisingly, Isle Royale, the largest of Michigan's islands has never been systematically surveyed for natural communities.

Further effort is needed to undertake a more current and comprehensive prioritization of ecological inventories. New element occurrence data gathered in the *Island Database* can be used to augment and refine the inventory priorities identified by Soule (1993). Soule used additional criteria than simply where and when surveys have occurred to identify priority inventory needs by considering the *potential* for natural features to occur on individual islands. Factors used for assessing this included physical features and known natural features on neighboring islands and the adjacent mainland. The accompanying report, *Examples of Prioritization Schemes,* provides an overview of several other schemes for prioritizing based on biodiversity values and anticipated impacts and distributions of specific invasive species.

The *Island Database* provides the most current collection of information on Michigan's Great Lakes islands assets to date, including information on high quality ecosystems that have been surveyed and mapped. These data can be systematically assessed along with other island features of importance to identify core areas with the highest potential for long-term resilience. This will inform the three-pronged approach to addressing invasive species described in the accompanying *Guidebook for Action*. A site-based approach is used to identify and prioritize these core areas (sites), and vector and species-based approaches are used to identify target species and their current distribution and dispersal pathways in relation to the core areas. These data layers can be overlaid providing the spatial framework for selecting priority invasive species actions, including all action categories, such as surveys, outreach and education, blocking vectors, assigning special designations, EDR or implementing on-the-ground management.

Ideally, the *Island Database* would become a "living", dynamically updated island spatial dataset, however, many factors limit this today. We encourage user participation in setting this agenda, by exploring the currently available data, contributing data, and providing feedback on and how the database can be improved to better inform decision making to prioritize invasive species action.

Top Priorities for Michigan's Great Lakes Islands and Invasive Species

Improving Knowledge of the Status of Island Assets

- ***Ramp up the spatialization of cultural and socio-economic assets for use in planning for and prioritizing invasive species action.*** There are a lot more data on important biological diversity on Michigan's islands than on cultural and socio-economic assets. These additional datasets are needed for planning purposes in order to protect them from negative impacts from invasive species.
- ***Continue to expand systematic surveys of islands for natural features.*** Many islands lack complete data on biological diversity, particularly natural communities and rare plants and animals, and much of the existing data is old.
- ***Re-score islands for determining other priority inventory needs.*** It has been nearly 20 years since the last scoring process. Significant survey effort has been conducted since Soule recommended priority inventories in 1993 and this new information has been incorporated into the *Island Database*. The next step is to select scoring criteria and rescore Michigan's islands. Criteria that have been used previously in Michigan and elsewhere are provided in the accompanying *Examples of Prioritization Schemes* report.

Improving Knowledge of Invasive Species Distributions on Islands

- ***Establish mechanisms for streaming real-time invasive species distribution data in the Island Database.*** Currently the MISIN data is the only source that is regularly updated; other sources must be queried for current data which is time consuming and far from seamless.
- ***Mine and gather additional spatial data for priority invasive species on islands*** to optimize the use of the *Island Database* for invasive species management planning.
    - Inventory current or previously funded projects that address invasive species on islands for data that can be imported into the MISIN.
    - Spatialize additional invasive species distribution data that are known on islands but are not mapped in the MISIN or another spatial database.
- ***Encourage the use of use the MISIN mapping and reporting system by islanders.*** Identify and implement a strategy that includes training and technical expertise in identifying and reporting priority invasive species.

Invasive Species Prevention

- ***Post signage and outreach materials at strategic entry points and public use areas on islands.*** Utilize existing and/or establish materials as needed
- ***Establish inspection protocols at entry points for islands***, emphasizing those most heavily used.
- ***Conduct boat landing blitzes at appropriate locations on islands.***

Early Detection and Response/Vector Management

- ***Establish and implement detection-monitoring protocols at likely entry points and hot spots.***
- ***Establish one or more well-trained strike teams and operational protocols*** for early detection assessment and response on Michigan's islands for priority invasive species.
- ***Identify and map all island vectors*** and determine how to measure vector strength

Control

- ***Conduct systematic shoreline surveys*** for phragmites, reed canary grass and non-native cat-tails and implement control.
- ***Inventory funded projects that address invasive species*** on islands to leverage funding and expertise, build synergies and avoid duplication of effort.
- ***Use the Island Database to overlay existing data*** on island assets, invasive species distribution, points of entry and vector pathways. Identify important places where control is warranted and achievable. Develop a strategic plan of action to demonstrate to potential funders that funds will be used effectively.

Monitoring Treatments

- ***Develop and use practical treatment-monitoring protocols*** for control efforts on islands.
- ***Use the MISIN treatment tracking or other similar tracking system*** for all treatments.

Technology

- ***Equip and train CISMA coordinators to use spatial data tools*** such as ArcMap and ArcGIS to inform the planning and prioritizing of invasive species action. A common topic of discussion among CISMA coordinators is the lack of access to spatial tools due to costs, the ephemeral nature of funding and staff turn-over. The ability to plan effectively requires spatial analysis.

Education and Outreach

- ***Identify the top 5-10 species for islands*** within each CISMA jurisdiction and conduct invasive species "*101*" for islanders
- ***Conduct training on Michigan's native ecosystems and most vulnerable species*** for Michigan's island stakeholders.
- ***Establish and provide training on decontamination protocols*** to prevent and minimize the spread of invasive species on islands.

Funding

- ***Initiate a campaign to identify funding sources*** for work to address invasive species on Great Lakes islands – Federal and State agencies, NGOs, foundations, conservancies, philanthropists.

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Appendix 2

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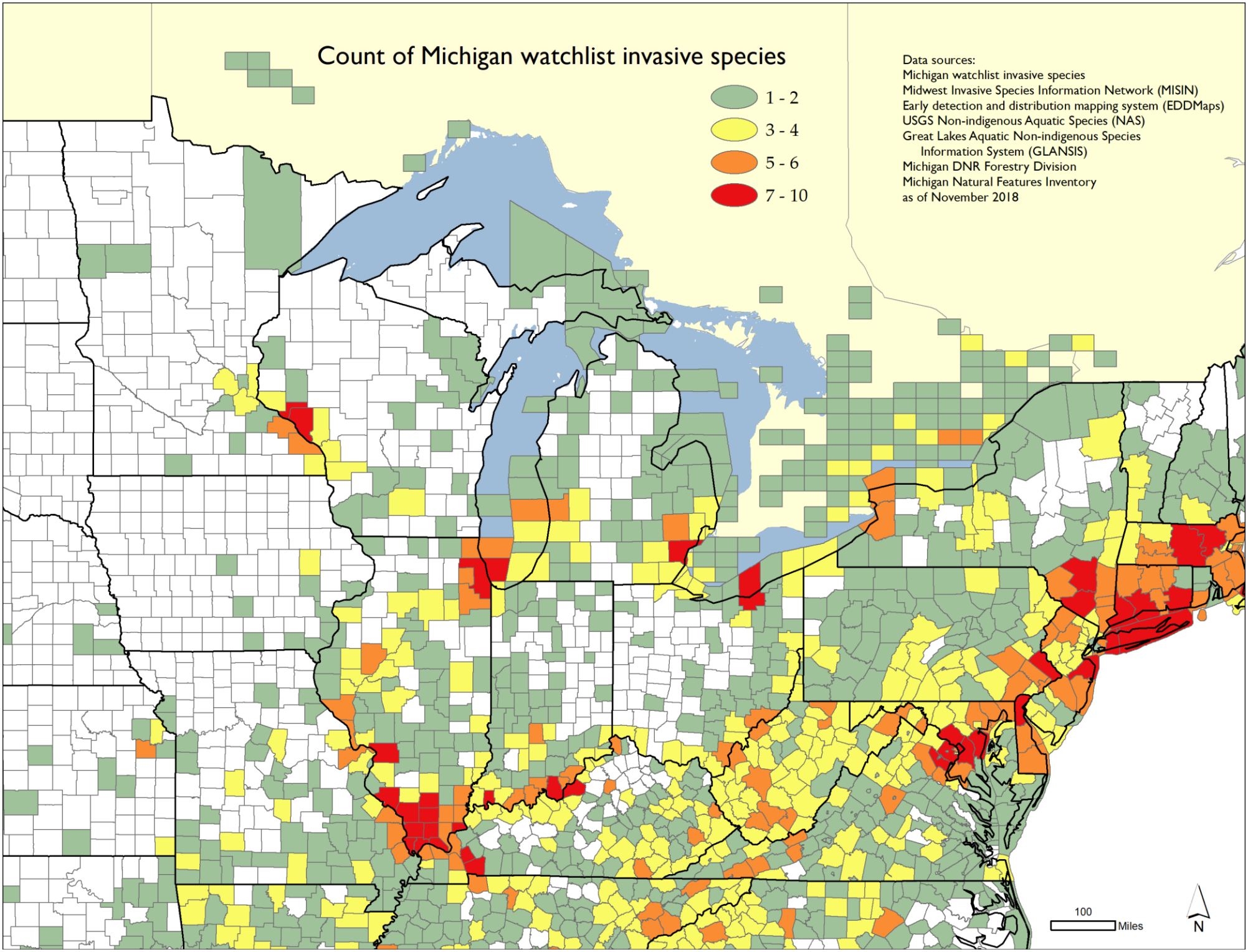
Appendix 3.

Michigan Great Lakes Islands Attribute Table

See the spreadsheet "Digital Appendix 3 MI GL Islands attribute table.xlsx"

Appendix 4

Watch List County Range Maps


Count of Michigan watchlist invasive species
1 - 2
3 - 4
5 - 6
7 - 10
Data sources:
Michigan watchlist invasive species
Midwest Invasive Species Information Network (MISIN)
Early detection and distribution mapping system (EDDMaps)
USGS Non-indigenous Aquatic Species (NAS)
Great Lakes Aquatic Non-indigenous Species
Information System (GLANSIS)
Michigan DNR Forestry Division
Michigan Natural Features Inventory
as of November 2018
100
Miles
N


Asian longhorned beetle
Anoplophora glabripennis
Data sources:
Midwest Invasive Species Information Network (MISIN)
Early detection and distribution mapping system (EDDMaps)
USGS Non-indigenous Aquatic Species (NAS)
Great Lakes Aquatic Non-indigenous Species
Information System (GLANSIS)
Michigan DNR Forestry Division
as of July 2019
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Miles
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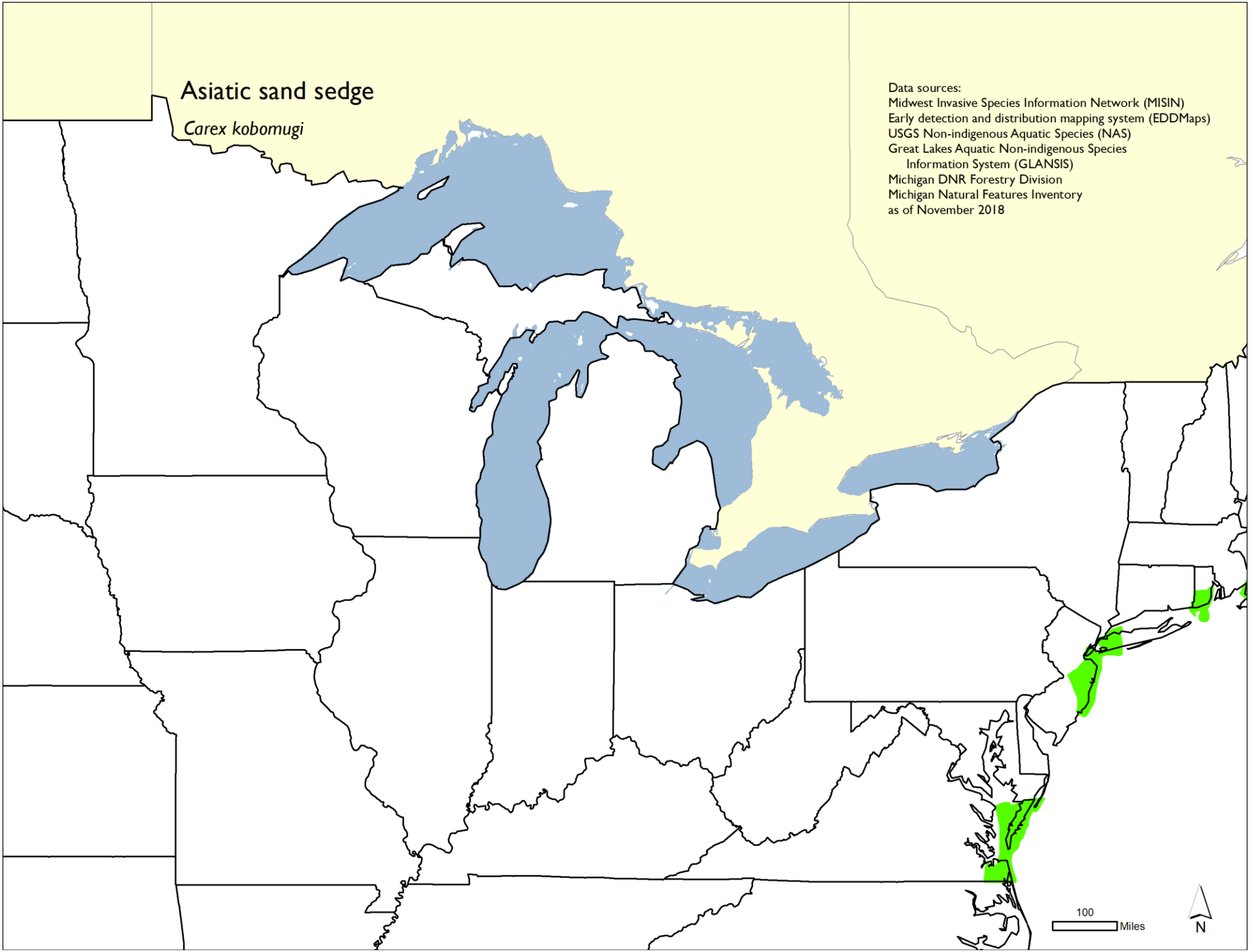
Asiatic sand sedge
Carex kobomugi
Data sources:
Midwest Invasive Species Information Network (MISIN)
Early detection and distribution mapping system (EDDMaps)
USGS Non-indigenous Aquatic Species (NAS)
Great Lakes Aquatic Non-indigenous Species
Information System (GLANSIS)
Michigan DNR Forestry Division
Michigan Natural Features Inventory
as of November 2018
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Miles
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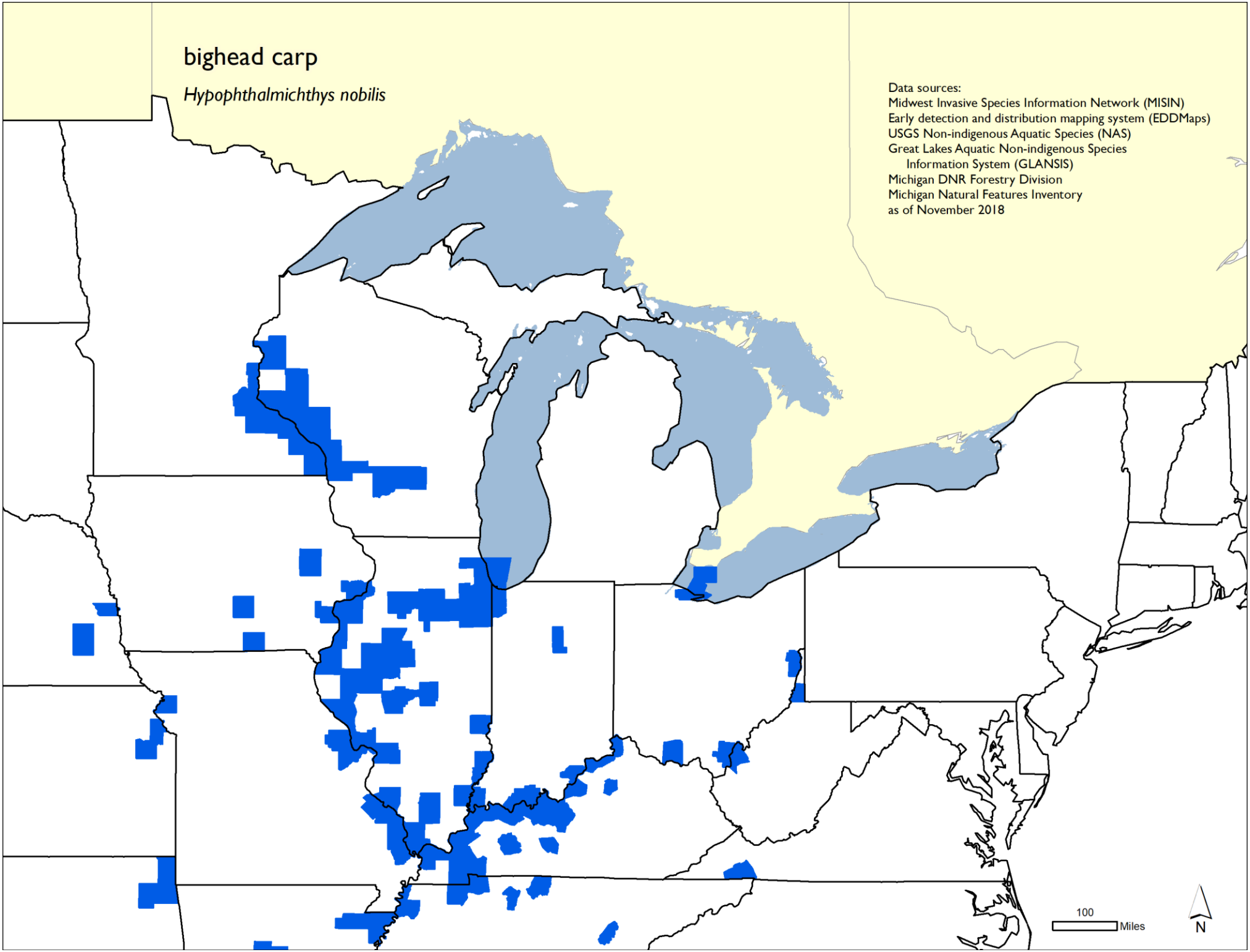
bighead carp
Hypophthalmichthys nobilis
Data sources:
Midwest Invasive Species Information Network (MISIN)
Early detection and distribution mapping system (EDDMaps)
USGS Non-indigenous Aquatic Species (NAS)
Great Lakes Aquatic Non-indigenous Species
Information System (GLANSIS)
Michigan DNR Forestry Division
Michigan Natural Features Inventory
as of November 2018
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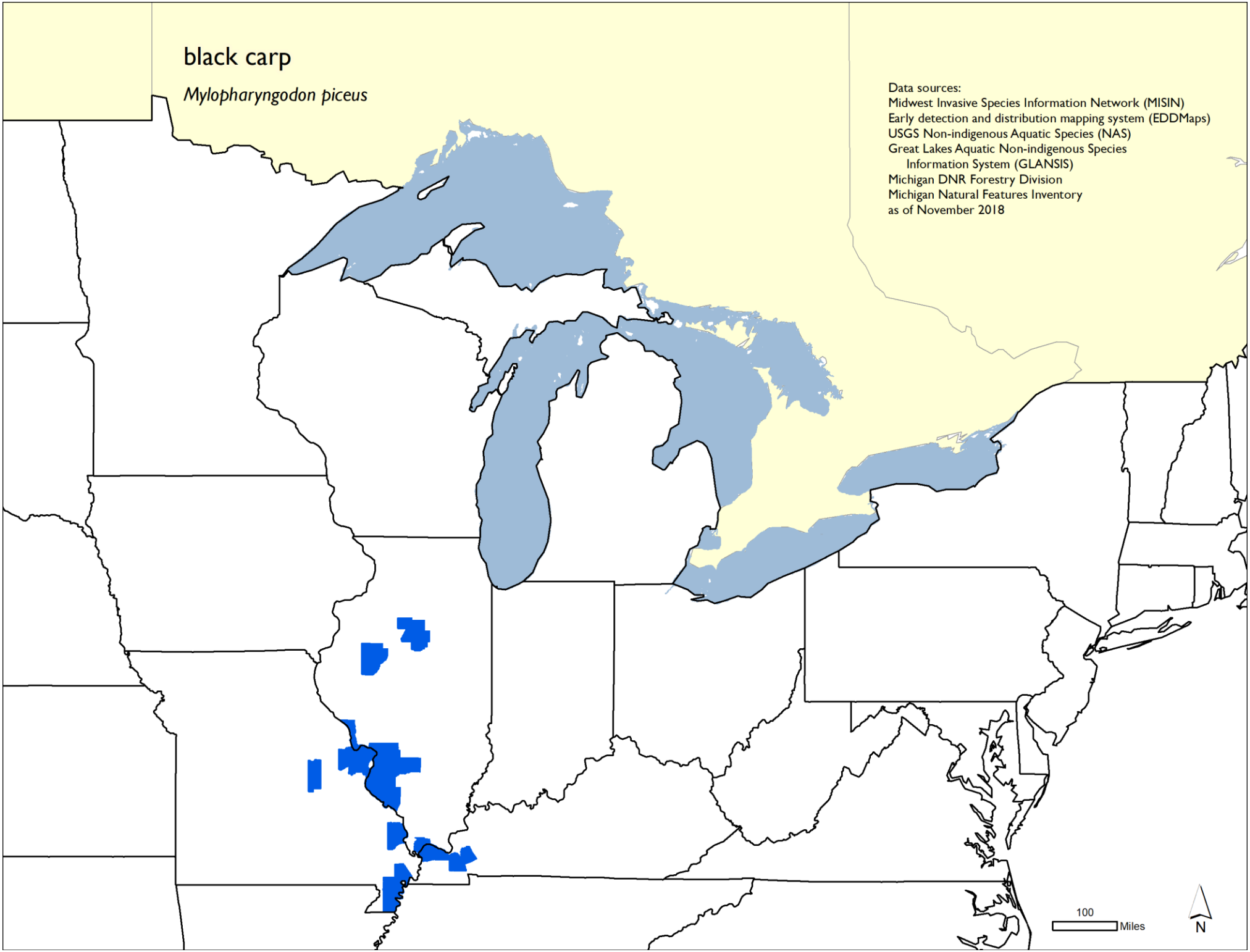
black carp
Mylopharyngodon piceus
Data sources:
Midwest Invasive Species Information Network (MISIN)
Early detection and distribution mapping system (EDDMaps)
USGS Non-indigenous Aquatic Species (NAS)
Great Lakes Aquatic Non-indigenous Species
Information System (GLANSIS)
Michigan DNR Forestry Division
Michigan Natural Features Inventory
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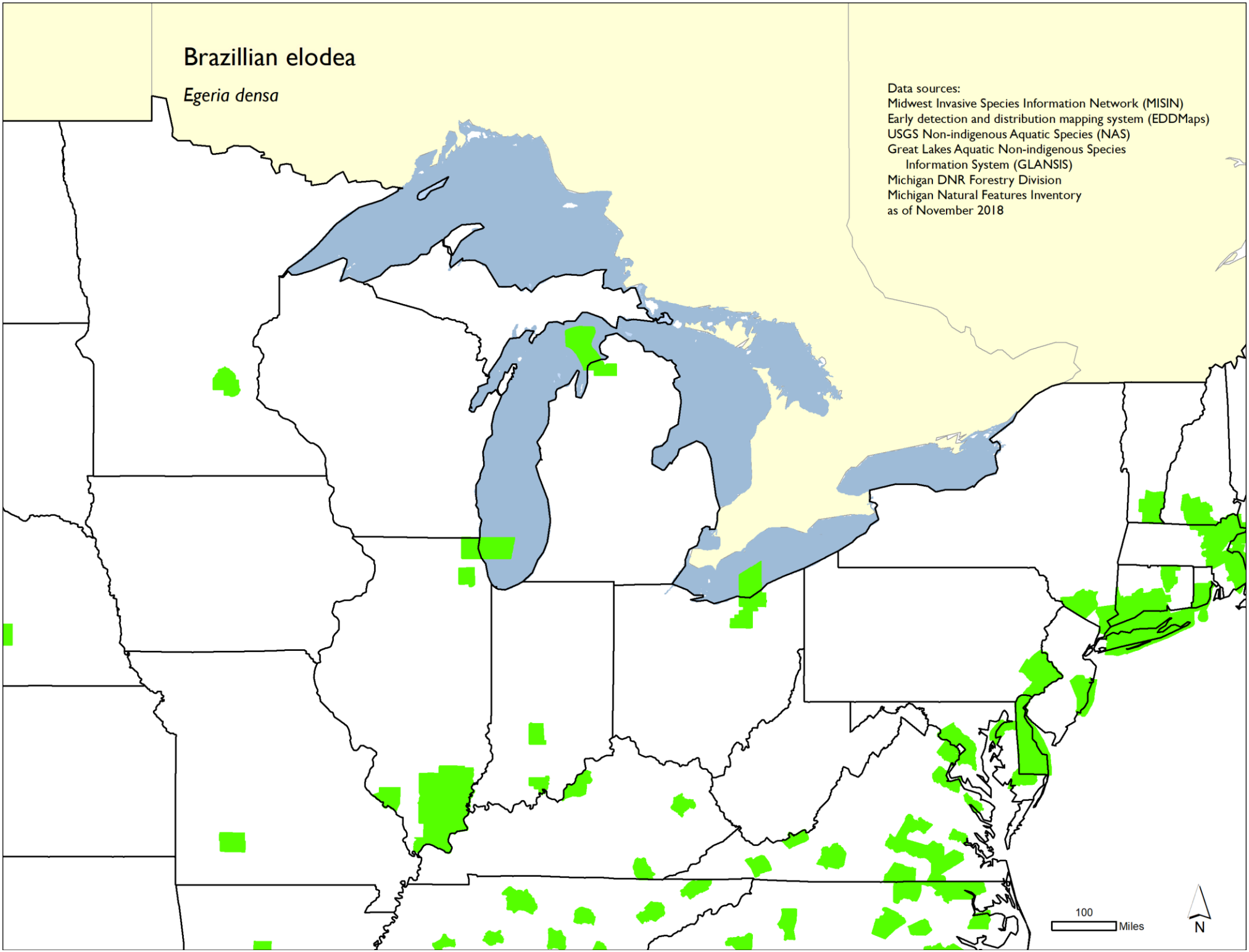
Brazillian elodea
Egeria densa
Data sources:
Midwest Invasive Species Information Network (MISIN)
Early detection and distribution mapping system (EDDMaps)
USGS Non-indigenous Aquatic Species (NAS)
Great Lakes Aquatic Non-indigenous Species
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Michigan DNR Forestry Division
Michigan Natural Features Inventory
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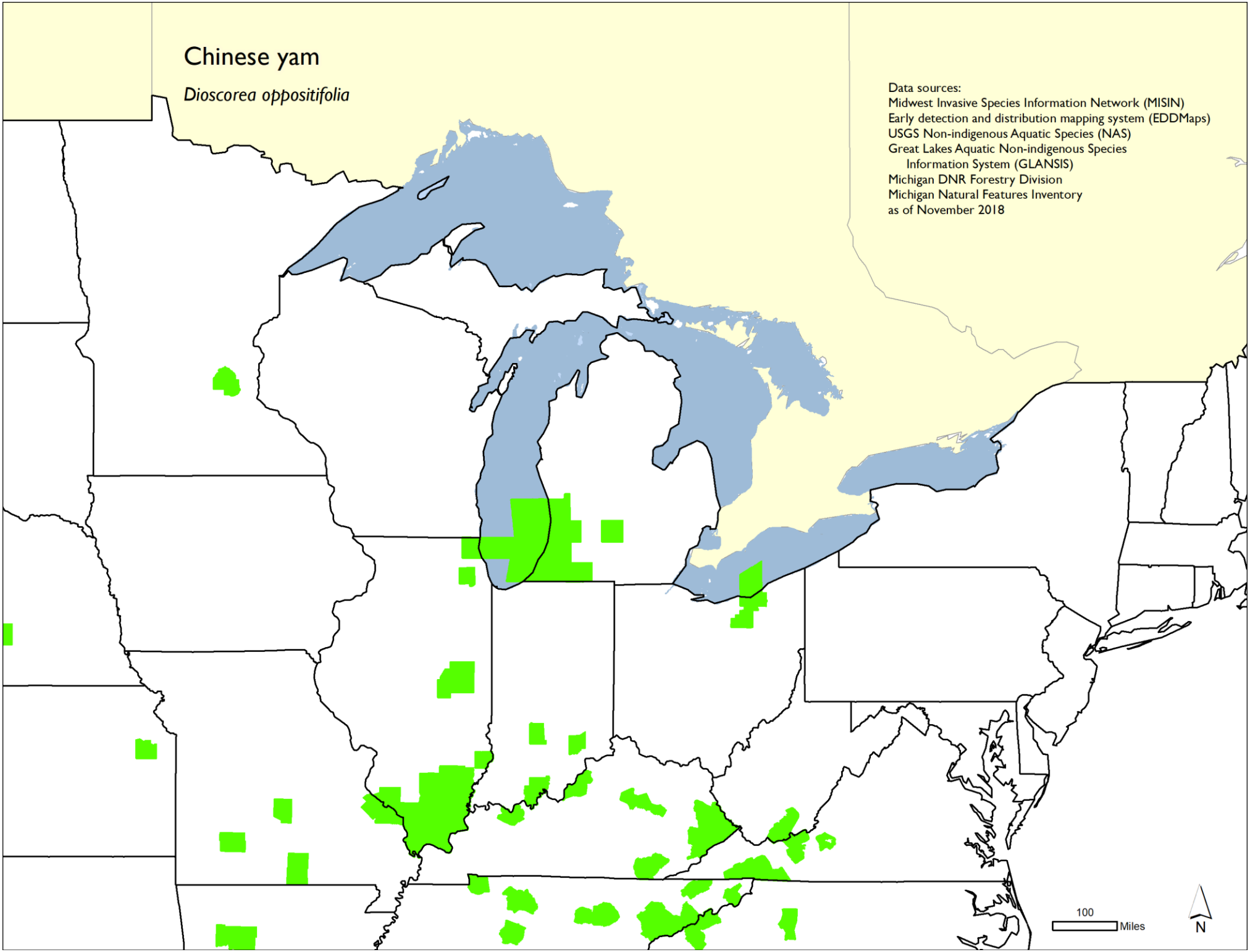
Chinese yam
Dioscorea oppositifolia
Data sources:
Midwest Invasive Species Information Network (MISIN)
Early detection and distribution mapping system (EDDMaps)
USGS Non-indigenous Aquatic Species (NAS)
Great Lakes Aquatic Non-indigenous Species
Information System (GLANSIS)
Michigan DNR Forestry Division
Michigan Natural Features Inventory
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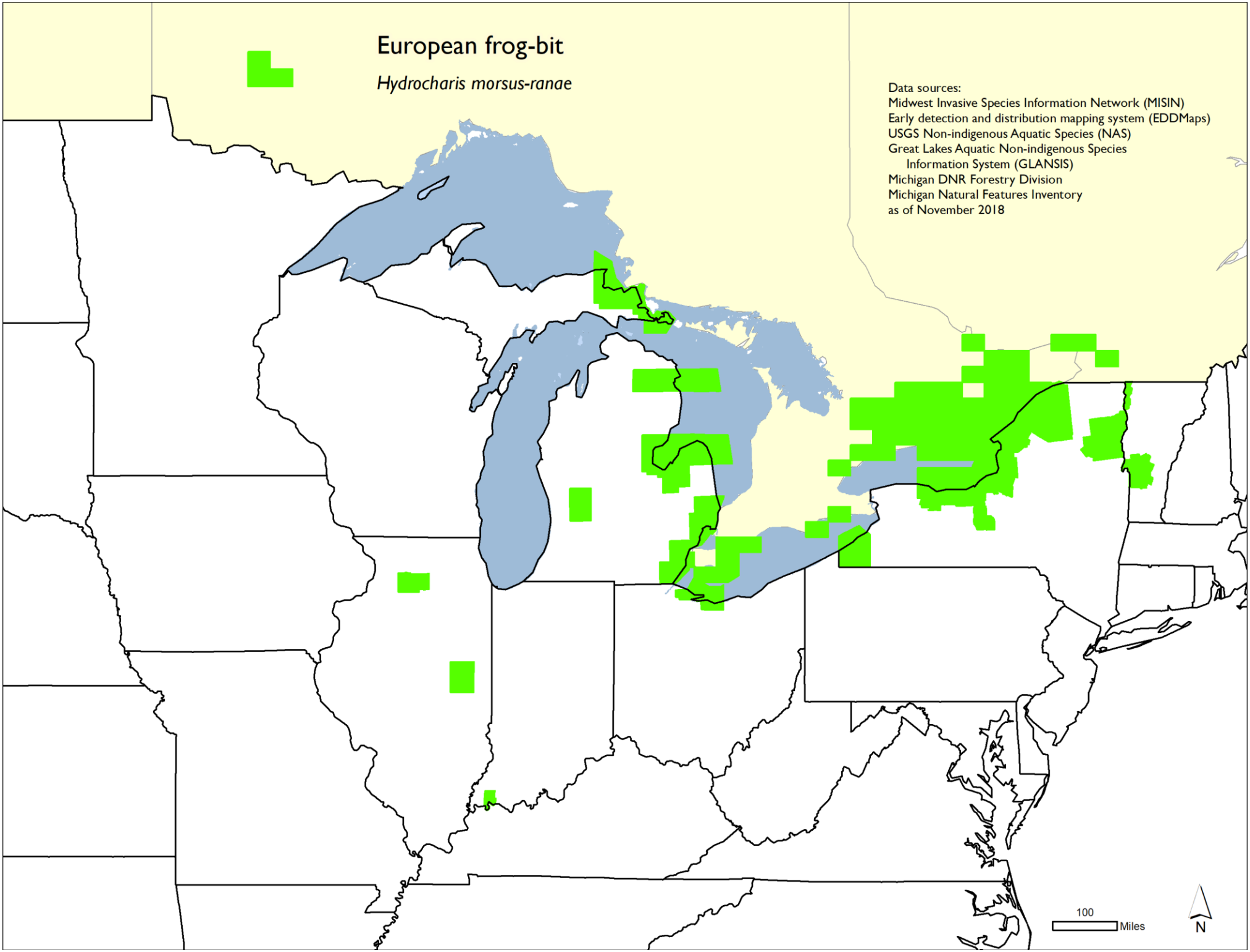
European frog-bit
Hydrocharis morsus-ranae
Data sources:
Midwest Invasive Species Information Network (MISIN)
Early detection and distribution mapping system (EDDMaps)
USGS Non-indigenous Aquatic Species (NAS)
Great Lakes Aquatic Non-indigenous Species
Information System (GLANSIS)
Michigan DNR Forestry Division
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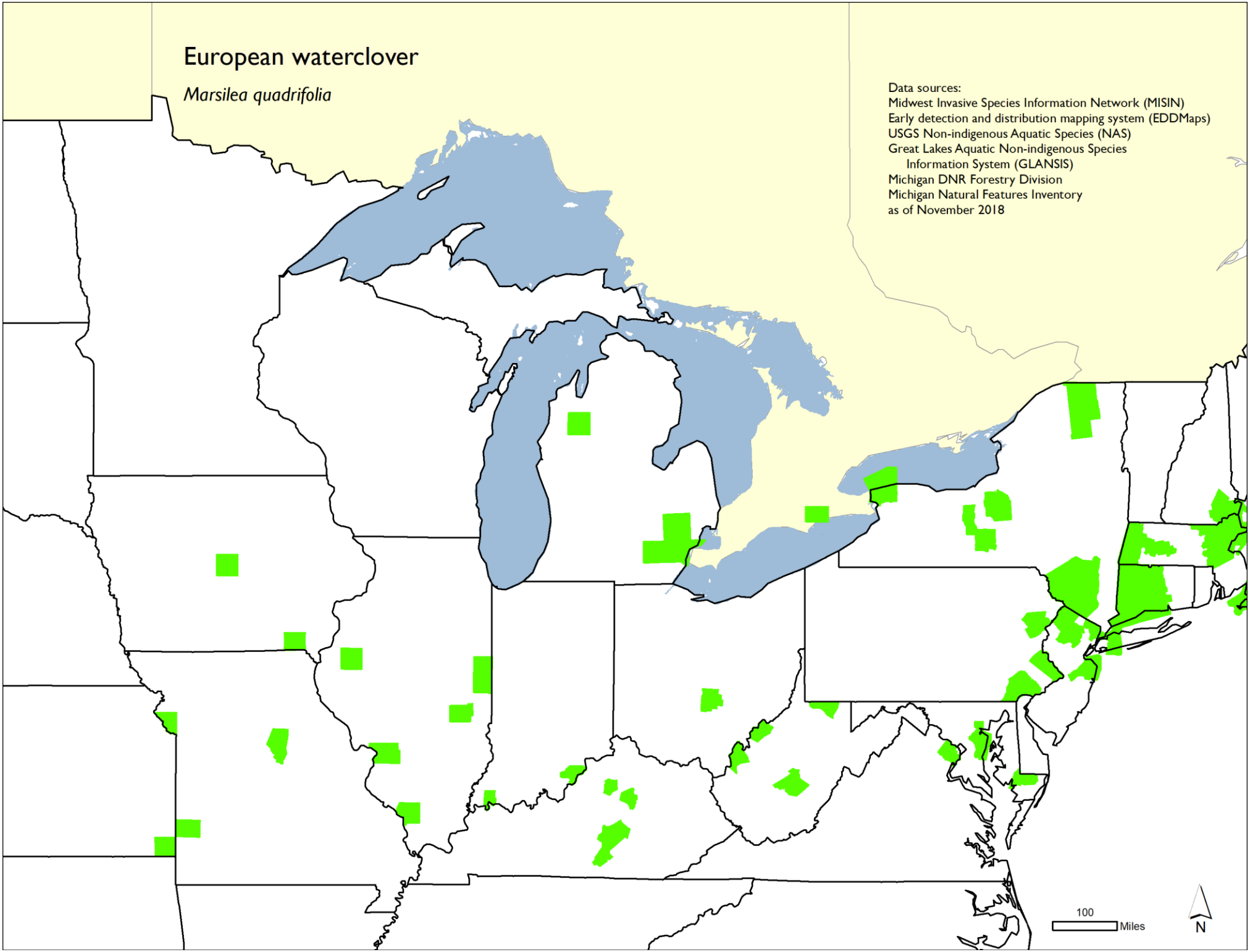
European waterclover
Marsilea quadrifolia
Data sources:
Midwest Invasive Species Information Network (MISIN)
Early detection and distribution mapping system (EDDMaps)
USGS Non-indigenous Aquatic Species (NAS)
Great Lakes Aquatic Non-indigenous Species
Information System (GLANSIS)
Michigan DNR Forestry Division
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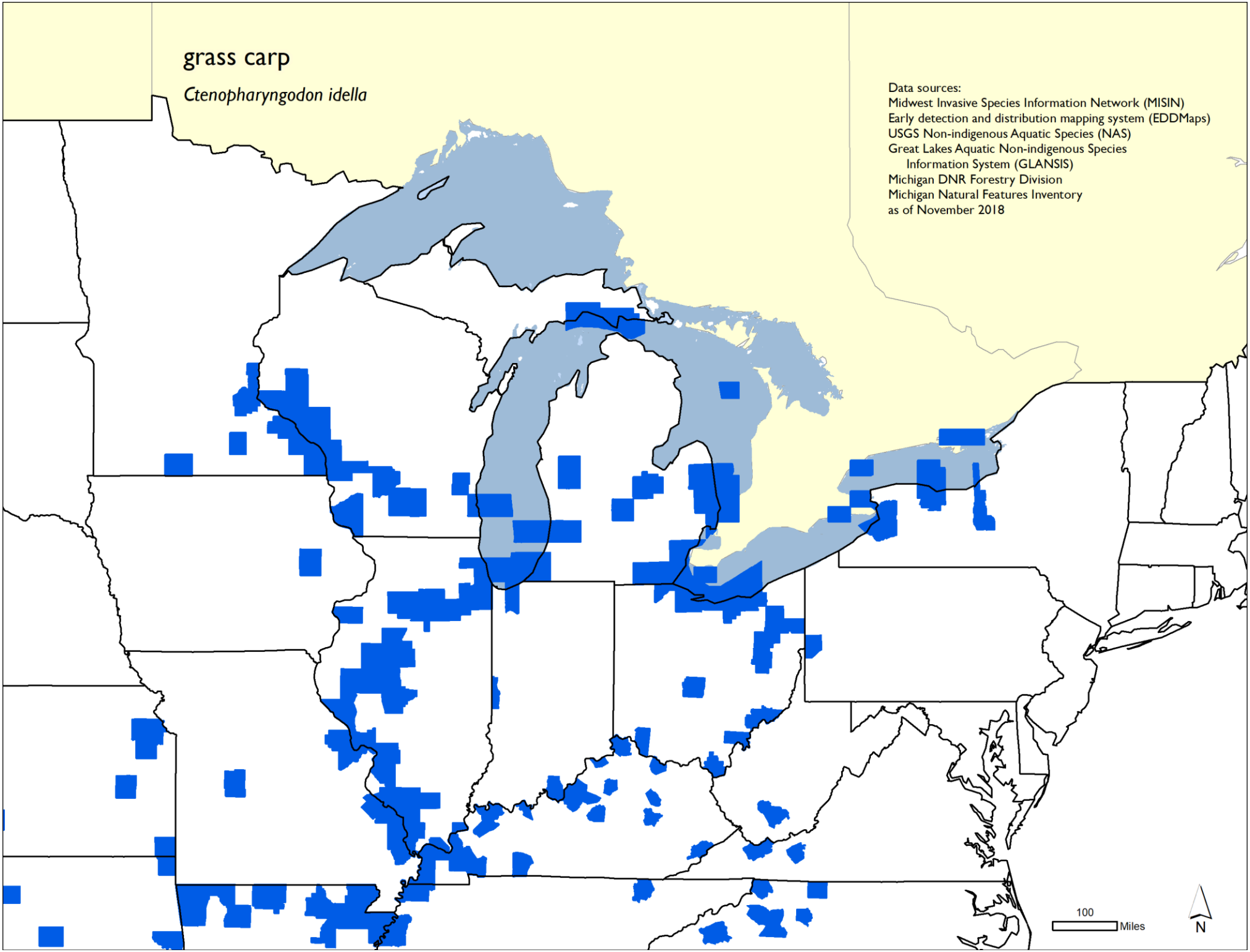
grass carp
Ctenopharyngodon idella
Data sources:
Midwest Invasive Species Information Network (MISIN)
Early detection and distribution mapping system (EDDMaps)
USGS Non-indigenous Aquatic Species (NAS)
Great Lakes Aquatic Non-indigenous Species
Information System (GLANSIS)
Michigan DNR Forestry Division
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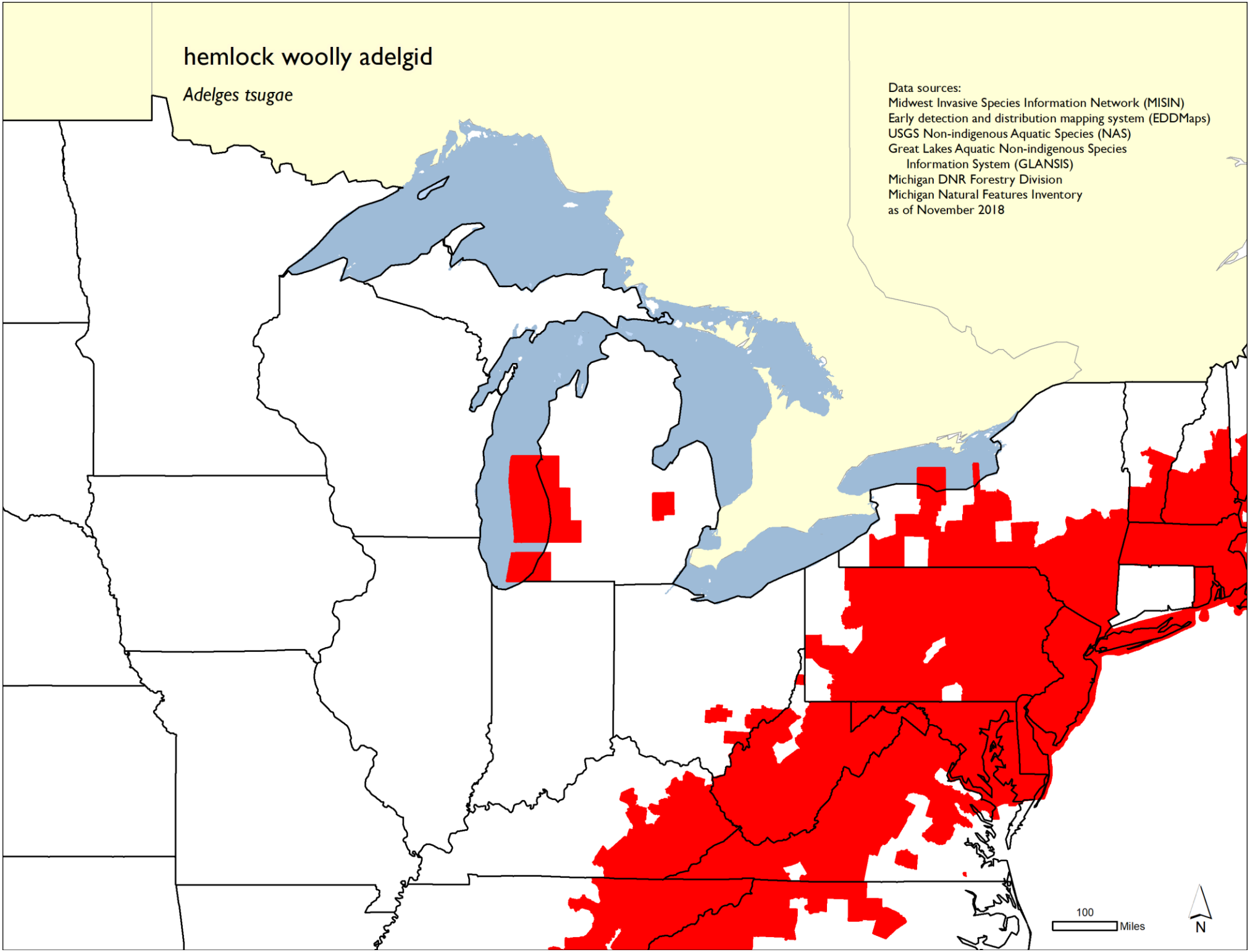
hemlock woolly adelgid
Adelges tsugae
Data sources:
Midwest Invasive Species Information Network (MISIN)
Early detection and distribution mapping system (EDDMaps)
USGS Non-indigenous Aquatic Species (NAS)
Great Lakes Aquatic Non-indigenous Species
Information System (GLANSIS)
Michigan DNR Forestry Division
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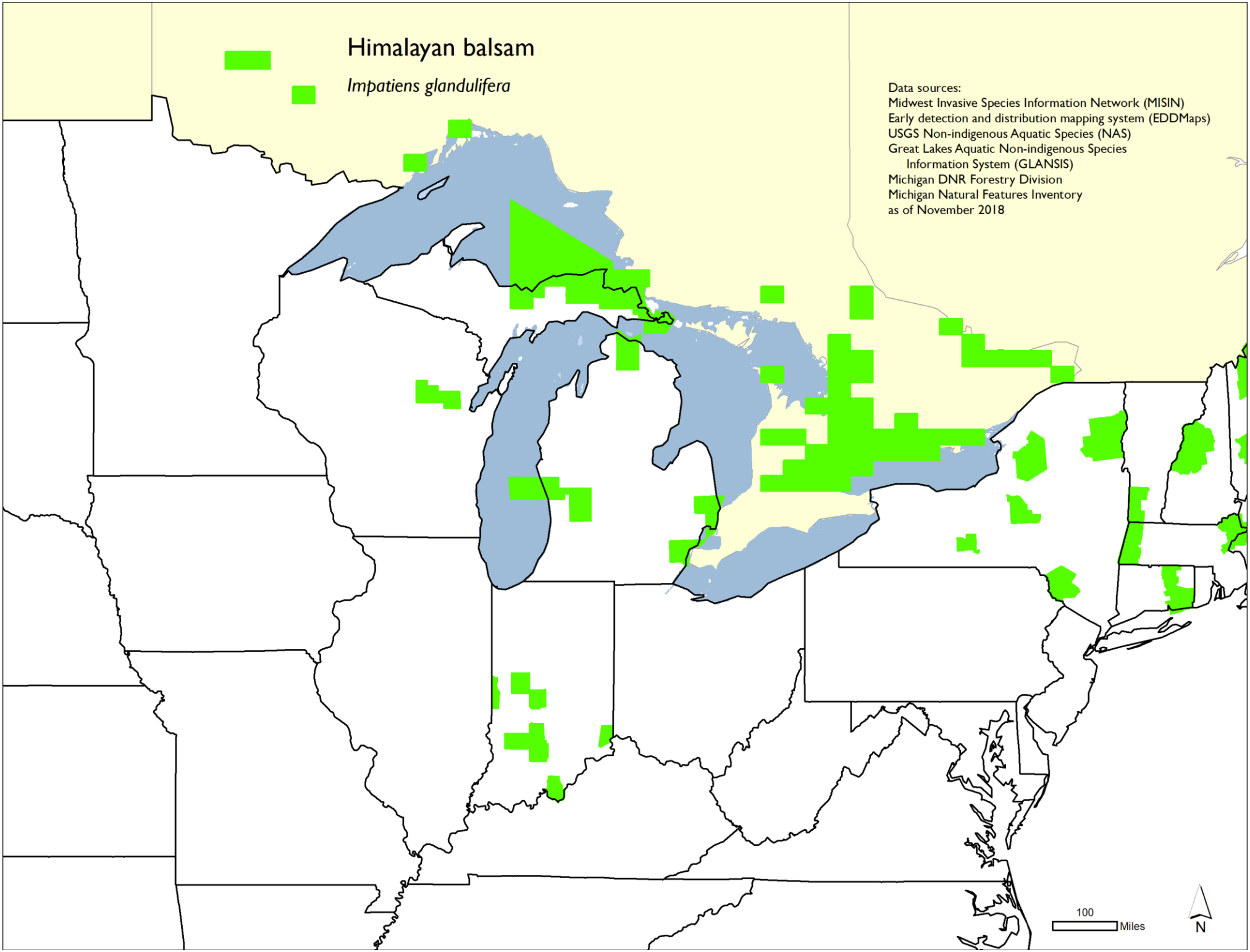
Himalayan balsam
Impatiens glandulifera
Data sources:
Midwest Invasive Species Information Network (MISIN)
Early detection and distribution mapping system (EDDMaps)
USGS Non-indigenous Aquatic Species (NAS)
Great Lakes Aquatic Non-indigenous Species
Information System (GLANSIS)
Michigan DNR Forestry Division
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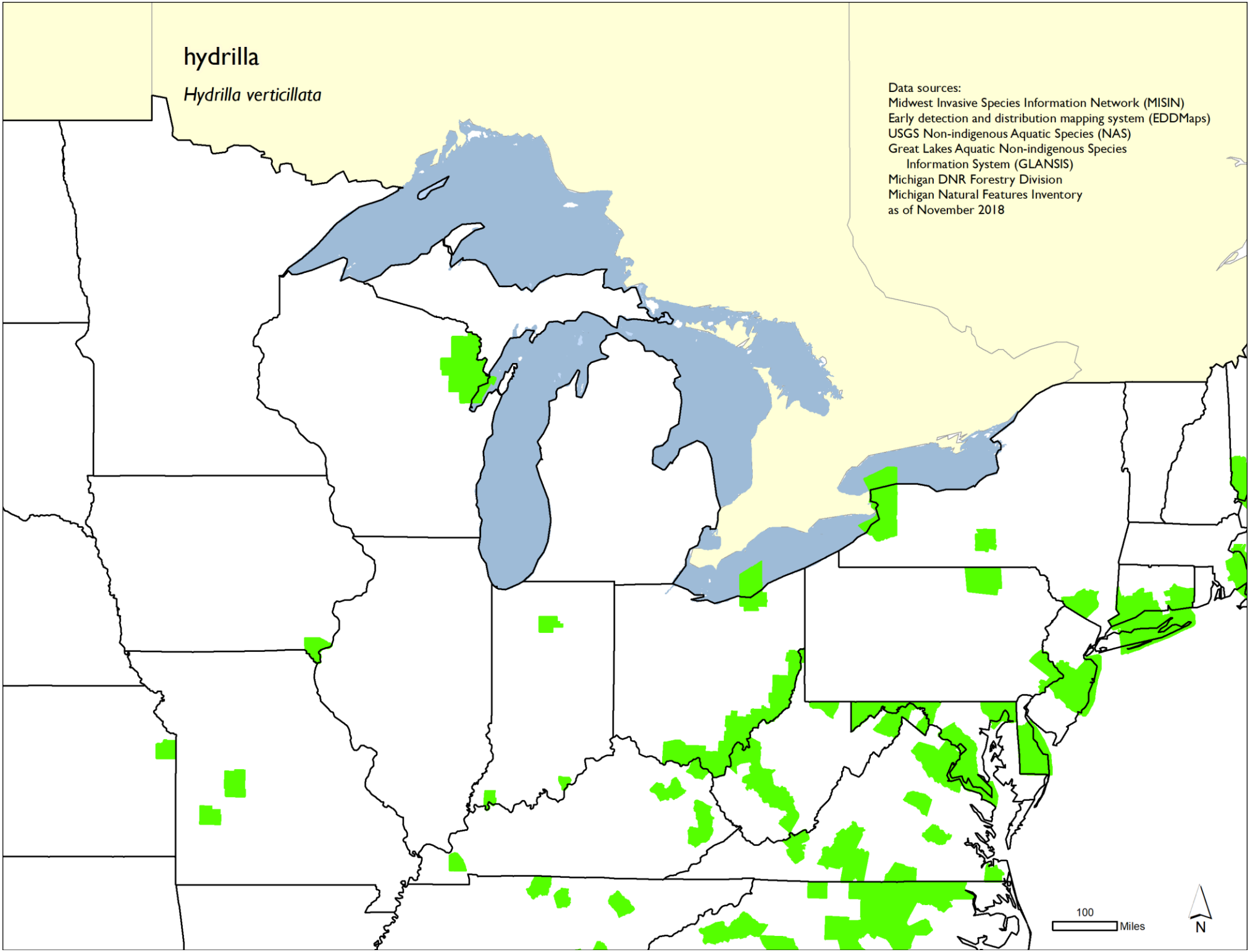
hydrilla
Hydrilla verticillata
Data sources:
Midwest Invasive Species Information Network (MISIN)
Early detection and distribution mapping system (EDDMaps)
USGS Non-indigenous Aquatic Species (NAS)
Great Lakes Aquatic Non-indigenous Species
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Michigan DNR Forestry Division
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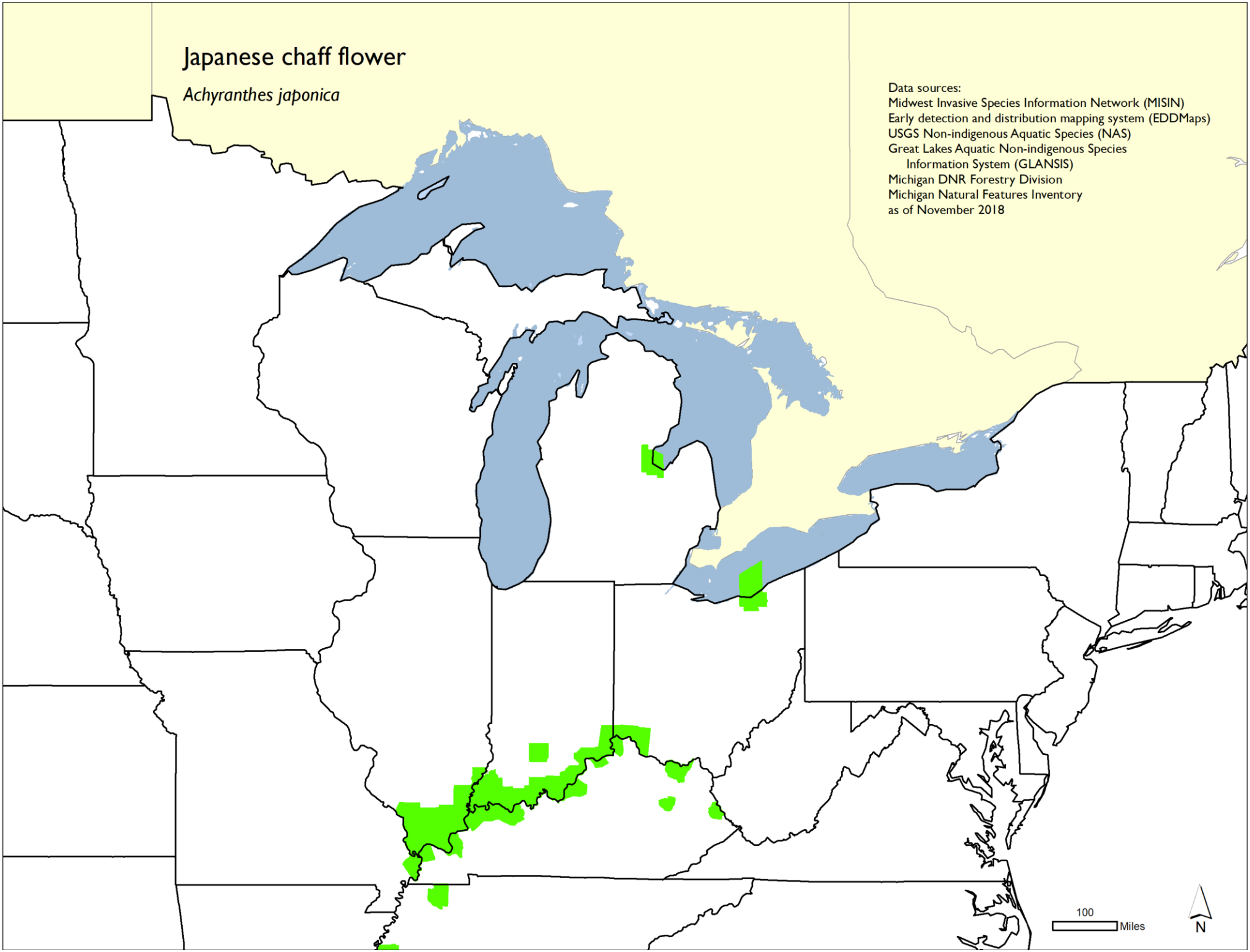
Japanese chaff flower
Achyranthes japonica
Data sources:
Midwest Invasive Species Information Network (MISIN)
Early detection and distribution mapping system (EDDMaps)
USGS Non-indigenous Aquatic Species (NAS)
Great Lakes Aquatic Non-indigenous Species
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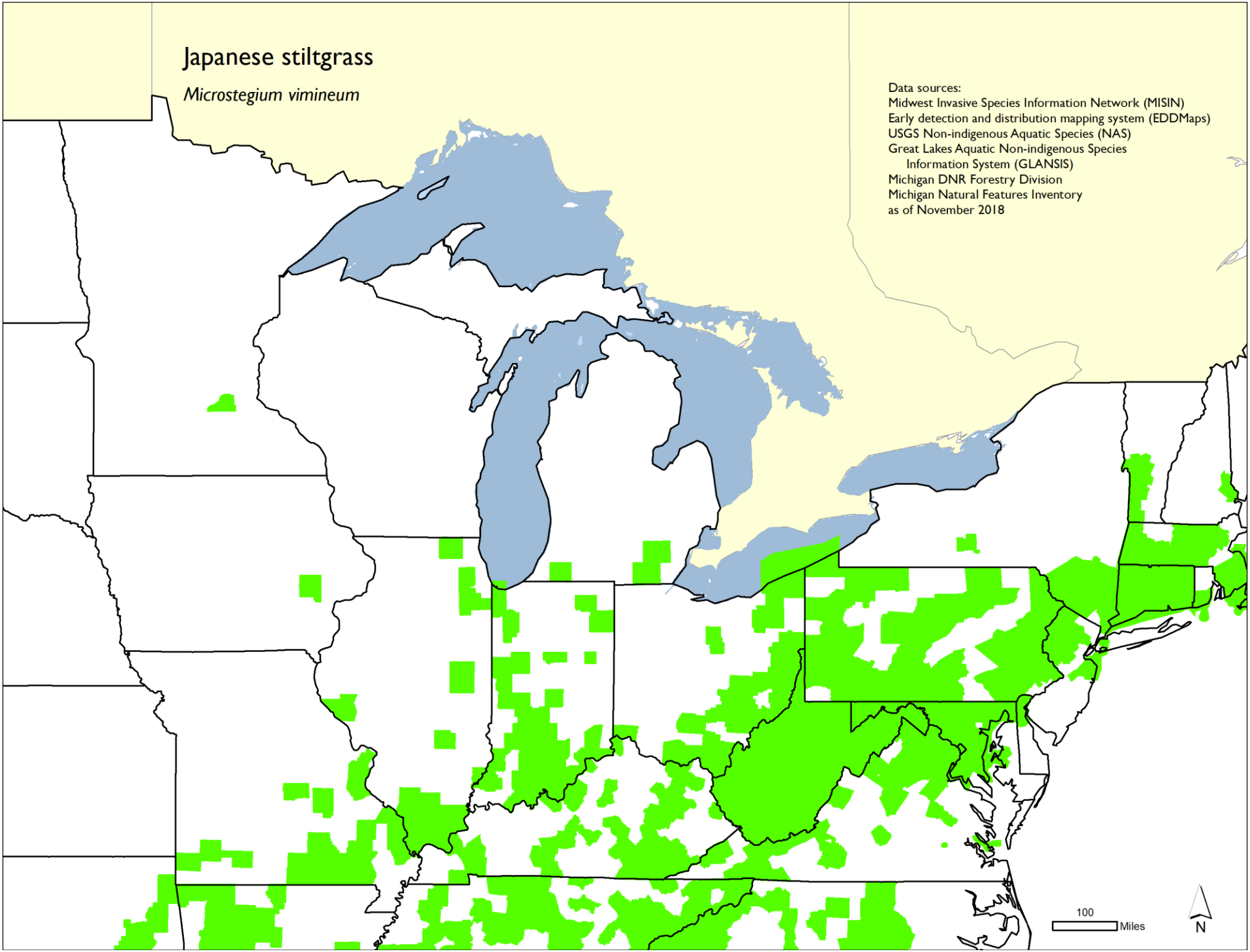
Japanese stiltgrass
Microstegium vimineum
Data sources:
Midwest Invasive Species Information Network (MISIN)
Early detection and distribution mapping system (EDDMaps)
USGS Non-indigenous Aquatic Species (NAS)
Great Lakes Aquatic Non-indigenous Species
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Michigan DNR Forestry Division
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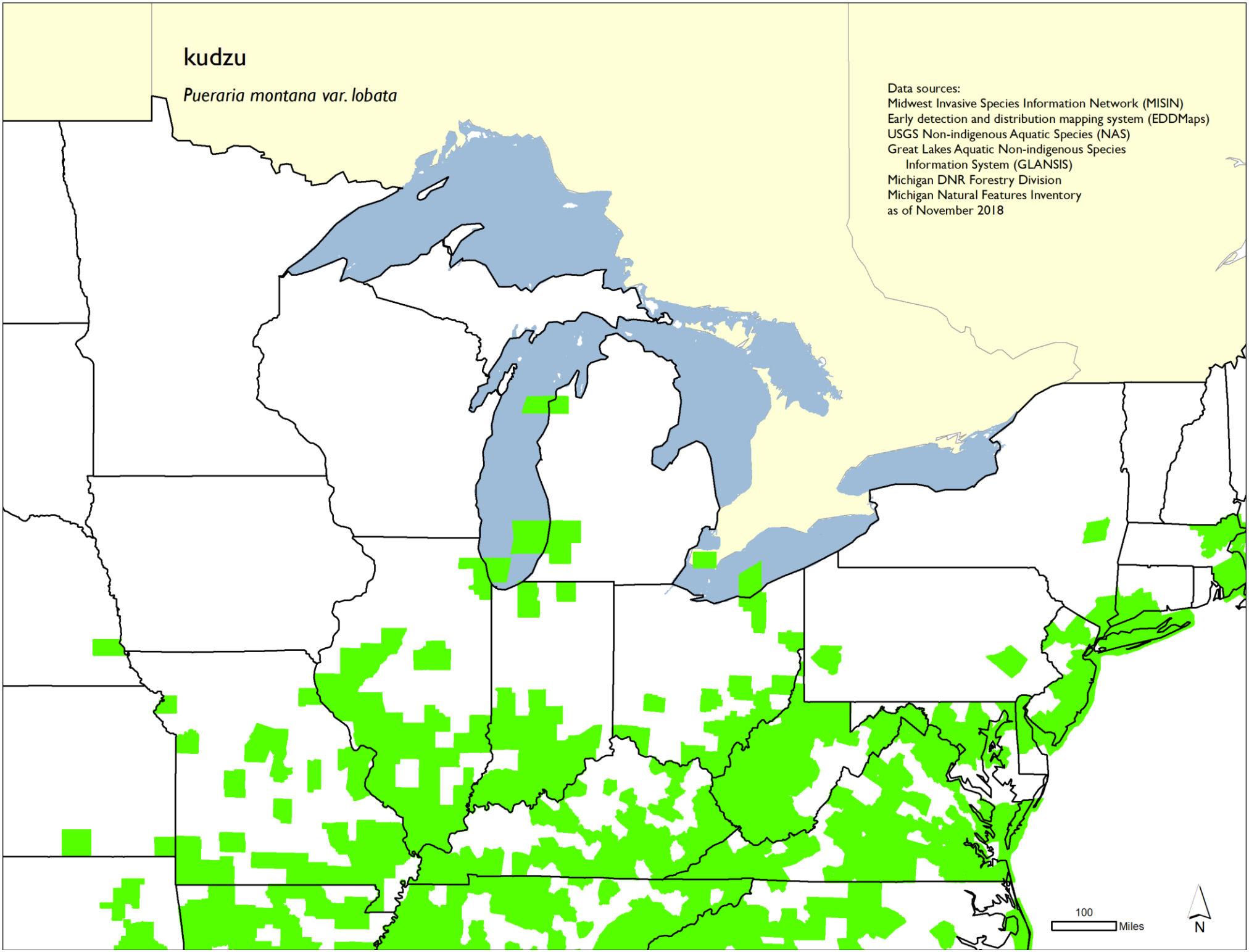
kudzu
Pueraria montana var. lobata
Data sources:
Midwest Invasive Species Information Network (MISIN)
Early detection and distribution mapping system (EDDMaps)
USGS Non-indigenous Aquatic Species (NAS)
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Information System (GLANSIS)
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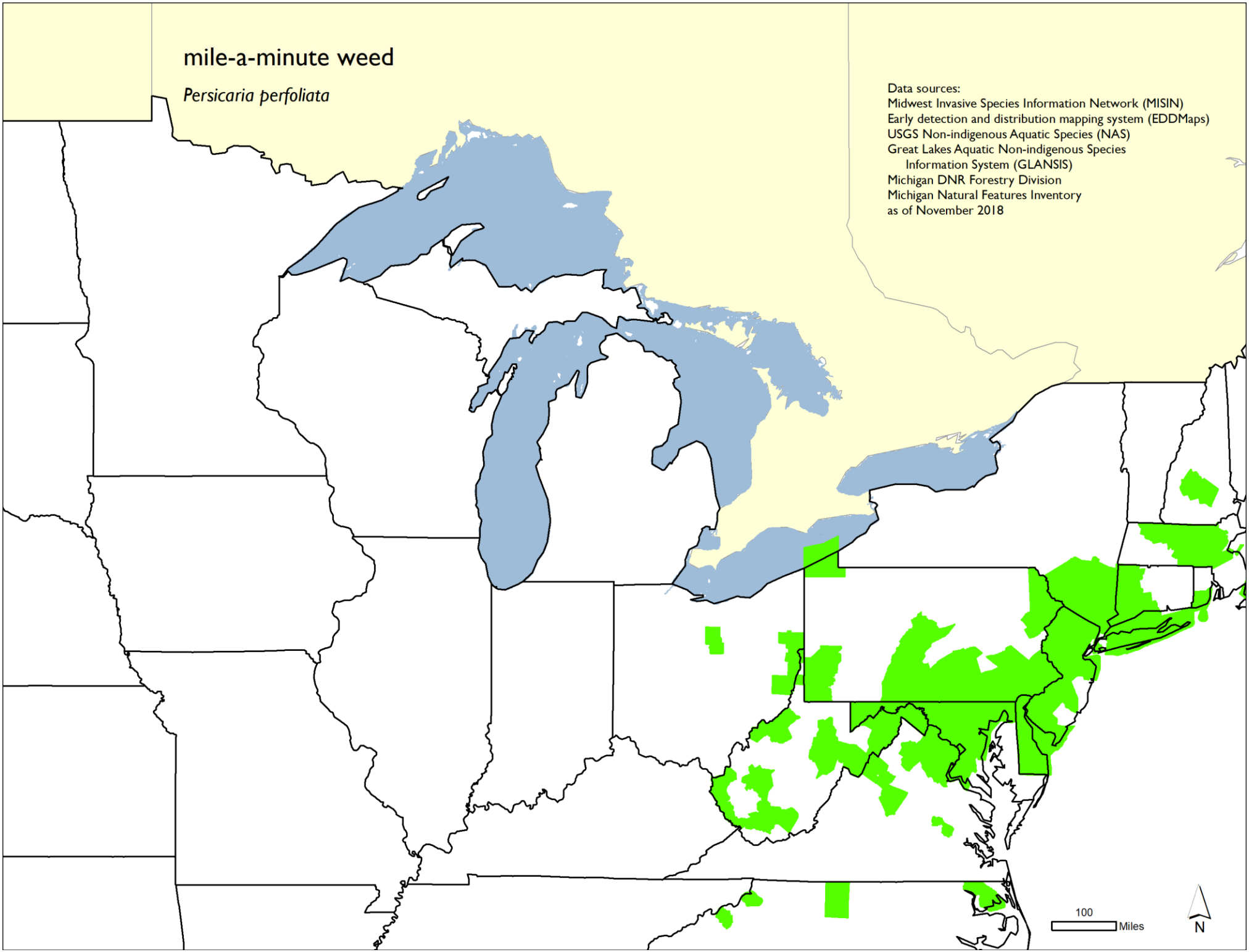
mile-a-minute weed
Persicaria perfoliata
Data sources:
Midwest Invasive Species Information Network (MISIN)
Early detection and distribution mapping system (EDDMaps)
USGS Non-indigenous Aquatic Species (NAS)
Great Lakes Aquatic Non-indigenous Species
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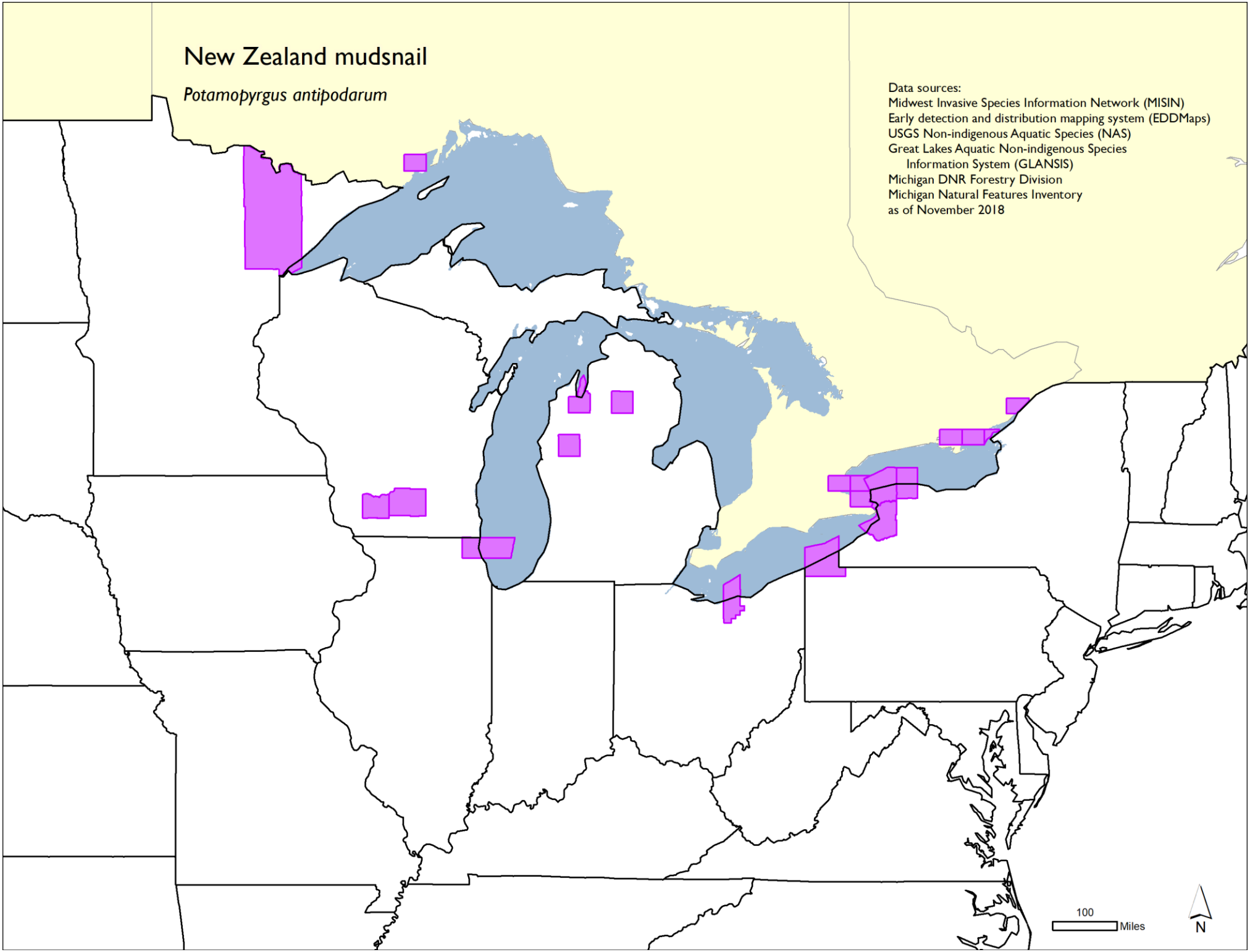
New Zealand mudsnail
Potamopyrgus antipodarum
Data sources:
Midwest Invasive Species Information Network (MISIN)
Early detection and distribution mapping system (EDDMaps)
USGS Non-indigenous Aquatic Species (NAS)
Great Lakes Aquatic Non-indigenous Species
Information System (GLANSIS)
Michigan DNR Forestry Division
Michigan Natural Features Inventory
as of November 2018
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northern snakehead
Channa argus
Data sources:
Midwest Invasive Species Information Network (MISIN)
Early detection and distribution mapping system (EDDMaps)
USGS Non-indigenous Aquatic Species (NAS)
Great Lakes Aquatic Non-indigenous Species
Information System (GLANSIS)
Michigan DNR Forestry Division
Michigan Natural Features Inventory
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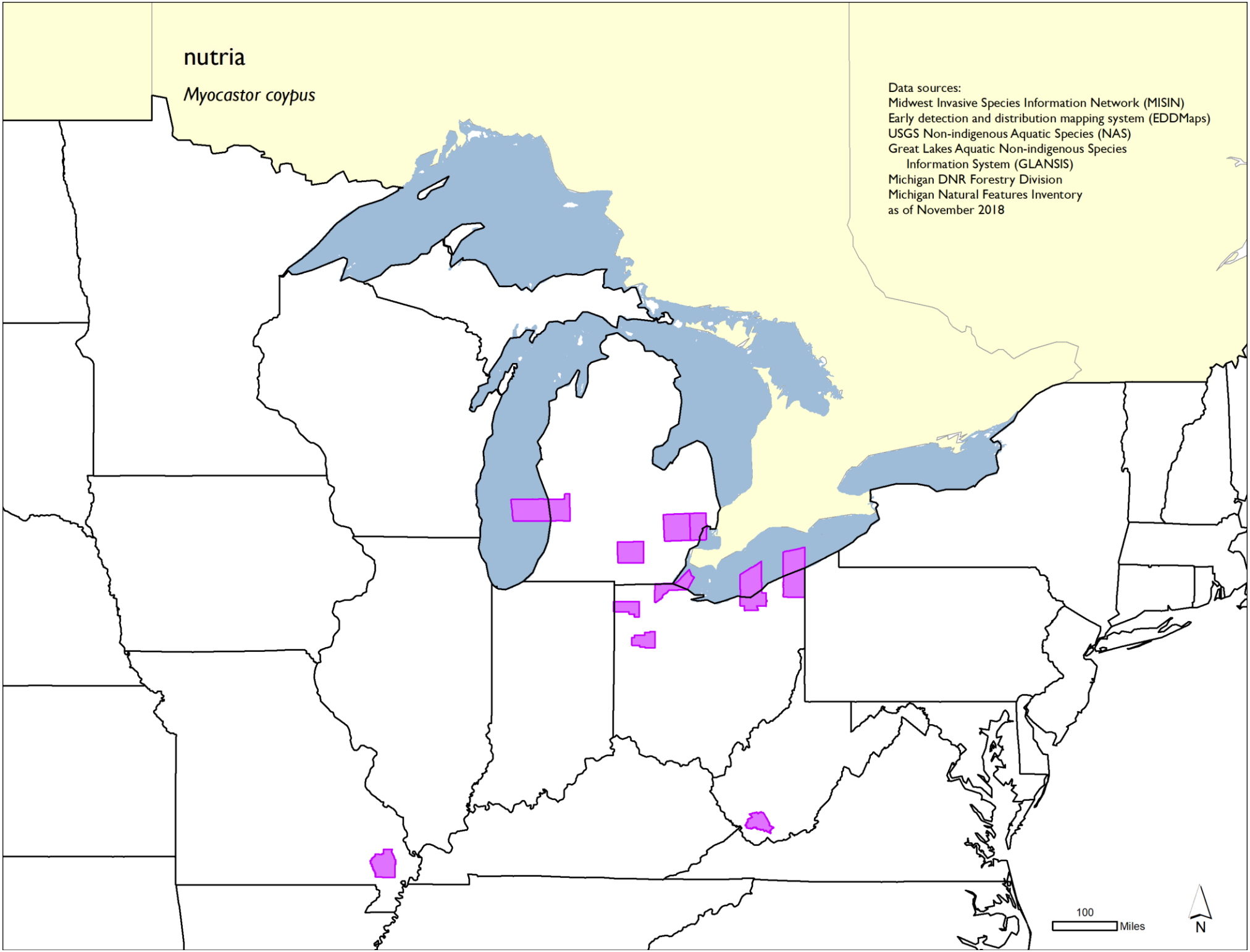
nutria
Myocastor coypus
Data sources:
Midwest Invasive Species Information Network (MISIN)
Early detection and distribution mapping system (EDDMaps)
USGS Non-indigenous Aquatic Species (NAS)
Great Lakes Aquatic Non-indigenous Species
Information System (GLANSIS)
Michigan DNR Forestry Division
Michigan Natural Features Inventory
as of November 2018
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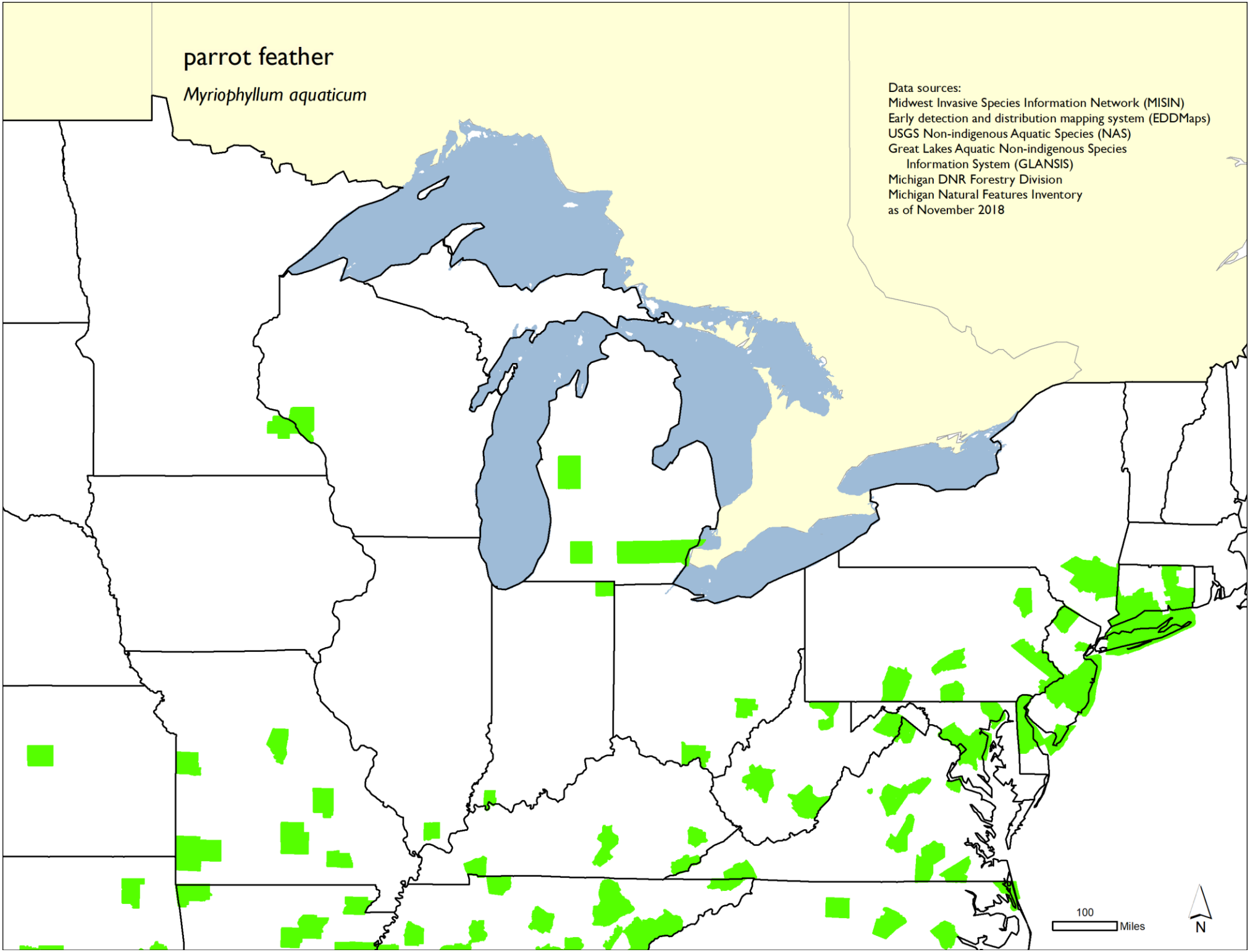
parrot feather
Myriophyllum aquaticum
Data sources:
Midwest Invasive Species Information Network (MISIN)
Early detection and distribution mapping system (EDDMaps)
USGS Non-indigenous Aquatic Species (NAS)
Great Lakes Aquatic Non-indigenous Species
Information System (GLANSIS)
Michigan DNR Forestry Division
Michigan Natural Features Inventory
as of November 2018
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Miles
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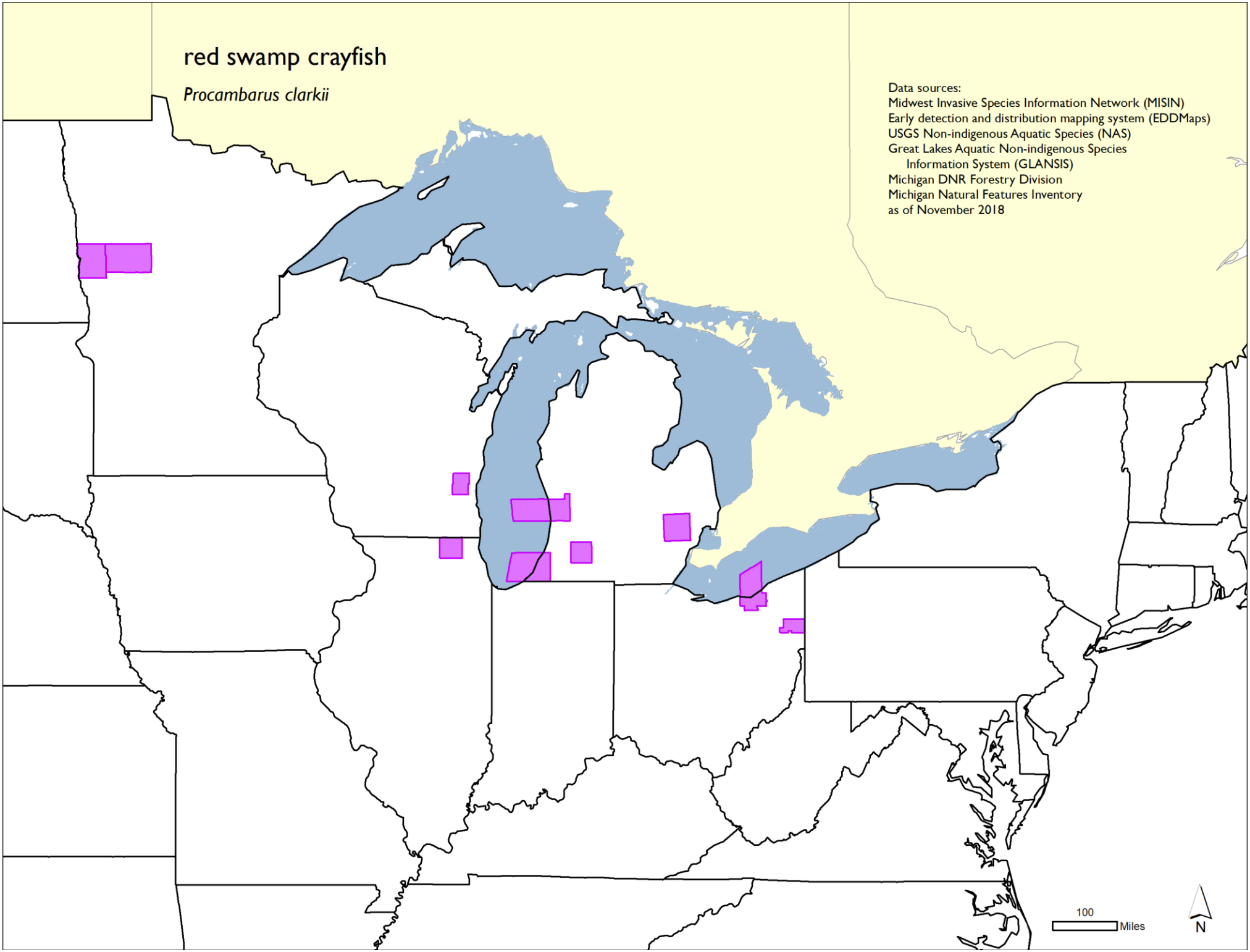
red swamp crayfish
Procambarus clarkii
Data sources:
Midwest Invasive Species Information Network (MISIN)
Early detection and distribution mapping system (EDDMaps)
USGS Non-indigenous Aquatic Species (NAS)
Great Lakes Aquatic Non-indigenous Species
Information System (GLANSIS)
Michigan DNR Forestry Division
Michigan Natural Features Inventory
as of November 2018
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Miles
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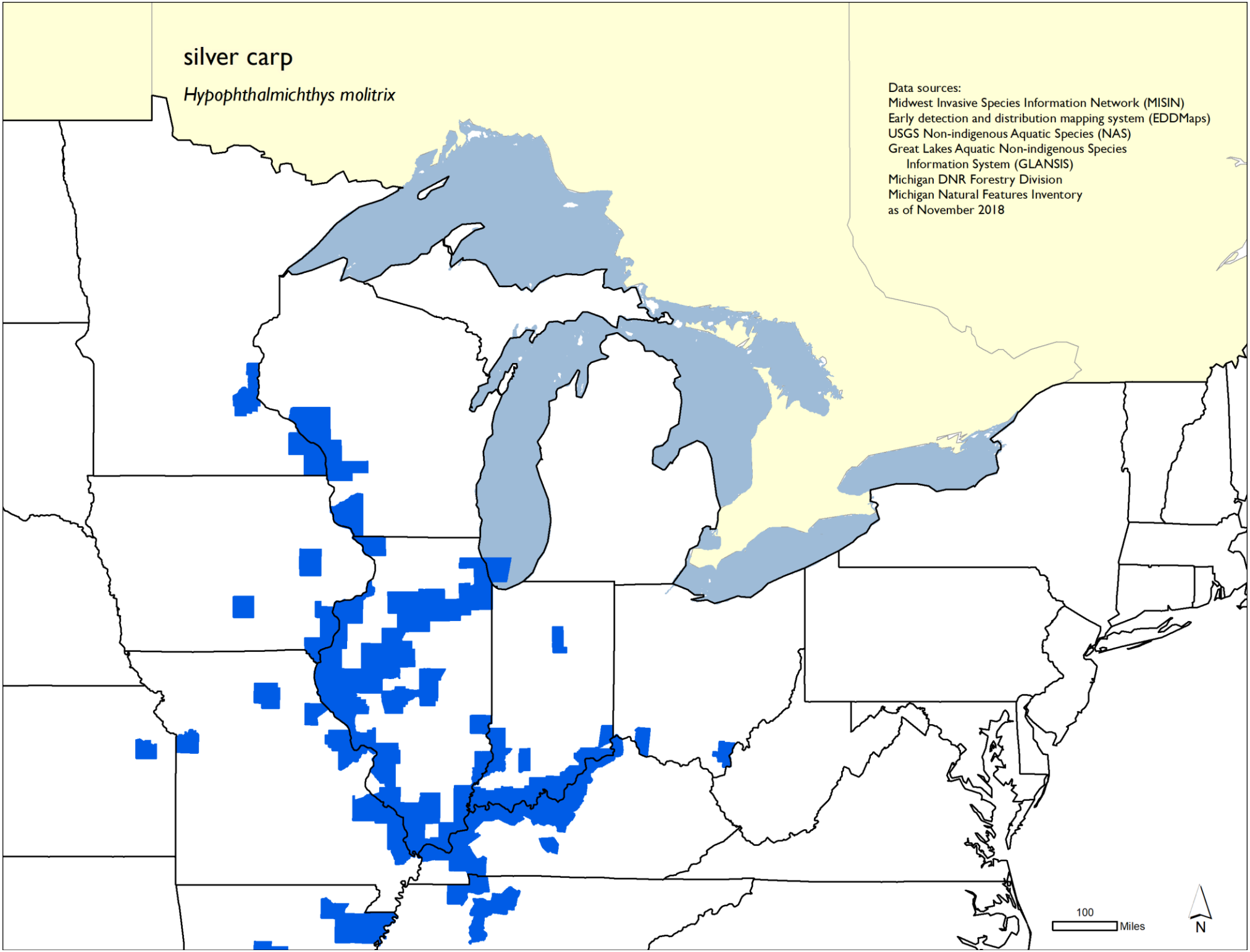
silver carp
Hypophthalmichthys molitrix
Data sources:
Midwest Invasive Species Information Network (MISIN)
Early detection and distribution mapping system (EDDMaps)
USGS Non-indigenous Aquatic Species (NAS)
Great Lakes Aquatic Non-indigenous Species
Information System (GLANSIS)
Michigan DNR Forestry Division
Michigan Natural Features Inventory
as of November 2018
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Miles
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thousand cankers disease
Geosmithia morbida
Data sources:
Midwest Invasive Species Information Network (MISIN)
Early detection and distribution mapping system (EDDMaps)
USGS Non-indigenous Aquatic Species (NAS)
Great Lakes Aquatic Non-indigenous Species
Information System (GLANSIS)
Michigan DNR Forestry Division
as of April 2019
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Miles
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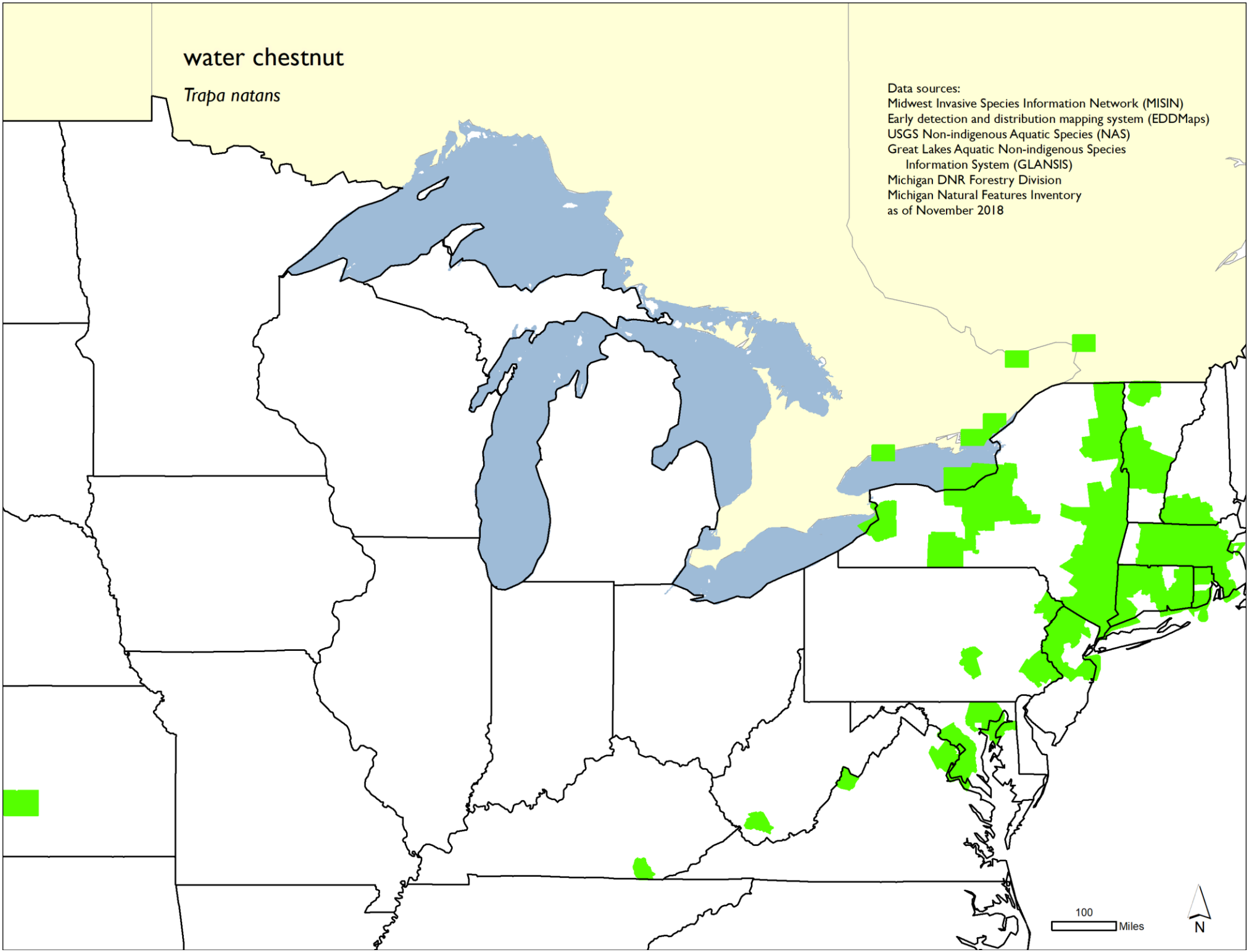
water chestnut
Trapa natans
Data sources:
Midwest Invasive Species Information Network (MISIN)
Early detection and distribution mapping system (EDDMaps)
USGS Non-indigenous Aquatic Species (NAS)
Great Lakes Aquatic Non-indigenous Species
Information System (GLANSIS)
Michigan DNR Forestry Division
Michigan Natural Features Inventory
as of November 2018
100
Miles
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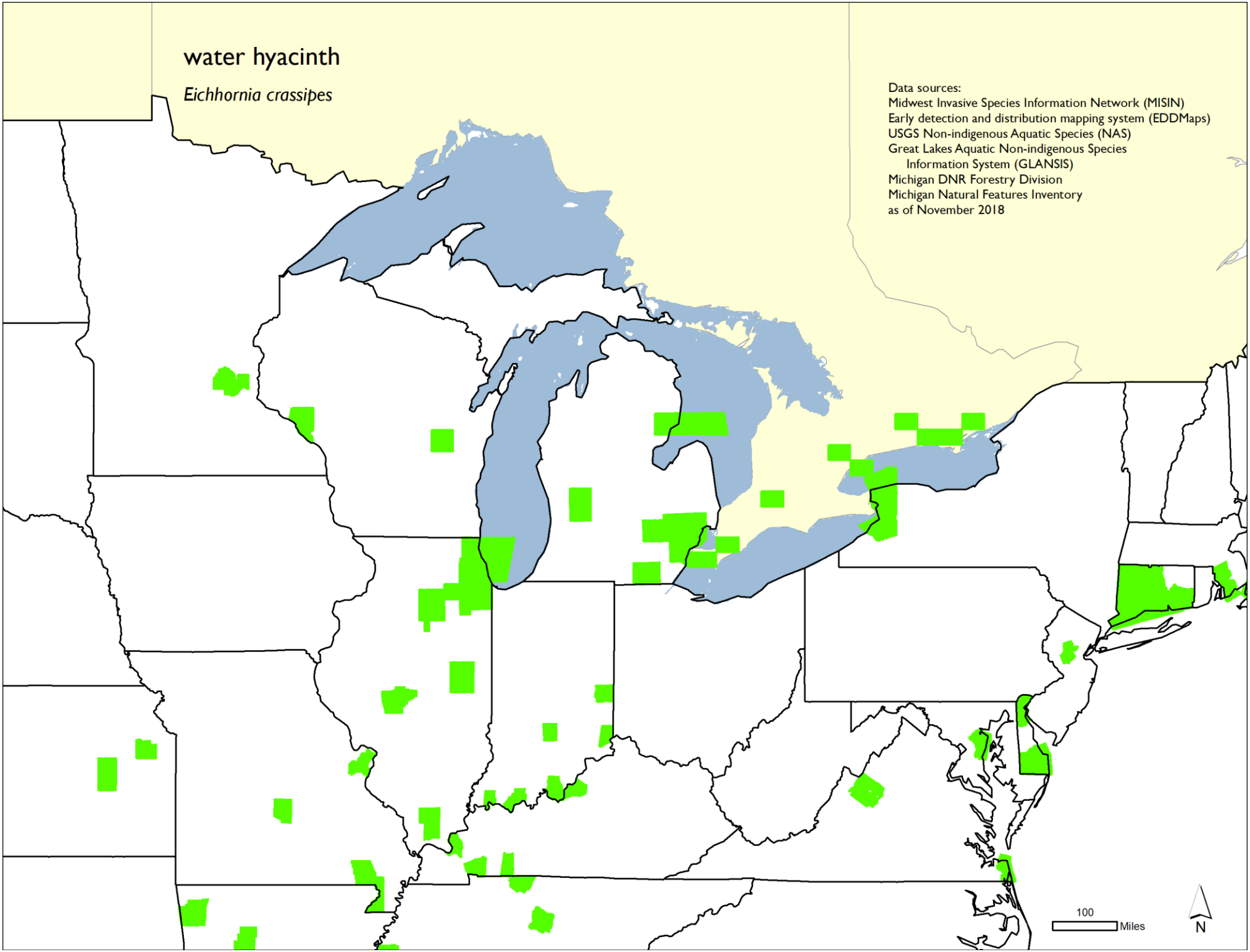
water hyacinth
Eichhornia crassipes
Data sources:
Midwest Invasive Species Information Network (MISIN)
Early detection and distribution mapping system (EDDMaps)
USGS Non-indigenous Aquatic Species (NAS)
Great Lakes Aquatic Non-indigenous Species
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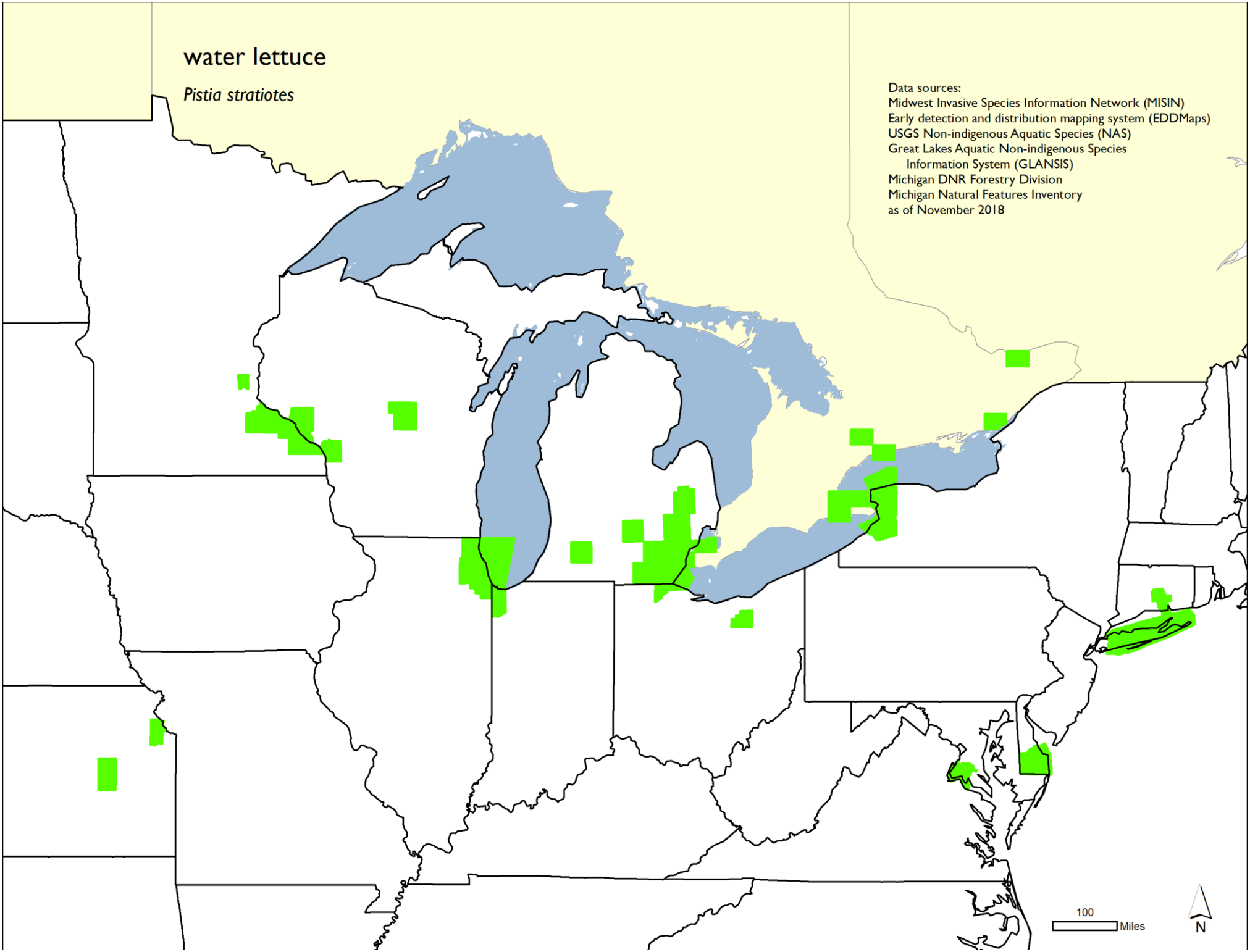
water lettuce
Pistia stratiotes
Data sources:
Midwest Invasive Species Information Network (MISIN)
Early detection and distribution mapping system (EDDMaps)
USGS Non-indigenous Aquatic Species (NAS)
Great Lakes Aquatic Non-indigenous Species
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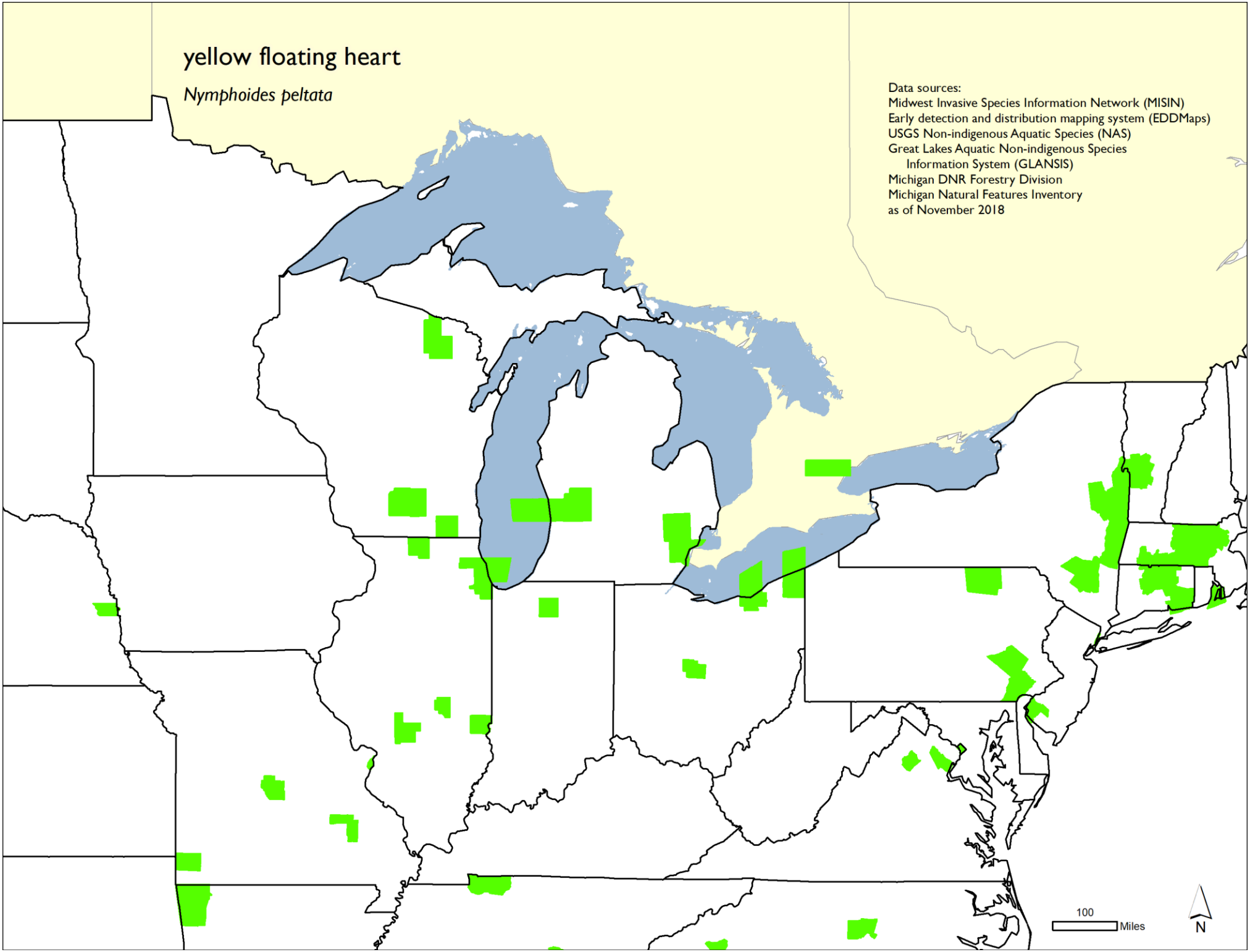
yellow floating heart
Nymphoides peltata
Data sources:
Midwest Invasive Species Information Network (MISIN)
Early detection and distribution mapping system (EDDMaps)
USGS Non-indigenous Aquatic Species (NAS)
Great Lakes Aquatic Non-indigenous Species
Information System (GLANSIS)
Michigan DNR Forestry Division
Michigan Natural Features Inventory
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100
Miles
N

Appendix 5.

Rare Animals and Plants Found on Michigan's Great Lakes Islands

Scientific name	Common name	Class	Endemic*	Federal Status	State Status	Global Rank	State Rank
Pseudacris maculata	Boreal chorus frog	Amphibian			SC	G5	S1
Gavia immer	Common loon	Bird			T	G5	S3
Botaurus lentiginosus	American bittern	Bird			SC	G5	S3
Ixobrychus exilis	Least bittern	Bird			T	G5	S3
Nycticorax nycticorax	Black-crowned night-heron	Bird			SC	G5	S3
Pandion haliaetus	Osprey	Bird			SC	G5	S4
Haliaeetus leucocephalus	Bald eagle	Bird			SC	G5	S4
Circus hudsonius	Northern harrier	Bird			SC	G5	S4
Accipiter gentilis	Northern goshawk	Bird			SC	G5	S3
Buteo lineatus	Red-shouldered hawk	Bird			T	G5	S4
Falco columbarius	Merlin	Bird			T	G5	S3
Falco peregrinus	Peregrine falcon	Bird			E	G4	S3
Tympanuchus phasianellus	Sharp-tailed grouse	Bird			SC	G5	S3S4
Coturnicops noveboracensis	Yellow rail	Bird			T	G4	S2
Rallus elegans	King rail	Bird			E	G4	S2
Gallinula galeata	Common gallinule	Bird			T	G5	S3
Charadrius melodus	Piping plover	Bird	Yes	LE	E	G3	S2
Phalaropus tricolor	Wilson's phalarope	Bird			SC	G5	S3
Hydroprogne caspia	Caspian tern	Bird			T	G5	S2
Sterna hirundo	Common tern	Bird			T	G5	S2
Sterna forsteri	Forster's tern	Bird			T	G5	S2
Chlidonias niger	Black tern	Bird			SC	G4G5	S2
Cistothorus palustris	Marsh wren	Bird			SC	G5	S3
Protonotaria citrea	Prothonotary warbler	Bird			SC	G5	S3
Xanthocephalus xanthocephalus	Yellow-headed blackbird	Bird			SC	G5	S2
Cottus ricei	Spoonhead sculpin	Fish			SC	G5	S1S2
Acipenser fulvescens	Lake sturgeon	Fish			T	G3G4	S2
Hiodon tergisus	Mooneye	Fish			T	G5	S1
Coregonus artedi	Lake herring or Cisco	Fish	Yes		T	G5	S3
Coregonus bartlettii	Siskiwit lake cisco	Fish	Yes		T	G3THQ	SH
Macrhybopsis storeriana	Silver chub	Fish			SC	G5	S1
Opsopoeodus emiliae	Pugnose minnow	Fish			E	G5	S1
Moxostoma carinatum	River redhorse	Fish			T	G4	S2

Scientific name	Common name	Class	Endemic*	Federal Status	State Status	Global Rank	State Rank
Noturus stigmosus	Northern madtom	Fish			E	G3	S1
Percina copelandi	Channel darter	Fish			E	G4	S1
Percina shumardi	River darter	Fish			E	G5	S1
Sorex fumeus	Smoky shrew	Mammal			T	G5	S1
Myotis lucifugus	Little brown bat	Mammal			SC	G3	S1
Myotis sodalis	Indiana bat	Mammal		LE	E	G2	S1
Myotis septentrionalis	Northern long-eared bat	Mammal		LT	SC	G1G2	S1
Canis lupus	Gray Wolf	Mammal		LE	SC	G5	S4
Lynx canadensis	Lynx	Mammal		LT	E	G5	S1
Alces americanus	Moose	Mammal			SC	G5	S4
Clemmys guttata	Spotted turtle	Reptile			T	G5	S2
Emydoidea blandingii	Blanding's turtle	Reptile			SC	G4	S2S3
Pantherophis gloydi	Eastern fox snake	Reptile	Yes		T	G3	S2
Opheodrys vernalis	Smooth green snake	Reptile			SC	G5	S3
Sistrurus catenatus	Eastern massasauga	Reptile		LT	SC	G3	S3
Nicrophorus americanus	American burying beetle	Insect		LE	X	G2G3	SH
Bombus terricola	Yellow banded bumble bee	Insect			SC	G3G5	SNR
Bombus pensylvanicus	American bumble bee	Insect			SC	G3G4	SNR
Pyrgus centaureae wyandot	Grizzled skipper	Insect			SC	G5T1T2	S1S2
Euchloe ausonides	Large marble	Insect			SC	G5	SH
Plebejus idas nabokovi	Northern blue	Insect			T	G5TU	S2
Oeneis macounii	Macoun's arctic	Insect			SC	G5	SH
Papaipema aweme	Aweme borer	Insect			SC	G1	S1
Euxoa aurulenta	Dune cutworm	Insect			SC	G5	S2S3
Somatochlora hineana	Hine's emerald dragonfly	Insect		LE	E	G2G3	S1
Trimerotropis huroniana	Lake Huron locust	Insect	Yes		T	G2G3	S2S3
Alasmidonta viridis	Slippershell	Mussel			T	G4G5	S2S3
Cyclonaias tuberculata	Purple wartyback	Mussel			T	G5	S2
Elliptio complanata	Eastern elliptio	Mussel			SC	G5	S2
Epioblasma obliquata perobliqua	White catspaw	Mussel		LE	E	G1T1	SH
Epioblasma torulosa rangiana	Northern riffleshell	Mussel		LE	E	G2T2	S1
Epioblasma triquetra	Snuffbox	Mussel		LE	E	G3	S1S2
Lampsilis fasciola	Wavyrayed lampmussel	Mussel			T	G5	S2
Lasmigona compressa	Creek heelsplitter	Mussel			SC	G5	S3
Lasmigona costata	Flutedshell	Mussel			SC	G5	SNR
Ligumia nasuta	Eastern pondmussel	Mussel			E	G4	S2
Ligumia recta	Black sandshell	Mussel			E	G4G5	S1?

Scientific name	Common name	Class	Endemic*	Federal Status	State Status	Global Rank	State Rank
Obliquaria reflexa	Threehorn wartyback	Mussel			E	G5	S1
Obovaria olivaria	Hickorynut	Mussel			E	G4	S1
Obovaria subrotunda	Round hickorynut	Mussel			E	G4	S1
Pleurobema sintoxia	Round pigtoe	Mussel			SC	G4G5	S3
Potamilus alatus	Pink heelsplitter	Mussel			SC	G5	SNR
Ptychobranchus fasciolaris	Kidney shell	Mussel			SC	G4G5	S2
Toxolasma parvum	Lilliput	Mussel			E	G5	S1
Truncilla truncata	Deertoe	Mussel			SC	G5	S2S3
Villosa fabalis	Rayed bean	Mussel		LE	E	G2	S1S2
Villosa iris	Rainbow	Mussel			SC	G5Q	S3
Pisidium amnicum	Greater European pea clam	Pea clam			SC	G5	SNA
Pisidium idahoense	Giant northern pea clam	Pea clam			SC	G5	SNR
Pyganodon lacustris	Lake floater	Mussel	Yes		SC	GU	SNR
Carychium nannodes	File thorn	Snail			SC	G5	SNR
Pupilla muscorum	Widespread column	Snail			SC	G5	S2
Vertigo bollesiana	Delicate vertigo	Snail			T	G4	S2
Vertigo elatior	Tapered vertigo	Snail			SC	G5	S3
Vertigo nylanderi	Deep-throat vertigo	Snail			E	G3G4	S1?
Vertigo pygmaea	Crested vertigo	Snail			SC	G5	S1S2
Vertigo hubrichti	Hubricht's vertigo	Snail			E	G3Q	S2
Vertigo paradoxa	Mystery vertigo	Snail			SC	G4G5Q	S3S4
Vertigo cristata	Crested vertigo	Snail			SC	G5	S3
Planogyra asteriscus	Eastern flat-whorl	Snail			SC	G4	S2S3
Vallonia gracilicosta albula	A land snail (no common name)	Snail			E	G4Q	S2
Vallonia parvula	Trumpet vallonia	Snail			SC	G4	SNR
Catinella exile	Pleistocene catinella	Snail			T	G2	S1
Euconulus alderi	A land snail (no common name)	Snail			T	G4Q	S2
Mesodon elevatus	Proud globe	Snail			T	G5	SH
Mesodon pennsylvanicus	Proud globelet	Snail			SC	G4	SNR
Appalachina sayanus	Spike-lip crater	Snail			SC	G5T5	S1
Cincinnatia cincinnatiensis	Campeloma spire snail	Snail			SC	G5	S3
Fontigens nickliniana	Watercress snail	Snail			SC	G5	S2S3
Stagnicola contracta	Deepwater pondsnail	Snail	Yes		E	G1	SH
Stagnicola woodruffi	Coldwater pondsnail	Snail			SC	G2G3Q	SNR
Physella magnalacustris	Great Lakes physa	Snail			SC	G5Q	SNR
Adlumia fungosa	Climbing fumitory	Plant			SC	G4	S3
Allium schoenoprasum	Chives	Plant			T	G5	S2

Scientific name	Common name	Class	Endemic*	Federal Status	State Status	Global Rank	State Rank
Amerorchis rotundifolia	Small round-leaved orchis	Plant			E	G5	S1
Antennaria rosea	Rosy pussytoes	Plant			E	G5	SX
Arnica lonchophylla	Longleaf arnica	Plant			E	G5	S1
Arnoglossum plantagineum	Prairie indian-plantain	Plant			SC	G4G5	S3
Asclepias purpurascens	Purple milkweed	Plant			T	G5?	S2
Asclepias sullivantii	Sullivant's milkweed	Plant			T	G5	S2
Asplenium rhizophyllum	Walking fern	Plant			T	G5	S2S3
Asplenium ruta-muraria	Wall-rue	Plant			E	G5	S1
Asplenium viride	Green spleenwort	Plant			SC	G4	S3
Astragalus neglectus	Cooper's milk vetch	Plant			SC	G4	S3
Barbarea orthoceras	Northern Winter Cress	Plant			SC	G5	SNR
Beckmannia syzigachne	Slough grass	Plant			T	G5	S2
Bistorta vivipara	Alpine bistort	Plant			T	G5	S1S2
Botrychium campestre	Prairie Moonwort or Dunewort	Plant			T	G3G4	S2
Botrychium mormo	Goblin moonwort	Plant			T	G3	S2
Botrychium spathulatum	Spatulate moonwort	Plant			T	G3	S2
Bromus pumpellianus	Pumpelly's bromegrass	Plant			T	G5T4	S2
Calamagrostis lacustris	Northern reedgrass	Plant			SC	G3Q	S1
Callitriche hermaphroditica	Autumnal water-starwort	Plant			SC	G5	S2
Calypso bulbosa	Calypso or fairy-slipper	Plant			T	G5	S2
Camassia scilloides	Wild hyacinth	Plant			T	G4G5	S2
Canadanthus modestus	Great northern aster	Plant			T	G5	S1
Carex atratiformis	Sedge	Plant			T	G5	S2
Carex media	Sedge	Plant			T	G5T5	S2S3
Carex richardsonii	Richardson's sedge	Plant			SC	G5	S3S4
Carex rossii	Ross's sedge	Plant			T	G5	S2
Carex scirpoidea	Bulrush sedge	Plant			T	G5	S2
Carex squarrosa	Sedge	Plant			SC	G4G5	S1
Castilleja septentrionalis	Pale Indian paintbrush	Plant			T	G5	S2S3
Cerastium brachypodum	Shortstalk chickweed	Plant			T	G5	S2
Cerastium velutinum	Field Chickweed	Plant			X	G5T4?	SX
Cirsium hillii	Hill's thistle	Plant			SC	G3	S3
Cirsium pitcheri	Pitcher's thistle	Plant	Yes	LT	T	G2G3	S3
Clematis occidentalis	Purple clematis	Plant			SC	G5	S3
Collinsia parviflora	Small blue-eyed Mary	Plant			T	G5	S2
Corispermum pallasii	Pallas' bugseed	Plant			SC	G4?	SNR

Scientific name	Common name	Class	Endemic*	Federal Status	State Status	Global Rank	State Rank
Crataegus douglasii	Douglas's hawthorn	Plant			SC	G5	S3S4
Cryptogramma acrostichoides	American rock-brake	Plant			T	G5	S2
Cypripedium arietinum	Ram's head lady's-slipper	Plant			SC	G3	S3
Cystopteris tennesseensis	Tennessee bladder fern	Plant			T	G5	S2
Danthonia intermedia	Wild oat grass	Plant			SC	G5	S1S2
Dichanthelium leibergii	Leiberg's panic grass	Plant			T	G4	S2
Draba arabisans	Rock whitlow grass	Plant			SC	G4	S3
Draba glabella	Smooth whitlow grass	Plant			E	G5	S1
Draba incana	Twisted whitlow grass	Plant			T	G5	S1
Drosera anglica	English sundew	Plant			SC	G5	S3
Dryopteris filix-mas	Male fern	Plant			SC	G5	S3
Dryopteris fragrans	Fragrant cliff woodfern	Plant			SC	G5	S3
Eleocharis compressa	Flattened spike rush	Plant			T	G4	S2
Elymus glaucus	Blue wild-rye	Plant			SC	G5	S3
Empetrum nigrum	Black crowberry	Plant			T	G5	S2
Endodeca serpentaria	Virginia snakeroot	Plant			T	G4	S2
Erigeron acris	Fleabane	Plant			T	G5	S1S2
Euphorbia commutata	Tinted spurge	Plant			T	G5	S1
Euphrasia hudsoniana	Eyebright	Plant			T	G5?	S1
Euphrasia nemorosa	Eyebright	Plant			T	G5	S1
Fimbristylis puberula	Chestnut sedge	Plant			X	G5	SX
Fraxinus profunda	Pumpkin ash	Plant			T	G4	S2
Galearis spectabilis	Showy orchis	Plant			T	G5	S2
Geum triflorum	Prairie smoke	Plant			T	G5	S2S3
Graphephorum melicoides	Purple false oats	Plant			SC	G4	SNR
Gymnocarpium robertianum	Limestone oak fern	Plant			T	G5	S2
Hibiscus laevis	Smooth rose-mallow	Plant			X	G5	SX
Huperzia appalachiana	Mountain fir-moss	Plant			SC	G5	S2
Huperzia selago	Fir clubmoss	Plant			SC	G5	S3
Hydrastis canadensis	Goldenseal	Plant			T	G3G4	S2
Iris lacustris	Dwarf lake iris	Plant	Yes	LT	T	G3	S3
Juncus brachycarpus	Short-fruited rush	Plant			T	G4G5	S1S2
Juncus stygius	Moor rush	Plant			T	G5	S1S2
Juncus vaseyi	Vasey's rush	Plant			T	G5	S1S2
Lactuca floridana	Woodland lettuce	Plant			T	G5	S2
Leymus mollis	American dune wild-rye	Plant			SC	G5	S3
Linum sulcatum	Furrowed flax	Plant			SC	G5	S2S3
Littorella uniflora	American shore-grass	Plant			SC	G5	S2S3

Scientific name	Common name	Class	Endemic*	Federal Status	State Status	Global Rank	State Rank
Lonicera involucrata	Black twinberry	Plant			T	G5T4T5	S2
Luzula parviflora	Small-flowered wood rush	Plant			T	G5	S1
Mertensia paniculata	Northern Bluebell	Plant			SC	G5	SNR
Mimulus michiganensis	Michigan monkey flower	Plant	Yes	LE	E	G5T1	S1
Moehringia macrophylla	Big-leaf sandwort	Plant			T	G5	S1
Morus rubra	Red mulberry	Plant			T	G5	S2
Mulgedium pulchellum	Blue lettuce	Plant			X	G5T5	SX
Myriophyllum alterniflorum	Alternate-leaved water-milfoil	Plant			SC	G5	S2S3
Myriophyllum farwellii	Farwell's water milfoil	Plant			T	G5	S2
Nelumbo lutea	American lotus	Plant			T	G4	S2
Neottia auriculata	Auricled twayblade	Plant			SC	G3G4	S2S3
Nymphaea leibergii	Pygmy water lily	Plant			E	G5	S1
Omalotheca sylvatica	Woodland everlasting	Plant			T	G4	S1
Oplopanax horridus	Devil's club	Plant			T	G5	S2
Orobanche fasciculata	Broomrape	Plant			T	G4G5	S2
Osmorhiza depauperata	Sweet Cicely	Plant			T	G5	S2
Packera indecora	Northern ragwort	Plant			T	G5	S1
Panax quinquefolius	Ginseng	Plant			T	G3G4	S2S3
Panicum philadelphicum	Philadelphia panic-grass	Plant			T	G5?	S2
Parnassia palustris	Marsh grass-of-parnassus	Plant			T	G5	S2
Pellaea atropurpurea	Purple cliff brake	Plant			T	G5	S2
Penstemon calycosus	Beard tongue	Plant			T	G5	S2
Phacelia franklinii	Franklin's phacelia	Plant			T	G5	S1
Phaseolus polystachios	Wild bean	Plant			X	G5	SX
Pinguicula vulgaris	Butterwort	Plant			SC	G5	S3
Platanthera leucophaea	Prairie white-fringed orchid	Plant		LT	E	G2G3	S1
Platanthera unalascensis	Alaska orchid	Plant			SC	G5	S2S3
Poa alpina	Alpine bluegrass	Plant			T	G5	S1S2
Poa interior	Inland bluegrass	Plant			SC	G5T5	SNR
Poa secunda	Canbyi's bluegrass	Plant			E	G5	S1
Polygala incarnata	Pink milkwort	Plant			X	G5	SX
Potentilla litoralis	Prairie cinquefoil	Plant			T	G5T5	S1
Potentilla supina	Sand cinquefoil	Plant			T	G5	SU
Prosartes trachycarpa	Northern fairy bells	Plant			T	G5	S1
Pterospora andromedea	Pine-drops	Plant			T	G5	S2
Pyrola minor	Lesser Pyrola	Plant			SC	G5	SNR

Scientific name	Common name	Class	Endemic*	Federal Status	State Status	Global Rank	State Rank
Quercus shumardii	Shumard's oak	Plant			SC	G5	S2
Ranunculus cymbalaria	Seaside crowfoot	Plant			T	G5	SX
Ranunculus macounii	Macoun's buttercup	Plant			T	G5	S1
Ranunculus rhomboideus	Prairie buttercup	Plant			T	G5	S2
Ribes oxyacanthoides	Northern gooseberry	Plant			SC	G5	S3
Sagina nodosa	Pearlwort	Plant			T	G5	S2
Sagittaria montevidensis	Arrowhead	Plant			T	G4G5	S1S2
Salix pellita	Satiny willow	Plant			SC	G5	S2
Salix planifolia	Tea-leaved willow	Plant			T	G5	S1
Sarracenia purpurea f. heterophylla	Yellow pitcher plant	Plant			T	G5T1T2Q	S1
Saxifraga paniculata	Encrusted saxifrage	Plant			T	G5	S1
Saxifraga tricuspidata	Prickly saxifrage	Plant			T	G5	S2
Schoenoplectus torreyi	Torrey's bulrush	Plant			SC	G5?	S2S3
Scirpus georgianus	Georgia bulrush	Plant			SC	G5	SNR
Scleria triglomerata	Tall nut rush	Plant			SC	G5	S3
Scutellaria parvula	Small skullcap	Plant			T	G4	S2
Silene virginica	Fire pink	Plant			E	G5	S1
Silphium perfoliatum	Cup plant	Plant			T	G5	S2
Sisyrinchium hastile	Blue-eyed-grass	Plant			X	GUGHQ	SNA
Smilax herbacea	Smooth carrion-flower	Plant			SC	G5	S3
Solidago houghtonii	Houghton's goldenrod	Plant	Yes	LT	T	G3	S3
Spinulum canadense	Clubmoss	Plant			SC	G5T4T5	SNR
Sporobolus heterolepis	Prairie dropseed	Plant			SC	G5	S3
Stellaria longipes	Stitchwort	Plant			SC	G5	S2
Strophostyles helvula	Trailing wild Bean	Plant			SC	G5	S3
Subularia aquatica	Awlwort	Plant			E	G5	S1
Tanacetum huronense	Lake Huron tansy	Plant			T	G5T4T5	S3
Tofieldia pusilla	False asphodel	Plant			T	G5	S2
Trichostema brachiatum	False pennyroyal	Plant			T	G5	S1
Triplasis purpurea	Sand grass	Plant			SC	G4G5	S2
Trisetum spicatum	Downy oat-grass	Plant			SC	G5	S2S3
Vaccinium cespitosum	Dwarf bilberry	Plant			T	G5	S1S2
Vaccinium uliginosum	Alpine blueberry	Plant			T	G5	S2
Vaccinium vitis-idaea	Mountain cranberry	Plant			E	G5	S1
Viburnum edule	Squashberry or mooseberry	Plant			T	G5	S2S3
Viola epipsila	Northern marsh violet	Plant			E	G4G5	SX
Woodsia alpina	Northern woodsia	Plant			E	G4G5	S1
Zizania aquatica	Wild rice	Plant			T	G5	S2S3

*Great Lakes endemic

As of 2019-04-19

Appendix 6.

Natural Community Types found on Michigan's Great Lakes Islands

Community name	Endemic*	Global Rank	State Rank
Alvar		G2?	S1
Bog		G3G5	S4
Boreal Forest		GU	S3
Clay Bluff	Yes	GNR	S2
Coastal Fen	Yes	G1G2	S2
Dry-mesic Northern Forest		G4	S3
Emergent Marsh		GU	S4
Granite Bedrock Lakeshore		G4G5	S2
Granite Lakeshore Cliff		GU	S1
Great Lakes Barrens	Yes	G3	S2
Great Lakes Marsh	Yes	G2	S3
Hardwood-Conifer Swamp		G4	S3
Interdunal Wetland	Yes	G2?	S2
Lakeplain Oak Openings	Yes	G2?	S1
Lakeplain Wet Prairie	Yes	G2	S1
Lakeplain Wet-mesic Prairie	Yes	G1?	S1
Limestone Bedrock Glade		G2G4	S2
Limestone Bedrock Lakeshore		G3	S2
Limestone Cliff		G4G5	S2
Limestone Cobble Shore		G2G3	S3
Limestone Lakeshore Cliff		G4G5	S1
Mesic Northern Forest		G4	S3
Northern Fen		G3	S3
Northern Hardwood Swamp		G4	S3
Northern Shrub Thicket		G4	S5
Northern Wet Meadow		G4G5	S4
Open Dunes	Yes	G3	S3
Poor Conifer Swamp		G4	S4
Poor Fen		G3	S3
Rich Conifer Swamp		G4	S3
Sand and Gravel Beach		G3?	S3
Sandstone Lakeshore Cliff		G3	S2
Sinkhole		G3G5	S2
Southern Hardwood Swamp		G3	S3
Volcanic Bedrock Lakeshore		G4G5	S2
Volcanic Lakeshore Cliff		GU	S1
Wet-mesic Flatwoods		G2G3	S2
Wooded Dune and Swale Complex	Yes	G3	S3

*Great Lakes endemic

Appendix 7.
Federal and State Status and Global and State Rank Definitions

Federal Status	
Value	**Description**
LE	Listed endangered
LT	Listed threatened
State Status	
Value	**Description**
E	Endangered
T	Threatened
SC	Special concern
Global Rank	
Value	**Description**
G1	Critically imperiled
G2	Imperiled
G3	Vulnerable
G4	Apparently secure
G5	Secure
GH	Possibly extinct
GX	Presumed extinct
Variants	**Description**
G#G#	Uncertainty about exact status
GU	Unrankable
GNR	Unranked
GNA	Not applicable
Qualifiers	**Description**
?	Inexact
Q	Questionable taxonomy
State Rank	
Value	**Description**
S1	Critically Imperiled
S2	Imperiled
S3	Vulnerable
S4	Apparently secure
S5	Secure
SH	Possibly Extirpated
SX	Presumed Extirpated
Variants	**Description**
S#S#	Range Rank
SU	Unrankable
SNR	Unranked
SNA	Not Applicable
Qualifier	**Description**
?	Inexact

Appendix 8.
Special Designations List

Designation	Level	Agency
Cisco Lake	State	DNR
Coastal Environmental Area	State	DEQ
Cormorant Management Site	State	DNR
Critical Dune	State	DEQ
Dedicated Management Area	State	DNR
Designated Dune Area	State	DEQ
Eastern Massasauga Managed Land	State	DNR
Forest Habitat Core Interior	State	DNR
Forest Stewardship Area	State	DNR
Historic State Park	State	DNR
Natural Area Legally Dedicated	State	DNR
Natural Area Non-legally Dedicated	State	DNR
Natural Beauty Road	State	DNR
Recreational/Scenic Value	State	DNR
State Forest	State	DNR
State Game Area	State	DNR
State Park	State	DNR
Trout Stream	State	DNR
EPA Area of Concern (AOC)	Federal	EPA
NOAA National Marine Sanctuary	Federal	NOAA
NPS Designated Historic Place	Federal	NPS
NPS Legislated Wilderness	Federal	NPS
NPS National Lakeshore	Federal	NPS
NPS National Park	Federal	NPS
USFS National Recreation Area	Federal	USFS
USFS Research Natural Area	Federal	USFS
USFS Roadless Area	Federal	USFS
USFS Scenic Area	Federal	USFS
USFS Wild and Scenic River	Federal	USFS
USFS Wilderness Area	Federal	USFS
USFWS - Wilderness Area	Federal	USFWS
USFWS Critical Habitat (Hine's emerald dragonfly)	Federal	USFWS
USFWS Critical Habitat (Piping plover)	Federal	USFWS
Audubon Important Bird Area	Other	Audubon
RAMSAR Wetland of International Importance	Other	RAMSAR
USFWS Midwest Region Coastal Program Focus Area	Other	USFWS

Appendix 9. Table of Vector Assessment (condensed vectors)

For the invasive species/full vector table, see **Digital Appendix 9 Full invasive species vector tables.xlsx**

Taxa/Species	*Scientific Name*	Commercial/ Recreational Fishing[1]	Human Activity & Commerce[2]	Natural Forces[3]	Host Vector Organisms[4]	Commercial Transportation[5]	Recreational Transportation[6]	Aquaculture Aquaria/Game Farms/Gardens[7]	Total
Birds									
Eurasian collared dove	*Streptopelia decaocto*	0	0	1	0	0	0	0	1
mute swan	*Cygnus olor*	0	1	1	0	0	0	0	2
cormorant	*Phalacrocorax auritus*	0	0	1	0	0	0	1	2
Crustaceans									
red swamp crayfish	*Procambarus clarkii*	2	2	0	0	0	0	2	6
yabby	*Cherax destructor*	2	0	0	0	0	0	2	4
rusty crayfish	*Orconectes rusticus*	3	1	0	0	0	0	0	4
marbled crayfish (marmorkreb)	*Procambarus fallax (forma virginalis)*	0	0	0	0	0	0	1	1
Chinese mitten crab	*Eriocheir sinensis*	2	0	1	0	2	0	1	6
killer shrimp	*Dikerogammarus villosus*	0	0	0	0	1	0	0	1
fishhook waterflea	*Cercopagis pengoi*	0	0	0	0	2	0	0	2
spiny waterflea	*Bythotrephes longimanus*	2	0	0	0	2	0	0	4
Fish									
round goby	*Apollonia melanostomus*	0	0	0	0	2	0	0	2
tubenose goby	*Proterorhinus semilunaris*	0	0	0	0	2	0	0	2
grass carp (fertile)	*Ctenopharyngodon idella*	0	1	0	0	0	0	1	2
bighead carp	*Hypophthalmichthys nobilis*	0	0	0	0	0	0	2	2

Taxa/Species	*Scientific Name*	Commercial/ Recreational Fishing[1]	Human Activity & Commerce[2]	Natural Forces[3]	Host Vector Organisms[4]	Commercial Transportation[5]	Recreational Transportation[6]	Aquaculture Aquaria/Game Farms/Gardens[7]	Total
silver carp	*Hypophthalmichthys molitrix*	0	1	0	0	0	0	1	2
black carp	*Mylopharyngodon piceus*	0	0	0	0	0	0	1	1
northern snakehead	*Channa argus*	2	0	0	0	0	0	2	4
bitterling	*Rhodeus sericeus*	2	0	0	0	1	0	1	4
western mosquitofish	*Gambusia affinis*	0	1	0	0	0	0	0	1
Eurasion ruffe	*Gymnocephalus cernuus*	2	0	0	0	1	0	0	3
ide	*Leuciscus idus*	0	0	0	0	0	0	1	1
Japanese weatherfish	*Misgurnus anguillicaudatus*	2	0	0	0	0	0	2	4
rudd	*Scardinius erythrophthalmus*	2	0	0	0	0	0	1	3
sea lamprey	*Petromyzon marinus*	2	0	0	0	4	0	0	6
stone moroko (topmouth gudeon)	*Pseudorasbora parva*	2	0	0	0	0	0	2	4
tench	*Tinca tinca*	2	0	0	0	0	0	1	3
wels catfish	*Silurus glanis*	0	0	0	0	0	0	1	1
white perch	*Morone americana*	2	0	0	0	1	0	0	3
zander (pike-perch)	*Sander lucioperca*	0	0	0	0	0	0	1	1
Mammals				0					
feral swine	*Sus scrofa*	0	0	1	0	0	0	1	2
nutria	*Myocastor coypus*	0	0	0	0	0	0	1	1
Mollusks									
quagga mussel	*Dreissena rostriformis bugensis*	0	0	1	0	1	0	0	2

Taxa/Species	*Scientific Name*	Commercial/ Recreational Fishing[1]	Human Activity & Commerce[2]	Natural Forces[3]	Host Vector Organisms[4]	Commercial Transportation[5]	Recreational Transportation[6]	Aquaculture Aquaria/Game Farms/Gardens[7]	Total
zebra mussel	*Dreissena polymorpha*	0	0	1	0	1	0	1	3
New Zealand mudsnail	*Potamopyrgus antipodarum*	0	0	2	0	1	0	1	4
Asian clam	*Corbicula fluminea*	3	1	2	1	4	0	2	13
Asian clam	*Corbicula largillierta*	3	1	2	1	4	0	2	13
Asian clam	*Corbicula sp. form D*	3	1	2	1	4	0	2	13
Asian clam	*Corbicula squalida*	3	1	2	1	4	0	2	13
brown garden snail (common garden snail)	*Cantareus aspersa*	0	2	1	0	4	1	1	9
Carthusian snail	*Monacha cartusiana*	0	0	0	0	1	0	0	1
giant African snail	*Lissachatina fulica*	2	1	1	0	2	1	1	8
girdled snail	*Hygromia cinctella*	0	0	1	0	0	0	2	3
golden mussel	*Limnoperna fortunei*	2	0	2	0	2	0	0	6
heath snail	*Xerolenta obvia*	0	0	0	0	3	0	0	3
wrinkled dune snail	*Candidula intersecta*	0	0	0	0	4	1	0	5
Japanese/Chinese mystery snail	*Cipangopaludina chinensis*	2	1	0	0	0	0	0	3
Plants									
Asiatic sand sedge	*Carex kobomugi*	0	0	0	0	2	0	1	3
Autumn olive	*Elaeagnus umbellata*	0	1	0	1	0	2	5	9
Chinese yam	*Dioscorea oppositifolia*	0	1	0	0	0	0	1	2
Giant hogweed	*Heracleum mantegazzianum*	0	1	4	0	1	1	3	10
Himalayan balsam	*Impatiens glandulifera*	0	0	3	0	0	0	4	7
Japanese stiltgrass	*Microstegium vimineum*	0	0	2	0	1	0	1	4

Taxa/Species	*Scientific Name*	Commercial/ Recreational Fishing[1]	Human Activity & Commerce[2]	Natural Forces[3]	Host Vector Organisms[4]	Commercial Transportation[5]	Recreational Transportation[6]	Aquaculture Aquaria/Game Farms/Gardens[7]	Total
Japanese knotweed	*Fallopia japonica*	0	1	3	0	1	2	4	11
Kudzu	*Pueraria montana var. lobata*	0	0	1	0	0	0	4	5
Mile-a-minute weed	*Persicaria perfoliata*	0	0	1	0	1	0	3	5
Phragmites	*Phragmites australis*	0	0	3	0	2	0	1	6
Purple loosestrife	*Lythrum salicaria*	0	1	2	0	2	2	4	11
African oxygen weed	*Lagarosiphon major*	0	0	3	0	2	2	3	10
Brazilian elodea (waterweed)	*Egeria densa*	2	0	1	1	0	1	1	6
Carolina fanwort	*Cabomba caroliniana*	2	0	2	1	3	1	2	11
Curly-leaved pondweed	*Potamogeton crispus*	0	0	2	1	2	1	5	11
Eurasian watermilfoil	*Myriophyllum spicatum*	2	0	2	0	1	1	2	8
European frog-bit	*Hydrocharis morsus-ranae*	2	0	3	1	1	2	3	12
European Water-clover	*Marsilea quadrifolia*	0	0	0	1	0	0	1	2
Flowering rush	*Butomus umbellatus*	1	0	1	1	0	1	0	4
Giant salvinia	*Salvinia molesta, auriculata, biloba, or herzogii*	2	2	3	1	4	1	3	16
Hydrilla	*Hydrilla verticillata*	1	0	2	0	1	0	3	7
Parrot feather	*Myriophyllum aquaticum*	0	0	2	0	0	1	7	10
Starry stonewort	*Nitellopsis obtusa*	2	0	0	1	1	1	0	5
Water chestnut (water caltrop)	*Trapa natans*	2	0	2	1	2	1	4	12
Water hyacinth	*Eichhornia crassipes*	2	0	1	1	0	1	3	8
Water lettuce	*Pistia stratiotes*	2	0	2	0	1	1	4	10

Taxa/Species	*Scientific Name*	Commercial/ Recreational Fishing[1]	Human Activity & Commerce[2]	Natural Forces[3]	Host Vector Organisms[4]	Commercial Transportation[5]	Recreational Transportation[6]	Aquaculture Aquaria/Game Farms/Gardens[7]	Total
Water soldier	*Stratiotes aloides*	2	0	2	0	0	1	2	7
Yellow Floating Heart	*Nymphoides peltata*	0	0	2	1	1	0	4	8
Algae				0		0			
Cylindro	*Cylindrospermopsis raciborskii*	2	0	1	1	1	1	0	6
Insects				0	0		0		
Asian longhorned beetle	*Anoplophora glabripennis*	0	0	1	1	1	0	0	3
mountain pine beetle	*Dendroctonus ponderosae*	0	0	1	0	0	0	0	1
balsam woolly adelgid	*Adelges piceae*	0	0	1	1	0	0	0	2
hemlock woolly adelgid	*Adelges tsugae*	0	0	1	1	0	0	0	2
brown marmorated stink bug	*Halyomorpha halys*	0	1	1	0	4	2	1	9
emerald ash borer	*Agrilus planipennis*	0	0	2	0	1	1	1	5
gypsy moth	*Lymantria dispar*	0	1	2	0	1	1	1	6
Japanese beetle	*Popillia japonica*	0	0	1	0	1	0	3	5
Annelids									
an oligochaete	*Ripistes parasita*	0	0	0	0	2	0	0	2
Bryozoa									
a freshwater bryozoan	*Lophopodella carteri*	0	0	0	1	0	0	3	4
Viruses									
viral hemmorrhagic septicemia (VHSV)	*Oncorhynchus 2 novirhabdovirus*	2	0	0	2	0	0	0	4
Bacteria									
muskie pox	*Piscirickettsia cf. salmonis*	0	0	0	2	0	0	0	2

Taxa/Species	*Scientific Name*	Commercial/ Recreational Fishing[1]	Human Activity & Commerce[2]	Natural Forces[3]	Host Vector Organisms[4]	Commercial Transportation[5]	Recreational Transportation[6]	Aquaculture Aquaria/Game Farms/Gardens[7]	Total
bacterial kidney disease (BKD)	*Renibacterium salmoninarum.*	0	0	0	2	0	0	1	3
Fungi (Microsporidia)									
yellow perch parasite	*Heterosporis* sp.	0	0	0	0	0	0	0	0
thousand cankers disease	*Geosmithia morbida*	0	0	0	1	0	1	0	2
beech bark disease	*Neonectria* spp.	0	0	0	1	0	0	0	1
oak wilt	*Bretziella fagacearum*	0	0	1	1	0	0	0	2
Total		64	20	83	30	93	32	128	

[1]Bait, boats/trailers, commercial fishing gear, fishing gear, commercial harvesters, intentional stocking, live seafood
[2]Biological control, biological supply, clothing, footwear, consumables, debris/waste, feeding by people, food/medicine market
[3]Alewife populations (high), currents (water), larval dispersal, dispersed by land/waterbirds & small mammals, dispersal of young, floating vegetation/debris, flooding, ice bridge, insect dispersal, root connections underground, soil, sand, and gravel, wind
[4]Fish to fish, infected waters
[5]Aircraft, artificial waterways, bulk freight/cargo, containers and packaging (non-wood), containers and packaging (wood), international shipping, machinery/equipment, marble/stone/ tile imports, rail cars, ship ballast water/sediment, ship bilge water, ship hull fouling, ship structures above water line, shipping containers
[6]Boats/trailers, firewood transport, land vehicles, machinery/equipment
[7]Aquaculture/human food, aquaria release, aquarium trade/watergardens, commercial greenhouse, escape from gardens, fish stocking, game farm escapes, ornamental plant, nursery stock, plants or plant parts, potted plants, intentional release

Appendix 10.

CISMA Island Attributes Summary

CISMA name	Islands	Minimum area (ac)	Maximum area (ac)	Mean area (ac)	Total area (ac)	Stream length (mi)	Lake area (ac)	Coastal wetland area (ac)
CAKE CISMA	69	0.011	36,760	703	48,480	13.4	1,288	784
Central Upper Peninsula CWMA	96	0.016	13,552	196	18,779	15.7	242	429
Detroit & Western Lake Erie CWMA	54	0.116	5,061	165	8,888	17.9	210	736
East Saginaw	268	0.012	570	9	2,310	0.6	6	1,540
Keweenaw ISMA	457	0.013	138,819	312	142,484	176.3	8,989	2,794
Lake St. Clair CISMA	33	1.823	7,339	378	12,475	28.1	56	7,490
Northeast Michigan CISMA	86	0.023	280	12	1,003	0.0	0	380
Northwest Michigan CISMA	9	0.919	14,404	2,686	24,176	2.2	343	6
Three Shores CISMA	637	0.001	83,290	265	169,090	78.0	5,158	10,404

CISMA name	EO count	Rare animal species	Rare plant species	Community types	Rookery count	Federally listed species	Great Lake endemics	Mean spawning species	Unique invasive species
CAKE CISMA	257	30	18	19	6	6	14	8	61
Central Upper Peninsula CWMA	96	18	23	10	7	4	4	11	16
Detroit & Western Lake Erie CWMA	134	44	24	3	2	7	2	29	85
East Saginaw	63	30	3	3	3	4	3	8	13
Keweenaw ISMA	702	23	82	2	14	3	2	4	29
Lake St. Clair CISMA	60	22	10	6	1	1	5	32	12
Northeast Michigan CISMA	40	9	9	4	4	2	2	11	11
Northwest Michigan CISMA	85	12	17	8	0	2	8	5	13
Three Shores CISMA	535	49	49	21	24	9	10	10	41

Appendix 11

Wisconsin Ch. NR 40 Invasive Species List

WISCONSIN CH. NR 40 INVASIVE SPECIES LIST

EFFECTIVE LISTING DATE
September 1, 2009 [A]
June 1, 2011 [B]
May 1, 2015 [C]

ALGAE AND CYANOBACTERIA

PROHIBITED CATEGORY:

1. *Caulerpa taxifolia* (Killer algae)[C]
2. *Cylindrospermopsis raciborskii* (Cylindro, cyanobacteria)[A]
3. *Didymosphenia geminata* (Didymo or rock snot)[A] except in Lake Superior
4. *Nitellopsis obtusa* (Starry stonewort, alga)[A]
5. *Prymnesium parvum* (Golden alga)[A]
6. *Stigonematales* spp. (Novel cyanobacterial epiphyte of the order Stigonematales linked with avian vacuolar)[A]
7. *Ulva* species (including species previously known as Enteromorpha species)[A]

RESTRICTED CATEGORY:

None.

PLANTS

PROHIBITED CATEGORY:

1. *Achyranthes japonica* (Japanese chaff flower)[C]
2. *Akebia quinata* (Fiveleaf akebia or Chocolate vine)[C]
3. *Ampelopsis brevipedunculata* (Porcelain berry)[A] including the variegated cultivar
4. *Arundo donax* (Giant reed)[C]
5. *Azolla pinnata* (Mosquito fern)[C]
6. *Berberis vulgaris* (Common barberry)[C]
7. *Cabomba caroliniana* (Fanwort, Carolina fanwort)[A]
8. *Cardamine impatiens* (Narrow leaf bittercress)[C]
9. *Celastrus loeseneri* (Asian loeseneri bittersweet)[C]
10. *Centaurea diffusa* (Diffuse knapweed)[C]
11. *Centaurea repens* (Russian knapweed)[C]
12. *Centaurea solstitialis* (Yellow star thistle)[A]
13. *Crassula helmsii* (Australian swamp crop or New Zealand pygmyweed)[A]
14. *Cytisus scoparius* (Scotch broom)[A]
15. *Digitalis lanata* (Grecian foxglove)[C]
16. *Dioscorea batatas* or *Dioscorea polystacha* (Chinese yam)[C]
17. *Dioscorea oppositifolia* (Indian yam)[A]
18. *Egeria densa* (Brazilian waterweed or wide-leaf anacharis)[A]
19. *Eichhornia azurea* (Anchored water hyacinth)[C]
20. *Eichhornia crassipes* (Water hyacinth, floating)[C]
21. *Fallopia sachalinensis* or Polygonum sachalinense (Giant knotweed)[A]
22. *Fallopia* x *bohemicum* or *F.* x *bohemica* or *Polygonum* x *bohemicum* (Bohemian knotweed)[C]
23. *Glossostigma cleistanthum* (Mudmat)[C]
24. *Heracleum mantegazzianum* (Giant hogweed)[A]
25. *Hydrilla verticillata* (Hydrilla)[A]
26. *Hydrocharis morsus–ranae* (European frogbit)[A]
27. *Hydrocotyle ranunculoides* (Floating marsh pennywort)[C]
28. *Hygrophila polysperma* (Indian Swampweed)[C]
29. *Impatiens glandulifera* (Policeman's helmet)[C]
30. *Ipomoea aquatica* (Water spinach, swamp morning-glory)[C]
31. *Lagarosiphon major* (Oxygen–weed, African elodea or African waterweed)[A]
32. *Lepidium latifolium* (Perennial or broadleaved pepperweed)[A]
33. *Lespedeza cuneata* or *Lespedeza sericea* (Sericea or Chinese lespedeza)[A]
34. *Limnophila sessiliflora* (Asian marshweed)[C]
35. *Lonicera japonica* (Japanese honeysuckle)[A]
36. *Lythrum virgatum* (Wanded loosestrife)[C]
37. *Microstegium vimineum* (Japanese stilt grass)[A]
38. *Myriophyllum aquaticum* (Parrot feather)[A]
39. *Najas minor* (Brittle naiad, or lesser, bushy, slender, spiny or minor naiad or waternymph)[A]
40. *Nelumbo nucifera* (Sacred Lotus)[C]
41. *Nymphoides peltata* (Yellow floating heart)[A]
42. *Oenanthe javanica* (Java waterdropwort or Vietnamese parsley)[C]
43. *Oplismenus hirtellus* ssp. *undulatifolius* (Wavy leaf basket grass)[C]
44. *Ottelia alismoides* (Ducklettuce)[C]
45. *Paulownia tomentosa* (Princess tree)[A]
46. *Petasites hybridus* (Butterfly dock)[C]
47. *Phellodendron amurense* (Amur Cork Tree)[C] except male cultivars and seedling rootstock
48. *Pistia stratiotes* (Water lettuce)[C]
49. *Polygonum perfoliatum* or *Persicaria perfoliata* (Mile–a–minute vine)[A]
50. *Pueraria montana* or *P. lobata* (Kudzu)[A]
51. *Quercus acutissima* (Sawtooth oak)[A]
52. *Ranunculus ficaria* (Lesser celandine)[C]
53. *Rubus armeniacus* (Himalayan blackberry)[C]
54. *Rubus phoenicolasius* (Wineberry or wine raspberry)[A]
55. *Sagittaria sagittifolia* (Hawaii arrowhead)[C]
56. *Salvinia herzogii* (Giant Salvinia)[C]
57. *Salvinia molesta* (Giant salvinia)[C]
58. *Sorghum halepense* (Johnsongrass)[C]
59. *Stratiotes aloides* (Water Soldiers)[C]
60. *Taeniatherum caput-medusae* (Medusahead)[C]
61. *Torilis arvensis* (Spreading hedgeparsley)[A]
62. *Trapa natans* (Water chestnut)[A]
63. *Tussilago farfara* (Colt's foot)[C]
64. *Typha domingensis* (Southern cattail)[C]
65. *Typha laxmannii* (Graceful cattail)[C]
66. *Vincetoxicum rossicum* or *Cynanchum rossicum* (Pale or European swallow–wort)[A]
67. *Wisteria floribunda* (Japanese wisteria)[C]
68. *Wisteria sinensis* (Chinese wisteria)[C]

PROHIBITED/RESTRICTED CATEGORY:

1. *Anthriscus sylvestris* (Wild chervil)[A] restricted in Adams, Barron, Chippewa, Crawford, Columbia, Dane, Dodge, Dunn, Fond du Lac, Grant, Green, Green Lake, Iowa, Jefferson, Juneau, Kenosha, Lacrosse, Lafayette, Marquette, Milwaukee, Monroe, Ozaukee, Polk , Racine, Richland, Rock, Sauk, Sheboygan, Taylor, Vernon, Walworth, Waukesha, and Washington counties; prohibited elsewhere – Updated county list in 2015
2. *Bunias orientalis* (Hill mustard)[A] restricted in Dane, Grant, Green, Iowa, Lafayette, and Rock counties; prohibited elsewhere – Updated county list in 2015
3. *Cirsium palustre* (European marsh thistle)[A] restricted in Ashland, Bayfield, Chippewa, Clark, Door, Florence, Forest, Iron, Langlade, Lincoln, Marathon, Marinette, Menominee, Oconto, Oneida, Price, Rusk, Sawyer, Shawano, Taylor and Vilas counties; prohibited elsewhere – Updated county list in 2015
4. *Conium maculatum* (Poison hemlock)[A] restricted in Buffalo, Crawford, Dane, Grant, Green, Iowa, Jefferson, Kenosha, La Crosse, Lafayette, Milwaukee, Monroe, Ozaukee, Racine, Richland, Rock, Sauk, Sheboygan, Trempealeau, Vernon, Walworth, and Waukesha counties; prohibited elsewhere – Updated county list in 2015
5. *Epilobium hirsutum* (Hairy willow herb)[A] restricted in Brown, Calumet, Door, Kenosha, Kewaunee, and Manitowoc counties; prohibited elsewhere – Updated county list in 2015
6. *Glyceria maxima* (Tall or reed mannagrass)[A] restricted in Brown, Calumet, Columbia, Dane, Dodge, Door, Fond du Lac, Green, Jefferson, Kenosha, Kewaunee, Manitowoc, Milwaukee, Outagamie, Ozaukee, Racine, Rock, Sheboygan, Walworth, Washington, Waukesha and Winnebago counties; prohibited elsewhere – Updated county list in 2015
7. *Humulus japonicus* (Japanese hops)[A] restricted in Buffalo, Crawford, Dane, Grant, Green, Iowa, Jackson, La Crosse, Lafayette, Monroe, Pepin, Richland, Sauk, Trempealeau, and Vernon counties; prohibited elsewhere – Updated county list in 2015
8. *Leymus arenarius* or *Elymus arenarius* (Lyme grass or sand ryegrass)[A] restricted in Door, Kenosha, Kewaunee, Manitowoc, Milwaukee, Ozaukee, Racine, and Sheboygan counties; prohibited elsewhere – Updated county list in 2015
9. *Linaria dalmatica* (Dalmatian toadflax)[C] restricted in Juneau and Bayfield counties; prohibited elsewhere
10. *Lonicera maackii* (Amur honeysuckle)[A] restricted in Adams, Brown, Buffalo, Calumet, Columbia, Crawford, Dane, Dodge, Fond du Lac, Grant, Green, Green Lake, Iowa, Jefferson, Juneau, Kenosha, Kewaunee, La Crosse, Lafayette, Manitowoc, Marquette, Milwaukee, Monroe, Outagamie, Ozaukee, Racine, Richland, Rock, Sauk, Sheboygan, Vernon, Walworth, Washington, Waukesha, Waupaca, Waushara and Winnebago counties; prohibited elsewhere – Updated county list in 2015
11. *Phragmites australis* non-native ecotype (Phragmites or Common reed non-native ecotype)[A] restricted in Brown, Calumet, Columbia, Dane, Dodge, Door, Florence, Fond du Lac, Forest, Green Lake, Jefferson, Kenosha, Kewaunee, Langlade, Manitowoc, Marathon, Marinette, Marquette, Menominee, Milwaukee, Oconto, Outagamie, Ozaukee, Portage, Racine, Rock, Shawano, Sheboygan, Walworth, Washington, Waukesha, Waupaca, Waushara, and Winnebago counties; prohibited elsewhere - Moved to Prohibited/Restricted from Restricted in 2015
12. *Solidago sempervirens* (Seaside goldenrod)[C] restricted in Kenosha, Milwaukee and Racine counties; prohibited elsewhere
13. *Torilis japonica* (Japanese hedgeparsley or erect hedgeparsley)[A] restricted in Adams, Brown, Calumet, Columbia, Crawford, Dane, Dodge, Door, Fond du Lac, Grant, Green, Green Lake, Iowa, Jefferson, Juneau, Kenosha, Kewaunee, La Crosse, Lafayette, Langlade, Manitowoc, Marathon, Marinette, Marquette, Menominee, Milwaukee, Monroe, Oconto, Outagamie, Ozaukee, Portage, Racine, Richland, Rock, Sauk, Shawano, Sheboygan, Vernon, Walworth, Washington, Waukesha, Waupaca, Waushara, and Winnebago counties; prohibited elsewhere – Updated county list in 2015
14. *Vincetoxicum nigrum* or *Cynanchum louiseae* (Black or Louise's swallow–wort)[A] restricted in Columbia, Crawford, Dane, Grant, Green, Iowa, Jefferson, Juneau, Kenosha, La Crosse, Lafayette, Milwaukee, Monroe, Racine, Richland, Rock, Sauk, Vernon, Walworth and Waukesha counties; prohibited elsewhere

RESTRICTED CATEGORY:

1. *Acer tataricum* subsp. *ginnala* (Amur maple)[C] *except all cultivars
2. *Aegopodium podagraria* (Bishop's goutweed)[C]
3. *Ailanthus altissima* (Tree of heaven)[A]
4. *Alliaria petiolata* (Garlic mustard)[A]
5. *Alnus glutinosa* (Black alder)[C] *except all cultivars and hybrids
6. *Artemisia absinthium* (Wormwood)[C]
7. *Berberis thunbergii* (Japanese barberry)[C] *This restriction only applies to the parent type, the variety atropurpurea, the hybrid of B. thunbergii x B. Koreana, and the following cultivars. Berberis thunbergii cultivars: Sparkle, 'Anderson' Lustre Green™, Erecta, 'Bailgreen' Jade Carousel®, Angel Wings, Painter's Palette, Inermis ('Thornless'), Pow Wow, Golden Ring, Kelleriis, Kobold, 'JN Variegated' Stardust™ and Antares. Variety atropurpurea cultivars: Marshall Upright ('Erecta'), Crimson Velvet, 'Bailtwo' Burgundy Carousel®, Red Rocket, 'Monomb' Cherry Bomb™, 'Bailone' Ruby Carousel®, JN Redleaf, Rose Glow and Silver Mile. Hybrid of B. thunbergii x B. koreana cultivars: Tara and 'Bailsel' Golden Carousel®
8. *Butomus umbellatus* (Flowering rush)[A]
9. *Campanula rapunculoides* (Creeping bellflower)[A]
10. *Caragana arborescens* (Siberian peashrub)[C] *except the cultivars Lorbergii, Pendula, and Walkerii
11. *Carduus acanthoides* (Plumeless thistle)[A]
12. *Carduus nutans* (Musk thistle or Nodding thistle)[A]
13. *Celastrus orbiculatus* (Oriental bittersweet)[A]
14. *Centaurea biebersteinii*, *Centaurea maculosa* or *Centaurea stoebe* (Spotted knapweed)[A]

15. *Centaurea jacea* (Brown knapweed)[C]
16. *Centaurea nigra* (Black knapweed)[C]
17. *Centaurea nigrescens* (Tyrol knapweed)[C]
18. *Chelidonium majus* (Celandine)[A] - Moved to Restricted from Prohibited/Restricted in 2015
19. *Cirsium arvense* (Canada thistle)[A]
20. *Coronilla varia* (Crown vetch)[C]
21. *Cynoglossum officinale* (Hound's tongue)[A]
22. *Dipsacus laciniatus* (Cut−leaved teasel)[A]
23. *Dipsacus sylvestris* or *Dipsacus fullonum* (Common teasel)[A]
24. *Elaeagnus angustifolia* (Russian olive)[A]
25. *Elaeagnus umbellata* (Autumn olive)[A]
26. *Epipactis helleborine* (Helleborine orchid)[A]
27. *Euonymus alatus* (Burning bush)[C] *including the cultivar 'Nordine' and excluding all other cultivars
28. *Euphorbia cyparissias* (Cypress spurge)[A]
29. *Euphorbia esula* (Leafy spurge)[A]
30. *Fallopia japonica* or *Polygonum cuspidatum* (Japanese knotweed)[A]
31. *Filipendula ulmaria* (Queen of the meadow)[C]
32. *Galeopsis tetrahit* (Hemp nettle, brittlestem hemp nettle)[A]
33. *Galium mollugo* (White bedstraw)[C]
34. *Hesperis matronalis* (Dame's rocket)[A]
35. *Impatiens balfourii* (Balfour's touch-me-not)[C]
36. *Iris pseudacorus* (Yellow iris)[C]
37. *Knautia arvensis* (Field scabiosa)[C]
38. *Lonicera morrowii* (Morrow's honeysuckle)[A]
39. *Lonicera tatarica* (Tartarian honeysuckle)[A]
40. *Lonicera* x *bella* (Bell's or showy bush honeysuckle)[A]
41. *Lysimachia nummularia* or *L. nummelaria* (Moneywort)[A] *except the cultivar Aurea and yellow and gold leaf forms
42. *Lysimachia vulgaris* (Garden yellow loosestrife)[C]
43. *Lythrum salicaria* (Purple loosestrife)[A]
44. *Morus alba* (White mulberry)[C] *except male cultivars
45. *Myosotis scorpioides* (Aquatic forget-me-not)[C]
46. *Myosotis sylvatica* or *M. sylvaticum* (Woodland forget-me-not)[C]
47. *Myriophyllum spicatum* (Eurasian watermilfoil)[A]
48. *Najas marina* (Spiny naiad)[C]
49. *Pastinaca sativa* (Wild parsnip)[A] *except for the garden vegetable form
50. *Phalaris arundinacea* var. *picta* (ribbon grass or gardener's garters and other ornamental variegated varieties and cultivars)[C] *this restriction does not include the parent type - reed canary grass.
51. *Pimpinella saxifraga* (Scarlet pimpernel or Burnet saxifrage)[C]
52. *Populus alba* (White poplar)[C]
53. *Potamogeton crispus* (Curly−leaf pondweed)[A]
54. *Rhamnus cathartica* (Common buckthorn)[A]
55. *Rhamnus frangula* or *Frangula alnus* (Glossy buckthorn)[A] *including the Columnaris (tall hedge) cultivar but excluding the cultivars Asplenifolia and Fineline (Ron Williams)
56. *Robinia hispida* (Rose acacia or Bristly locust)[C]
57. *Robinia pseudoacacia* (Black locust)[C] *except all cultivars
58. *Rosa multiflora* (Multiflora rose)[A]
59. *Tanacetum vulgare* (Tansy)[A] *except the cultivars Aureum and Crispum
60. *Typha angustifolia* (Narrow-leaf cattail)[A]
61. *Typha* x *glauca* (Hybrid cattail)[A]
62. *Ulmus pumila* (Siberian elm)[C] *except hybrids and individuals used as rootstock
63. *Valeriana officinalis* (Garden heliotrope or Valerian)[C]

Phase-out: Restricted only plants located in Wisconsin prior to their effective listing date may be transported, transferred, and introduced without a permit for a period not to exceed 3 years for herbaceous plants and woody vines, or 5 years for trees and shrubs, from their effective listing date.

FISH AND CRAYFISH

PROHIBITED CATEGORY:

1. Channidae (Snakehead family)[A] including *Channa argus* (Northern snakehead) , *Channa bleheri* (Rainbow snakehead), *Channa gachua* (Dwarf snakehead), *Channa maculata* (Blotched snakehead), *Channa marulius* (Bullseye snakehead), *Channa punctata* (Spotted snakehead), and *Channa striata* (Chevron snakehead)
2. *Ctenopharyngodon idella* (Grass carp)[A]
3. *Cyprinella lutrensis* (Red shiner)[A]
4. *Hypophthalmichthys molitrix* (Silver carp)[A]
5. *Hypophthalmichthys nobilis* (Bighead carp)[A]
6. *Mylopharyngodon piceus* (Black carp)[A]
7. *Sander lucioperca* (Zander)[A]
8. *Scardinius erythrophthalmus* (Rudd)[A]
9. *Tinca tinca* (Tench)[A]
10. All other nonnative fish and nonnative crayfish except:
    a. Established nonnative fish species and established nonnative crayfish species
    b. Nonnative viable fish species in the aquarium trade
    c. Nonnative fish species in the aquaculture industry
    d. Nonviable fish species
    e. Genetically modified fish species

RESTRICTED CATEGORY:

1. Established nonnative fish species and established nonnative crayfish species
    a. *Alosa pseudoharengus* (Alewive)[A]
    b. *Cyprinus carpio* (Common carp)[A]
    c. *Gambusia affinis* (Western mosquitofish)[A] - Moved to Restricted from Prohibited in 2015
    d. *Gambusia holbrooki* (Eastern mosquitofish)[A] - Moved to Restricted from Prohibited in 2015
    e. *Gasterosteus aculeatus* (Three-spine stickleback)[A]
    f. *Gymnocephalus cernuus* (Ruffe)[A]
    g. *Morone americana* (White perch)[A]
    h. *Neogobius melanostomus* (Round goby)[A]
    i. *Orconectes rusticus* (Rusty crayfish)[A]
    j. *Osmerus mordax* (Rainbow smelt)[A]

k. *Petromyzon marinus* (Sea lamprey)[A]
l. *Proterorhinus marmoratus* (Tubenose Goby)[A]

2. Nonnative viable fish species in the aquarium trade
   a. *Acipenser ruthenus* (Sterlet)[A]
   b. *Carassius auratus* (Goldfish)[A]
   c. *Cyprinus carpio* (Koi carp)[A]
   d. *Leuciscus idus* (Ide)[A]
   e. *Misgurnus anguillicaudatus* (Weather loach)[A]
   f. *Myxocyprinus asiaticus* (Chinese hi-fin banded shark)[A]
   g. *Rhodeus* spp. (Bitterling)[A]
3. Nonnative fish species in the aquaculture industry
   a. *Lepomis microlophus* (Redear sunfish)[A]
   b. *Oncorhynchus gorbuscha* (Pink salmon)[A]
   c. *Oncorhynchus kisutch* (Coho salmon)[A]
   d. *Oncorhynchus mykiss* (Rainbow trout)[A]
   e. *Oncorhynchus tshawytscha* (Chinook salmon)[A]
   f. *Salmo salar* (Atlantic salmon)[A]
   g. *Salmo trutta* (Brown trout)[A]
   h. *Salvelinus alpinus* (Arctic char)[A]
   i. *Salvelinus fontinalis* x *Salmo trutta* (Tiger trout)[A]
   j. *Tilapia* spp. (Tilapia)[A]
4. Nonviable fish species
5. Viable genetically modified native and nonnative fish species.

AQUATIC INVERTEBRATES EXCEPT CRAYFISH

PROHIBITED CATEGORY:

1. *Bithynia tentaculata* (Faucet snail)[A]
2. *Bythotrephes cederstroemi* (Spiny water flea)[A]
3. *Cercopagis pengoi* (Fishhook water flea)[A]
4. *Corbicula fluminea* (Asian clam)[A]
5. *Daphnia lumholtzi* (Water flea)[A]
6. *Dikerogammarus villosus* (Killer Shrimp)[C]
7. *Dreissena rostriformis* (Quagga mussel)[A]
8. *Eriocheir sinensi* (Chinese mitten crabs)[A]
9. *Hemimysis anomala* (Bloody shrimp)[A]
10. *Limnoperna fortunei* (Golden mussel)[C]
11. *Melanoides tuberculata* (Malaysian trumpet snail)[C]
12. *Potamopyrgus antipodarum* (New Zealand mud snail)[A]

RESTRICTED CATEGORY:

1. *Cipangopaludina chinensis* (Chinese mystery snail)[A]
2. *Cipangopaludina japonica* (Japanese trapdoor snail or Japanese mystery snail)[C]
3. *Dreissena polymorpha* (Zebra mussel)[A]
4. *Valvata piscinalis* (European valve snail)[C]
5. *Viviparus georgianus* (Banded mystery snail)[C]

TERRESTRIAL INVERTEBRATES AND PLANT DISEASE-CAUSING MICROORGANISMS

PROHIBITED CATEGORY:

1. *Adelges tsugae* (Hemlock woolly adelgid)[A]
2. *Anoplophora glabripennis* (Asian longhorned beetle)[A]
3. *Dendroctonus ponderosae* (Mountain Pine Beetle)[C]
4. *Geosmithia morbida* (Thousand cankers disease of walnut)[C]
5. *Lymantria dispar* (Asian race)[A] (Asian Gypsy moth)[A]
6. *Phytophthora ramorum* (Sudden oak death pathogen)[A]
7. *Pityophthorus juglandis* (Walnut twig beetle)[C]

RESTRICTED CATEGORY:

1. *Agrilus planipennis* (Emerald ash borer)[A] - Moved to Restricted from Prohibited in 2015
2. *Amynthas* or *Amynthus* species (Jumping worm)[A] - Moved to Restricted from Prohibited in 2015
3. *Lymantria dispar* (European Gypsy moth)[A]

Cryptococcus fagisuga (Scale associated with beech bark disease)[A] - removed from ch. NR 40 on May 1, 2015

TERRESTRIAL AND AQUATIC VERTEBRATES EXCEPT FISH

PROHIBITED CATEGORY:

1. *Myiopsitta monachus* (Monk or Quaker parakeet or parrot)[A]
2. *Myocastor coypus* (Nutria)[C]
3. *Sus domestica* (Feral domestic swine)[A]
4. *Sus scrofa* (Russian boar & other wild swine)[A]

RESTRICTED CATEGORY:

None.

Trachemys scripta elegans (Red-eared slider with a carapace (top shell) length of less than 4 inches)[A] - removed from ch. NR 40 on May 1, 2015

FUNGUS

PROHIBITED CATEGORY:

6. *Pseudogymnoascus destructans* (White-nose syndrome fungal pathogen)[B]

RESTRICTED CATEGORY:

None.

Appendix 12.
Midwest Invasive Plant List

Updated May 2019

Updates from March 2018 in pink highlight

Illinois Law

Aq = IL Aquatic Injurious Plant Species
N = Illinois noxious weed
E = Illinois exotic weed

Illinois List

A = Invasive plants of concern

Indiana Law

N = Indiana noxious weed
P = Prohibited plant species
Pt = Prohibited terrestrial plant
PAq = Prohibited aquatic plant

Indiana List[1]

H = High invasive rank
M = Medium invasive rank
L = Low invasive rank
C = Caution species

Iowa Law

Pr = Primary noxious weed
S = Secondary noxious weed
Aq = Prohibited aquatic plant

Iowa List

A = General invasive plant list

Michigan Law

N = Noxious weed
P = Prohibited plant species
R = Restricted plant species

Michigan list (Appendix C)

A = Widespread distribution in 1 or more of MI's ecoregions
B = Local distribution in 1 or more of MI's ecoregions
C = Isolated distribution in 1 or more of MI's ecoregions
W = Watch list

Minnesota Law

MN Aquatic Plants
PAq = Prohibited aquatic plant
RAq = Restricted aquatic plant

MN Noxious weeds
E = Noxious weed, eradicate list
C = Noxious weed, control list
R = Noxious weed, restricted list

Minnesota List

A = Terrestrial invasive plant
B = Terrestrial invasive plant, early detection species
Aq = Aquatic invasive plant

Missouri Law

A = General noxious weed list

Missouri List

A = General invasive plant list
Aq = Aquatic nuisance species

Ohio Law

P = Prohibited noxious weed
R = Restricted invasive plants

Ohio List[6]

A = Invasive
B = Pending further review

Wisconsin Law

N = Noxious Weed
P = Prohibited
R = Restricted

Wisconsin List

A = Invasive[2]
INR = Invasive, not restricted
C = Caution: aquatics terrestrials

		Laws								Lists							
Common Name	**Latin Name**	**IL**	**IN**	**IA**	**MI**	**MN**	**MO**	**OH**	**WI**	**IL**	**IN**	**IA**	**MI**	**MN**	**MO**	**OH**	**WI**
velvetleaf	*Abutilon theophrasti*			S								A					
Amur maple	*Acer ginnala, Acer tataricum ssp. ginnala*					SR			R[7, 9]					A			
Norway maple	*Acer platanoides*										H		B	A		B	C
Japanese chaff flower	*Achyranthes japonica*		Pt[8]						P	A	H					B	
Russian knapweed, hardheads	*Acroptilon repens / Centaurea repens / Centaurea picris/Rhaponticum repens*			Pr	N			P	P				C				
Bishop's goutweed	*Aegopodium podagraria*								R								
tree of heaven	*Ailanthus altissima*		Pt[8]			R		R	R	A	H	A	A	B	A	A	
Fiveleaf akebia or Chocolate vine	*Akebia quinata*								P	A							
silk tree, mimosa	*Albezia julibrissin*									A					A		
garlic mustard	*Alliaria petiolata*		Pt[8]			R		R	R	A	H	A	A	A	A	A	A
wild garlic	*Allium vineale*									A							
black alder	*Alnus glutinosa*								R[7, 9]		H		B				
carelessweed, Palmer amaranth	*Amaranthus palmerii*[5]			Pr		E		P									
tall waterhemp	*Amaranthus tuberculatus*[5]							P									
common ragweed	*Ambrosia artemisifolia*[5]	N															
giant ragweed	*Ambrosia trifida*[5]	N															
porcelain berry	*Ampelopsis brevipedunculata*					R			P		C		C			B	
heartleaf peppervine	*Ampelopsis cordata*												C				
wild chervil	*Anthriscus sylvestris*								P, R[3]								
common burdock	*Arctium minus*											A				B	A
Wormwood	*Artemisia absinthium*								R								
mugwort	*Artemisia vulgaris*										H						
small carpgrass	*Arthraxon hispidus*		Pt[8]								H					B	
giant reed	*Arundo donax*								P		C						
mosquito fern	*Azolla pinnata*	Aq	PAq						P								
yellow rocket	*Barbarea vulgaris*															B	
forage kochia	*Bassia prostrata*							P									
kochia	*Bassia scoparia*							P									
Japanese barberry	*Berberis thunbergii*		Pt[8]			R[7]			R[7, 9]	A	H	A	A	A		A	A
common barberry	*Berberis vulgaris*		P			C		R	P		C						
hoary alyssum	*Berteroa incana*													A			INR
caucasian bluestem	*Bothriochloa bladhii*														A		
yellow bluestem	*Bothriochloa ischaemum*														A		

		Laws								Lists							
Common Name	**Latin Name**	**IL**	**IN**	**IA**	**MI**	**MN**	**MO**	**OH**	**WI**	**IL**	**IN**	**IA**	**MI**	**MN**	**MO**	**OH**	**WI**
wild mustard	*Brassica arvensis*			S													
smooth brome	*Bromus inermis*												A	A			INR
cheatgrass	*Bromus tectorum*											A					C
hill mustard	*Bunias orientalis*								P, R[3]								
flowering rush	*Butomus umbellatus*	Aq	PAq	Aq	R	PAq		R	R	A	H		B	Aq		A	
fanwort	*Cabomba caroliniana*				P	RAq			P				C				
European water-starwort, pond water-starwort	*Callitriche stagnalis*																C
creeping bellflower	*Campanula rapunculoides*								R								A
Siberian peashrub	*Caragana arborescens*								R[7, 9]					A			
hairy bittercress	*Cardamine hirsuta*																INR
narrowleaf bittercress	*Cardamine impatiens*					C			P		M		C	B			
plumeless thistle	*Carduus acanthoides*		Pt[8]			C			R		H		C				
musk thistle	*Carduus nutans*	N	Pt[8]		N		A	P	R	A	H	A	B	A	A		
	Carduus spp.			Pr													
Asiatic sand sedge	*Carex kobomugi*												W				
caulerpa or Mediterranean killer algae	*Caulerpa taxifolia*	Aq	PAq														
Asian loeseneri bittersweet	*Celastrus loeseneri*								P								
Asian bittersweet, oriental bittersweet	*Celastrus orbiculatus*	E	Pt[8]			E		R	R	A	H	A	A	B		A	A
spotted knapweed	*Centaurea biebersteinii, C. maculosa or C. stoebe*		Pt[8]		N	C	A	R	R	A	H	A	A	A	A	A	A
diffuse knapweed	*Centaurea diffusa*					E			P				B				
brown knapweed	*Centaurea jacea*					E			R								
knapweed	*Centaurea L.*											A					
black knapweed	*Centaurea nigra*								R								
alpine knapweed	*Centaurea nigrescens*								R								
yellow star thistle	*Centaurea solstitialis*					E			P			A	C	B			
meadow knapweed	*Centaurea x moncktonii*					E								B			
celandine	*Chelidonium majus*								R								
tall thistle	*Cirsium altissimum*			Pr													
Canada thistle	*Cirsium arvense*	N	N	Pr	N	C	A	P	N, R	A	H	A	A	A	A	A	A
bull thistle	*Cirsium lanceolatum*			Pr													
European marsh thistle	*Cirsium palustre*								P, R[3]				B				
thistles	*Cirsium spp.*			Pr													
bull thistle	*Cirsium vulgare*		Pt[8]		N					A	H	A	A	A			

		Laws								Lists							
Common Name	**Latin Name**	**IL**	**IN**	**IA**	**MI**	**MN**	**MO**	**OH**	**WI**	**IL**	**IN**	**IA**	**MI**	**MN**	**MO**	**OH**	**WI**
sweet autumn virginsbower	*Clematis terniflora*										C						
poison hemlock	*Conium maculatum*	E	Pt[8]	S		E		P	P, R[3]		H			A		A	
lily of the valley	*Convallaria majalis*												C				INR
field bindweed	*Convolvulus arvensis*		Pt[8]	Pr	N		A	P	N		H					B	INR
hedge bindweed	*Calystegia sepium*				N			P									
marestail	*Conyza canadensis* [5]							P									
Australian swamp crop	*Crassula helmsii*					PAq			P								
hawksbeard	*Crepis tectorum*																A
dodder	*Cuscuta spp.*				N												
cylindro	*Cylindrospermopsis raciborskii*				P												
black swallow-wort	*Cynanchum louiseae / Vincetoxium nigrum*		Pt[8]			E		R	P, R[3]	A	H		B	B		A	
pale swallow-wort	*Cynanchum rossicum / Vincetoxicum rossicum*		Pt[8]						P	A	H		B				
Houndstongue	*Cynoglossum officinale*								R								
Scotch broom	*Cytisus scoparius*								P								
Wild carrot, Queen Anne's lace	*Daucus carota*			S		R					M	A		A			INR
Grecian foxglove	*Digitalis lanata Ehrh.*					E			P					B			
Chinese yam	*Dioscorea polystachya (oppositifolia)*		Pt[8]						P	A	H		W		A	A	
common teasel	*Dipsacus fullonum / Dipsacus sylvestris*		Pt[8]			E	A	R	R	A	H		A	B	A	A	A
cutleaf teasel	*Dipsacus laciniatus*		Pt[8]			E	A	R	R	A	H		A	B	A	A	A
teasel	*Dipsacus spp.*	E		S								A					
Indian strawberry	*Duchesnea indica/ Potentilla indica*														A		
Brazilian waterweed	*Egeria densa*	Aq	PAq		P	RAq		R	P	A	H		W	Aq			
anchored water hyacinth	*Eichhornia azurea*	Aq	PAq						P		H						
common water hyacinth	*Eichhornia crassipes*					PAq			P				C,W				
Russian olive	*Elaeagnus angustifolia*	E						R	R		M	A	B	A		A	A
thorny olive	*Elaeagnus pungens*	E															
autumn olive	*Elaeagnus umbellata*	E	Pt[8]		R			R	R	A	H	A	A		A	A	A
quackgrass	*Elytrigia repens/ Elymus repens/ Agropyron repens*			Pr	N												INR
hairy willow herb	*Epilobium hirsutum*							R	P, R[3]				B			A	
helleborine orchid	*Epipactis helleborine*								R								A
burning bush	*Euonymus alatus*								R[7, 9]	A	M	A					
wintercreeper	*Euonymus fortunei*		Pt[8]							A	H				A	A	C
Cypress spurge	*Euphorbia cyparissias*								R				B				A

		Laws								Lists							
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leafy spurge	*Euphorbia esula*		Pt[8]	Pr	N	C		P	N,R	A	H	A	A	A	A		A
queen of the meadow	*Filipendula ulmaria*								R								
glossy buckthorn	*Frangula alnus / Rhamnus frangula*	E	Pt[8]			R		R	R[7]	A	H		A	A		A	A
goatsrue	*Galega officinalis*										M						
hemp nettle	*Galeopsis tetrahit*								R				A				
white bedstraw	*Galium mollugo*								R								
yellow bedstraw	*Galium verum*																C
Creeping Charlie, ground ivy	*Glechoma hederacea*										M			A			C
mudmat	*Glossostigma cleistanthum*								P								
tall or reed mannagrass	*Glyceria maxima*								P, R[3]	A							
common baby's breath	*Gypsophila paniculata*												B				C
garden baby's breath	*Gypsophila scorzonerifolia*									A							
English ivy	*Hedera helix*[5]										M						C
wild sunflower	*Helianthus annus*[5]			S													
orange day-lily, tawny day-lily	*Hemerocallis fulva*												C			B	C
giant hogweed	*Heracleum mantegazzianum*	E			P, N	E		P, R	P	A	M	A	C	B			
dame's rocket	*Hesperis matronalis*		Pt[8]					R	R		H	A	A			A	A
orange hawkweed	*Hieracium aurantiacum*													A			INR
yellow hawkweed	*Hieracium caespitosum*																A
Japanese hops	*Humulus japonicus*		Pt			E			P, R[3]	A	H		C	B	A		
hydrilla	*Hydrilla verticillata*	Aq	PAq		P	PAq		R	P	A	H		W		A, Aq		
European frogbit	*Hydrocharis morsus-ranae*	Aq	PAq		P	PAq		R	P		H		C,W				
floating marsh pennywort	*Hydrocotyle ranunculoides*								P								
Indian swampweed, miramar weed	*Hygrophilia polysperma*	Aq	PAq			PAq			P		H						
St. John's wort	*Hypericum perforatum*										L		A				INR
balfour's touch-me-not	*Impatiens balfourii*								R								
Himalayan balsam	*Impatiens glandulifera*								P				C,W				
British yellowhead	*Inula britannica*													B			
Chinese water spinach	*Ipomoea aquatica*	Aq	PAq			RAq			P		H						
morning glory	*Ipomoea spp.*				N											A	
Blackberry Lily	*Iris domestica*																C
yellow iris	*Iris pseudacorus*	Aq	PAq			RAq			R		H		C	A, Aq			A
field scabiosa	*Knautia arvensis*								R								
golden rain tree	*Koelreuteria paniculata*														A		
Korean clover	*Kummerowia stipulacea*										M						
Japanese clover	*Kummerowia striata*										M						

		Laws								Lists							
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oxygen–weed, African elodea or African waterweed	*Lagarosiphon major*	Aq	PAq		P	PAq			P								
dotted duckweed	*Landoltia punctata*														Aq		C
motherwort	*Leonurus cardiaca*																A
hairy whitetop	*Lepidium appelianum*							P									
hoary cress, perennial peppergrass	*Lepidium draba / Cardaria draba*			Pr	N			P									
pepperweed	*Lepidium latifolium*		Pt[8]						P		H						
bicolor lespedeza	*Lespedeza bicolor*									A	M						
sericea lespedeza	*Lespedeza cuneata*		Pt[8]						P	A	H	A	B		A		
oxeye daisy	*Leucanthemum vulgare / Chrysanthemum leucanthemum*													A			
lyme grass or sand ryegrass	*Leymus arenarius or Elymus arenarius*								P, R[3]		C						
Amur privet	*Ligustrum amurense*										C						
Japanese privet	*Ligustrum japonica*											A					
blunt leaved privet, border privet	*Ligustrum obtusifolium*		Pt[8]								H	A	B				
California privet	*Ligustrum ovalifolium*										C						
Chinese privet	*Ligustrum sinense*									A	C	A					
common privet	*Ligustrum vulgare*										C	A	B			B	C
American frogbit/Sponge plant	*Limnobium spongia*[5]																C
Asian marshweed	*Limnophila sessiliflora*	Aq	PAq						P		H						
Dalmation toadflax	*Linaria dalmatica*					E			P, R[3]					B			
butter and eggs, common toadflax	*Linaria vulgaris*													A			INR
fragrant honeysuckle	*Lonicera fragrantissima*	E										A					
Japanese honeysuckle	*Lonicera japonica*	E	Pt[8]					R	P		H		A		A	A	
Amur honeysuckle	*Lonicera maacki*	E	Pt[8]			R		R	P, R[3]	A	H	A	A		A	A	A
Morrow's honeysuckle	*Lonicera morrowii*	E	Pt[8]			R		R	R	A	H	A	A	A	A	A	A
Standish's honeysuckle	*Lonicera standishii*											A					
Tatarian honeysuckle, Amur honeysuckle	*Lonicera tatarica*	E	Pt[8]			R		R	R	A	H	A	A	A		A	A
Bell's honeysuckle, Amur honeysuckle	*Lonicera x bella*		Pt[8]			R			R		H	A	C	A			A
European fly honeysuckle, dwarf honeysuckle	*Lonicera xylosteum*											A	A				
bird's-foot trefoil	*Lotus corniculatus*												B	A			INR
big-leaf lupine	*Lupinus polyphyllus*[5]																C

		Laws								Lists							
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moneywort	*Lysimachia nummularia*								R[7]				C				A
golden loosestrife	*Lysimachia vulgaris*								R				A				
purple loosestrife	*Lythrum salicaria*	E	P	Aq	R	PAq, C	A	P, R	R	A	H	A	A	A, Aq	A, Aq	A	A
purple loosestrife	*Lythrum spp.*		P														
purple loosestrife	*Lythrum virgatum*		P			PAq, C		R	P								
European water-clover	*Marsilea quadrifolia*												C,W				C
white sweet clover	*Melilotus alba*										M		A	A	A	A	INR
yellow sweet clover	*Melilotus officinalis*										M		C	A	A	A	INR
Japanese stiltgrass	*Microstegium vimineum*		Pt[8]					R	P	A	H		C,W		A	A	
Amur silver grass	*Miscanthus sacchariflorus*													A			
Chinese maiden grass, Chinese silvergrass	*Miscanthus sinensis*										M					A	INR
giant miscanthus	*Miscanthus x gigantea*										C						
monochoria, arrowleaf, or false pickerelweed	*Monochoria hastata*	Aq	PAq														
heartshape or false pickerelweed	*Monochoria vaginalis*	Aq	PAq														
white mulberry	*Morus alba*		Pt[8]						R[7, 9]		H	A	A			B	A
forget me not	*Myosotis scorpioides*								R							ds	A
woodland forget-me-not	*Myosotis sylvatica*								R								
parrot feather	*Myriophyllum aquaticum*	Aq	PAq		P	RAq		R	P		H		W				
variable-leaf watermilfoil	*Myriophyllum heterophyllum*												A				
Eurasian watermilfoil	*Myriophyllum spicatum*	Aq	PAq	Aq	R	PAq		R	R	A	H		A	Aq	Aq	A	A
spiny naiad	*Najas marina*								R								
brittle naiad	*Najas minor*	Aq	PAq	Aq		PAq			P		H		C	Aq	Aq	B	
heavenly bamboo	*Nandina domestica*														A		
serrated tussock	*Nasella trichotoma*				N			P									
watercress	*Nasturtium officinale / Rorippa nasturtium-aquaticum*												A				C
sacred lotus	*Nelumbo nucifera*								P								
Apple of Peru	*Nicandra physalodes*							P									
starry stonewort	*Nitellopsis obtusa*				P	PAq			P				B	Aq			
nonnative waterlilies	*Nymphaea spp.*					RAq								Aq			
yellow floating hearts	*Nymphoides peltata*	Aq	PAq		P			R	P		H		W				
java waterdropwort	*Oenanthe javanica*								P								
Scotch thistle	*Onopordum acanthium*						A										
wavy leaf basket grass	*Oplismenus hirtellus ssp. Undulatifolius*								P								

		Laws								Lists							
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star-of-Bethlehem	*Ornithogalum umbellatum*																C
duck lettuce	*Ottelia alismoides*	Aq	PAq						P		H						
butterweed, cressleaf groundsel	*Packera glabella / Senecio glabellus* [5]							P									
wild parsnip	*Pastinaca sativa*					C[7]		P	R		M	A	A	A		A	A
princess tree	*Paulownia tomentosa*								P	A	C					B	
butterfly dock, pestilence wort	*Petasites hybridus*								P								
reed canary grass	*Phalaris arundinacea*		Pt[8]							A	H	A	A	A, Aq	A	A	INR
variegated ribbon grass	*Phalaris arundinacea var. picta*								R[7]								
Amur cork tree	*Phellodendron amurense*		Pt[8]						P[7]		H		C			A	
common reed	*Phragmites australis ssp australis*				R	R		R	P, R[3]	A	H		A	A, Aq	A	A	A
yellow groove bamboo	*Phyllostachys aureasculata*							P[11]									
Burnet saxifrage	*Pimpinella saxifraga*								R								
Austrian pine	*Pinus nigra*												C				
scotch pine	*Pinus sylvestris*												B				INR
water lettuce	*Pistia stratiotes*								P				C,W				
buckthorn plantain	*Plantago lanceolata*			S													
Canada bluegrass	*Poa compressa*																A
Kentucky bluegrass	*Poa pratensis*																A
Bohemian knotweed	*Polygonum x bohemicum/Fallopia x bohemica*	E	Pt[8]						P							A	
Oriental lady's thumb	*Polygonum caespitosum/Polygonum posumbu*												C				
Japanese knotweed	*Polygonum cuspidatum/Fallopia japonica*	E	Pt[8]		P	SR		P	R	A	H	A	A	A	A	A	A
mile–a–minute vine	*Polygonum perfoliatum/Persicaria perfoliata*		Pt[8]					P	P		H		W			B	
giant knotweed	*Polygonum sachalinense/Fallopia schalinensis/Reynoutria sachalinensis*	E	Pt[8]			SR			P				C			A	
white poplar	*Populus alba*								R[9]				B				A
Lombardy poplar	*Populus nigra var. italica*												C				
curly-leaved pondweed	*Potamogeton crispus*	Aq	PAq	Aq	R	PAq		R	R	A	H		A	Aq		A	A

		Laws								Lists							
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kudzu	*Pueraria montana var. lobata*	E, N	P				A	P, R	P	A	H	A	C,W		A	A	
callery pear	*Pyrus calleryana*							R[10]		A	H				A	A	INR
sawtooth oak	*Quercus acutissima*								P		C						
lesser celandine	*Ranunculus ficaria/Ficaria verna*	E						R	P		C		C			A	
sharp-tooth buckthorn	*Rhamnus arguta*	E															
common buckthorn	*Rhamnus cathartica*	E				R		R	R	A	H	A	A	A	A	A	A
Dahurian buckthorn	*Rhamnus davurica*	E															
Japanese buckthorn	*Rhamnus japonica*	E															
buckthorn	*Rhamnus spp. (excluding Frangula alnus)*			Pr													
Chinese buckthorn	*Rhamnus utilis*	E															
jetbead	*Rhodotypos scandens*										C		C				
Bristly locust	*Robinia hispida*[5]								R[9]				C				
black locust	*Robinia pseudoacacia*[5]					R			R[7, 9]	A			A	A			A
dog rose	*Rosa canina*															B	
multiflora rose	*Rosa multiflora*	E	P	S		R	A	R	R	A	H	A	A	A	A	A	A
Himalayan blackberry	*Rubus armeniacus*								P								
wineberry, wine raspberry	*Rubus phoenicolasius*								P		C					B	
sheep sorrel, red sorrel	*Rumex acetosella*			S													A
smooth dock	*Rumex altissimus*			S													
sour dock	*Rumex crispus*			S													
arrowhead	*Sagittaria sagittifolia*	Aq	PAq						P								
Russian thistle	*Salsola Kali var. enuifolia*							P									
giant salvinia species	*Salvinia auriculata, S. biloba, S. herzogii*	Aq	PAq		P				P								
aquarium watermoss or giant salvinia	*Salvinia molesta*	Aq	PAq		P	PAq			P								
bouncing bet, soapwort	*Saponaria officinalis*										M		A			A	A
tall fescue	*Schenodorus arundinacea / Festuca arundinacea*										M				A		A
crownvetch	*Securigera varia / Coronilla varia*		Pt[8]			R			R	A	H	A	A	A	A		A
coffeeweed	*Sesbania herbacea*														A		
bur cucumber	*Sicyos angulatus*[5]		N														
bladder campion	*Silene vulgaris*												A				
horsenettle	*Solanum carolinense*			Pr	N												
climbing nightshade, bittersweet nightshade	*Solanum dulcamara*												A				A
seaside goldenrod	*Solidago sempervirens*[5]								P, R[3]								

		Laws									Lists							
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perennial sow thistle	*Sonchus arvensis*	N		Pr	N			P							A			
sorghum almum	*Sorghum x almum*	N	N		N			P										
shatter cane	*Sorghum bicolor*		N	S				P										
Johnson grass	*Sorghum halepense*	N	N		N		A	P	P		A	H				A		
Exotic bur-reed	*Sparganium erectum*	Aq	PAq															
Japanese meadowsweet	*Spiraea japonica*											C						
common chickweed	*Stellaria media*													A				
water aloes or water soldiers	*Stratiotes aloides*	Aq				PAq			P					W				
medusahead	*Taeniatherum caput-medusae*								P									
salt cedar	*Tamarix spp.*	E		Aq									A					
common tansy	*Tanacetum vulgare*					C			R[7]					A	A			A
Spreading hedgeparsley	*Torilis arvensis*								P			C						
Japanese hedgeparsley or erect hedgeparsley	*Torilis japonica*								P, R[3]			C		A	B			
poison ivy	*Toxicodendron radicans / Rhus toxicodendron*[5]					SR												
water chestnut	*Trapa natans*	Aq	PAq		P	PAq		R	P			H		W				
puncturevine	*Tribulus terrestris*			S	N													
red clover	*Trifolium pratense*																	A
white clover	*Trifolium repens*																	A
ravennagrass	*Saccharum ravennae / Tripidium ravennae*																B	
colt's foot	*Tussilago farfara*								P									
narrow-leaved cattail	*Typha angustifolia*[5]		PAq					R	R		A	H		A			A	A
southern cattail	*Typha domingensis*[5]								P									
graceful cattail	*Typha laxmannii*								P									
hybrid cattail	*Typha x glauca*							R	R		A	C		A			A	A
Chinese elm	*Ulmus parvifolia*												A					
Siberian elm	*Ulmus pumila*								R[7, 9]			M	A		A		A	A
garden heliotrope	*Valeriana officinalis*								R									
common mullein	*Verbascum thapsus*													B				
European brooklime	*Veronica beccabunga var. beccabunga*													B				
European cranberry-bush	*Viburnum opulus var. opulus*											C		B				INR
vetch	*Vicia cracca*											M			A			
hairy vetch, cow vetch	*Vicia villosa*													A	A			
large-leaved periwinkle	*Vinca major*											C						
periwinkle	*Vinca minor*											M		B				C

		Laws								Lists							
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grapevines	*Vitis sp.*							P[11]									
Japanese wisteria	*Wisteria floribunda*								P								
Chinese wisteria	*Wisteria sinensis*								P		C						
cocklebur	*Xanthium commune*			S													

[1] Indiana list is based on assessments by the Indiana Invasive Species Council's Plant Advisory Committee

[2] Wisconsin list from the Invasive Plant Association of Wisconsin's (IPAW's) Working List of Invasive Plants

[3] Prohibited or restricted by county. See text of state law for more detail.

[4] Also designated as an invasive aquatic plant statewide under s. NR 109.07 (2).

[5] Species is native to North America

[6] Ohio list from the Ohio Invasive Plants Council's plant assessments

[7] There are cultivar and/or hybrid exemptions to the rule or regulation

[8] Prohibitions go into effect 04/18/2020

[9] Prohibitions go into effect 05/01/2020

[10] Prohibitions go into effect 01/07/2023

[11] Only regulated under certain growing conditions (see regulation for details)

Appendix 13
Michigan's Noxious Weed List

Michigan's Prohibited Noxious Weeds

Scientific Name	common name
*Agropyron repens** (synonym *Elytrigia repens*)	quack grass
Cardaria draba	whitetop=hoary cress=perennial pepperweed
Carduus acanthoides	plumeless thistle
Carduus nutans	nodding thistle
Centaurea maculosa	spotted knapweed
Centaurea picris	Russian knapweed
Cirsium arvense	Canada thistle
Cirsium vulgare	bull thistle
Convolvulus arvensis	field bindweed
Convolvulus sepium	hedge bindweed
Cuscuta spp	dodder
Cyperus esculentus, both seed and tubers	yellow nutsedge, chufa
Euphorbia esula	leafy spurge
Ipomea species	morning glory
Nasella trichoma	serrated tussock
Solanum carolinense	horse nettle
Sonchus arvensis	perennial sowthistle
Sorghum halapense including *Sorghum almum* and seed which cannot be distinguished from *johnsongrass*	johnsongrass
Tribulus terrestris	puncturevine

Michigan's Restricted Noxious Weeds

Scientific Name	Common Name
Abutilon theophrasti	velvetleaf
Allium canadense	wild nion
Allium vineale	wild garlick
Avena fatua	wilt oat
Barbarea vulgaris	yellow rocket
Berteroa incana	hoary allysum
Brassica juncea	indian mustard
Brassica nigra	black mustard
Datura stramonium	jimsonweed
Daucus carota	wild carrot
Plantago lanceolatua	buckhorn plantain
Raphanus raphanistrum	wild radish
Rumex crispus	curled dock
Seteria faberii	giant foxtail

Michigan's Restricted Noxious Weeds cont.

Sinapis arvensis	**charlock**
Solanum species: including all of the following species and any other species with indistinguishable seed	
Solanum dulcamara	bittersweet nightshade
Solanum eleagifolium	silver weed nightshade
Solanum nigrum	black nightshade
Solanum ptycanthum	eastern black nighshade
Solanum sarrachoides	hairy nighshade
Thapsis arvense **Deregulated as of December 2015**	pennycress = fanweed
Xanthium strumarium	cockebur

Appendix 14

Working List of Priority Species for Michigan's Great Lakes Islands

Scientific Name	Common Name	Designation
Algae		
Cylindrospermopsis raciborskii	Cylindro	Prohibited
Fungi (Microsporidia)		
Neonectria spp.	beech bark disease	
Bretziella fagacearum	oak wilt	
Geosmithia morbida	thousand cankers disease	Watch List
Heterosporis sp.	yellow perch parasite	
Plants – Terrestrial and Wetland*		
Acer platanoides	Norway maple	T, P**
Acer tartaricum subsp. ginnala	amur maple	T, P
Achyranthes japonica	Japanese chaff flower	Watch List
Aegopodium podagraria	bishop's goutweed	T, P
Ailanthus altissima	tree of heaven	T,P
Alliaria petiolata	garlic mustard	T
Alnus glutnosa	black alder	T
Ampelopsis breviligulata	porcelain berry	T
Arundo donax	giant reed	T
Berberis thunbergii	Japanese barberry	T, P
Cardamine impatiens	narrow-leaved bittercress	T
Carduus acanthoides	plumeless thistle	T
Carduus nutans	nodding/musk thistle	T
Carex kobomugi	Asiatic sand sedge	Watch List
Celastrus orbiculatus	Oriental bittersweet	T
Centaurea spp. (diffusa, jacea, nigra, repens)	knapweeds	T
Centaurea stoebe	spotted knapweed	T
Cirsium arvense	Canada thistle	T
Cirsium palustre	European marsh thistle	T
Cynanchum louiseae	black swallow-wort	T
Cynanchum rossicum	pale swallow-wort	T
*Dioscorea oppositifolia**	Chinese yam	Watch List
Dipsacus laciniatus	cut-leaf teasel	T
Dipsacus fullonum	wild teasel	T
Elaeagnus umbellata	autumn olive	Restricted
Euonymus alatus	burning bush	T, P
Euphorbia cyparissias	Cypress spurge	T
Euphorbia esula	leafy spurge	T
Fallopia japonica	Japanese knotweed	Prohibited
Fallopia sachalinense	giant knotweed	T, P
Fallopia x bohemicum	Bohemian knotweed	

Ficaria verna	lesser celandine	T
Galium mollugo	white bedstraw	T, P
Glyceria maxima	reed mannagrass	T
Gypsophila paniculata	baby's breath	T
Heracleum mantegazzianum	giant hogweed	Prohibited
Hesperis matronalis	dame's rocket	T
Humulus japonicus	Japanese hops	T
Impatiens glandulifera	Himalayan balsam	Watch List
Lepidium latifolium	perennial pepperweed	T
Lespedeza cuneata	Chinese lespedeza	T
Leymus arenarius	lyme-grass	T
Linaria dalmatica	dalmatian toadflax	T
Lonicera japonica	Japanese honeysuckle	T
Lonicera maackii	Amur honeysuckle	T
Lonicera morrowii	Morrow's honeysuckle	T
Lonicera tatarica	Tatarian honeysuckle	T
Lonicera x bella	Bell's honeysuckle	T
Lysimachia nummularia	moneywort	T
Lythrum salicaria	purple loosestrife	Restricted
Melilotus alba	white sweet-clover	T
Melilotus officinalis	yellow sweet-clover	T
Mentha x piperita	peppermint	T
Microstegium vimineum	Japanese stiltgrass	Watch List
Miscanthus sinensis	Chinese silvergrass	S
Myosotis scorpioides	Forget-me-not	T
Pastinaca sativa	wild parsnip	T
Paulownia tomentosa	princess tree	T
Persicaria perfoliata	mile-a-minute weed	Watch List
Petasites hybridus	butterbur	T
Phellodendron amurense	Amur corktree	T
Phalaris arundinacea (non-native)	Reed canary grass	T
Phragmites australis	phragmites	Restricted
Pimpinella saxifraga	scarlet pimpernel	T
Pinus nigra	Austrian pine	T, P
Pinus sylvestris	Scots pine	T
Pueraria montana var. lobata	kudzu	Watch List
Pyrus calleryana	Callery pear / Bradford	P
Rhamnus cathartica	common buckthorn	T
Rhodotypos scandens	black jetbead	T
Robinia pseudoacacia	black locust	T
Rosa multiflora	multiflora rose	T
Rubus phoenicolasius	Japanese wineberry	T
Securigera varia	crown vetch	T
Silene vulgaris	bladder campion	T
Solanum dulcamara	bittersweet nightshade	T
Torilis japonica	Japanese hedge-parsley	T

Tussilago farfara	coltsfoot	T
Typha angustifolia	narrow-leaved cat-tail	T
Typha x glauca	hybrid cat-tail	T
Typha domingensis	southern cat-tail	T
Typha laxmannii	graceful cattail	T
Valeriana officinalis	valerian	T
Vinca minor	common periwinkle	T, P
Wisteria x formosa	hybrid wisteria	T, P
Plants - Aquatic		
Lagarosiphon major	African oxygen weed	Prohibited
Egeria densa	Brazilian elodea (waterweed)	Watch List; Prohibited
Cabomba caroliniana	Carolina fanwort	Prohibited
Callitriche stagnalis	pondwater starwort	T
Crassula helmsii	swamp stonecrop	T
Potamogeton crispus	curly-leaved pondweed	Restricted
Myriophyllum spicatum	Eurasian watermilfoil	Restricted
Hydrocharis morsus-ranae	European frog-bit	Watch List; Prohibited
Hygrophila polysperma	Indian swampweed	T
Marsilea quadrifolia	European water-clover	Watch List
Butomus umbellatus	flowering rush	Restricted
Salvinia molesta, auriculata, biloba, or herzogii	giant salvinia	Prohibited
Hydrilla verticillata	hydrilla	Watch List; Prohibited
Myriophyllum aquaticum	parrot feather	Watch List; Prohibited
Najas minor	brittle water nymph	T
Najas marina	spiny naiad	T
Nitellopsis obtusa	starry stonewort	Prohibited
Trapa natans	water chestnut (water caltrop)	Watch List; Prohibited
Eichhornia crassipes	water hyacinth	Watch List
Pistia stratiotes	water lettuce	Watch List
Stratiotes aloides	water soldier	Watch List; Prohibited
Nymphoides peltata	yellow floating heart	Watch List; Prohibited
Annelids		
Ripistes parasita	an oligochaete	
Bacteria		
Piscirickettsia cf. salmonis	muskie pox	
Renibacterium salmoninarum.	bacterial kidney disease (BKD)	
Birds		
Phalacrocorax auritus	double-crested cormorant	
Streptopelia decaocto	Eurasian collared dove	Prohibited

Cygnus olor	mute swan	
Bryozoa		
Lophopodella carteri	a freshwater bryozoan	
Crustaceans		
Bythotrephes longimanus	spiny waterflea	
Cercopagis pengoi	fishhook waterflea	
Cherax destructor	Yabby crayfish	Prohibited
Dikerogammarus villosus	killer shrimp	Prohibited
Eriocheir sinensis	Chinese mitten crab	
Orconectes rusticus	rusty crayfish	Restricted
Procambarus clarkii	red swamp crayfish	Watch List; Prohibited
Procambarus fallax (forma virginalis)	marbled crayfish (marmorkreb)	
Fish		
Apollonia melanostomus	round goby	Prohibited
Channa argus	northern snakehead	Watch List; Prohibited
Cherax destructor	yabby	Prohibited
Ctenopharyngodon idella	grass carp (fertile)	Watch List; Prohibited
Gambusia affinis	western mosquitofish	
Gymnocephalus cernuus	Eurasion ruffe	Prohibited
Hypophthalmichthys molitrix	silver carp	Watch List; Prohibited
Hypophthalmichthys nobilis	bighead carp	Watch List; Prohibited
Leuciscus idus	ide	Prohibited
Misgurnus anguillicaudatus	Japanese weatherfish	Restricted
Morone americana	white perch	
Mylopharyngodon piceus	black carp	Watch List; Prohibited
Petromyzon marinus	sea lamprey	
Proterorhinus semilunaris	tubenose goby	Prohibited
Pseudorasbora parva	stone moroko (topmouth gudeon)	Prohibited
Rhodeus sericeus	bitterling	Prohibited
Sander lucioperca	zander (pike-perch)	Prohibited
Scardinius erythrophthalmus	rudd	Prohibited
Silurus glanis	wels catfish	Prohibited
Tinca tinca	tench	Prohibited
Insects		
Adelges piceae	balsam woolly adelgid	
Adelges tsugae	hemlock woolly adelgid	Prohibited
Agrilus planipennis	emerald ash borer	Prohibited
Anoplophora glabripennis	Asian longhorned beetle	Watch List; Prohibited
Dendroctonus ponderosae	mountain pine beetle	

Halyomorpha halys	brown marmorated stink bug	
Lycorma delicatula	spotted lanternfly	Watch List
Lymantria dispar	gypsy moth	
Popillia japonica	Japanese beetle	
	Mammals	
Myocastor coypus	nutria	Watch List; Prohibited
Sus scrofa	feral swine	Prohibited
	Mollusks	
C. fluminea	Asian clam	
C. largillierta	Asian clam	
C. sp. form D	Asian clam	
C. squalida	Asian clam	
Candidula intersecta	wrinkled dune snail	Prohibited
Cantareus aspersa	brown garden snail (common garden snail)	Prohibited
Cipangopaludina chinensis	Japanese/Chinese mystery snail	
Dreissena polymorpha	zebra mussel	Restricted
Dreissena rostriformis bugensis	quagga mussel	Restricted
Hygromia cinctella	girdled snail	Prohibited
Limnoperna fortunei	golden mussel	Prohibited
Lissachatina fulica	giant African snail	Prohibited
Monacha cartusiana	Carthusian snail	Prohibited
Potamopyrgus antipodarum	New Zealand mudsnail	Watch List; Prohibited
Xerolenta obvia	heath snail	Prohibited
	Viruses	
Oncorhynchus 2 novirhabdovirus	viral hemmorrhagic septicemia (VHSV)	

*orange-red indicates plant species that were added from original list; may be uncommon on some islands

T: Threat is well known; problematic elsewhere

P: Planted commonly; let's nip them in the bud