

Guidebook for Planning Invasive Species Action

Michigan's Great Lakes Islands



Submitted to:

USFWS Great Lakes Coastal Program
3090 Wright Street
Marquette, MI 49855

Submitted by:

Michigan Natural Features Inventory

Higman, P.J., H.D. Enander, D.A. Hyde, P.J. Badra, K.M. Korroch

MNFI Report Number 2019-20

Photo Credits- Cover: A long day on Garden Island, 2015. Photo by Phyllis J. Higman

Higman, P.J., H.D. Enander, D.A. Hyde, P.J Badra and K.M. Korroch. 2019. Guidebook for Planning Invasive Species Action Michigan's Great Lakes Islands. Report to the USFWS Great Lakes Coastal Program. MNFI Report No, 2019-20.

Copyright 2019 Michigan State University Board of Trustees. Michigan State University Extension programs and materials are open to all without regard to race, color, natural origin, gender, religion, age, disability, political beliefs, sexual orientation, marital status, or family status.

Table of Contents

Invasive Species Management Planning Framework	2
An Adaptive Management Approach is Not Optional.....	2
The Invasion Curve Informs Strategies	2
A Prioritized Three-Pronged Approach is Useful.....	4
Information Needed to Inform Management	4
Foundation and Data Management Needs	5
Template for Planning Invasive Species Action	6
Some Lessons Learned	9
Some Tips for Planning	10
Action Ideas	13
Vector Management/Prevention/Early Detection	13
Control / Management	17
Monitoring	21
Protection Actions.....	22
References	22

Invasive Species Planning Resources

Many plans, papers, and reports were reviewed to identify information specific to invasive species on islands. Little data specific to Great Lakes islands was discovered, however, there is a rich literature for oceanic islands, including a detailed guide for invasive species planning and management on islands (IUCN 2018), and several excellent resources for invasive species planning in general. These are shown in the table below ordered by date. They start with identifying the scope of work and proceed systematically through foundational needs and specific steps to determine actions. The steps are similar across all plans; however, their arrangement and specific actions differ based the assets, conditions and management goals specific to the scope of the study.

In the case of Michigan Great Lakes islands, the scope of planning includes the islands and nearby waters and lands that influence them. Here, we summarize overarching guiding principles drawn from these documents and our professional experience studying Great Lakes islands and invasive species. Then we outline a *Template for Action* that outlines recommended key steps in the planning process and provide examples of specific actions that have been taken by others. Examples of prioritizing biodiversity elements and invasive species, and examples of success stories are provided in the accompanying documents: *Prioritization Schemes* and *Case Studies*,

Key Source Documents for Invasive Species Management Planning	
Meeting the Challenge of Invasive Species: A Framework for Action	Higman & Campbell, 2009
Michigan’s Aquatic Invasive Species State Management Plan 2013 Update	MDEQ, MDNR, MDARD, MDOT, 2013
Forest Service National Strategic Framework for Invasive Species Management	USFS, 2013
Gravel Island, Green Bay, Harbor Island, Huron, and Michigan Islands National Wildlife Refuges: Comprehensive Conservation Plan and Land Protection Plan	Lenz et al. 2013
National Invasive Species Council Management Plan 2016-2018	NISC, 2016
National Park Service, Plant Management Strategic Plan	NPS, 2016
Little Bay Bands of Odawa Indians Aquatic Invasive Species Plan	Jansen, 2017
Little Bay Bands of Bands of Odawa Indians Terrestrial Invasive Species Plan - DRAFT	May & Higman, 2017
Land Management Guide to Developing an Invasive Plant Management Plan	USFWS & California IPC, Invasive Plant Council, 2018
Michigan’s Terrestrial Invasive Species Management Plan	MDEQ, MDNR, MDARD, MDOT, 2017
Data Matters: Informing the Eradication of Invasive Species on Islands: North American the Arctic Region	Island Conservation, 2018
Strategic Invasive Species Management Plan: A Strategy for Collaboration in Oakland County	Lehnhardt et al., Applied Ecological Services, 2017
Guidelines for Invasive Species Planning and Management on Islands	IUCN, 2018
Invasive Plant Management Planning Technical Considerations Natural Resource Report NPS/NRSS/BRD/NRR—2018/1820	Dingman et al., 2018
Michigan CISMA Websites and Strategic Plans	Multiple documents & dates

Invasive Species Management Planning Framework

The information presented here provides a theoretical backdrop for making effective decisions regarding invasion management that is commonly utilized through the conservation community. Nearly identical themes were presented in all the key planning documents and reports that we reviewed; they were simply organized in slightly different ways and with slightly different focuses based on the target audience. These common themes are organized below to provide a framework for thinking about invasions that builds upon the long history and experiences of key conservation organizations, practitioners, researchers, communities and individuals who have been working hard to mitigate the negative impacts of invasive species.

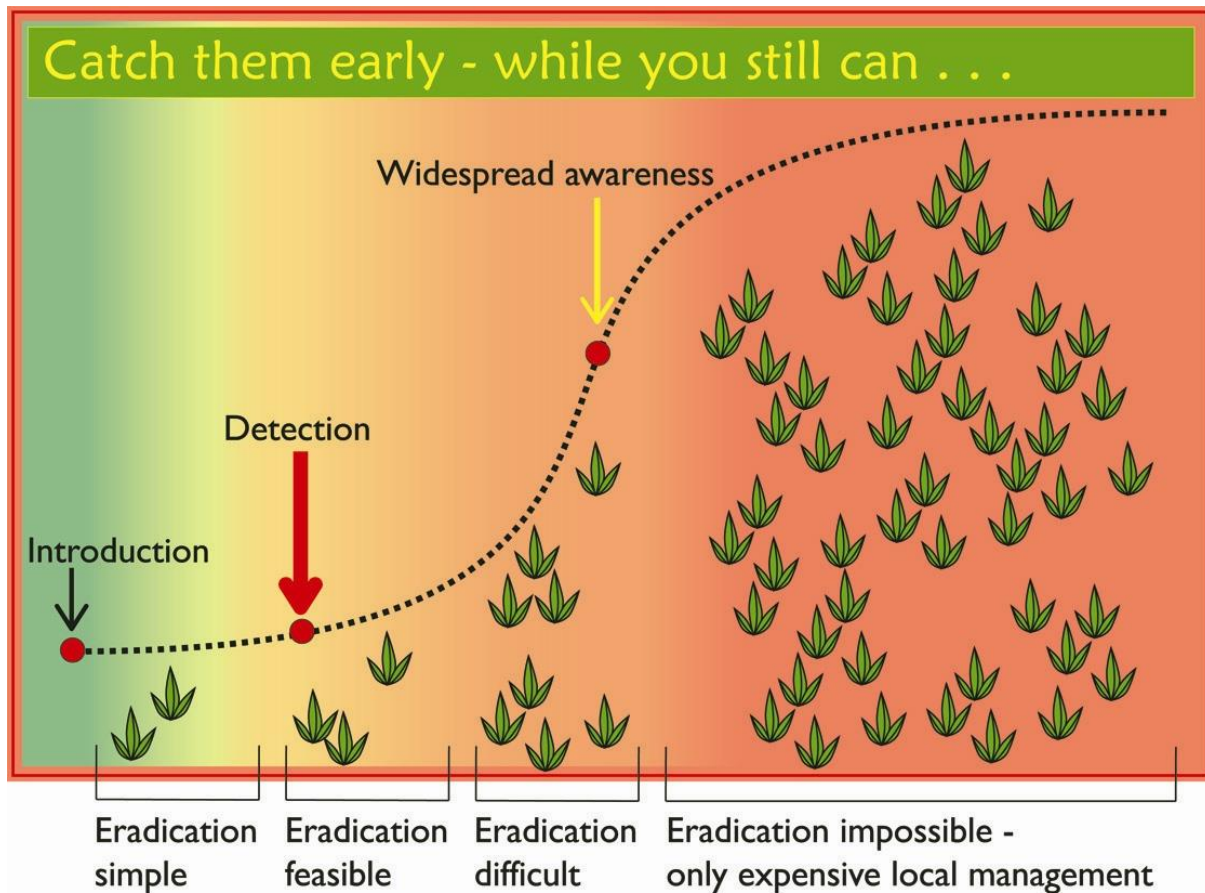
An Adaptive Management Approach is Not Optional

Because significant resources are invested to address invasive species, it is important to treat actions taken as experiments to learn from, not simply as items to cross-off a list and forget. Time must be taken up front to thoughtfully plan this work and to monitor it in order to move beyond a shotgun approach. Five key items that are often neglected, at least in part, are highlighted below to reinforce their importance in the overall planning template. These tenets are critical for evaluating and informing how resources are used in the future to improve invasive species management work. These are especially important for higher risk activities that are necessary for moving the needle on invasive species management because of data and knowledge gaps. These tenets are typically considered in relation to site-specific management, however, they are equally applicable to other actions, such as delivery of an educational program or creating a sub-committee. It is essential to learn from all actions that are implemented.

- 1. Define explicit goals for actions to be implemented.*
- 2. Consider unintended consequences of possible actions that could be detrimental to what you are trying to protect.*
- 3. Document activities, decision-making processes and data gathered.*
- 4. Define and implement pre- and post-action measurements.*
- 5. Assess the results of actions and adapt them accordingly.*

The Invasion Curve Informs Strategies

The invasion curve depicts the life cycle of a typical invasion, as shown below. An invader must arrive and successfully reproduce in order to become a problem. If successful, there is often a time-lag during which the population size remains low and the invader is either not detected or is ignored. Over time, the population grows to more detectable levels and eventually increases exponentially until there is widespread awareness of the invader. At this point, costs of managing the invader escalate while successful control rates plummet.



This invasion life cycle diagram leads to several key strategies that can be employed to most effectively manage invasions. These strategies currently dominate invasion science today and determining which species belongs in which category is the challenge. It is both an art and a science and is rooted by specific management goals and site conditions. It is also scale dependent.

- Prevention:** take measures to stop invaders from arriving and/or spreading to new sites.
- Early detection and response (EDR):** detect new invasion early and implement carefully considered responses to eradicate or manage them where feasible and where success is likely.
- Containment:** limit the spread of priority species source populations where successful eradication, control or restoration is not feasible.
- Asset-based Control and Restoration:** identify high value sites (assets) and focus invasive species management efforts on the most important sites where action is most urgent and is most likely to be successful.

A Prioritized Three-Pronged Approach is Useful

Most planning efforts recognize three primary focal areas for designing action plans to address invasive species. These arise directly from examination of the invasion curve shown above and are described briefly below. They can be used at any scale and can be intertwined to create a more comprehensive strategy.

Vector-based approach: focused on prevention; identification of key entry points and pathways of spread for priority invaders; strategies are focused on blocking the entry and spread of new species to new areas

Species-based approach: focused on early detection and response for priority species wherever they are uncommon; establishment of detection-monitoring protocols in key locations, tap into a network of professionals and non-professionals to report new occurrences; assessment of reported occurrences and mounting a carefully considered response, if determined as feasible and likely to succeed

Site-based approach: focused on asset-based management; identification of the most important sites where successful intervention is likely to be achieved.

Michigan has progressed by leaps and bounds toward developing a common understanding of the invasion curve and key strategies and associated costs to address invasive species. It has educated a statewide network of professionals and individuals who understand the need for prevention, early detection and response, and asset-based management strategies. It is an outstanding achievement that most CISMAs in Michigan actively implement prevention and EDR strategies for priority species. Less emphasis has been placed on systematic implementation of the site-based approach in this community of managers. This approach is a critically important tool for protecting Michigan's most valued assets currently at risk due to invasions. Many people involved in invasive management know much more about priority invasive species than about Michigan's native systems and requests are increasing for assistance in identifying priority sites, particularly native natural communities.

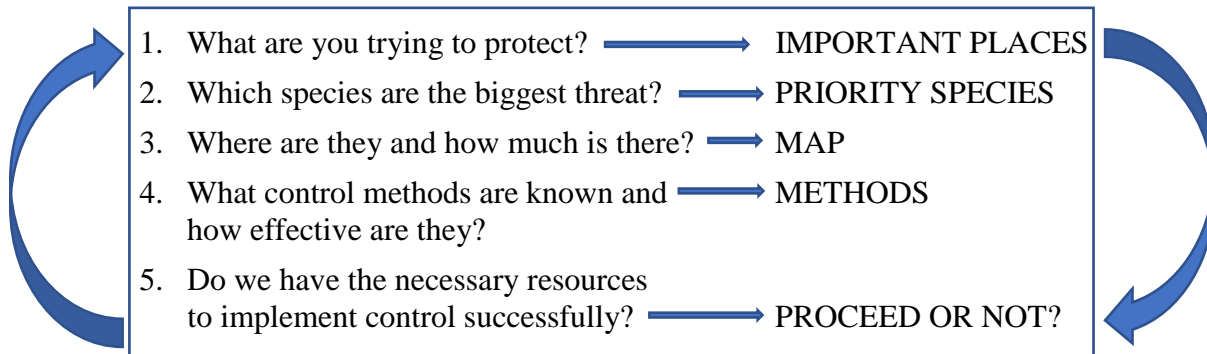
Lesser attention to the site-based approach, is in part due to the global emphasis on the cost-effective strategies of prevention and EDR, which are also critically important. But it is also because it is easier to prioritize and address species that are uncommon. Ironically, capitalizing on the site-based approach is one of the most important tools for prioritizing the management of more established species. By shifting the focus from simply priority invasive species to the most important sites, decisions about which infestations to treat become much easier, while at the same time priority species can be targeted.

Information Needed to Prioritize Invasive Species Action Effectively

When considering which actions to take to address invasive species, it is easy to want to jump to on-the-ground action immediately. While there is some urgency in acting quick, it is arguably necessary to answer some key questions before proceeding. Resources can easily be wasted on

actions that do not move the needle on invasive species work or that even cause unintended consequences detrimental to the things you are trying to protect, such as loss of a native seed banks, erosion, or secondary invasions. If the answers to the questions highlighted below not known, available resources may be better used for gathering the pertinent information or implementing important achievable actions elsewhere. While these key questions were originally based on making site-level management decisions, like the tenets above, they are equally applicable at other scales and for other types of action, such as where to put signage, who to educate, and what method of outreach will be most effective.

Key Questions



Foundational and Data Management Needs

Many other factors besides identifying priority species and prioritizing action are necessary for building and sustaining a successful, long-term invasive species action initiative for Michigan’s Great Lakes islands. These are exemplified and made visible through the significant struggles and successes of key agencies, teams, and networks, including the USFWS, EPA, USFS, NPS, EGLE, MDNR, MDARD and MDOT, State of Michigan Invasive Species Core Teams, the Michigan Invasive Species Coalition, Michigan’s CIMSAs, stewardship clusters and other partners, who have moved forward strategically in the face of incomplete data and uncertain funding. Vision and leadership, partnerships, coordination and communication, information and data management systems, generation of support and funding, and legislative policies and procedures are essential ingredients that provide the infrastructure that frames Michigan’s successful invasive species initiatives. These same ingredients are needed to mount and sustain a successful invasive species action initiative for Michigan’s Great Lakes islands, Michigan is well poised to grow an island initiative and the *Island Database* provides the most current collection of information on Michigan’s Great Lakes islands from which to plan.

Infrastructure Needs for a Successful Island Initiative

- ❖ Vision, Leadership and Partnerships
- ❖ Coordination and communication
- ❖ Information and data management systems
- ❖ Generation of support and sustainable funding
- ❖ Legislative policy and procedures

Template for Planning Invasive Species Action

Using the theoretical backdrop and key resources discussed above as a guide, the following template was developed to assist stakeholders with planning and implementing invasive species actions for Michigan's Great Lakes islands. It can be used as a checklist to ensure that important consideration and processes are not glossed over in a rush to act.

1. Identify scope of work

- Identify islands and the diversity of partners within your jurisdiction.
- Explore the island database for important island assets.
- Inventory island partners, plans and activities.

2. Map important places on the islands (ecological, cultural and socio-economic).

3. Identify priority invasive species, learn their biology, reproductive propagules and modes of dispersal and how to identify them.

4. Map entry points, pathways of spread and potential hot-spots for invasive species introductions based on a vector assessment.

- Review the island database for any existing spatial data on vectors.
- Identify other potential vectors that may not be captured
- Consider propagules and modes of dispersal.

5. Compile and map invasive species distribution and abundance data.

- Use existing data from the MISIN and other sources.
- Categorize species as A-E list species (page 33) or other similar way – note that this will require reviewing available information on impact levels of species in addition to their distribution. See *Examples of Prioritization Schemes* document for some examples.

6. Identify and prioritize actions (this is the wish list, not the do list).

- Overlay data layers and identify where management is most important or can have the biggest impact.
- Consider non-control actions, such as mapping distribution and abundance or outreach and education, where needed as well as control actions.
- Identify where prevention, EDR, containment, and asset-based control will be best employed.
- Consider vector, species, and site-based approaches.
- Consider outliers, sources and pathways.
- Consider upstream to downstream movement of propagules.
- Consider where research may be needed.
- Identify small high priority, achievable actions while building capacity-over time.

7. Establish operational and documentation procedures and decision-making criteria for all management actions (use existing CISMA structure.

- Safety protocols.
- Mapping protocols.
- Data management and storage protocols.
- Treatment tracking protocols.
- Partnership engagement.
- Communication strategies.
- Roles and responsibilities (How decisions are made and who makes them)

8. Consider actions for vector, species, and site-based approaches.

Note: some of the following descriptions are repetitive since many of the steps are the same. They are separated to remind users to consider all three approaches in order to find the best set of actions that together are likely to achieve success.

➤ **Vector-based management (preventing entry and spread of priority species to new sites):**

- Emphasize blocking entry points and pathways leading to most important sites.
- Design and implement on-going detection monitoring in the most important places, including hot-spots of entry points or public use areas.

➤ **Species-based EDR (responding to priority invasive species where they are uncommon):**

Note: EDR priorities will differ depending on the scale, e.g., entire Great Lakes, regionally, island, or site.

- Sign up for MISIN early-alerts for selected priority species in your region.
- Assess reported EDR occurrences for extent and abundance, site conditions, pathways for spread, secondary invaders, etc.
- Determine if there are important natural, cultural, or socio-economic features of importance that may require permitting or preclude certain management options.
- Establish partner involvement and communication.
- Use decision-making criteria to determine if response is warranted.
- Document decisions and reasons for making them.
- If a response is determined, define response management goals.
- Compile and assess management options – conduct risk-benefit analysis.
- Assess available resources including funding, expertise, long-term action.
- Select preferred option(s) – consider principles of integrated pest management.
- Design and implement pre and post-monitoring for each response.
- Implement response.
- Assess monitoring results and adapt actions accordingly.
- Document all actions and results; enter data into treatment tracking system.
- Share results widely; celebrate and showcase successes.

- **Asset-based site management (high priority sites where success is likely):**
 - Establish partner involvement and communication.
 - Learn or define overall site management goal(s).
 - Assess site for extent and abundance or priority species, site conditions, pathways for spread, secondary invaders, etc.
 - Determine if there are important natural, cultural, or socio-economic features of importance that may require permitting or preclude certain management options.
 - Define invasive species management goals within overall site management goals.
 - Identify invasive species of concern and their distribution and abundance.
 - Compile and assess management options – conduct risk-benefit analysis.
 - Assess available resources.
 - Select preferred option(s) – consider principles of integrated pest management.
 - Design and implement pre and post-monitoring.
 - Implement management.
 - Assess monitoring results to determine if you are reaching your management goals.
 - Determine how management should be adapted accordingly.
 - Document all actions and results; enter data into treatment tracking system.
 - Share results widely; celebrate and showcase successes.

9. Review all identified potential vector, species and site-based actions and select those that:

- Are achievable in both the short and long-term – from ecological, technical, social and economic perspectives.
- Will have the biggest impact on the target invader, the best protection of site assets, and the most positive influence on people to build support and engagement in decision-making.
- Can be accomplished with available resources -- expertise and contractors are available, known methods are effective, unintended consequences are considered and avoided, and multi-year plans are spelled out and can be sustained.

10. Consider a long-term vision to build upon successes, increase capacity and support, and increase knowledge of important island assets and needs.

- Conduct additional inventories of natural and cultural features.
- Work to understand economic priorities and identify where land use conflicts need to be resolved that influence or are influenced by invasive species.
- Integrate invasive species planning with other island planning processes.
- Utilize partner expertise and partnerships to leverage funding and additional support.
- Conduct outreach to raise awareness and engage islanders.
- Build long-term on-island staff presence to lead and coordinate future efforts.

Some Lessons Learned

1. Start small with achievable actions

- It can be overwhelming; there are so many species, gaps, and too few resources.
- Better to do good work on a few species or at a few sites, than to do ineffective work, or even detrimental work on many species or at many sites.
- Fully fund top priorities before allocating to lower priority items (IUCN).

2. Think ten years ahead

- Your current plan will be outdated quickly; look ahead and be prepared for change and new paradigms.

3. Keep your eye on new developments in invasion science

- Be on the lookout for potential non-target or legacy impacts of various herbicides previously not known or revealed.
- Learn about novel management methods, e.g., e-DNA for detection, gene silencing)
- Read up on the of climate change, invasive species and resiliency strategies.
- Read up on rapid evolution and novel ecosystems.

4. Never be complacent

- Theories change as new information comes to light - do not be afraid to change your ways as you learn more.

5. Value your own expertise

- What you see on the ground is important. Share your stories.

6. Learn from what you do

- It is a tragedy when money and effort are put into management activities that are not carefully documented, secured and made available to the larger community. Management activities are best implemented as experiments to learn from and they should be carefully planned, monitored, assessed and documented along with decision-making.

7. Fortify and connect intact core areas for resiliency

- Invasive species simplify ecosystems; simplified ecosystems are more vulnerable to change. Find the most intact systems to work out from and connect.

8. Consideration of invasive species is too often an afterthought in planning processes

- This leading threat to functional, high-quality ecosystems and resiliency should be integrated up front into all resource management activities.

Some Tips for Planning Steps

*All references, unless otherwise noted, refer to the final report for this project.

1. Scope of Work

- A list of islands associated with each CISMA is provided in Appendix 10 and a summary of selected CISMA-island statistics is shown on pages 24-25 of the final report.
- Ownership of all islands can be viewed by querying the database.
- Assets of particular importance to Great Lakes islands are described in step 2.
- Some partner data may already be in the database;
 - ✓ it would be useful to improve these data as additional partners, plans and activities are identified.

2. Map Island Assets

- Assets of particular importance to Great Lakes islands include:
 - ✓ Federally and State endangered and threatened species
 - ✓ State special concern species
 - ✓ Great Lakes endemics species
 - ✓ Colonial waterbird sites
 - ✓ Migrating bird stopover habitat
 - ✓ Fish spawning areas
 - ✓ Sites with special designations
 - ✓ Significant cultural sites
 - ✓ Historic sites
 - ✓ High quality natural communities
 - ✓ Lakes and streams
 - ✓ Cultural and historical resources
 - ✓ Economically important resources
- A list of all database attributes is provided in Appendix 3 of the final report.
- Additional non-spatial data can be queried in the accompanying Zotero Bibliography; it is printed and provided as Appendix 1 in the report.
- Systematic surveys have not been conducted on every island and many surveys are outdated. Consider conducting surveys on your islands.
- Cultural and economic values are less well documented and deserve further attention in order to identify important sites and activities sites that can be spatially represented. Work with partners to gather these data.

3. Identify priority invasive species, learn their biology, reproductive propagules and modes of dispersal and how to identify them. Identify threat level where possible.

- A discussion of priority invasive species is on page 26-32 of the final report.
- Species that are common or widespread on the mainland may be absent, uncommon or very local on islands.
- The goal is to stop entry, establishment, reproduction and dispersal of priority species.
- Compiled lists to be aware of include:

- ✓ Michigan's prohibited and restricted list
 - ✓ Michigan's noxious weed list
 - ✓ Michigan's watch list species
 - ✓ An expanded working list for Great Lakes Islands developed by MNFI (Appendix 14 of the final report)
 - ✓ GLANSIS Range Expansion and Watch List species lists
 - these are identified at the Great Lakes scale
 - ✓ Wisconsin DNR Invasive Species NR 40 List (Appendix 11 of the final report)
- There are many resources for investigating life cycles and dispersal modes
- ✓ State of Michigan Invasive Species Website
 - ✓ Michigan Invasive Species Information Network (MISIN)
 - This site has identification modules for many priority species
 - ✓ MInvasives Website
 - ✓ USGS Non-indigenous Aquatic Species Database and Website (NAS),
 - ✓ Great Lakes Aquatic Nonindigenous Species Information System (GLANSIS)
 - ✓ WDNR Invasive Species Website
 - ✓ Global Invasive Species
 - ✓ Midwest Invasive Plant Network (MIPN)
 - ✓ Global Invasive Species Database (GISD),
 - ✓ CABI Compendium of Invasive Species
 - ✓ NatureServe
 - ✓ Early Detection and Distribution and Mapping System (EDDMapS), and
 - ✓ Invasive.org.
 - ✓ iMapInvasives

4. Map entry points, pathways and potential invasive species hot-spots based on vector assessment.

- Vectors for 93 species are compiled in Appendix 9 of the final report.
- Key vectors that are currently in the spatial database for at least some islands include sites and pathways associated with these activities:
- ✓ Food/fishing-Commercial
 - ✓ Food/fishing Recreational
 - ✓ Human activity & Commerce
 - ✓ Transportation/Commercial/Trade
 - ✓ Transportation – Recreational
 - ✓ Natural forces such as water currents and storms
 - ✓ Aquaculture/Aquaria/Game farms/Gardens
 - ✓ Roads and trails
- Speak up about other known vectors so they can be added to the *Island Database*

5. Compile and map invasive species distribution and abundance data

- Distributions can be viewed on the MISIN, NAS, GLANSIS, EDDMapS separately
- ✓ The island database holds a one-shot-in-time map from all of these sources; currently only the MISIN data is regularly updated.
 - ✓ This is an important gap to address

- Inform the MISIN, GLANSIS, MISC or MNFI of additional distribution datasets you learn of.
- Categorize species as A-E list species (page 32 of the final report) or other similar way considering both impact level and current distribution data.
- See *Examples of Prioritization Schemes* document for some additional examples.
- Grow your data over time; consider:
 - ✓ Systematic surveys over time, prioritizing by values, species, and vectors.
 - ✓ Dedicated surveys based on management goals and available data: site-based, species-based, vector-based including, hot-spots.
 - ✓ Opportunistic Surveys: equip professionals and community members with identification of highest priority species so they can capture points with phone app such as the MISIN.
 - ✓ Citizen Scientists: mapping priority species is one of the most useful ways volunteers can contribute.

6. Identify and prioritize where and which actions are needed (this is the wish list, not the do list).

- Overlay data layers collected in Steps 1-5 and identify where action is most important and/or can have the biggest impact.
 - ✓ Spatial maps are essential for state-of-the-art decision-making and the *island database* is designed for users to be able to view features in a GIS format to identify the intersection of invasive species, with island assets, vectors, various land uses and partner activities.
 - ✓ Consider non-control actions, such as mapping, establishing ordinances or outreach and education; the maps can inform these decisions as much as decisions about control action. Immediate control action is not always wise.
 - ✓ Identify where prevention, EDR, containment, and asset-based control actions could be best employed.
 - ✓ Consider vector, species, and site-based approaches.
 - ✓ Consider outliers, sources and pathways.

You now have your wish list – before moving forward be sure to address Step Seven.

7. Establish operational and documentation procedures and decision-making criteria for all management actions.

- Different agencies, partners and networks typically have their own operational procedures and decision-making processes that appear to be working well. Be sure to review and update the following periodically:
 - ✓ Safety protocols.
 - ✓ Mapping protocols.
 - ✓ Data management and storage protocols.
 - ✓ Treatment tracking protocols.
 - ✓ Partnership engagement strategies.
 - ✓ Communication strategies.
 - ✓ Roles and responsibilities (how decisions are made and who makes them)

- There is a gap regarding invasive species data gathering that could be improved, particularly on islands.
 - ✓ Reach out to the Core teams, MISIN, GLANSIS, MISC, or MNFI if you have relevant datasets.
 - ✓ Share your ideas about how the MISIN mapping and treatment tracking protocols can be improved to better meet your needs.
 - ✓ Try not to reinvent the wheel.

Your wish list and operational procedures are in place, which actions can be implemented successfully; how and who should do it?

8. Consider actions for vector, species, and site-based approaches.

The process for each of these approaches are laid out in the template; here we provide some examples of resources and actions that have been used for one or more of these approaches.

Action Ideas

Vector Management/Prevention/Early Detection

Ballast water regulations

<http://www.imo.org/en/OurWork/Environment/BallastWaterManagement/Pages/Default.aspx>

Boater, angler, ORV behavior Studies

Stopping Invasive Species with Behavioral Psychology August 21th at 1:00 pm CT

Presented by Ken Donnelly, behavioral psychologist and president at Beyond Attitude Consulting
Description: Many invasive species pathways include human behavior, like boating, hiking, and camping. Changing people's behavior can be challenging, as anyone who has ever made a New Year's resolution knows very well. Just because people think something should be done, doesn't mean it will get done. Fortunately, the application of behavioral psychology greatly improves traditional communications programs in getting people to adopt the behaviors that interrupt pathways. People attending the webinar will learn how to apply behavioral psychology to nurture the behaviors that stop the spread of invasive species

Boat Design to minimize propagule attachment

<https://www.maisrc.umn.edu/news/boat-designs>

<https://www.marinadockage.com/boat-manufacturers-focus-design-prevent-spread-invasive-species/>

Boater Laws

<https://www.michigan.gov/invasives/0,5664,7-324--492502--,00.html>

Boot brushes

<https://www.cal-ipc.org/product/boot-brush-single/>

<https://www.playcleango.org/resources/signage>

Clean, drain dry

<http://micbcw.org/> and <http://stopaquaticinvasives.org/>

Decontamination procedures / Best Control Practices for Invasive Species

<https://www.inghamconservation.com/wp-content/uploads/2016/05/Invasive-Species-Decontamination-Guidelines.pdf>

Disposal guidelines

https://www.michigan.gov/documents/invasives/Invasive_Plant_Disposal_Guide_accessible_word_626157_7.pdf

Dog sniffers

<https://www.nynjtc.org/news/dog-will-change-way-we-fight-invasives>

Don't Move Firewood

<https://www.dontmovefirewood.org/map/michigan/>

https://www.michigan.gov/mdard/0,4610,7-125-2390_18298_45067---,00.html

Drone detection mapping

Development of an Automated Monitoring Platform for Invasives in Coastal Ecosystems

Report Number 2019-05. Cohen, J.G. and M.J. Lewis <https://mnfi.anr.msu.edu/publications/reports>

Dumpsters for invasive species

<https://www.habitatmatters.org/e-newsletterblog/dumpsters-available-for-invasive-species-disposal>

Early Alerts

Contact the MISIN to sign up for e-mail alerts when the species you select are detected in the region you select. <https://www.misin.msu.edu/about/contact/>

http://www.misin.msu.edu/train/MISIN/Protocols/MISINAlertsSignup_2019.pdf

e-DNA Detection

https://www.usgs.gov/ecosystems/invasive-species-program/science/invasive-species-tools?qt-science_center_objects=0#qt-science_center_objects

<https://content.govdelivery.com/accounts/MIDNR/bulletins/24ed023>

Education

Play Clean Go: <https://www.playcleango.org/resources/signage>

<https://www.michigan.gov/invasives/0,5664,7-324-68000---,00.html>

<https://www.michiganseagrant.org/lessons/lessons/by-broad-concept/life-science/invasive-species/activity-great-lakes-most-unwanted/>

https://www.regions.noaa.gov/great-lakes/index.php/great_lakes-restoration-initiative/invasive-species/

Emerald Ash Borer Detected on Beaver Island

<http://www.beaverislandforum.com/viewtopic.php?t=12478>

GLDIATR – Great Lakes Detector of Invasive Aquatics in Trade

<https://www.glc.org/work/gldiatr/about>

GLAHF - Great Lakes Aquatic Habitat Framework

<https://www.glahf.org/>

Go Beyond Beauty:

<https://www.habitatmatters.org/go-beyond-beauty.html>

Habitattitude: Habits, Attitude, and Habitat

<https://www.habitattitude.net/>

Habitat Suitability Modeling

<http://www.natureserve.org/conservation-tools/species-distribution-modeling>

INvasive Species Effects Assessment Tool (INSEAT)

<https://onlinelibrary.wiley.com/doi/full/10.1002/ece3.5020>

Inspections

<https://www.glc.org/news/blitz-062819>

<https://content.govdelivery.com/accounts/MIDNR/bulletins/1fc544e>

Invasive species Identification

Identification training modules: <https://www.misin.msu.edu/species-training/>

Field Guides:

Aquatic Invasive Species: <https://mnfi.anr.msu.edu/pdfs/AquaticsFieldGuide.pdf>

Terrestrial Invasive species: <https://mnfi.anr.msu.edu/invasive-species/InvasivePlantsFieldGuide.pdf>

Michigan Invasive Species:

<https://www.michigan.gov/invasives/0,5664,7-324-68002---,00.html>

Asian Carp Identification – Ontario

<http://www.invadingspecies.com/asian-carps/>

Landing Blitzes

<https://www.michigan.gov/invasives/0,5664,7-324--379312--,00.html>

Lobby for species to be added to the Prohibited and Restricted species list

https://www.michigan.gov/invasives/0,5664,7-324-68002_74282---,00.html

Michigan Invasive Species Coalition

<https://www.michiganinvasives.org/resources/>

MISIN – Midwest Invasive Species Information Network Phone App for Reporting

https://play.google.com/store/apps/details?id=edu.msu.misin&hl=en_US

Mock exercises

Hydrilla after action response:

<file:///C:/Users/higmanp/Downloads/2017%20Mock%20Exercise%20after%20action%20report%2031418.pdf>

Municipal Workshops

<https://www.inghamconservation.com/wp-content/uploads/2019/01/2019-Municipal-Trainings.pdf>

New Invasive Species Sale Law

Registration required to sell aquatic organisms:

<https://www.michigan.gov/invasives/0,5664,7-324-68071---,00.html>

Ontario's Invasive Species Awareness Program

<http://www.invadingspecies.com/asian-carps/>

Ordinances

<https://www.michigan.gov/invasives/0,5664,7-324-68071---,00.html>

Play, clean, go

<https://www.playcleango.org/>

Prioritization Schemes

See *Examples of Prioritization Schemes* for Invasive Species Action. Search MNFI Publications

<https://mnfi.anr.msu.edu/publications>

Regulation

https://www.michigan.gov/documents/deq/deq-ess-caap-manufguide-chap2_313406_7.pdf

<https://www.michigan.gov/invasives/0,5664,7-324-68071---,00.html>

Response Plan for Aquatic Invasive Species in Michigan

https://www.michigan.gov/documents/deq/wrd-ais-response-plan_455659_7.pdf

Ripple - Reduce

Invasive Pet and Plant escapes:

https://www.michigan.gov/invasives/0,5664,7-324-68000_75850---,00.html

Risk Assessment

<https://www.mipn.org/plantlist/invasive-plant-risk-assessment/>

<https://www.fs.fed.us/foresthealth/applied-sciences/mapping-reporting/invasive-species-risk/index.shtml>

https://www.aphis.usda.gov/aphis/ourfocus/planthealth/plant-pest-and-disease-programs/pests-and-diseases/sa_weeds/sa_noxious_weeds_program/ct_riskassessments

Roads

MDOT and Road Commissions: Connect to educate and help address invasions along roadsides.

https://www.doi.gov/sites/doi.gov/files/uploads/isac_infrastructure_white_paper.pdf

Signage

<https://www.playcleango.org/resources/signage>

https://www.michigan.gov/documents/invasives/deq-tou-wrd-AIS_LandownersGuide_639642_7.pdf

Stiltgrass Alert

<https://legacylandconservancy.org/wp-content/uploads/2019/03/Stiltgrass-Flyer-Jim-and-Andrea.pdf>

STOP the Invasives Week at state parks

STOP the Invasives programs will be offered at many state parks across Michigan. Come learn about the invasive species in your area and what you can do to help prevent their spread.

We'll be promoting awareness and offering learning opportunities focused on how to identify, manage and understand the impact of invasive species with a week of programming in many of Michigan's state parks.



Strategic detection-monitoring surveys

Identify entry-point hot-spots and monitor them regularly; engage volunteers to help.

Strike Teams

Establish trained teams dedicated to responding to early detections. Contact West Michigan Cisma

<https://www.michiganinvasives.org/westmichiganconservation/>

Vector Assessments

<https://www.invasivespeciesinfo.gov/subject/pathways>

Volunteer Stewardship:

https://www.michigan.gov/dnr/0,4570,7-350-79119_11859_62524---,00.html

Wisconsin Detector Tool

<https://fyi.extension.wisc.edu/wifdn/>

Control / Management

Aquatic Invasive Plant Control Grant

<https://www.michigan.gov/egle/0,9429,7-135--496315--,00.html>

Best Control Practices

<https://mnfi.anr.msu.edu/publications/best-control-practice-guides>

Bid packages

<https://www.invasiveplantcontrol.com/wp-content/uploads/2018/04/bidspecs.pdf>

Case Studies

See *Examples of Case Studies* submitted with this report. Search publications on MNFI Website.

<https://mnfi.anr.msu.edu/publications>

Control Database - Wisconsin

<https://mipncontroldatabase.wisc.edu/>

Cooperative Invasive Species Management Areas (CISMA's) Cookbook

<https://bugwoodcloud.org/mura/mipn/assets/File/CWMACookbook2011.pdf>

Cut stump herbicide applicator (how to-assemble one)

<http://www.clmcd.org/downloads/herbicide20applicator.pdf>

Decontamination procedures / Best Management Practices for Invasive Species

<https://www.inghamconservation.com/wp-content/uploads/2016/05/Invasive-Species-Decontamination-Guidelines.pdf>

https://www.michigan.gov/documents/deq/qol-wrd-policy-invasive-species-decontamination_476846_7.pdf

Drone mapping pre and post-monitoring for precision treatment

Development of an Automated Monitoring Platform for Invasives in Coastal Ecosystems

Report Number 2019-05. Cohen, J.G. and M.J. Lewis <https://mnfi.anr.msu.edu/publications/reports>

Forum for discussion on the MISIN.

<https://forum.michiganinvasives.org/>

Great Lakes Hydrilla Collaborative

<http://hydrillacollaborative.com/>

Great Lakes Phragmites Collaborative

<https://www.greatlakesphragmites.net>

Great Lakes Coastal Wetland Decision Support Tool

<https://greatlakeswetlands.org/DST/Home.vbhtml>

Great Lakes Coastal Wetland Restoration Assessment

<https://glcwra.wim.usgs.gov/>

Guide to the Control of Invasive Phragmites

https://www.michigan.gov/documents/deq/wrd-ais-guide-phragmites_622427_7.pdf

Invasive crayfish Collaborative

<https://iiseagrant.org/join-a-new-great-lakes-collaborative-to-help-stop-invasive-crayfish/>

Invasive Mussel Collaborative

<https://invasivemusselcollaborative.net/>

Integrated pest management

https://www.michigan.gov/mdard/0,4610,7-125-1566_2405_37164-121365--,00.html

Management Goals

Make them SMART (specific, measurable, achievable, results-oriented and time-bound):

Example: Populations of spotted knapweed in areas A and B will decrease at a rate of 25% per year until eradicated by 2010. (USFWS and California Invasive Plant Council, 2018)

Michigan Invasive Species

<https://www.michigan.gov/invasives/0,5664,7-324-68001---,00.html>

Michigan Invasive Species Coalition

<https://www.michiganinvasives.org/resources/>

Michigan Invasive Species Grant Program

<https://www.michigan.gov/invasives/0,5664,7-324-71276---,00.html>

Midwest Invasive Plant Network (MIPN)

<https://www.mipn.org/>

Mondrian look-up tool

<https://sites.google.com/uni.edu/phragmiteslookuptable/home>

National Invasive Species Information Center (NISIC)

<https://www.invasivespeciesinfo.gov/>

Non-target Effects

BMPs for Wildland Stewardship: Protection Wildlife When Using Herbicides for Invasive Plant Management

<https://www.pesticideresearch.com/site/wp-content/uploads/2012/05/BMPHerbicide.pdf>

Novel Techniques

Gene silencing:

<https://www.greatlakesphragmites.net/files/GLC-Webinar.pdf>

<https://www.usgs.gov/media/images/gene-silencing>

CRISPR: <http://sitn.hms.harvard.edu/flash/2014/removing-threat-from-invasive-species-with-genetic-engineering/>

<https://www.nationalgeographic.com/news/2014/7/140717-gene-drives-invasive-species-insects-disease-science-environment/>

Microbial symbiosis: <https://www.ncbi.nlm.nih.gov/pubmed/25745417>

Phragmites Treatment and Management Prioritization Tool

https://www.michigan.gov/documents/deq/wrd-ais-phragtool_423447_7.pdf

Prioritization Schemes

See *Examples of Prioritization Schemes* submitted with this report. Check MNFI Website.

<https://mnfi.anr.msu.edu/publications>

Private landowner engagement and cost-sharing

<https://huronpines.org/invasives/>

Research contests for technological innovations to address invasive species

<https://news.mongabay.com/2019/07/conservation-tech-prize-with-invasive-species-focus-announces-finalists/>

[Pig-finding drone-based thermal cameras](#)

Starry Stonewort Collaborative

<http://fingerlakesinvasives.org/starry-stonewort-collaborative/>

Tool and equipment sharing

Invasive Species Injectors for Rent

EXCITING NEWS! The Mid-Michigan Cooperative Invasive Species Management Area (CISMA) has invasive species injectors available for local landowners in Clinton, Eaton, Ingham, and Ionia counties. These injectors are useful for local residents to treat small infestations of invasive Japanese, giant, and Bohemian knotweeds and are best used when knotweed is in bloom- August into September. They can also be used for treating invasive phragmites. Through this injector rental program, the Mid-Michigan CISMA hopes to empower local citizens in invasive species management. Learn more: [MMCISMA](#)



Invasive species injectors will be available for four-day rental sessions with a refundable deposit. Contact your county conservation district to learn more and reserve your rental dates:

Volunteers

Michigan Conservation Steward Program

<https://mnfi.anr.msu.edu/programs/conservation-stewards-program>

The Stewardship Network

<https://stewardshipnetwork.org/>

State park stewardship Program

https://www.michigan.gov/dnr/0,4570,7-350-79137_79767_79860_81155---,00.html

The DNR will host several volunteer stewardship workdays in August at state parks in Berrien County.

Workdays are an enjoyable way to spend time outdoors while restoring Michigan's ecosystems and learning about its inhabitants.

Workday details (including meeting locations, the stewardship volunteer registration form and links to individual park maps and directions) are available on the DNR website at Michigan.gov/DNRVolunteers. Volunteers are asked to register either by using the form or by emailing freih@michigan.gov.



Woody Invasive of the Great Lakes Collaborative (WIGL)

<https://www.mipn.org/control/woody-invasives-collaborative/>

Monitoring

Drone detection mapping

Development of an Automated Monitoring Platform for Invasives in Coastal Ecosystems

Report Number 2019-05. Cohen, J.G. and M.J. Lewis <https://mnfi.anr.msu.edu/publications/reports>

Great Lakes Coastal Wetland Monitoring Program

Standardized Measures of Coastal Wetland Condition: Implementation at a Laurentian Great Lakes Basin-Wide Scale <https://link.springer.com/article/10.1007/s13157-016-0835-7>

Michigan Clean Water Corps

<https://micorps.net/lake-monitoring/>

Photo-monitoring

DNR Stewardship

http://www.michigandnr.com/FTP/parks/Stewardship_Volunteers/Photo-monitoring/Photographic%20Monitoring%20Protocol.pdf

Phragmites Adaptive Management Framework (PAMF)

<https://www.greatlakesphragmites.net/pamf/>

Tying Management Goals, Treatments, and Monitoring Protocols together for Adaptive Management (MNFI)

<https://mnfi.anr.msu.edu/invasive-species/Tying-Management-Goals-Treatments-and-Monitoring-Protocols-Together-for-Adaptive-Management.pdf>

Protection Actions

Special designations

Isle Royale gets historic designation

<https://news.jrn.msu.edu/2019/03/isle-royale-gets-historic-designation/>

<https://fas.org/sgp/crs/misc/R45340.pdf>

https://www.michigan.gov/dnr/0,4570,7-350-79133_79200---,00.html

https://www.michigan.gov/documents/ConservationAreaMgtGuidelines_162564_7.pdf

Conservation Easements

<https://www.conservationeasement.us/what-is-a-conservation-easement/>

References

- Higman, P.J., H.D. Enander, D.A. Hyde, P.J. Badra, K.M. Korroch. 2019. Preserving the Legacy of Michigan’s Great Lakes Islands: A Planning Framework and Database for Invasive Species Action. Report to the USFWS Great Lakes Coastal Program. MNFI Report Number 2019-17. 40 pp.
- Higman, P.J., D.A. Hyde, H.D. Enander. 2019. Examples of Prioritization Schemes for Invasive Species Action. Report to the USFWS Great Lakes Coastal Program. MNFI Report No, 2019-18.
- Higman, P.J. Hyde, H.D. Enander. 2019. Examples of Case Studies – Successful Invasive Species Efforts. Report to the USFWS Great Lakes Coastal Program. MNFI Report No, 2019-19.
- USFWS and California Invasive Plant Council, 2018. Land Manager’s Guide to Developing an Invasive Plant Management Plan. Cal-IPC Publication 2018-01. National Wildlife Refuge System, Pacific Southwest Region. Inventory and Monitoring Initiative. Sacramento, CA. California Invasive Plant Council, Berkeley, CA. Available at www.cal-ipc.org and data.gov.