Great Lakes Hydrilla Risk Assessment

Great Lakes Hydrilla Collaborative Webinar

June 11, 2019



Great Lakes RESTORATION

ecology and environment, inc. Global Environmental Specialists

US Army Corps of Engineers®

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Presentation Overview

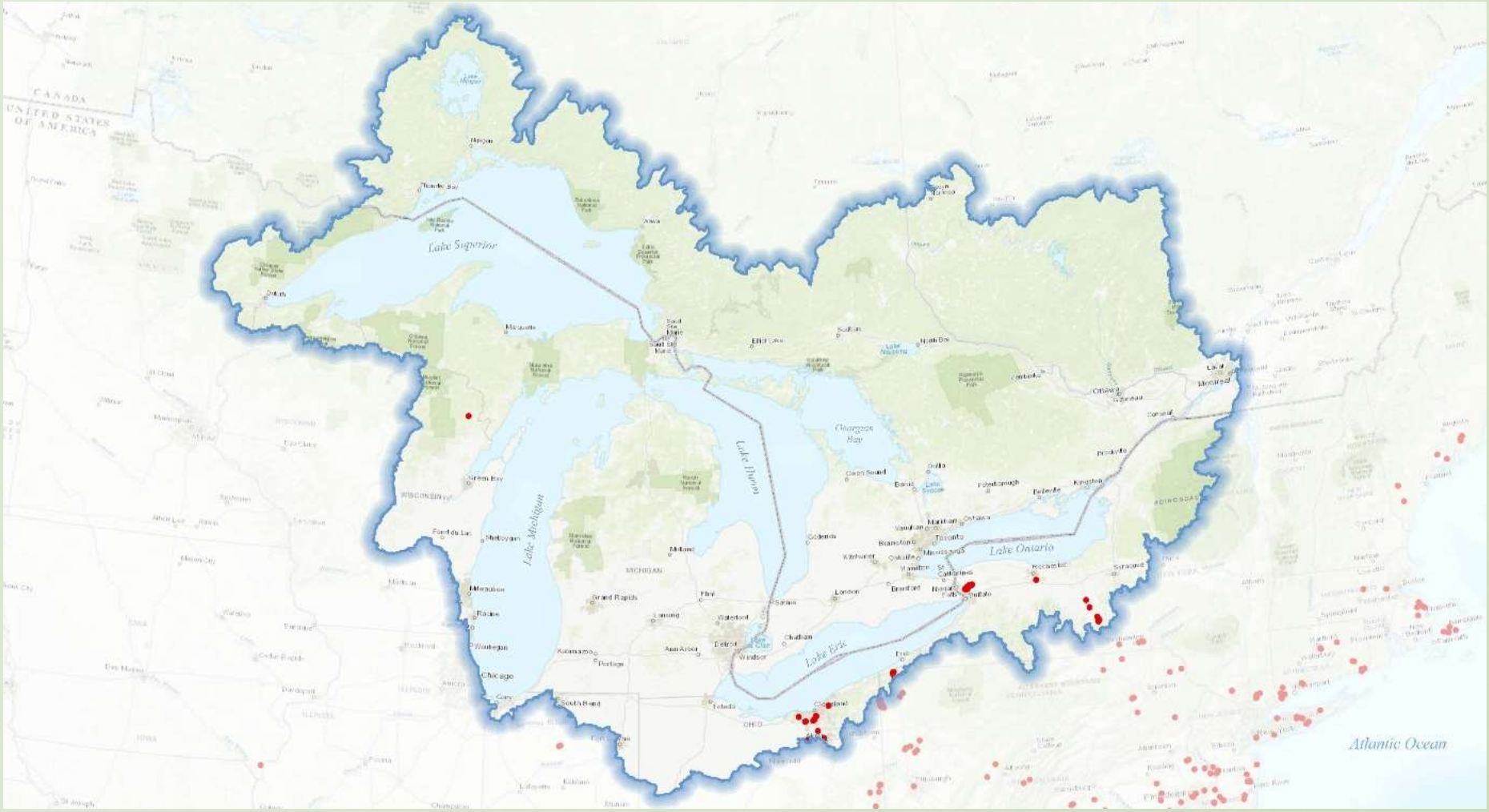
- Quick Review: Why is Hydrilla a Problem?
- Project Objectives
- Risk Assessment (RA) Framework
- Summary of RA Results
- Potential Impacts of Hydrilla in the Great Lakes Basin
- Recommendations and BMPs
- Key Takeaways

Why is Hydrilla a Problem?

- Highly invasive: ***the perfect water weed***
- Rapid growth:
  - Up to 1 inch per day
  - Forms dense mats that block light, displacing native plants
- Reproduces in several ways (fragmentation, tubers, turions, seeds)
- Rapid spread, primarily by fragmentation
- Fragments spread by natural and anthropogenic means (water flow, recreational boats/trailers)
- Tubers remain viable in sediment for years, allowing plant to overwinter and re-grow each spring, even when above-ground biomass dies off

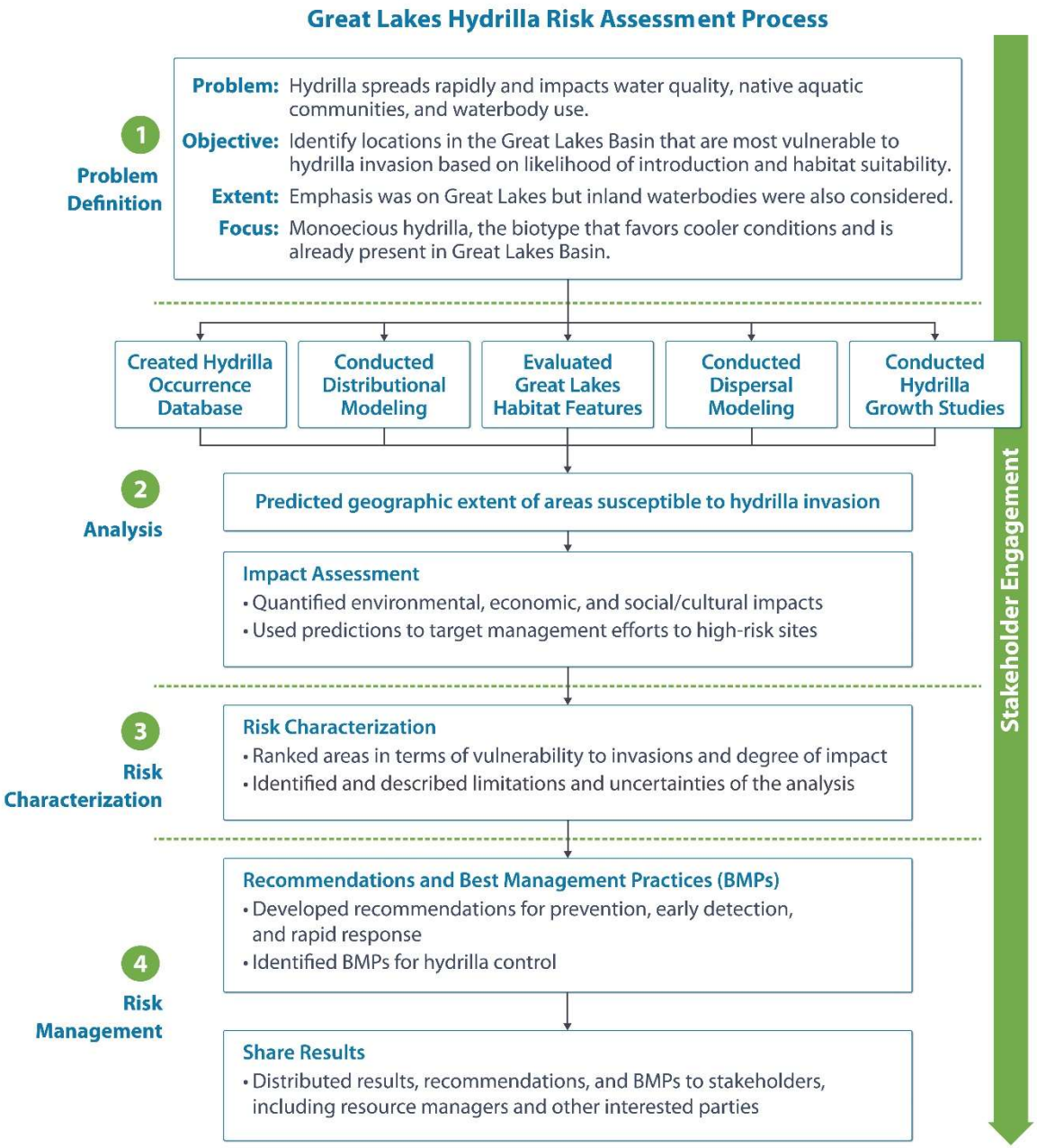
Hydrilla in Cayuga Inlet at Johnsons Boat Yard
Photo: B. Johnson, Racine-Johnson Aquatic Ecologists

Hydrilla in Great Lakes Basin

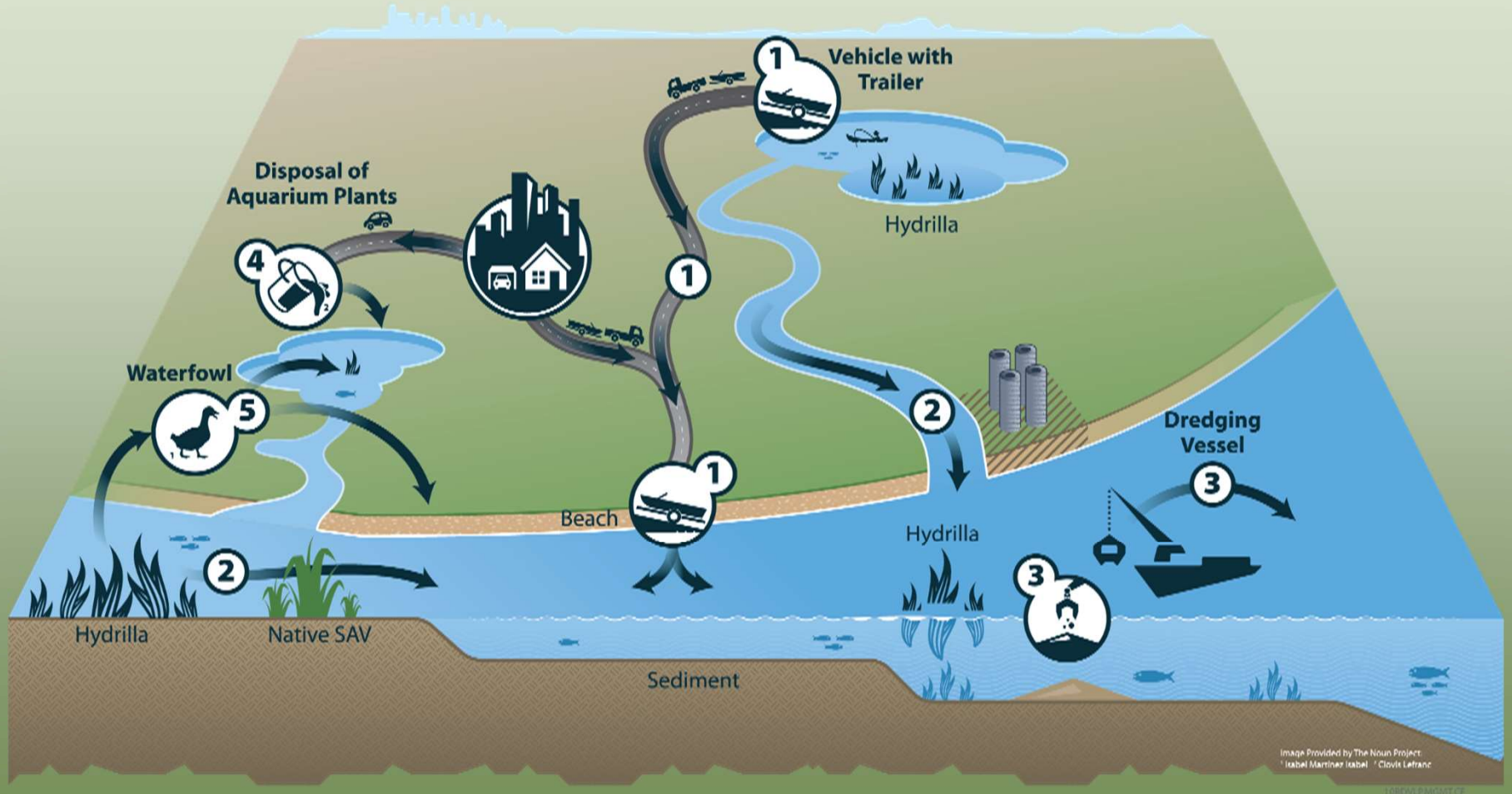


Project Objectives

- **Identify locations most vulnerable to invasion based on likelihood of introduction and environmental suitability**
- Secondary Objectives:
  - Evaluate effects of photoperiod, temperature, and interspecies competition on monoecious Hydrilla growth
  - Assess ecological, economic, and social/cultural impacts of Hydrilla establishment
  - Develop recommendations for prevention, early detection, and response to reduce risk of spread
  - Identify best management practices for Hydrilla prevention, detection, management, and monitoring


Great Lakes Hydrilla Risk Assessment Process
1
Problem Definition
Problem: Hydrilla spreads rapidly and impacts water quality, native aquatic communities, and waterbody use.
Objective: Identify locations in the Great Lakes Basin that are most vulnerable to hydrilla invasion based on likelihood of introduction and habitat suitability.
Extent: Emphasis was on Great Lakes but inland waterbodies were also considered.
Focus: Monoecious hydrilla, the biotype that favors cooler conditions and is already present in Great Lakes Basin.
Created Hydrilla Occurrence Database
Conducted Distributional Modeling
Evaluated Great Lakes Habitat Features
Conducted Dispersal Modeling
Conducted Hydrilla Growth Studies
2
Analysis
Predicted geographic extent of areas susceptible to hydrilla invasion
Impact Assessment
• Quantified environmental, economic, and social/cultural impacts
• Used predictions to target management efforts to high-risk sites
3
Risk Characterization
Risk Characterization
• Ranked areas in terms of vulnerability to invasions and degree of impact
• Identified and described limitations and uncertainties of the analysis
4
Risk Management
Recommendations and Best Management Practices (BMPs)
• Developed recommendations for prevention, early detection, and rapid response
• Identified BMPs for hydrilla control
Share Results
• Distributed results, recommendations, and BMPs to stakeholders, including resource managers and other interested parties
Stakeholder Engagement

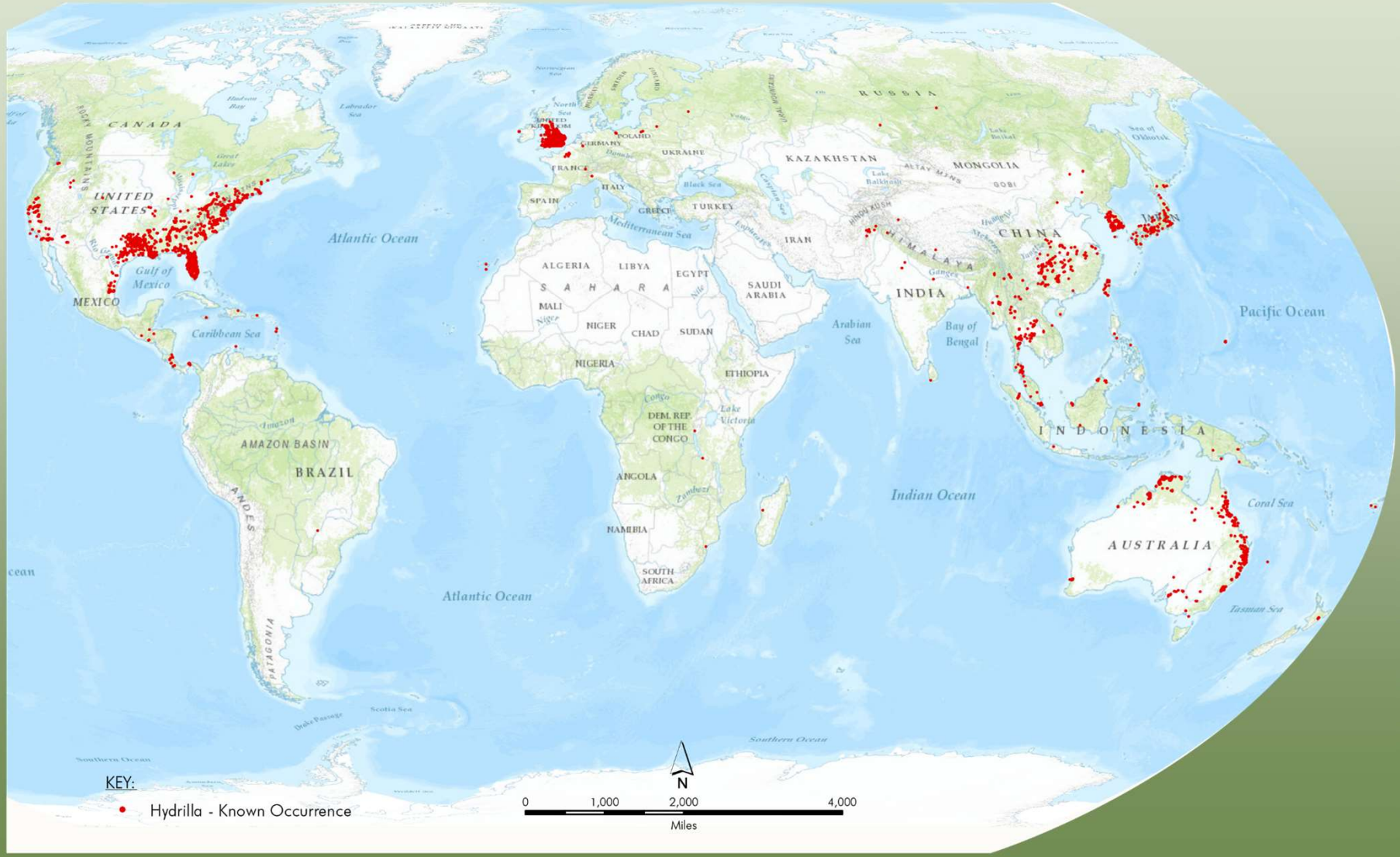
Conceptual Site Model Illustrating Potential Means of Hydrilla Movement in a Typical Great Lakes Environment



Potential Transport Mechanisms

1. Recreational Watercraft Movement
2. Water flow
3. Dredge Spoils Disposal (with Hydrilla Tubers)
4. Intentional Release (Aquarium Disposal)
5. Waterfowl Movement

Hydrilla Locations from Assembled Hydrilla Occurrence Database



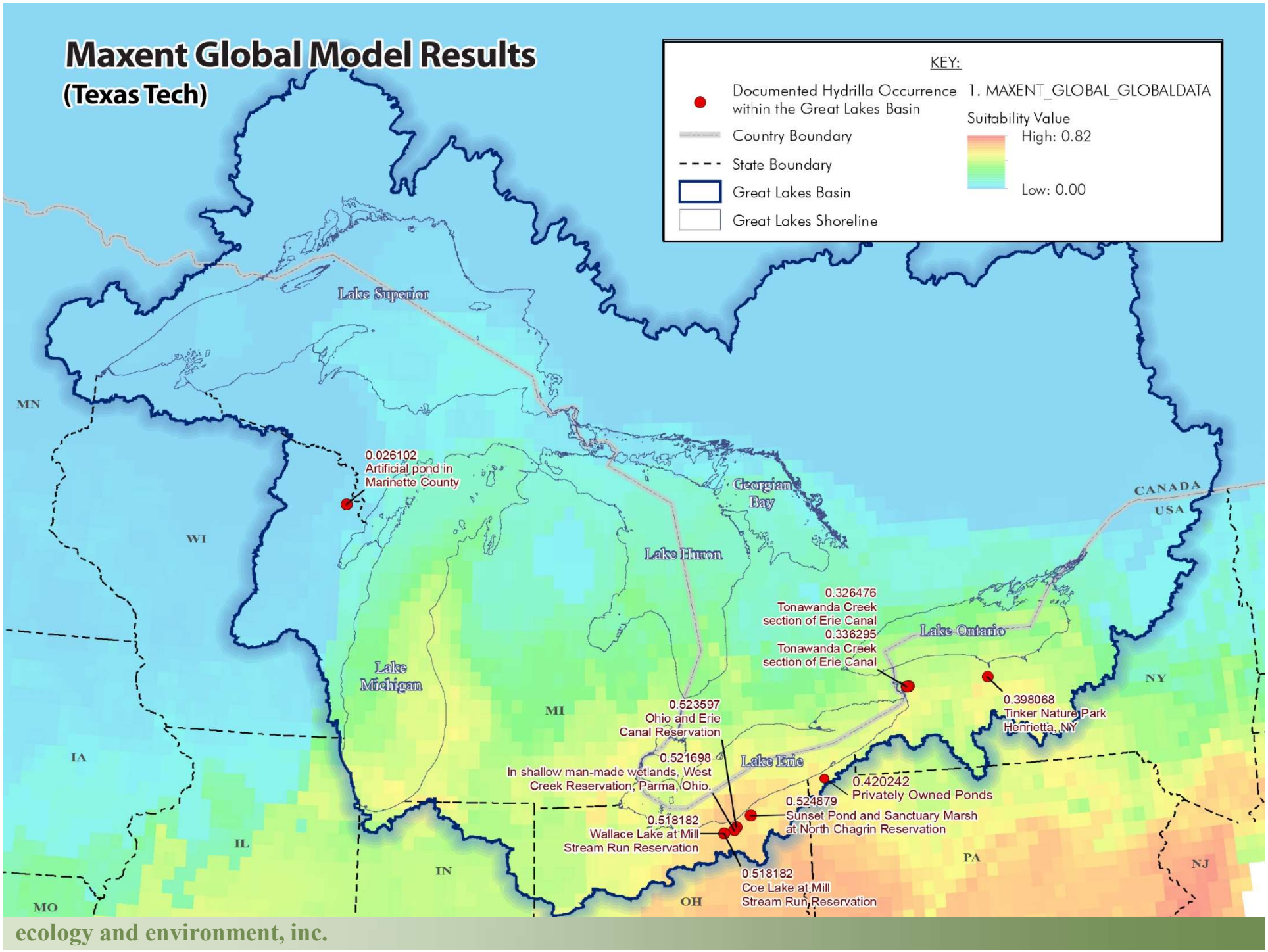
Distributional Modeling

Distributional modeling is used to understand and predict habitat suitability for an invasive species.

The primary question that distributional modeling is used to answer is: **Can the site support a self-sustaining population?**

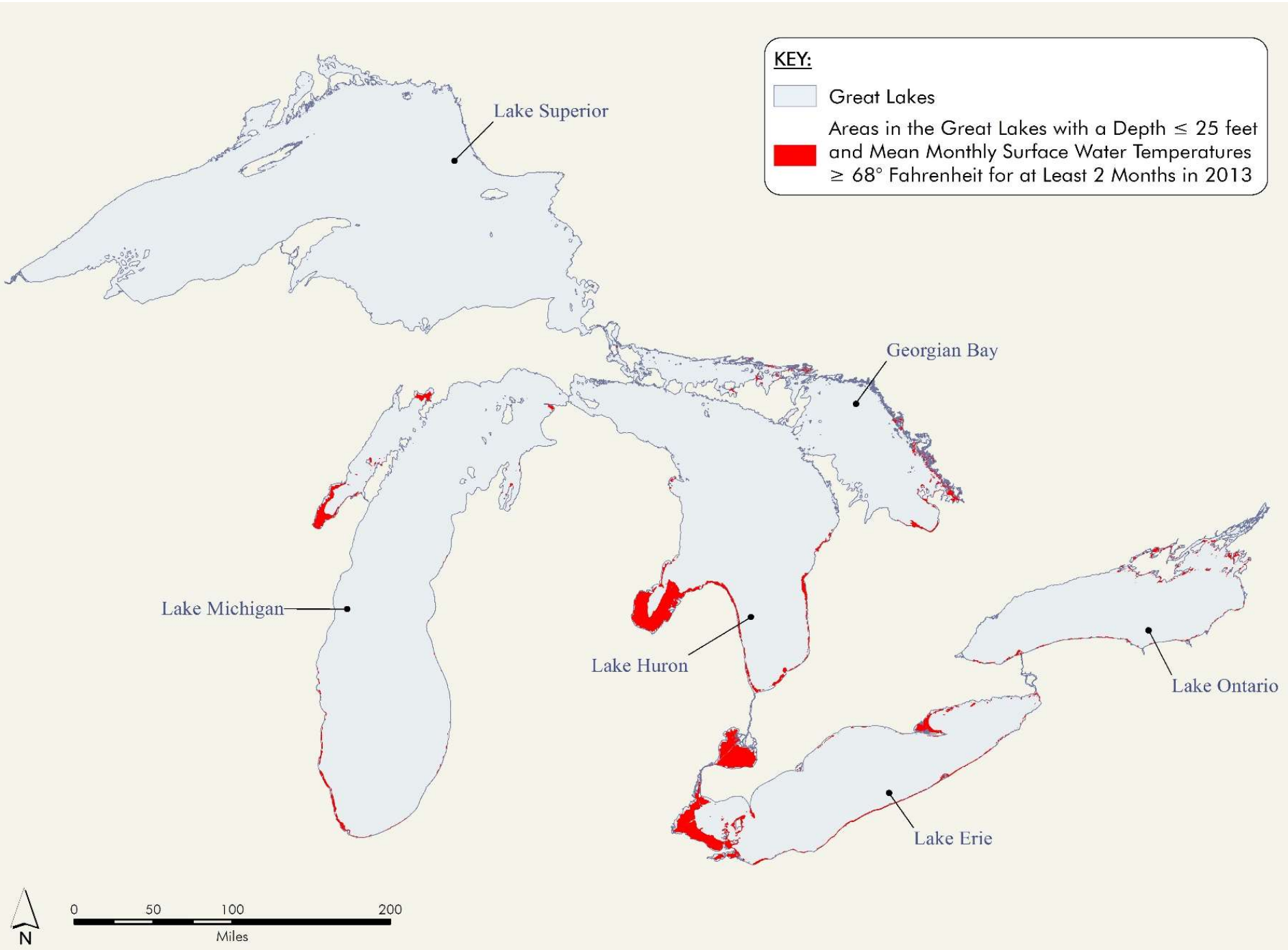
Done by Texas Tech University (S. Soto and M. Barnes):

- Main inputs are Hydrilla occurrence database and atmospheric temperature data (Bioclim layers 1 to 11)
- Maxent and Maxlike models used
- Models created using global and NA only Hydrilla occurrences
- Models created with Hydrilla occurrences partitioned by biotype
- Selected Maxent global model results


Maxent Global Model Results
(Texas Tech)
KEY:
Documented Hydrilla Occurrence within the Great Lakes Basin
Country Boundary
State Boundary
Great Lakes Basin
Great Lakes Shoreline
1. MAXENT_GLOBAL_GLOBALDATA
Suitability Value
High: 0.82
Low: 0.00
Lake Superior
MN
WI
MI
IA
IL
IN
OH
MO
PA
NY
NJ
CANADA
USA
Georgian Bay
Lake Huron
Lake Michigan
Lake Ontario
Lake Erie
0.026102
Artificial pond in Marinette County
0.326476
Tonawanda Creek section of Erie Canal
0.336295
Tonawanda Creek section of Erie Canal
0.398068
Tinker Nature Park Henrietta, NY
0.523597
Ohio and Erie Canal Reservation
0.521698
In shallow man-made wetlands, West Creek Reservation, Parma, Ohio.
0.420242
Privately Owned Ponds
0.524879
Sunset Pond and Sanctuary Marsh at North Chagrin Reservation
0.518182
Wallace Lake at Mill Stream Run Reservation
0.518182
Coe Lake at Mill Stream Run Reservation

Habitat Suitability Measures

Measure	Data Source
• Bathymetry/Water depth	GLIN
• Water surface temperature	GLAHF/NOAA GLSEA
• Light penetration	MTRI
• Substrate/Sediment	GLAHF
• Submerged aquatic vegetation	
– Cladophora	MTRI
– Eurasian water-milfoil	EDDMapS
• Wave action	GLAHF


KEY:
Great Lakes
Areas in the Great Lakes with a Depth ≤ 25 feet and Mean Monthly Surface Water Temperatures ≥ 68° Fahrenheit for at Least 2 Months in 2013
Lake Superior
Georgian Bay
Lake Michigan
Lake Huron
Lake Ontario
Lake Erie
N
0
50
100
200
Miles

Dispersal Modeling

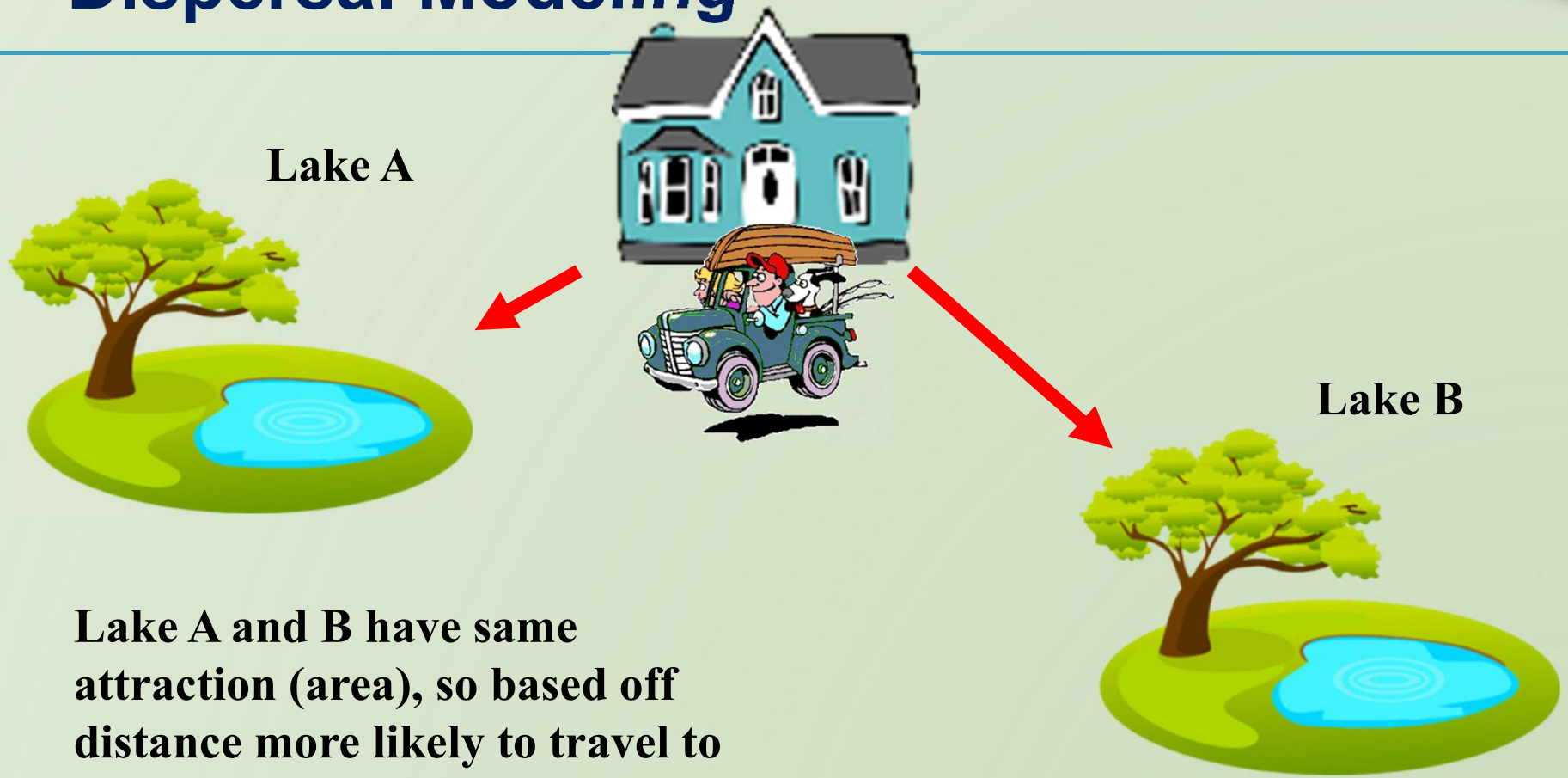
Dispersal modeling is used to understand likelihood of introduction and subsequent dispersal of a species into new habitats.

Primary question: **Can the invasive species get there?**

Done by University of Toledo (K. Hebebrand and J. Bossenbroek):

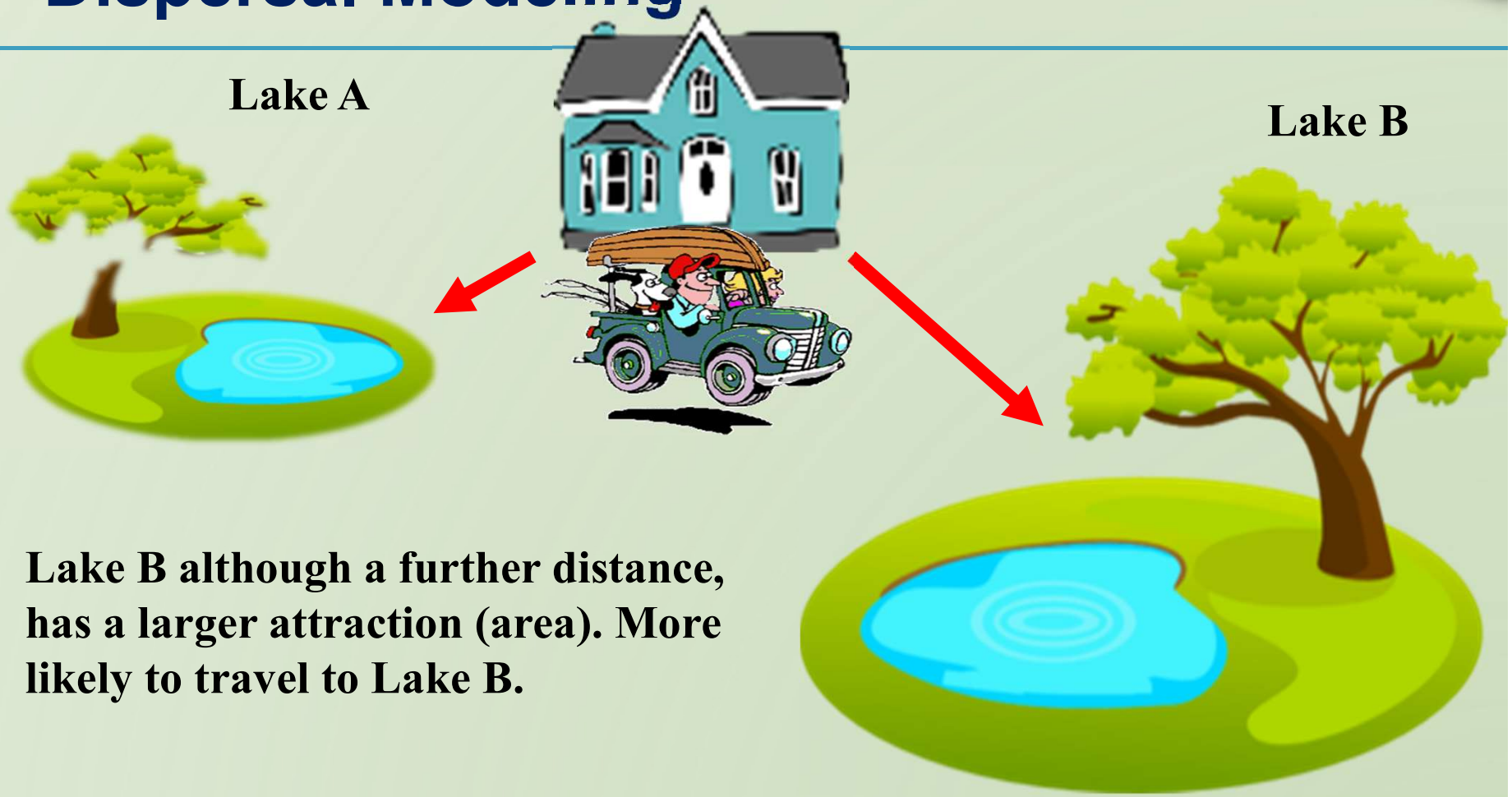
- Gravity model used to predict spread of Hydrilla into and within Great Lakes Basin (GLB) via recreational boats and trailers
- Model built on Hydrologic Unit Codes (HUC) for 210 US watersheds
- Data used included: county boater registration data, watershed boundaries and locations, and known Hydrilla occurrences in the U.S.
- Model estimated waterbody area (ha) and proportion of total water body area within each watershed infested in 2025
- Hydrilla will spread in the U.S. and into the GLB over the next 10 yrs.

Dispersal Modeling



Lake A and B have same attraction (area), so based off distance more likely to travel to Lake A.

Dispersal Modeling



Lake B although a further distance, has a larger attraction (area). More likely to travel to Lake B.

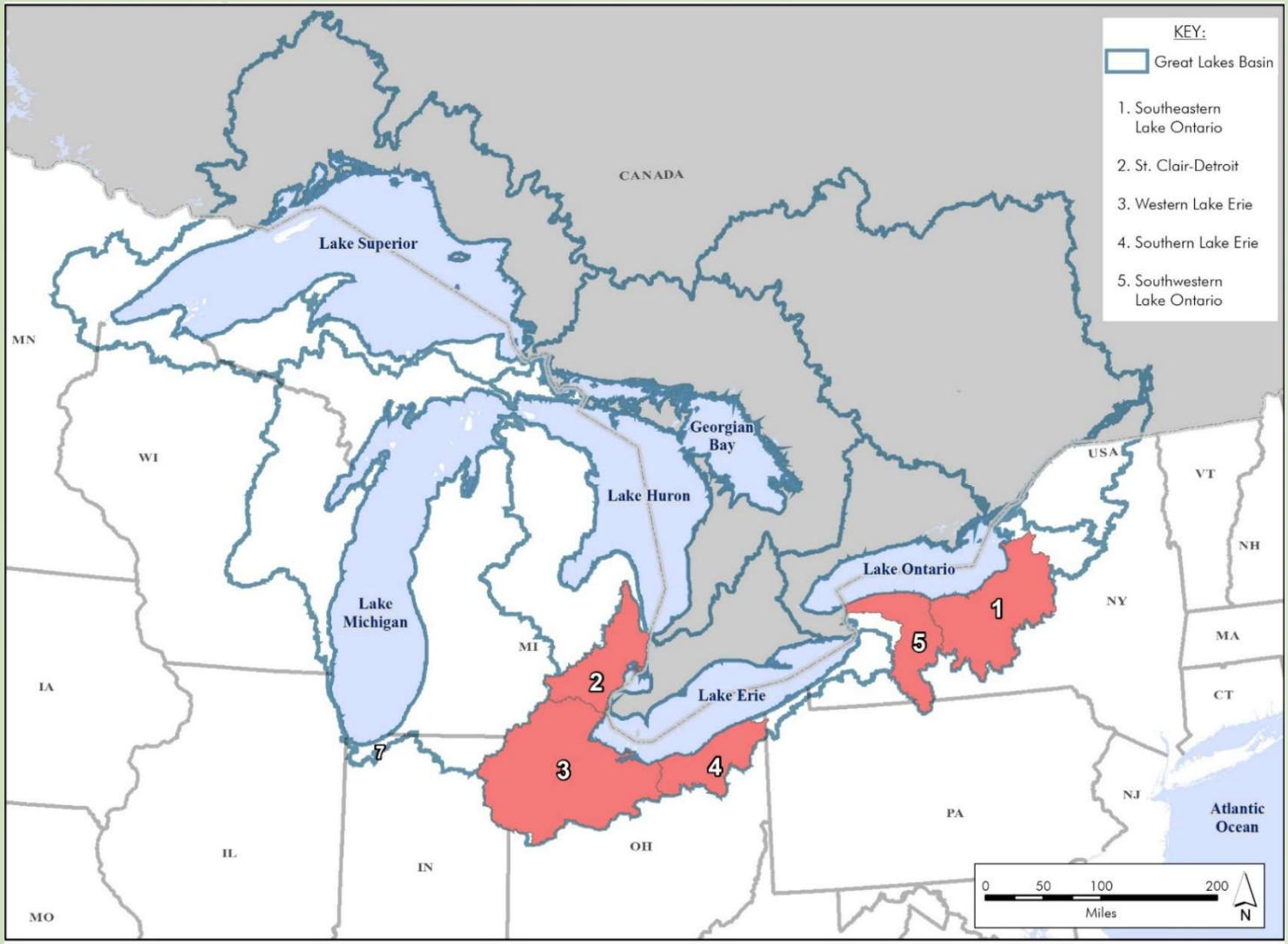
Dispersal Model Results (UT)

Gravity model results for all Great Lakes Basin watersheds ranked on overall proportion future infested area of water to total area of water within that watershed (Hebebrand and Bossenbroek 2017).

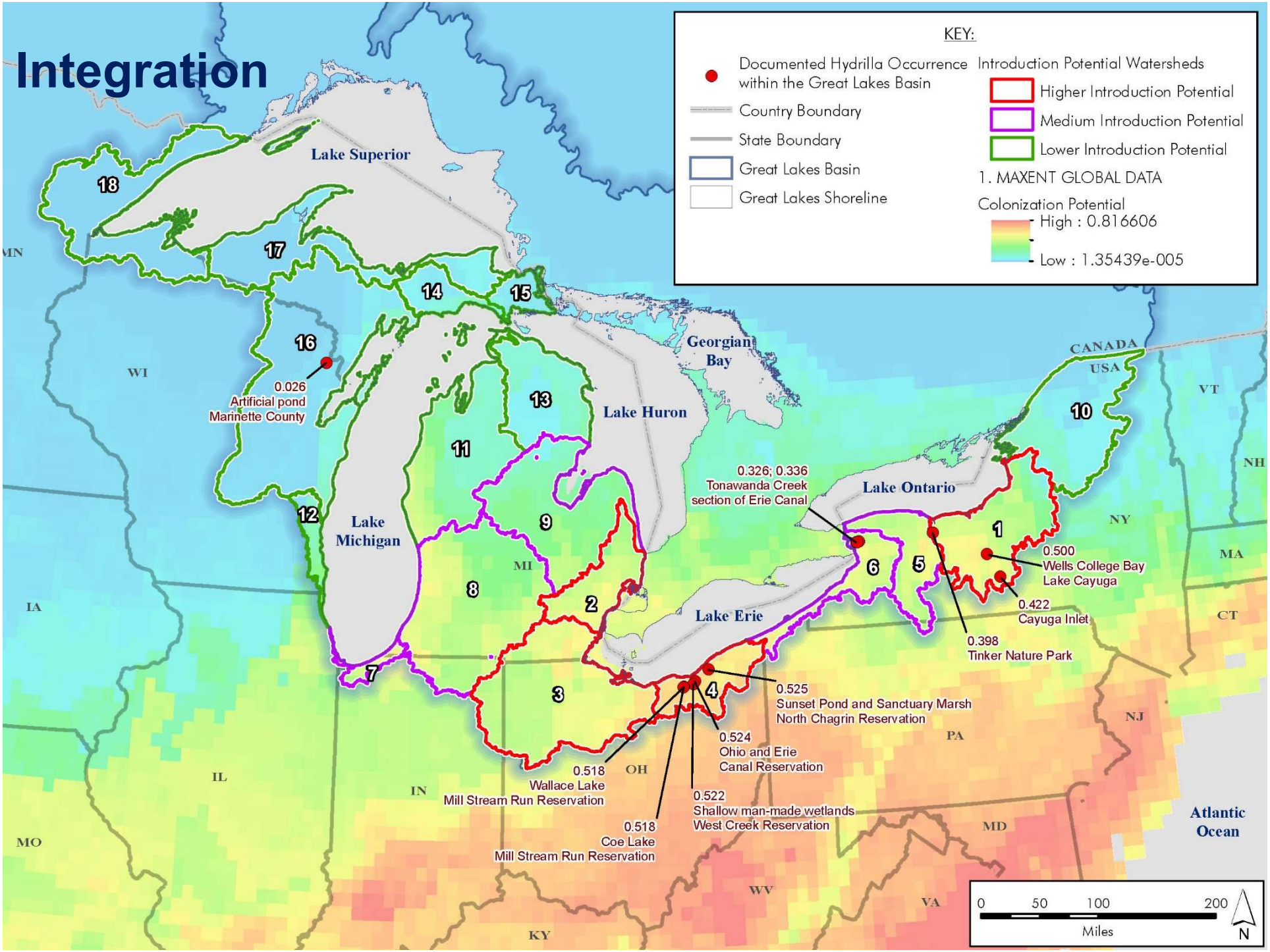
Watershed Name	Current Area (ha) Infested	Current Proportion Infested	2025 Area (ha) Infested	2025 Proportion Infested
1. Southeastern Lake Ontario	17167	0.03	29434	0.0514
2. St. Clair-Detroit	0	0	2755	0.0392
3. Western Lake Erie	0	0	14837	0.0365
4. Southern Lake Erie	15.7	0.00	20879	0.0338
5. Southwestern Lake Ontario	0	0	4369	0.0134
6. Eastern Lake Erie-Lake Erie	0	0	6694	0.0128
7. Southwestern Lake Michigan 2	0	0	5553	0.0099
8. Southeastern Lake Michigan	0	0	8754	0.0088
9. Southwestern Lake Huron- Lake Huron	0	0	843	0.0069
10. Northeastern Lake Ontario- Lake Ontario-St. Lawrence	0	0	508	0.0015
11. Northeastern Lake Michigan- Lake Michigan 2	0	0	313	0.0014
12. Southwestern Lake Michigan 1	0	0	190	0.0009
13. Northwestern Lake Huron 2	0	0	363	0.0004
14. Northeastern Lake Michigan- Lake Michigan 1	0	0	148	0.0002
15. Northwestern Lake Huron 1	0	0	72.6	0.0001
16. Northwestern Lake Michigan	0	0	17.5	0.0001
17. Southern Lake Superior-Lake Superior	0	0	12.5	0.0001
18. Western Lake Superior	0	0	0	0

High Introduction Potential Medium Introduction Potential Low Introduction Potential

Dispersal Model Results: Highest Risk Watersheds



Integration



Risk Characterization

Most vulnerable Great Lakes areas:

- Littoral zone habitats sheltered from excessive wave action (embayments, harbors, etc.) along south shores of Lakes Erie and Ontario and along Lake St. Claire shoreline

Most vulnerable inland areas:

- Inland waterbodies in watersheds bordering Lakes Erie and Ontario in NY, PA, OH and southeast MI
- Inland waterbodies likely more at risk because they are less turbulent, shallower, and warmer that the Great Lakes
- Currently all known Hydrilla infestations in Great Lakes Basin are in inland locations

Potential Impacts: Environmental

- Water Quality / Aquatic Plant Communities
- Fish / Benthos
- Pathogens
- Water Fowl / Wildlife
- Hydrology

Category of Environmental Impact	General Hydrilla Impacts	Potential Great Lakes Basin Resources Impacted by Hydrilla by 2025
Water Quality and Aquatic Plant Communities 	• Thick mats that can block sunlight, resulting in death of vegetation at depth. Dead and dying vegetation falls to the bottom, reducing dissolved oxygen levels which can kill aquatic plants. • Thick mats reduce water movement and mixing, increasing water temperatures near the surface (thermal stratification). • Increases pH levels in the water. • May outcompete other cool-climate submerged aquatic plant species, or may influence them through changes in water quality. A limited amount of hydilla may: • Improve water quality in waterbodies with little or no existing vegetation or with high nutrients	• 236,000 acres of waterbodies infested • 3,200 acres of coastal wetlands infested
Fisheries and Benthic Macroinvertebrates[1] 	At higher densities: • Dense canopies degrade water quality (lower levels of dissolved oxygen, increase in temperatures and pH) which limits reproduction or leads to death of fish. • Excessive hydrilla coverage may confine certain fish species to limited areas resulting in increased competition and decreased spawning success. At limited densities: • Limited hydrilla coverage provides food for fish and benthic macroinvertebrates as well as habitat by providing structure within water column and places to hide from predators.	• 804 fish spawning and nursery locations identified through the Atlas of the Spawning and Nursery Areas of the Great Lakes susceptible to introduction and establishment
Pathogens 	• Hydrilla leaves are a host for a cyanobacterium (pathogen) that causes avian vacuolar myelinopathy (AVM), a fatal disease in bald eagles, when eaten by the birds.	N/A
Waterfowl and Wildlife 	• Hydrilla can serve as a food source and appears safe for consumption by fish and wildlife; benefits may be highest where no native vegetation exists. • Hydrilla my exclude native vegetation communities and degrade water quality, negatively impacting habitat for waterfowl and wildlife.	• Approximately 1,900 acres of National Wildlife Refuge habitat infested • Approximately 80,000 acres of Important Bird Areas with prominent aquatic habitat infested
Hydrology 	• Hydrilla can reduce the flow of water, leading rising water levels and flooding.	N/A

[1] Literature on impacts of hydrilla on aquatic organisms reflects a mixed review regarding whether hydrilla is beneficial or harmful. The type of impact on fish populations depends on factors like presence of existing vegetation, size of the waterbody, and scale and density of the infestation.

Potential Impacts: Cultural/Social and Tribal

Cultural / Social

- Natural Shoreline Features
- Water-Dependent & Water-Related Features & Uses
- Impacts on Community Perception & Character

Tribal

- Aquatic Resources (e.g. wild rice)

Potential Impacts: Economic

Minimum and Maximum Estimated Annual Economic Loss Associated with the Establishment of Hydrilla in the Great Lakes

Resource Affected	Minimum Estimated Annual Economic Loss	Maximum Estimated Annual Economic Loss
Recreational Fishing/Angling	$(29,574,008)[1]	$34,814,477
Beach Use	$10,348,000	$31,206,000
Recreational Boating	$87,344,800	$422,887,200
Commercial Navigation/Dredging	$2,277,000	$9,776,250
Water Supply	not estimated	not estimated
Total	$70,395,792	$498,683,927

Notes: [1]This value is positive.

*Economic losses associated with impacts on the uses above are expected to be between **$70 million and $500 million** annually if Hydrilla becomes established in the Great Lakes.*

Risk Management: Recommendations

Prevention	Detection	Rapid Response
Develop public information/awareness campaign – what is Hydrilla, how to identify, and threats	Prioritize visual monitoring at boat ramps/launches and inlets without Hydrilla, popular recreational waterbodies and marinas, and waters with depths <25’	Focus response on use of contact herbicide
Signage at access points	Develop specific process for reporting sightings of Hydrilla with agency verification	Advocate that state agencies develop streamlined process for rapid response upon detection
Watercraft inspection at access points in high risk areas	Focus monitoring near existing infestations, especially on invasion points	

Risk Management: BMPs

Hydrilla Prevention BMPs:

- Develop a public information campaign to educate the public, specifically recreational water users, on what Hydrilla is, how to identify it, and the threat it poses.
- Develop a targeted educational campaign for angler groups focused on prevention, including impacts of Hydrilla on sport fishing and need to be proactive in prevention.
- Post signage at all access points and implement watercraft inspections at areas of high traffic or at highest use boat ramps within priority public waterbodies.
- For coastal wetland restoration projects within the littoral zones of the Great Lakes, include specific requirements for pre-construction screening of fill material and post-construction monitoring of invasive species, including Hydrilla, in project plans and specs.

Risk Management: BMPs

Early Detection BMPs:

- Train professionals to detect Hydrilla early. Provide information on who to contact if Hydrilla is found, or a plant is suspected to be Hydrilla.
- Develop a specific process for people to report sightings/presence of Hydrilla, including agency verification.
- Visual monitoring should prioritize (a) boat ramps/launches and inlets in waterbodies without existing infestations, (b) popular recreational waterbodies and embayments with marinas, and (c) waters with depths < 25 feet.
- Focus monitoring efforts on areas near existing infestations, using a bathymetric map or transects prioritized by likely invasion points or potentially threatened resources.
- Include signage at boat ramps to help aid early detection and provide outreach to lake associations, lake user groups, and marina owners; content should include how to report Hydrilla or plants suspected to be Hydrilla.

Risk Management: BMPs

Hydrilla Management BMPs – General:

- Conduct surveys when water temperatures reach 62.6°F for at least 2 weeks
- Conduct pre-treatment plant surveys beginning in mid-July to inform annual treatment plan
- Employ chemical treatment after tubers have sprouted (late June to July) but prior to formation of new ones (late August to November)
- Use bathymetric data to determine water volume, to inform efficient and cost-effective application
- Provide herbicide applicators with GIS shapefiles of treatment areas

Risk Management: BMPs EK18

Hydrilla Management BMPs – Treatment:

Rapid Response

- Focus response efforts on use of contact herbicide
- Advocate that state agencies develop a streamlined process that facilitates rapid response upon detection

Long-Term Control of Patches

- Apply contact herbicides at maximum label rates and limit public access in treatment areas
- Use benthic mats on very small patches in shallow, low-velocity water
- Use limnocorrals to isolate Hydrilla beds for direct herbicide application

Slide 28

EK18 This is a new slide to better mirror final RA content.
Evans, Kathleen, 5/3/2019

Risk Management: BMPs

Monitoring BMPs:

For all control projects, annual monitoring is critical to assess rate of plant expansion, inform the treatment plan, and evaluate the efficacy of a treatment plan.

- Assess tuber presence and density through annual fall tuber sampling
- Assess plant species diversity and abundance through annual rake-toss data from pre- and post-treatment surveys

Stakeholder Outreach

- Identified over 65 agencies, organizations, and tribes in the Great Lakes Basin with interest in aquatic invasive species and their impacts.
- Conducted interviews with 20+ resource managers, agency leads, and outreach leaders representing Great Lakes states and other states with Hydrilla history.
- Information shared with stakeholders during development on the risk assessment by distributing project factsheet and reports, presentations, and websites (e.g., http://hydrillacollaborative.com).

Key Takeaways

- ***Effective outreach and coordination are critical in communicating the threat of Hydrilla.*** We need your help to support dissemination of project recommendations and BMPs regarding Hydrilla, especially in the highest risk watersheds.
- **Highest risk watersheds:**
  - Southeastern Lake Ontario
  - St. Clair-Detroit
  - Western Lake Erie
  - Southern Lake Erie
  - Southwestern Lake Ontario
- Any costs spent to prevent the spread of hydrilla into the Great Lakes Basin or to eradicate hydrilla before it becomes established in the Great Lakes Basin ***would be more than offset by the economic losses avoided***.

Thank You

For more information contact:

- **Kris Erickson – kerickson@ene.com**
- **Michael Greer – michael.j.greer@usace.army.mil**

Project Team

Great Lakes RESTORATION

ecology and environment, inc.
Global Environmental Specialists

US Army Corps of Engineers®

ERDC
ENGINEER RESEARCH & DEVELOPMENT CENTER

NC STATE UNIVERSITY

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