Development of an Aquatic Invasive Species surveillance plan for the U.S. waters of the Laurentian Great Lakes

State and federal collaboration to develop a plan to guide future surveillance across the region.

- GLRI project – funded by USFWS (Mike Hoff)
- led by MDEQ (Sarah Le Sage)
- Contracted TNC to facilitate to and provide technical support

<u>Management Core Team</u>

State Agencies, and USFWS.

Provinces – active observers

<u>Technical Advisory Team</u>

USEPA, USFWS, Wayne State University, University of Toledo

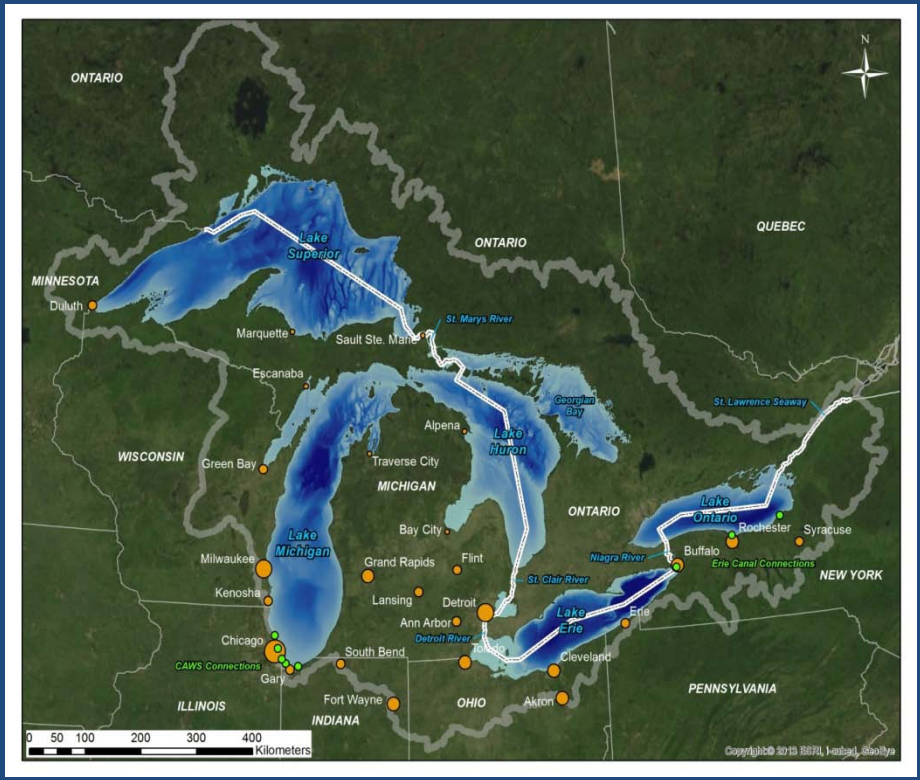
Governance

- Written commitment from all States to actively participate
- Informal governance structure - operate by consensus
- Operate by face to face meetings, webinar and comments on written material
- Envision a living document – that will be updated
- Guiding document – sets out a plan rather formal commitment – scale of any surveillance effort will be resource dependent – by negotiation

Laurentian Great Lakes

Scope:

- US waters of Great Lakes, connecting channels and tributaries up to first barrier
- Plants and animals (fish and invertebrates)



The Draft Plan!

Plan comprised

- Species watchlist
  - Inform surveillance methods and sampling design
  - Site selection – (pathway weighting)
- Site selection,
- Sampling design, sampling methods,
- Information Management and Planning

Species Watch list

Based on GLANSIS watch list (67 Species)

Number of species in each taxonomic group with high or moderate impact ratings.

Taxa (no. spp.)	Environmental (unknown)	Socio-economic (unknown)
Fish (27)	17 (10)	6 (3)
Annelid (1)	0 (0)	0 (0)
Rotifer (3)	0 (2)	0 (0)
Bryozoan (1)	1 (0)	1 (0)
Platyhelminthes (1)	0 (1)	0 (1)
Crustacean (24)	11 (11)	0 (0)
Mollusk (2)	1 (1)	1 (0)
Plants (8)	8 (0)	8 (0)

Impact rankings for some species were unknown (indicated in parentheses).

Additional species

Localized NAS species

- Twenty five localized NAS
- plants (n = 15). Fish (n = 3), algae (n = 2), mollusks (n = 1), crustaceans (n = 1), and Platyhelminthes (n = 1)

Additional watch list species (104 species)

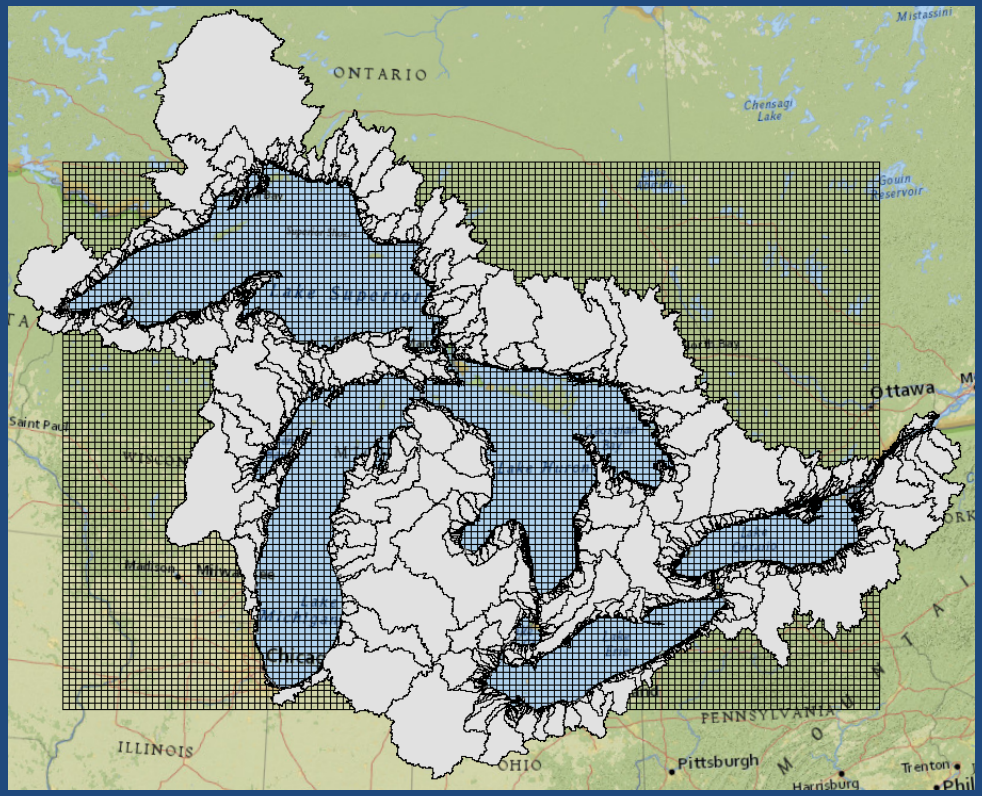
- Species identified by one or more risk assessments as potential threats to the Great Lakes Basin
  - USFWS ERSS, Annex 6, DFO assessments, Erie Canal Risk Assessment, GL Least Wanted List, GLMRIS
    - 56 species : 24 plants, 10 mollusk, 14 fish, 3 crustaceans
- Regulated Species probably not assessed by GLANSIS
    - 48 species: 38 plants, 6 fish, 2 algae, 1 crustacean, 1 crayfish

- These species currently being assessed

Site Prioritization System

- 10km^2 grid squares – using GLAHF framework
- 8,758 10 km^2 grid squares in the U.S. waters and tributaries up to the first barrier
- 2,744 coastal grid squares

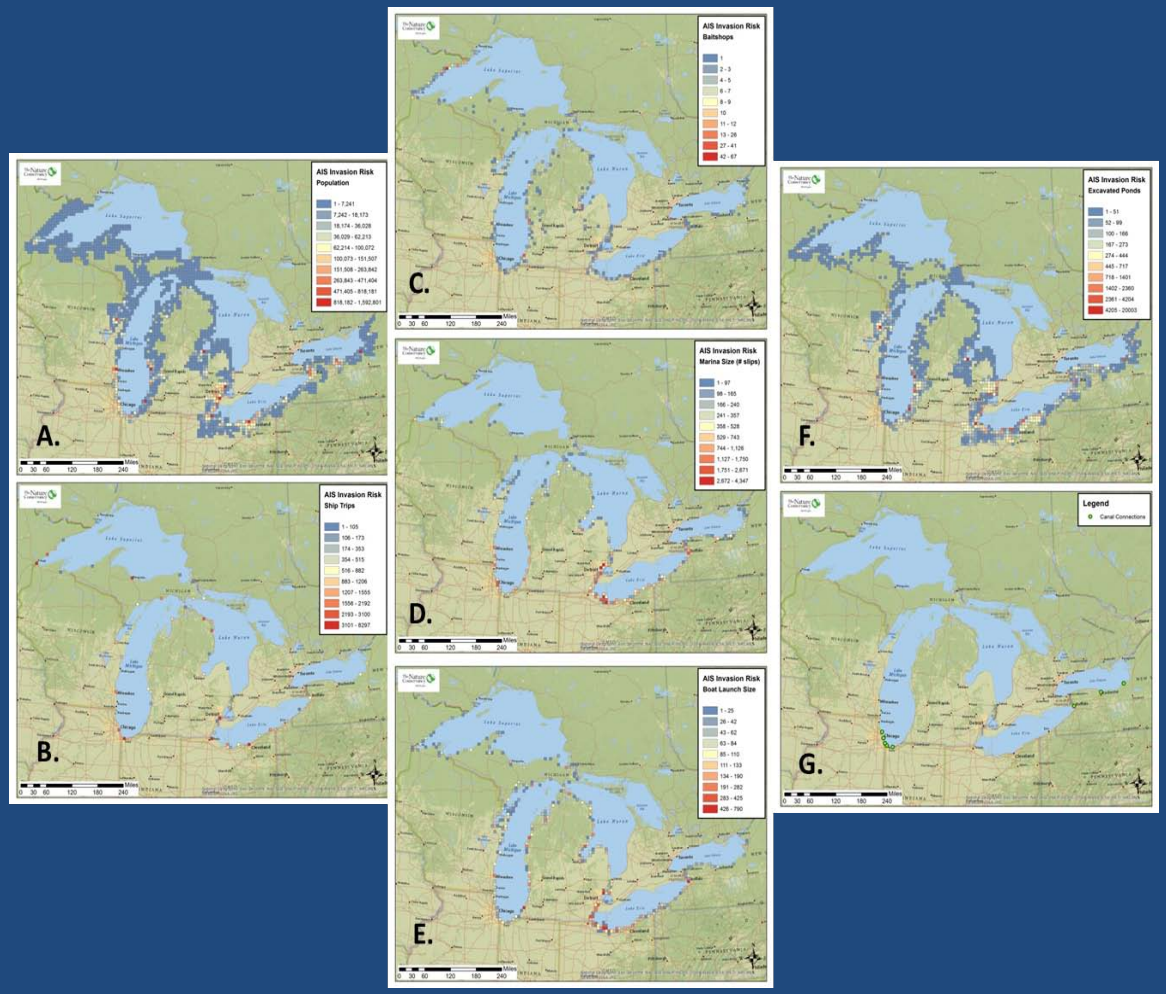
(shoreline & tributaries).



GLAHF
Great Lakes Aquatic Habitat Framework

Surrogate variables for invasion pathways

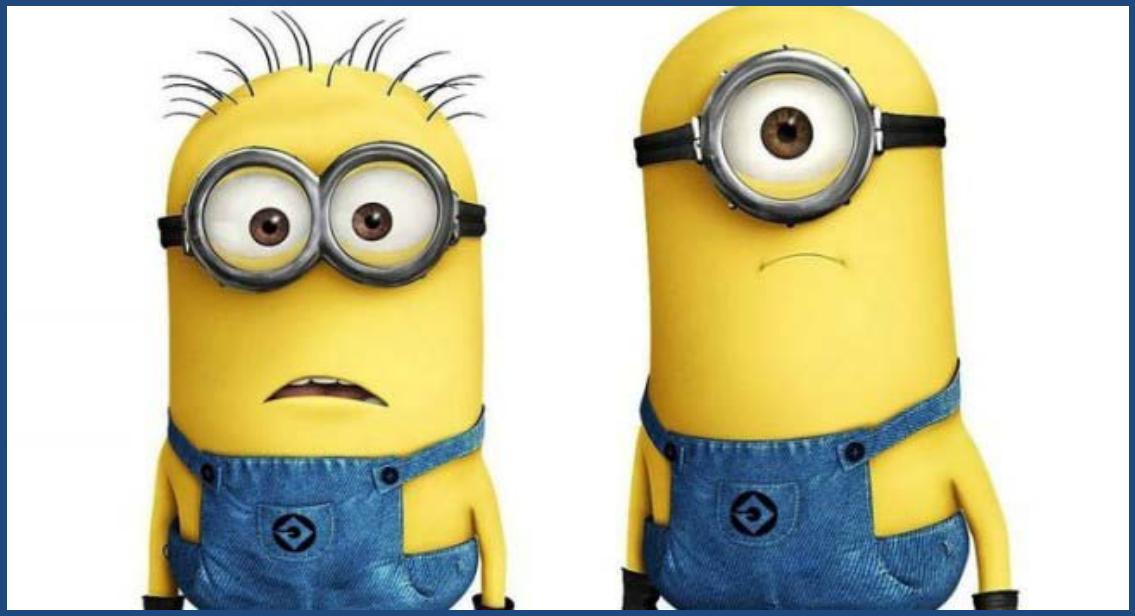
A. Population
B. Ship visits
C. Bait shops
D. Marina size
E. Boat launch size
F. Excavated ponds
G. Canals



Surrogates selected: Data available across all US states – best available surrogates
About 1,500 grid squares have attributes resulting in index scores greater than zero.

The challenge!

How to combine multiple pathways to predict invasion risk?

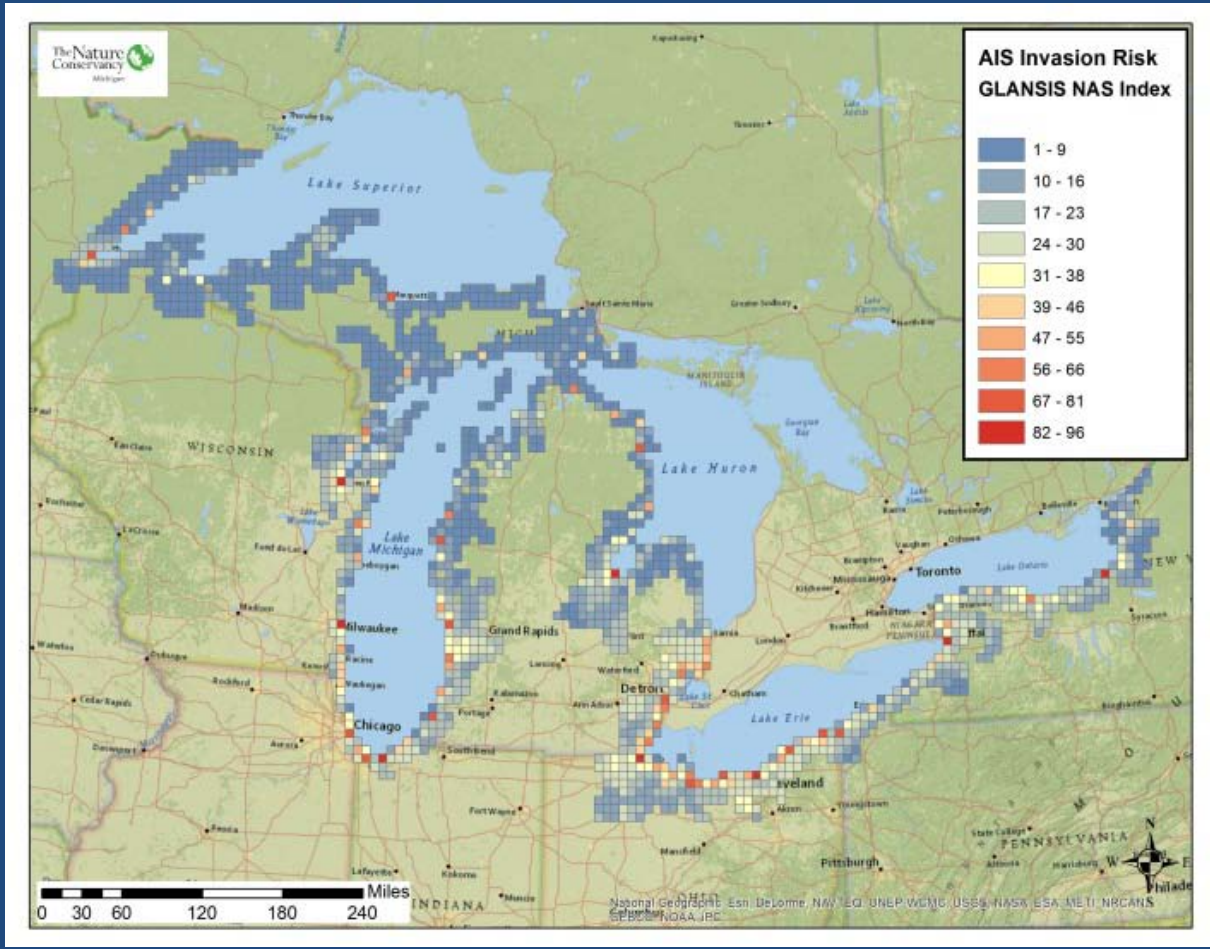


Multiple potential approaches

- Unweighted model – just add everything together –assume equal risk across all pathways, risk is cumulative (additive)
- Historic patterns – as a predictor of future patterns
  - Great Lakes Scale role each pathway has played in primary introduction into Great Lakes
  - BRT model relating surrogates to USGS NAS distribution data (how well do surrogates explain local patterns of introduction)
- Predicted future invaders (watch list)
- Some combination of above

Established species index:

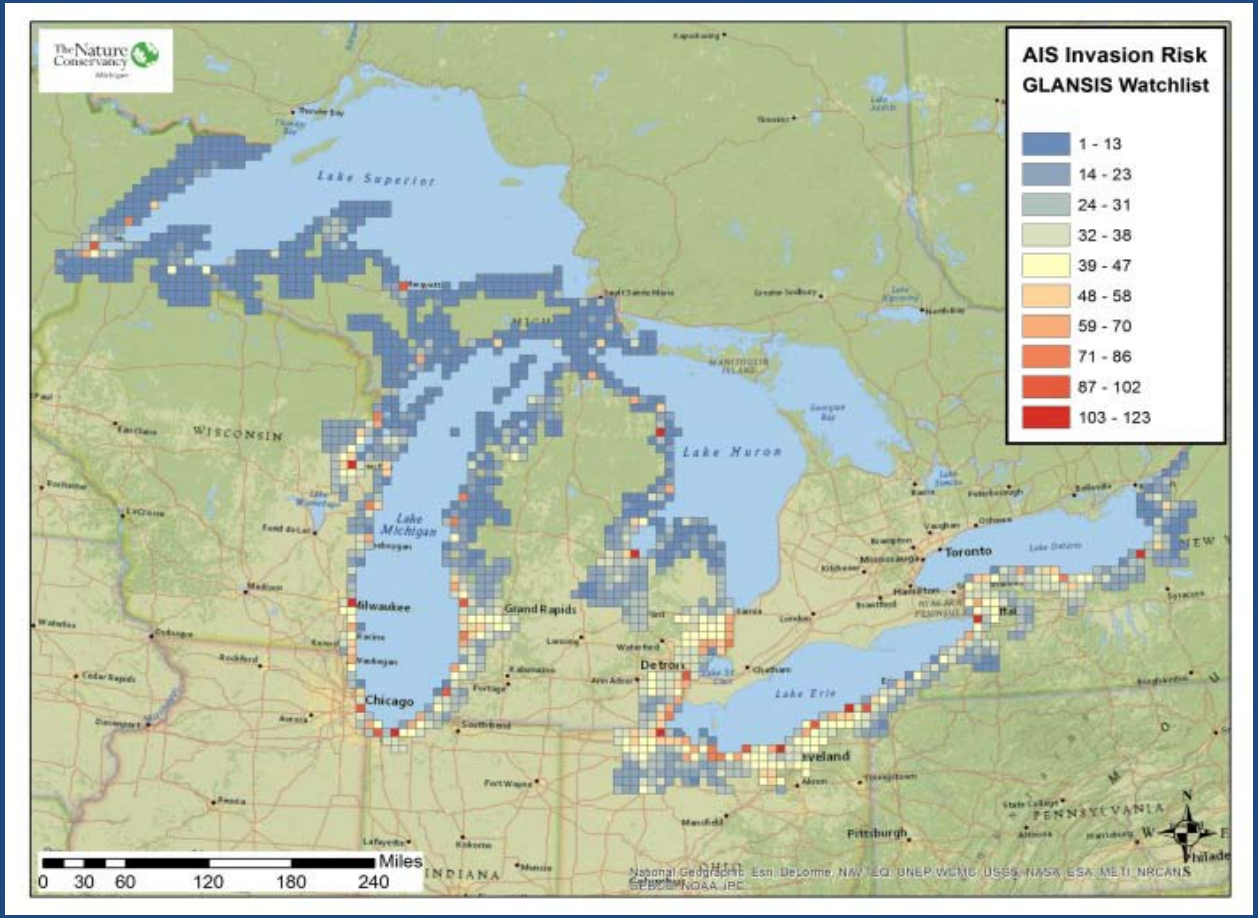
Spatial surrogates	weighting
U.S. Population (2013)	0.21
Shipping vessel trips to port (2004–2013)	0.44
Bait shops (2012 & 2013)	0.22
Marina size (# of boat slips)	
Boat launch size (# of parking spaces)	
Ponds	0.2
Canals	0.11



- Pathway of introduction assigned for every established NAS
- Pathway weightings derived from relative proportion of all NAS in each pathway.

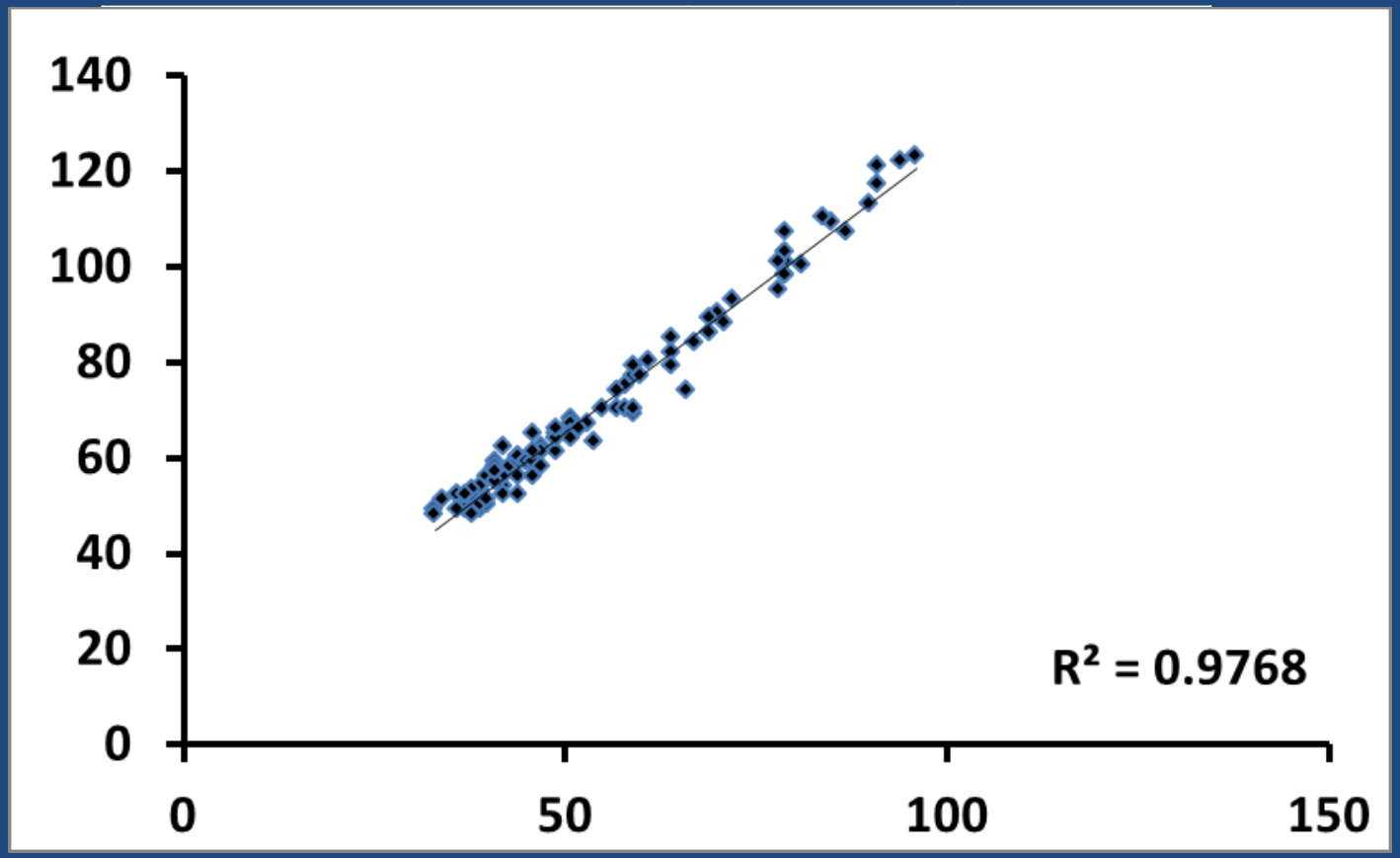
GLANSIS watch list index

Spatial surrogates	Weighting
U.S. Population (2013)	0.31
Shipping vessel trips (2004–2013)	**0.58**
Bait shops (2012 & 2013)	**0.12**
Marina size	
Boat launch size	
Ponds	0.31
Canals	0.15

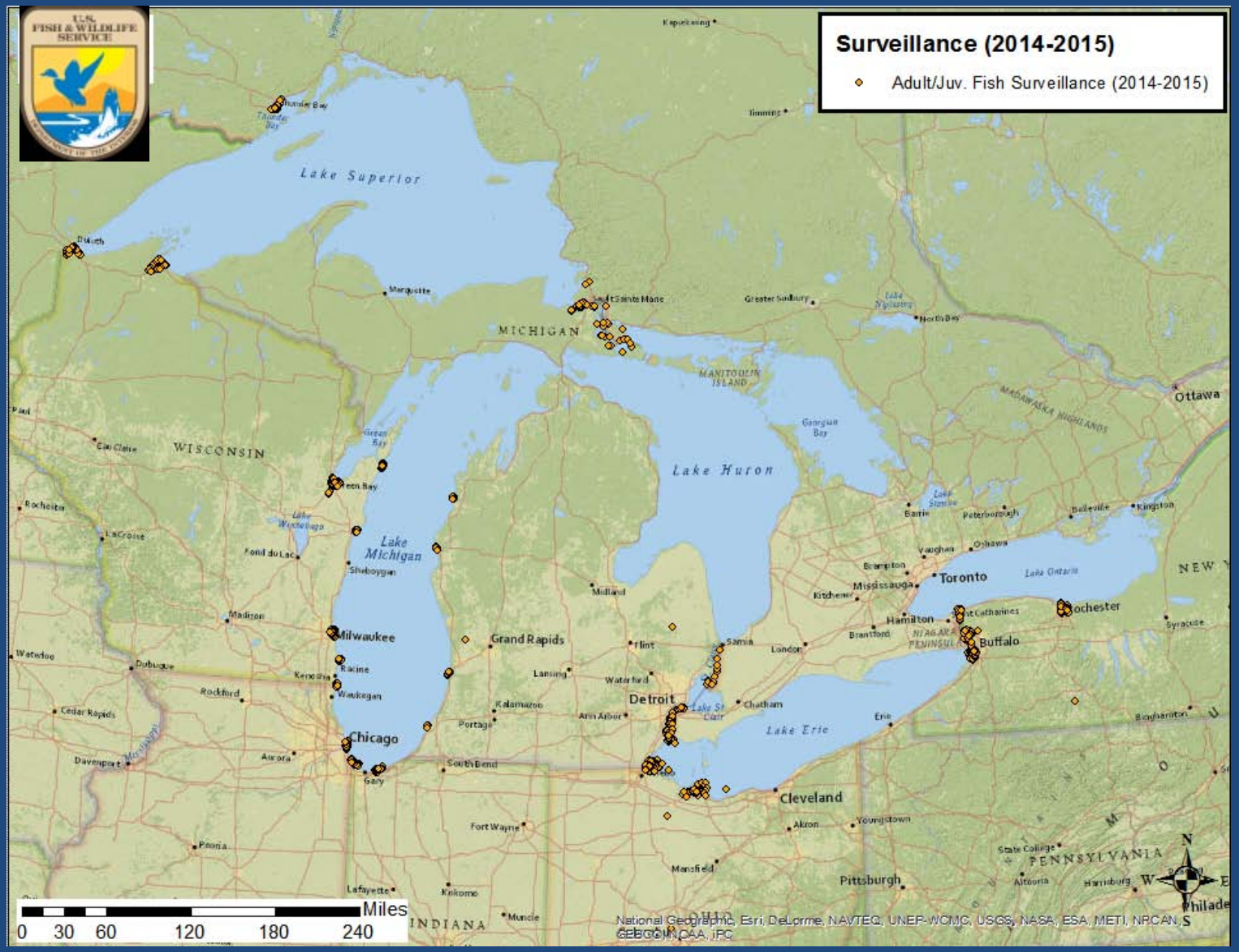


- **P**athway of introduction assigned for every species on watch list
- Pathway weights derived based on relative proportion of all watch list species assigned to each pathway.

Index scores: Established NAS vs Watch list (Top 100 sites only)



Existing Surveillance Efforts
USFWS – fish (2014, 2015)



Optimizing Surveillance Effort

Assuming finite resources:

- There is a cost to sampling areas of low risk
- Ideally sampling effort at areas of high risk meets some minimum detection threshold
- There is an opportunity cost to over sampling areas of high risk

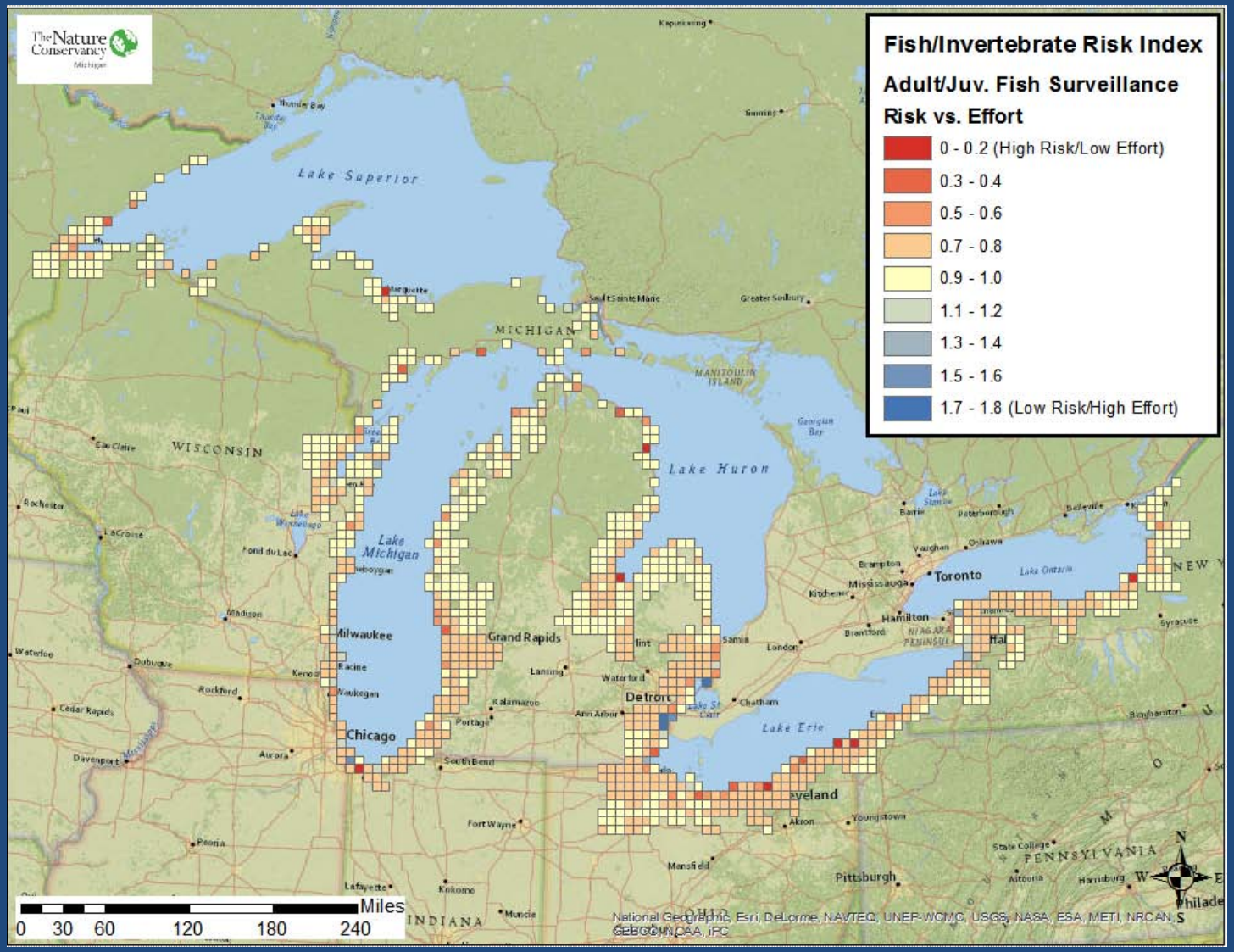
Subtract effort from risk to identify future priorities

Low Risk w. High Effort

		Effort									
		1.1	**1.2**	**1.3**	**1.4**	**1.5**	**1.6**	**1.7**	**1.8**	**1.9**	**2**
Risk	**0.1**	1	1.1	1.2	1.3	1.4	1.5	1.6	1.7	1.8	1.9
	0.2	0.9	1	1.1	1.2	1.3	1.4	1.5	1.6	1.7	1.8
	0.3	0.8	0.9	1	1.1	1.2	1.3	1.4	1.5	1.6	1.7
	0.4	0.7	0.8	0.9	1	1.1	1.2	1.3	1.4	1.5	1.6
	0.5	0.6	0.7	0.8	0.9	1	1.1	1.2	1.3	1.4	1.5
	0.6	0.5	0.6	0.7	0.8	0.9	1	1.1	1.2	1.3	1.4
	0.7	0.4	0.5	0.6	0.7	0.8	0.9	1	1.1	1.2	1.3
	0.8	0.3	0.4	0.5	0.6	0.7	0.8	0.9	1	1.1	1.2
	0.9	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9	1	1.1
	1	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9	1

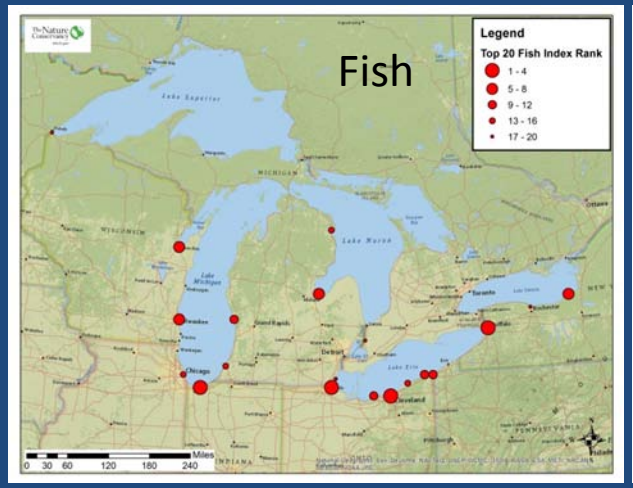
High Risk w. Low Effort

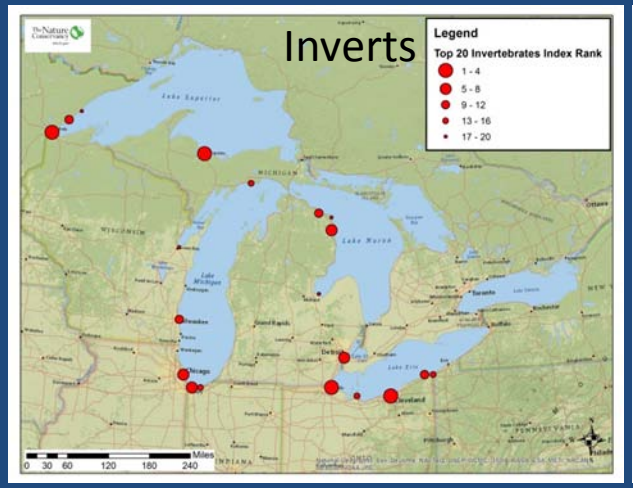
Optimizing sampling effort

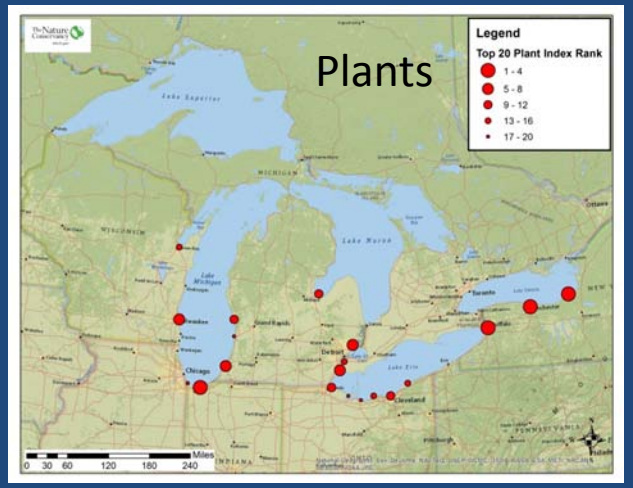


Next steps

- Site vulnerability
- Site Suitability
- Update watch list – and site prioritization functions
- Average of NAS and GLANSIS
- Weight pathways by cumulative risk versus species richness
- All species model versus fish, invert, plants or some combination of these (e.g. USFWS fish/invert)







The end! Questions?

- GLRI project – funded by USFWS – led by MDEQ
- Sarah Le Sage, Mike Hoff,

<u>Science collaborators</u>

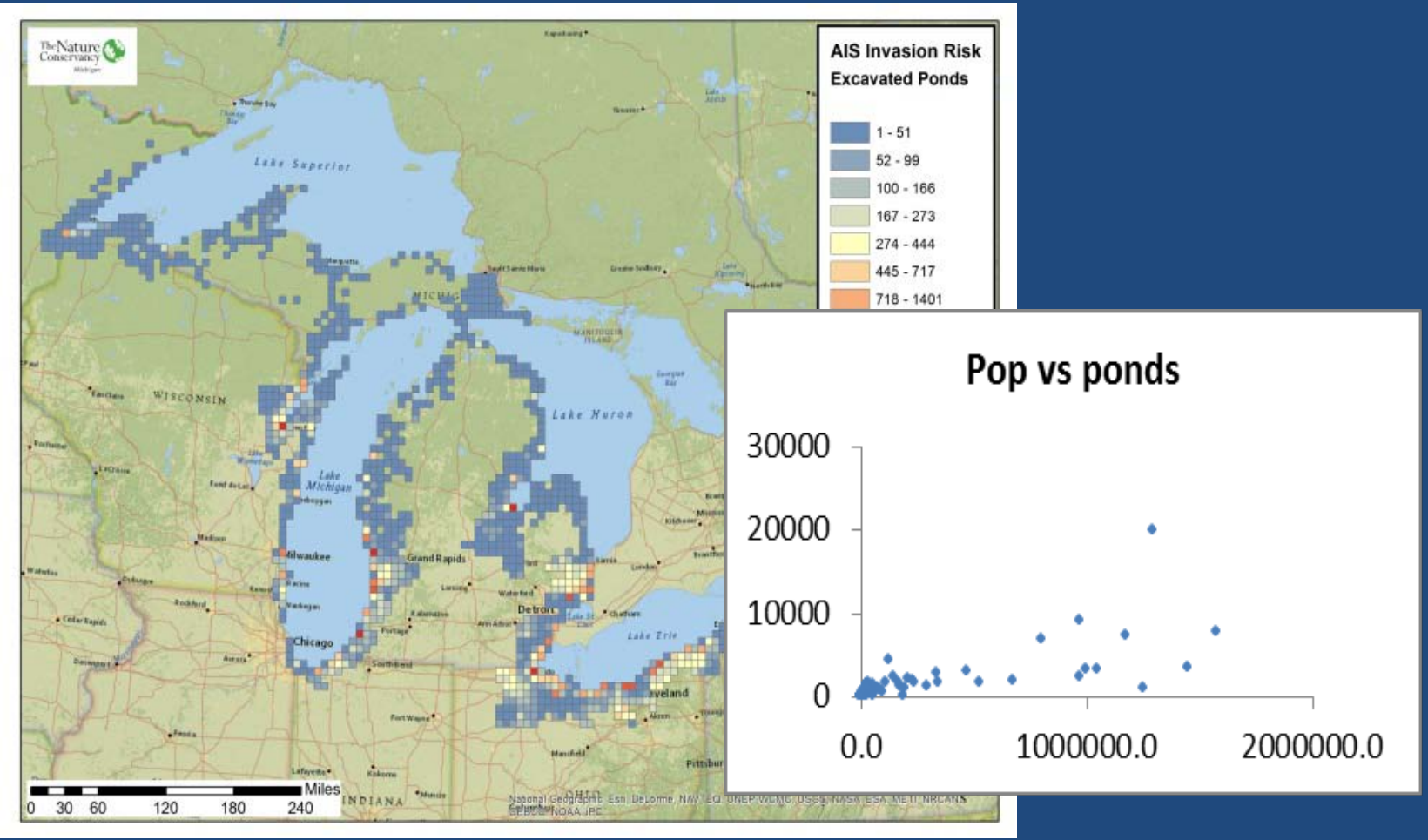
Andrew Tucker, Gust Annis, Joel Hoffman, Anette Trebitz, Tim Strakosh, Stephen Hensler,, Donna Kashian, Alisha Davidson, Jon Bossenbroek, Erica Jensen, Lindsay Chadderton

<u>Management collaborators</u>

John Navarro, Robert Wakeman, Nick Popoff, Kevin Irons, Vic Santucci, Eric Fischer, Jim Grazio, Kelly Pennington, Cathy McGlyn, Sandra Keppner, Francine MacDonald, Tim Johnson, Robert Haltner Darin Simpkins, Josh Schloesser, Maureen Ferry, Mark Brouder

GLEC

Ponds

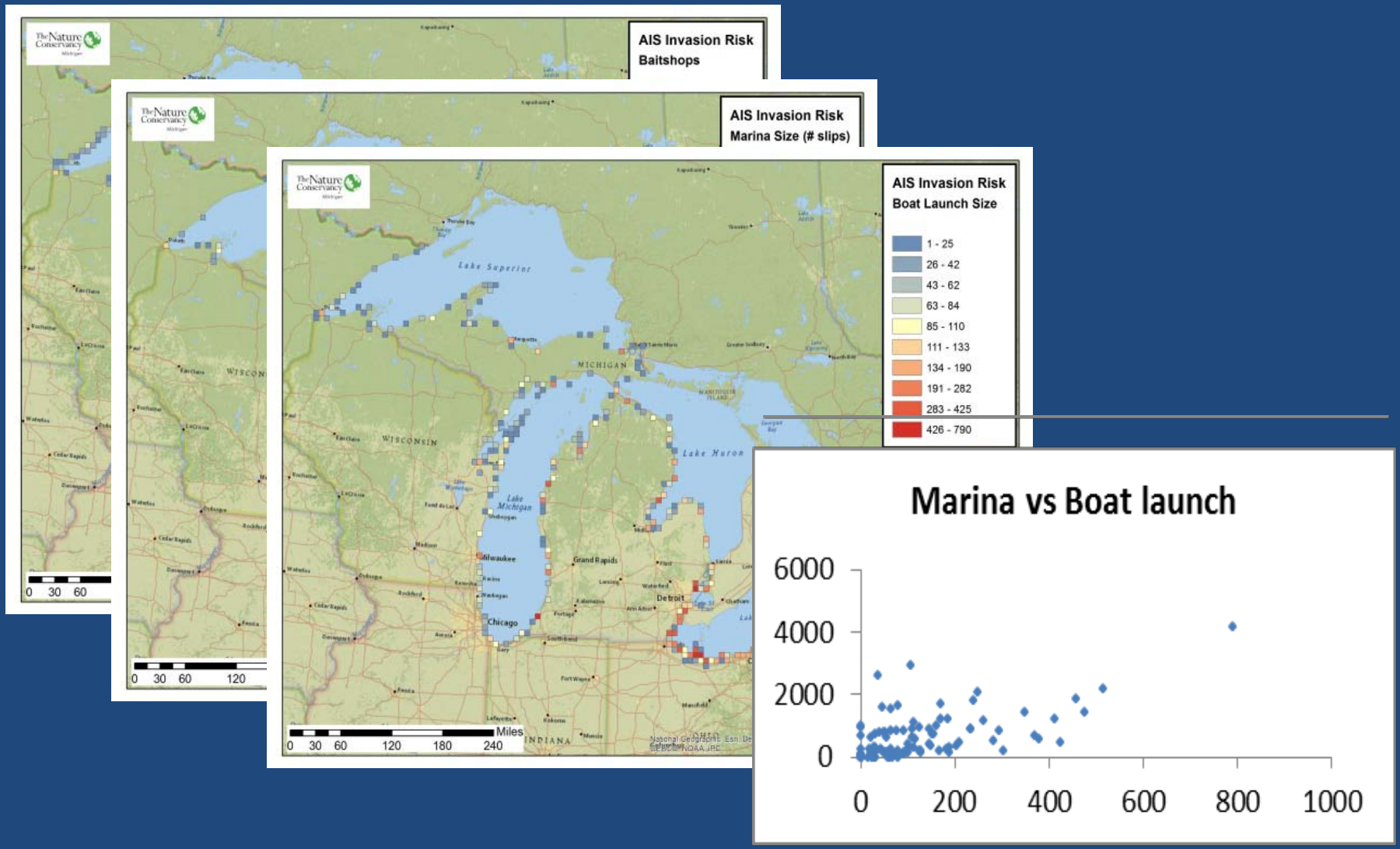


Surrogate for stocking and live trade pathways – water gardens, planting, private ponds

Number of ponds in Catchment flowing into a grid square

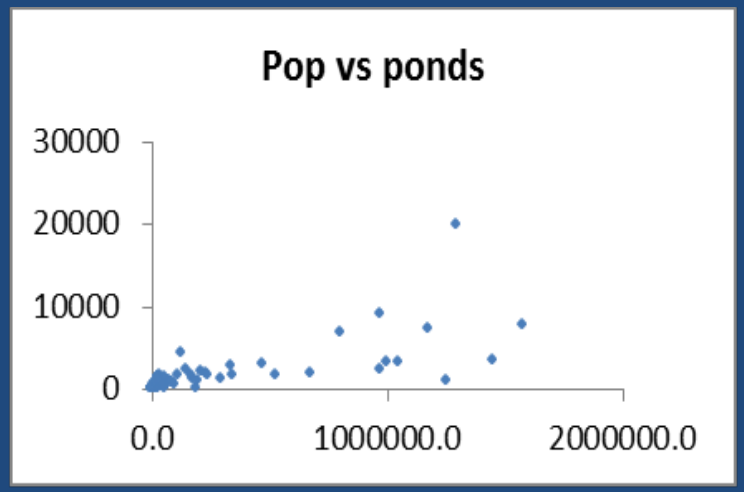
National Wetlands Inventory (NWI) “excavated” freshwater ponds. USFWS -2015

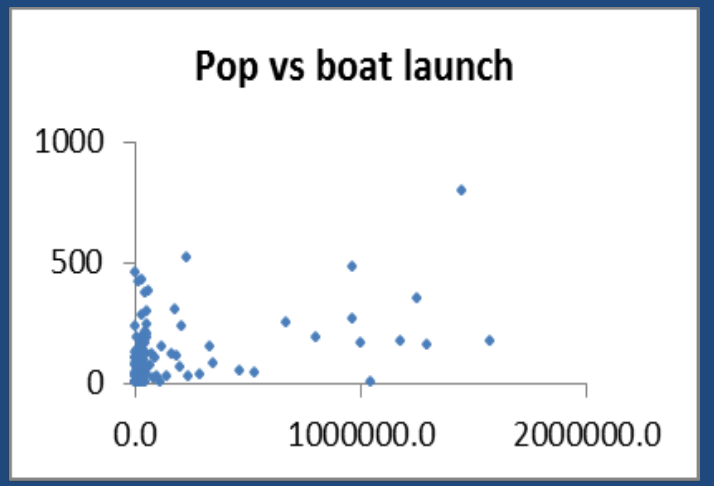
Combined boating & fishing pathways

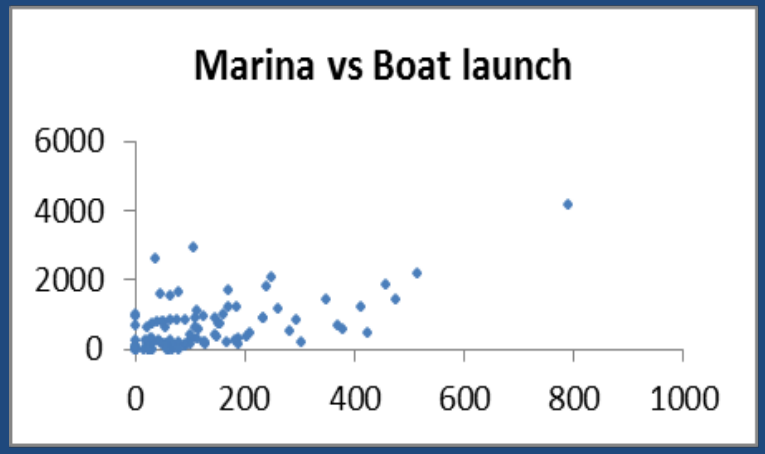


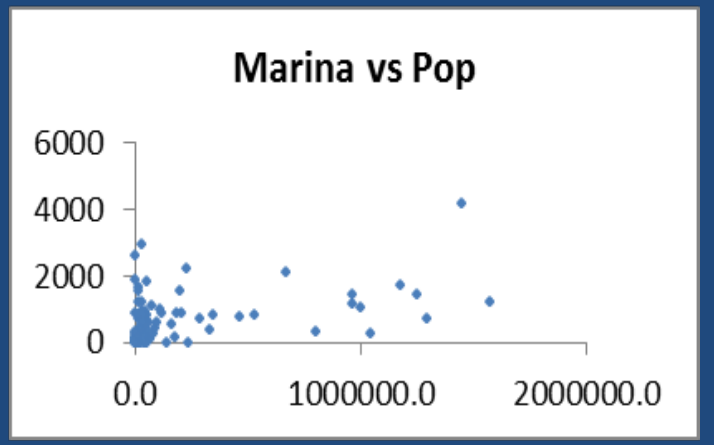
Three data layers represent different aspect of recreational boating pathway – but not highly correlated - so combined into one variable

Surrogates


Pop vs ponds
30000
20000
10000
0
0.0
1000000.0
2000000.0


Pop vs boat launch
1000
500
0
0.0
1000000.0
2000000.0


Marina vs Boat launch
6000
4000
2000
0
0
200
400
600
800
1000


Marina vs Pop
6000
4000
2000
0
0.0
1000000.0
2000000.0

Top ranked sites consistent across all five models

Location Name	State	Average index rank	Rank unweighted index	Rank GLANSIS watch list weighted	Rank GLANSIS NAS weighted	Rank BRT weighted	Rank weighted indices average
Toledo/Maumee River	OH	3	4	**1**	**1**	8	1
Buffalo/Niagara River	NY	4.4	1	**5**	**5**	7	4
Milwaukee/Kinnickinnic R.	WI	5	5	**4**	**4**	10	2
Saginaw Bay/Saginaw River	MI	5.4	**6**	8	**6**	2	5
Cleveland/Cuyahoga River	OH	6	7	**2**	**2**	16	3
Portage/Portage-Burns	IN	7.2	2	**3**	**3**	22	6
Green Bay/Fox River mouth	WI	8	8	**7**	**7**	11	7
Oswego/Oswego River	NY	8.2	3	6	8	15	9
Lorain/Lake Erie	OH	8.6	**9**	13	**9**	4	8
Benton H./St. Joseph R.	MI	10.6	10	**16**	**16**	1	10
Grand Haven/Grand River	MI	11	12	14	13	5	11

Planning cycle