Multi-Jurisdictional Collaborations and Structured Approach for Grass Carp Control in Lake Erie

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Grass Carp in the Great Lakes

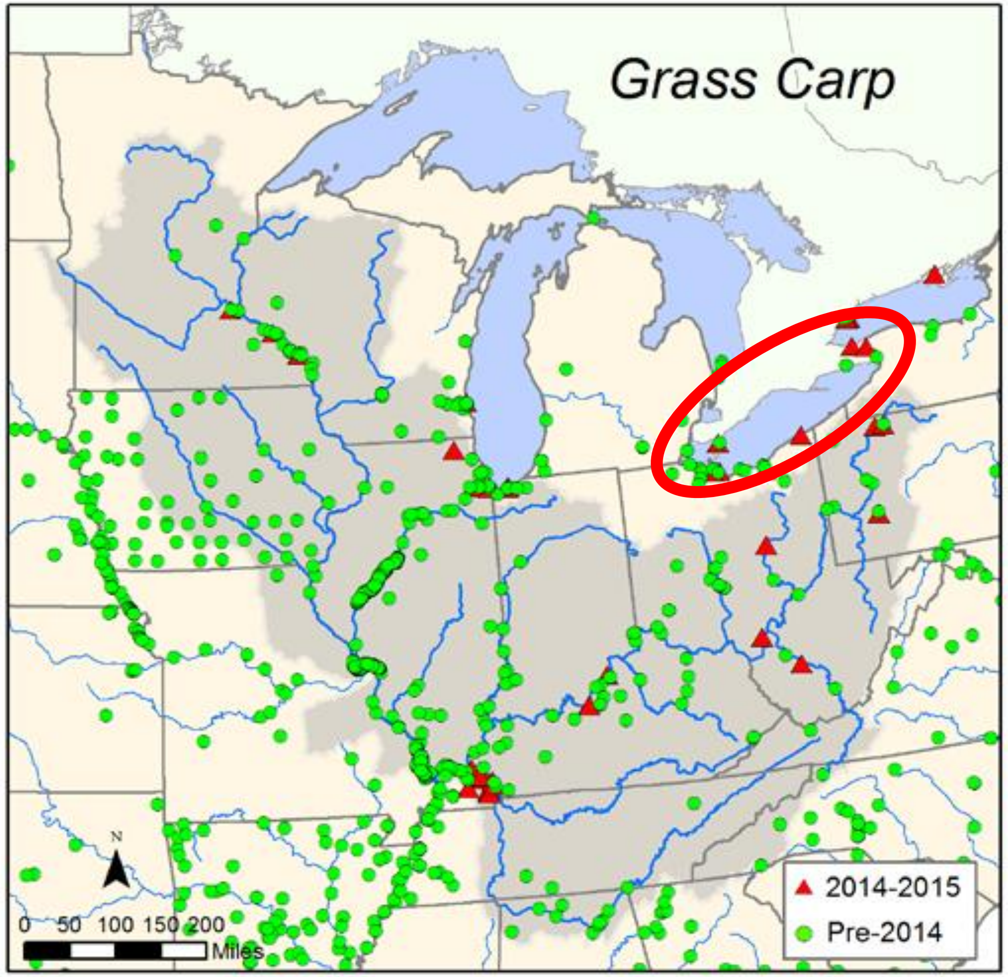
1963: Brought to U.S. for aquatic vegetation control research

1968 – 1978: Spread facilitated by brood stock sharing, escapes, and bio-control promotion

1980's: Methods and regulations to mitigate spread risk

- Non-reproductive fish (triploid)
- USFWS triploid certification program

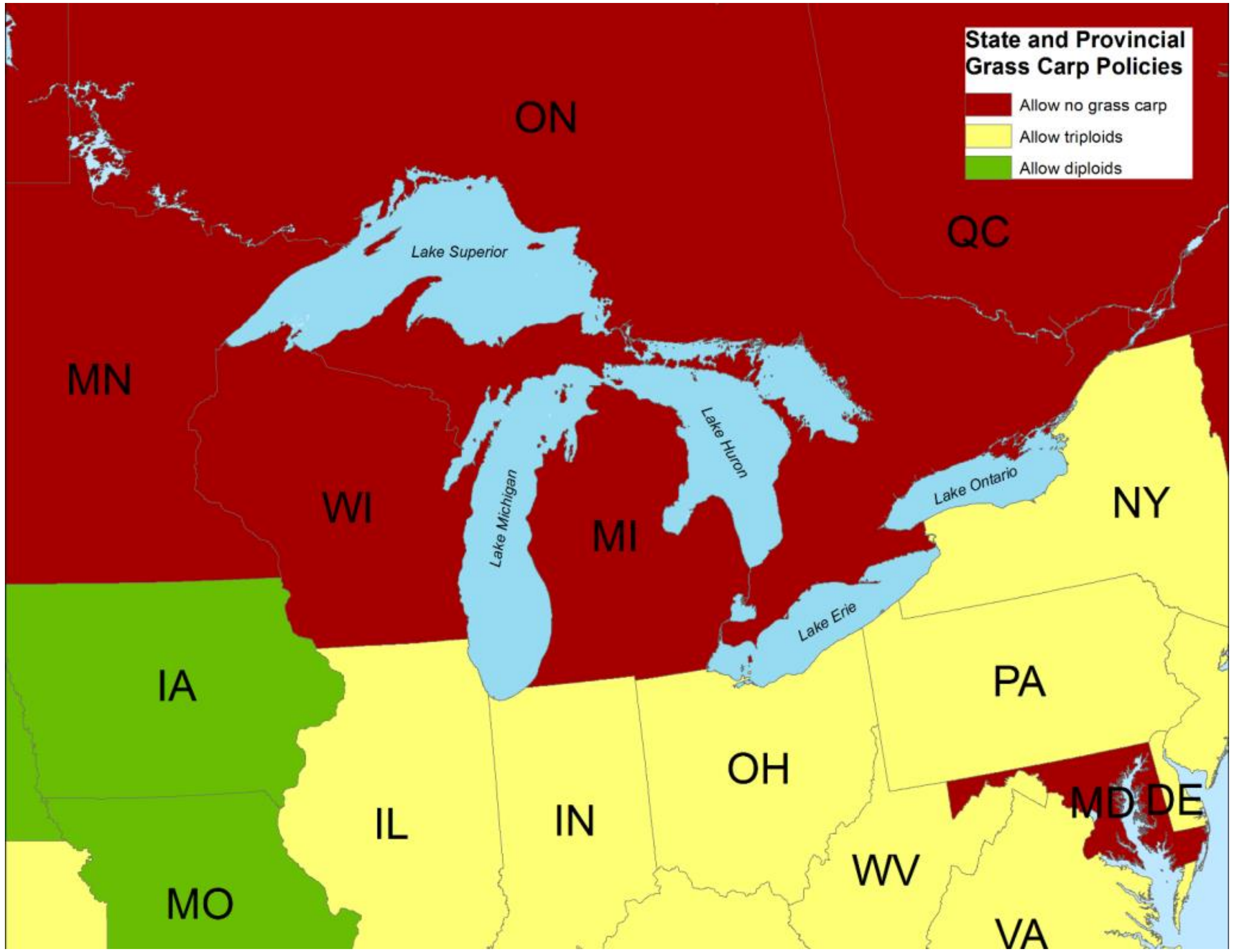
1985: First reported in Lake Erie



Source: 2016 Asian Carp Action Plan, ACRCC

Regulations in Great Lakes Basin

- Regulations vary across region
  - Compliance and enforcement can be a challenge
  - Diploid fish exist open systems
- Historic captures in Lake Erie assumed triploid escapees or accidental releases



A Growing Concern

- **Firs**
- **Inc**
- **Do**
- **Est iota**

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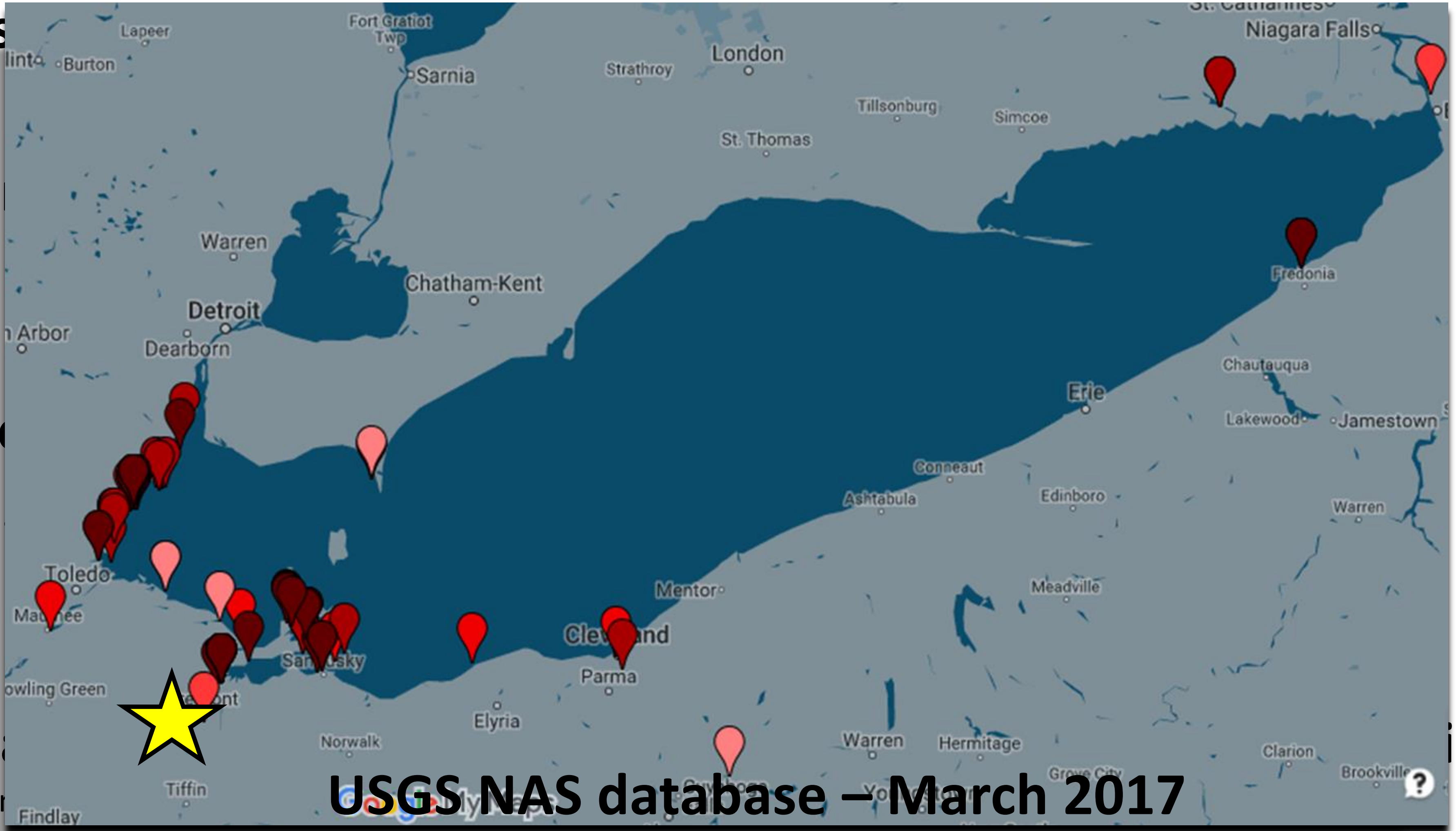


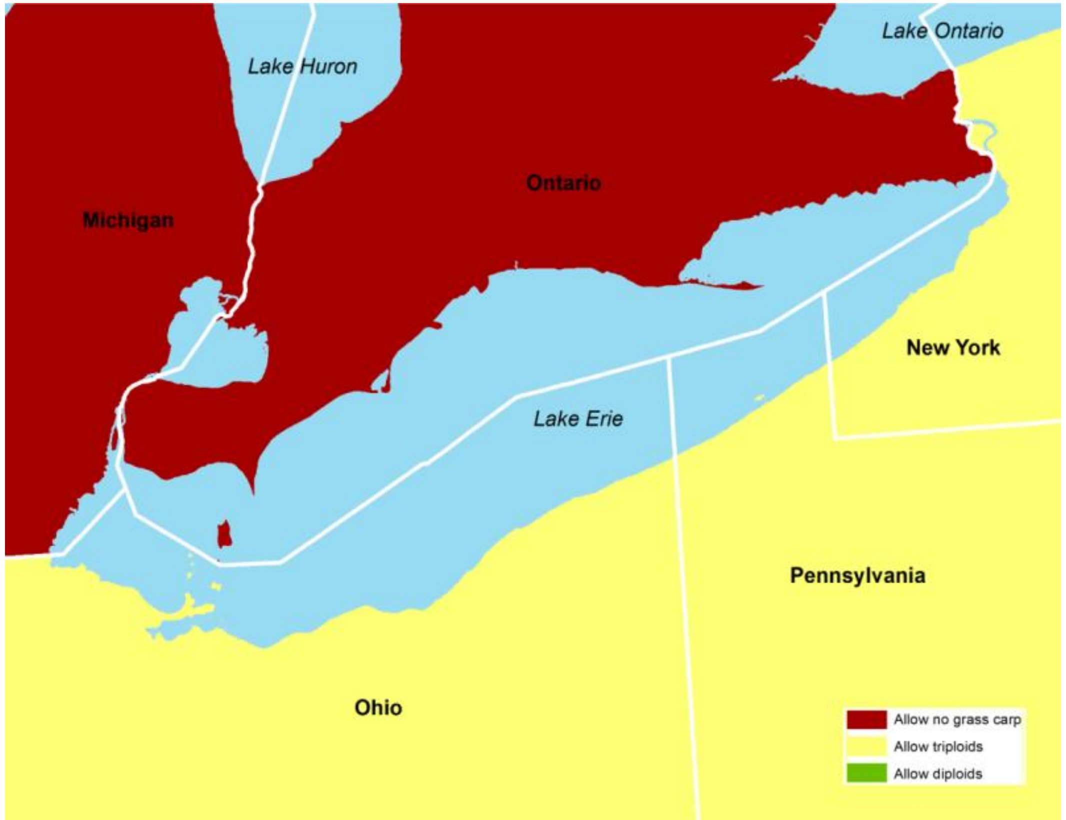
USGS NAS database – March 2017

Lake Erie Fisheries Management

Inter jurisdictional issues are addressed through the **Joint Strategic Plan for Great Lakes Fisheries**

Lake Erie Committee

- Michigan
- Ontario
- Ohio
- Pennsylvania
- New York



Lake Erie Committee

- **2012 – Increased reports from Michigan and Ohio commercial fishermen**

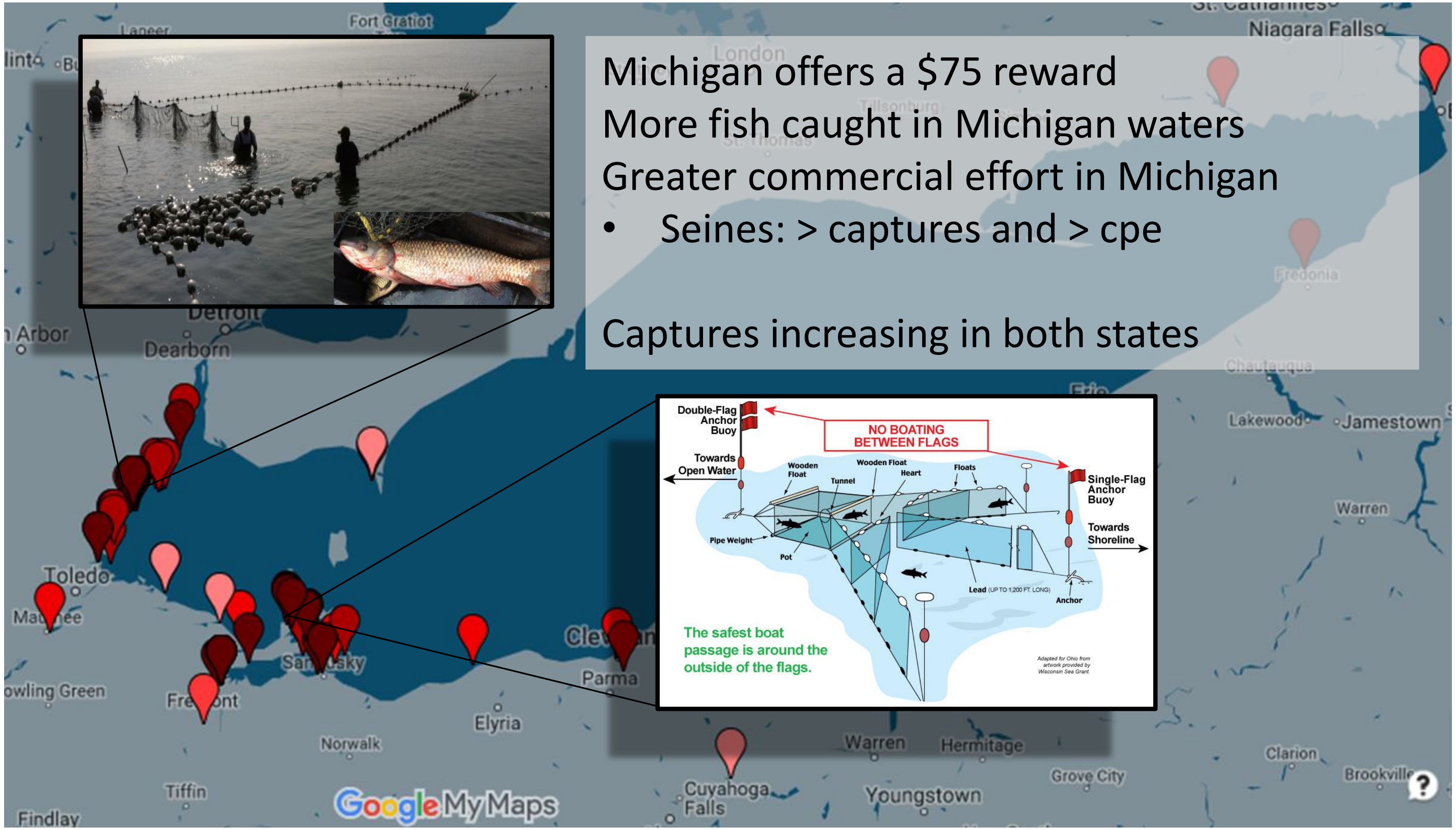
- **Asian carp position statement**
  - Advance prevention, monitoring, and control
  - Use science to inform decision making

- **Mutual Aid Agreement for AIS**

Working with Commercial Fishers

Michigan offers a $75 reward
More fish caught in Michigan waters
Greater commercial effort in Michigan
- Seines: > captures and > cpe

Captures increasing in both states



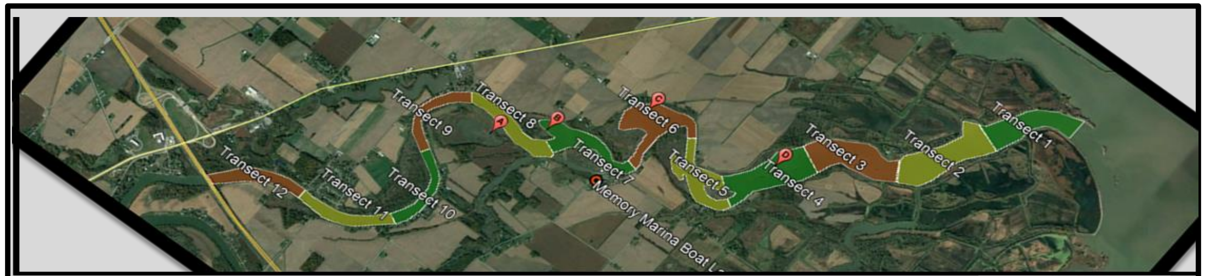
Collaborating with Regional Partners

2014 Invasive Carp Response Exercise

- Michigan shoreline, “hot ponds” area
- 96 hrs of electrofishing
- 58 hrs of gill netting
- 2 capture

Funding Source

Great Lakes RESTORATION



2017 Invasive Carp Response Exercise

- Sandusky River, Ohio
- 26 hrs of electrofishing
- 33 hrs of gill netting
- 8 captures

Reduce the unknowns through research

Reproductive Status and Natal Origin

- Ploidy analysis and otolith microchemistry

Tributary Use and Large-Scale Movement

- Great Lakes acoustic telemetry array and real-time receivers

Timing and magnitude of spawning events

- Ichthyoplankton sampling in the Sandusky and Maumee River

Additional research and monitoring

Asian carp early detection and field monitoring program

Ecological Risk Assessment of Grass Carp for the Great Lakes Basin

Early detection and monitoring program

- Ichthyoplankton and adult sampling in Sandusky and Maumee rivers and bays

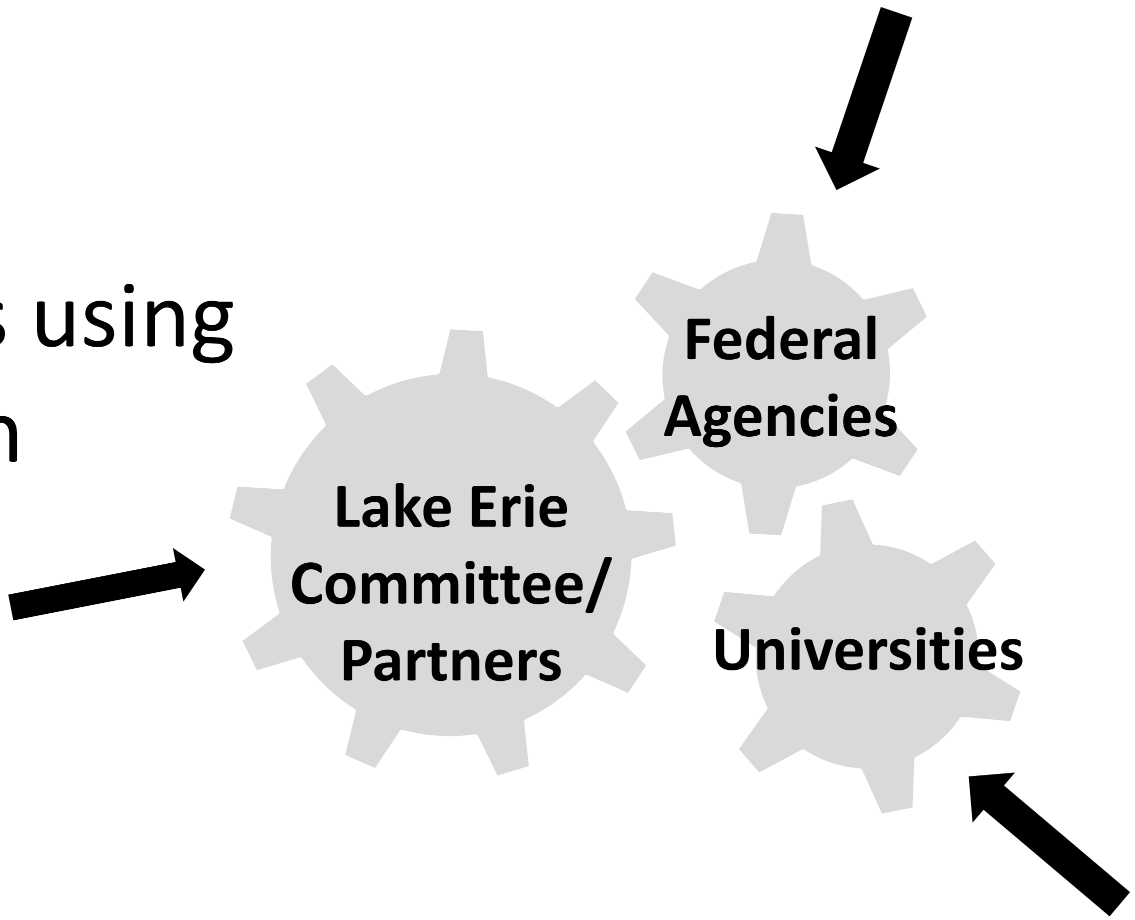
Optimizing electrofishing settings for grass carp

LEC Initiates a Structured Decision Making Exercise

Bring groups together to:

1. Establish goals and objectives using the best available information

2. Collaboratively carry out management actions



Structured Decision Making

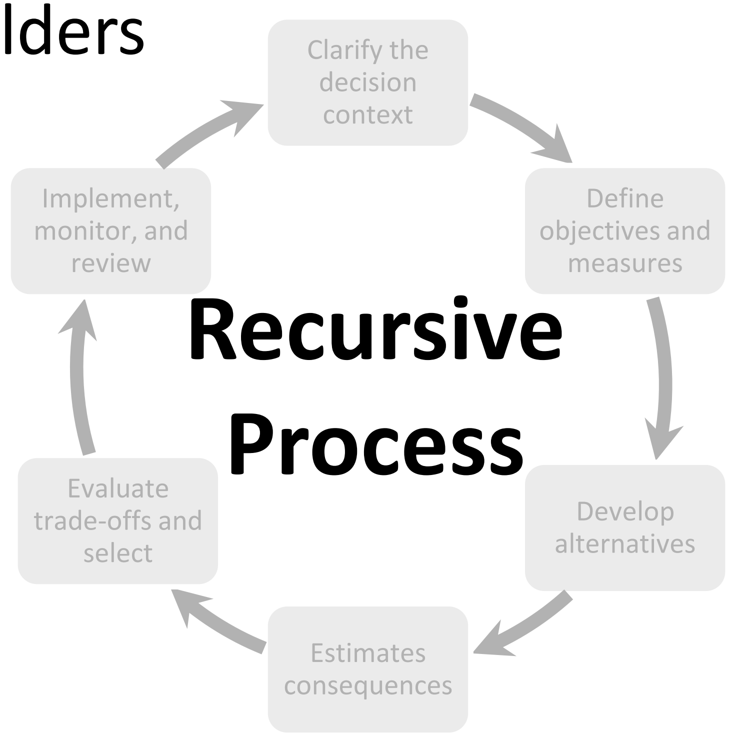
A formal, transparent, and collaborative decision making framework

Incorporates available information and stakeholders values

Successful management and satisfied stakeholders

PrOACT framework

- **Pr**oblem definition
- **O**bjectives
- **A**lternatives
- **C**onsequences
- **T**radeoffs

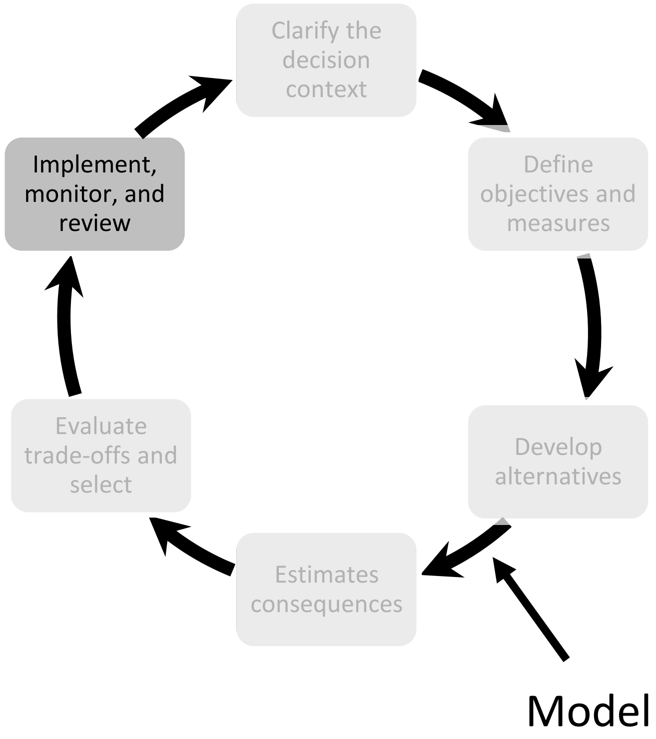


SDM workshops

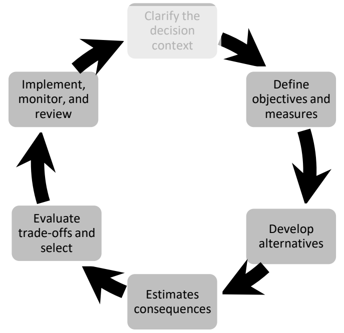
Michigan State University hosted three workshops

Participants from 13 international entities

1. December 2016 – set foundation
2. June 2017 – refine SDM components
3. September 2017 – consequences and tradeoffs

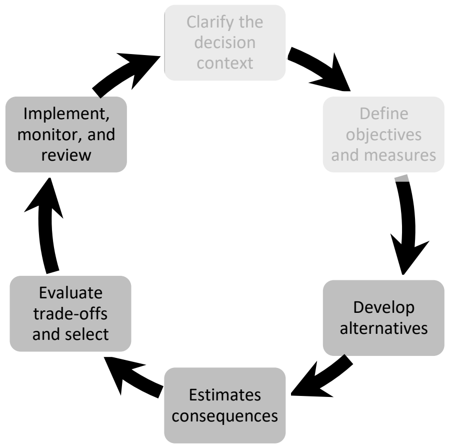


Clarify the decision context



Develop a strategy for controlling Grass Carp in Lake Erie to socially and environmentally acceptable levels

Define objectives and measures

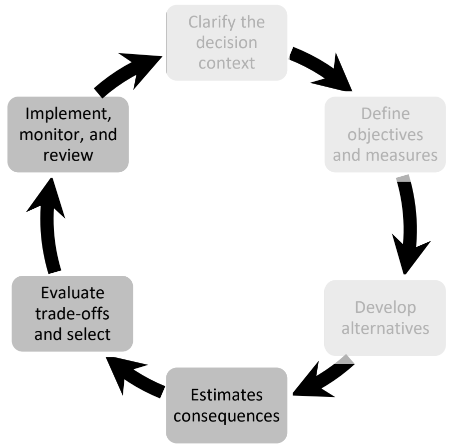


1. **Fulfill public trust and responsibility**
   - Minimize risk of spread/abundance
   - Minimize ecosystem engineering impacts

2. **Minimize management associated costs**
   - Minimize dollars spent

3. **Minimize collateral damage**
   - Avoid economic stress to stakeholders
     - Recreational and commercial
   - Avoid affects on native ecosystems
     - Migratory fishes, T & E species, and public sentiment

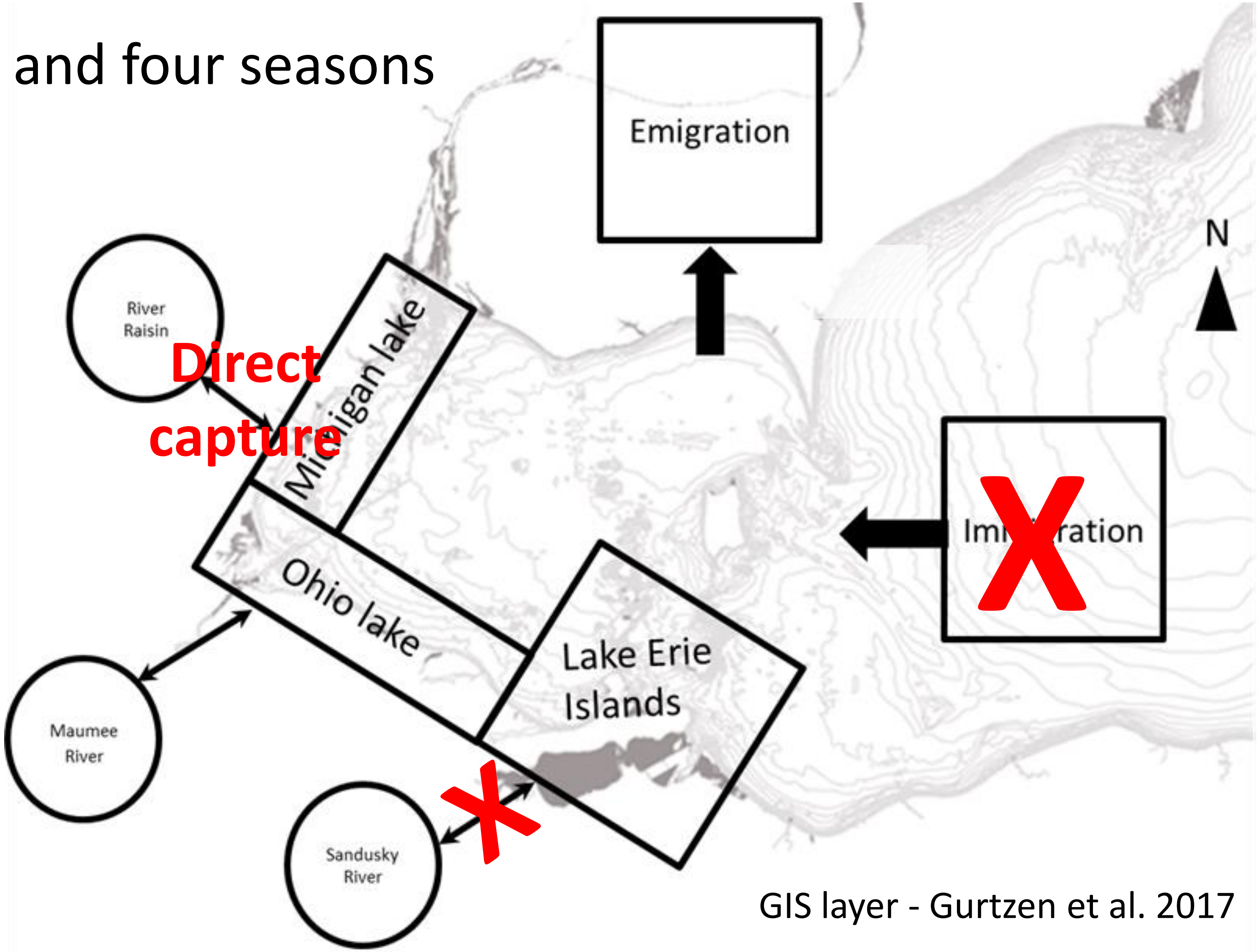
Management action alternatives



- **Removal** – Increase total mortality
  - Direct capture, harvest incentives, or chemical controls
- **Barriers** – Reduce spawning effort
  - Behavioral or physical
- **Flow modifications** – Reduce preferred spawning conditions
  - Control structures or channel modifications

Population model

- Three regions, two habitats, and four seasons
- Matrix population model
  - Project abundance at age
  - Allows seasonal movements
  - Quantifies uncertainty
- Evaluate spatially and temporally specific management actions



GIS layer - Gurtzen et al. 2017

Evaluate Management Scenarios

1. **No management action**

2. **General removal action**
   - Planned management actions and commercial removal across seasons and habitats

MDNR

3. **Concentrated removal action**
   - Planned management actions and commercial removal concentrated in seasons and areas with high catchability

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4. **Concentrated removal action + barrier**
   - Addition of a seasonal behavioral barrier in the Sandusky River

Consequence Table

- Fundamental objectives
- Means objectives
- Management options
- Measureable attributes
  - Normalized to 0-1 scale
  - 0 = worst outcome
  - 1 = best outcome

Fundamental objectives	Means objectives	Scenario 1	Scenario 2	Scenario 3	Scenario 4
Fullfill public trusts and repsonsibility	Min. risk of spread/abundance at 5 years (10 fish/ha)				
	Min. risk of spread/abundance at 10 years (10 fish/ha)				
	Min. risk of spread/abundance at 25 years (10 fish/ha)				
	Min. risk of spread/abundance at 50 years (10 fish/ha)				
	Min. ecosystem engineering impacts at 5 years (34% vegetation loss)				
	Min. ecosystem engineering impacts at 10 years (34% vegetation loss)				
	Min. ecosystem engineering impacts at 25 years (34% vegetation loss)				
	Min. ecosystem engineering impacts at 50 years (34% vegetation loss)				
Min. management associated costs	Min. dollars spent annually ($84,000)				
Min. collateral damage	Avoid economic stress -recreational				
	Avoid economic stress - commercial				
	Min. impacts on migratory fishes				
	Min. impacts on T&E species				
	Max. public sentiment				

Consequence Table

- Compare tradeoffs across objectives
  - Green = best (1)
  - Red = worst (0)

- Compare cumulative impacts of each scenario
  - Weighted average of normalized measureable attributes
  - Expected utility

Fundamental objectives	Means objectives	Scenario 1	Scenario 2	Scenario 3	Scenario 4	W_1
Fullfill public trusts and repsonsibility	Min. risk of spread/abundance at 5 years (10 fish/ha)	1.000	1.000	1.000	1.000	[redacted]
	Min. risk of spread/abundance at 10 years (10 fish/ha)	1.000	1.000	1.000	1.000	[redacted]
	Min. risk of spread/abundance at 25 years (10 fish/ha)	0.000	0.059	0.112	1.000	[redacted]
	Min. risk of spread/abundance at 50 years (10 fish/ha)	0.000	0.000	0.000	1.000	[redacted]
	Min. ecosystem engineering impacts at 5 years (34% vegetation loss)	0.000	0.562	0.600	1.000	[redacted]
	Min. ecosystem engineering impacts at 10 years (34% vegetation loss)	0.000	0.478	0.563	1.000	[redacted]
	Min. ecosystem engineering impacts at 25 years (34% vegetation loss)	0.000	0.042	0.100	1.000	[redacted]
	Min. ecosystem engineering impacts at 50 years (34% vegetation loss)	0.000	0.023	0.070	1.000	[redacted]
Min. management associated costs	Min. dollars spent annually ($84,000)	1.000	0.500	0.500	0.000	[redacted]
Min. collateral damage	Avoid economic stress -recreational	1.000	0.284	0.381	0.000	[redacted]
	Avoid economic stress - commercial	1.000	0.052	0.265	0.000	[redacted]
	Min. impacts on migratory fishes	1.000	0.387	0.481	0.000	[redacted]
	Min. impacts on T&E species	1.000	0.218	0.359	0.000	[redacted]
	Max. public sentiment	0.000	1.000	0.736	0.805	[redacted]
	E(U)	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]

Outcomes and Implementation

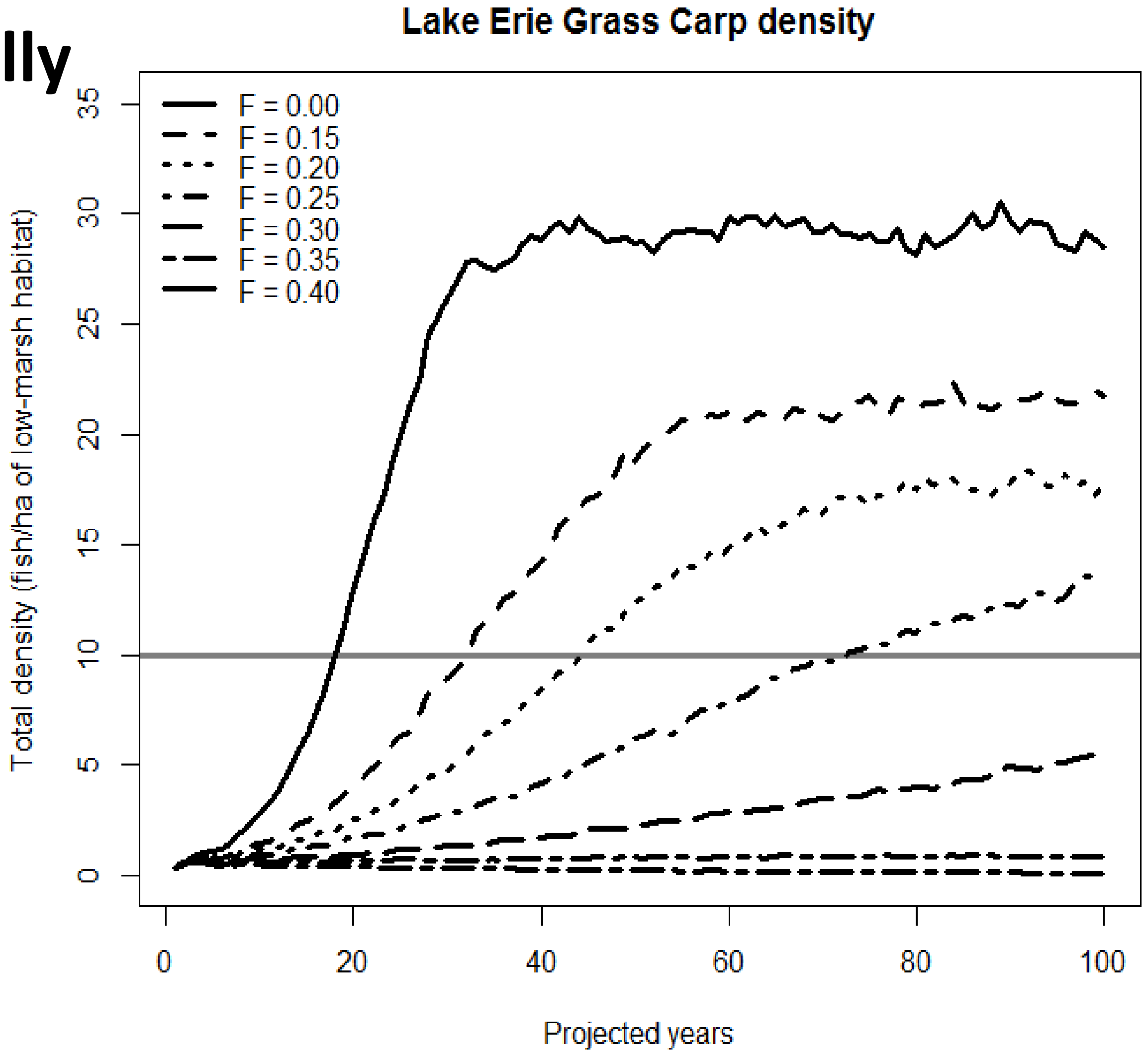
- **Management action takeaways**
  - Removal – increased effort in strategic locations
  - Barriers – costs and implementation must be evaluated

- **Key uncertainties**
  - Demographic parameters – survival and stock-recruitment
  - Seasonal movements
  - Catchability estimates – across gear types, seasons, habitats
  - Funding and effort

Setting a Removal Target

How many fish must be removed annually to stop population growth?

- Assume population size of 2,000
- Annual survival = 0.75
- Direct capture on age 3+ fish
  - 600 mm or greater
- **Fishing mortality = 0.35**
- **390 fish/year**



Collaborative Efforts Moving Forward

Dedicated effort to grass carp response

- Planned and rapid responses actions
- Partnership with commercial fishermen

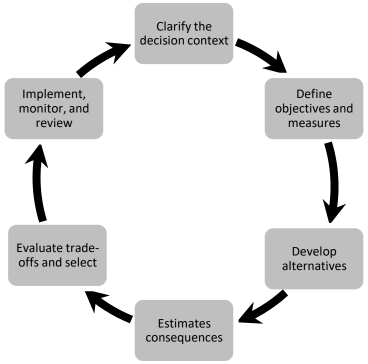
Continue ongoing research and monitoring

- Ploidy analysis, otolith microchemistry, early life history sampling in tributaries, telemetry study, and gain life history information

GLATOS
Great Lakes Acoustic Telemetry Observation System

Reconvene SDM working group in to 2018

- Update SDM components as new information is gathered
- Evaluate competing management action scenarios



Cooperating Partners

CMU
CENTRAL MICHIGAN UNIVERSITY

USGS
science for a changing world

Protecting Our Fishery
Great Lakes Fishery Commission
SCIENCE • SEA LAMPREY CONTROL • PARTNERSHIPS

Minnesota
DEPARTMENT OF NATURAL RESOURCES

PENNSYLVANIA FISH & BOAT COMMISSION

OHIO DEPARTMENT OF NATURAL RESOURCES
DIVISION OF WILDLIFE

Canada
Department of Fisheries & Oceans

DEPARTMENT OF NATURAL RESOURCES
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U.S. FISH & WILDLIFE SERVICE
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Questions?

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http://michigan.gov/invasivecarp

http://ohiodnr.gov/asiancarp