Using Adaptive Management to Combat Lake Erie Grass Carp

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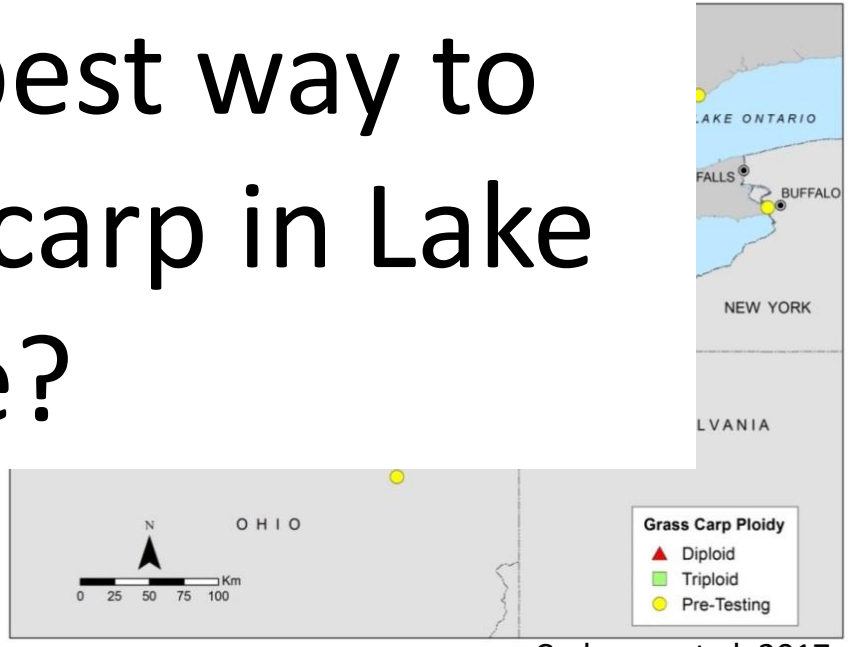
Grass Carp in Lake Erie

- Early 1
(MI)
- 1985:
water
- Increa
- Assumed to be triploid, but…
- Recent evidence of successful recruitment in Sandusky River (fertilized eggs)

What's the best way to control grass carp in Lake Erie?



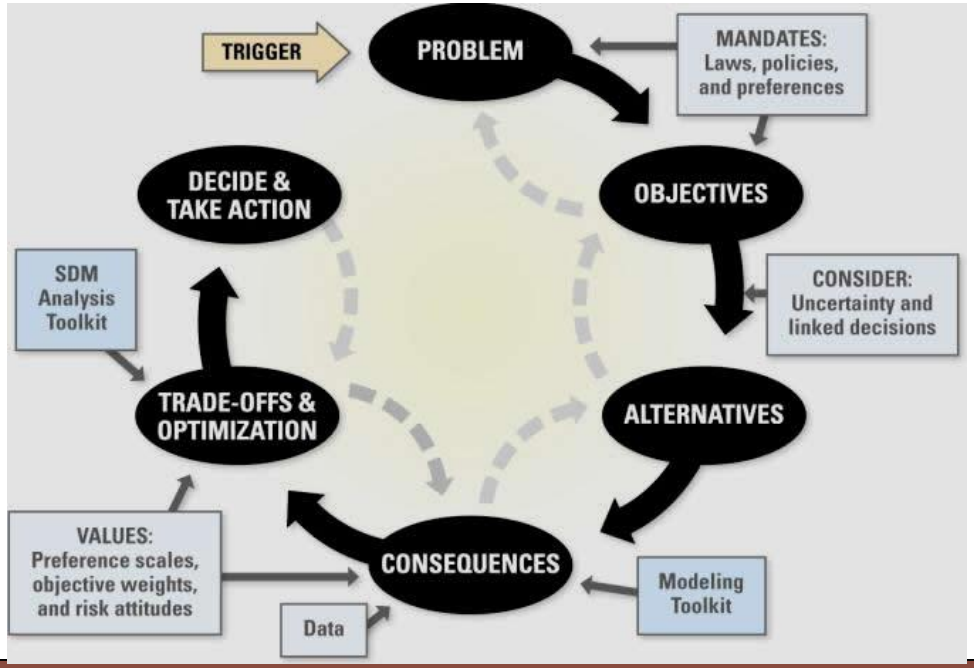
Cudmore et al. 2017

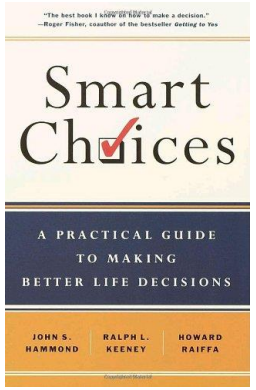
What Makes Decision Making Difficult?

- Objectives are complex, contradictory, or disputed
  - Different perspectives, disagreement on values
- Don't know all the possible actions/alternatives
- System dynamics may be poorly known (uncertainty)
- Trade-offs are difficult to make

Structured Decision Making

- Values-based, transparent, objective way to make complex decisions
- PrOACT Framework

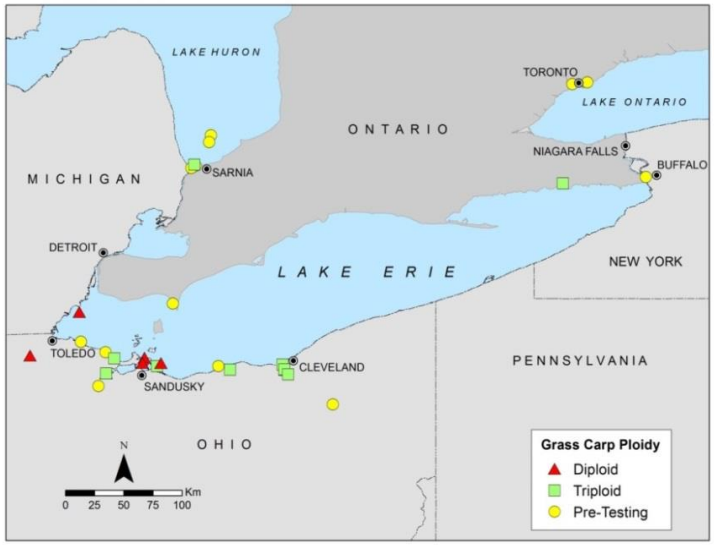


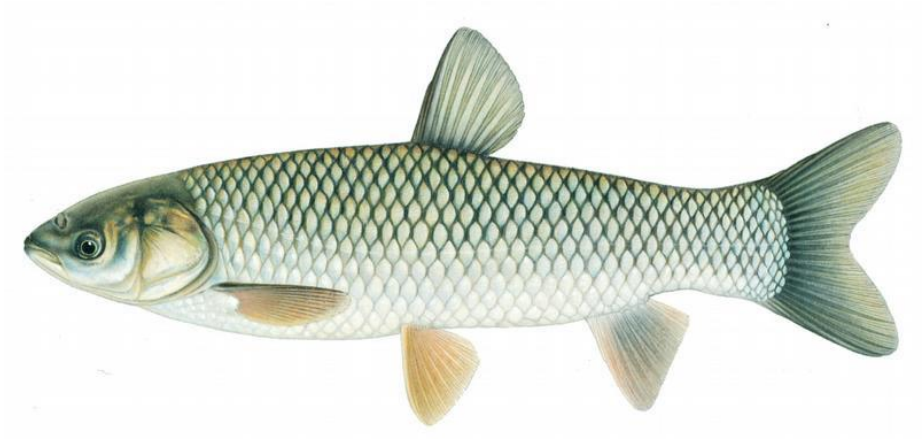


"A formal application of common sense for situations too complex for the informal use of common sense."
- R. Keeney

Problem Statement

Develop a strategy for controlling grass carp in Lake Erie to **socially** and **environmentally acceptable** levels





Objectives

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

2. **Minimize control costs**
   - Minimize dollars spent

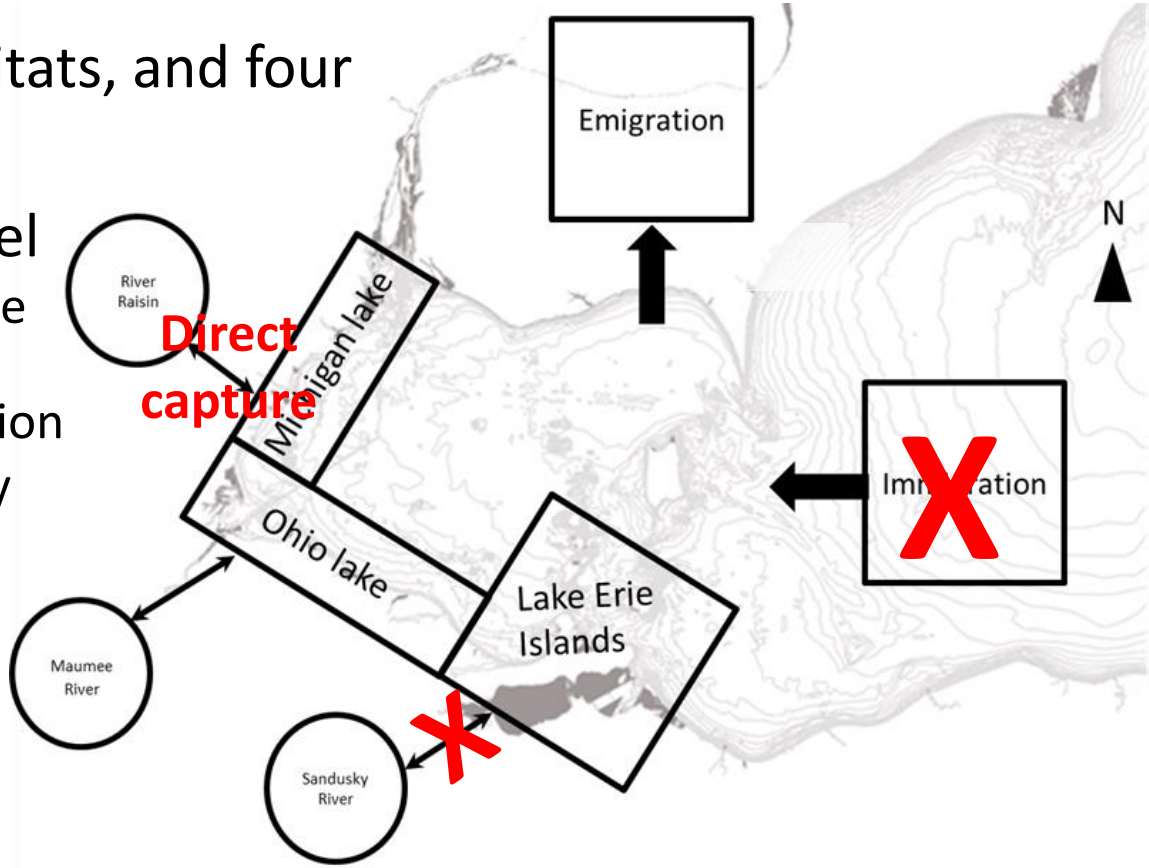
3. **Minimize collateral damage**
   - Avoid economic stress to stakeholders
     - Recreational and commercial
   - Avoid effects on native ecosystems
     - Migratory fishes, T & E species, and public sentiment

Alternatives

- **Removal** – Direct capture, harvest incentives, or chemical controls
  - Increase total mortality – add fishing mortality (*F*)
- **Barriers** – Behavioral or physical
  - Reduce spawning effort and therefore recruitment
- **Flow modifications** – Control structures or channel modifications
  - Reducing frequency of high flow events necessary for reproduction

Population model

- Three regions, two habitats, and four seasons
- Matrix population model
  - Project abundance at age
  - Uses Lake Erie data and prior literature information
  - Incorporates uncertainty through binomial and Poisson distributions
- Evaluate spatially and temporally specific management actions



Evaluate Control Scenarios

1. **No action**
2. **General removal action**
   - Removal efforts across seasons and habitats based on current best information
3. **Concentrated removal action**
   - Removal efforts concentrated in seasons and areas with high catchability
4. **Concentrated removal action + barrier**
   - Addition of a seasonal behavioral barrier in the Sandusky River

MDNR

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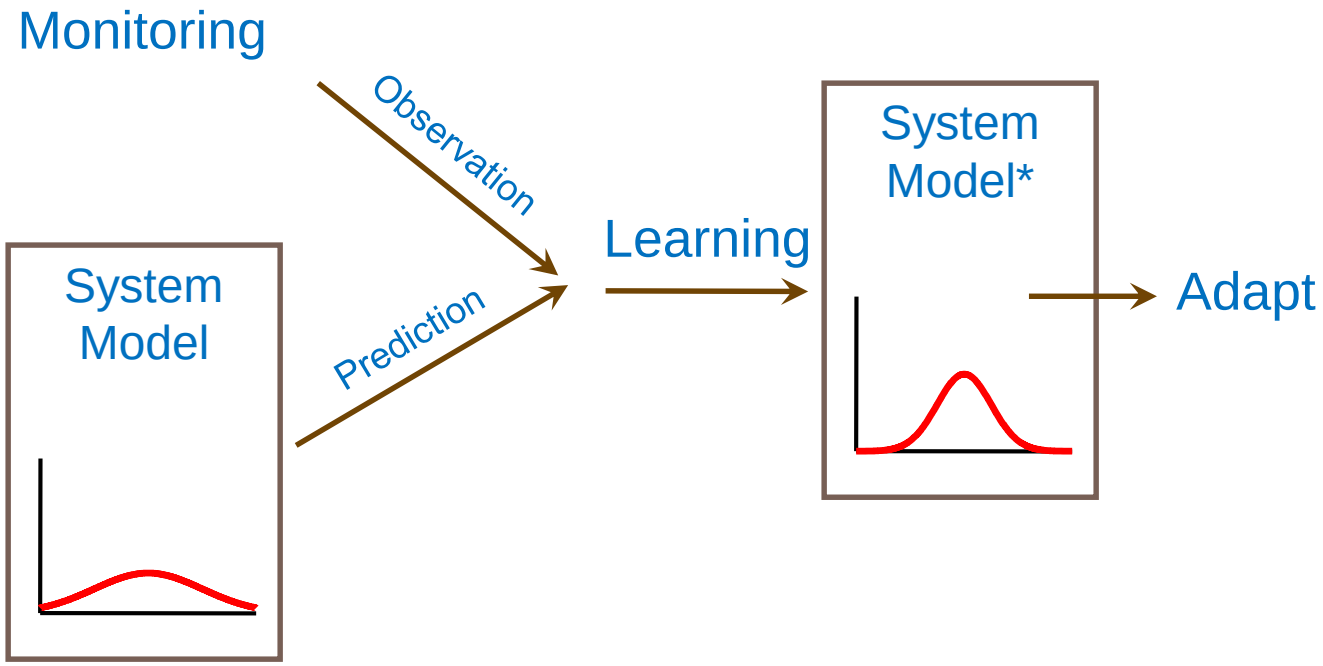
Outputs and implementation

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

- **Control scenario takeaways**
  - Removal may be effective – increased effort in strategic locations
  - Barriers may be effective – costs and implementation must be evaluated
  - Flow modification – determine priority for continued evaluation

Adaptive Management



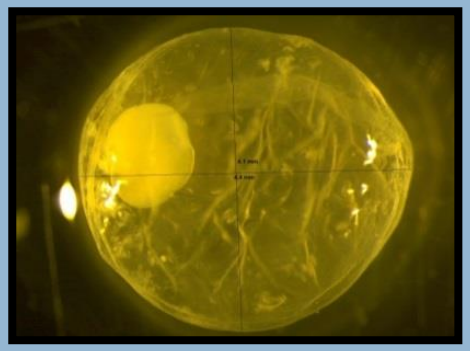
Addressing Key Uncertainties

- When and where to sample?
  - Ecology is not well known
  - Continue monitoring and research
- How to sample?
  - Challenging to capture when present
  - Avoid nets, resistant to electrofishing, and occupy inaccessible habitats
  - Optimal sampling gear not known

Michigan/Ohio Grass Carp Response

Grass Carp Focus Area

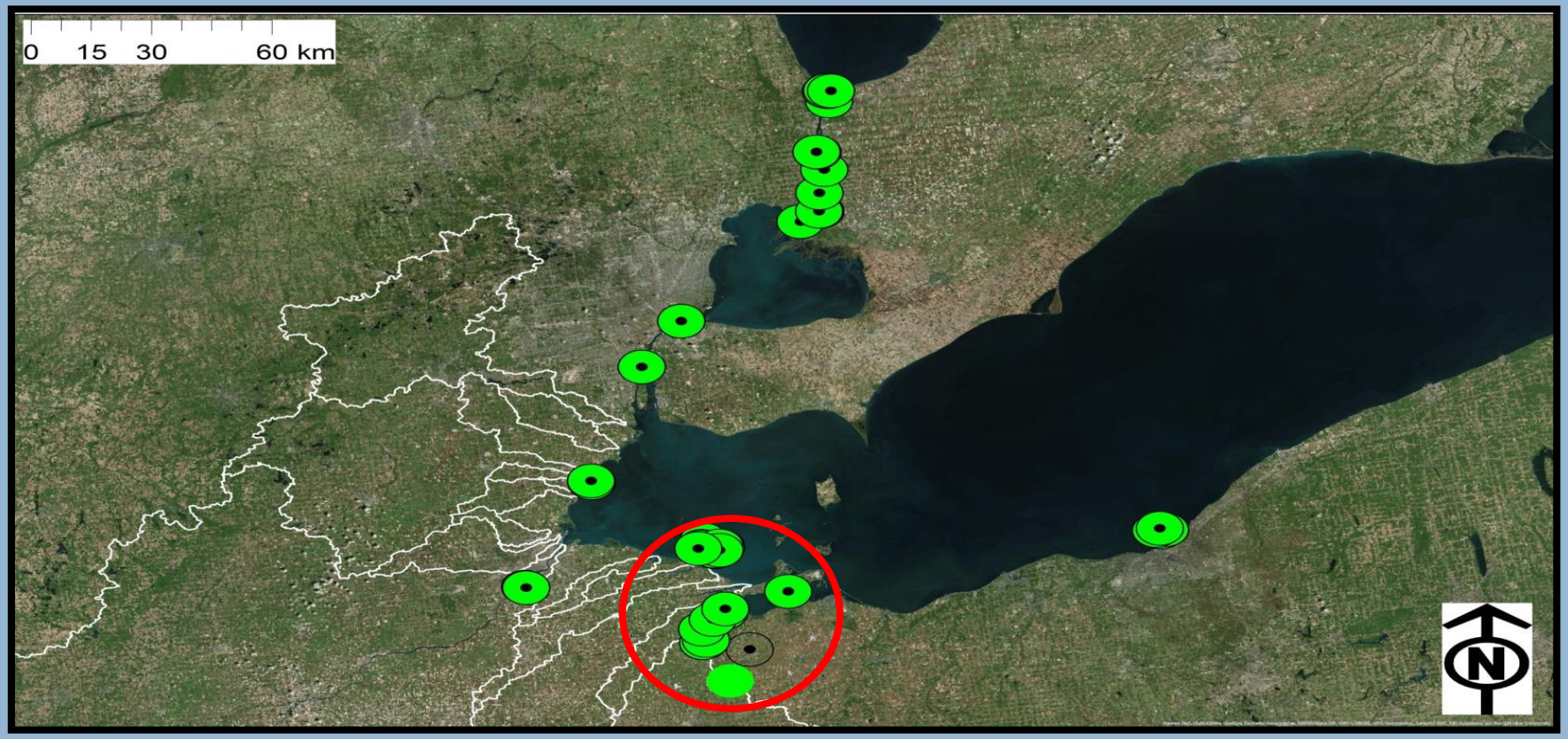
Addressing the Knowledge Gaps



- **Ploidy analysis: fertile vs. sterile**
- **Commercial fishermen: removal**
- **Egg/Larvae sampling: early life history**
- **Telemetry: seasonal movements**
- **Modeling: spawning and hatching locations**
- **Vegetation mapping: food availability/impact**

Grass Carp Detections in 2017

1. **Identify tributary use**
2. **Aggregations**
3. **Inter-basin movements**



2018 Targeted Response

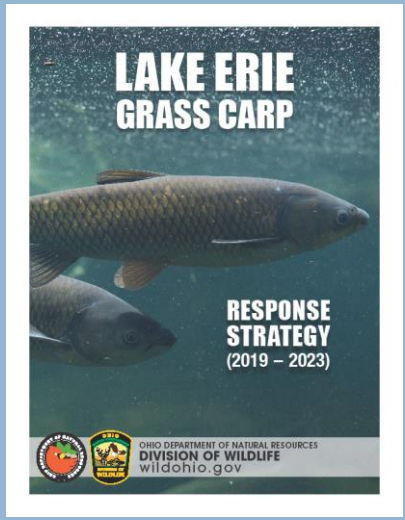
- **Locations were informed by telemetry**
- **Timing overlapped with suitable spawning conditions**
- **Increased capacity through Mutual Aid Agreement for AIS Response**

2018 Targeted Response

- High effort and participation
  - 63.7hrs TN; 70.5hrs EF
  - 71 people
- Tandem electrofishing most effective
- 30 Grass Carp captured
  - 27 Sandusky
  - 3 Maumee
- 75% of Grass Carp removed
- Moving towards targeted removal

5-Year Response Strategy

Prevent diploid Grass Carp from becoming further established in the Lake Erie basin and as the science develops, eradicate them from Lake Erie.



Outcome 1: Prevent Further Introduction / Expansion

- **Objective 1.1 – Secure Supply Chain**
- **Objective 1.2 – Insure Secure Bait Trade**
- **Objective 1.3 – Close Knowledge Gaps / Understand Life History**

Outcome 2: Manage Grass Carp Populations

- **Objective 2.1 – Removal & Prevention**
- **Objective 2.2 – Engage Commercial Netters**
- **Objective 2.3 – Evaluate Use of Innovative Control Technologies**

Moving Forward

- Grass Carp Assessment and Removal Program (GCARP)
- Ramp up real-time tracking
- University of Toledo Modeling
- Barrier Assessment