Structured Decision Making and Adaptive Management for AIS Responses:
An Application to Grass Carp in Lake Erie

Lucas Nathan[1], Kelly Robinson[2], Mark DuFour[3], Seth Herbst[1], Mike Jones[2], and Tammy Newcomb[1]

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Decision making can be difficult

- System dynamics not well understood (uncertainty)

- Objectives can be complex
  - Different perspectives
  - Trade-offs are difficult

- Don’t know all the possible alternatives or their consequences

..especially for invasive species

- Little information about species in new ecosystem or region
- Effects on socio-ecological system can be diverse and complex
- Further complicated when multiple jurisdictions are involved

History of Grass Carp in Lake Erie

- 1963: Introduced into U.S.
- 1980's: USFWS triploid certification program to reduce risk
- Mid-1980's: Found in Lake Erie, presumed triploids
- Early 2010's: Captures of diploids by commercial fishers
- Mid 2010's: Evidence of spawning increased concerns

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2014 Response

- Incentive program for commercial fishers
- Michigan and Ohio DNRs multi-agency response in Michigan waters of Lake Erie
- Great Lakes and St. Lawrence Governors and Premiers Mutual Aid Agreement
- Large amount of effort (>100 hours) and $$$ (>$100k)
- Resulted in **two** fish captured

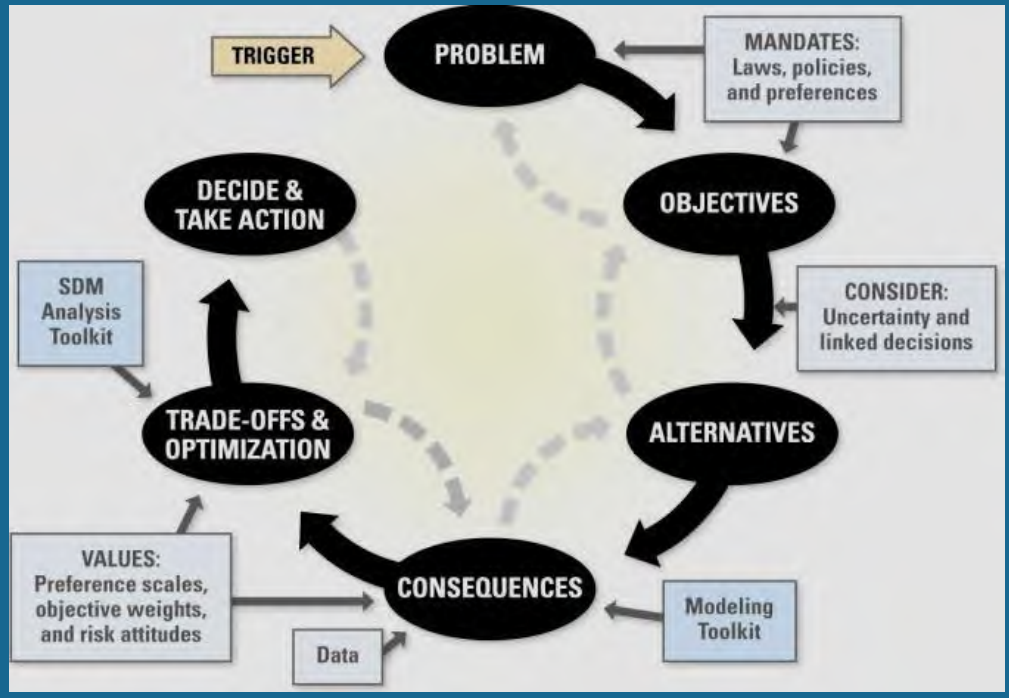
2014 Response

- Resulted in **two** fish captured

Need a more effective strategy and more coordinated decision-making process

Structured Decision Making (SDM)

- Used to help navigate complex decisions
- Incorporates available information and stakeholder values
- Formal structure for transparent and collaborative process



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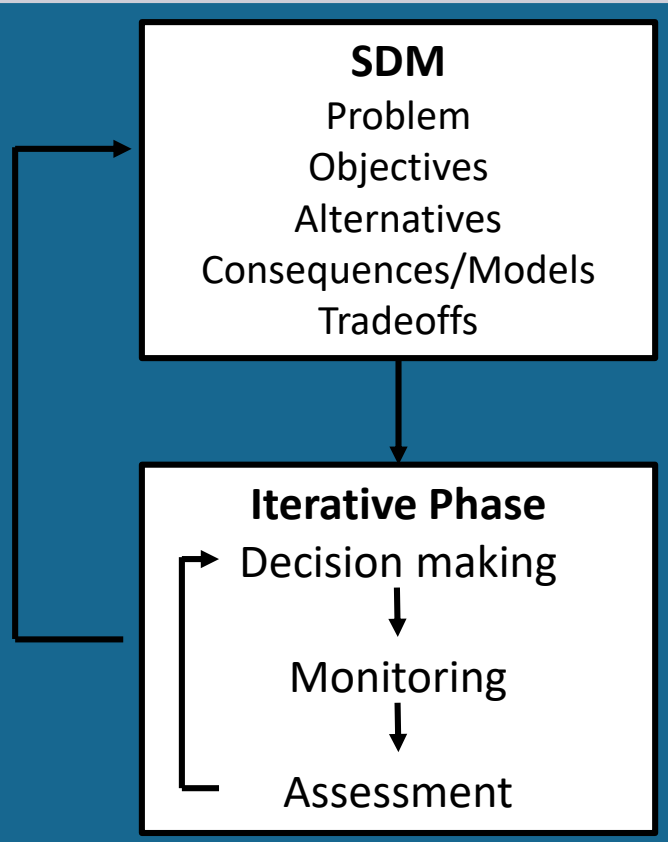
Adaptive Management

- Iterative strategy of implementing management with the goal of reducing uncertainty

- Explicitly incorporate learning into conservation actions



2016: Begin Grass Carp SDM Process

- Led by Michigan State University
- 3 workshops
- 13 organizations

SDM Process

- Identified problem, objectives, and uncertainties
- Evaluated alternatives using population projection model
  1. *No management action*
  2. *General removal action*
  3. *Concentrated removal action*
  4. *Concentrated removal action + barrier*

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Outcomes of SDM Process

- Key uncertainties
  - Seasonal movement patterns
  - Gear efficiency
  - Abundance
  - Feasibility of seasonal barrier

- Begin adaptive management
  - 5-year plan
  - Goals:
    - Remove 390 Grass Carp/year
    - Address uncertainties

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Addressing the Knowledge Gaps for Control

- ***Completed or on-going work:***
  - Gear efficiency/catchability
  - Seasonal movements and tributary use via telemetry
  - Judas fish response
  - Ploidy analysis (i.e., fertile vs. sterile)
  - Otolith microchemistry to determine natal origin
  - Early life history sampling in tributaries
  - Refine likely spawning and hatching locations in OH tributaries
  - Population genomics
  - Aquatic vegetation mapping

Great Lakes RESTORATION

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2018 Response – Ohio Waters

- Similar amount of effort as 2014
  - > 100 hours of E-fishing and netting effort
  - 14 organizations

- Telemetry, egg captures, FluEgg modeling used to identify spawning locations

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2018 Response – Ohio Waters

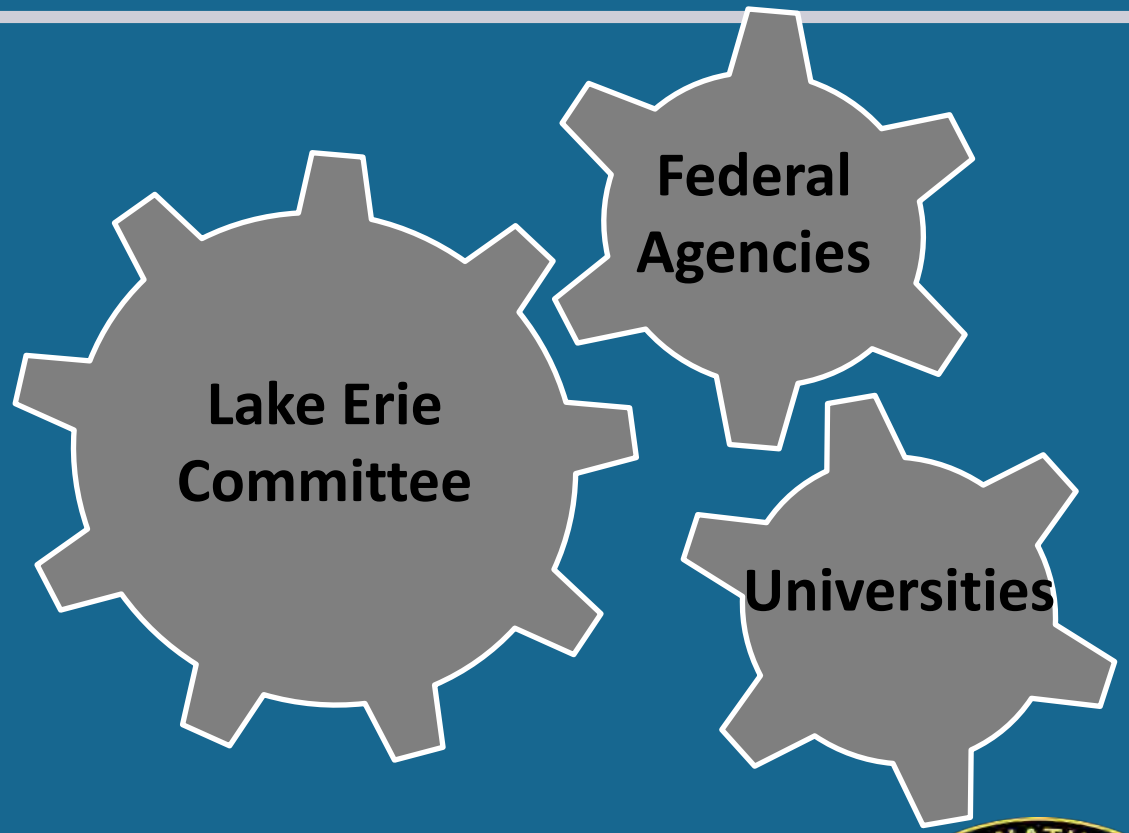
- 31 fish captured in one week
  - One of the largest single removal events of Grass Carp from Lake Erie

2019 Response Actions

- Continue to focus removal efforts during spawning periods in OH tributaries
- Increased capacity from GLRI funding
- Total of **159** fish removed in 2019 to date

Benefits of SDM and AM

- Provides transparency in decision-making process
- Promotes researcher-manager collaborations
- Explicit objectives used to guide collaborative efforts
- Effectiveness of removal efforts improved over time as uncertainties are addressed



Lessons Learned

- Funding is critical
  - GLRI funding for Lake Erie Grass Carp efforts via the Asian Carp Regional Coordinating Committee (ACRCC)
- Identifying partners early key to success
  - GLFC Joint Strategic Plan provided framework for collaboration
- Important to maintain inter-agency communication about ongoing work
- Inter-agency data and information sharing can be challenging

Thank you

nathanl@michigan.gov