Adaptive Management in Action: Grass Carp control in the Great Lakes

Grass Carp invasion timeline

- **1963**: Imported to U.S. to control aquatic vegetation
- **1983**: Triploid (sterile) Grass Carp developed
- **1980’s**: Reports of Grass Carp captured by commercial fishers in Lake Erie
- **2012**: Diploid Grass Carp that originated from the Sandusky River were captured
- **2015**: Grass Carp eggs found in the Sandusky River
- **2018**: First strike teams deployed, Grass Carp larvae found in Maumee River
- **2019-2022**: Continued effort

Continued effort
Why are Grass Carp a threat?

- Grass Carp captures have increased in recent years.
- Most Grass Carp captured in the western basin are diploid.
- Grass Carp harm aquatic ecosystems when abundant.
- Eat up to 100% of body weight per day.
Grass Carp are relatively rare; now is the time to act.
Management Action

- Prevent Grass Carp from attaining densities that cause adverse impacts
  - Science-based, adaptive management approach
  - Guide effective decision-making by management agencies
Adaptive Management Framework

- Informed by completed SDM process
- Uncertainty About Resource Response
- Emphasizes Learning While Doing

Adapted from US Department of the Interior Technical Guide
GC control and research collaborative structure

Lake Erie Committee & GLFC

Grass Carp Advisory Committee & Structured Decision Making

Removal

Early Detection

Research

Early Life History

Telemetry

Population Modeling

Novel Technology (Barriers, Attractants & eDNA)

Removal (Deer, Dog, Rabbit)

Early Life History (University of Toledo, USGS, Southern Illinois University)

Telemetry (University of Toledo)

Population Modeling (Southern Illinois University)

Novel Technology (University of Toledo, USGS, Southern Illinois University)
GC control and research collaborative structure

Lake Erie Committee & GLFC

Grass Carp Advisory Committee & Structured Decision Making

Removal

Early Detection

Early Life History

Telemetry

Population Modeling

Novel Technology (Barriers, Attractants & eDNA)

Research
Egg Sampling Methods

- Paired bongo net tows
  - Four boats
  - SpawnCast
- Sample processing
  - Eggs
  - Staging
  - Larval fish
- Seven rivers
  - Ohio = 5
  - Michigan = 2

Disclaimer: USGS SpawnCast is in beta testing and all data presented are provisional and subject to revision.
Egg Captures Highly Variable

**Sandusky**
- 2015: n=157
- 2016: n=420
- 2017: n=452
- 2018: n=518
- 2019: n=373
- 2020*: n=41
- 2021: n=167
- 2022: n=236

**Maumee**
- 2015*: n=0
- 2016*: n=0
- 2017: n=20
- 2018: n=49
- 2019: n=80
- 2020*: n=0
- 2021: n=225
- 2022: n=201

Eggs per Sample

*Note: * indicates years with no samples.
## No New Egg Detections

<table>
<thead>
<tr>
<th>River</th>
<th>Years Sampled</th>
<th>Number Samples</th>
<th>Number Samples with GC Eggs</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cuyahoga River</td>
<td>2019-2022</td>
<td>213</td>
<td>0</td>
</tr>
<tr>
<td>Huron River (OH)</td>
<td>2018, 2020-2022</td>
<td>107</td>
<td>0</td>
</tr>
<tr>
<td>Grand River (OH)</td>
<td>2022</td>
<td>26</td>
<td>0</td>
</tr>
<tr>
<td>St. Joseph River</td>
<td>2021-2022</td>
<td>35</td>
<td>0</td>
</tr>
<tr>
<td>Tittabawassee River</td>
<td>2021-2022</td>
<td>73</td>
<td>0</td>
</tr>
</tbody>
</table>
GC control and research collaborative structure

Lake Erie Committee & GLFC

Grass Carp Advisory Committee & Structured Decision Making

Removal
- Early Detection

Research
- Telemetry
- Population Modeling
- Novel Technology (Barriers, Attractants & eDNA)

Early Life History
- UT

Population
- USGS
- SIU

Barriers, Attractants & eDNA

Early Detection

Population Modeling

Telemetry

Novel Technology (Barriers, Attractants & eDNA)

UT

USGS

SIU
Capture Methods

Spawning
- High Flows
- Multiple Boats
- Electrofishing Only
- High Catch

Non-Spawning
- Fish not Aggregated
- Usually One Boat
- Electrofishing and Trammel Nets
- Variable Catch
Effort to remove Grass Carp is increasing
Captures increasing but with variability

Number Grass Carp Captured (Western Basin)

Year

ELH and Removal’s Fit into Framework

- Assess problem
- Design
- Implement
- Evaluate
- Monitor
- Adjust

Diagram:

- Assess problem → Design → Implement → Evaluate → Monitor → Adjust → Assess problem
Adaptive Management in Action – Maumee River

Lake Erie Committee & GLFC

Grass Carp Advisory Committee & Structured Decision Making

Removal

Early Detection

Research

Early Life History

Telemetry

Population Modeling

Novel Technology (Barriers, Attractants & eDNA)

Research Institutions:
- Lake Erie Committee & GLFC
- Grass Carp Advisory Committee
- Structured Decision Making

Early Life History Institutions:
- Early Life History
- Telemetry
- Population Modeling

Novel Technology Institutions:
- Novel Technology
ELH Research can Inform Removal Crews

1. Increased adult captures
2. Knowledge of potential spawning locations

Removal

Predicted spawning locations, notify removal crews in real time

Early Life History

1. Egg sampling
   a. SpawnCast
2. Egg staging
3. FluEgg

Let's see this in action
Adaptive Management in Action

UT Egg Sampling in Lower Maumee
Where do they Spawn? Let’s ask FluEgg
Predicted Maumee Spawning Locations

Legend
- Maumee River
- Dam
- Egg Captures
- Potential Spawning Area (model predicted)
- Known Spawning Location

USGS FluEgg modelling results are provisional and subject to revision.
Adaptive Management in Action

UT Egg Sampling in Lower Maumee

USGS FluEgg Model Predicts Spawning Above Mary Jane Thurston Dam

USFWS Scouted Area First Trip Resulted in Grass Carp Capture
Adaptive Management in Action

UT Egg Sampling in Lower Maumee

USGS FluEgg Model Predicts Spawning Above Mary Jane Thurston Dam

USFWS Scouted Area  
First Trip Resulted in Grass Carp Capture

Most Captures in Maumee Ever  
More Upstream ‘22 than Entire River ‘20-’21
Captures vary by Location

Legend
- Maumee River
- Egg Captures
- Potential Spawning Area (model predicted)
- Adult Captures (2022)
- Adult Captures (2020-2021)
- Known Spawning Location

USGS FluEgg modelling results are provisional and subject to revision.
Captures vary by Location

Legend
- Maumee River
- Egg Captures
- Potential Spawning Area (model predicted)
- Adult Captures (2022)
- Adult Captures (2020-2021)
- Known Spawning Location

USGS FluEgg modelling results are provisional and subject to revision

 thì the map shows captures of adult fish vary by location along the Maumee River. The map highlights Defiance and Toledo regions with different symbols representing different types of captures and potential spawning areas.
How do Removal Crews inform ELH?

Removal

1. Increased adult captures
2. Knowledge of potential spawning locations

Early Life History

1. Egg sampling
   a. SpawnCast
2. Egg staging
3. FluEgg

Predicted spawning locations, notify removal crews in real time
New Locations and Truthing

1. Increased adult captures
2. Knowledge of potential spawning locations

Removal

Adult capture locations, new rivers with adults, ground truth models

Early Life History

1. Egg sampling
   a. SpawnCast
2. Egg staging
3. FluEgg

Predicted spawning locations, notify removal crews in real time
Sample these areas for adults and early life history next spawning season.
Adaptive Management Showing Early Success

- Large coordinated removal and research effort
- Removal increases with effort
- Feedback loop
  - Early life history research helps target increased adult removals
  - Removal crews inform ELH of high-risk tributaries
  - Not isolated to these two groups
GC control and research collaborative structure

Lake Erie Committee & GLFC

Grass Carp Advisory Committee & Structured Decision Making

Removal

Early Detection

Research

Early Life History

Telemetry

Population Modeling

Novel Technology (Barriers, Attractants & eDNA)
Adaptive Management Showing Early Success

• Large coordinated removal and research effort

• Removal increases with effort

• Feedback loop
  • Early life history research helps target increased adult removals
  • Removal crews inform ELH of high-risk tributaries
  • Not isolated to these two groups

More Than Any One Organization Could Do Alone
Thank You