GRASS CARP IN LAKE ERIE: HISTORY, STATUS, AND HABITAT

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Photo: mdc.mo.gov
MULTI AGENCY EFFORTS

Ohio DNR
Michigan DNR
Fish & Wildlife Service
USGS
Fisheries & Oceans Canada
Ontario MNR
University of Windsor
University of Toronto
Bowling Green State University
University of Toledo
Holly Embke, Christine Mayer, Song Qian
All of the techs!
“Asian carp” is not a species.

This term gives me nightmares....
This is a Black Carp

…Common Carp

This is a Silver Carp

…Bighead Carp

…and this is a Silver Carp

eDNA - NO SPECIES?

…Silver Carp
“ASIAN CARPS” HISTORY

- Brought to U.S. in 60’s & 70’s for use in aquaculture ponds
  - Escaped into Mississippi River basin

- Black Carp: No observations in GL
- Silver Carp: eDNA in Lake MI & Erie, no captures
- Bighead Carp: 3 captures in Lake Erie (1997/2000), no eDNA
- Grass Carp: captures throughout Great Lakes, except Lake Superior
GRASS CARP IN LAKE ERIE
IMPACTS OF GRASS CARP

- Consume large amounts of aquatic vegetation
  - 20–100% of body weight per day
- Damage wetland ecosystems
- Impacts on native fish species, invertebrates, waterfowl
- May promote algal blooms

Fieldandstream.com
Timeline of Grass Carp in Lake Erie

1963: GC imported to US
Timeline of Grass Carp in Lake Erie

- **1963**: GC imported to US
- **1983**: Triploid process
Timeline of Grass Carp in Lake Erie

- 1963: GC imported to US
- 1983: Triploid process
- 1985: 1st GC found LE
Timeline of Grass Carp in Lake Erie

1963: GC imported to US
1983: 1st GC found LE
1985: Triploid process
2012: 6 juv GC likely from Sandusky River
Timeline of Grass Carp in Lake Erie

Eight fertilized eggs found and genetically confirmed

1963
1983
1985
2015

Spawning confirmed Sandusky River
Timeline of Grass Carp in Lake Erie

- 1963: GC imported to US
- 1983: Triploid process
- 1985: 1st GC found LE
- 2012: 6 juv GC likely from Sandusky River
- 2015: Spawning confirmed Sandusky
- 2016+: Continued sampling of Rivers
GRASS CARP CAPTURES IN LAKE ERIE

Report your sightings!

nas.er.usgs.gov
UT student discovers first grass carp eggs in Great Lakes tributary

By Christine Billau : June 2nd, 2016

A graduate student at The University of Toledo is the first researcher to find direct proof of grass carp, a type of invasive fish species, in a Great Lakes tributary.

Last summer in the Sandusky River, which flows into Lake Erie, she and Lake Erie’s Sandusky Bay after a period of heavy rains.
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HOW WE SAMPLE

(50 lbs. dog for scale)
SANDUSKY RIVER SPAWNING

2015: 4 events
- June 18, 29
- July 1, 13-14

2016: 0 detected

2017: 2 events
- May 30- June 1
- July 12

2018: 2 events
- May 23-25
- June 11-13

2019: 4 events
- May 29-30
- June 3-5, 17-20
- July 23
SPAWNNG DURING HIGH FLOWS

Flow needed to suspend eggs
SPAWNING DURING HIGH FLOWS
SPAWNING DURING HIGH FLOWS
SPAWNING DURING HIGH FLOWS

Sandusky River Discharge 2018

Sampling Dates
- No Eggs
- Eggs

Year
- 2015
- 2016
- 2017
- 2018

Discharge (cfs)

Date

SPAWNING DURING HIGH FLOWS

Sandusky River Discharge 2019

Sampling Dates
- No Eggs
- Eggs

Year
- 2015
- 2016
- 2017
- 2018
- 2019

Discharge (cfs)

Date
- 15 May
- 25 May
- 4 Jun
- 14 Jun
- 24 Jun
- 4 Jul
- 14 Jul
- 24 Jul
- 3 Aug
- 13 Aug
- 23 Aug
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EGGS ARE DEVELOPING

Stage 3

Stage 8

Stage 14

Stage 25

Photos: M. Tomczak

From Yi et al. 2006
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DO EGGS HATCH IN RIVER?

From Yi et al. 2006
DO EGGS HATCH IN RIVER?

- Development based on temperature
- Location in river based on flow

~9000 cfs
Stage 25

~2500 cfs
Stage 26
DO EGGS HATCH IN RIVER?
Heer, T., Wells, M.G., Jackson, P.R., Mandrak, N.E. Modelling Grass Carp egg transport using a 3-D hydrodynamic river model: The role of egg retention in dead zones on spawning success. In Review.
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FLUEGG ESTIMATED SPAWNING GROUNDS
2018 ODNR PLANNED ACTION & SPAWNING GROUND VERIFICATION

Brady’s Island

HWY 20
FURTHER VERIFICATION OF SPAWNING GROUNDS

Newly spawned eggs upstream of HWY 20
POST BALLVILLE DAM REMOVAL?

Impassable barrier at RKM 26 removed fall 2018

- Changes in river hydrology?
- Spawning location change?
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<td>Fremont… for now</td>
</tr>
<tr>
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But first.......... more bad news
MAUMEE RIVER SPAWNING

2017
July 13

2018
June 11-14
June 23-27

2019
May 29-?
In progress
2018: EGGS CAN HATCH IN RIVER
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REMOVAL AND RESEARCH EFFORTS

Objectives

- Secure aquaculture supply chain & bait
- Further research: life history, monitoring, minimize expansion, reduce populations
- Removal efforts (partners & commercial fishermen)
- Evaluate potential barriers
REMOVAL AND RESEARCH EFFORTS (U.S.)

UT/ODNR/MDNR/FWS - Strike Teams
(shock boat, nets, tracking on receivers, processing fish)

155+ Grass Carp removed in 2019!
BACK CALCULATING BIRTH YEARS

Diploid Birth Year

Number of Grass Carp

Birth Year

Data: USGS, ODNR, MDNR

Figure: Sabrina Jaffe, University of Toledo
REMOVAL AND RESEARCH EFFORTS

- Early detection
  - eDNA, surveillance
- Identify spawning locations
  - otolith microchemistry
  - egg collection, modeling
- Population estimates
  - genetics, mark-recapture, modeling
- Capture probability
- Baits & attractants
- Seasonal barriers
GRASS CARP ARE SPAWNING & EGGS ARE HATCHING: WHAT DOES THIS MEAN FOR ERIE?

- Eggs/Larvae ≠ recruitment
- Population unknown
- Possible damage to aquatic vegetation and wetlands
- Similar spawning requirements to other carp species (bighead, silver, black)
HABITAT:
SAV SURVEYS IN LAKE ERIE

Nicole King – University of Toledo Lake Erie Center
Jenny Hanson & Travis Harrison – USGS Upper Midwest Environmental Science Center
3-TIER ASSESSMENT

1. Object Based Image Analysis (OBIA)

2. Hydroacoustics

3. Rake Surveys
3-TIER ASSESSMENT

1. Object Based Image Analysis (OBIA)

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3-TIER ASSESSMENT

1. Object Based Image Analysis (OBIA)

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3. Rake Surveys
## Method Comparison

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<th>Method</th>
<th>Pros</th>
<th>Cons</th>
</tr>
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</table>
| OBIA   | - Large-scale mapping  
        - Provides starting point for likely submerged aquatic vegetation (SAV) locations  
        - Fast results | - Uses outdated imagery  
        - No community data |
| Sonar  | - Accurate detection of SAV | - Several transects needed/time consuming  
        - No community data |
| Rake   | - Community level data | - Time consuming  
        - Point data |
1. Aerial imagery and bathymetric contours were downloaded

2. Multispectral analysis using Trimble’s eCognition
   - visible light
   - near-infra red

3. Ruleset created and used to classify aquatic vegetation

4. Results exported and edited in ESRI’s ArcGIS.
   - Add density modifiers
VEGETATION MAPS: OBIA

[Images of vegetation maps with data points and tables showing acreages and hectares for different areas.]
VEGETATION SURVEYS: HYDROACOUSTICS
VEGETATION SURVEYS: RAKE SAMPLING

<table>
<thead>
<tr>
<th>SAV Species</th>
<th>Preference</th>
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<tbody>
<tr>
<td><em>Cladophora</em> spp.</td>
<td>High</td>
</tr>
<tr>
<td><em>Ceratophyllum demersum</em> (Coontail)</td>
<td>Low</td>
</tr>
<tr>
<td><em>Elodea canadensis</em> (Waterweed)</td>
<td>High</td>
</tr>
<tr>
<td><em>Heterantha dubia</em> (Water Stargrass)</td>
<td>High</td>
</tr>
<tr>
<td><em>Myriophyllum spicatum</em> (Eurasian Water Milfoil)</td>
<td>Med</td>
</tr>
<tr>
<td><em>Myriophyllum spp.</em> (Milfoil)</td>
<td>Med</td>
</tr>
<tr>
<td><em>Najas gracillima</em> (Slender Waternymph)</td>
<td>High</td>
</tr>
<tr>
<td><em>Najas guadalupensis</em> (Southern Waternymph)</td>
<td>High</td>
</tr>
<tr>
<td><em>Nitellopsis obtusa</em> (Starry stonewort)</td>
<td>High</td>
</tr>
<tr>
<td><em>Potamogeton nodosus</em> (Long-leaved Pondweed)</td>
<td>High</td>
</tr>
<tr>
<td><em>Potamogeton pectinatus</em> (Sago Pondweed)</td>
<td>High</td>
</tr>
<tr>
<td><em>Potamogeton pusillus</em> (Small Pondweed)</td>
<td>High</td>
</tr>
<tr>
<td><em>Potamogeton richardsonii</em> (Clasping Leaved Pondweed)</td>
<td>High</td>
</tr>
<tr>
<td><em>Vallisneria americana</em> (Eelgrass)</td>
<td>High</td>
</tr>
<tr>
<td><em>Zannichellia palustris</em> (Horned Pondweed)</td>
<td>High</td>
</tr>
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IDENTIFYING GC PREFERRED HABITAT
Method Agreement – Presence/Absence of SAV
- Rake Sampling & Hydroacoustics – 93% agreement
- Rake Sampling & OBIA – 69% agreement
- Hydroacoustics & OBIA – 54% agreement *increased to 72% agreement when SAV density >50% (hydroacoustics)

Hydroacoustics best at detecting presence/absence
OBIA difficulty detecting sparse SAV
Rake sometimes misses SAV when sparse or sporadic
Baseline data

• Track changes in distribution, density, community composition
  • changes *possibly* due to Grass Carp herbivory
• Comparing data and methods with others including TNC & Cleveland Metroparks
Questions?

Nicole.King2@UToledo.edu
PKocovsky@USGS.gov
DO EGGS HATCH IN RIVER?

10:30AM  6:30PM

7.12.17

Stage

20.9  19.2  17.1  12.4  10.1A  10.1B  6.5  4.3  2.7  1.6

RKM

flow
CUMULATIVE THERMAL UNITS

CTU = $t(T_c - T_{min})$

- $t = \text{time in hours}$
- $T_c = \text{treatment temperature in degrees Celsius}$
- $T_{min} = \text{thermal minimum in degrees Celsius}$

CTU = 9.915
Stage 3

CTU = 184.279
Stage 25

Development based on temperature

- CTU from George & Chapman 2015
- Temp of river (USGS gauge 04198000)

Hours post fertilization = $\frac{\text{CTU}}{(T - 13.5)}$

CTU=9.915, Water temp=20.48°C

Fertilization time = Capture time - HPF

11:27am - 12:53pm = 1.42