Assessing the spawning potential of Grass Carp in the Sandusky River

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Grass Carp

- Invasive herbivorous species of Asian Carp
- Diploid adults found throughout Mississippi River basin and in all Great Lakes, except Lake Superior
- Throughout literature, spawning is correlated with high flows
  - Semi-pelagic eggs kept in suspension
- Documentation of reproduction in the Sandusky River
  - First evidence in 2012
  - Direct confirmation in 2015

(https://www.noble.org/globalassets/images/news/ag-news-and-views/1997/06/grass-carp.jpg)

Objectives

1. Determine if Grass Carp are spawning in the Sandusky River
2. With spawning confirmation, determine most probable spawning locations using hydraulic modeling
3. Using estimated spawning locations, determine most likely hatch locations using hydraulic modeling

Field Sampling Methods

- Two sampling strategies:
  1. Egg sampling
     - Bongo net tows, five minutes each
     - 4 (2015)/5 (2016) sites, two points per site
     - ~10 km total distance
     - Once weekly - unless high flows, then 3x per week
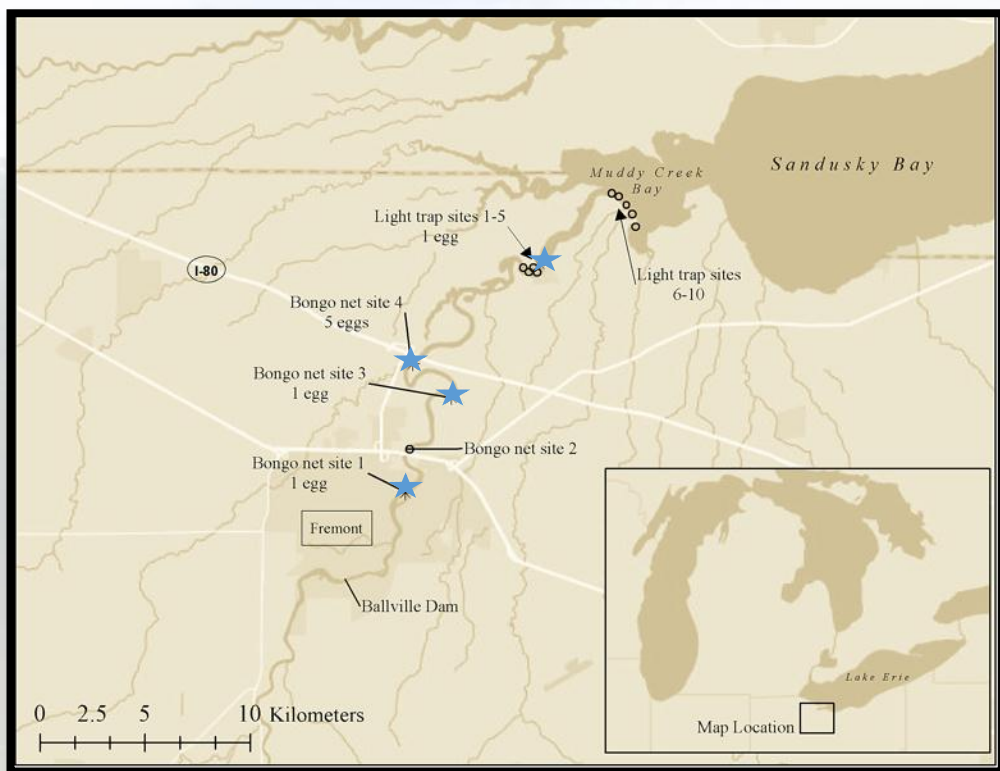

Bongo net (Holly Embke)

Field Sampling Methods

Light trap (Holly Embke)

- Two sampling strategies:
2. Larval fish sampling – larval light traps
   - Ten sites, three light traps per site
   - Retrieved after one hour
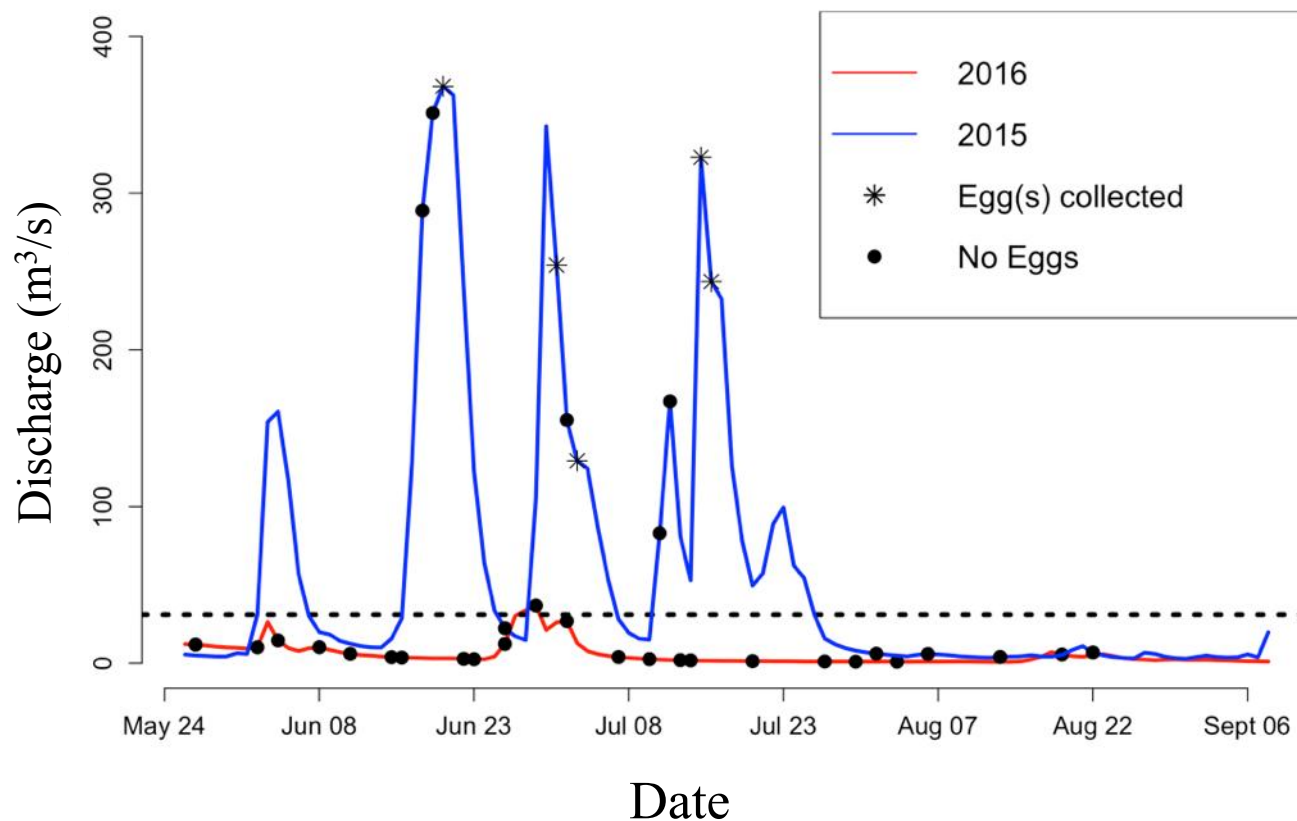   - Once weekly

Spawning Confirmed - 2015

Locations of eggs

- 8 eggs collected
  - 5 eggs genetically confirmed using q-PCR for Grass Carp-specific marker
  - Drift distance of ~17 km
- No Grass Carp larvae collected
- First direct confirmation of natural Grass Carp spawning in the Great Lakes basin

Embke et al., 2016 (JGLR)

Eggs + High Discharge

- 3 high-flow events
- All eggs collected day of peak flow or 1-2 days following peak

Discharge measurements from USGS gauge at Ballville Dam
(http://waterdata.usgs.gov/oh/nwis/inventory/?site_no=04198000)

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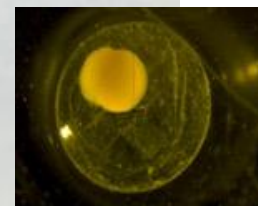
Real-Time Data for Model
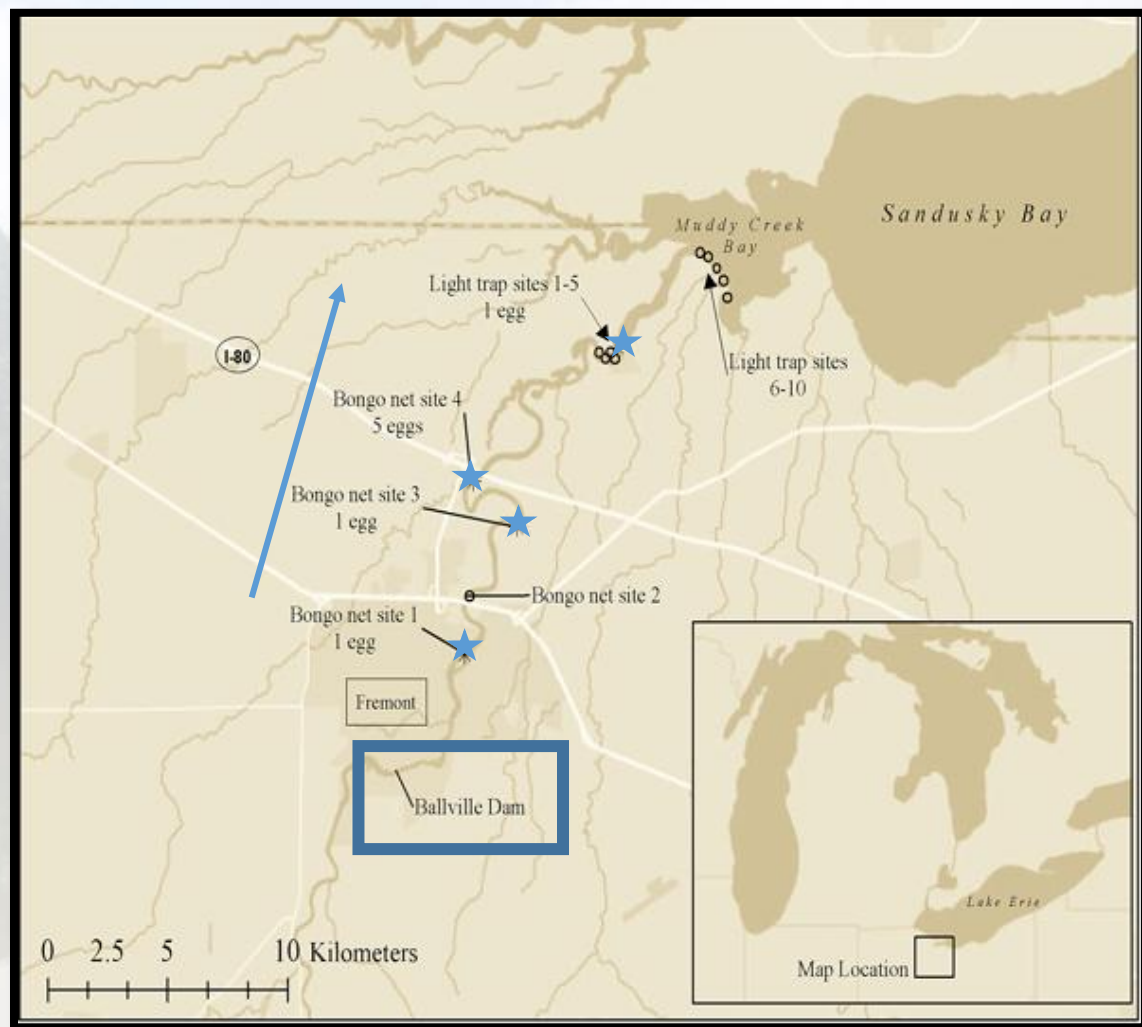
Locations of eggs in the Sandusky River

Developmental Stage(s)
2
8
10
9, 10, 10, 12
13
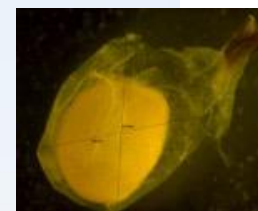
4-Step Modeling Process

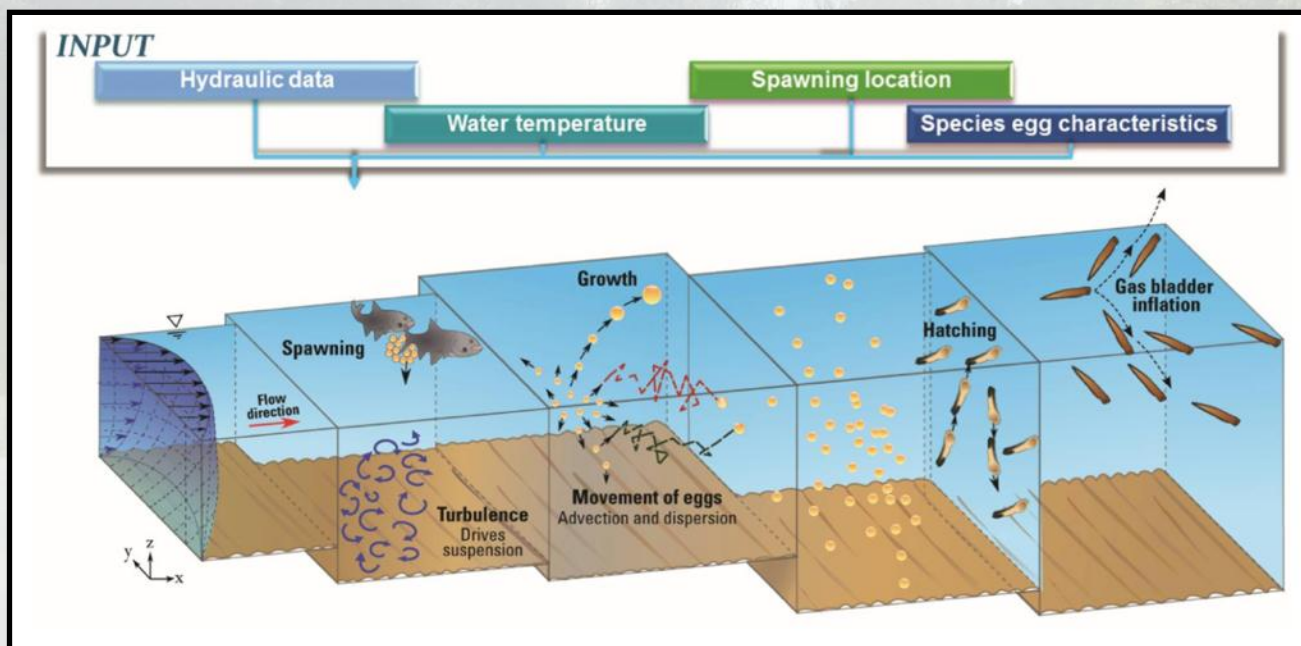1. HEC-RAS model simulations – hydraulic conditions

2. Fluvial Egg Drift Simulator (FluEgg)
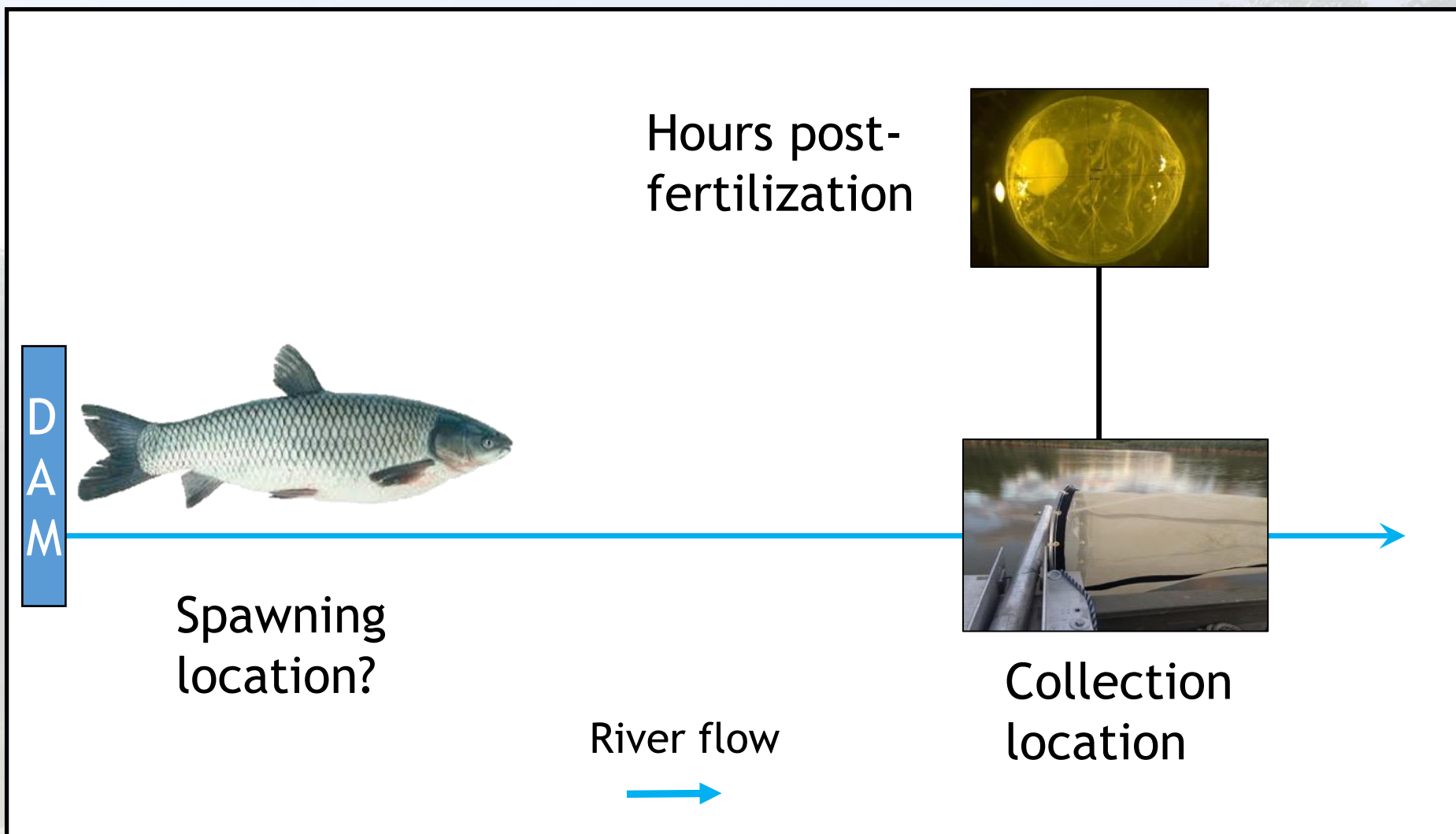
3. Probability distribution of spawning locations

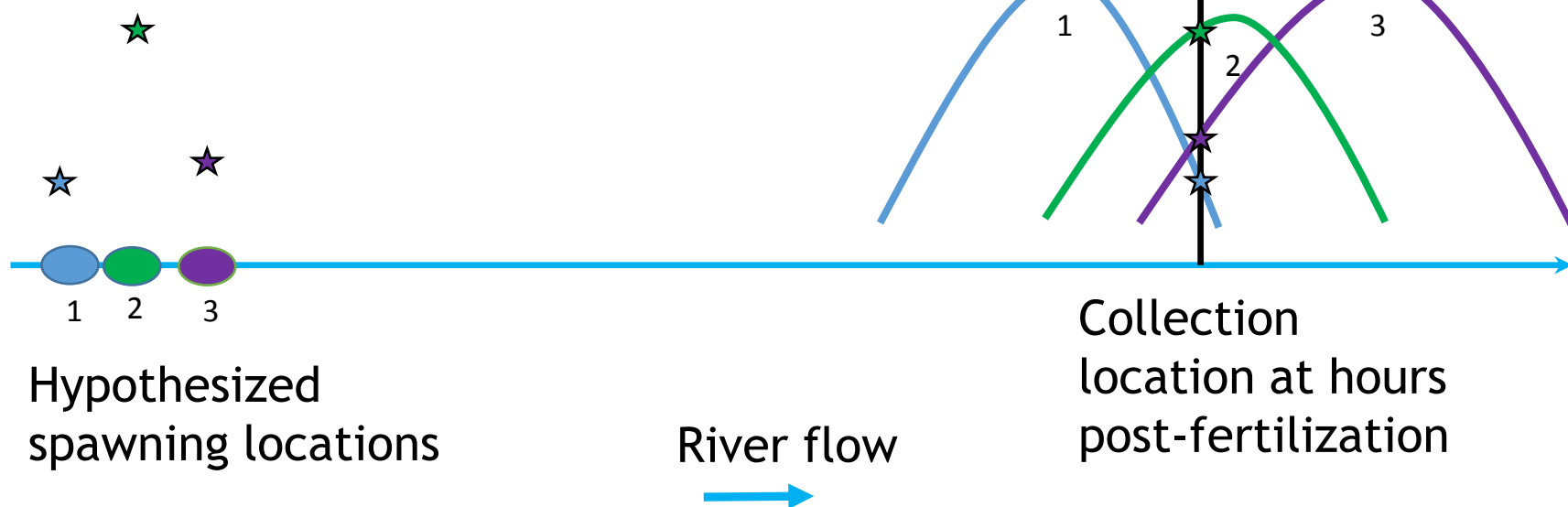4. Use spawning location prediction to determine hatch locations

FluEgg Background

- Model that tracks movement of Asian Carp eggs
- Breaks river into cells with discrete thermal and hydraulic characteristics
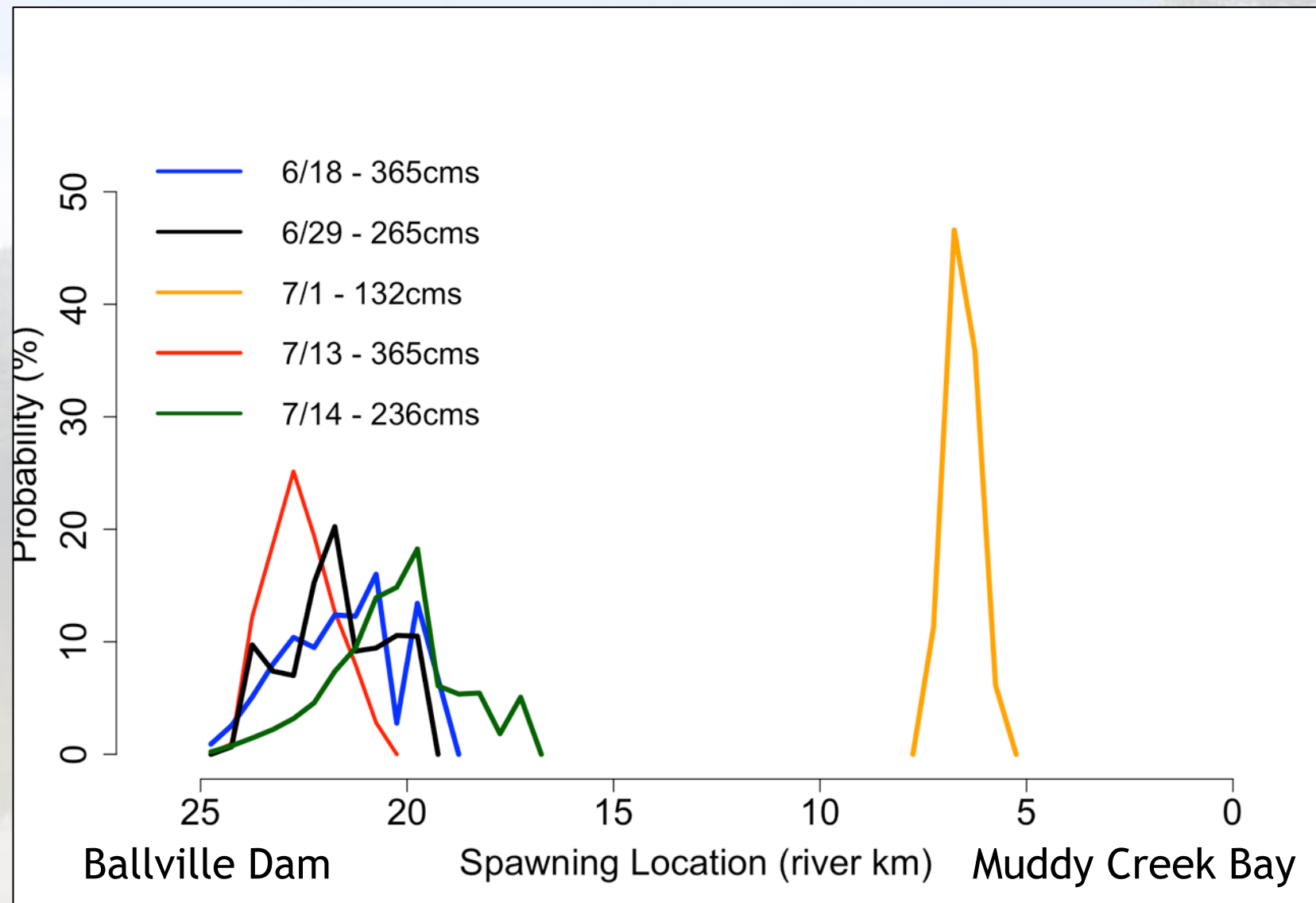- Run FluEgg separately for each date eggs collected (5 in total)
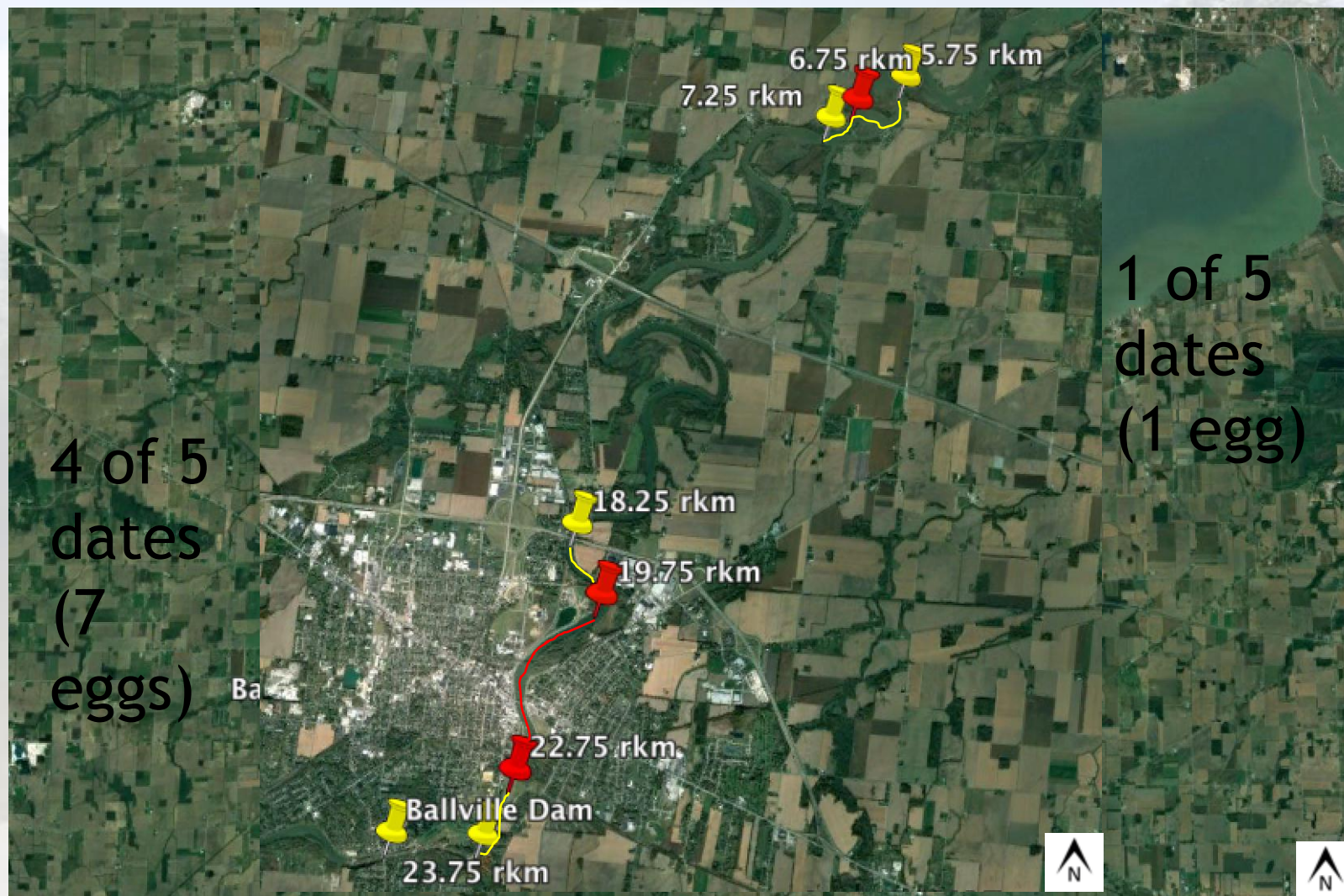

(Murphy et al., 2016)

Hours post-fertilization

Spawning location?

River flow

Collection location

DAM

Determining
Spawning Locations
- 1 set of conditions
(i.e. 1 date)

★ Intersection =
likelihoods

1

2

3

Collection
location at hours
post-fertilization

Hypothesized
spawning locations

1 2 3

River flow

Spawning Locations – All Eggs
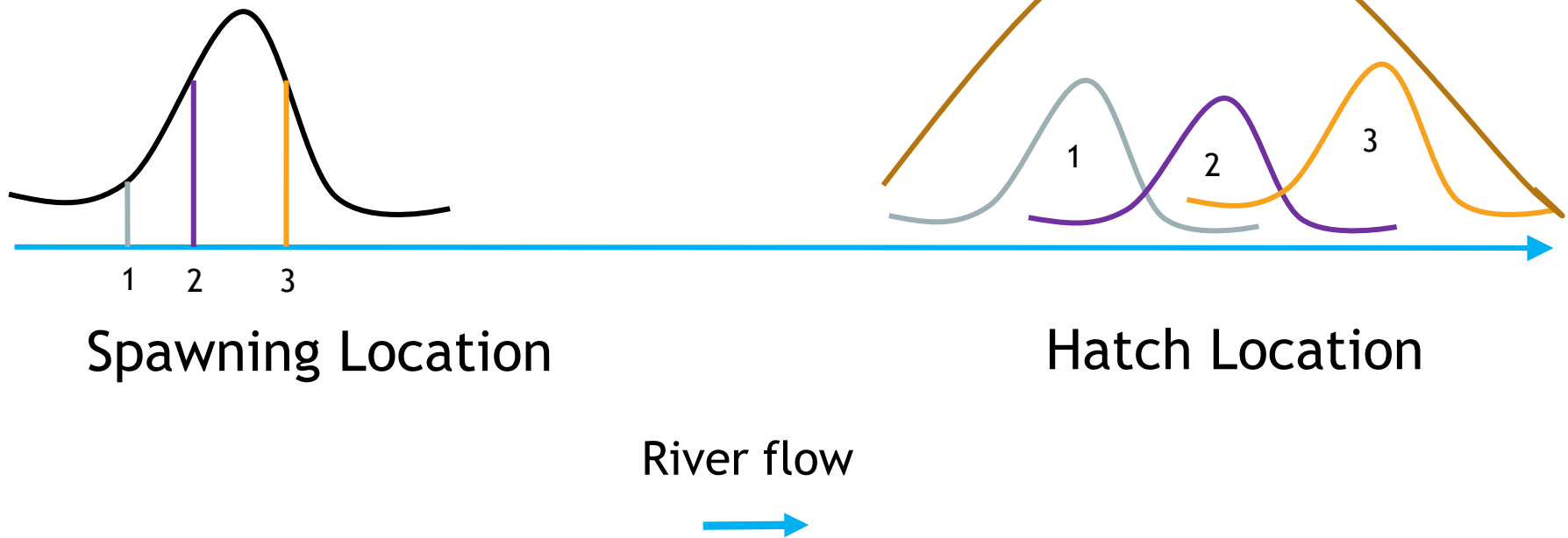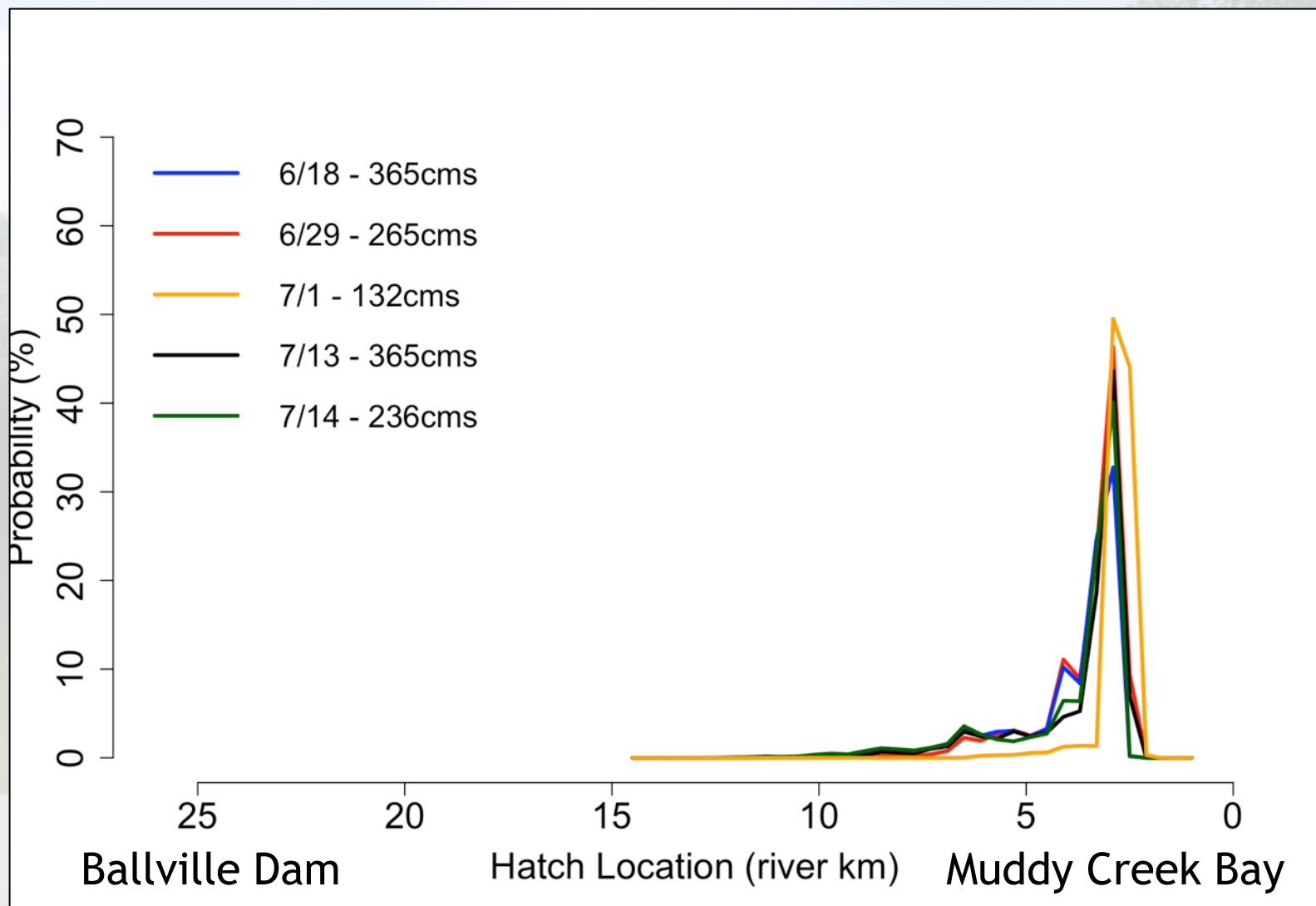
Spawning Locations – In River

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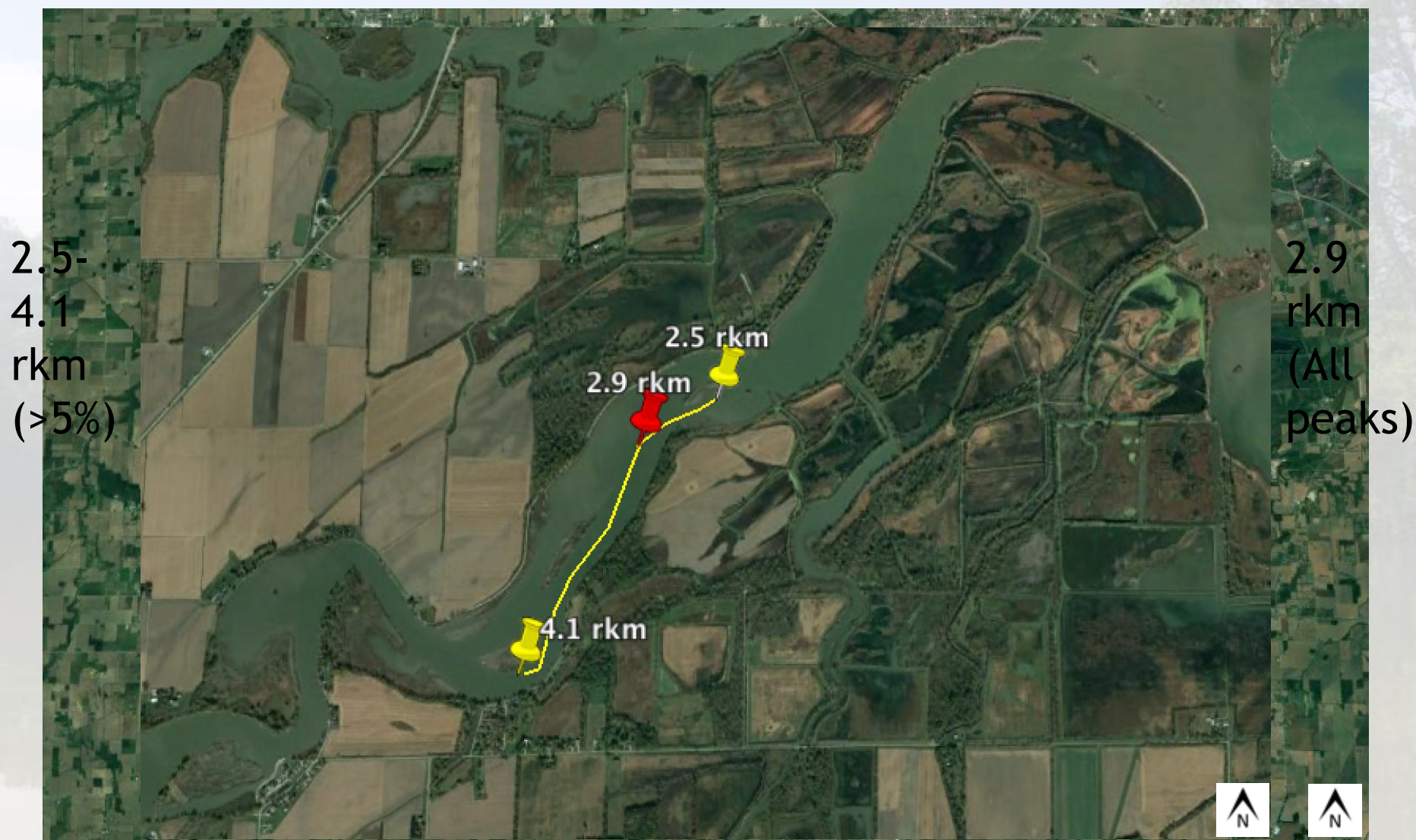
Determining Hatch Locations
- 1 set of conditions (i.e. 1 date)

Spawning Location

Hatch Location

River flow

Hatch Locations – All Eggs

Hatch Locations – In River

2.5-4.1 rkm (>5%)

2.9 rkm (All peaks)

2.5 rkm

2.9 rkm

4.1 rkm

Conclusions

- Natural spawning of Grass Carp in the Great Lakes basin confirmed

- High flows favor spawning in the Sandusky River

- Established methodology to estimate most probable spawning and hatch locations using collected data
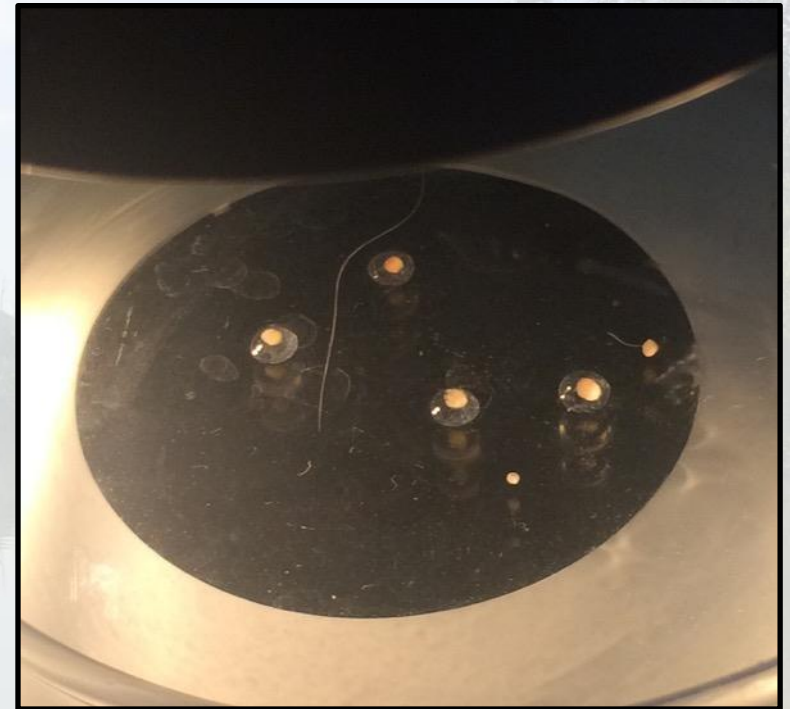
Grass Carp eggs

Future Work

- When updated ("unsteady-state") HEC-RAS is validated, re-run simulations

- Applications:
  - Modeling process can be used in other river systems to estimate sampling and hatch locations
  - Estimated spawning and hatch locations can be used for management actions
  - Expand sampling to similar systems to determine threat level of Grass Carp in the Great Lakes basin

Acknowledgments

- Ohio DNR – Division of Wildlife
- USGS Columbia Environmental Research Center
  - Amy George, Nathan Thompson
- University of Toledo
  - Ben Kuhaneck, Rachel Johnson, Nicole King
- Riverfront Marina

Questions?