

# Grass Carp Movement and Behavior: Acoustic telemetry

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# Grass Carp (GC) in the Laurentian Great Lakes: Lake Erie

## Threats

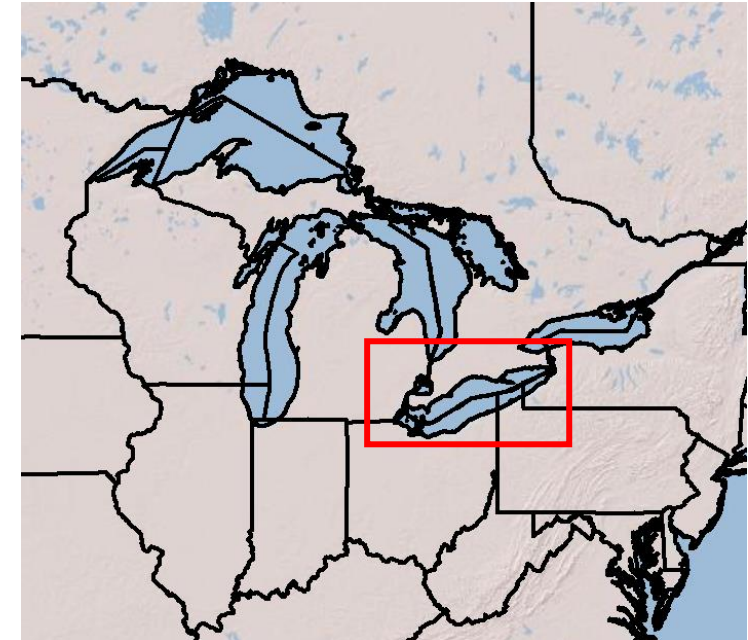
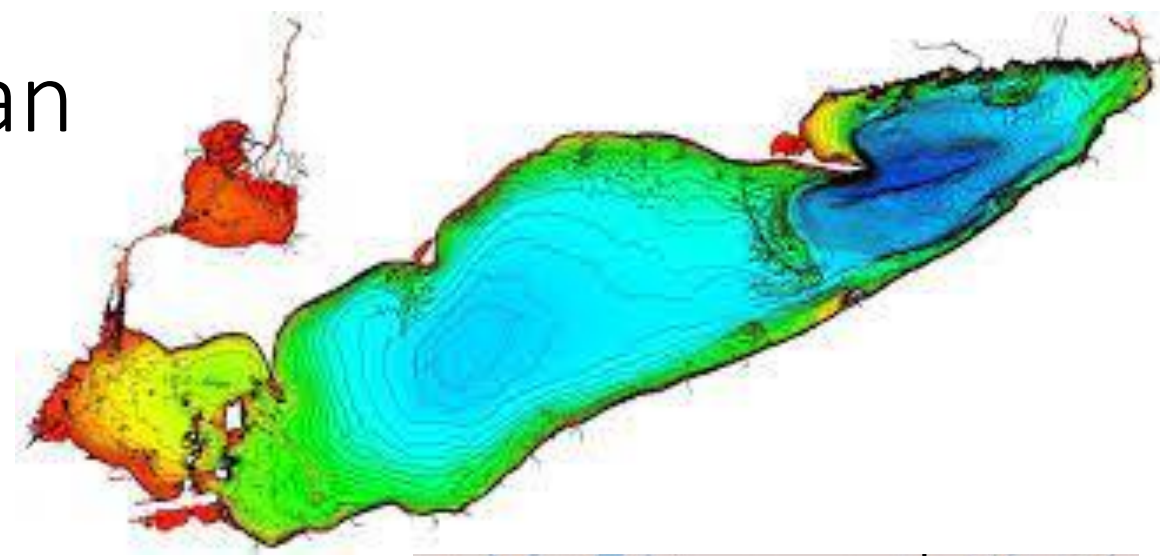
- Forages on Aquatic vegetation (Submerged and Emergent)
- Alter important habitat for juvenile fishes and waterfowl
  - Great Lakes coastal embayment and river mouths
- Long lived, large bodied

## Life History

- Spawn in rivers during Spring-Summer
  - Temperature  $>18^{\circ}\text{C}$  and High flows ( $>85\%$ )
- Juvenile recruitment and habitat use unknown
- Adults can return to lentic habitat and move long distance

## Management

- Grass Carp Advisory Committee (adaptive response strategy)
- Annual removal efforts 2018-present



# Research needs for eradication/removal

## Lake Erie GC adaptive response Strategy 2019-2023; LEC

- Understand Grass Carp preferred habitats, movement, and behavior
  - LEC 2020 Grass Carp priority: Expand nearshore telemetry array

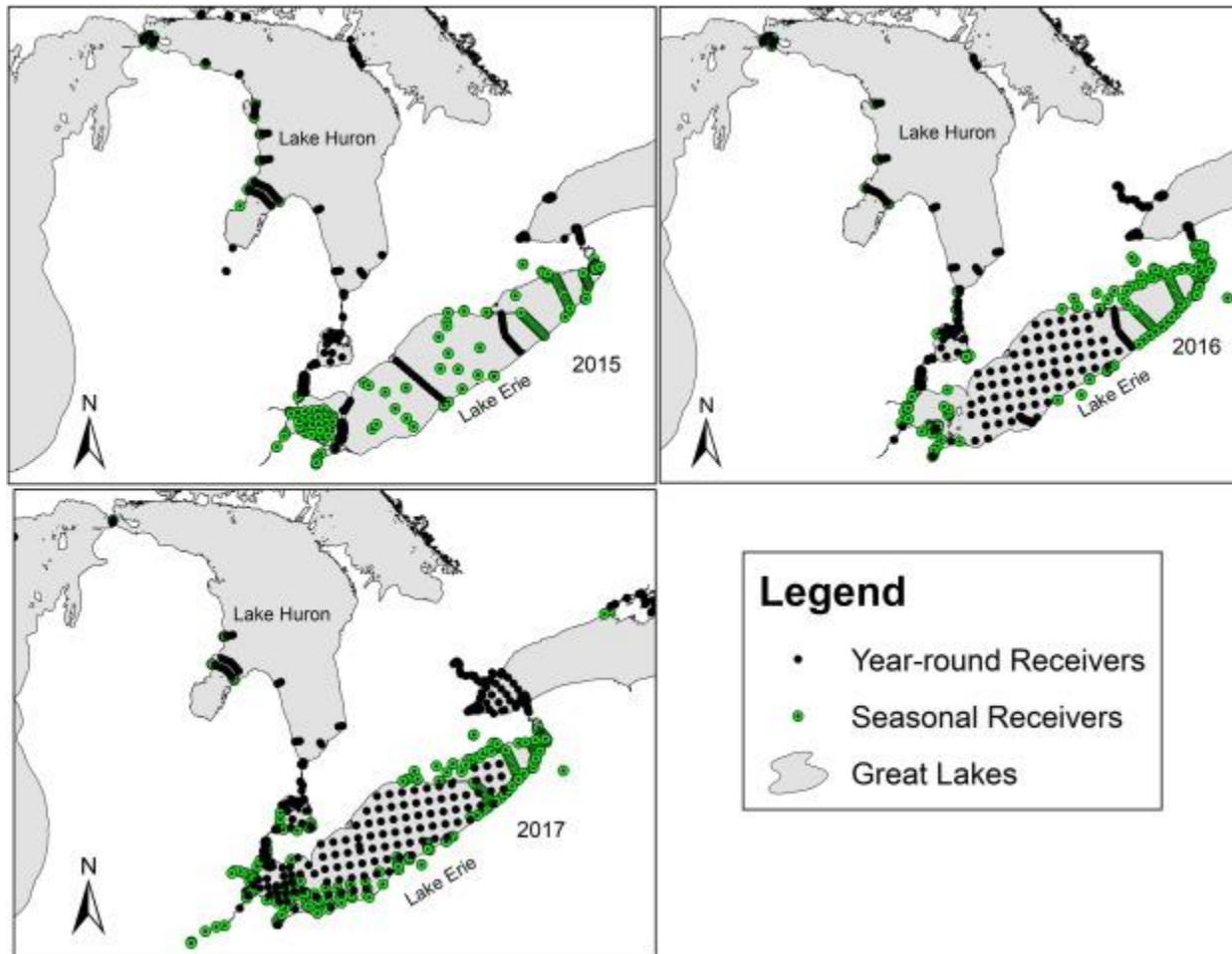
### **Goal: Understand the seasonal movements and habitat use of Grass Carp to aid and inform removal efforts**

- Objective 1-Understand lake-wide movements including nearshore and tributary habitats
- Objective 2-Determine fine-scale distribution and behavior in spawning tributaries





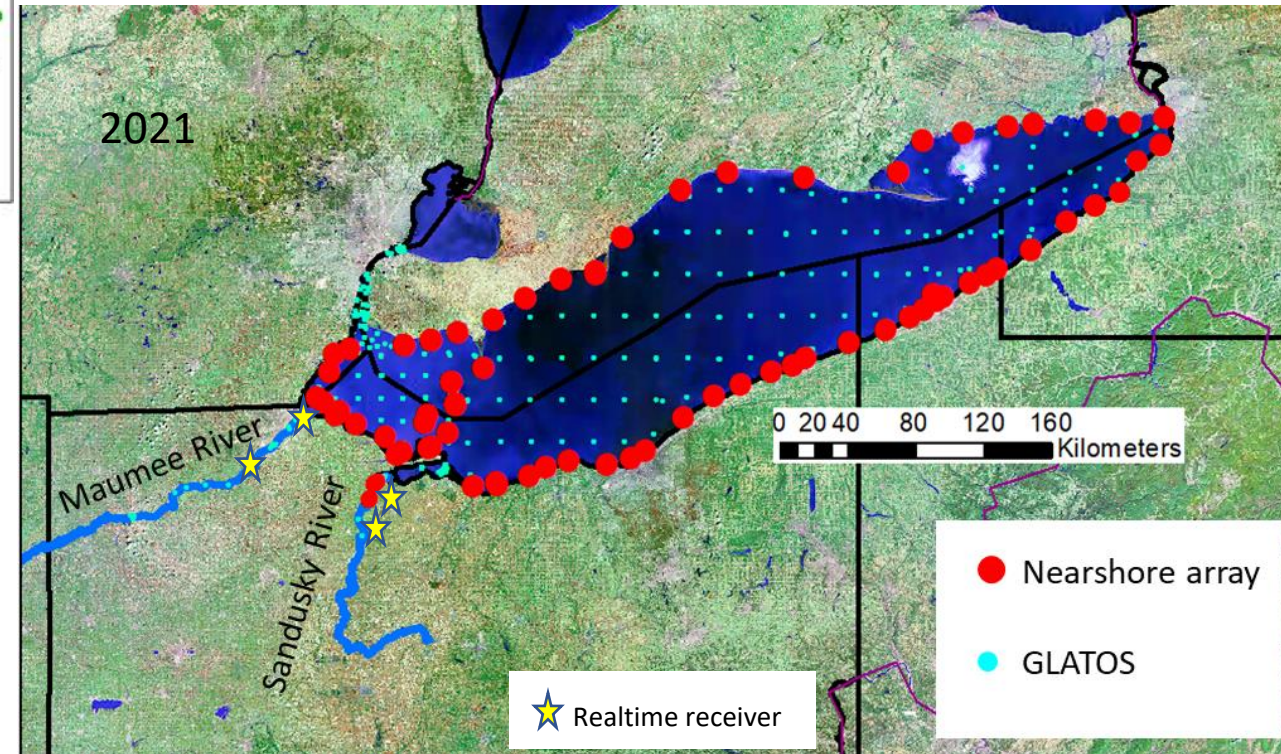
# Unique acoustic telemetry capabilities in Lake Erie



Harris et al. 2021; JGLR

## Lake Erie Grass Carp Nearshore Array

- Augment existing GLATOS arrays
- 72 receivers
- Full array starting in 2021
- Nearshore: <5m depth; <1km offshore



Vemco acoustic receivers VR2W; VR2Tx, VR2AR



# Tiered Grass Carp telemetry arrays in Lake Erie

## 1-Basin-wide: Lake Erie Grass Carp Nearshore Array

- Augment existing GLATOS arrays
- 72 receivers
- Full array starting in 2021
- Nearshore: <5m depth; <1km offshore

2022

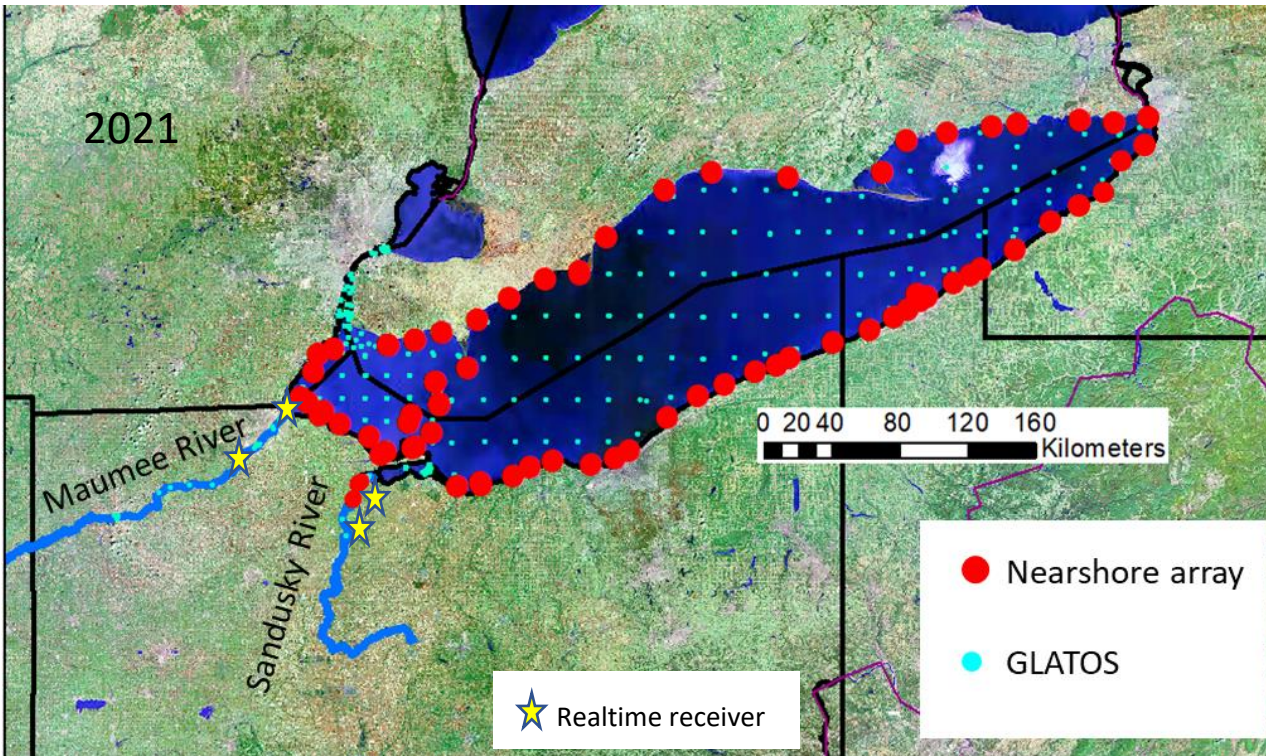
- 56 replaced with acoustic release

## 2-Fine-scale: Sandusky River array

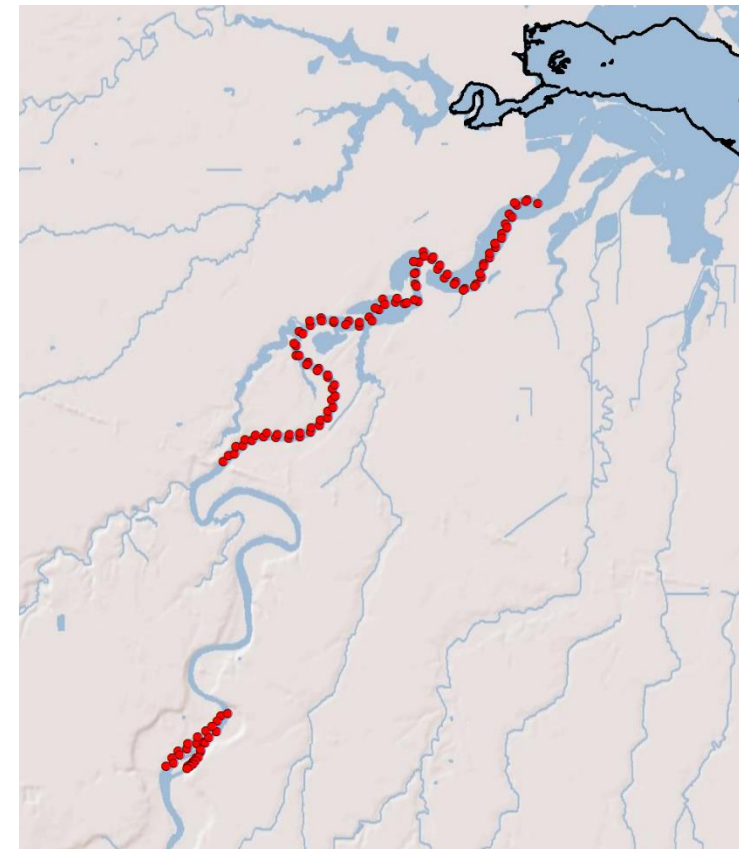
- Dense receiver arrays starting in 2020
- 2022 (Lower river, Brady's Island)
- 129 receiver total (VPS capabilities)

-2022 expansion by 60 receivers related to bait study in lower Sandusky (USGS-CERC)

Receivers collected in November 2022



Vemco/INNOVASEA acoustic receivers VR2W; VR2Tx, VR2AR

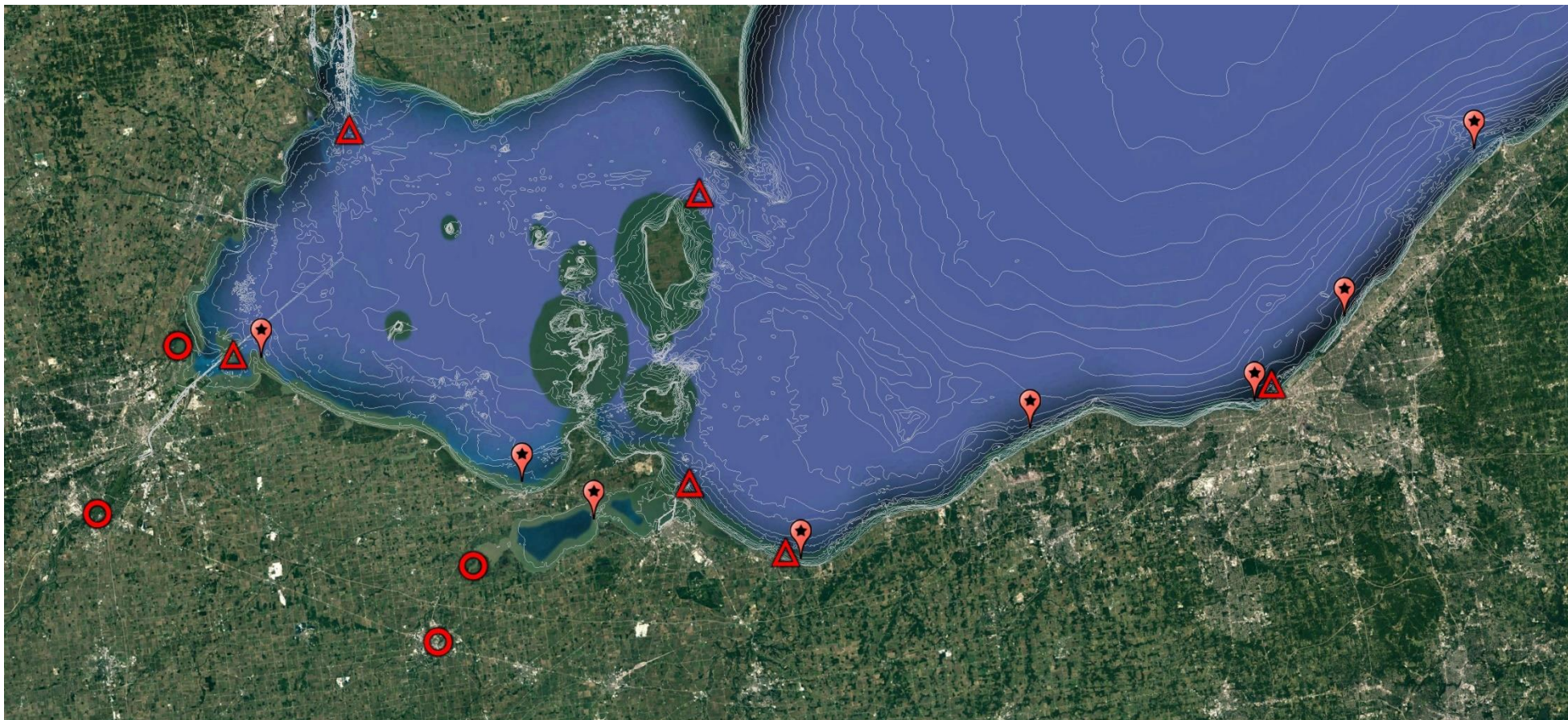




# 3-Alert array

- River real-time
  - Filtered alerts
- Near Real-time receivers
  - Monthly visits to river mouths
  - Email summaries?

- Setup of real-time buoys (~7)
  - Cleveland Water Alliance
  - Web interface
  - Email alerts?





# Grass Carp Movement Ecology: Lake Erie

## Methods and data

- 41 GC survived tagging
  - Harris et al. 2021
  - 95% diploid
  - V-16-4H (Vemco); ~6.7 yrs
- Time series from 2014 to present
- >8 million detections



## Previous results

- Most detections in west basin\*
- 1 GC moved into Lk. Huron\*
- GC not limited to only known spawning tributaries\*
- 1 GC moved to eastern basin of Lake Erie
- Seasonal patterns?



\*Harris et al. 2021

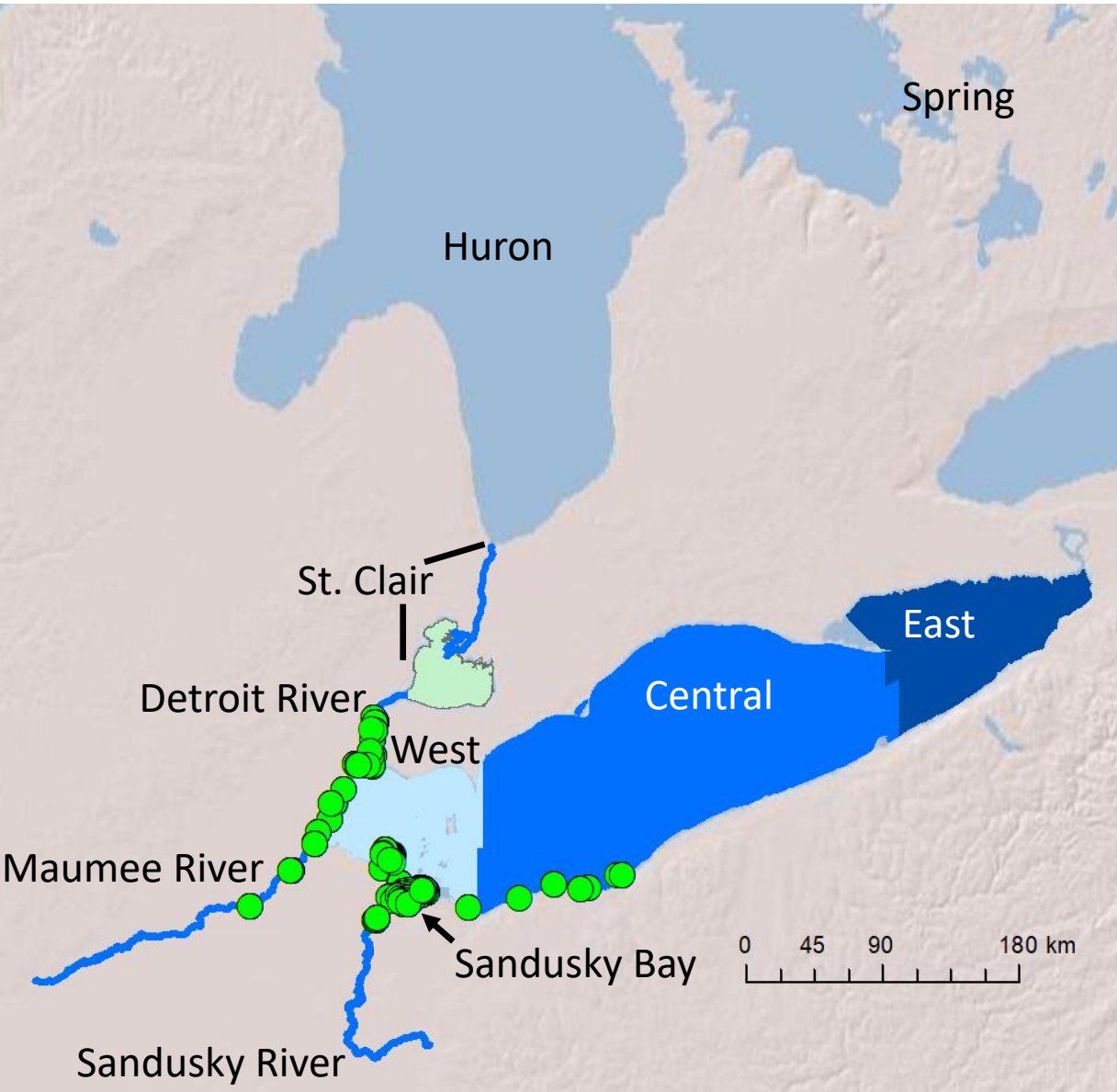
# Seasonal patterns (2014-2021)



- Winter
  - 2 Basins – Central, West
  - 3 Major Rivers – Detroit, Sandusky, Maumee
  - 2 Coastal – Sandusky Bay, Nearshore



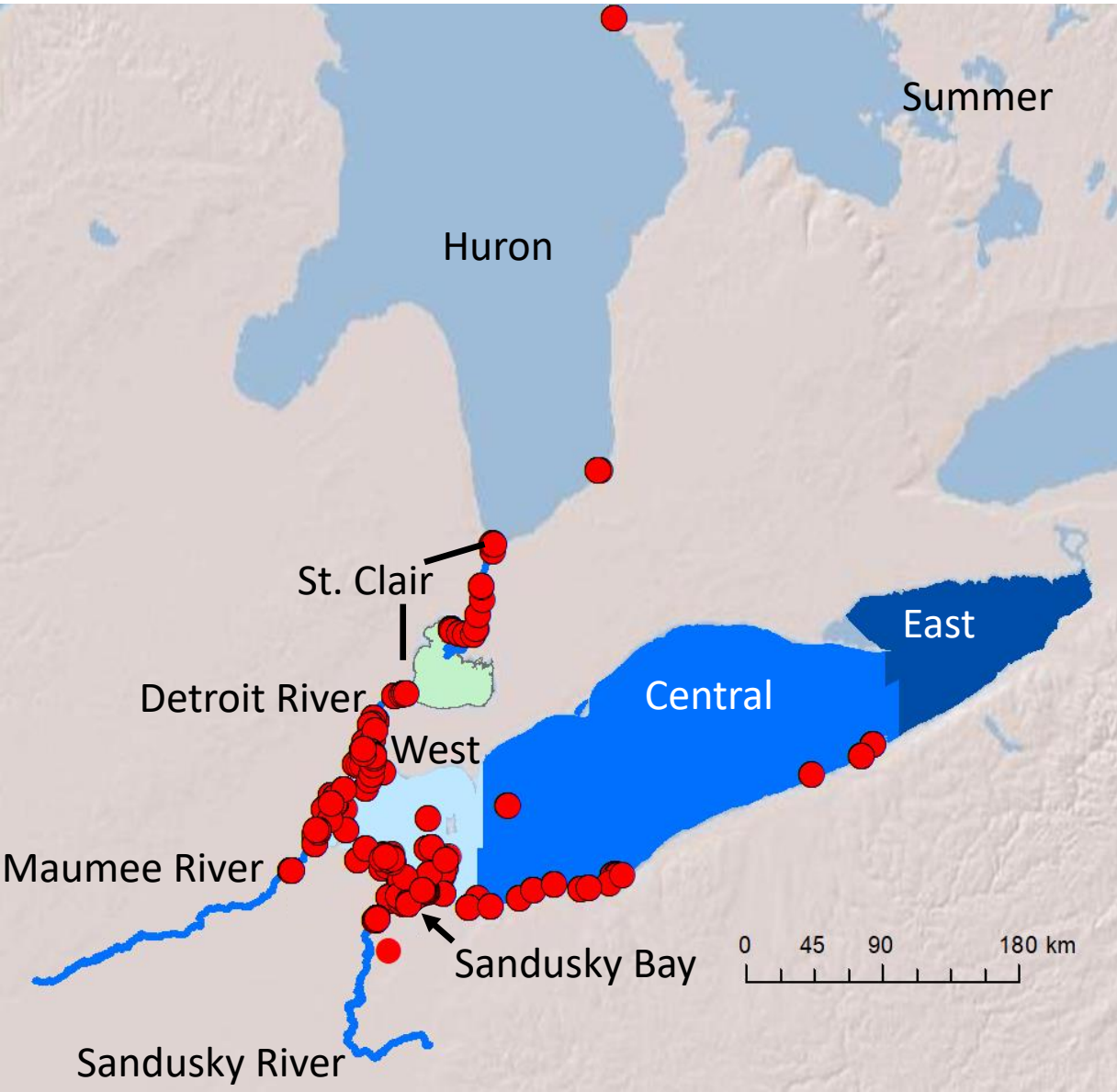
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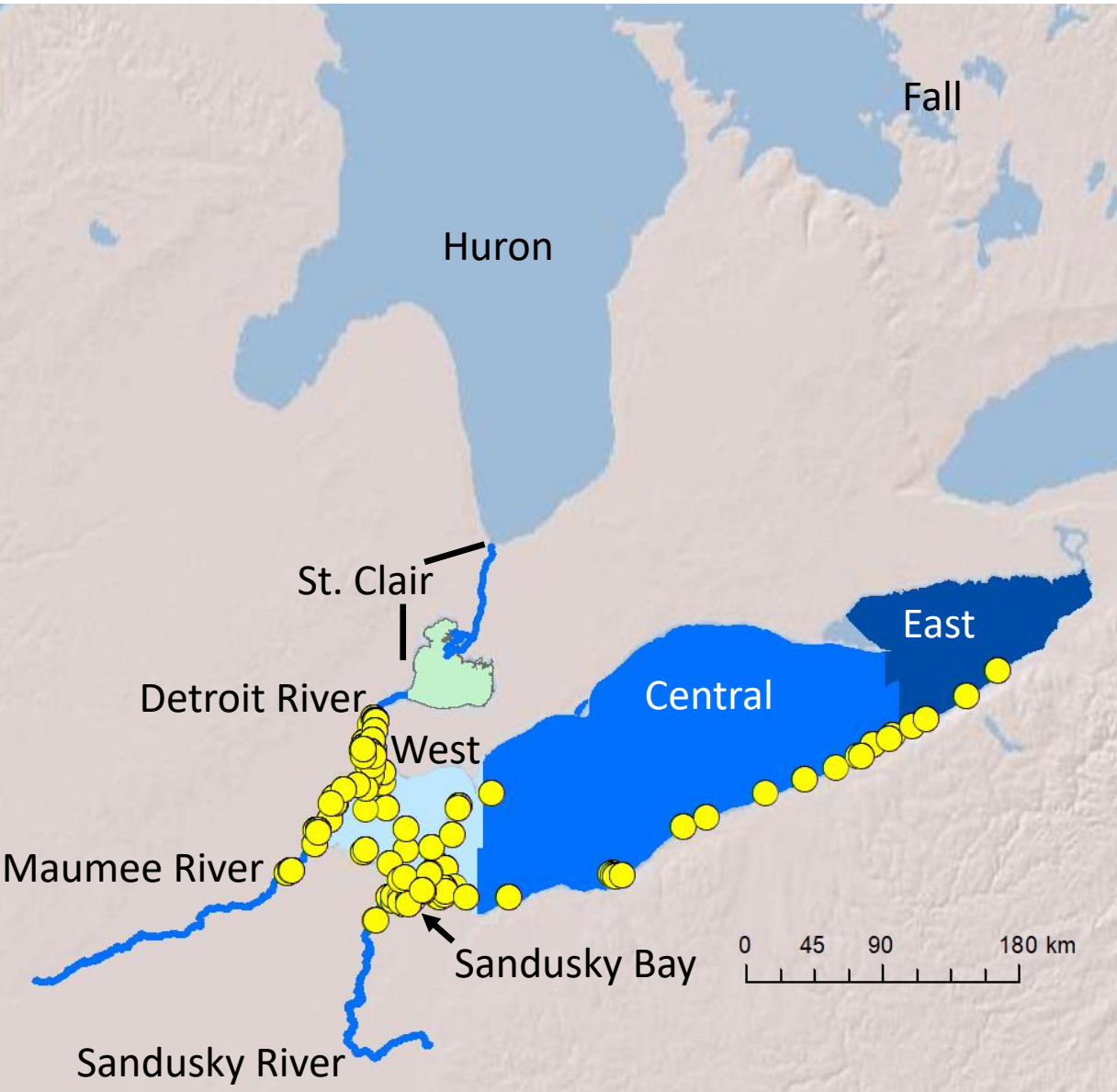
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- Winter
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  - 2 Coastal – Sandusky Bay, Nearshore
- Spring
  - 2 Basins – Central, West
  - 3 Major Rivers – Detroit, Sandusky, Maumee
  - 2 Coastal – Sandusky Bay, Nearshore
- Summer
  - 4 Basins – Central, West, St. Clair, Huron
  - 4 Major Rivers – Detroit, Sandusky, Maumee, St. Clair
  - 3 Coastal – Sandusky Bay, Nearshore, Islands



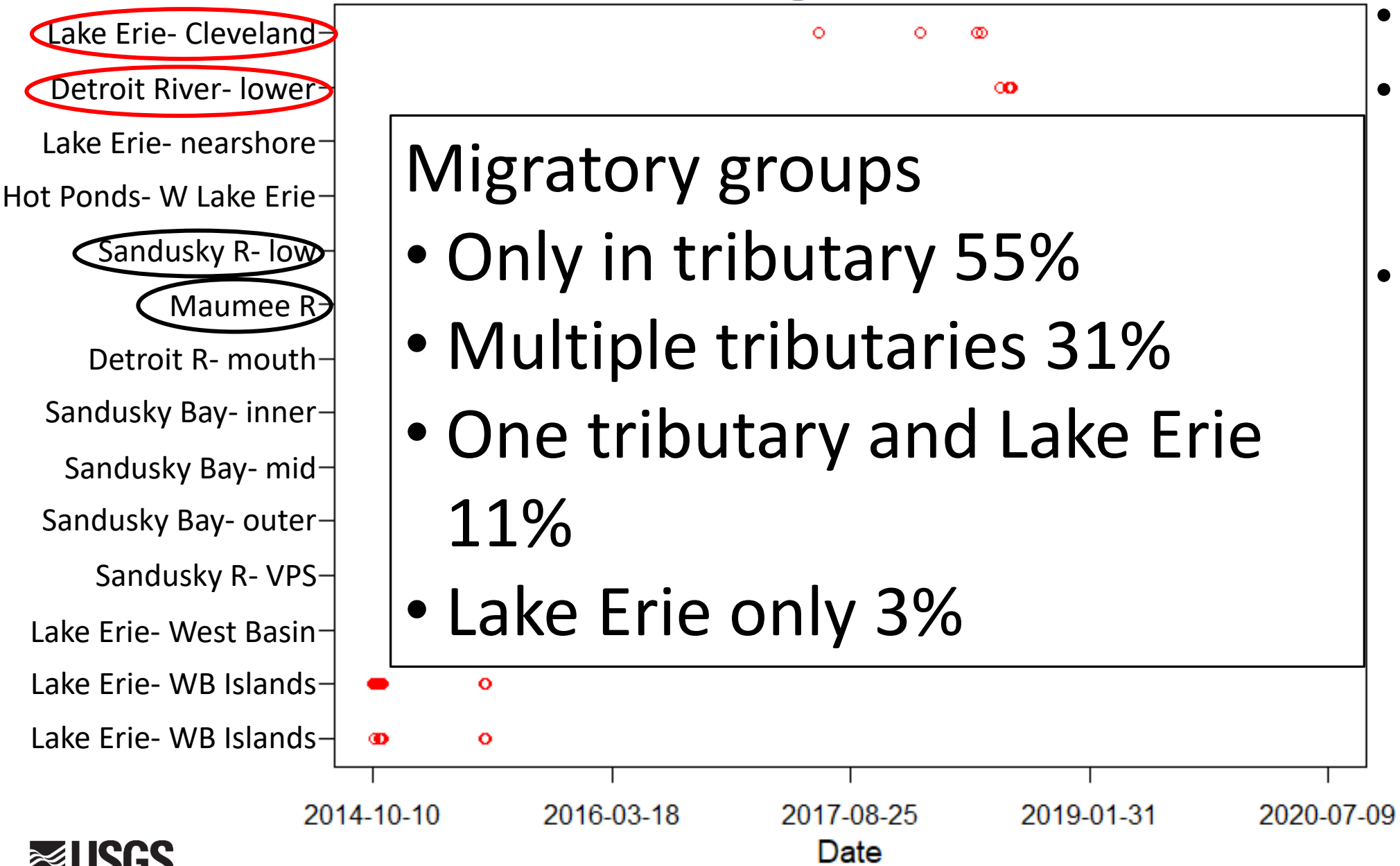
# Seasonal patterns (2014-2021)



- Winter
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  - 2 Basins – Central, West
  - 3 Major Rivers – Detroit, Sandusky, Maumee
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- Summer
  - 4 Basins – Central, West, St. Clair, Huron
  - 4 Major Rivers – Detroit, Sandusky, Maumee, St. Clair
  - 3 Coastal – Sandusky Bay, Nearshore, Islands
- Fall
  - 3 Basins – Central, West, East
  - 3 Major Rivers – Detroit, Sandusky, Maumee
  - 3 Coastal – Sandusky Bay, Nearshore, Islands



TagID: 24289



- Tagged in 2014
- Detected from Cleveland to Detroit River
- Multiple spawning tributaries
  - 3 major rivers in one year

# Novel 2022 detections: Confirmed spawning event

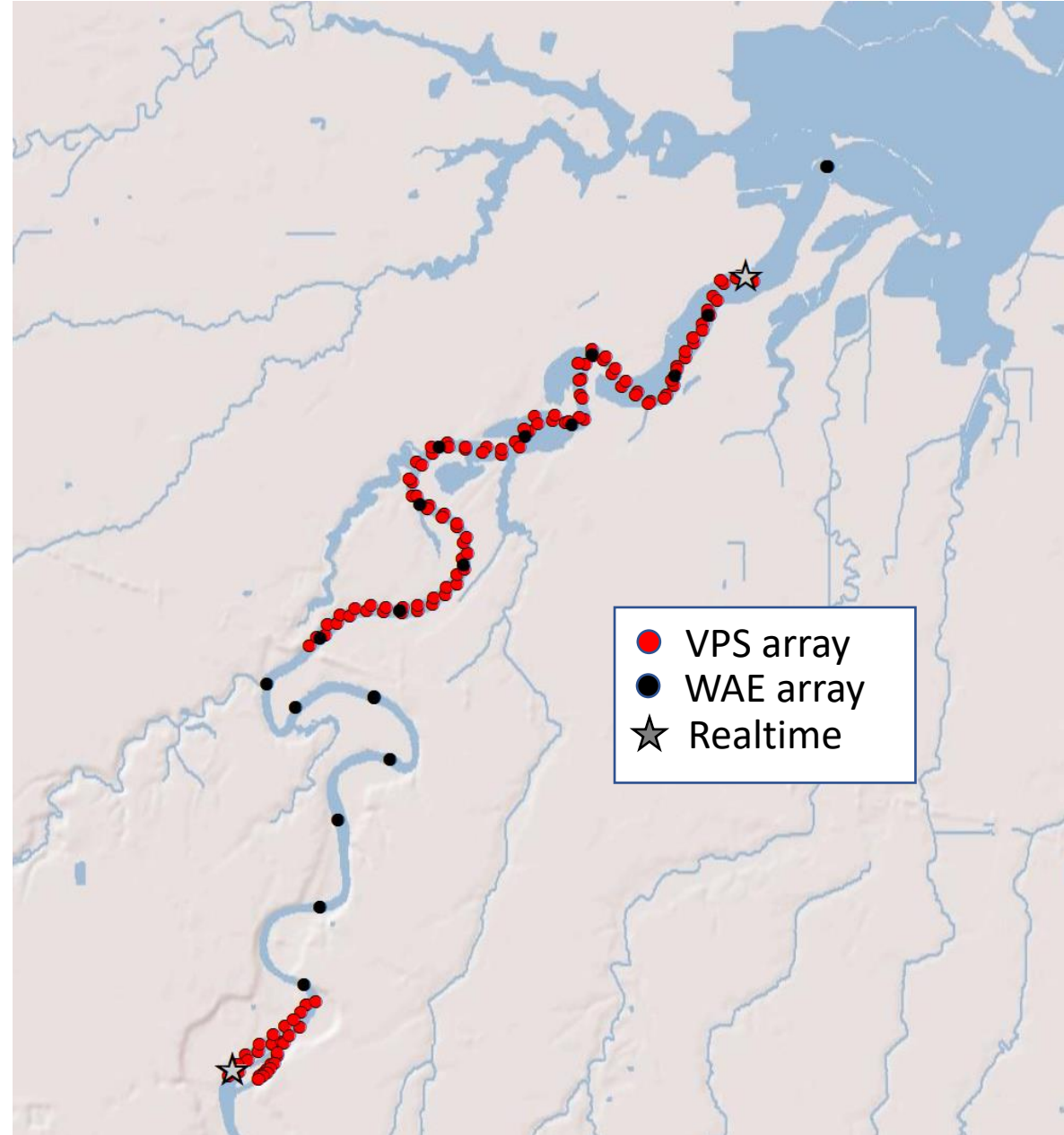
- Eggs captured\* during extended sampling on 5/23 in the Sandusky River, captured by VPS at Brady's island
  - 5/21; 1 Grass Carp
  - 5/22; 2 Grass Carp
  - 5/23\*; 5 Grass Carp
  - 5/24; 5 Grass Carp (3 new)
  - 5/25; 5 Grass Carp
  - 5/26; 2 Grass Carp
  - 5/27; 0 Grass Carp
  - 5/28; 1 Grass Carp



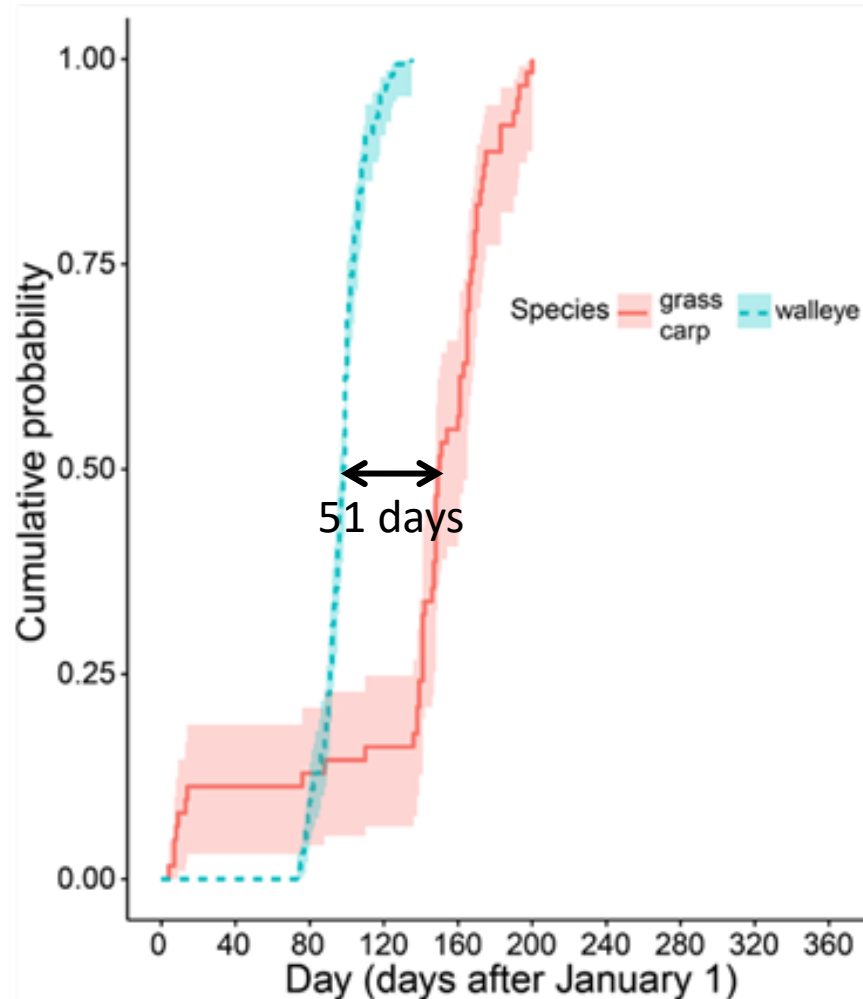
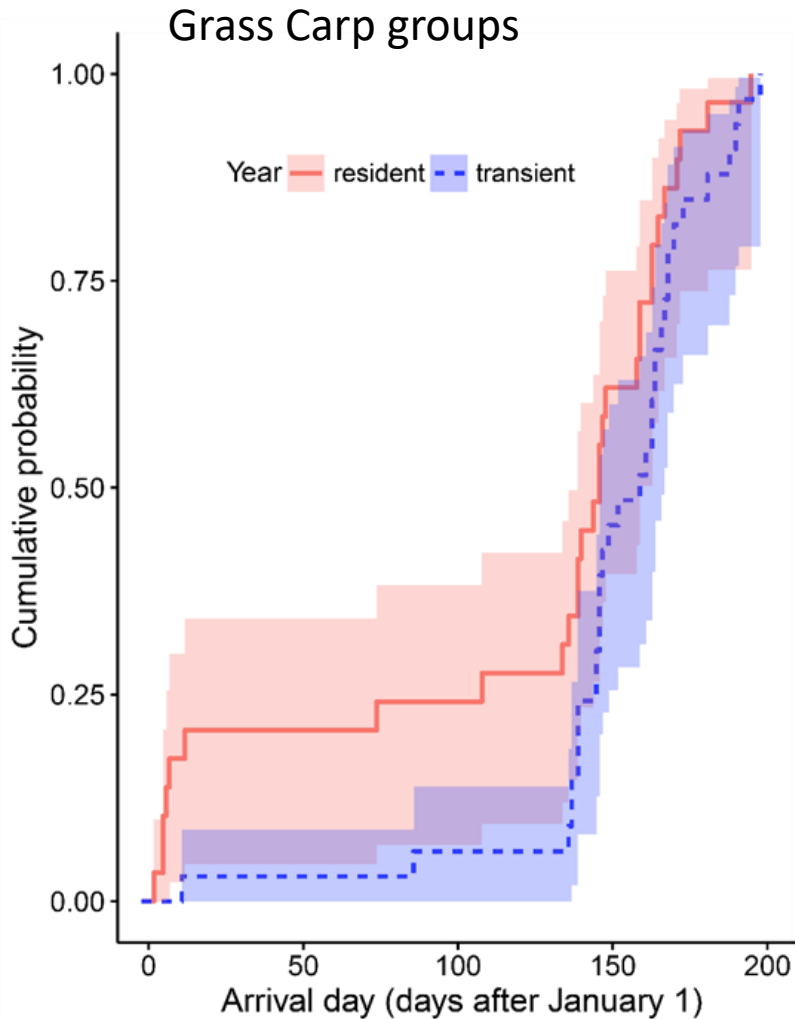


# Sandusky River barrier: native fishes

- 2021
  - Tagged 26 (recycled tags ~1.5 yr tag life)
    - 23 smallmouth buffalo; 2 bigmouth buffalo; 1 freshwater drum
    - Most stayed around Brady's island some moving into Bay, no detections outside of Bay
- 2022
  - Tagged 103
    - 30 smallmouth buffalo; 50 white bass; 9 channel catfish; 11 redhorse; 2 freshwater drum; 1 bowfin
    - 2.8 year tag life



# Timing of movement at Brady's island: Grass Carp and Walleye (Time-to-event analysis)

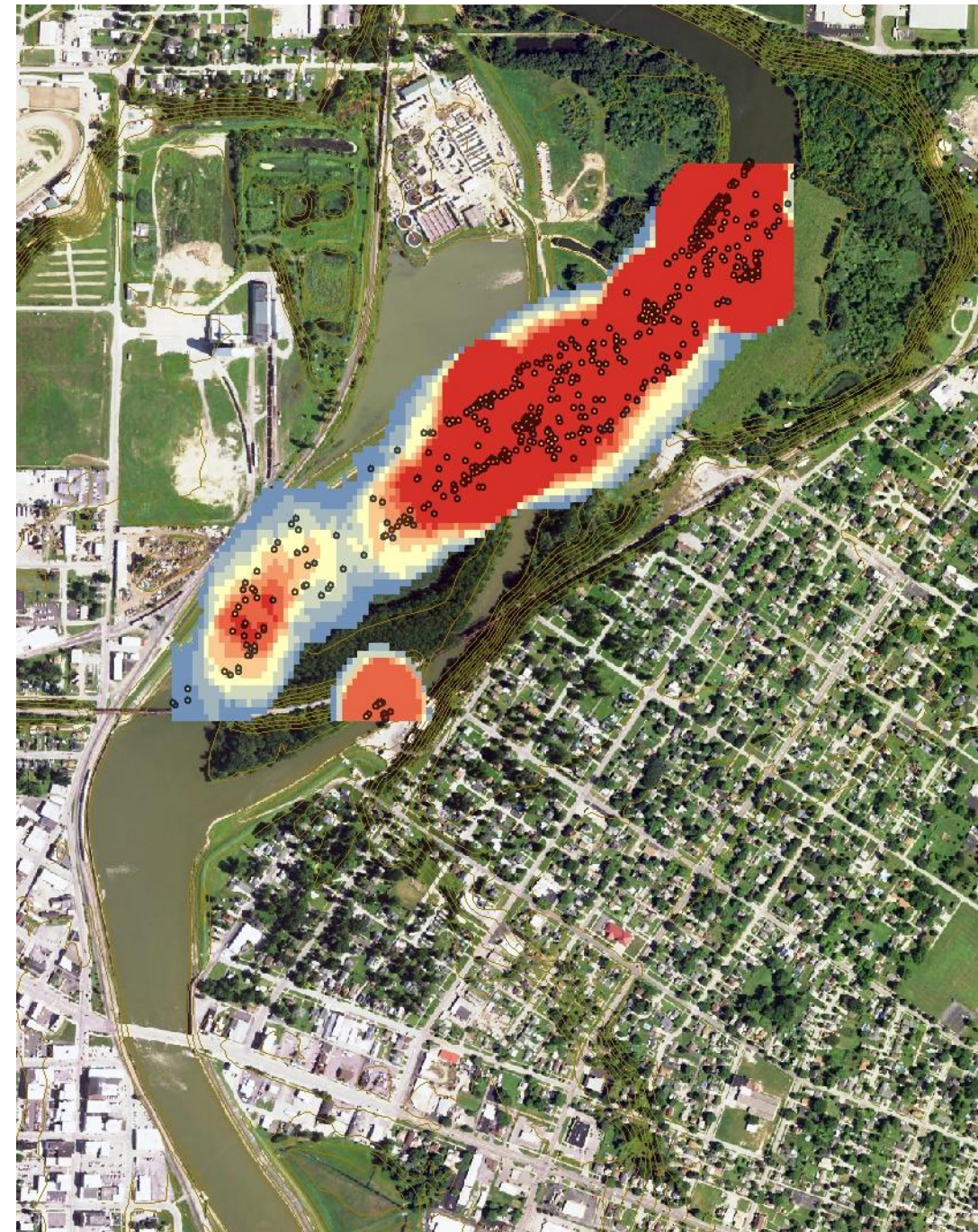


- 2015-2021
  - Majority of GC at Brady's by June
  - Minimal overlap with WAE
  - Almost all WAE gone before a quarter of GC arrive
- Abiotic factors
  - Day length, temperature, discharge



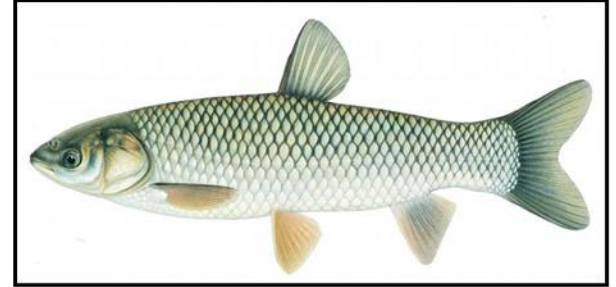
# Native fish summary

- All eight species detected
- 4 species outside of Sandusky system
  - White Bass
  - Silver Redhorse
  - Shorthead Redhorse
  - Smallmouth Buffalo
- Overlap during spawning?
  - 5/23/22 three species
    - Buffalo (n=12)
    - Freshwater Drum (n=2)
    - Silver Redhorse (n=1)



# Grass Carp Ecology and Life History

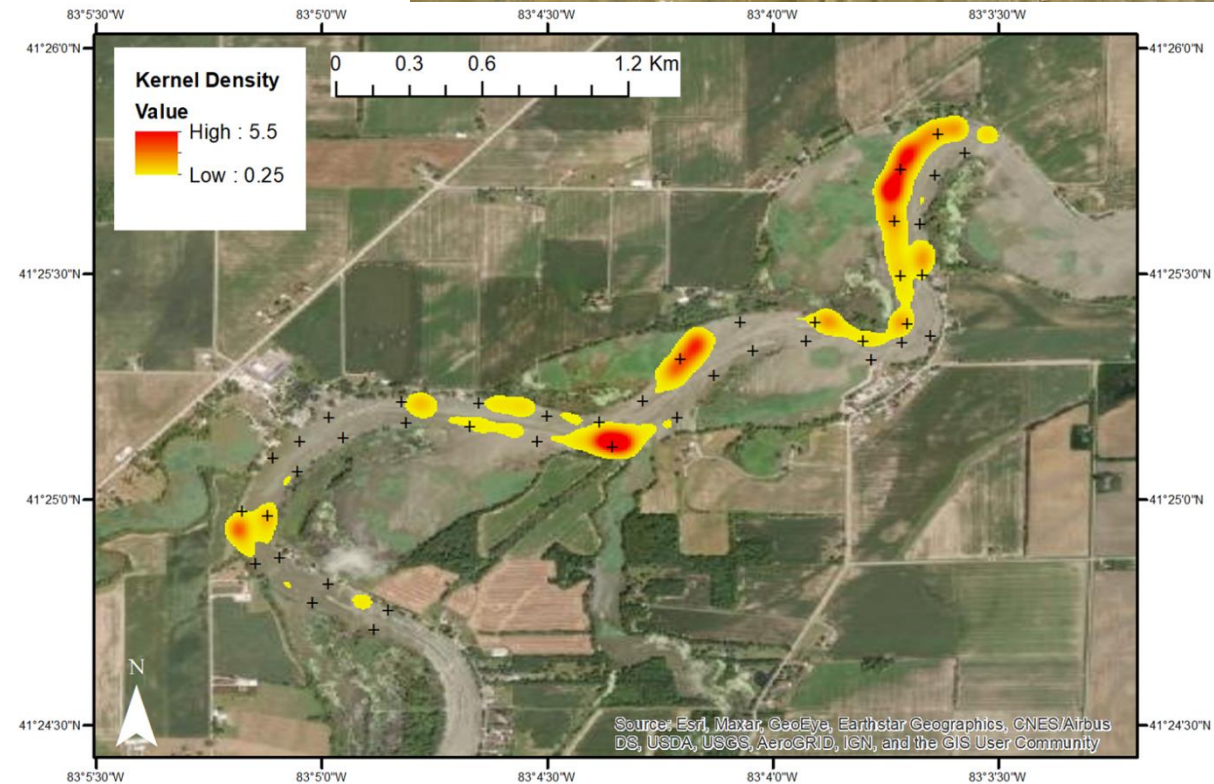
- Move throughout Lake Erie and Huron corridor
- Return to tributaries during spawning conditions
  - High spring/summer flows, increased day length
  - Individuals may visit multiple tributaries
  - Some individuals only in tributaries
- Unique lotic habitat use during spawning
- Nearshore habitats likely important movement corridors





# Grass Carp management: Removal

- What tributaries to focus on
- When Grass Carp arrive
- Different movement groups?
- Intra-river aggregations





# Questions

## USGS

Kevin Keretz  
Richard Oldham  
Sean Harris  
Branden Kohler  
Evelyn Pantelopoulos  
Jared Lesniewicz  
Erica Stegens  
Corbin Hilling  
Richard Kraus  
Ryan Jackson

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