Dead giveaway: Changes in mortality rates signal grass carp control strategy effectiveness

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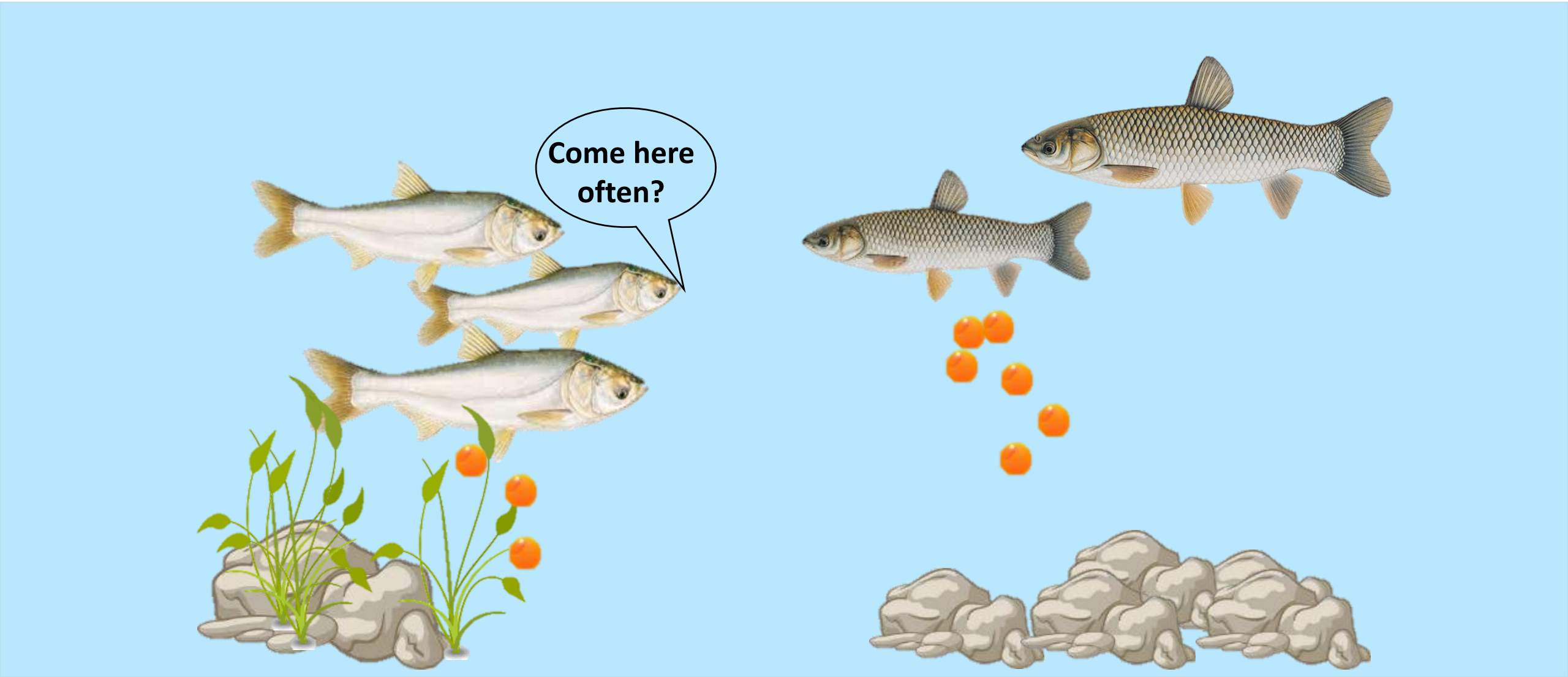
- **Grass Carp reproduction similar to other FMCC**
- **All enter rivers during high flow to spawn**



Grass Carp ecology and history differs from other FMCC

- **Eat plants, may damage wetlands**
- **Only FMCC known to reproduce in Great Lakes**

https://www.youtube.com/watch?v=HRwoZdRzXFo&app=desktop

Timeline of grass carp in US

1963 — Imported to U.S. to control aquatic vegetation

1981 — 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

Why are grass carp considered 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

Project goals

- **Remove GC from Lake Erie and tributaries**
- **Determine if removal is reducing population**
  - **How many fish are there?**
  - **Is removal affecting the population?**

Lake Erie Grass Carp Adaptive Response Strategy 2019-2023

Photo source: J. Francis, Michigan Department of Natural Resources

Lake Erie Committee

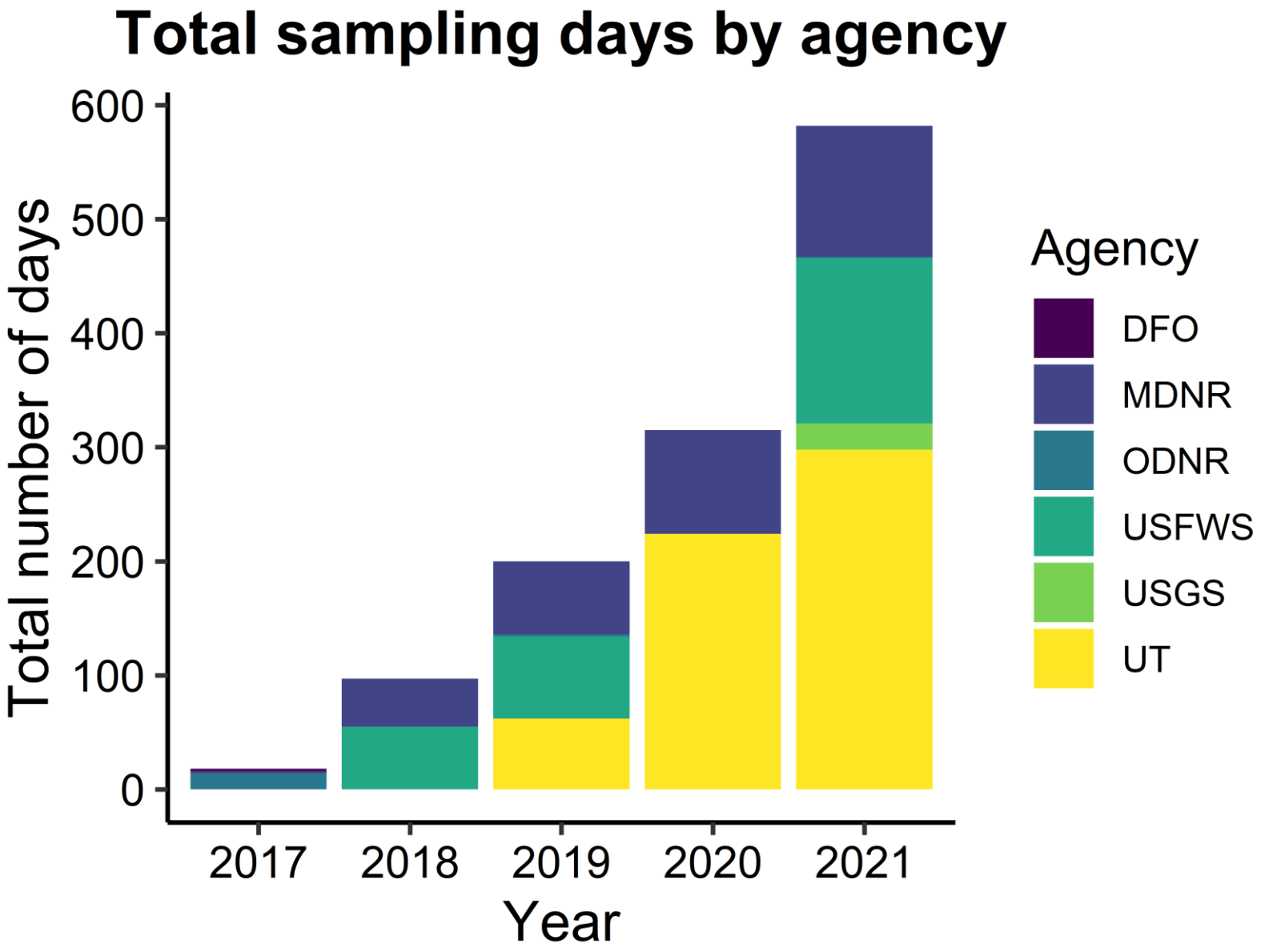
Great Lakes Fishery Commission

December 2018

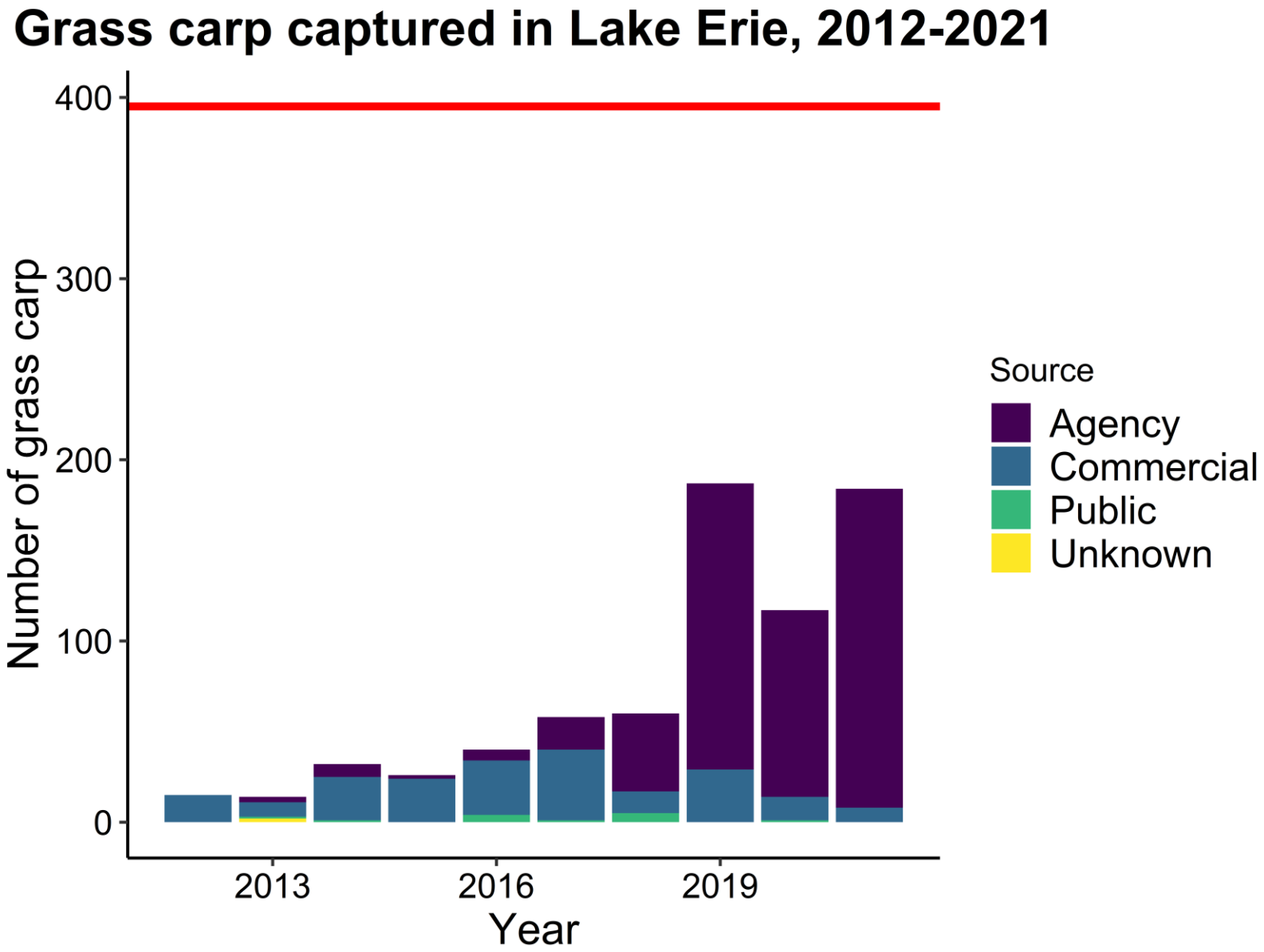
Variability in collection and data

- Commercial- incidental, voluntary, incentives
- Ongoing, removal
  - Sustained (sampling) and targeted (hunting)
  - Usually electrofishing and trammel net
- Evolving protocol
- Adapt to flow and weather
- Many participants!

Effort to manage grass carp is increasing



Initial Goal: Harvest 395 grass carp/year



2021 Lake Erie Grass Carp catch

Partners

River	Fish removed
Sandusky	104
Maumee	46
Lake Erie	1
Huron	2
Grand	5
Detroit	1
Cuyahoga	5
Ashtabula	4
Total	168

Other

Source	
Commercial/Other	8 (MI & OH)

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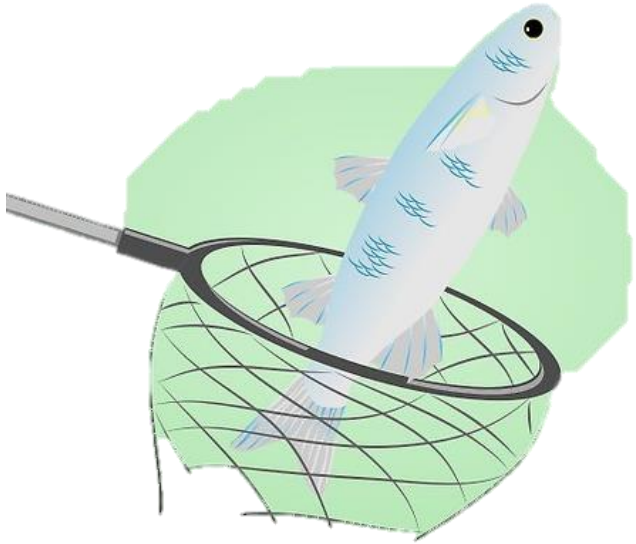
Estimate number GC present in Sandusky River

We have catch numbers



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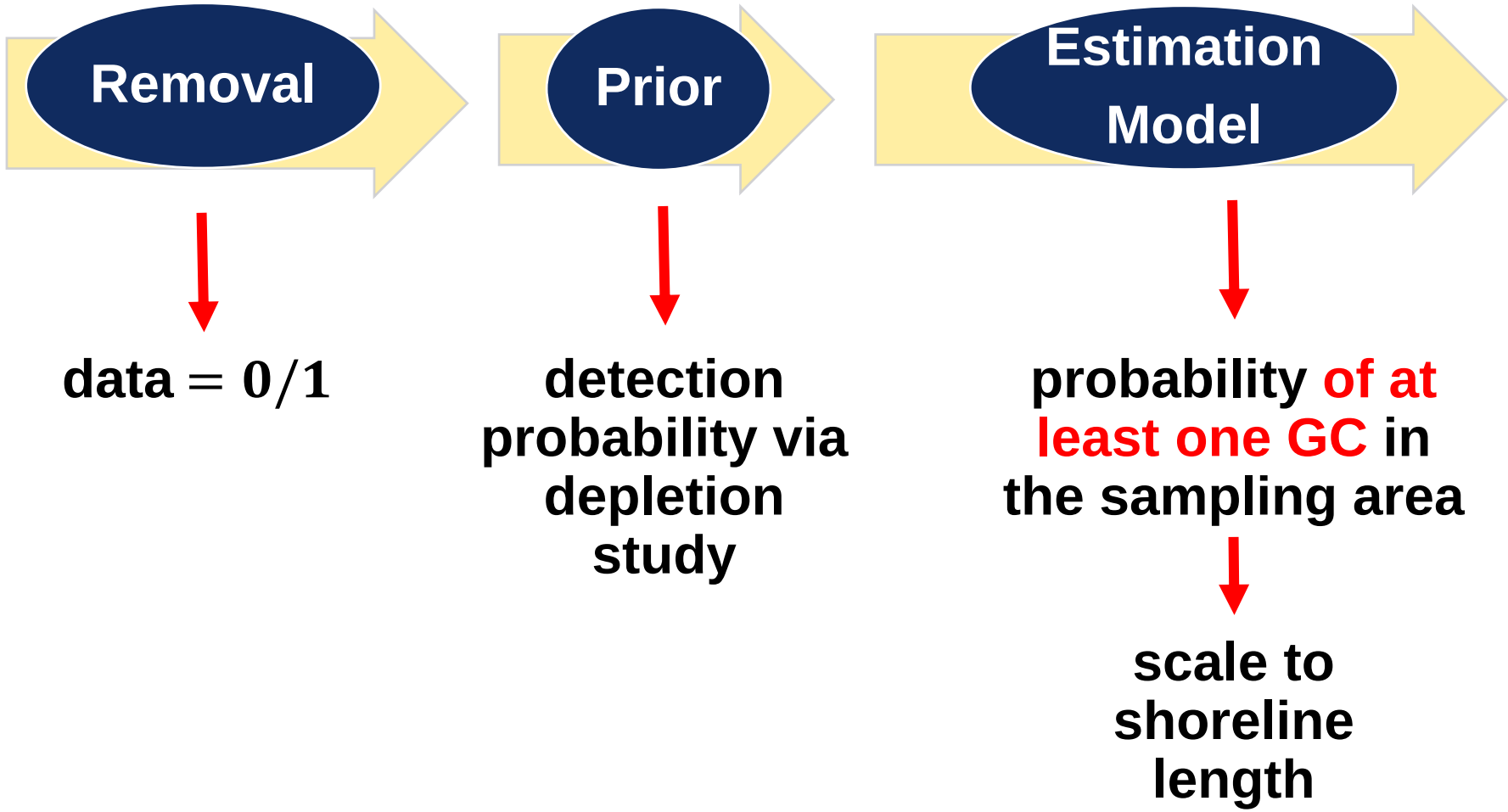
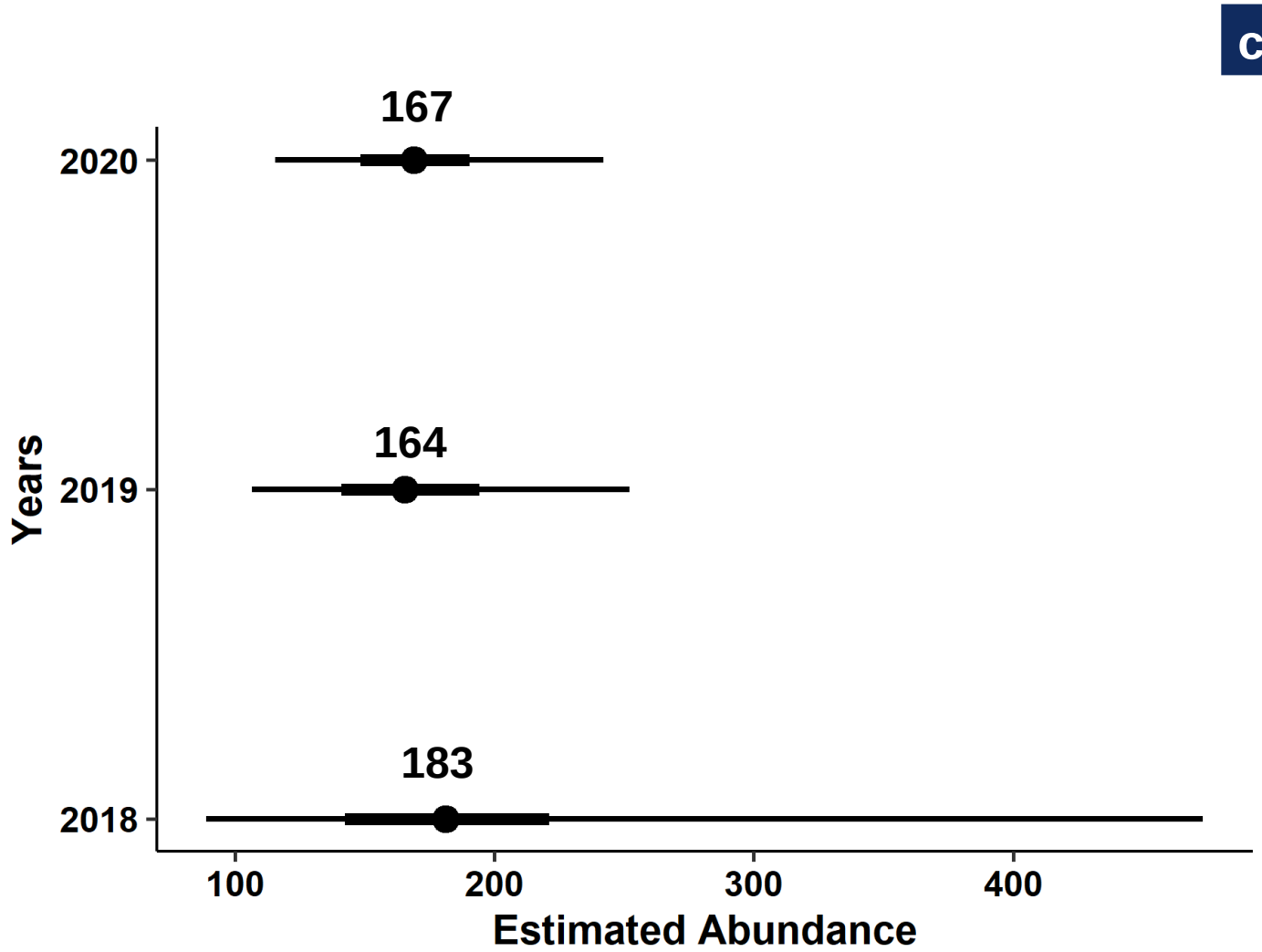
We want the number of fish present

https://epa.ohio.gov/dsw/tmdl/SanduskyRiver

Estimate number GC in Sandusky with Bayesian process



Little change in model GC abundance <u>at a given time</u> across three years. 2021 coming soon.



captures	events
66	239
26	122
4	19

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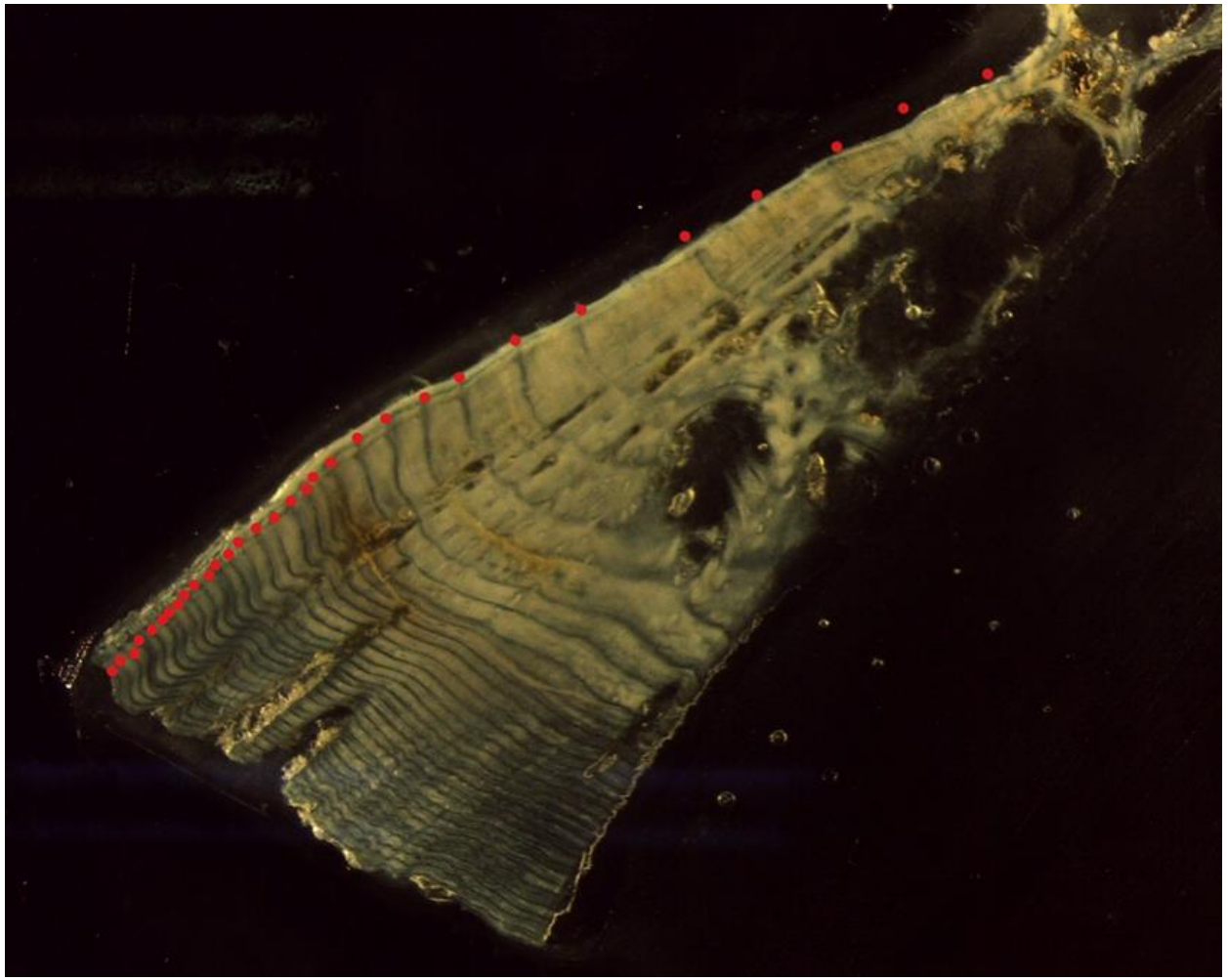
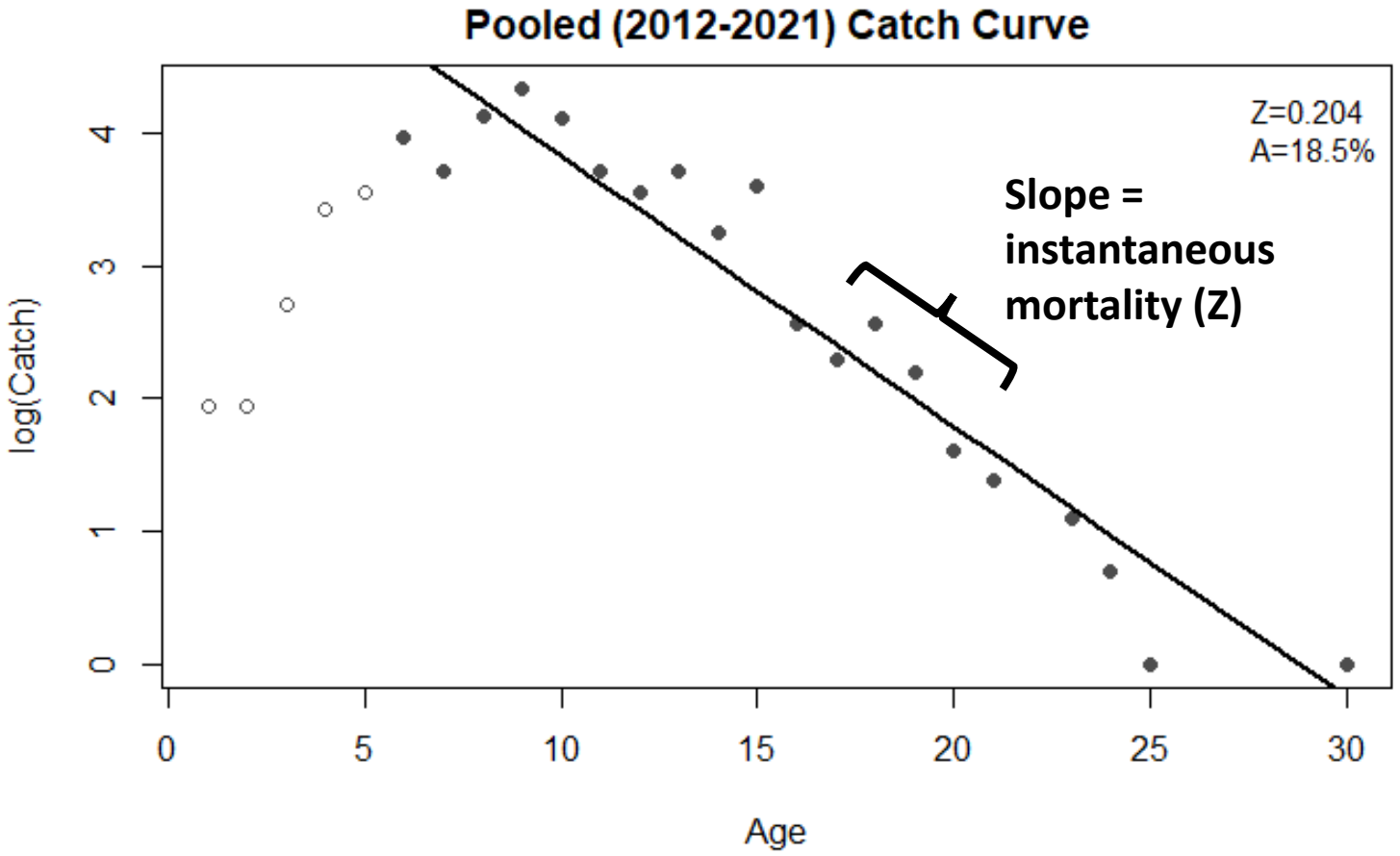
How has mortality rate changed?

Objectives:

- **Age all grass carp captured in the Lake Erie Basin**
- **Examine changes in mortality over time using two methods: catch curve analysis and multilevel linear modeling**



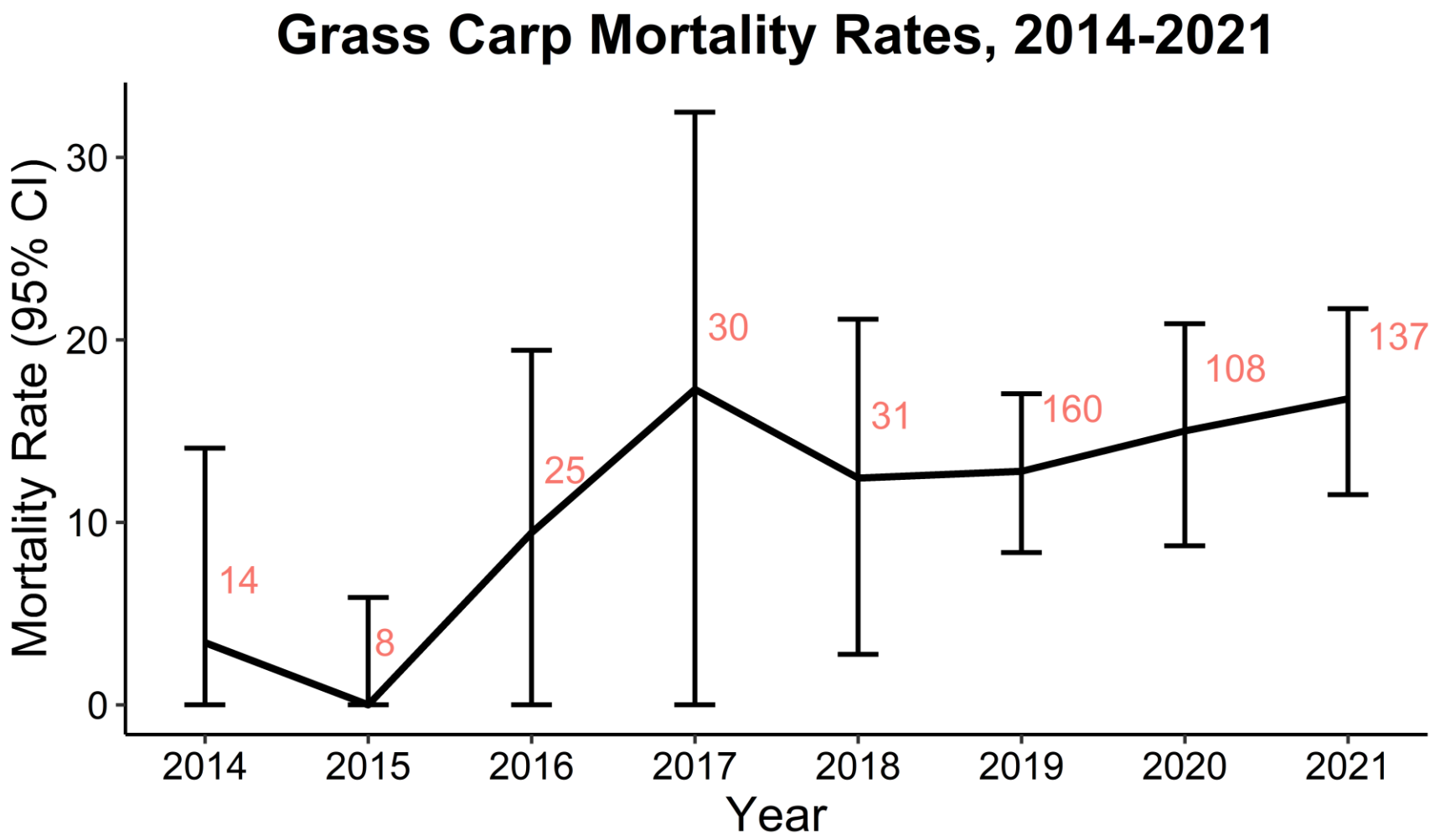
Catch-curve analysis estimates mortality



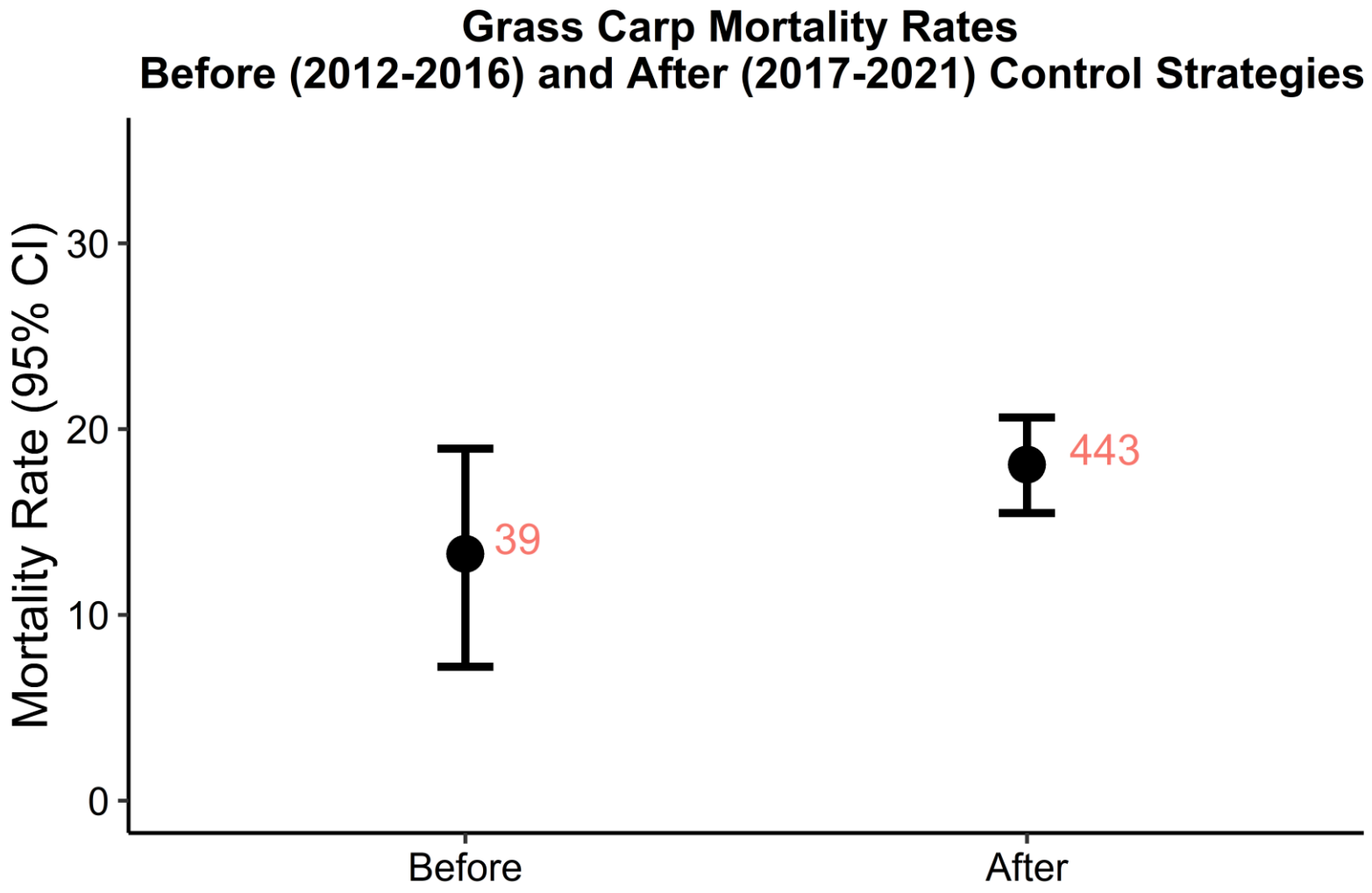
- Log number fish at successive ages
- < age-6, incompletely sampled
- Descending limb = decline in successive age classes
- Total annual mortality (A)

$$A = 1 - e^{-Z}$$

Mortality estimates increasing, but high uncertainty



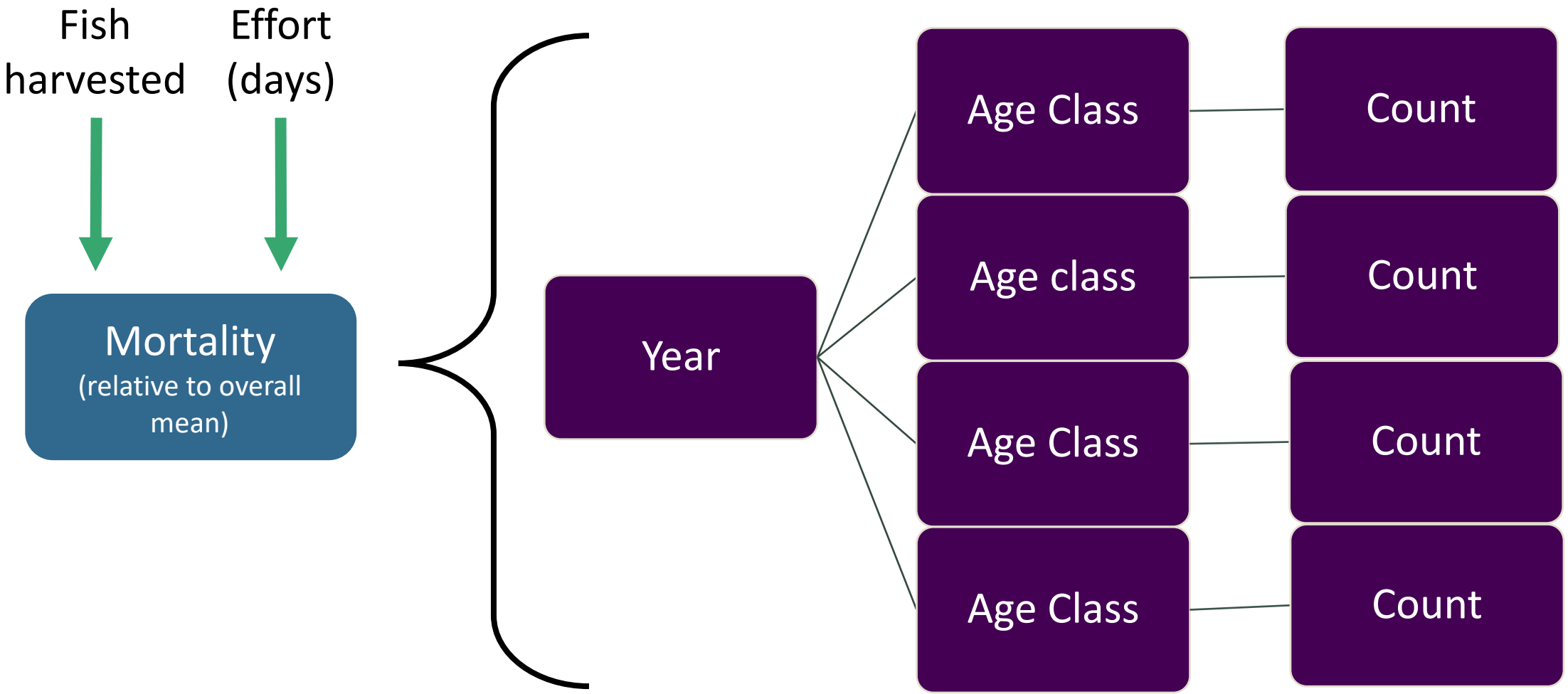
Before and after control suggests mortality is increasing



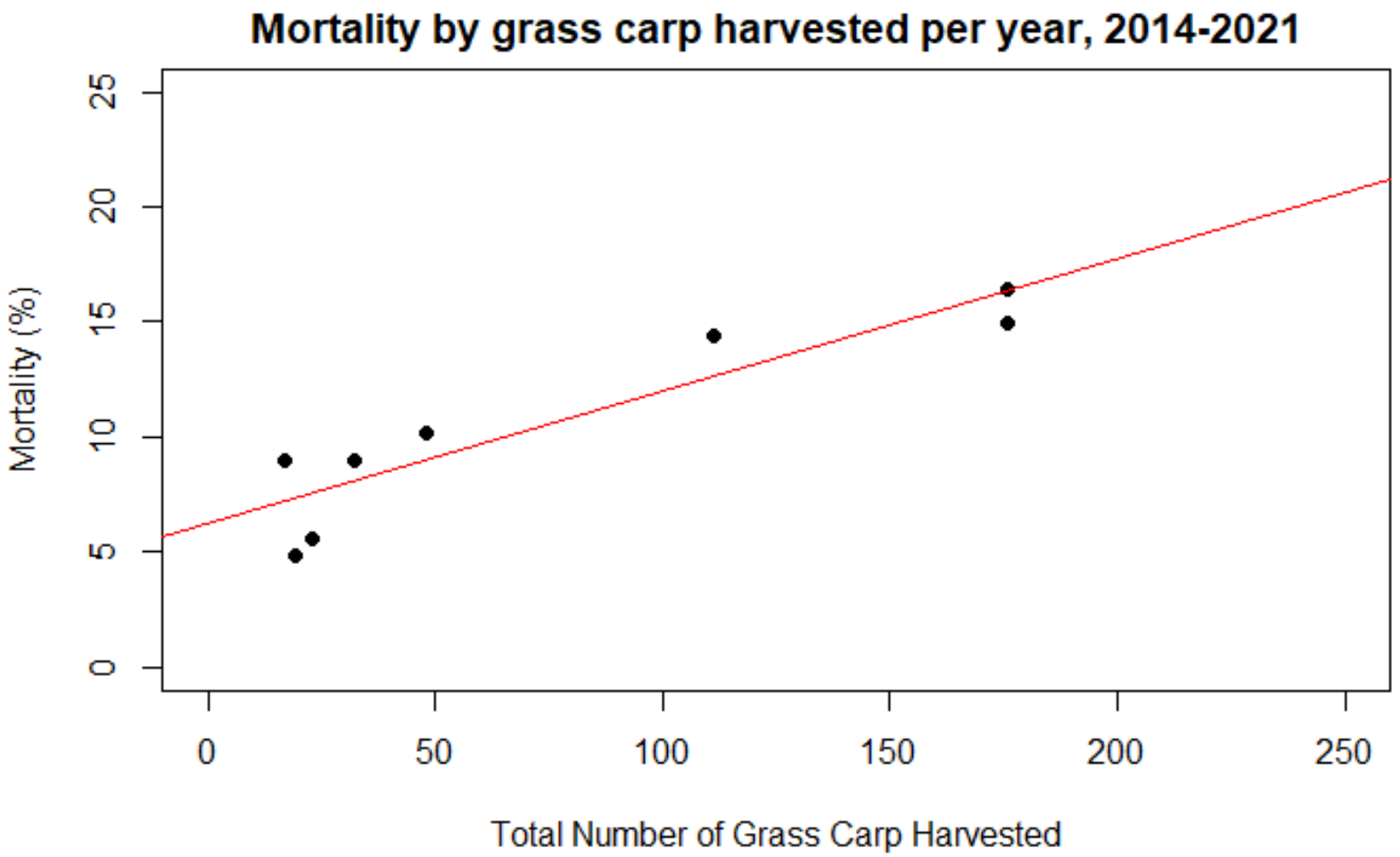
Multilevel Modeling Analysis

- Estimate mortality with multilevel linear model
  - all age classes and years at once
- “Shrinks” each years mortality rate towards the overall mean
- Can correlate annual mortality with the total measures of fishing effort

Multilevel linear modeling groups data



Preliminary: Mortality correlated with number of fish harvested per year



Cause for cautious optimism

- Removal effort is increasing
- Number of GC in Sandusky not changing
- Mortality higher after control (although variance also high)
  - Future work quantifying effort
  - Relatively short time span-keep going!

Thanks!

Funding Sources

Partners