Population Demographics of Silver Carp in a Large Mesotrophic Reservoir

Allison (DeRose) Lebeda, Timothy Spier, Neal Jackson

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Background: *Hypophthalmichthys molitrix*

- Silver Carp are an exotic planktivore from Eastern Asia.

Kolar et al. 2005

- Silver Carp were introduced in 1970s to promote water quality.

Freeze and Henderson 1982; Kolar et al. 2005

- Silver Carp escaped during flooding events by 1980.

Freeze and Henderson 1982

Invasion of Silver Carp

USGS Silver Carp Distribution as of October 2016

blueplanetsociety.blogspot.com

Illinoistimes.com

Silver Carp Population Demographics in the U.S.

- It's crucial to understand population demographics of Silver Carp to:
  - Predict impacts on native species
  - Evaluate control strategies
- Others have described population demographics for Midwestern rivers.
- Until recently, no one had looked at a Silver Carp population in a large reservoir.

Kentucky Lake

- Largest reservoir in the eastern United States
  - 296 km long
  - 64,870 ha surface area at full pool
  - Classified as mesotrophic

    Kerns et al. 2009, White 2014

- Notable recreational and commercial fisheries

- Silver Carp were officially documented in 2004.

  USGS Non-indigenous Aquatic Species List

Map Credit: Dalton Lebeda

Research Objectives

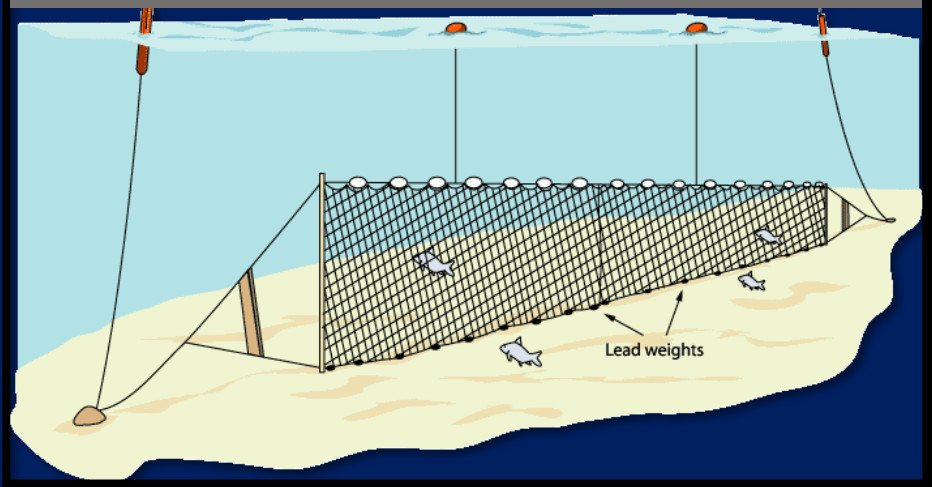
- Describe population metrics for Silver Carp in Kentucky Lake.
  - Size structure
  - Age
  - Growth
  - Mortality rates
  - Spawning periodicity
- Compare population metrics from Kentucky Lake Silver Carp to other populations in United States rivers.

Capture Methods & Biological Data Collected

Photo Credit: jasonhalfenoutdoors.com

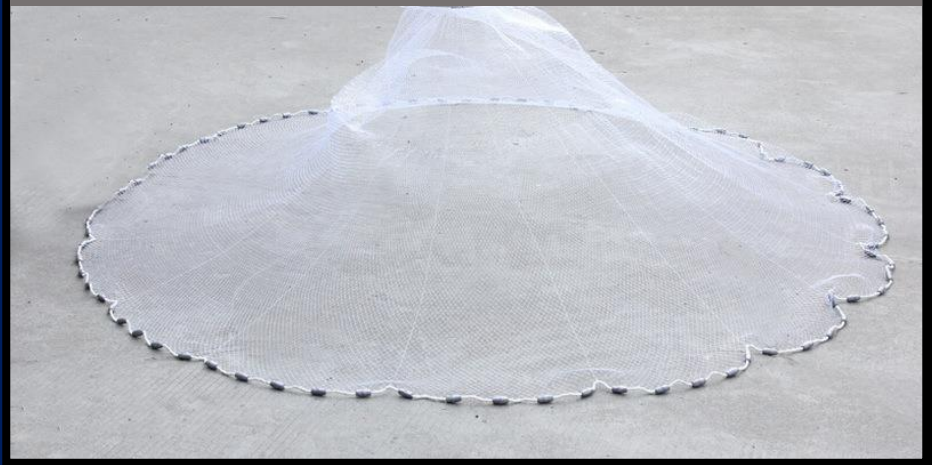
Photo Credit: Tim Spier

Effort: 1725 hours = 77 carp



Effort: 40 hours = 54 carp

Effort: = 21 carp



Effort: 17 trips = 289 carp

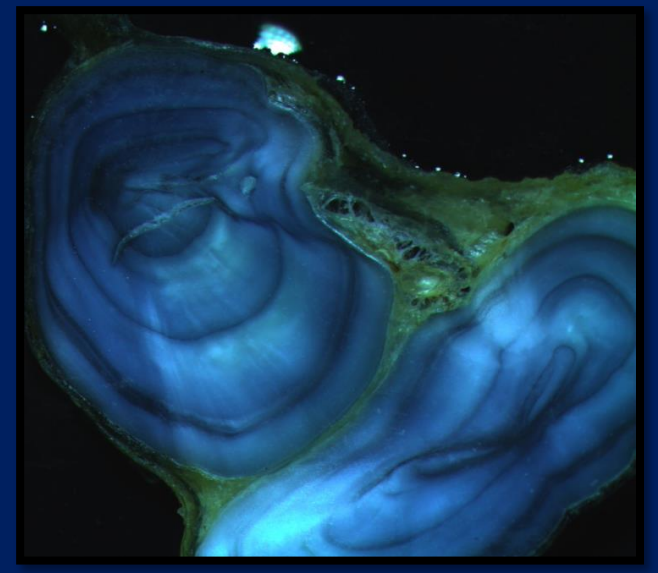
- Total length
- Weight
- Sex
- Gonad weight
- Fin ray for aging

Photo Credit: aliexpress.com

Photo Credit: wkms.org

Aging Using Pectoral Fin Rays

- Three 700 µm sections cut
- Annuli illuminated using reflected light
- 2 independent readers
- Consensus annuli agreed upon if ages differed



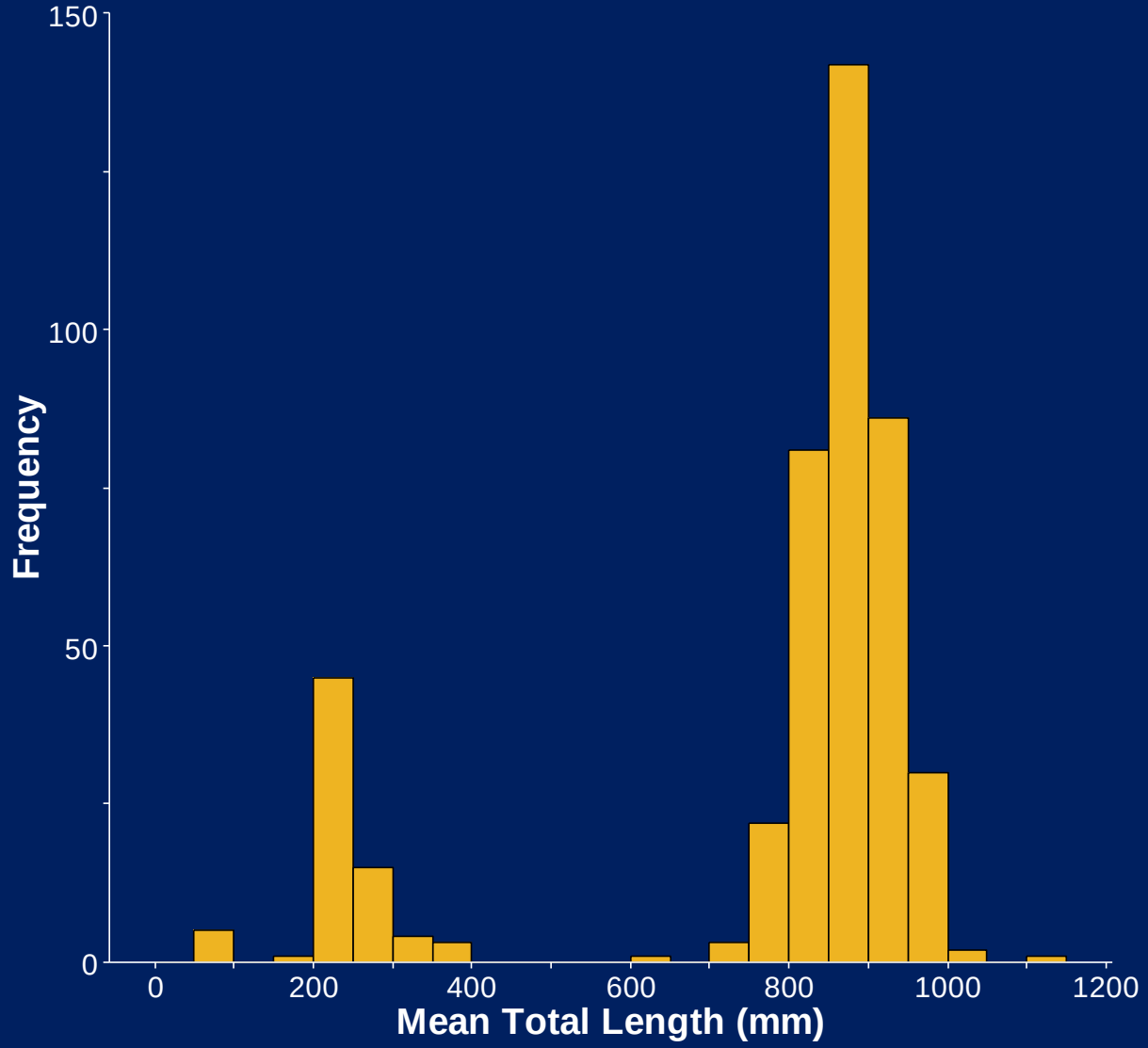
Statistical Analyses

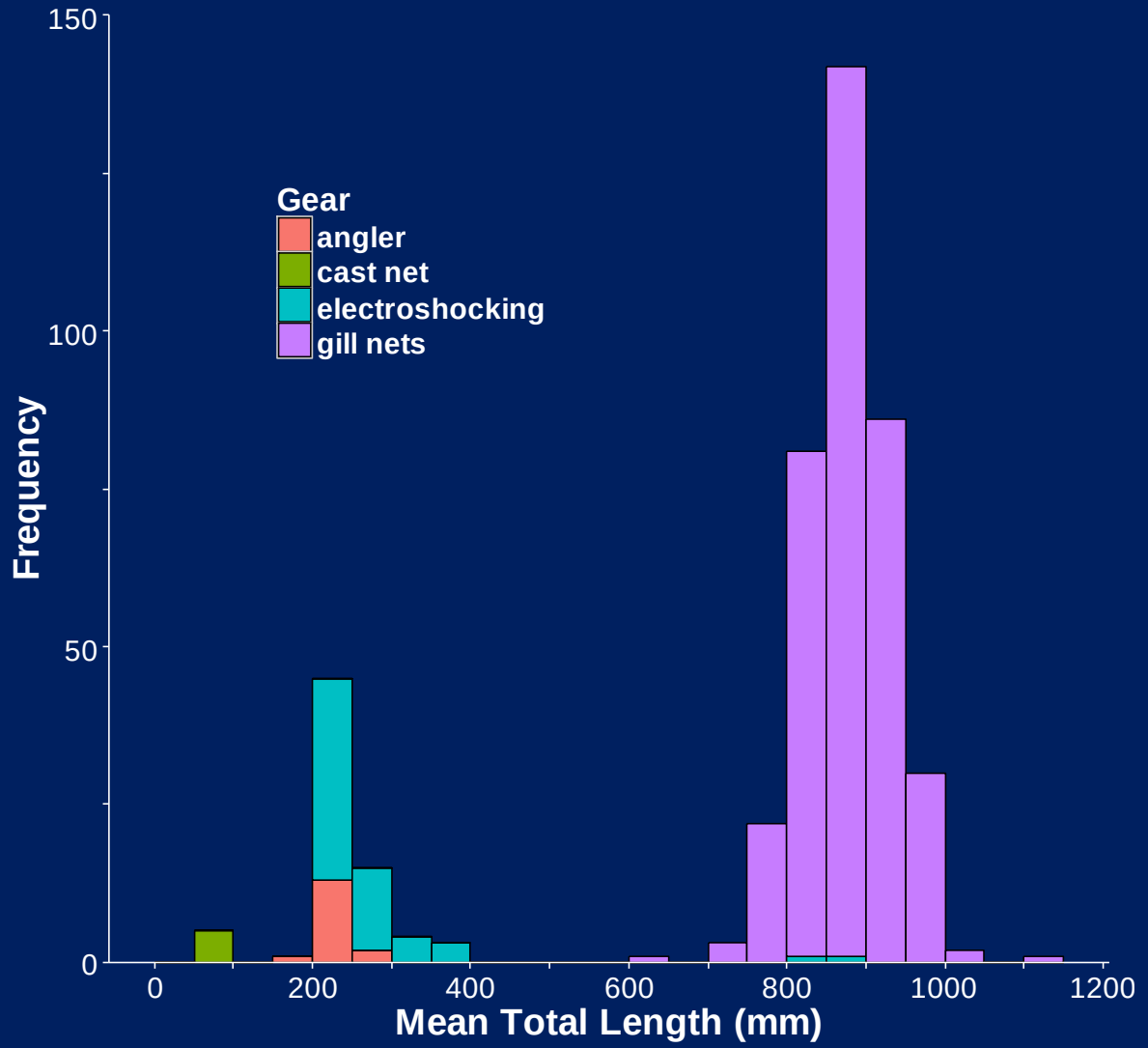
- Growth modeled using von Bertalanffy curve
- Mortality estimated using weighted catch curve regression
- Gonadosomatic Index (GSI) = 100*(gonad weight/body weight)

Results: Size Structure in Kentucky Lake

n = 441

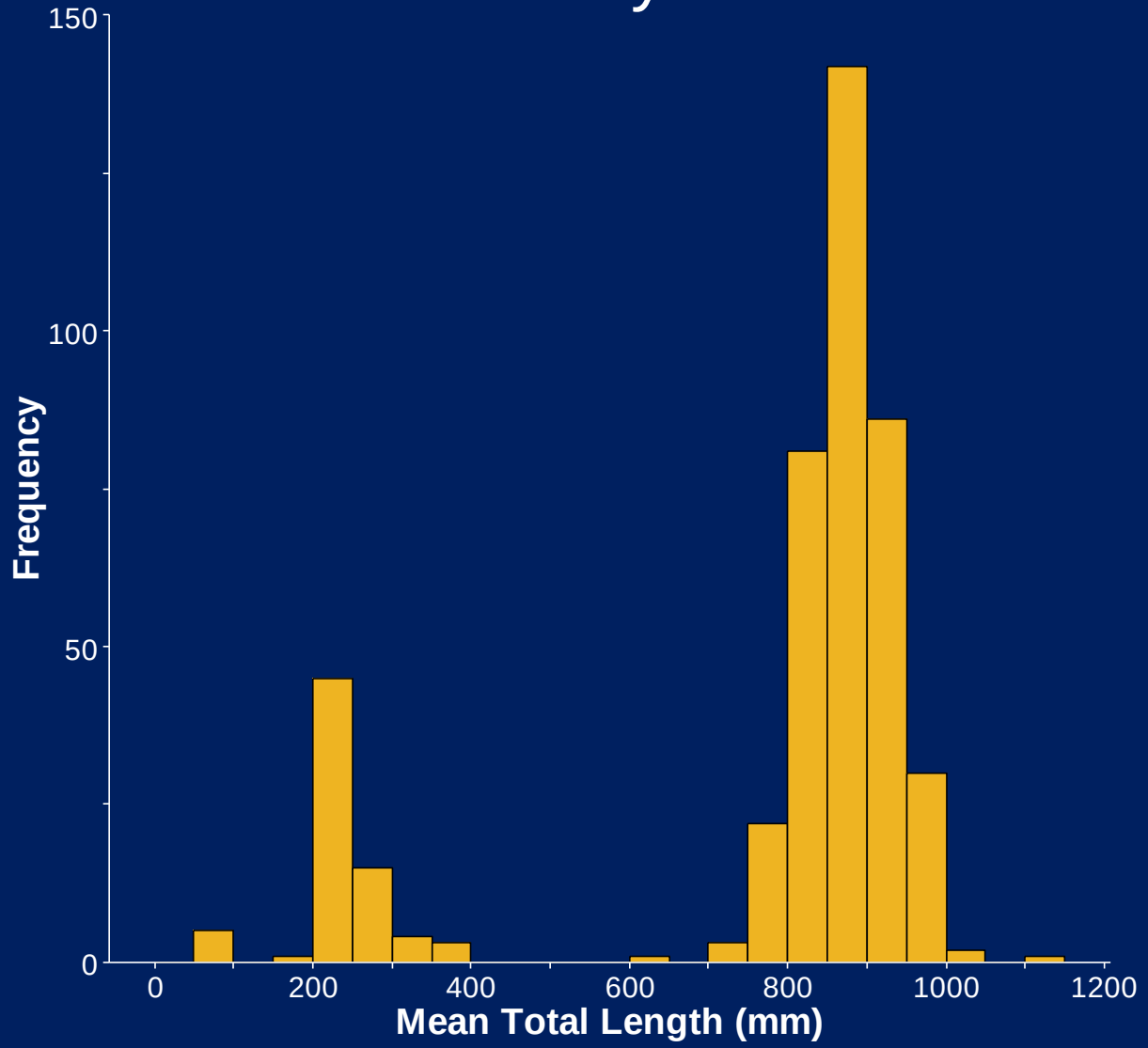
February 2015 – September 2016



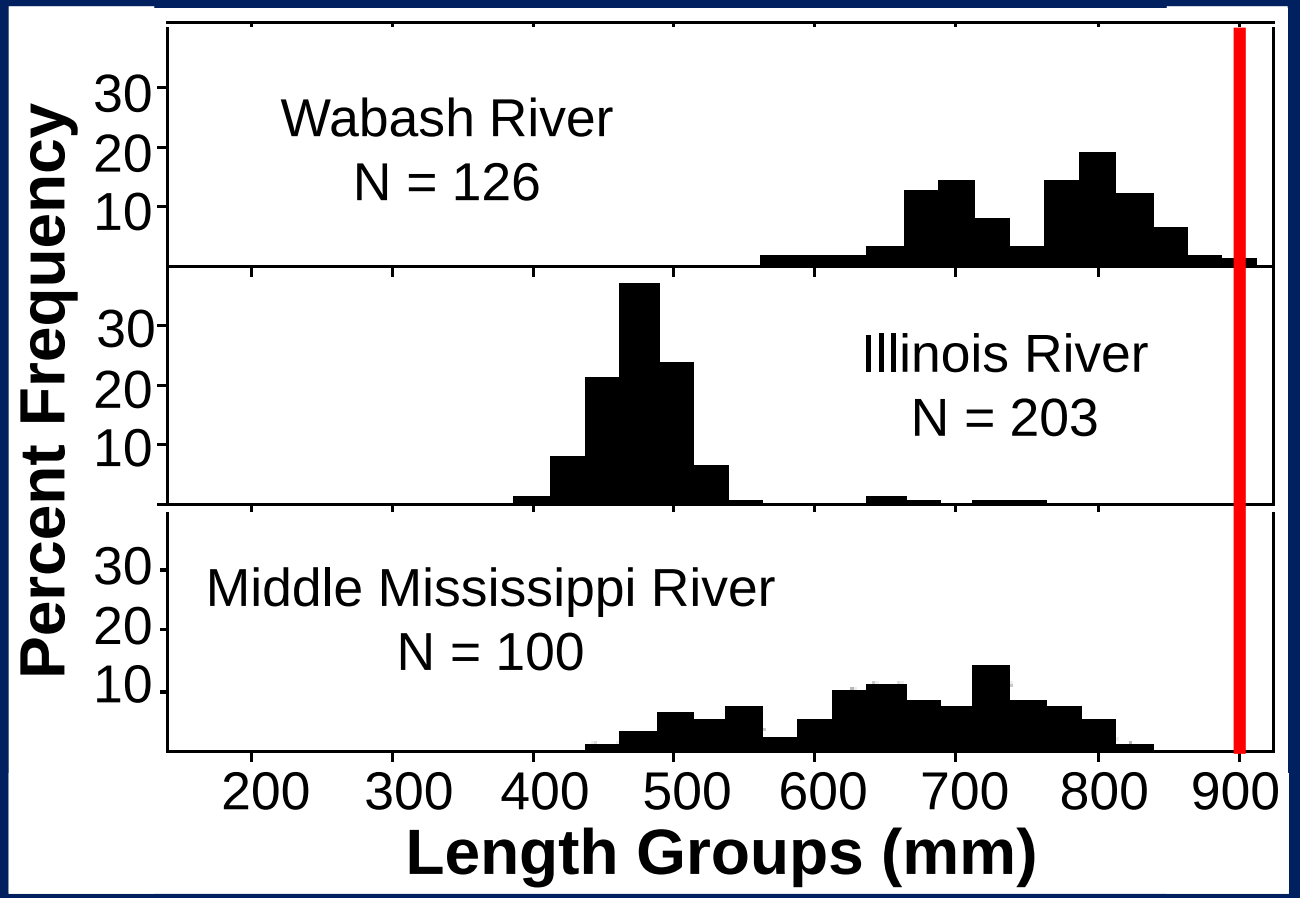


Results: Size Structure

Kentucky Lake



Other Populations

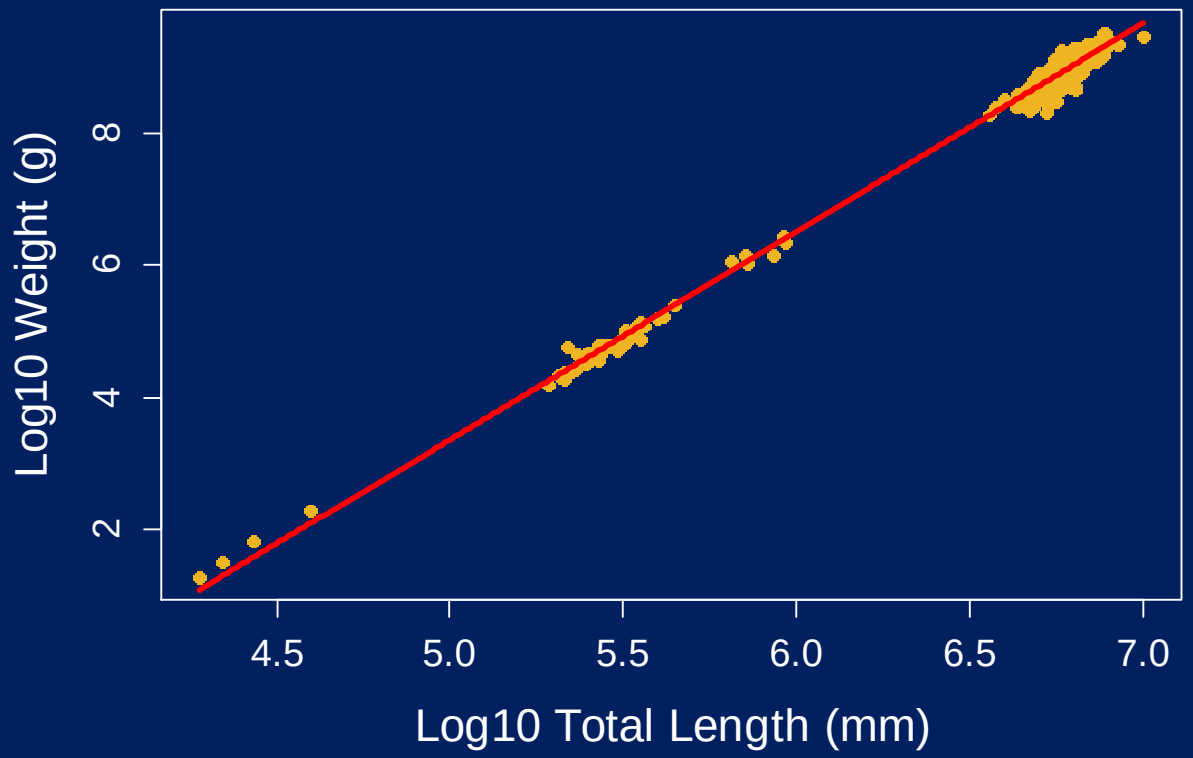


Ammended from Seibert et al. 2015

Results: Length–Weight Relationship

Kentucky Lake

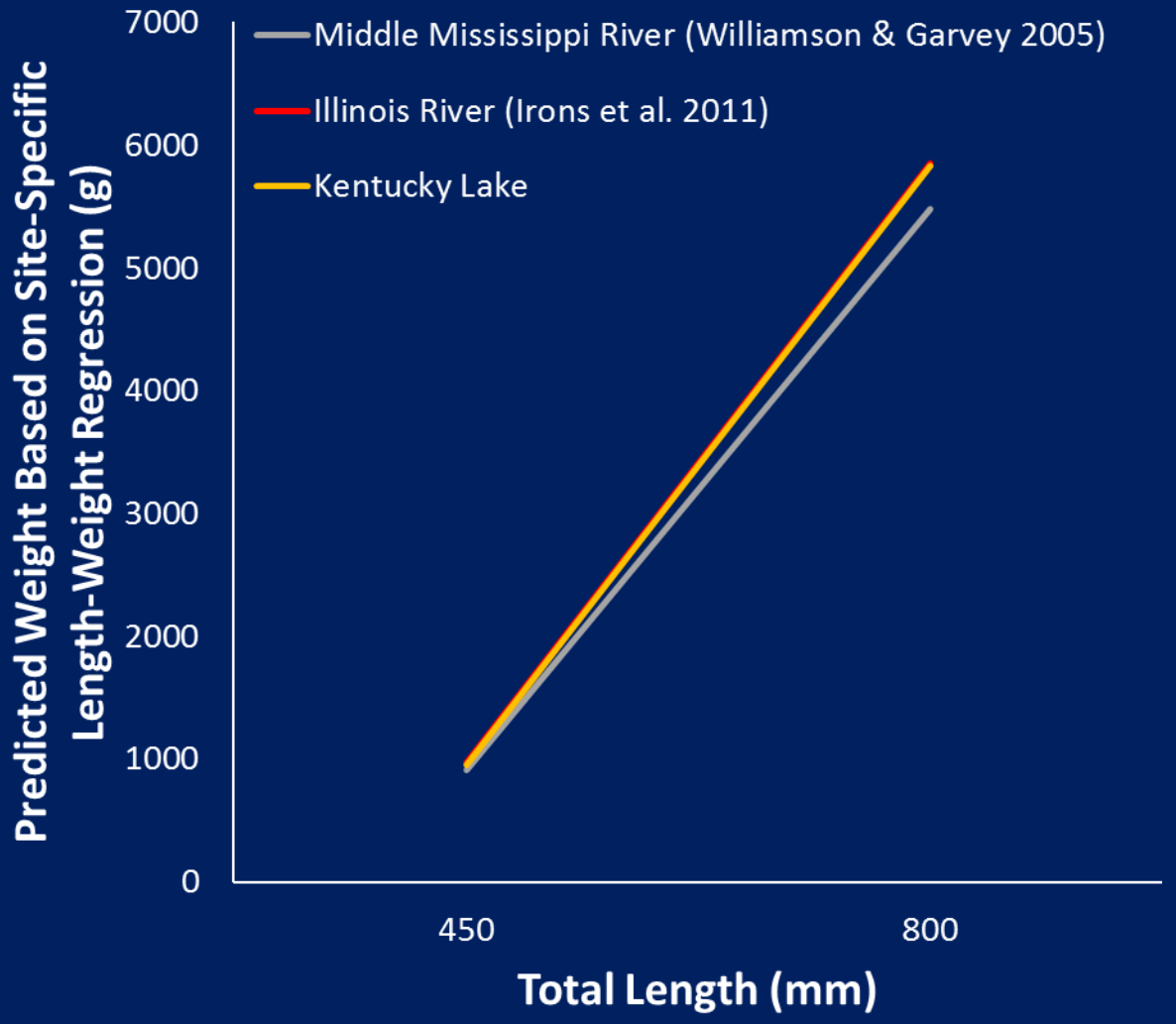
Log10(weight) = -12.39+3.15log10(length)



n = 439

R^2 = 0.99

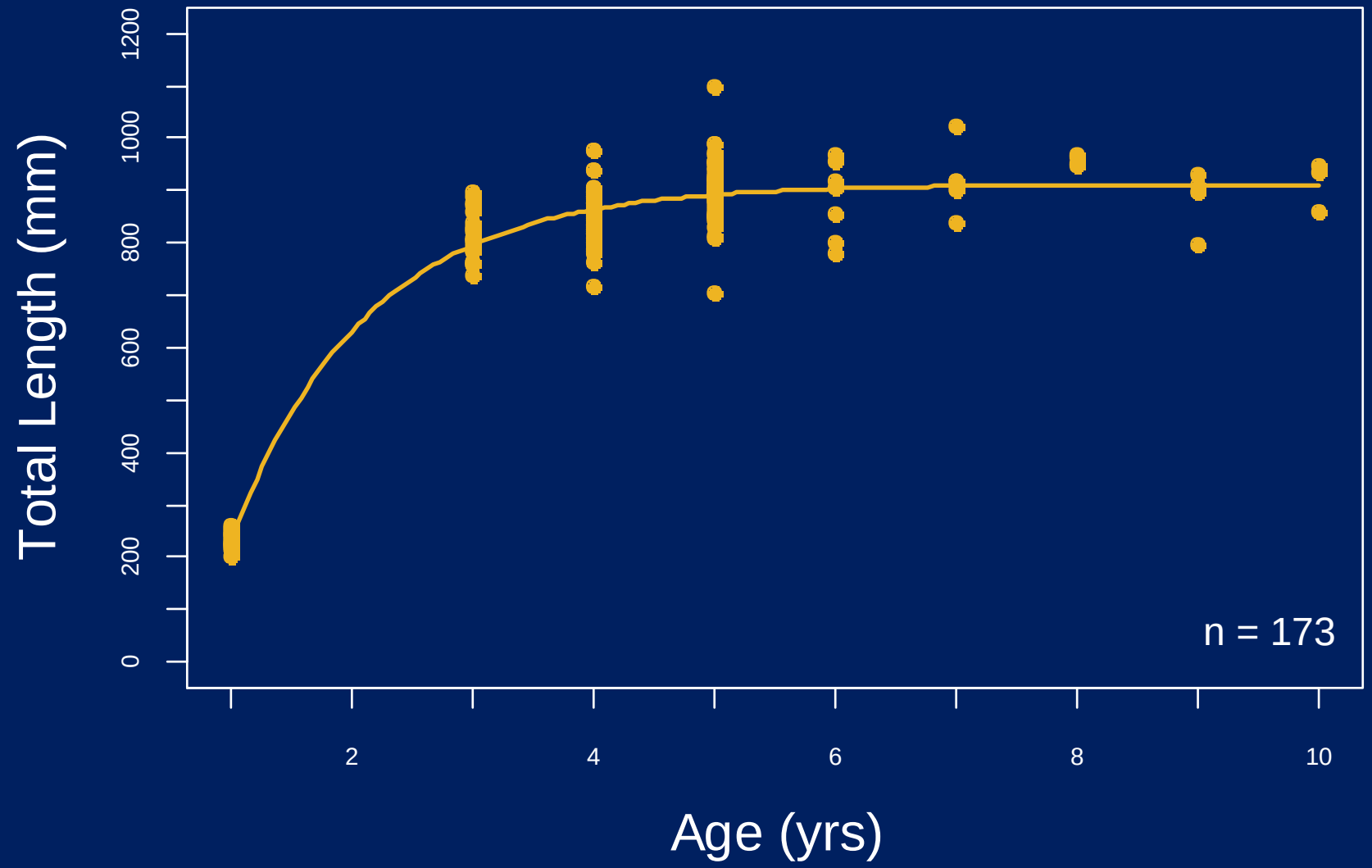
Other Populations



Ammended from Hayer et al. 2014

Results: Growth in Kentucky Lake

$$l_t = 912\ (1 - e^{-0.8849\ (t - (0.6630))})$$

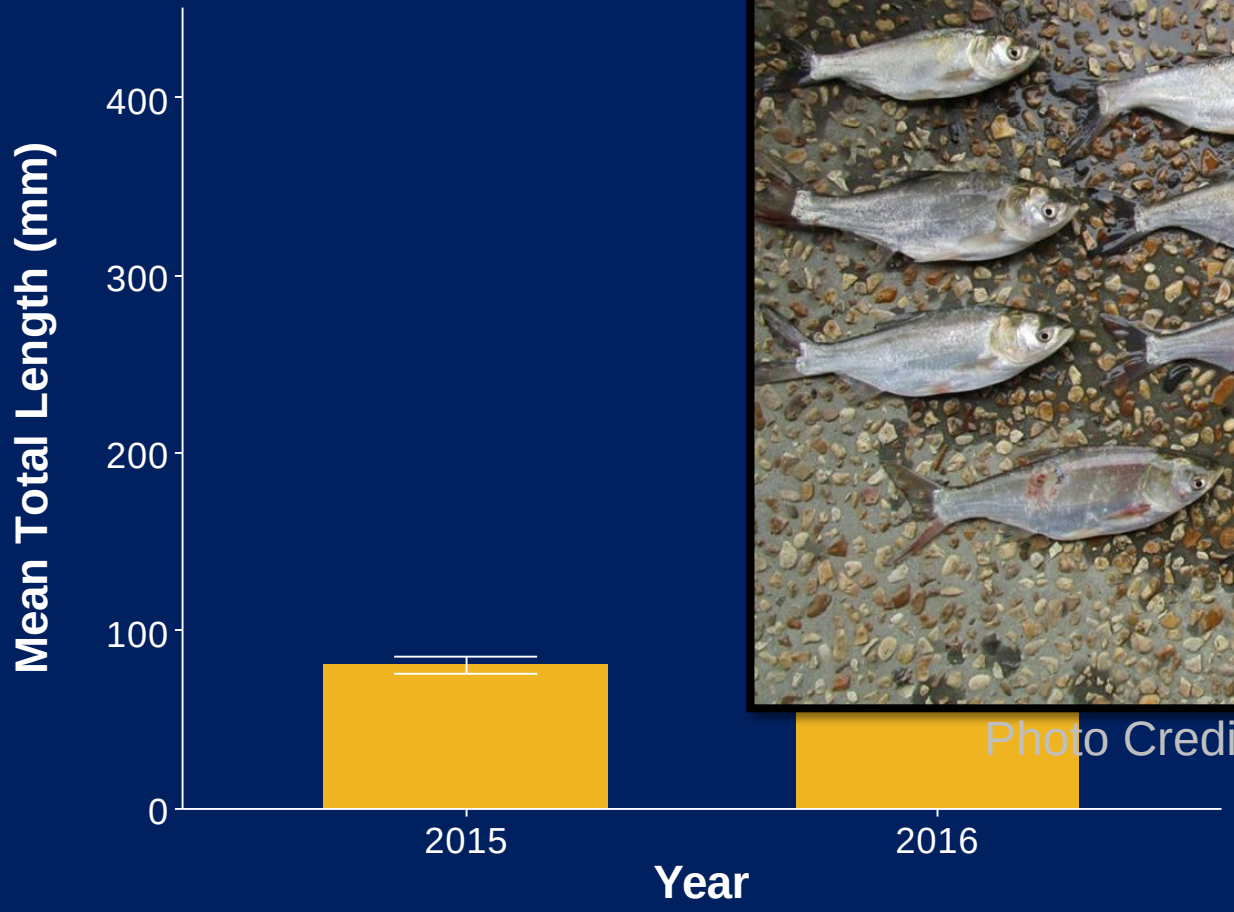


Results: Growth in Kentucky Lake

Juvenile Silver Carp

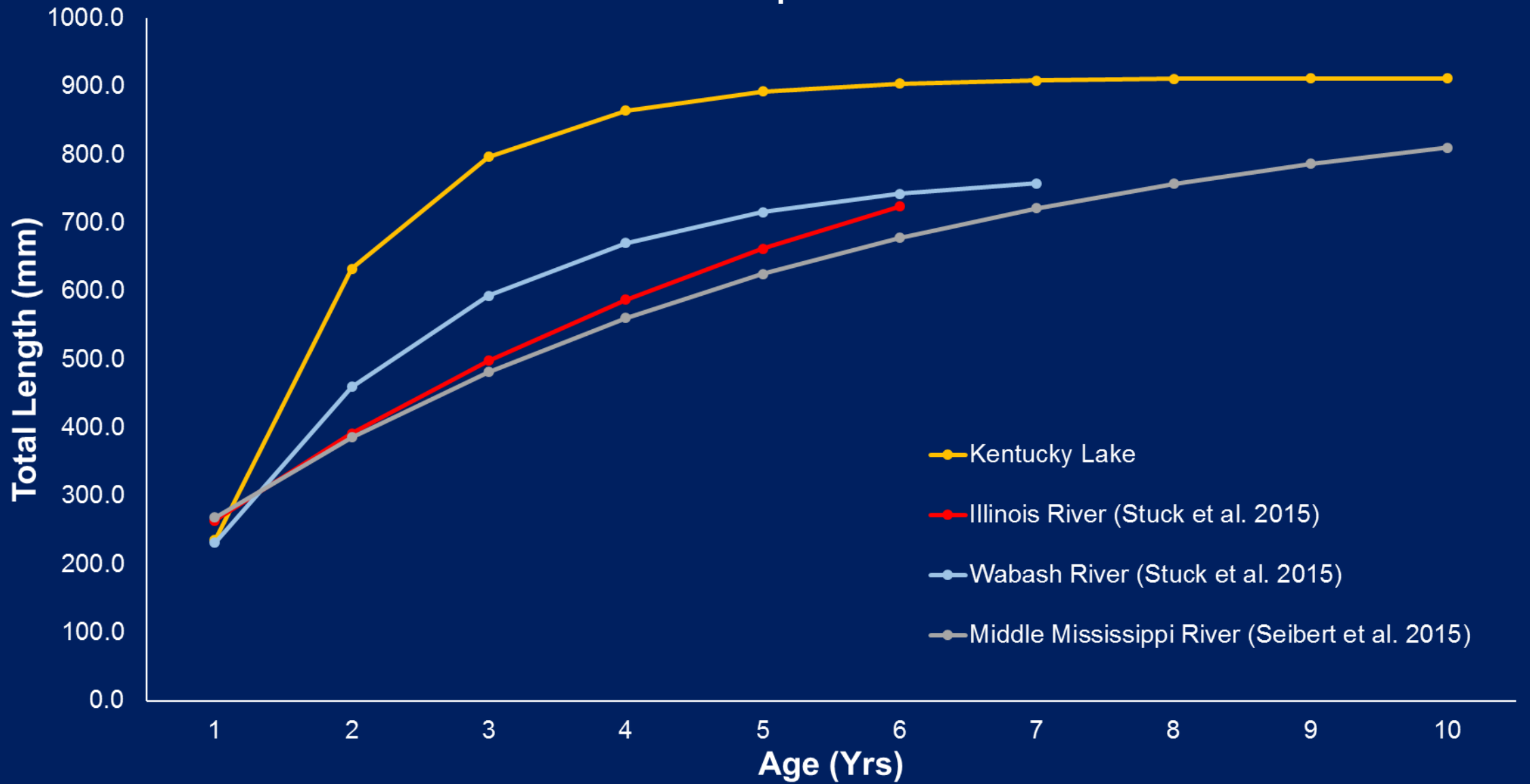
July 2015 to July 2016

Photo Credit: Dalton Lebeda



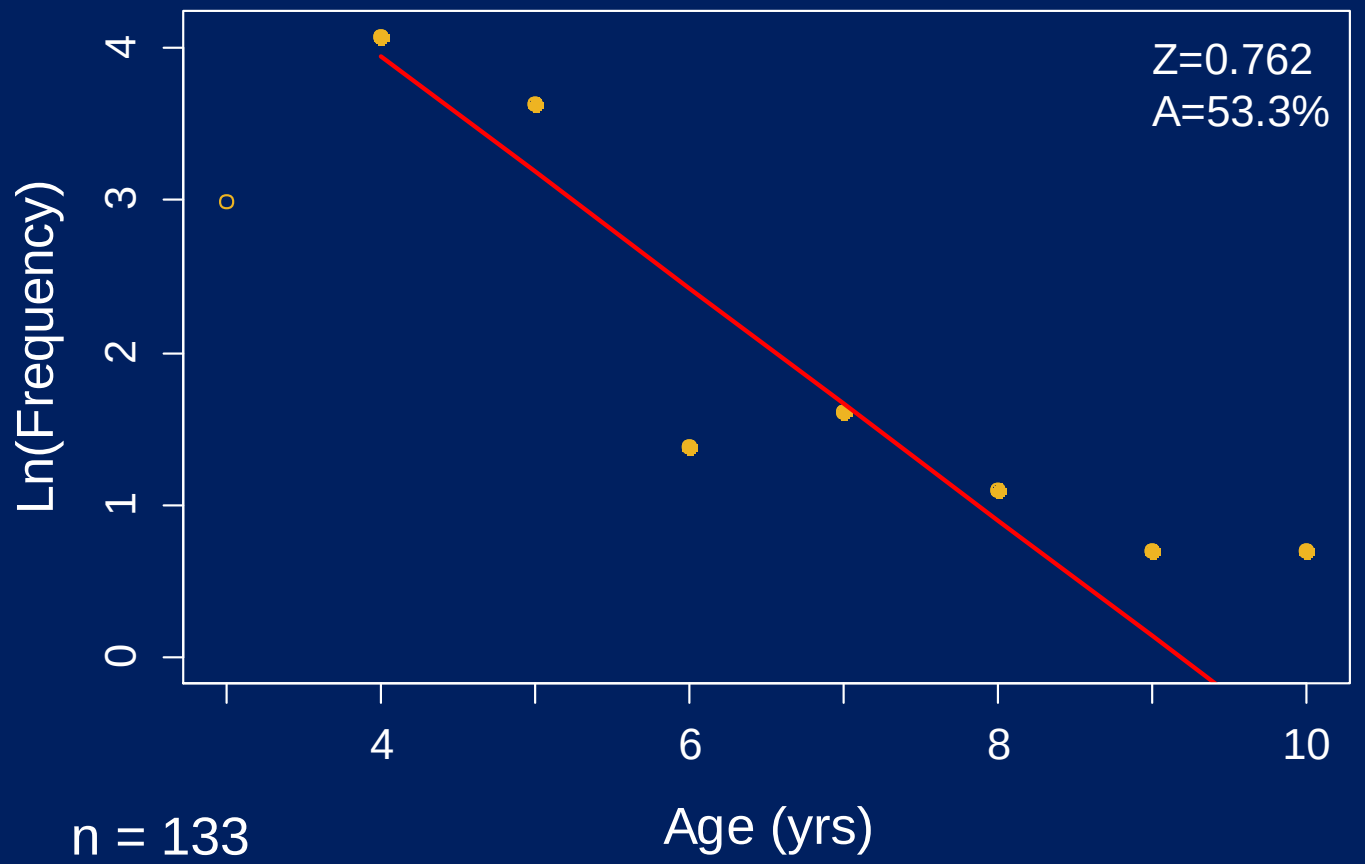
Results: Growth

Other Populations



Results: Mortality Rate in Kentucky Lake

2015 only



n = 133

R^2 = 0.797

P-value = <0.005

Other Populations

- Middle Mississippi River: 63%

  Seibert et al. 2015

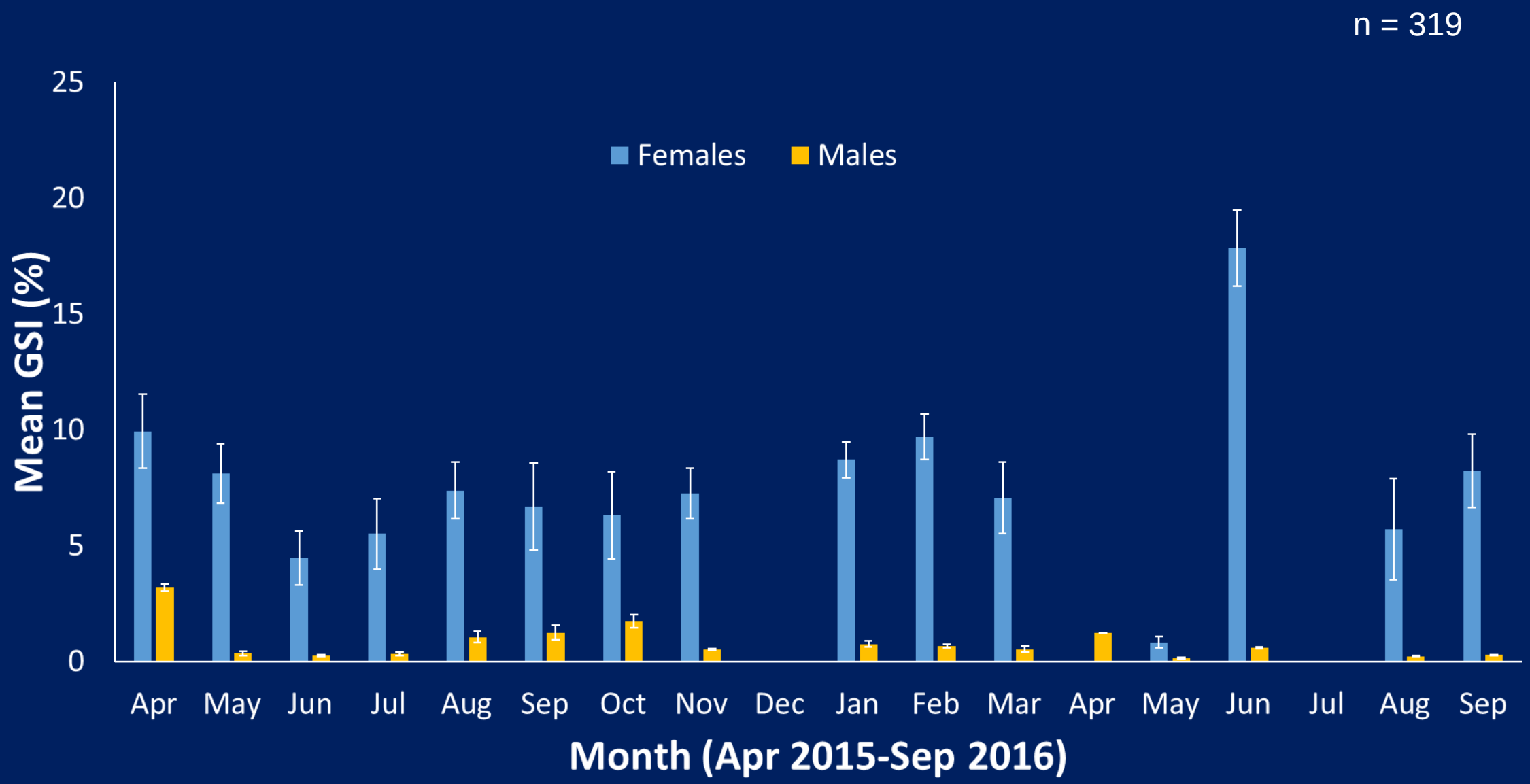
- Illinois River: 63.3%

  Stuck et al. 2015

- Wabash River: 43.6%

  Stuck et al. 2015

Results: Spawning Periodicity



Summary

- Describe and compare population metrics for Silver Carp in Kentucky Lake to other populations.
  - Size structure — MUCH LARGER
  - Age — COMPARABLE
  - Growth — MUCH FASTER
  - Mortality rates — LOWER
- These metrics represent population demographics of a fairly recent invasion in a large reservoir.

Current and Future Research

- We don’t know if the population characteristics seen in Silver Carp in Kentucky Lake are because of an early invasion or a large reservoir.
  - KDFWR is developing a long term sampling effort to monitor trends in abundance and population metrics.
- We don’t know how much immigration is contributing to the reservoir’s population.
  - We are conducting a telemetry study to follow movements of Silver Carp.

Photo Credit: Brad Hartman

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