Population Demographics of Silver Carp in a Large Mesotrophic Reservoir

Allison (DeRose) Lebeda, Timothy Spier, Neal Jackson
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
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

- 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

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
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

Mean Total Length (mm)

Frequency

Gear
- angler
- cast net
- electroshocking
- gill nets
Results: Size Structure

Kentucky Lake

Other Populations

- Wabash River: N = 126
- Illinois River: N = 203
- Middle Mississippi River: N = 100

Ammended from Seibert et al. 2015
Results: Length–Weight Relationship

Kentucky Lake

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

n = 439
R² = 0.99

Other Populations

Ammended from Hayer et al. 2014
Results: Growth in Kentucky Lake

\[ l_t = 912 \left(1 - e^{-0.8849 (t - 0.6630)}\right) \]

\( n = 173 \)
Results: Growth in Kentucky Lake

Juvenile Silver Carp

July 2015 to July 2016

Photo Credit: Dalton Lebeda
Results: Growth

Other Populations

- Kentucky Lake
- Illinois River (Stuck et al. 2015)
- Wabash River (Stuck et al. 2015)
- Middle Mississippi River (Seibert et al. 2015)

Total Length (mm)

Age (Yrs)
Results: Mortality Rate in Kentucky Lake

2015 only

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

n = 133
$R^2 = 0.797$
$P$-value $= <0.005$
Results: Spawning Periodicity

n = 319

[Bar chart showing mean GSI (%) for females and males across months from April 2015 to September 2016, with Jun showing a significantly higher value]
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
Acknowledgements

Field Help:
Dalton Lebeda  
Jessica Morris  
Brad Hartman  
Ronnie Hopkins  
Brad Richardson  
Clint Cunningham  
Nathan Ward  
Ben Tumolo  
Matt May  
Alex Vaisvil  
Christy Soldo  
Nathan Tillotson  
Josh Revell

Project Funding:
Graduate Innovation Assistantship  
Hattie Mayme Ross Scholarship  
Larry D. Pharris Memorial Wildlife Fund Scholarship  
Dr. Morgan Emory Sisk Jr. Memorial Scholarship  
Watershed Studies Research Institute Grants  
Jesse D. Jones College of Science, Engineering and Technology Travel Grants