ERDC Research on Invasive Fishes

Jan Jeffrey Hoover

ERDC Fish Ecology Team, Environmental Laboratory
US Army Engineer Research and Development Center
Vicksburg MS 39180

AQUATIC PLANT CONTROL RESEARCH PROGRAM

Grass Carp

- 1990s
  - Age & Growth
  - Movements
  - Stocking densities
  - Innovative collecting techniques
- Currently
  - Records in LMR
  - Entrainment by and dispersal from Bonnet Carré

Suckermouth Armored Catfishes

- Field studies of shoreline erosion in natural and urban waterways
- Greenhouse demonstrations of reduced aquatic vegetation and periphyton, increased turbidity/phytoplankton
- Literature review and workshop identifying multi-level impacts

Sea Lamprey

- Response to Metals
- Swim Performance
- Field Studies
  - Barriers
  - Traps

Asian (Bigheaded) Carp

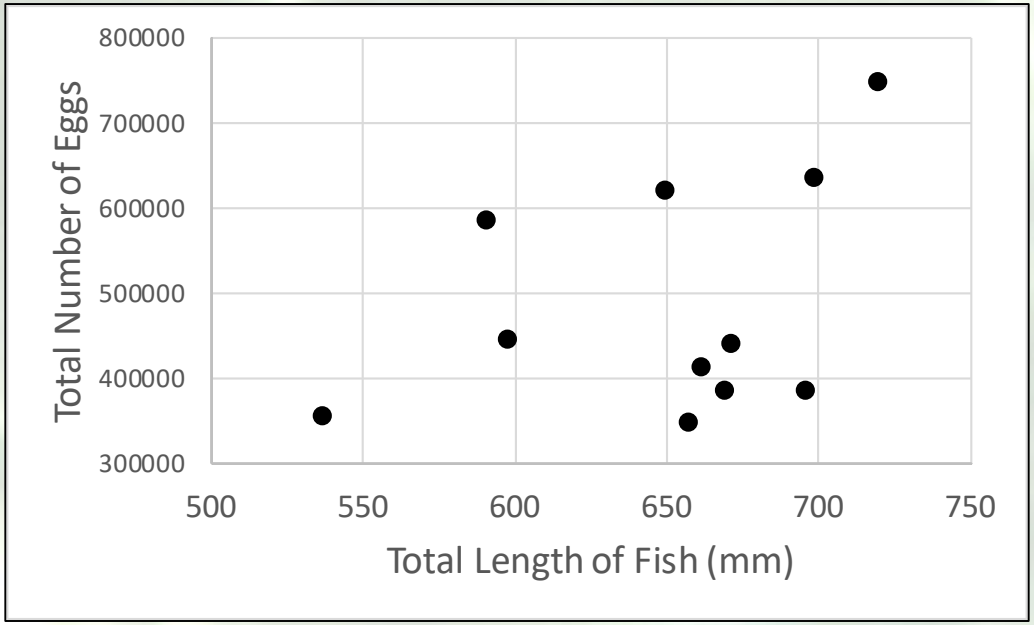
- Create empirically-based population models that reflect extreme capabilities of species
- Evaluate management scenarios including barriers and harvest

Tournament-based harvest…

… enables selective sub-sampling from 1000's of fish for jump parameters and population metrics.

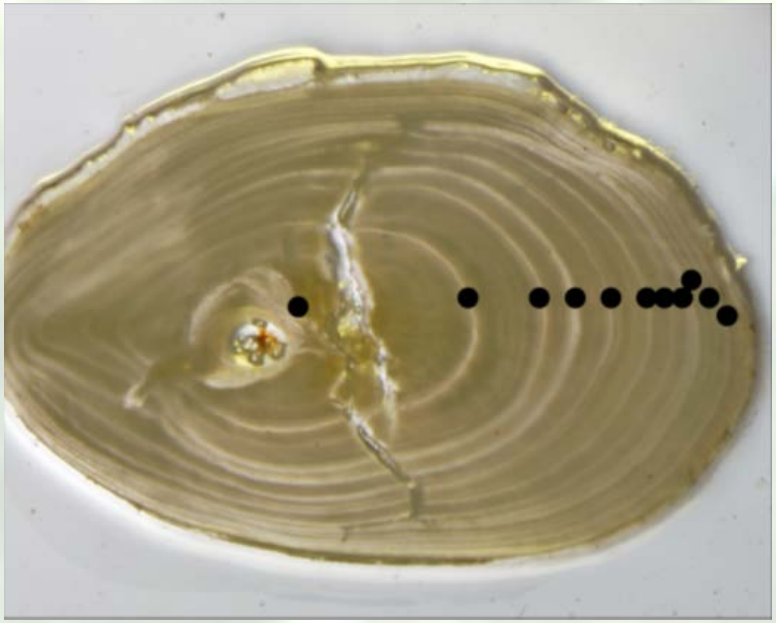
Asian Carp Fecundity

Size-fecundity relationship confounded by ovary development (diameter, GSI)



Asian Carp Age & Growth

- > 800 carp aged
- Growth, longevity, and other vital rates underestimated for populations in the Lower Mississippi River.

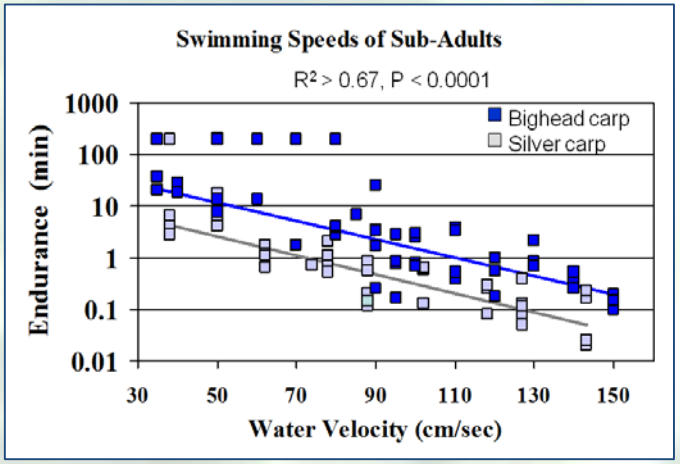


Asian Carp Locomotion

- Swim studies => specs for hydraulic barriers
- Jump studies => specs for vertical & hydraulic barriers

Asian Carp Swimming: Juveniles

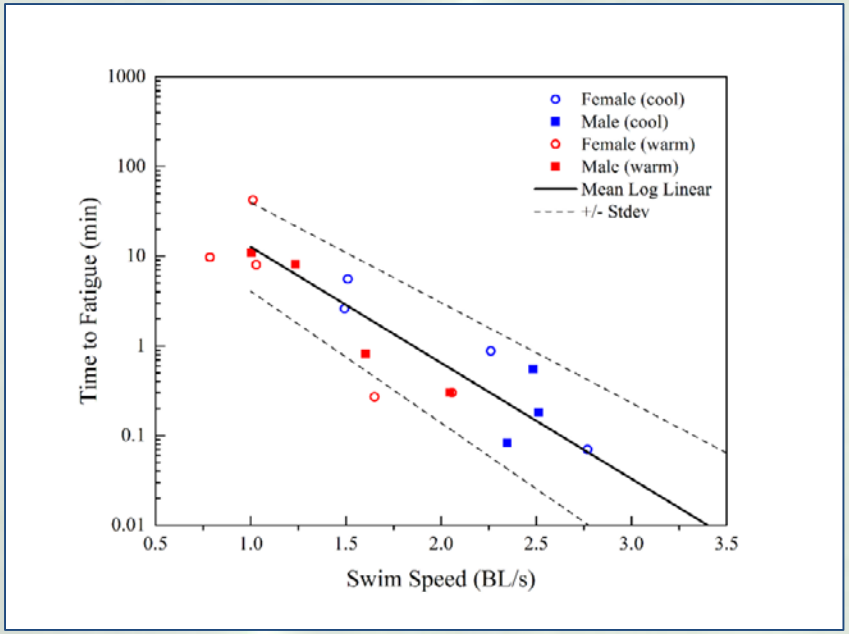
- Laboratory studies
  - Hatchery-reared
  - acclimitized
- High relative speeds (> 10 BL/S)
- Log-linear models
- Bighead Carp endurance > Silver Carp endurance

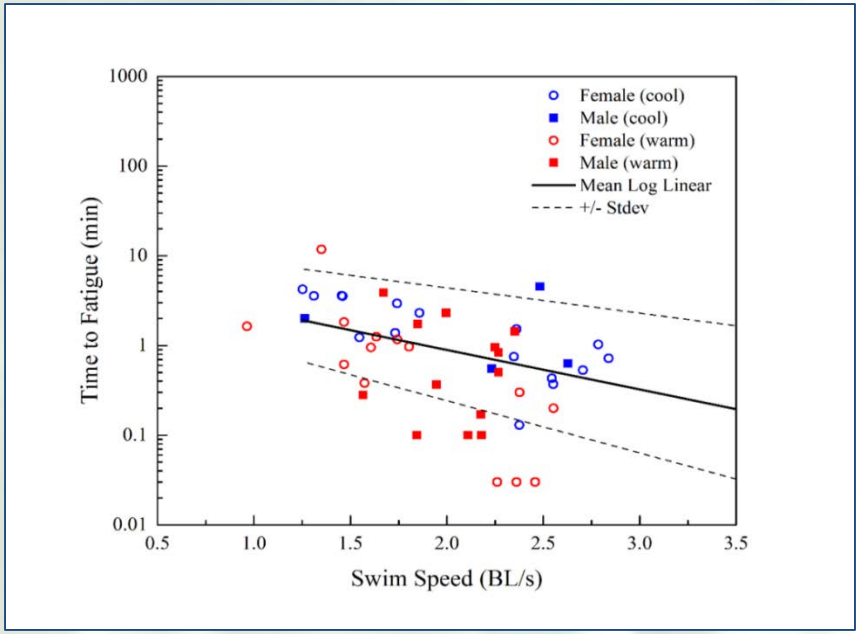


ERDC Mobile Swim Tunnel

Asian Carp Swimming: Adults

- Field study
- Non-acclimatized
- Low relative speeds (< 3 BL/s)
- Log-linear models
- Bighead Carp endurance > Silver at low speeds only


Female (cool)
Male (cool)
Female (warm)
Male (warm)
Mean Log Linear
+/- Stdev
Time to Fatigue (min)
Swim Speed (BL/s)
1000
100
10
1
0.1
0.01
0.5
1.0
1.5
2.0
2.5
3.0
3.5


Female (cool)
Male (cool)
Female (warm)
Male (warm)
Mean Log Linear
+/- Stdev
Time to Fatigue (min)
Swim Speed (BL/s)
1000
100
10
1
0.1
0.01
0.5
1.0
1.5
2.0
2.5
3.0
3.5

$R^2 = 0.78$

$R^2 = 0.23$

Silver Carp Jumping

- Observational studies of spatial patterns and environmental influences
- Videographic studies of jump parameters

Position Relative to Boat

Port
15.3%

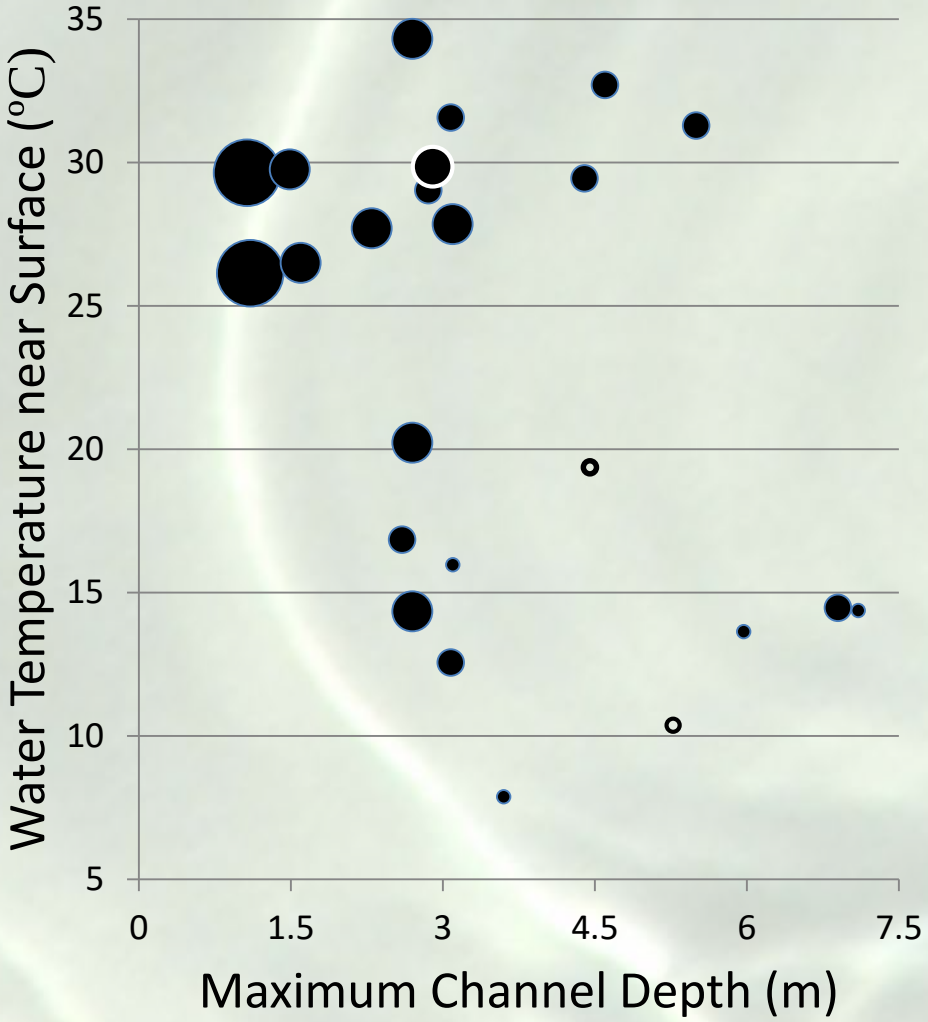
Stern
60.2%

Bow
9.0%

Starboard
15.2%

2462 observations

Silver Carp Jumps



Significant Correlates

- Channel Depth (-)
- Width (+)
- Conductivity (+)

Non-Significant Correlates

- Dissolved Oxygen
- Turbidity
- Carp Abundance (CPUE)

Carp-Catcher

FY 16 and FY 17

Silver Carp Jumping

- Fish size
  - 24-80 cm TL, 0.1-6.2 kg
  - MS >> MO > IL
- Jump height 0.4-2.7 m
- Jump distance 0.7-6.7 m
- Jump angle 35-75 deg
- Escape velocity
  - 4.2-15 body lengths/sec
  - 0.5-12.4 m/s*

*** Mean = 5.2 m/s. Compare with tunnel model extrapolated value of 5.45 m/s!**

Asian Carp Inter-Drainage Dispersal

- External tags attached to carp entrained at Bonnet Carré
- Populations monitored in Pearl River system (coincident with Gulf Sturgeon studies)

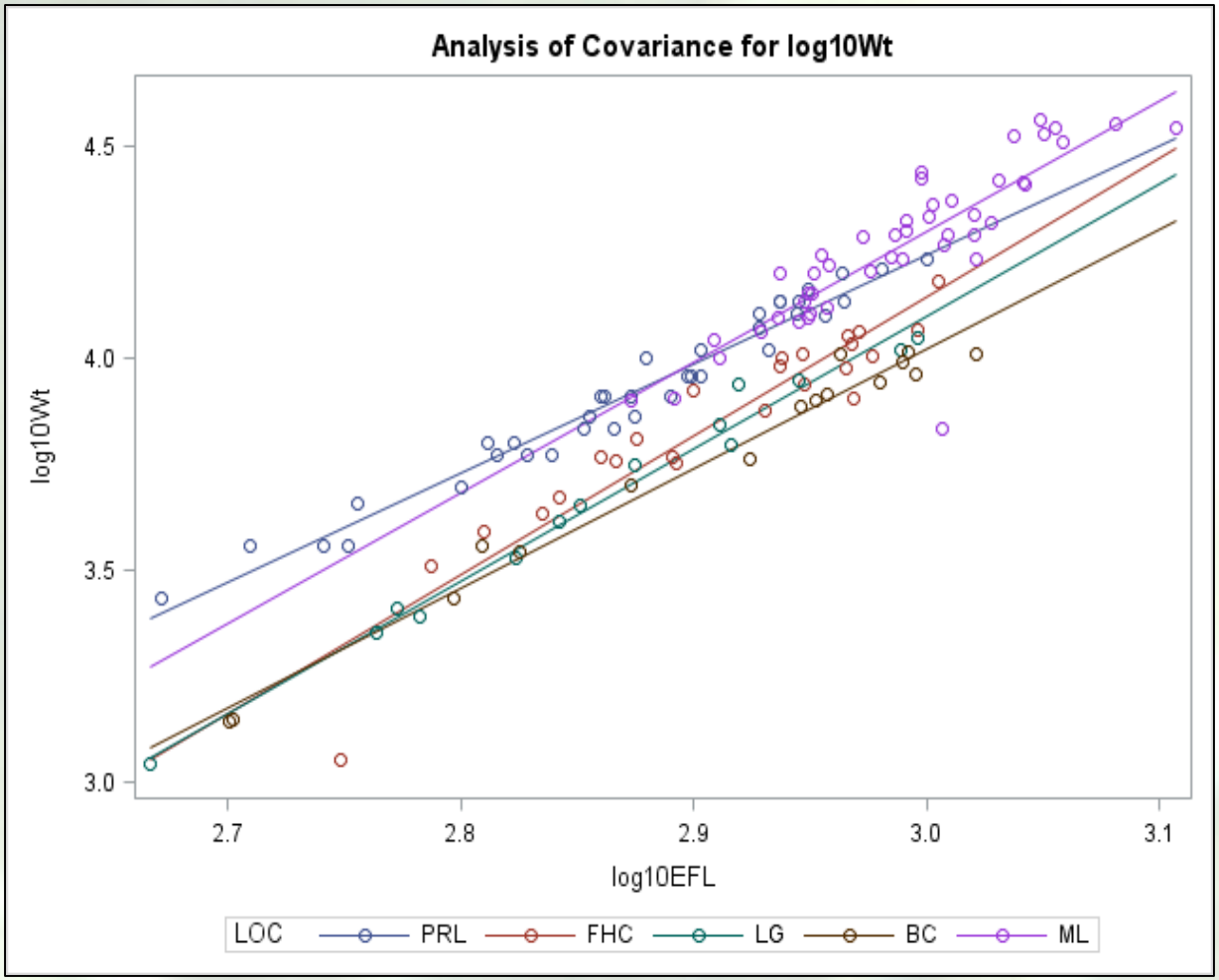
Asian Carp Ecological Models

Do Asian Carp impact Paddlefish?

Paddlefish are less robust…

Moon Lake (2012)
Pearl River (2008-2010)

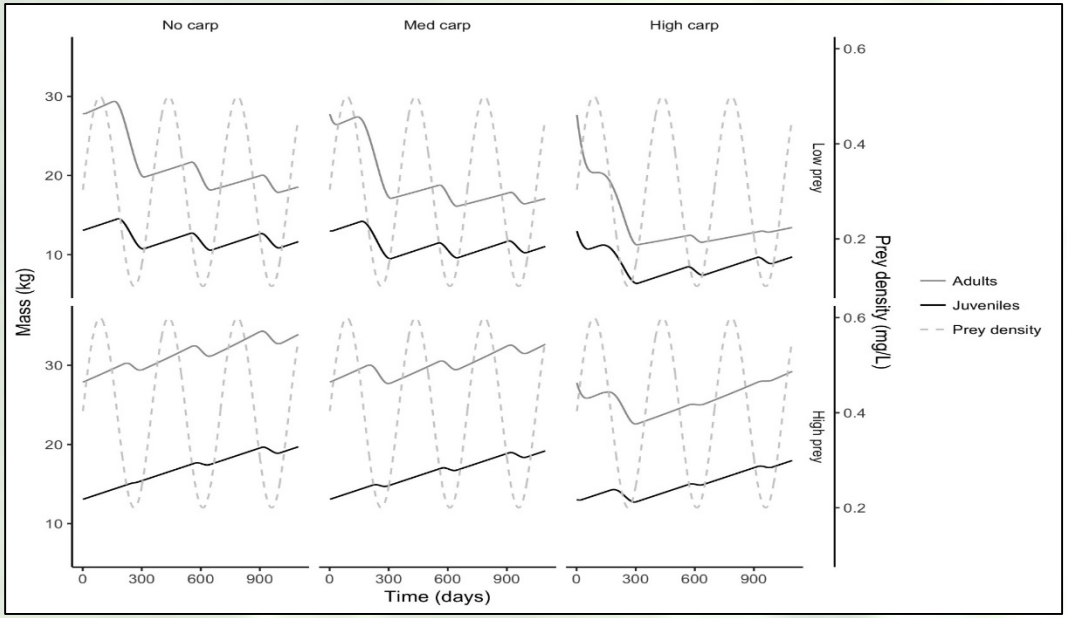
Forest Home Chute (< 2003)
Lake George, Delta (< 1991)
Bonnet Carre, Mississippi River (1980s?)



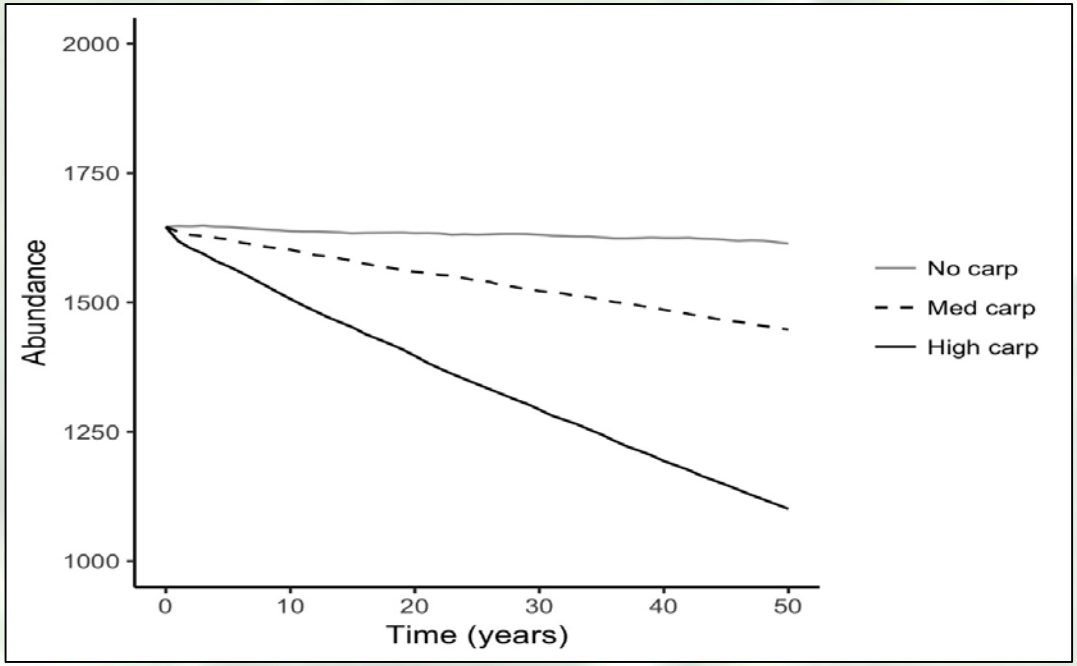
… with prolonged exposure to Asian Carp.

Asian Carp Ecological Models

Wisconsin
Bio-energetics model



Population Viability Analysis



APPLIED BIOMATHEMATICS

Developing Technologies

- Chemical Disinfection
- Synthetic Biology
  - Engineered pathogens
  - Engineered fishes
    - Limited lifespan
    - Daughterless strains

Developing Industries