# Investigating the Mechanism of Establishment of Invasive Carp in the Ohio River

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# Invasive Silver Carp

- Invasive species: introduced outside of its native range that causes or is likely to cause *impacts*

**Silver Carp** (*Hypopthalmichthys molitrix)*

- Native Range:
  - Eastern Asia
- Introduced Range:
  - 88 countries (worldwide)
- Impacts:
  - **Ecological** – large-bodied, low trophic position (planktivorous)
  - **Economic** – disrupt native fisheries, injuries to boaters

# Invasive Silver Carp Jumping!

Source: *U.S. Geological Survey*

Source: *Emily Carter*



Source: *Thad Cook*

Source: *Jason Goeckler*

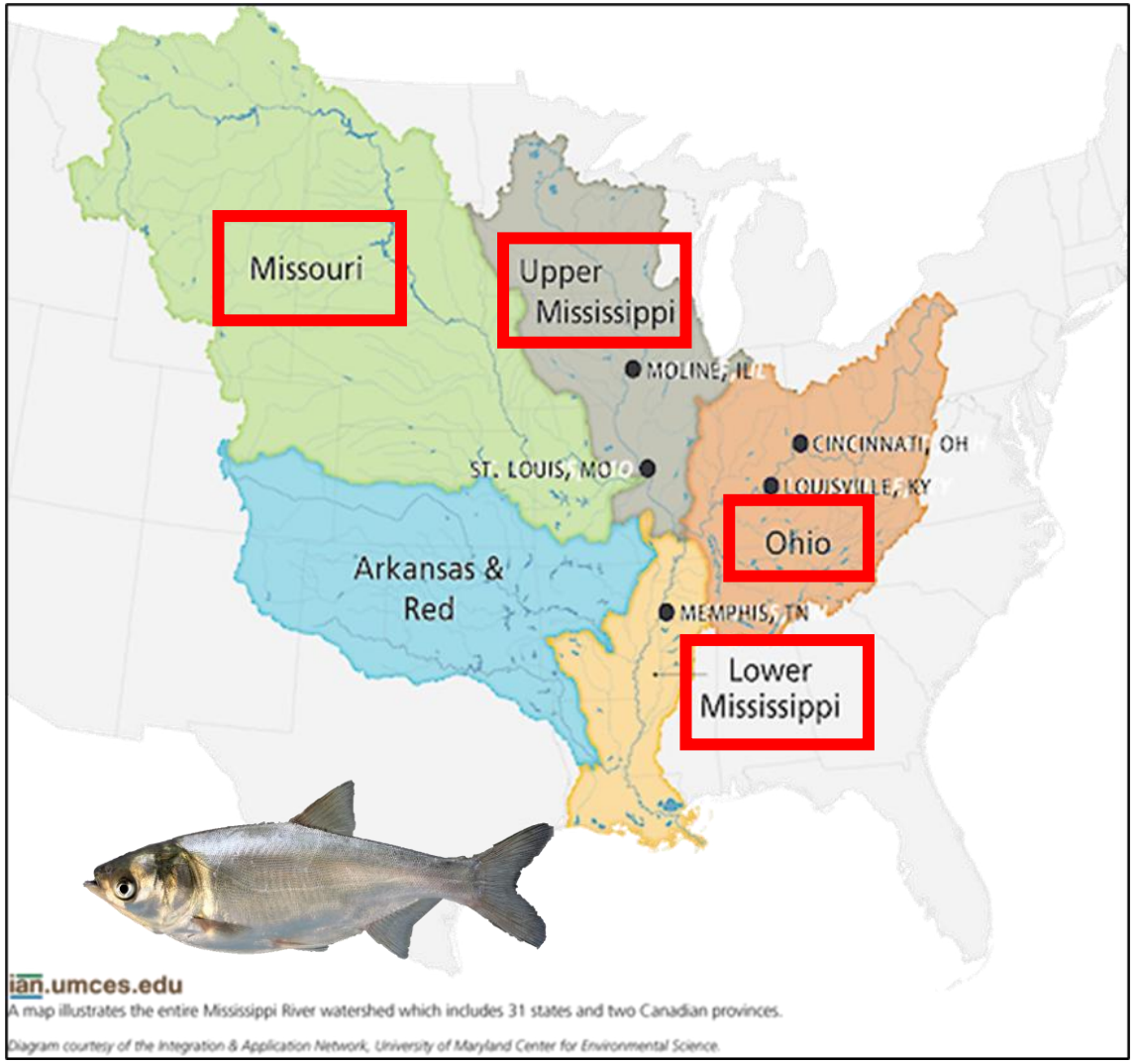
Source: *Denny Simmons*/Courier & Press

# Silver Carp Invasion in the Ohio River

Introduction in the **Lower Mississippi River**

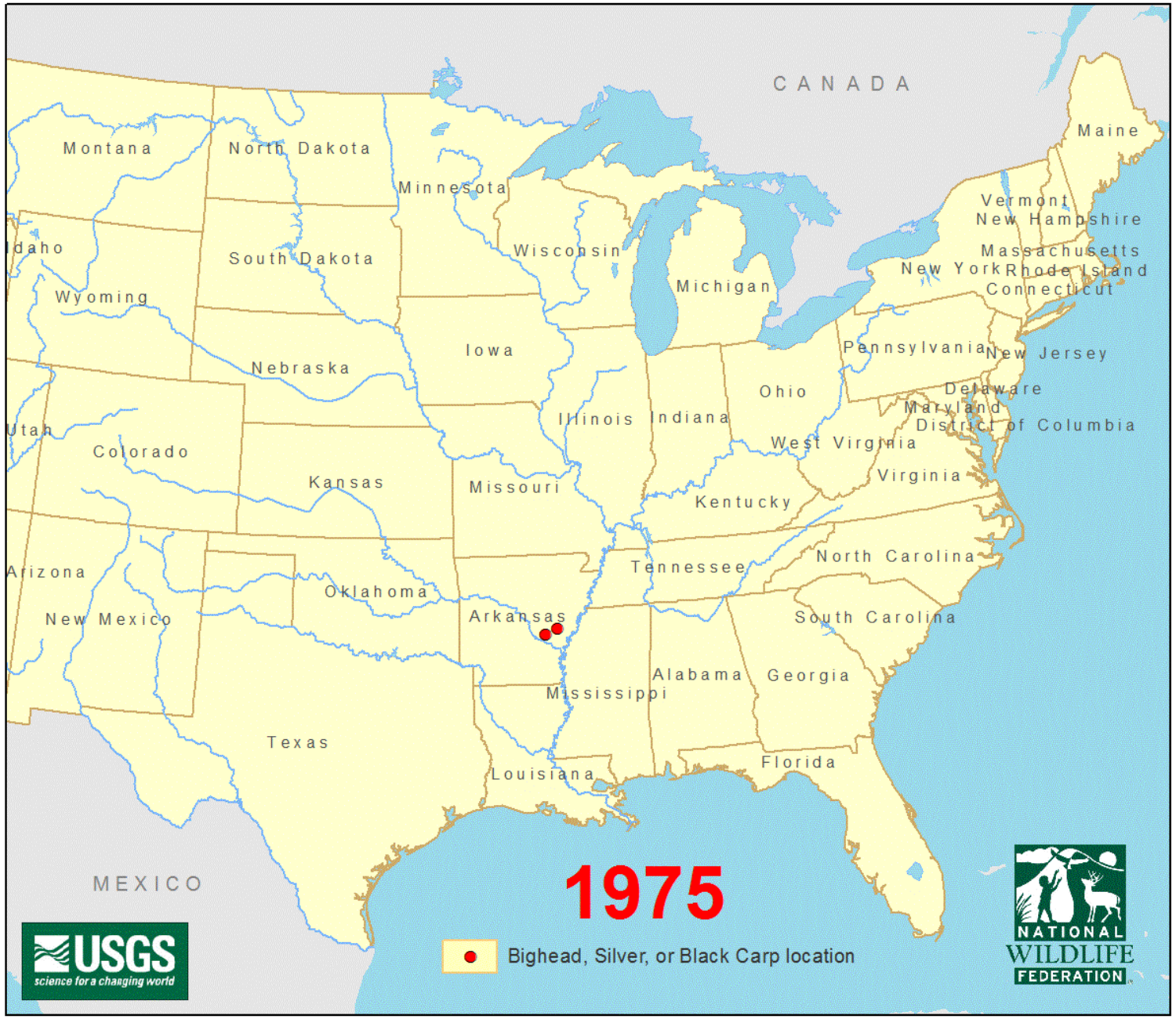
- Rapid population spread and hyper abundance throughout the **Upper Mississippi and Missouri**
- Spread slowed/stalled with lower abundances in **Ohio River** basin

**Question:**
Why has spread slowed/stalled in the Ohio River basin?



# Invasive Species Spread

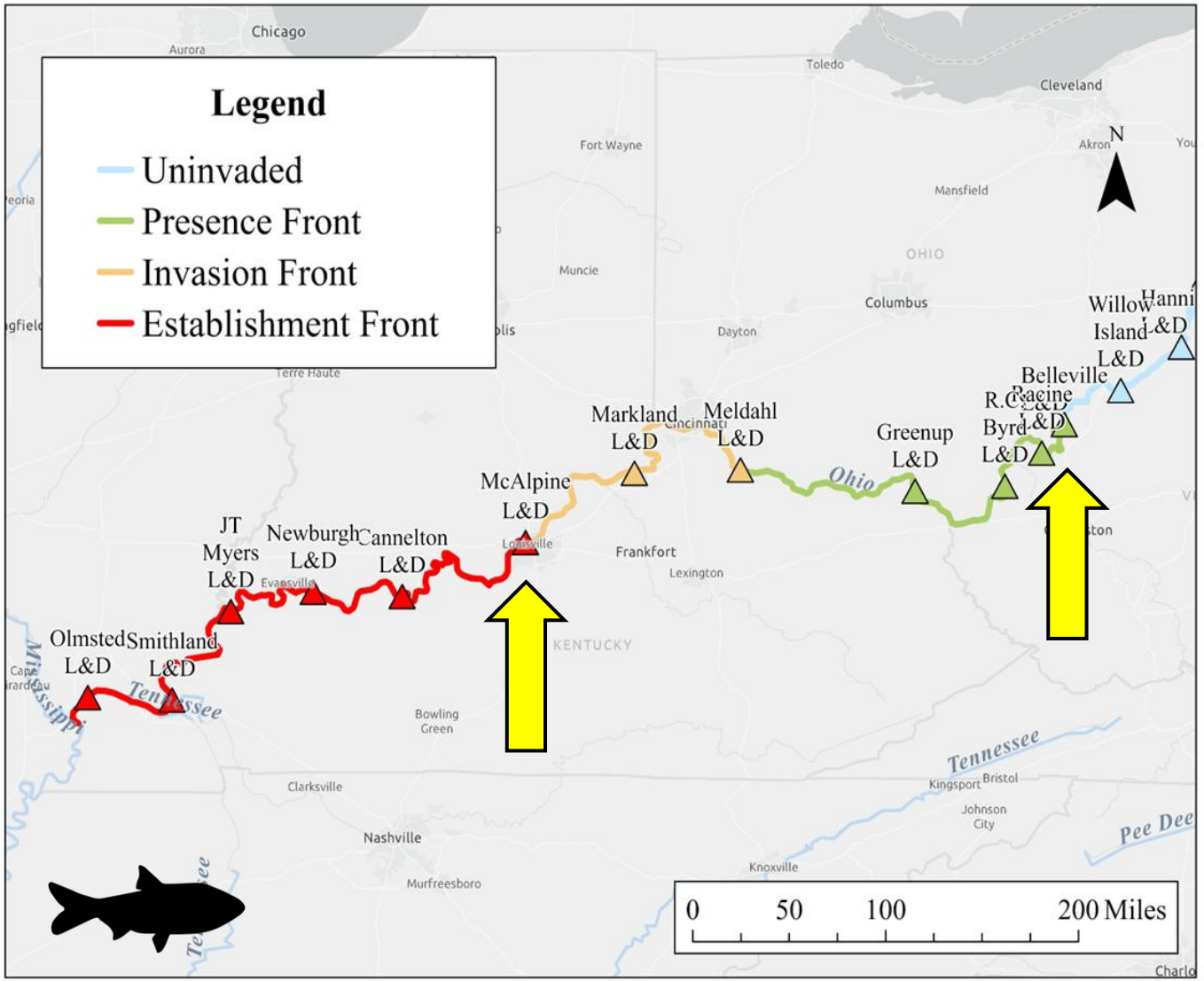
Secondary spread can be understood as a series of repeated ***dispersal*** and ***establishment*** events



# Understanding Carp Secondary Spread

- **Silver Carp Dispersal**
  - Adult carp occur and populations persist as far as WV (Shepta et al. 2026)

★ **Silver Carp Establishment**
  - Spawning and recruitment reduced upstream of McAlpine L&D

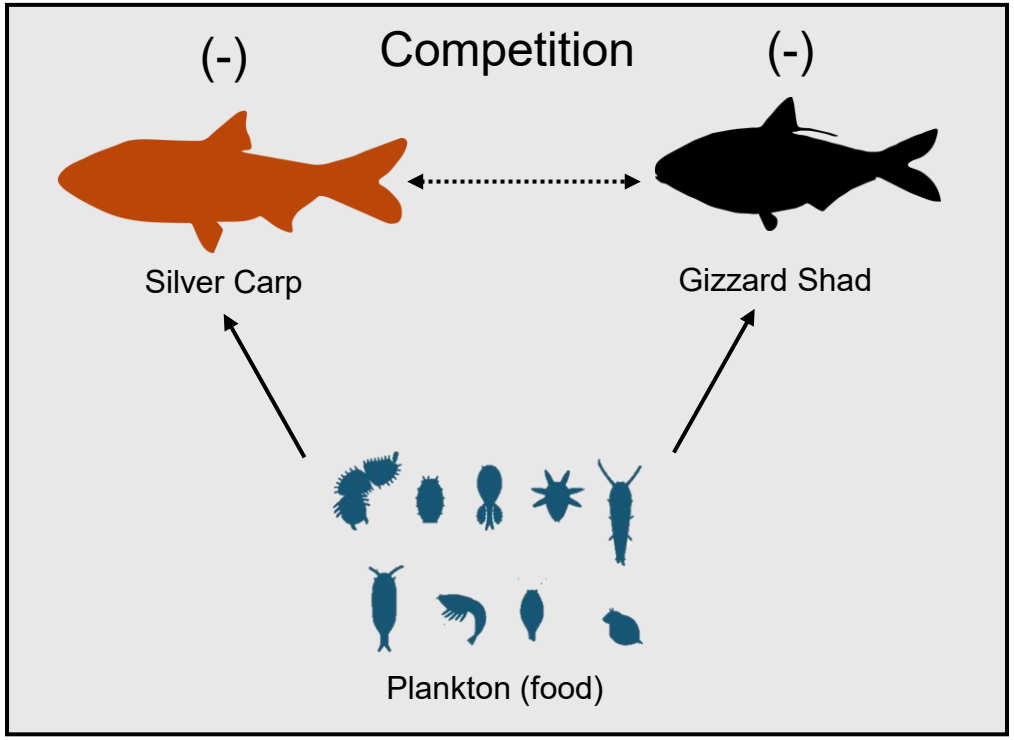


# Invasive Species Establishment

Establishment success – impacted by **abiotic conditions** (environment) and **biotic interactions**

**Abiotic conditions** limiting invasive carp - nursery habitat

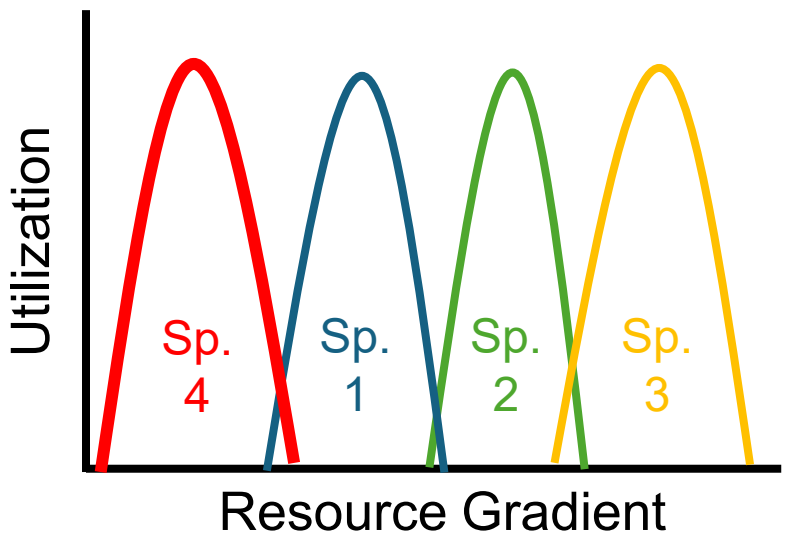
How are **biotic interactions** influencing silver carp?

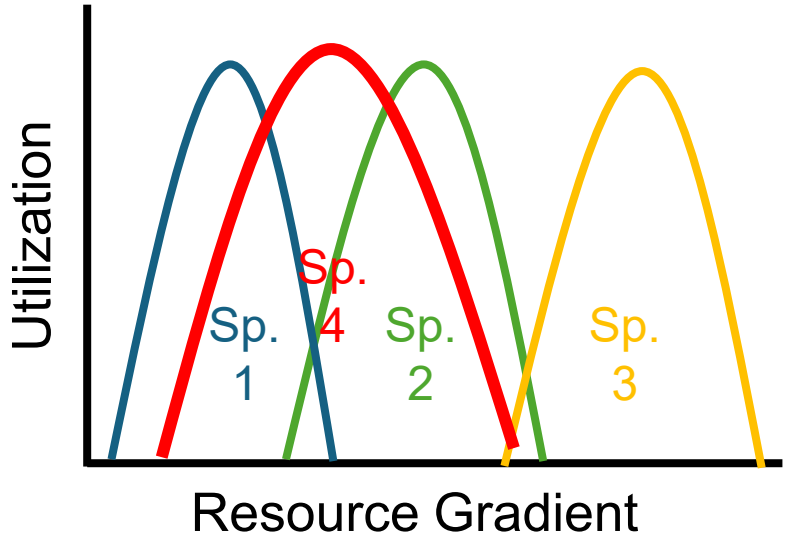


# Biotic Mechanisms of Establishment

| No Niche Overlap | Niche Overlap |
| --- | --- |
| • Easier to establish (**opportunistic strategy**)<br>• Limited direct competition for resources | • More difficult to establish (**biotic resistance**)<br>• Establish and competitively displace (**hostile take-over**)<br>• Establish and no impact (**coexistence**) |

**1. Opportunistic**



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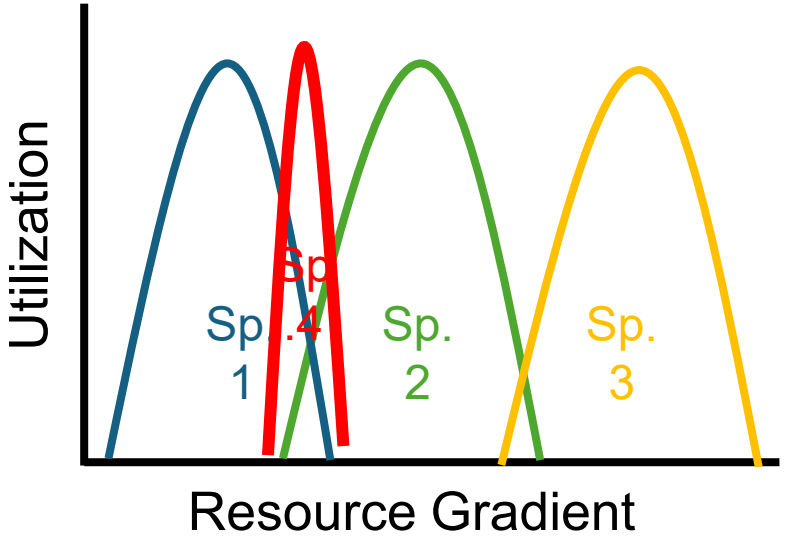
**2. Biotic Resistance**



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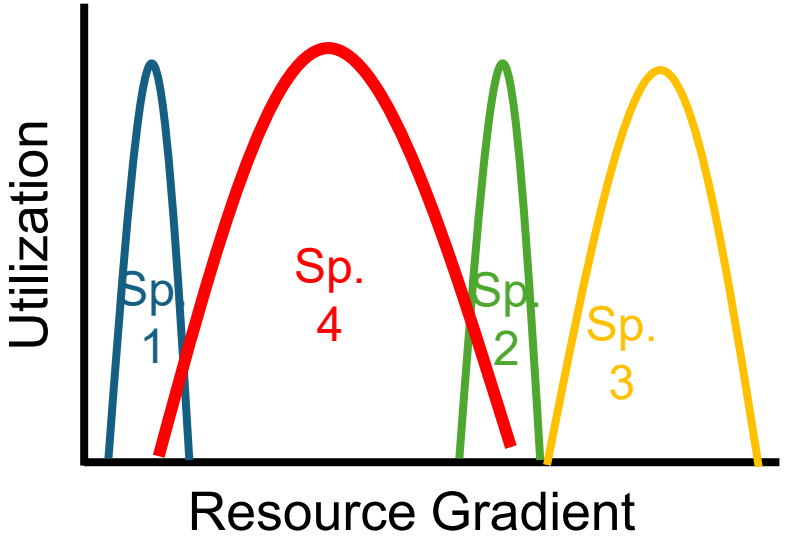
**3. Hostile Take-Over**



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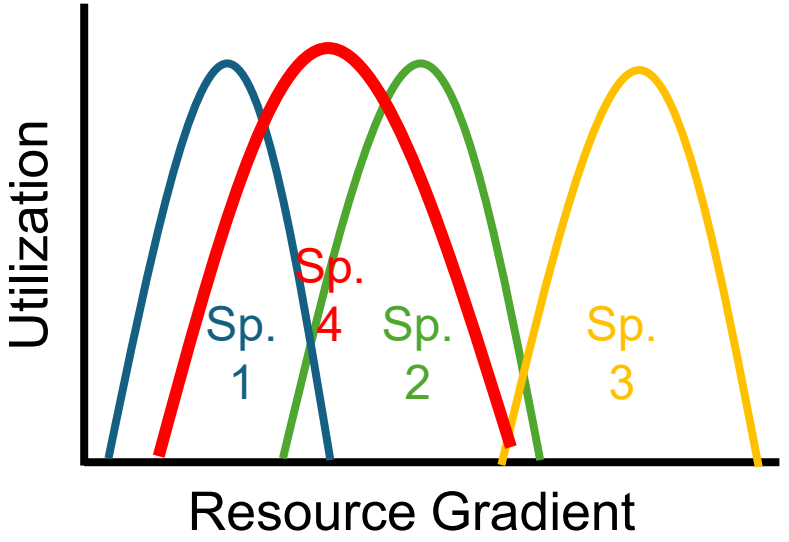
**4. Coexistence**



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**Question:**

Which establishment strategy describes silver carp invasion in the Ohio River?

**(1) Opportunistic**

**(2) Biotic Resistance**

**(3) Hostile Take-Over**

**(4) Coexistence**

1. Oppor

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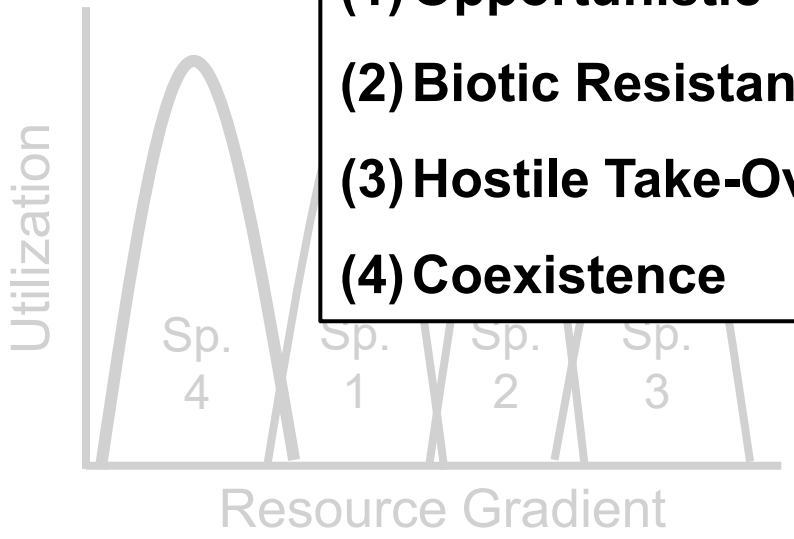
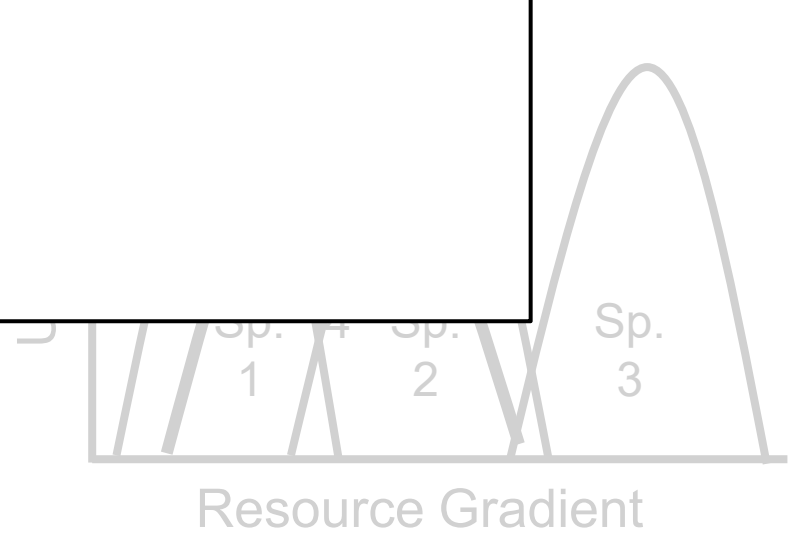
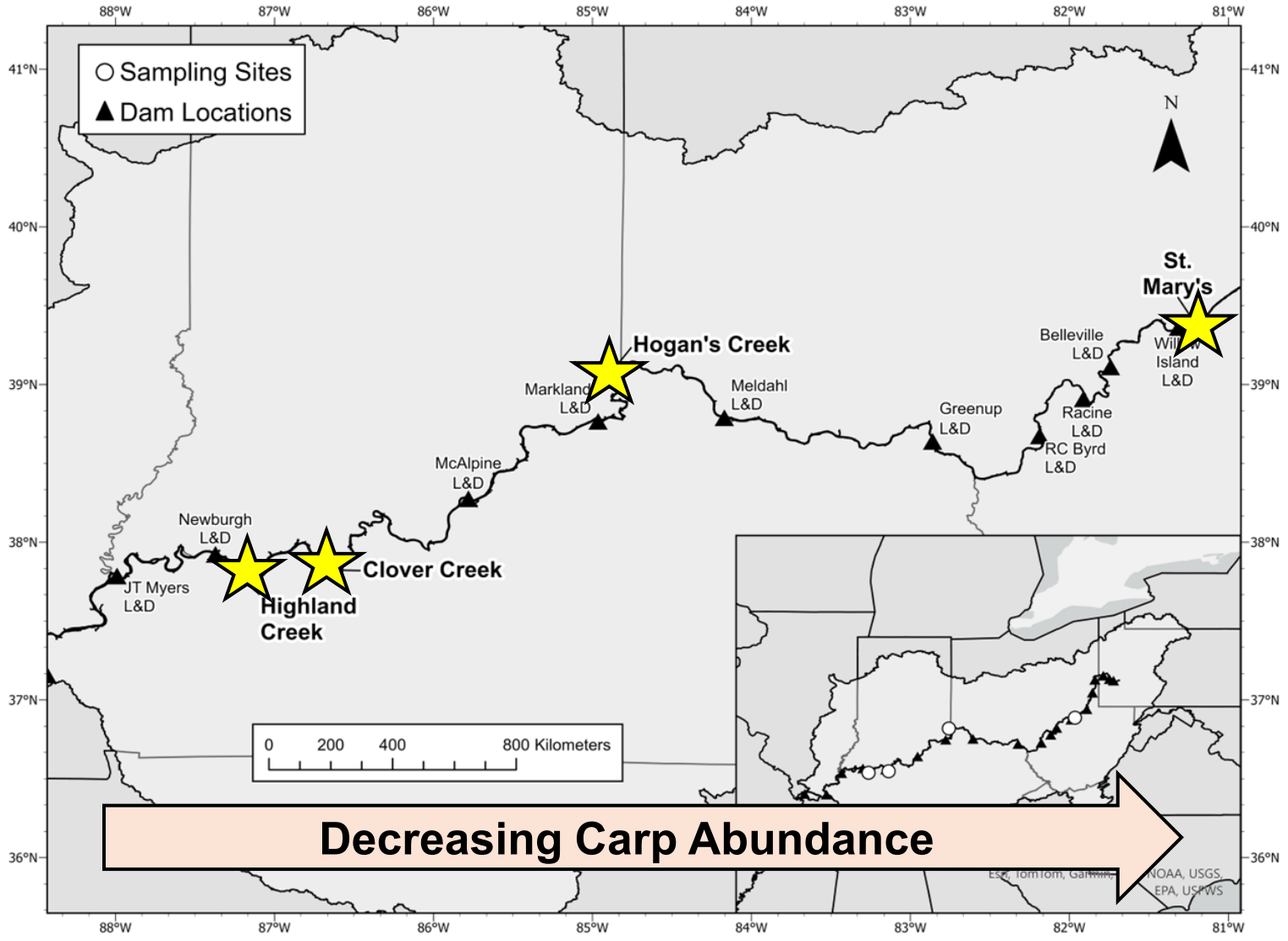
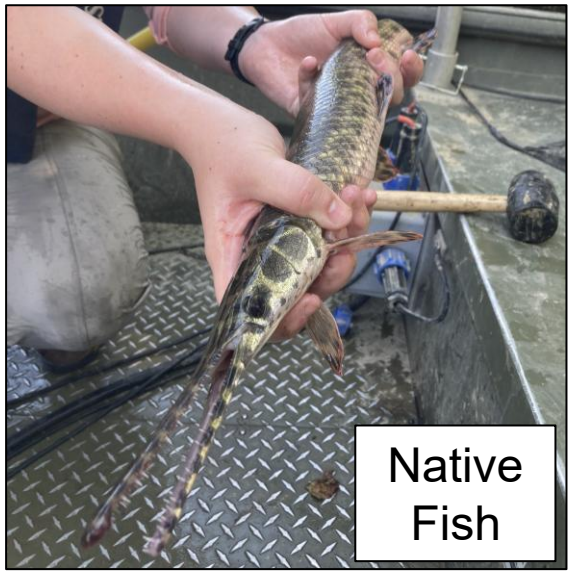


# Study Area: The Ohio River



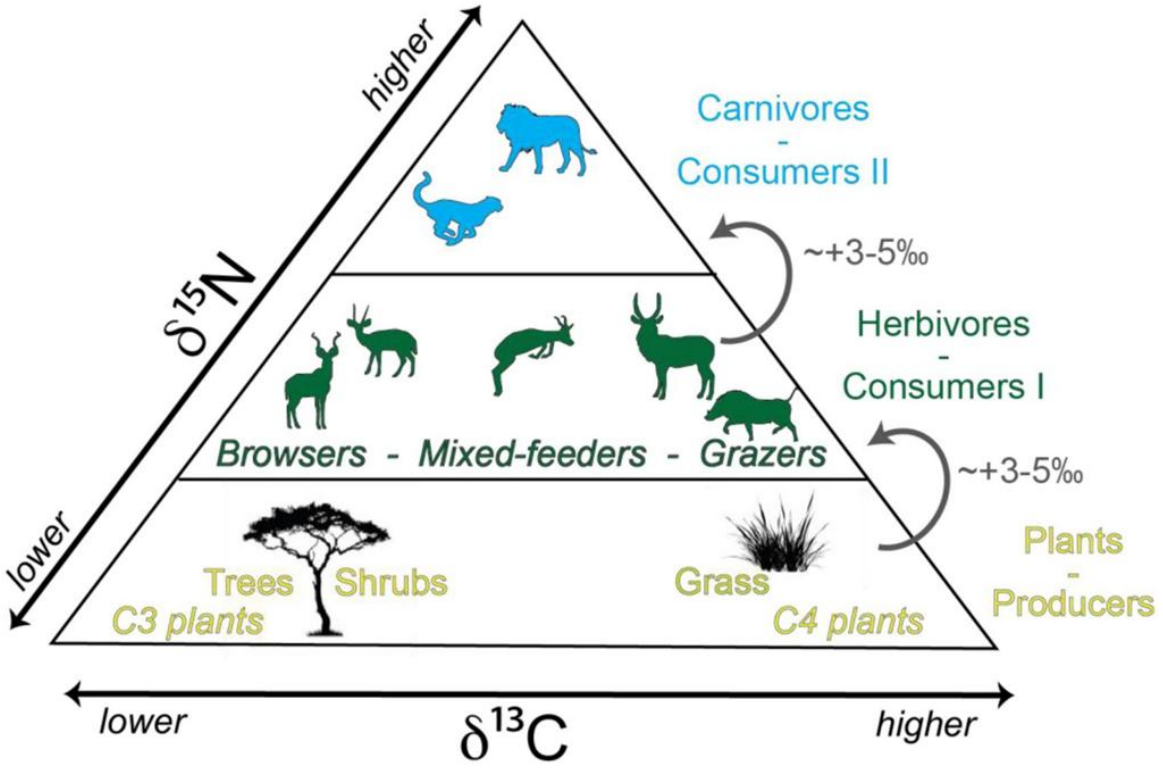




# Methods: Stable Isotope and Data Analysis

*Stable Isotope Analysis (muscle tissue)*:

- **$\delta^{13}C$** = carbon source (what is foodweb base?)
- **$\delta^{15}N$** = vertical trophic position (ex. herbivores vs carnivores)




Data Analysis Goals:

(1) **Overlap** in stable isotope signatures

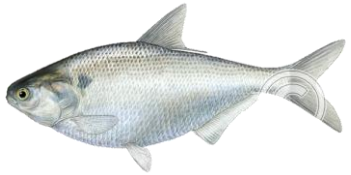
(2) **Shifts** in species isotopic signatures

# Example Stable Isotope Results

Invertivore

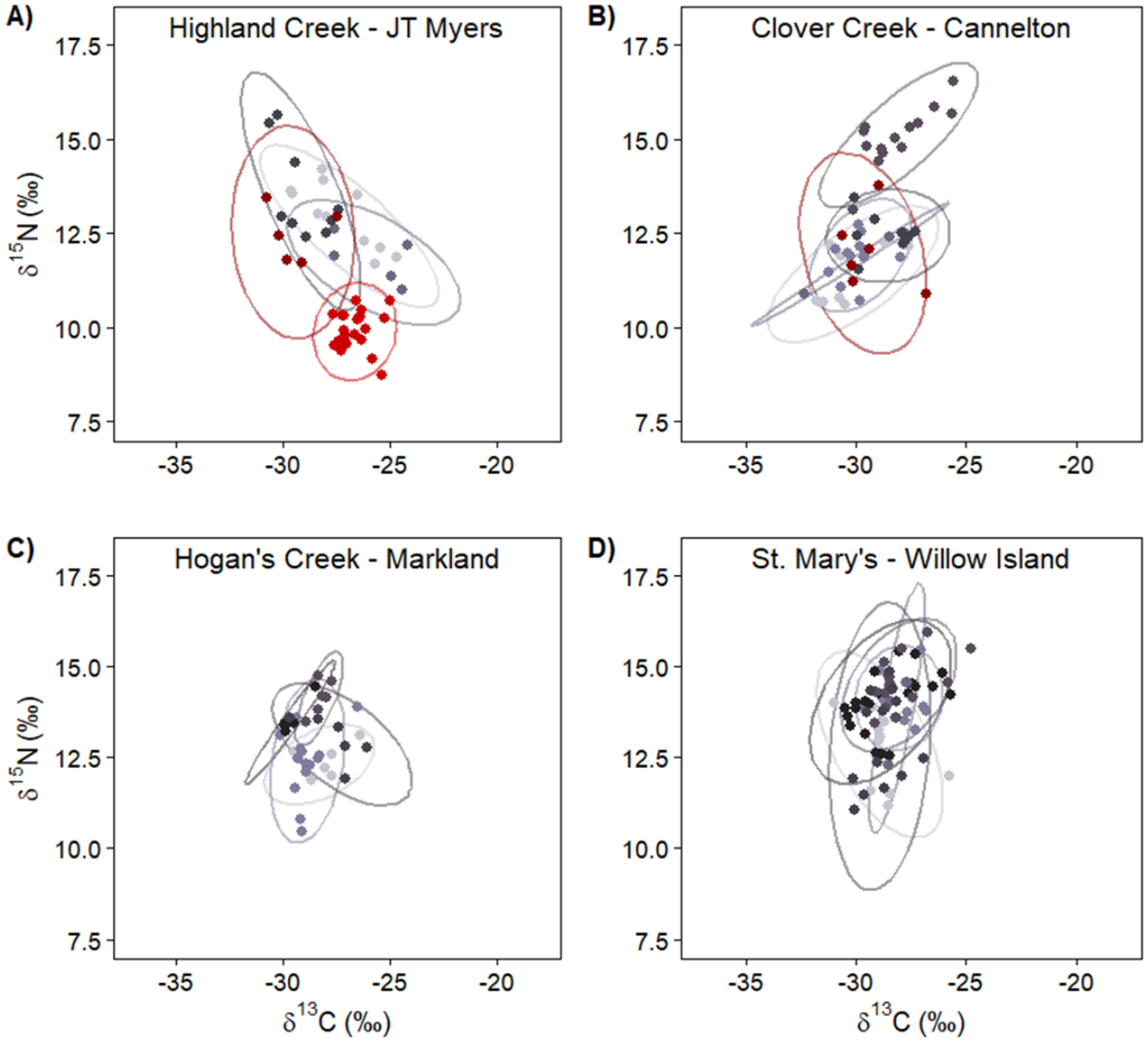
Omnivore

Piscivore

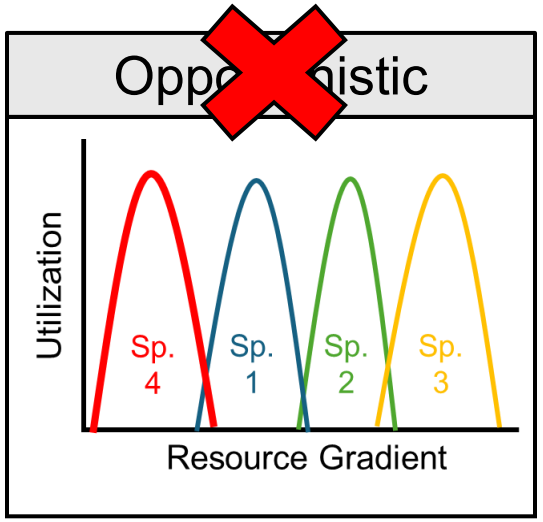


Planktivore

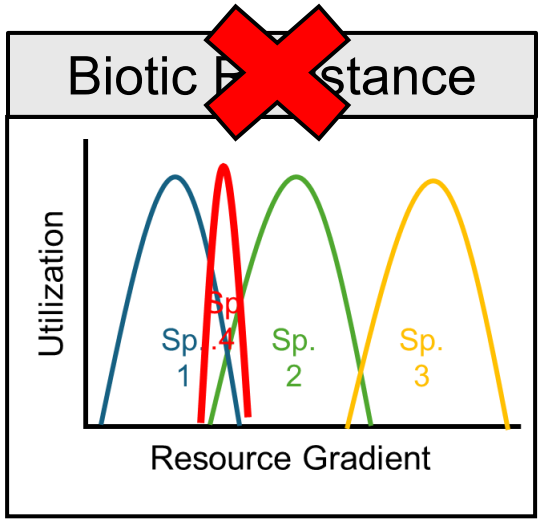
Silver Carp



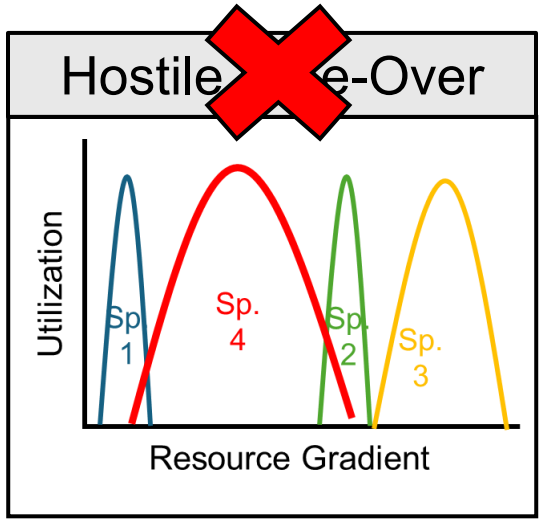
# Carp Invasion:
# The Role of Biotic Interactions



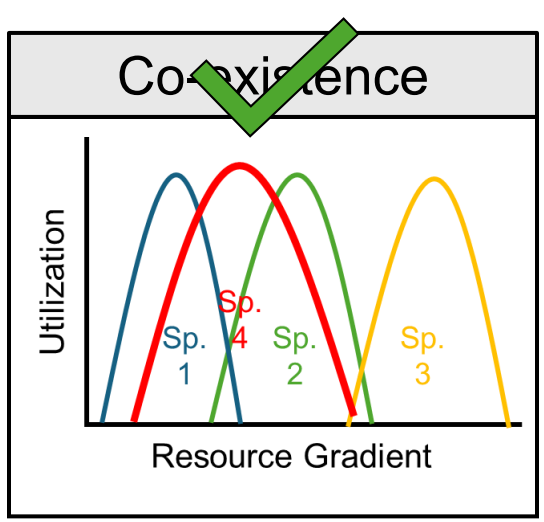

- Evidence of overlap with native FFGs (planktivores, benthic invertivores)




- Overlap with native FFGs
- No shifts in carp resource usage, large isotopic niche




- Overlap with native FFGs
- No shifts native FFGs niches correlated with carp presence




- Evidence points to co-existence (*currently*) in the Ohio River

# Silver Carp Spread Dynamics

- Extensive overlap but no observed shifts in silver carp isotopic niches
- **Co-existence** likely observed between native species and carp
- Biotic resistance is likely *not limiting* carp spread in the Ohio River

Spread likely slowed due to **abiotic factors** limiting their population growth in the Ohio River (Shepta et al. *in prep*)

# Acknowledgements


Thank you to all our collaborators!

**INDRN** (Craig Jansen)

**USGS** (Mark Rogers)

**KDFWS** (Andrew Stump, Jeff Herod, Maris Weihe)

**WVU** (Arantes and Murry lab members)

**USFWS** (Andrew Peters, Tyler Gross, Garrett Johnson, Ben Marcek, Neal Jackson)

**WVDNR** (Katie Zipfel)

**ORSANCO** (Aaron Rogers)

Thank you to our funding sources:
**USGS, WVWRI, USFWS**

# Thank you!



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