

Round gobies in the Great Lakes Basin:  
how the spreading invasion is affecting  
diets and growth of top predators in Lake  
Huron tributaries.



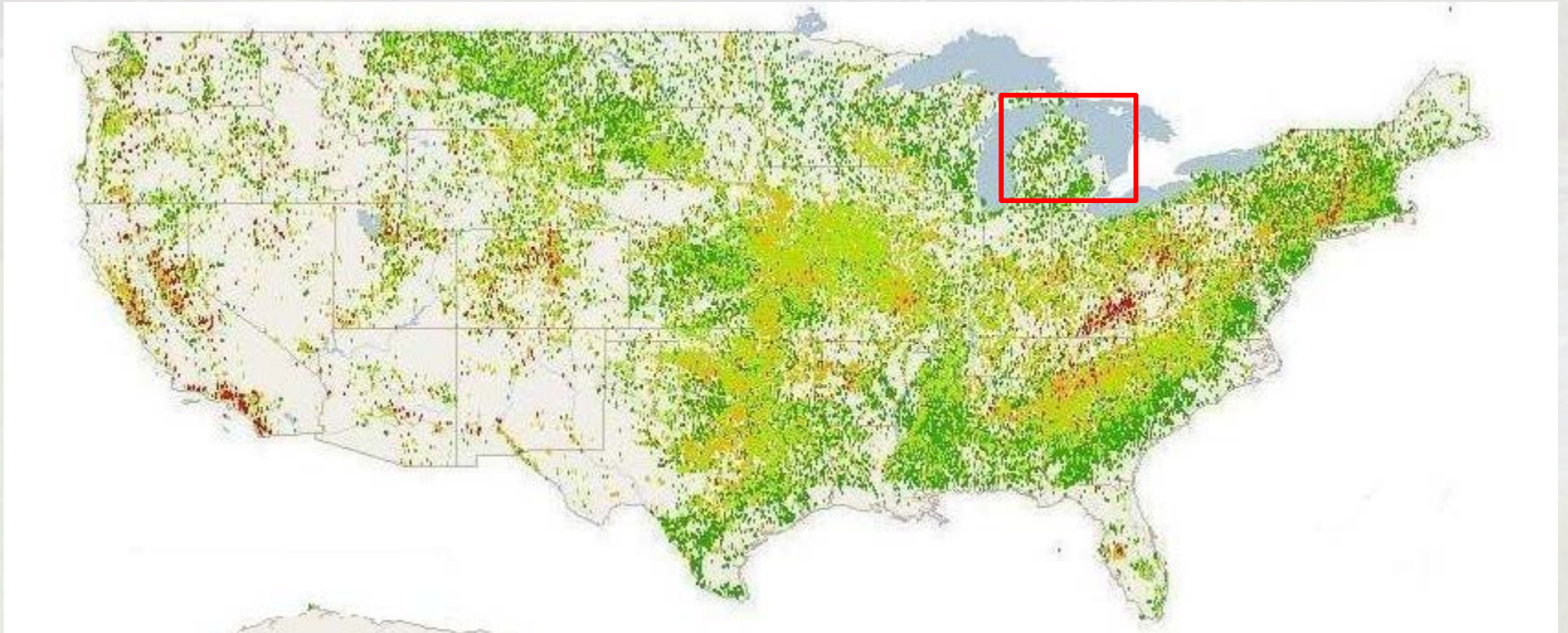
Clarence Fullard

2014 Knauss Sea Grant Fellow  
Aquatic invasive species analyst,  
NMFS



# Two Themes:

- Invasive species & habitat fragmentation



Source: USACE National Inventory of Dams

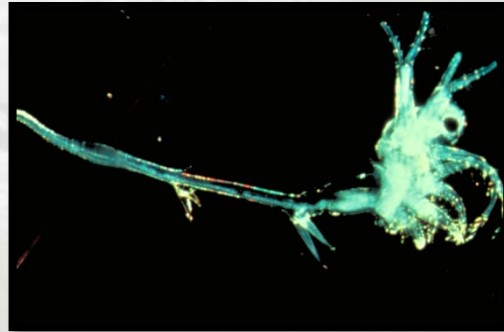
# Location

- Three Saginaw Bay tributaries, Lake Huron, Michigan



# Great Lakes Invasive Species

- > 150 invasive species are established
  - Crustaceans
  - Mollusks
  - Plants
  - Viruses



# Round Goby

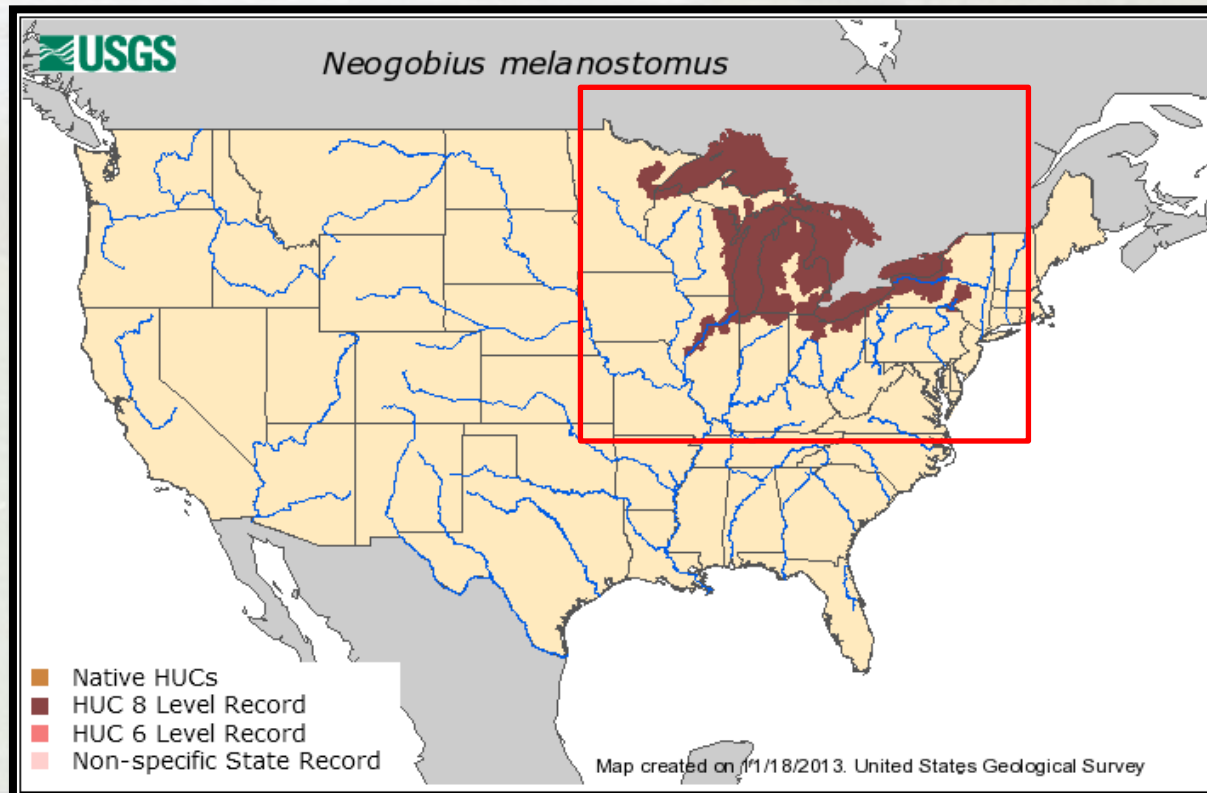
## *Neogobius melanostomus*

- Euryhaline/eurythermal
- Repeat spawner
- Highly adaptable diet



# Round Goby

- Well distributed throughout the Great Lakes
  - Primary invasion = lakes
  - Secondary invasion = tributaries



# Ecological Impacts

- Negative:
  - Macroinvertebrates
  - Fish egg and fry predation
  - Competition
  - Displace unionid mussel hosts
- Positive?
  - Smallmouth bass growth



# Study Area

Cass River: dam





# Study Area

Shiawassee River: rock ramp



# Study Area

Flint River: free-flowing



# Study Area



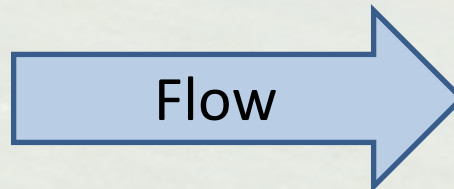
Cass River (dam)



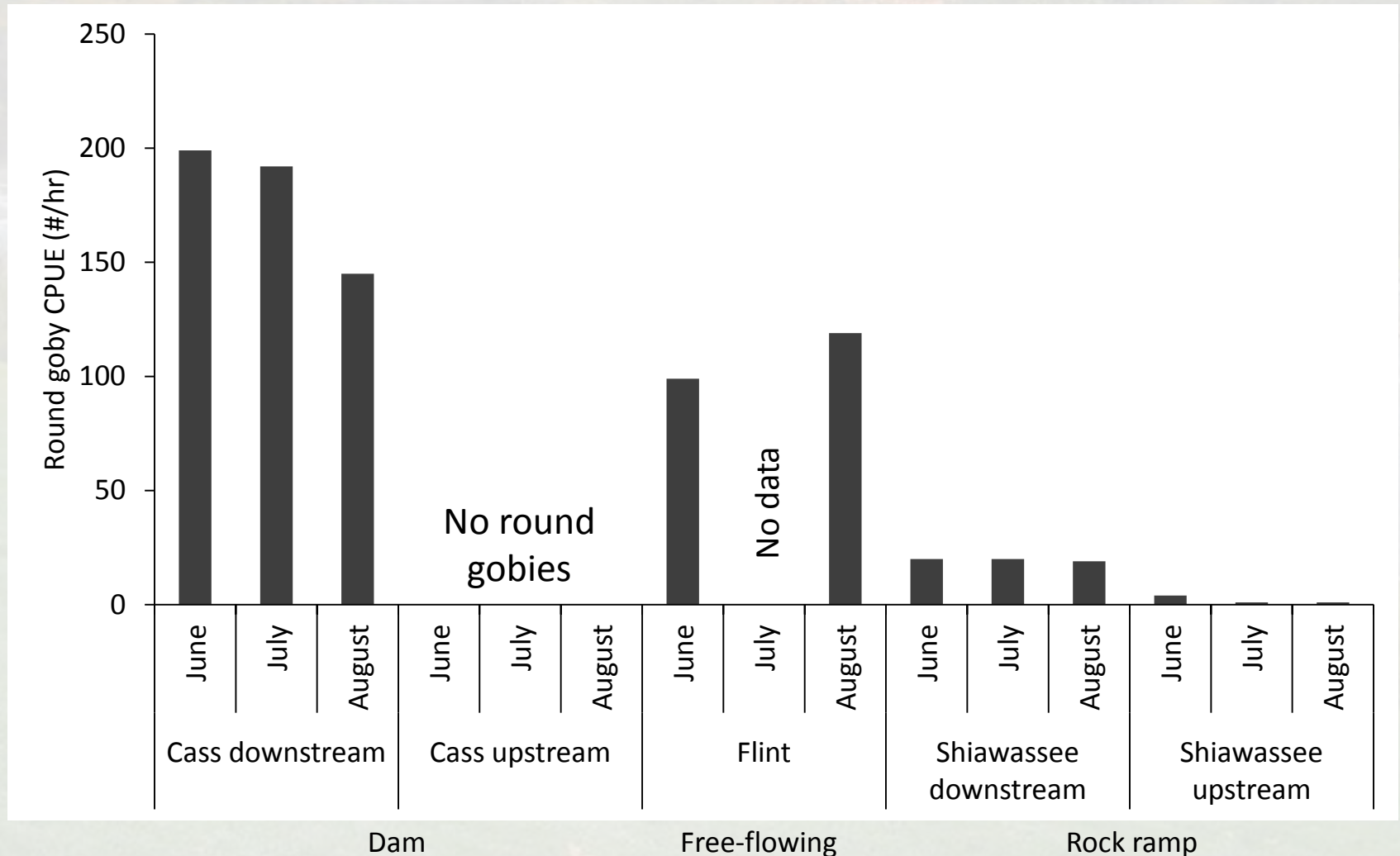
Shiawasse River (rock ramp)



Flint River (free-flowing)



# Invasive Species + Habitat Fragmentation = Gradient of Round Goby Abundance



# Native Predators

- Smallmouth bass
  - Common top predator
  - Piscivorous to generalist
  - Known to consume round gobies in Great Lakes
- Rock bass
  - Similar diet to smallmouth bass
  - Not well studied

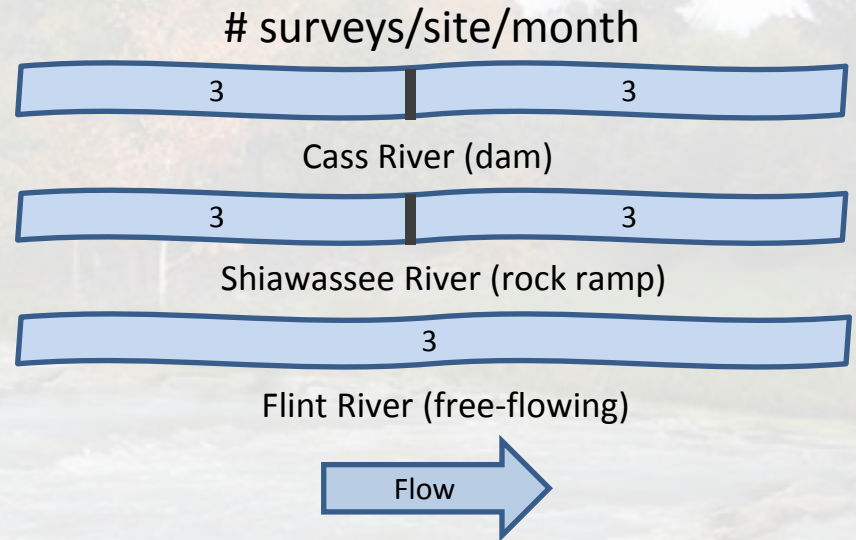


# Goal

- Describe how the round goby invasion is affecting the diets, trophic positions, and growth of smallmouth bass and rock bass
  - Are round gobies in rivers causing similar food web perturbations in streams as they are in the Great Lakes proper?

# Data Collection

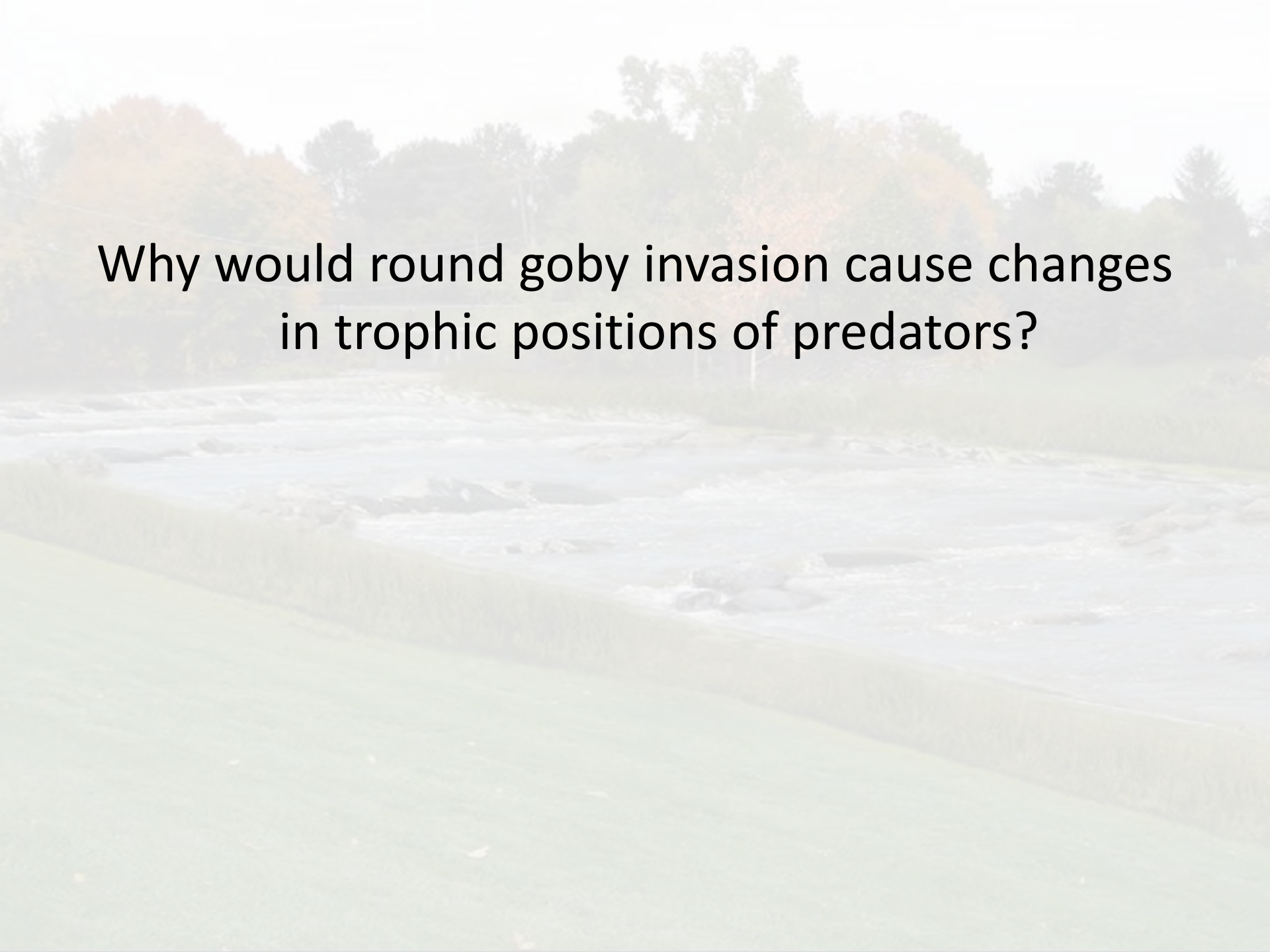
- Fish assemblages
- Diets
- Stable isotopes
- Growth



# Diet Analysis

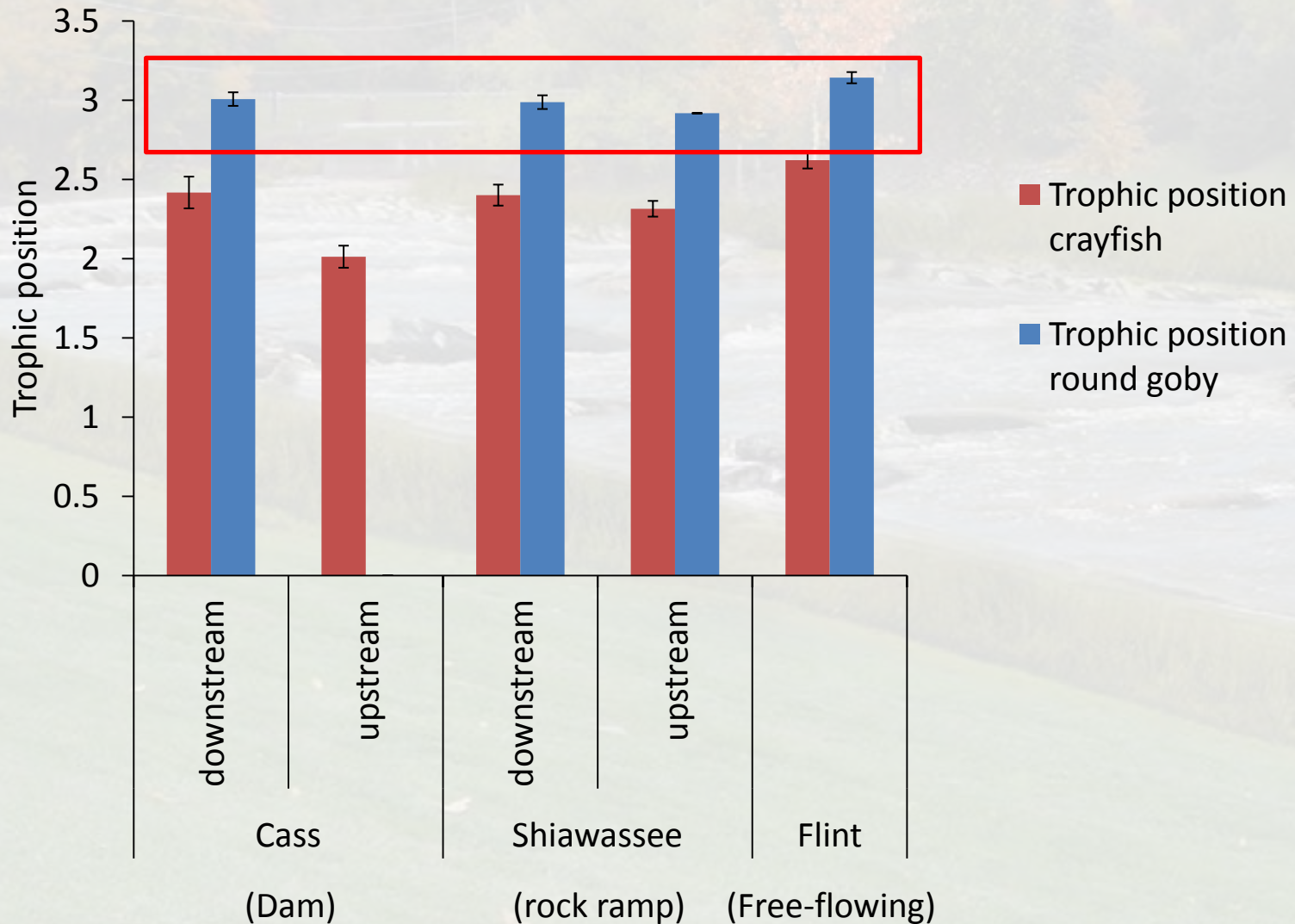
- Gut content information is only a snapshot of dietary habits
- Gut content analysis + stable isotope analysis
  - Greater temporal representation of feeding patterns

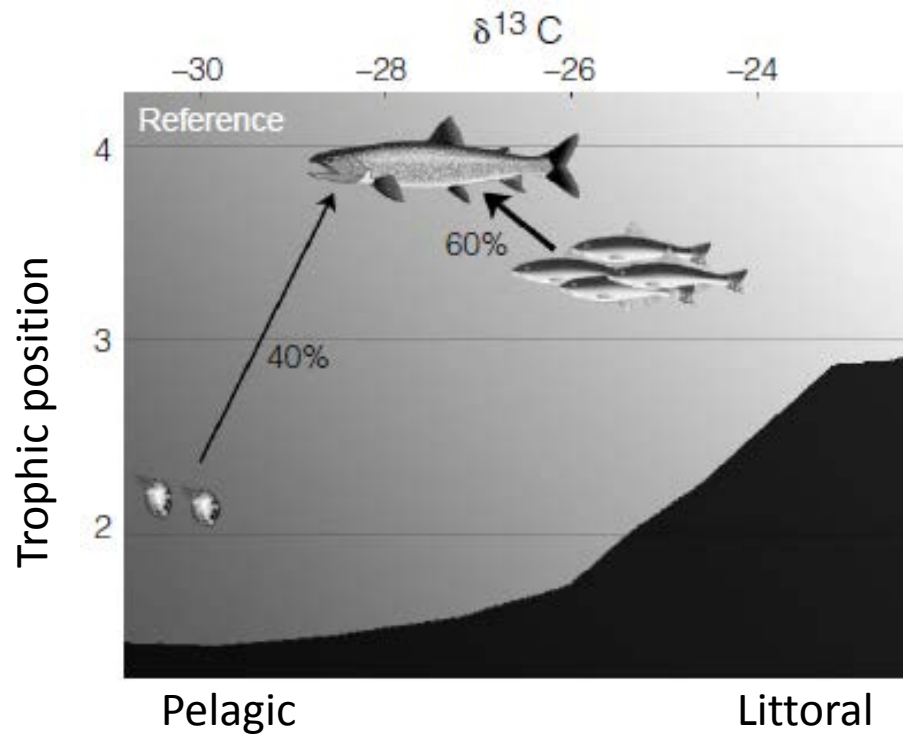


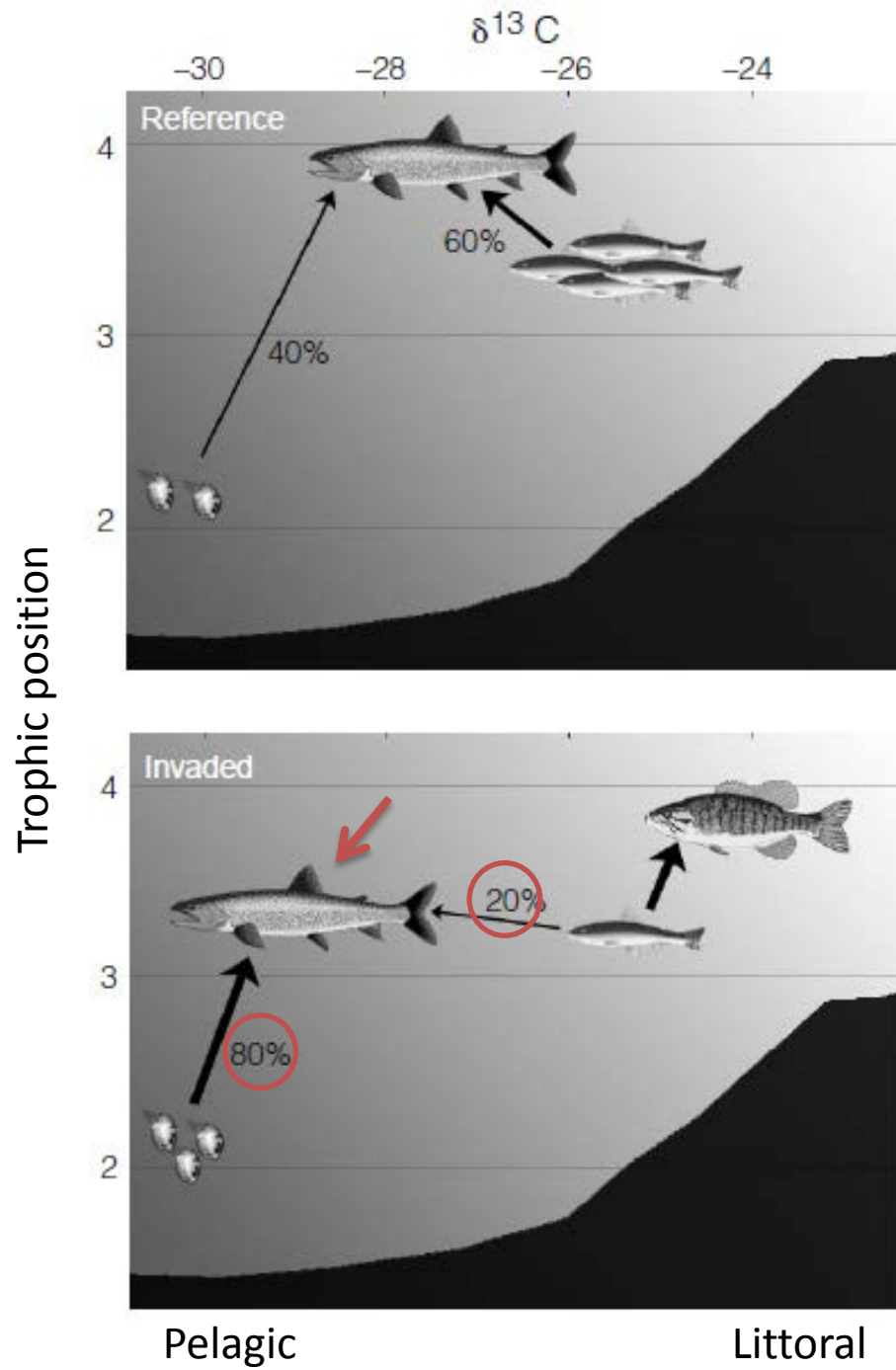
A background image showing a wide river with a dam in the distance. The water is turbulent, creating white rapids. The banks are covered in green grass, and a line of trees with autumn foliage is visible in the background under a bright sky.

Why would round goby invasion cause changes  
in trophic positions of predators?

# Crayfish & Round Goby Trophic Positions

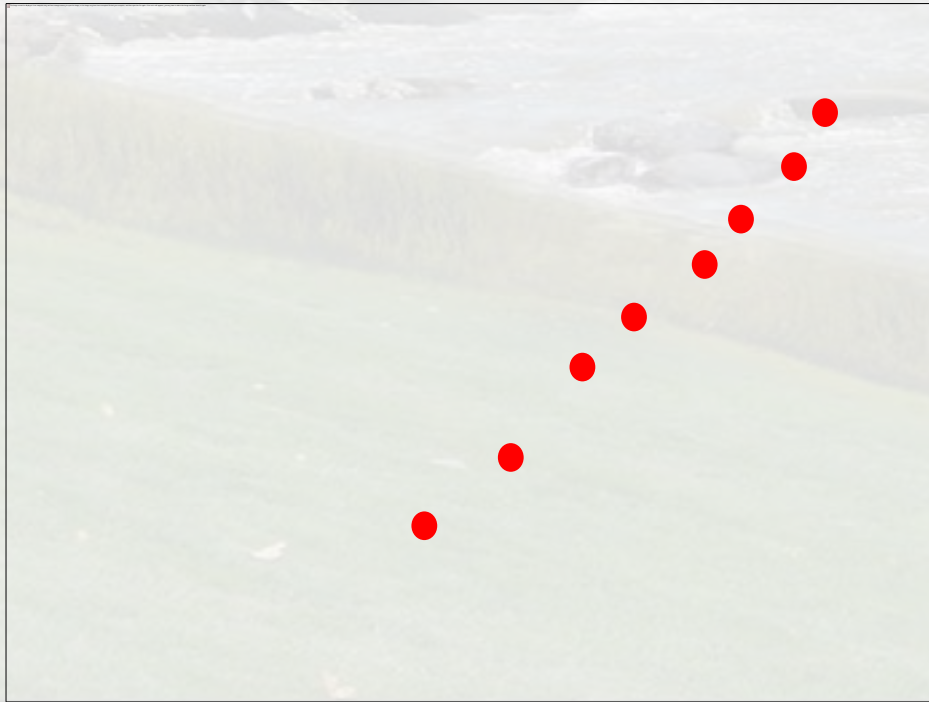






# Growth

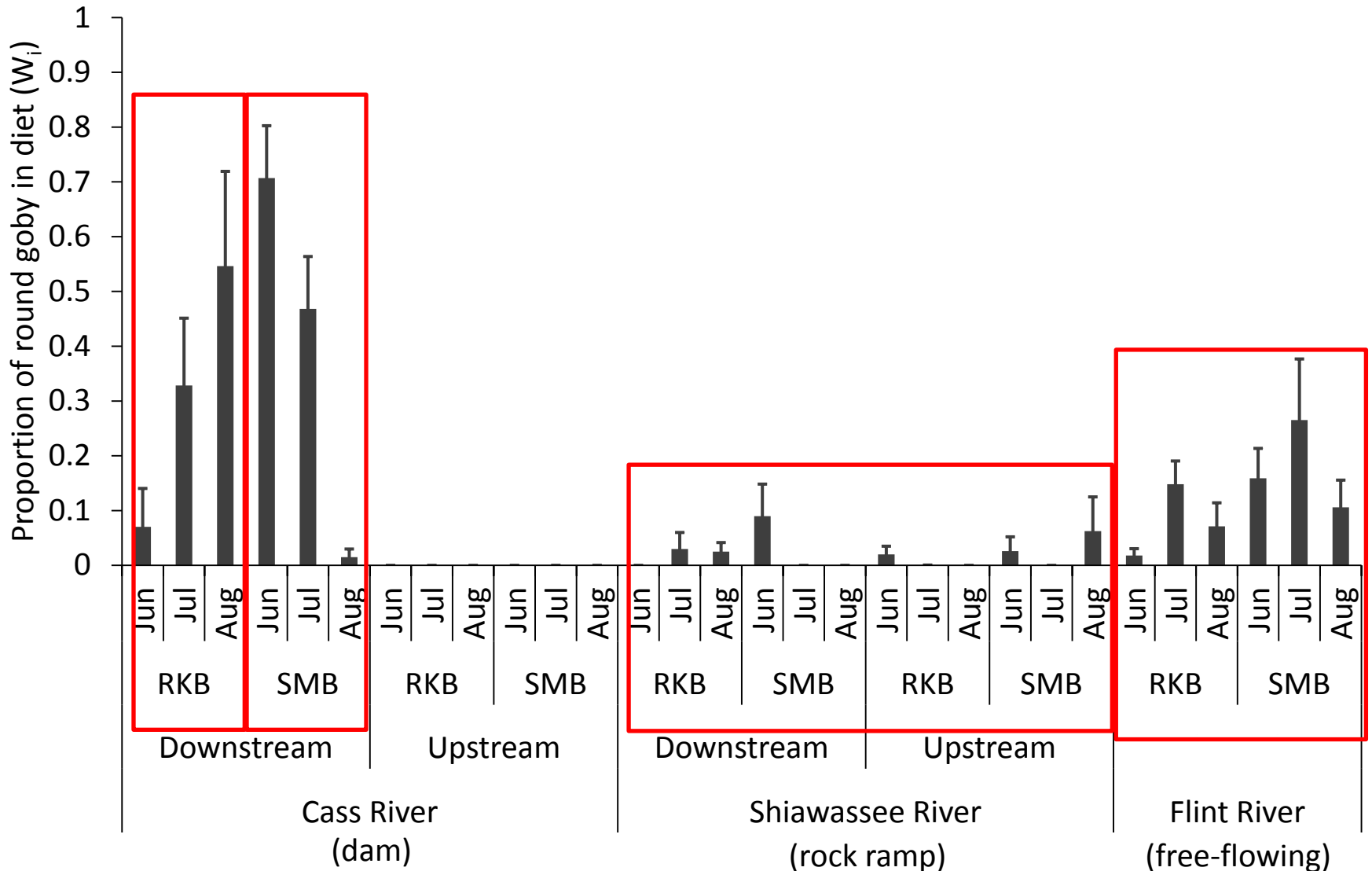
- Analyzed dorsal scales, back-calculated growth
  - 5 sites
  - Taken in August to reflect summer growth



# Results

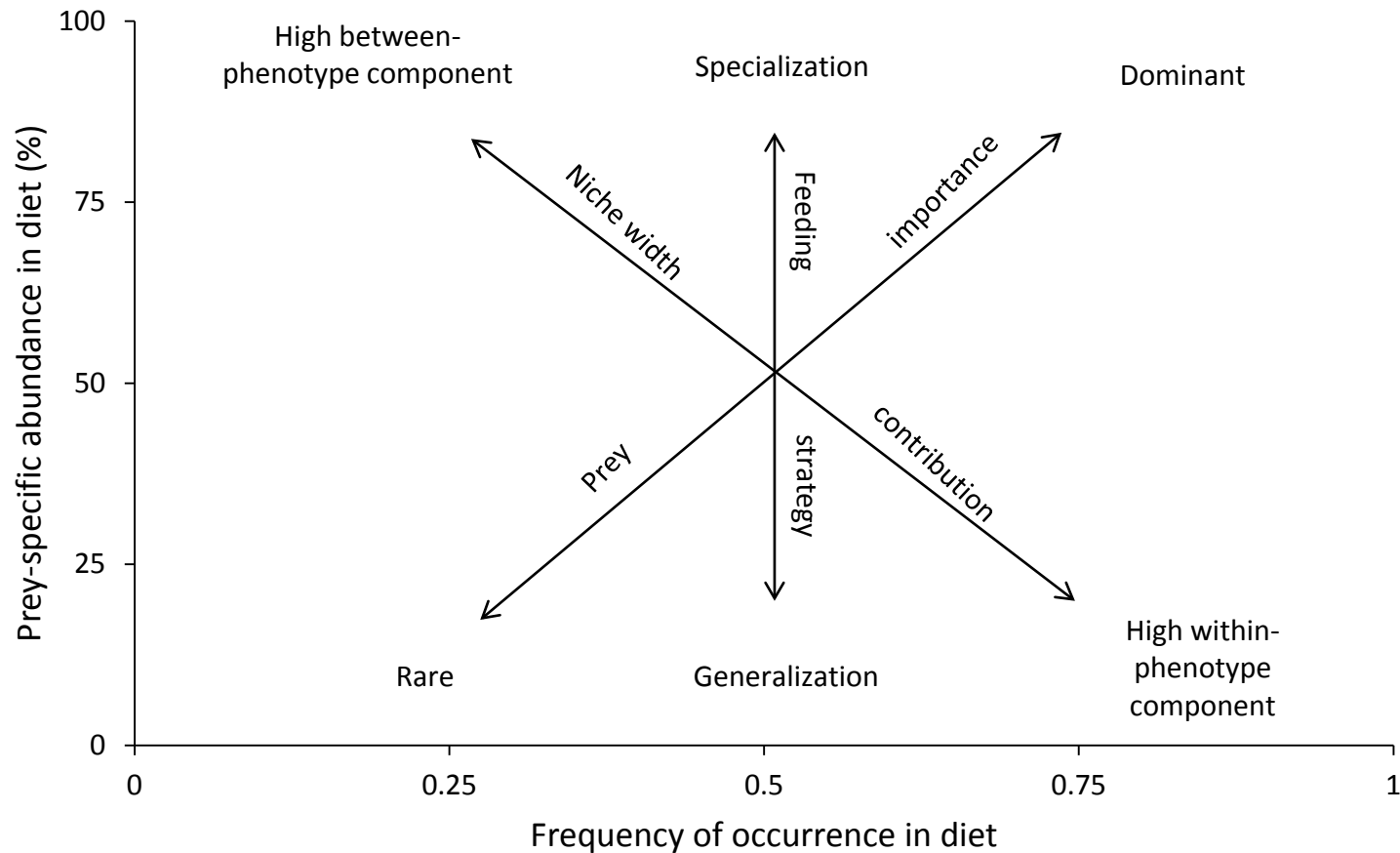


# Summary of Round Goby Consumption

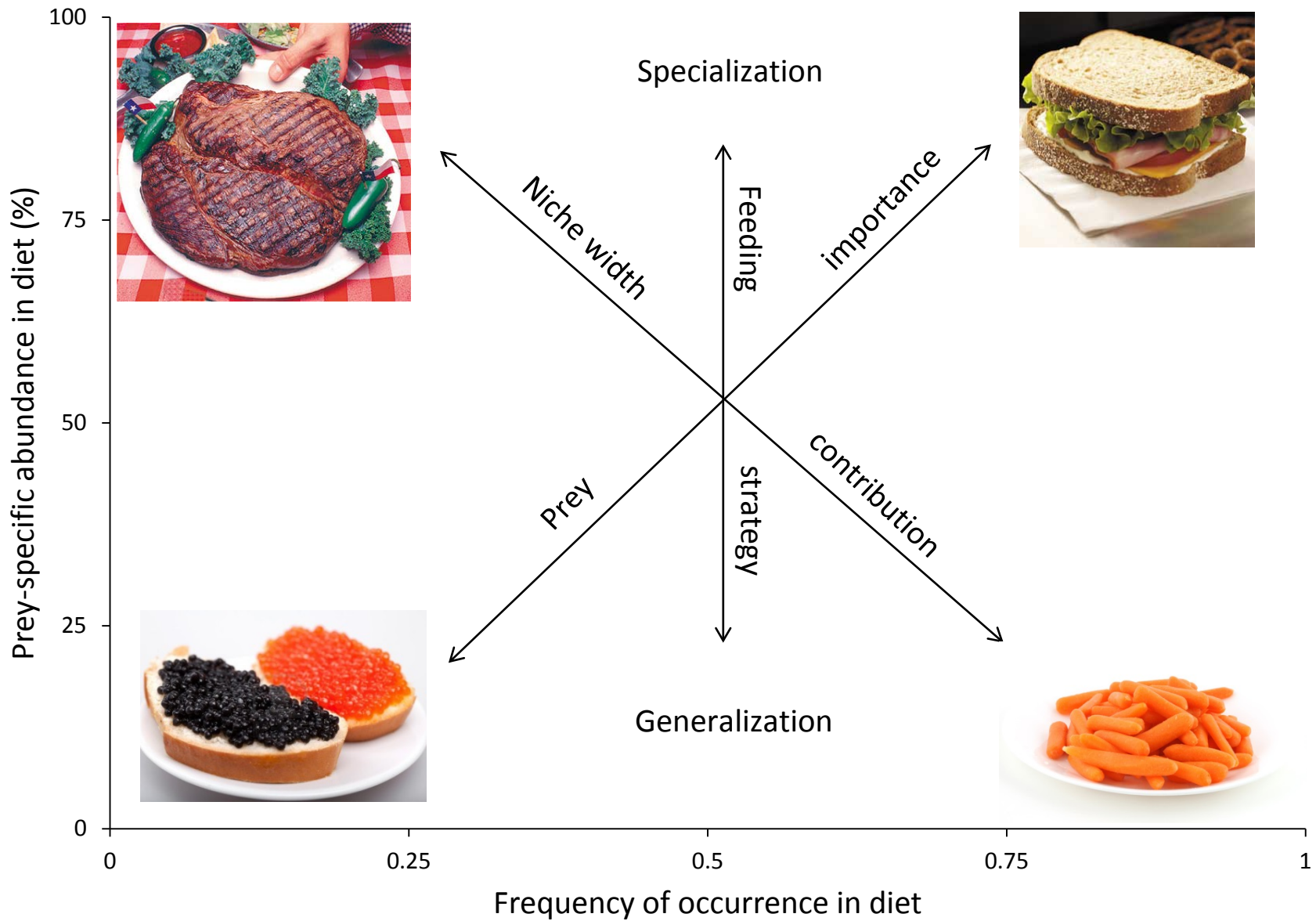


# Diet Analysis

- Graphical diet analysis (Costello diagram)
  - Identify dominant/rare prey types







# Smallmouth Bass



## High-BPC (steak)

## Dominant (ham sam)

## Rare (caviar)

## High-WPC (carrots)

Cass downstream<sub>June</sub>



Cass downstream<sub>July</sub>



Cass downstream<sub>August</sub>



Shi upstream<sub>June</sub>



Shi upstream<sub>July</sub>

Shi upstream<sub>August</sub>



Shi downstream<sub>June</sub>



Shi downstream<sub>July</sub>

Shi downstream<sub>August</sub>

Flint<sub>June</sub>














Flint<sub>July</sub>

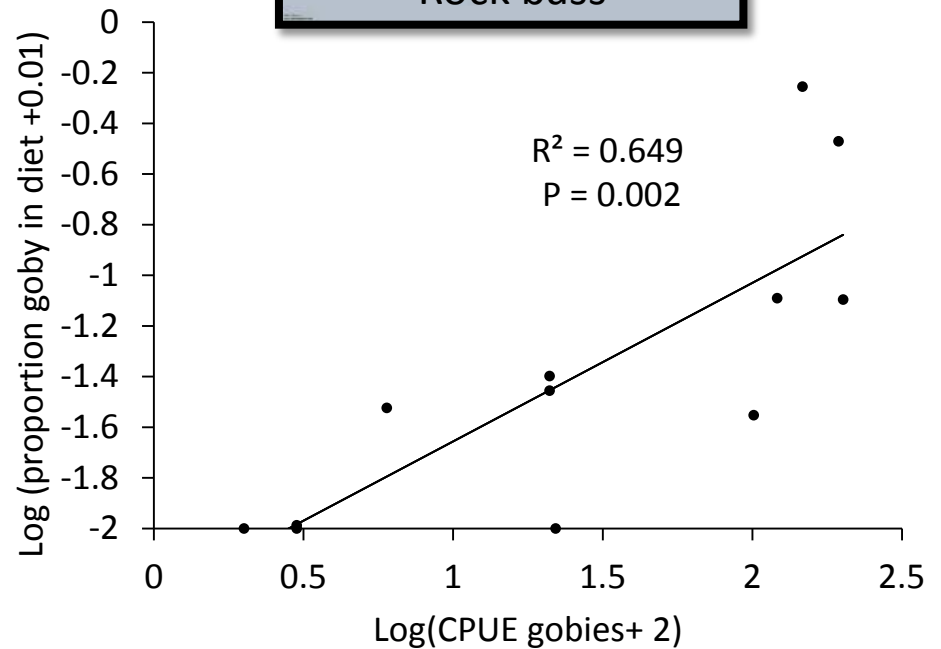
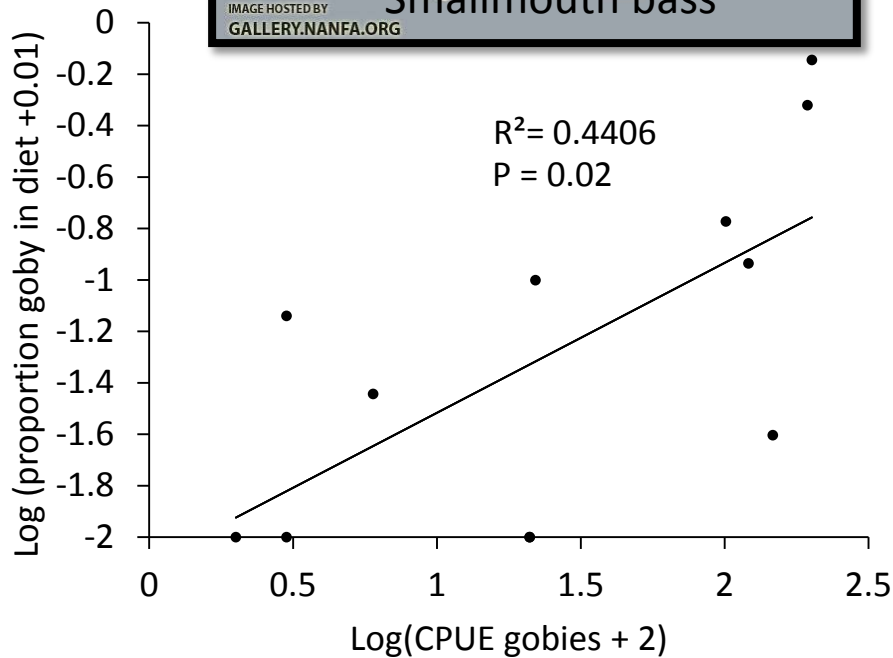


Flint<sub>August</sub>



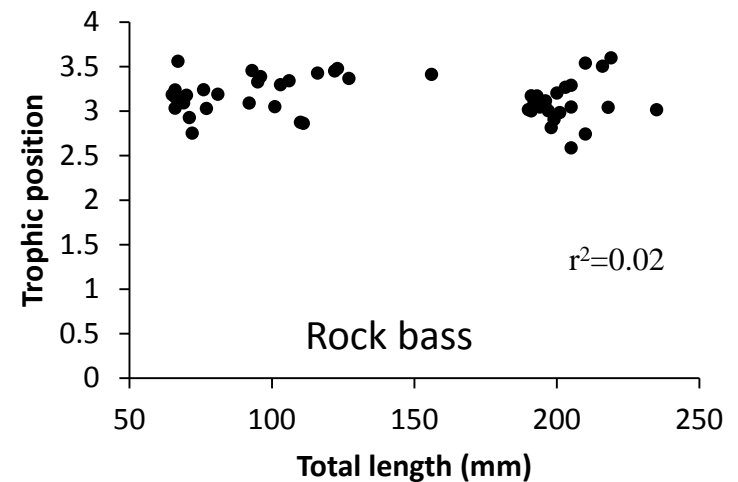
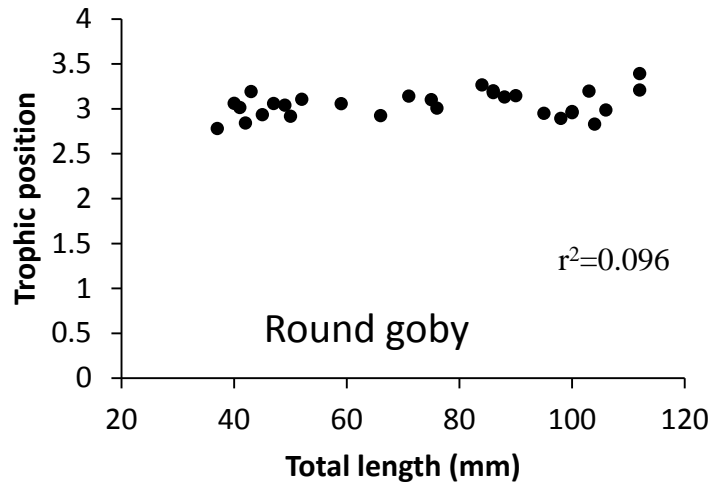
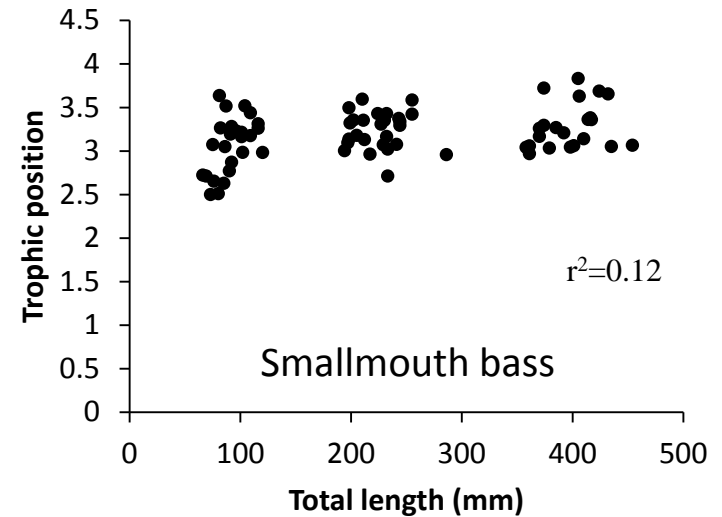
<b>Rock Bass</b> 	<b>High-BPC (steak)</b>	<b>Dominant (ham sam)</b>	<b>Rare (caviar)</b>	<b>High-WPC (carrots)</b>
Cass downstream <sub>June</sub>				
Cass downstream <sub>July</sub>				
Cass downstream <sub>August</sub>				
Shi upstream <sub>June</sub>	<hr/>	<hr/>	<hr/>	<hr/>
Shi upstream <sub>July</sub>				
Shi upstream <sub>August</sub>				
Shi downstream <sub>June</sub>				
Shi downstream <sub>July</sub>				
Shi downstream <sub>August</sub>	<hr/>	<hr/>	<hr/>	<hr/>
Flint <sub>June</sub>				
Flint <sub>July</sub>				
Flint <sub>August</sub>				

# More Round Gobies = More Round Goby Consumption



# Trophic Positions

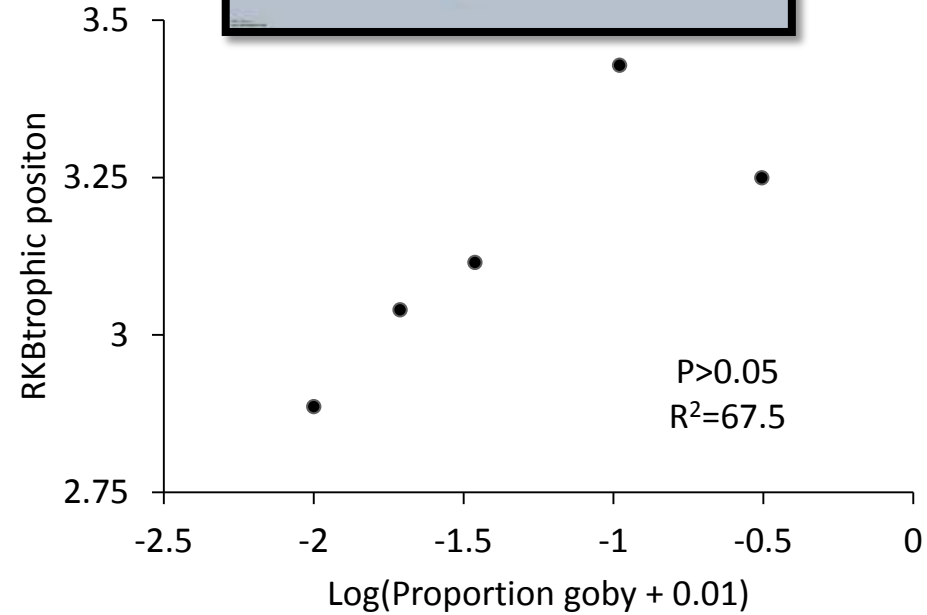
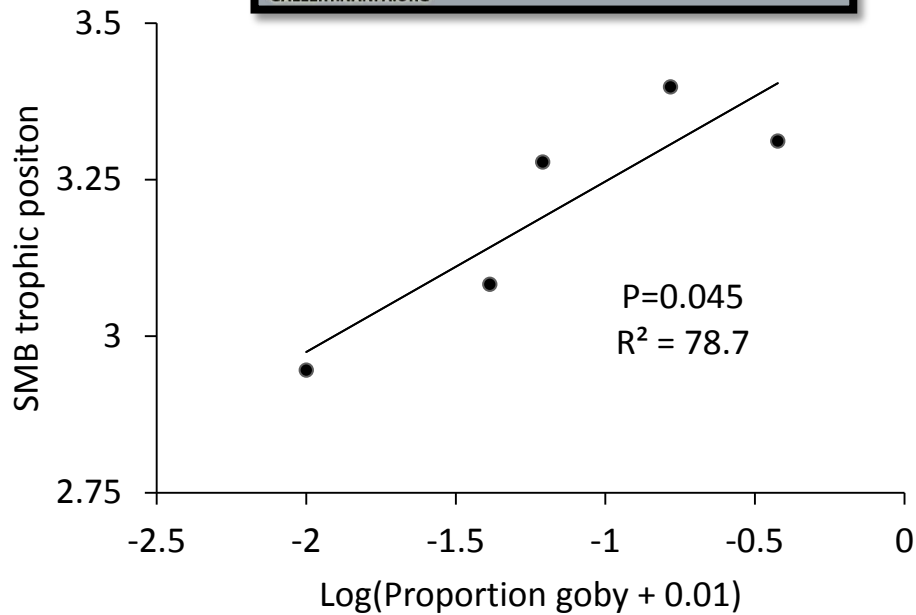
- Trophic position does not increase with total length
  - Fish were examined collectively



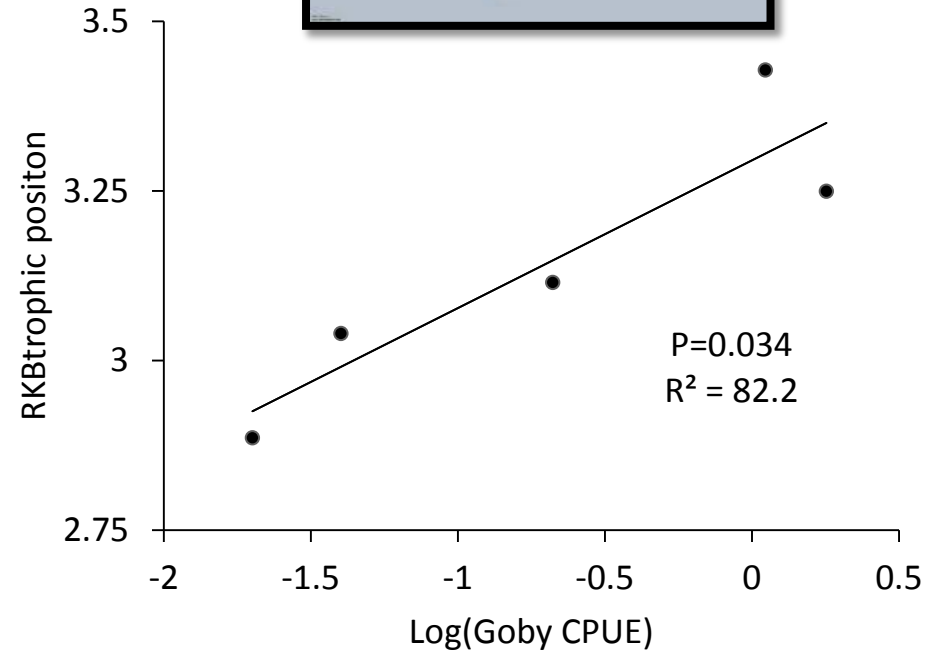
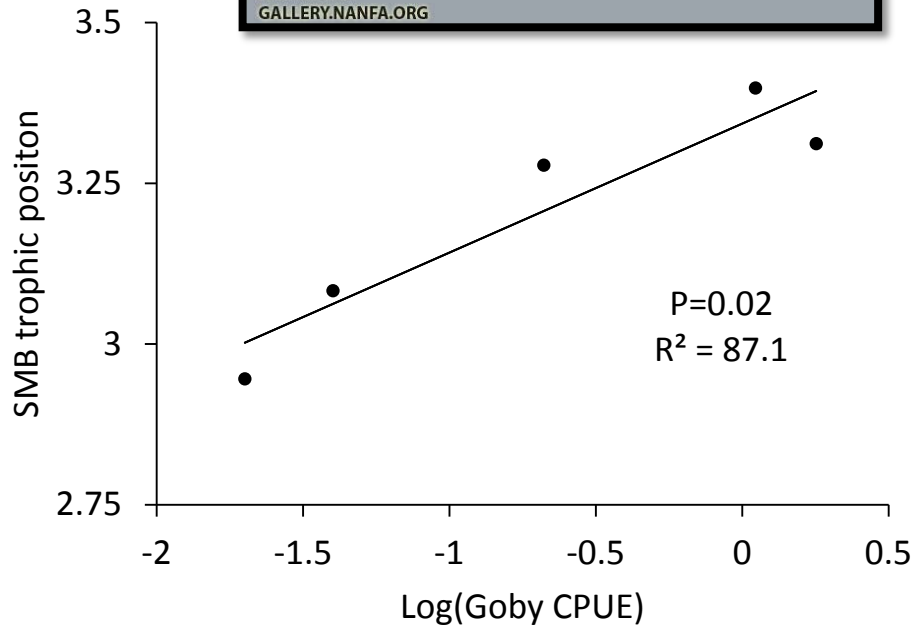
# Remember!

- You are what you eat!
  - Eat more  $\delta^{15}\text{N}$  prey, become more  $\delta^{15}\text{N}$  enriched

# Trophic Position vs. Proportion ( $W_i$ ) Round Goby in Diet



# More Round Gobies = Higher Consumer Trophic Position





# Growth Results

- Examined back-calculated growth increment in 2012 (outer ring only)
  - mm growth in 2012
  - Can't make assumptions about round goby abundance and predator feeding habits in past years
- Examined growth for each age group at 5 sites
  - Compared to round goby abundance

# Growth Results

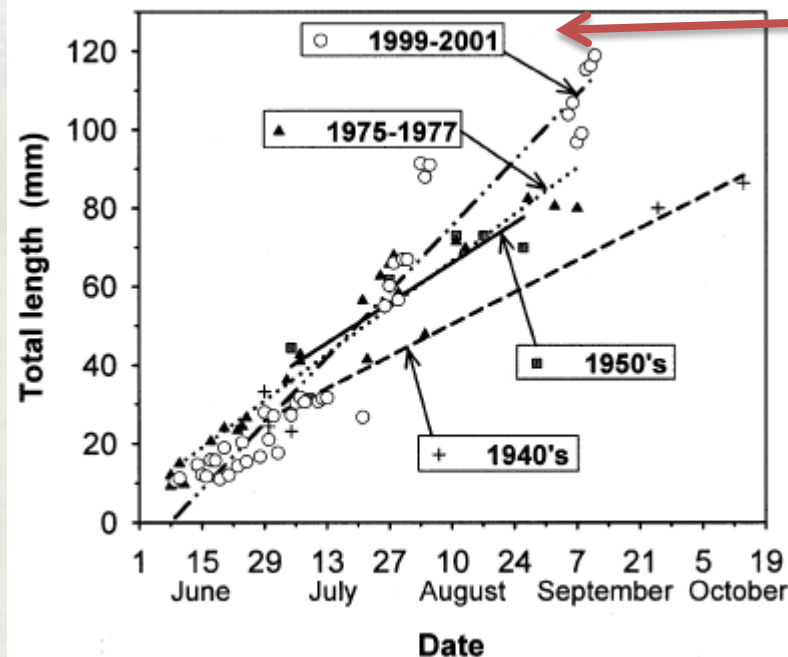
- No significant relationships between predator growth and round goby abundances
  - For age groups 2-5 for each predator
- Rationale:
  - Round goby are dominant prey only briefly, not making a substantial contribution to growth
    - Opportunistic, diverse feeding
    - Prey aren't limiting predator growth

# Growth Results

- Contrary to findings for YOY SMB in Lake Erie

## High Growth Rate of Young-of-the-year Smallmouth Bass in Lake Erie: a Result of the Round Goby Invasion?

Geoffrey B. Steinhart<sup>1,\*</sup>, Roy A. Stein, and Elizabeth A. Marschall



After round goby invasion in ~1990

# Conclusion

- Round goby invasion has:
  - Created novel prey (consumed opportunistically)
  - Lengthened food chain of rock bass and smallmouth bass
- .....but no changes to predator growth, why?
  - Highly opportunistic and diverse predator diets
  - Smallmouth and rock bass may not be prey limited
    - Already highly productive systems

# Next steps

- Examine contaminant transfer up the food web
  - Cass River dam slated for replacement with rock ramp in fall 2014
  - Increase in trophic position may cause increase in contaminant burden in fish tissue



# Acknowledgments

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Central Michigan University & Michigan State University

Cities of Frankenmuth, Flushing, and Chesaning, Michigan

# NOAA Aquatic Invasive Species Information

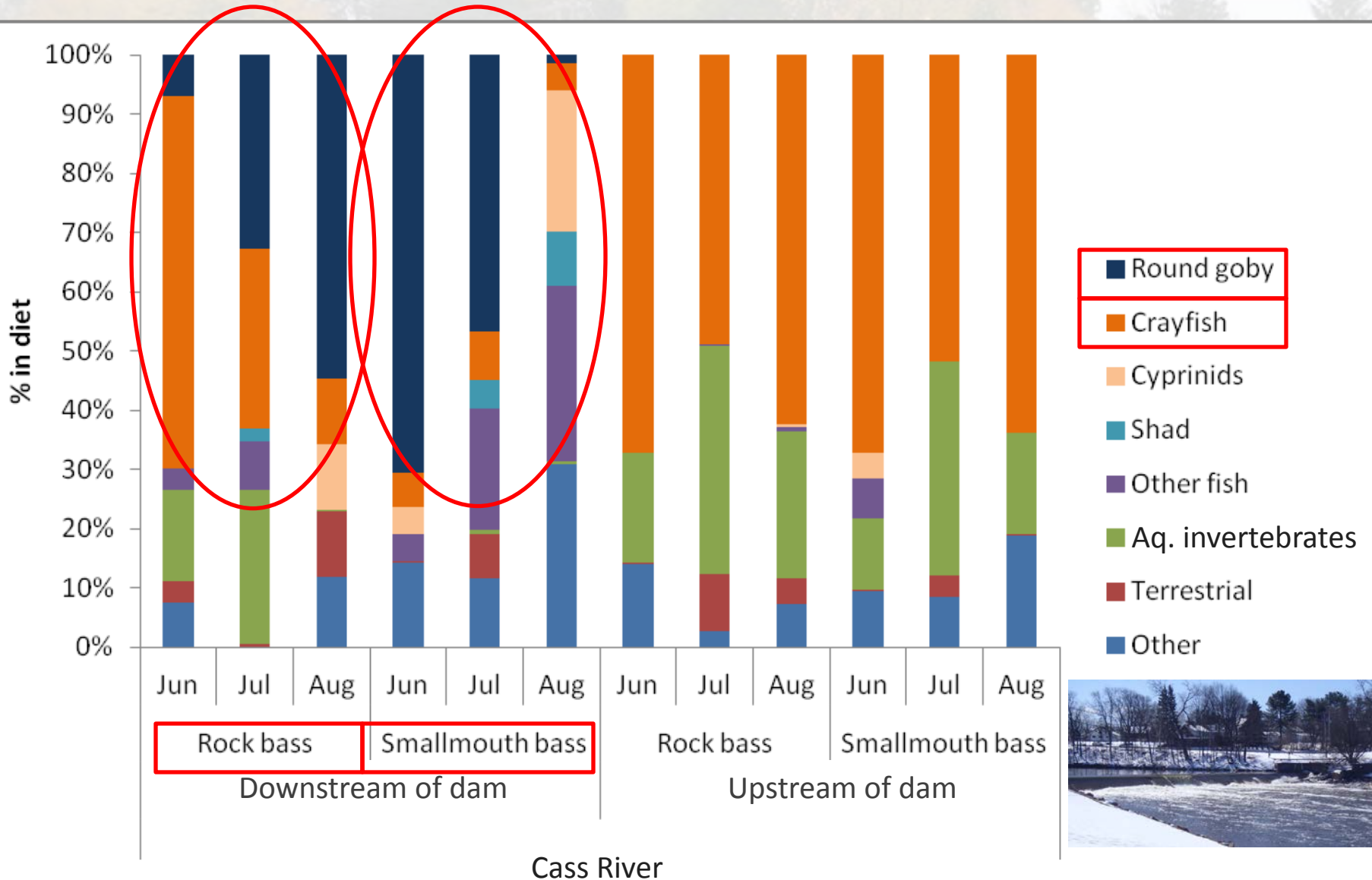
- NOAA is co-chair to:
  - Aquatic Nuisance Species Task Force (ANSTF)
  - National Invasive Species Council (NISC)
- NMFS & NOS work with:
  - Lionfish
  - Asian tiger shrimp
  - Chesapeake Bay invasive species
  - Tunicates
  - Green crabs
  - Non-natives & salmon in PNW
  - More

Questions?

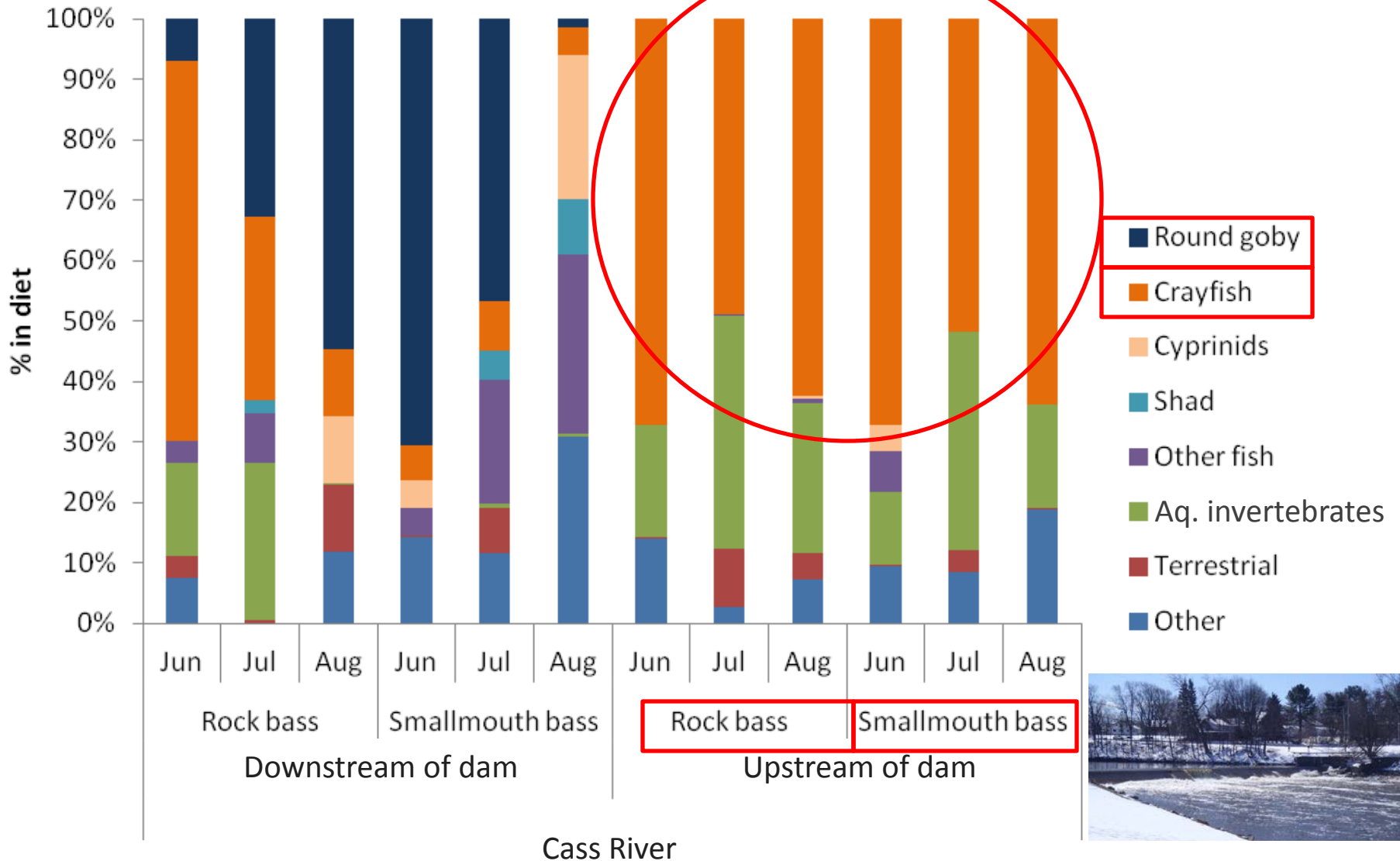




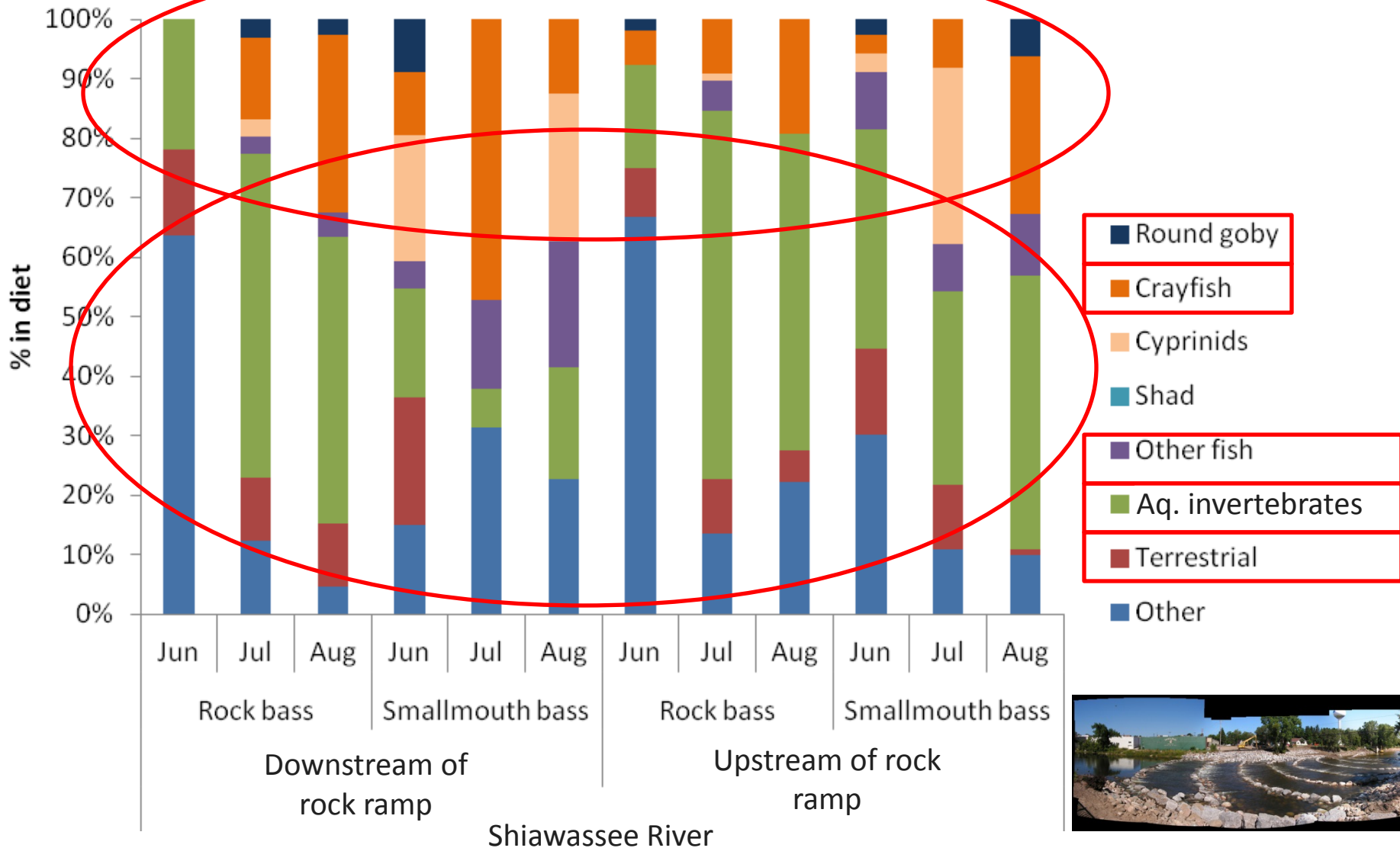
# Cass River Diet Results



# Cass River Diet Results



# Shiawassee River Diet Results



# Flint River Diet Results (free-flowing)

