

# Effects of Warm-Water Invasive Species on Native Colorado River Fishes



**David Ward**

**Grand Canyon Monitoring and Research Center**

**Southwest Biological Science Center**

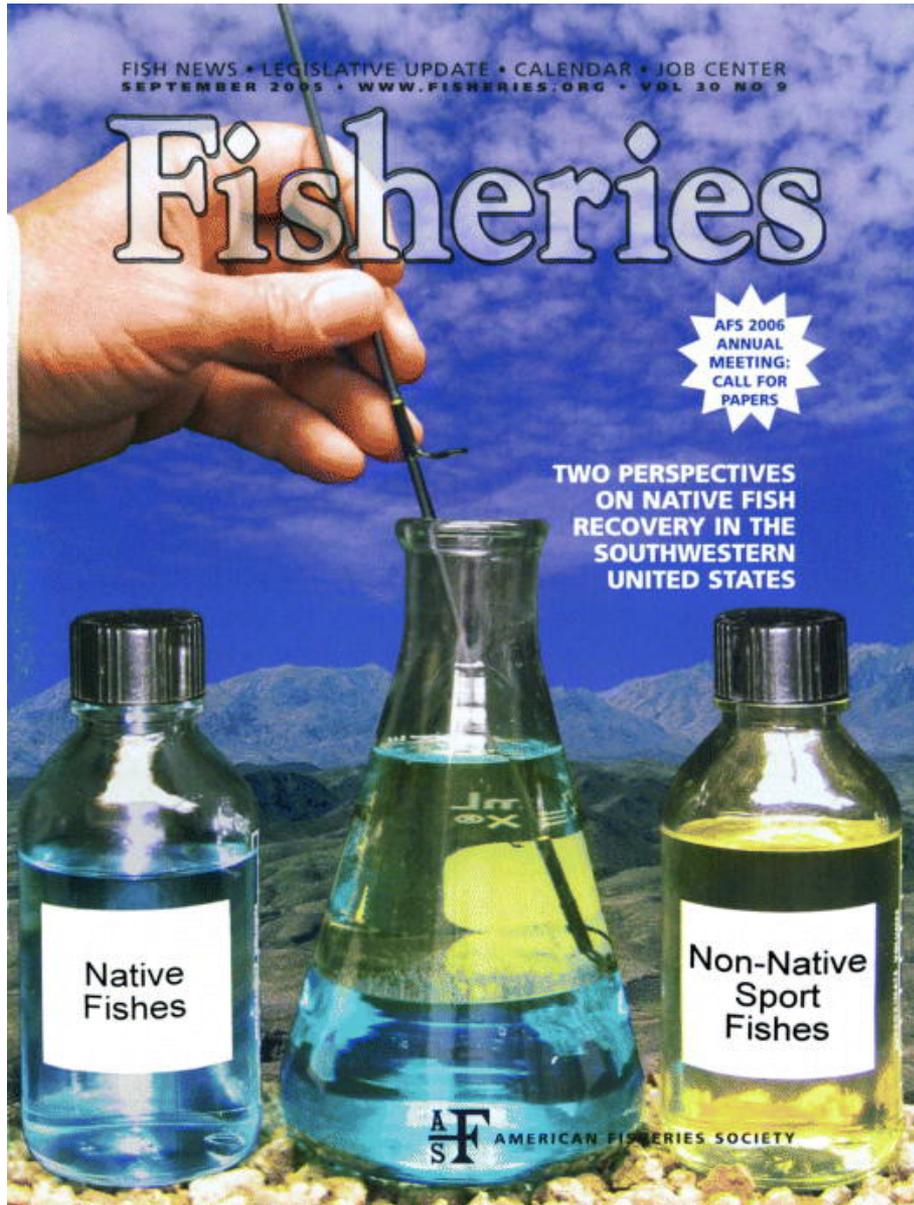
Project I.

LTEMP Resource Goal – Minimize impacts of  
Invasive Species

# Non-native fishes



# Incompatibility of native and nonnative fishes



Marsh and Pacey 2005  
Clarkson et al. 2005  
Mueller 2005

# Fundamental Question?

## Why are they incompatible?

- Why don't predators cause the extinction of prey in all cases?
- **How does any prey persist?**



# Answer:

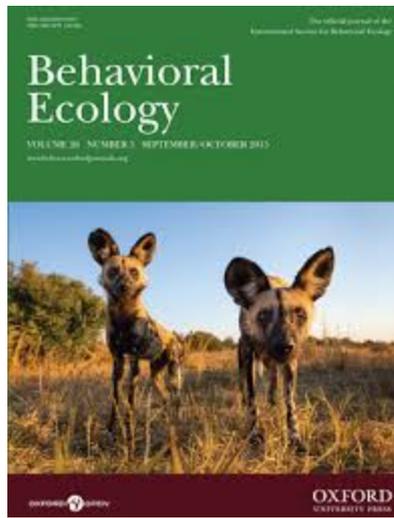
In co-evolved predator prey relationships the prey species have:

**Morphology, Physiology and Behavior –  
That render some individuals less vulnerable**

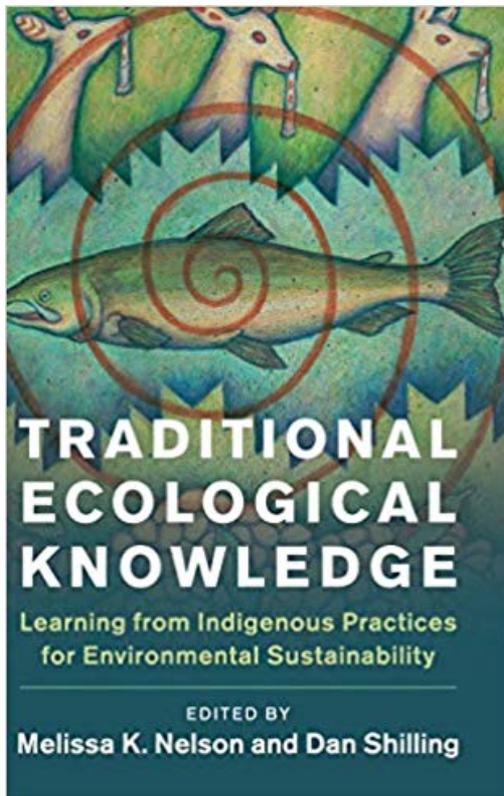


**Often the key to Effective  
Management is understanding**

- **Morphology**
- **Physiology**
- **Behavior**



# Behavioral Ecology



# Traditional Ecological Knowledge

# Assessing the morphology, physiology and Behavior of fish is often more difficult





# Reduced movement makes sense In the historic Colorado River



Reduced movement only works if you have:

1. High Turbidity
2. Sight feeding predators



Turbidity increases predation effectiveness of catfish.

**RZ suckers and catfish are Immiscible !**





# Differences in behavioral response

- Chub move away from threats



- Razorback suckers avoid movement



These predator avoidance behaviors and morphologies were shaped over a 3 million-year period



# Colorado Pikeminnow shaped the behavior and morphology of The Fish Community



# Predator Gapes

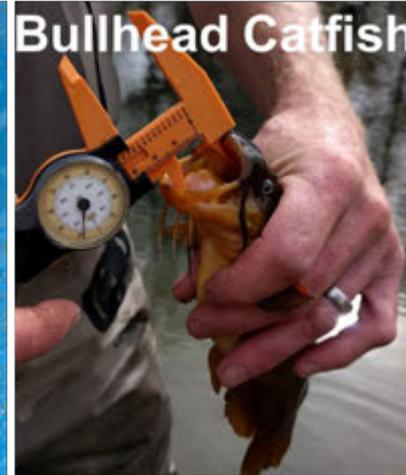
Flathead Catfish



Smallmouth Bass



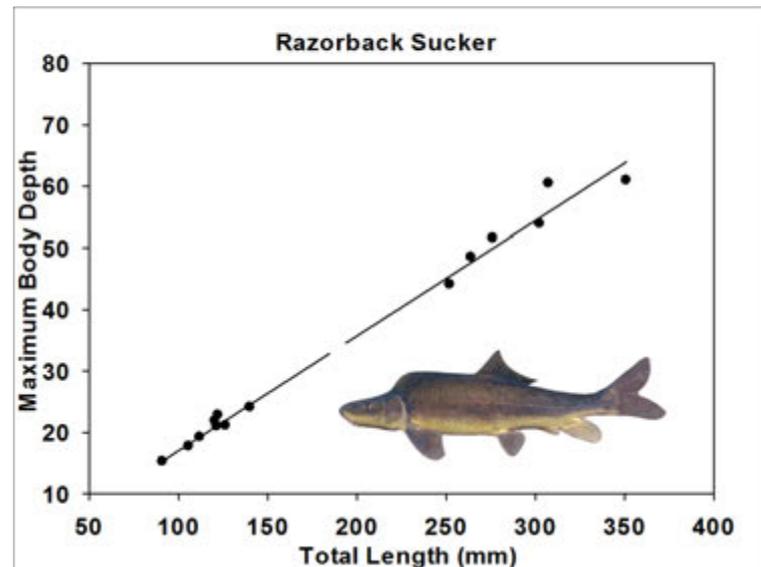
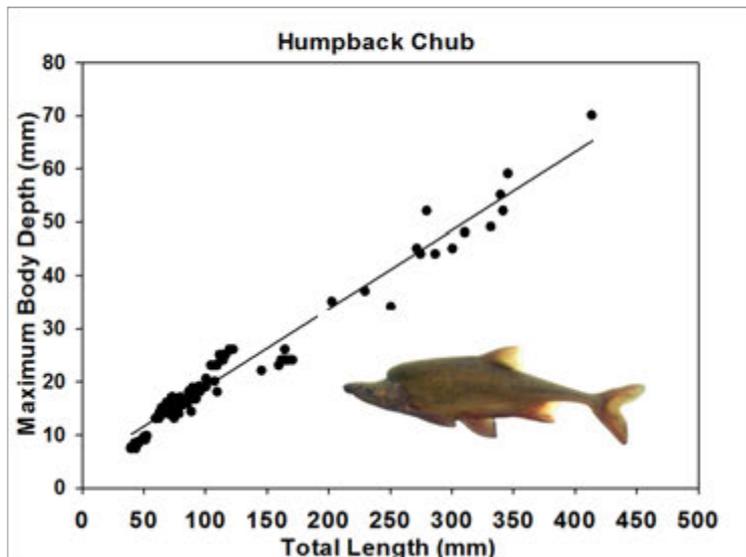
Bullhead Catfish



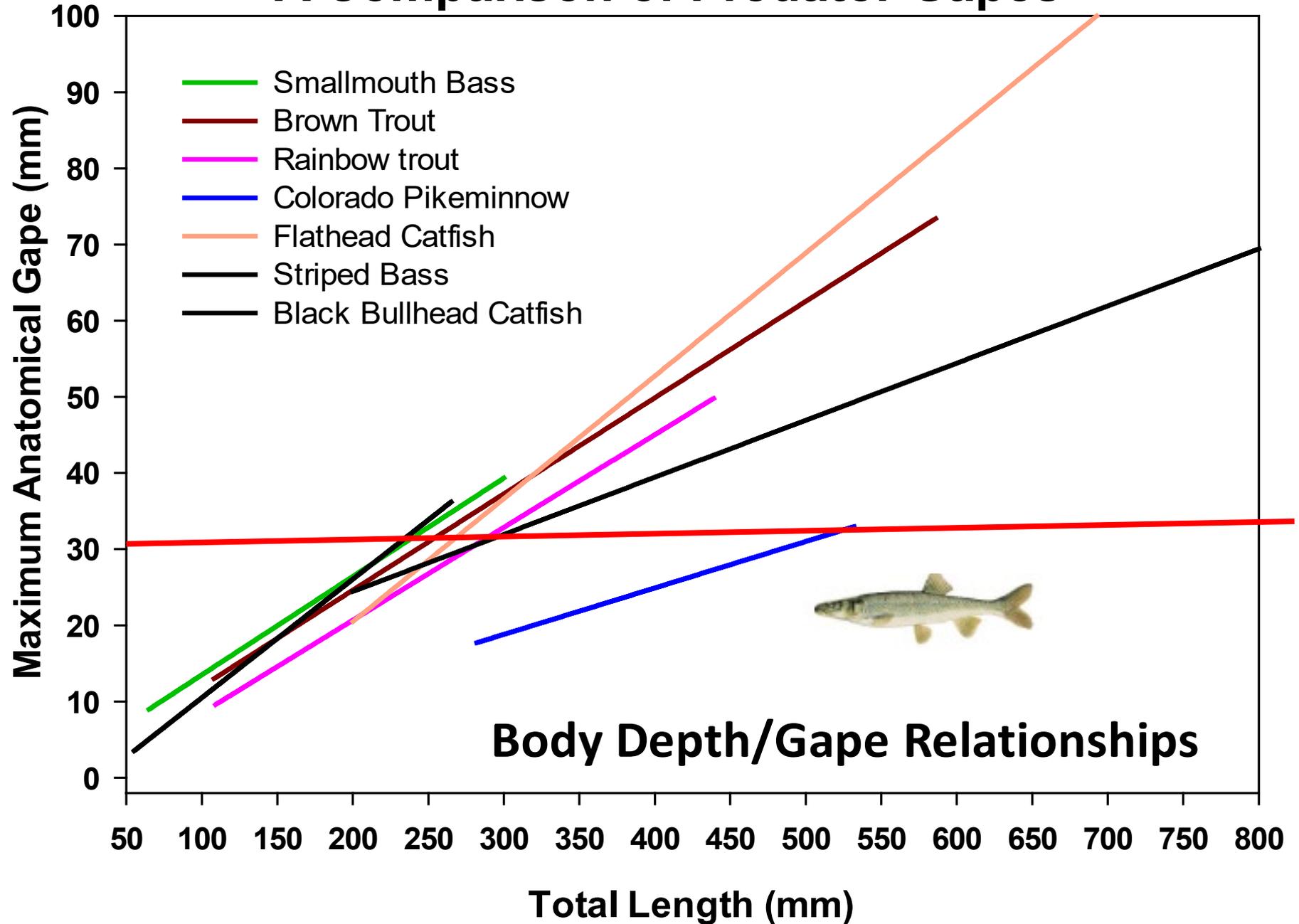
Colorado  
Pikeminnow



## Body depth of Humpback Chub and Razorback Sucker



# A Comparison of Predator Gapes



**Body Depth/Gape Relationships**

- **Behavior**



- **Morphology**



**Lets apply what we know to the  
introduced warm-water fish**

# Catfish !!!



Historically - Nothing similar in  
Colorado River

Prior to Glen Canyon Dam  
Most abundant fish in the Colorado River



(Dill 1944 surveys)

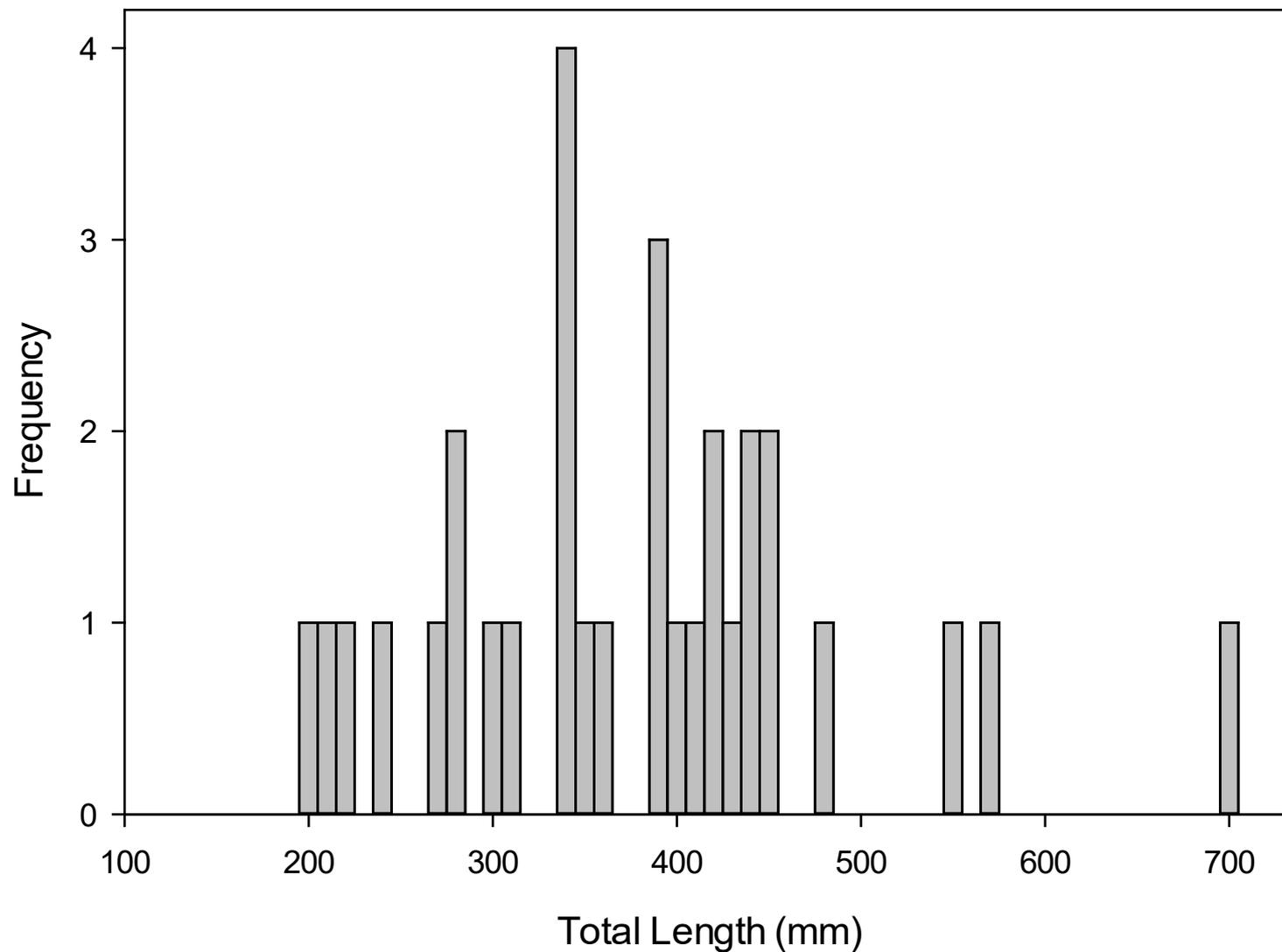
# What has changed in Western Grand Canyon in the last 15 years?



# Channel Catfish in the Little Colorado River



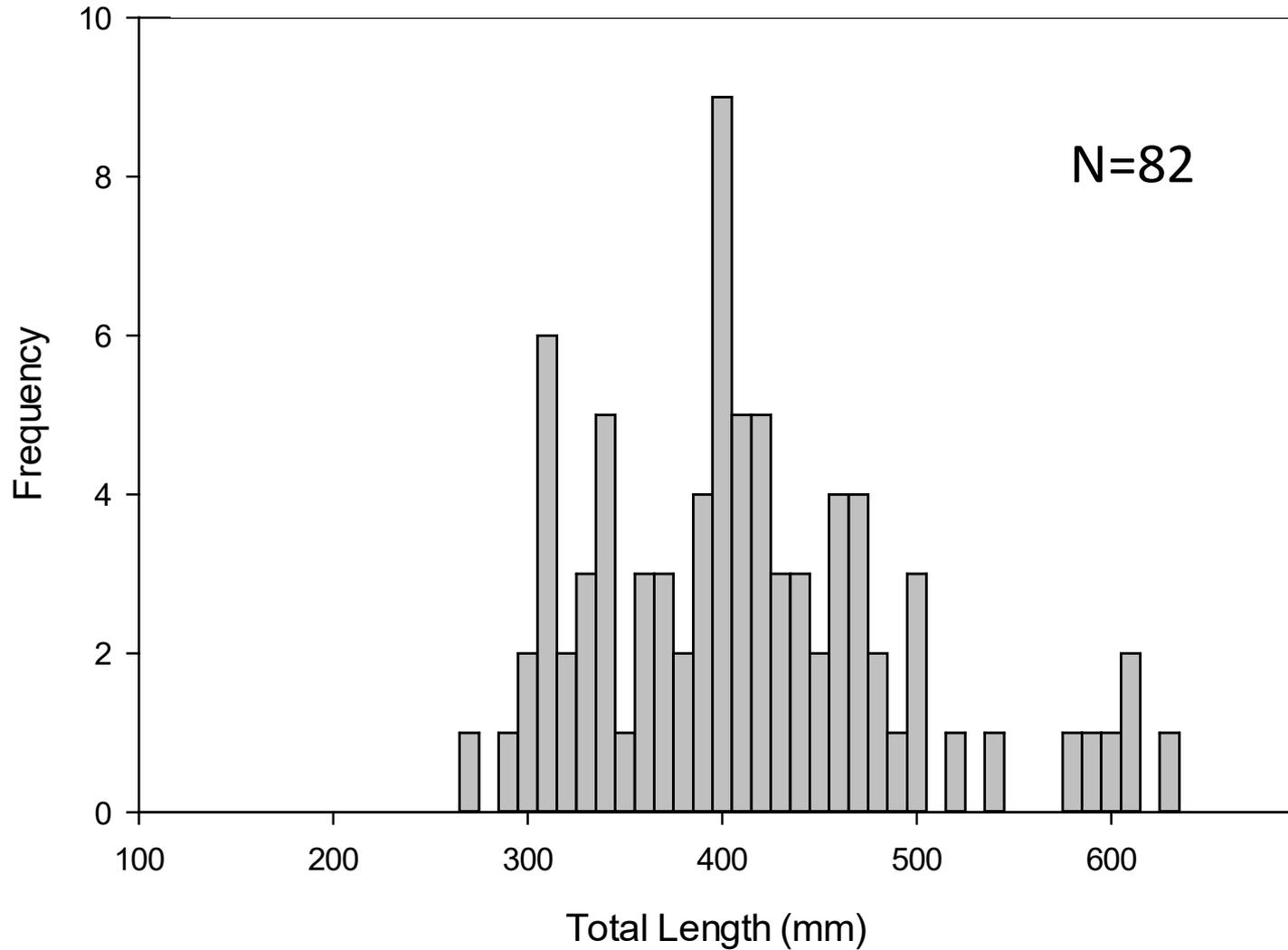
# Channel Catfish in the Little Colorado River (Angling 2018) May 20-24



**32 fish Average = 1 fish/hr**

# Channel Catfish in the Little Colorado River (Angling 2019)

## 4 Trips May - June



**Average size = 408 mm TL (Range = 261-630 mm TL)**

# 2019 Summary – Channel Catfish Angling in LCR

- 82 Fish caught and PIT tagged (109 angler-hours of effort)
- Mostly large adults (Average 16+ inches)
- Only 2 recaptures – no population estimate - Population is likely large – or moves a lot
- Widely distributed - Confluence - Atomizer Falls (Rkm 13.5)
- Catch is temperature dependent
- Found in deep water, under boulders



# Laboratory Predation Studies

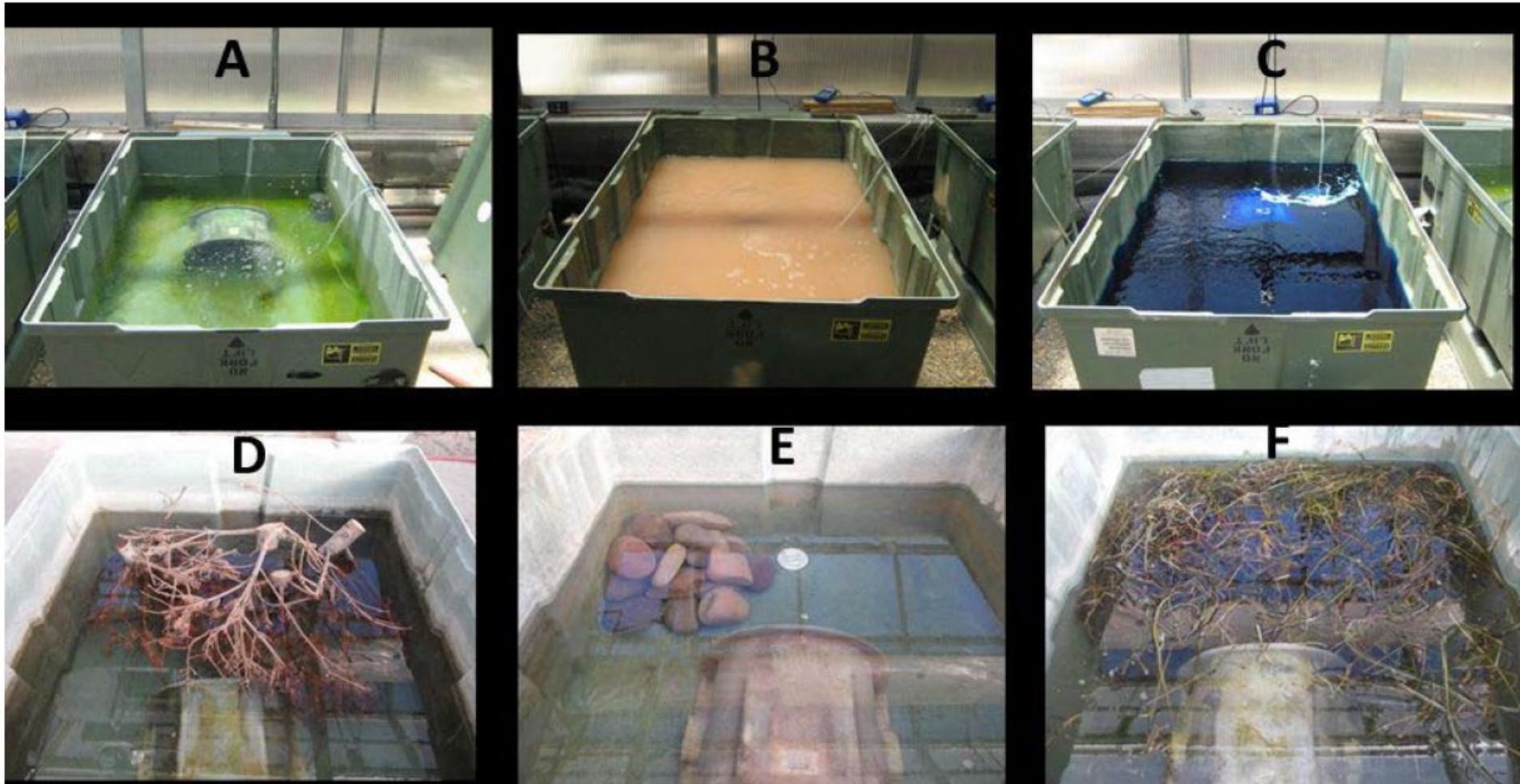


## Notes

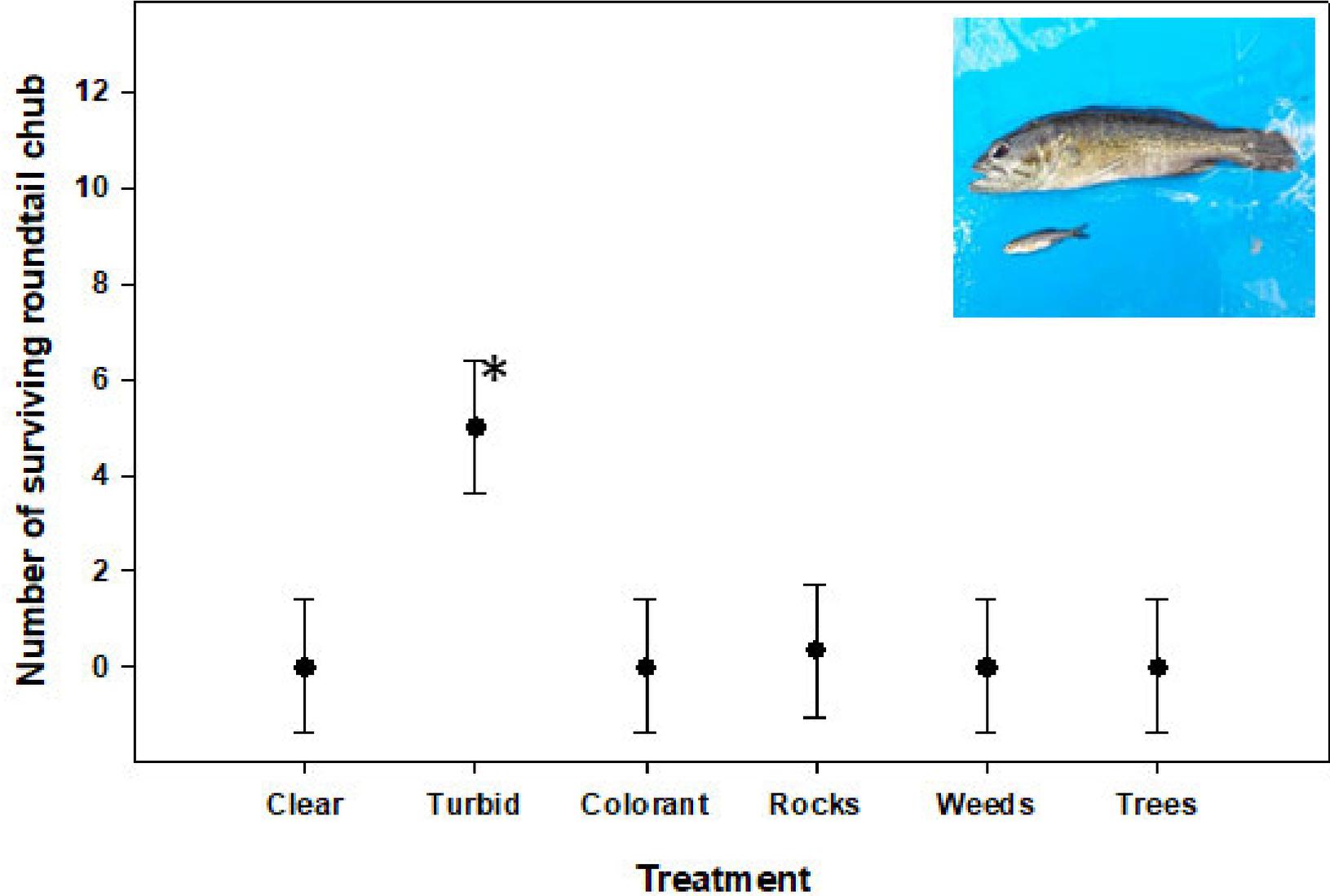
# What Environmental Conditions Reduce Predation Vulnerability for Juvenile Colorado River Native Fishes?

David L. Ward,\* Ben M. Vaage

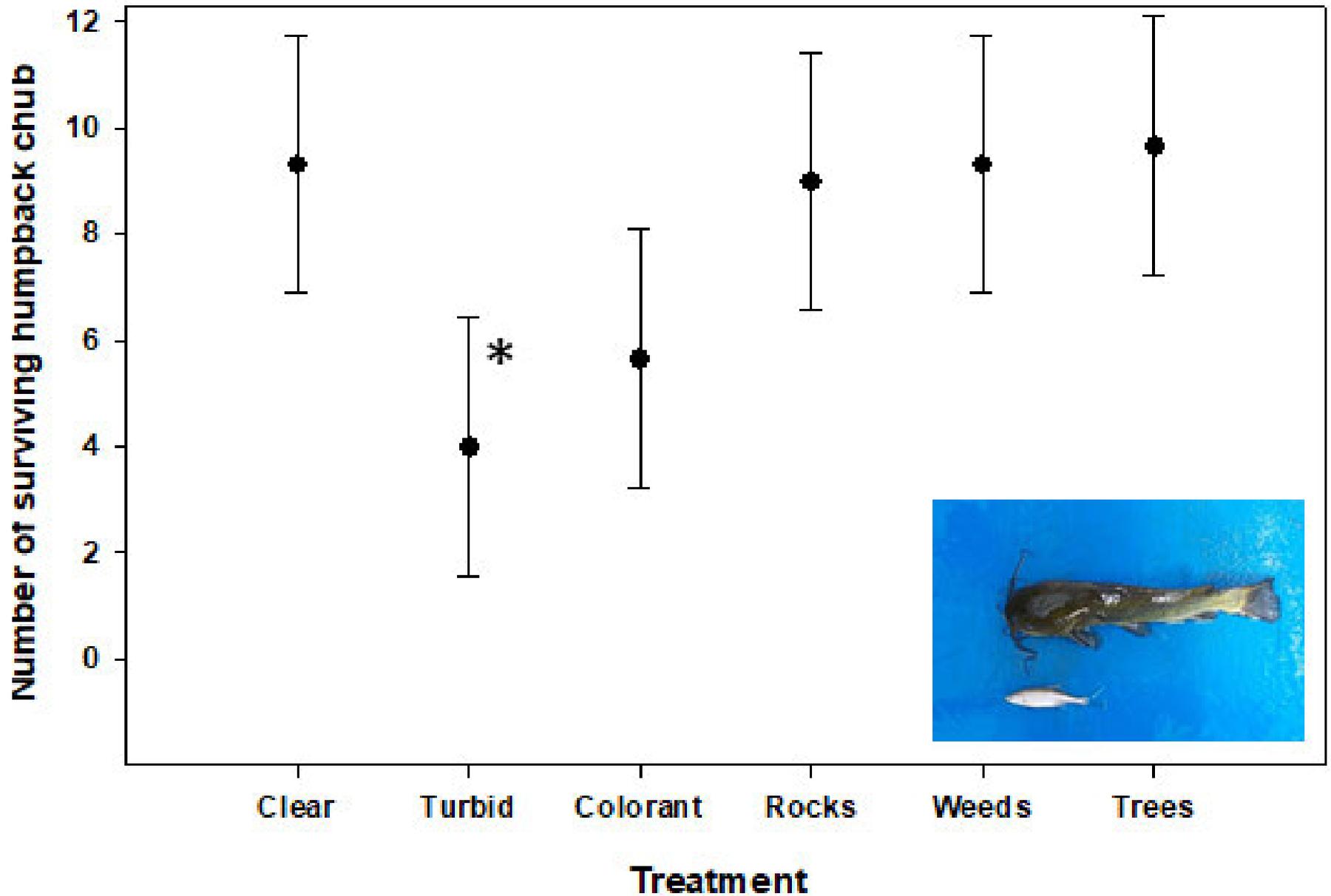
*Journal of Fish and Wildlife Management*



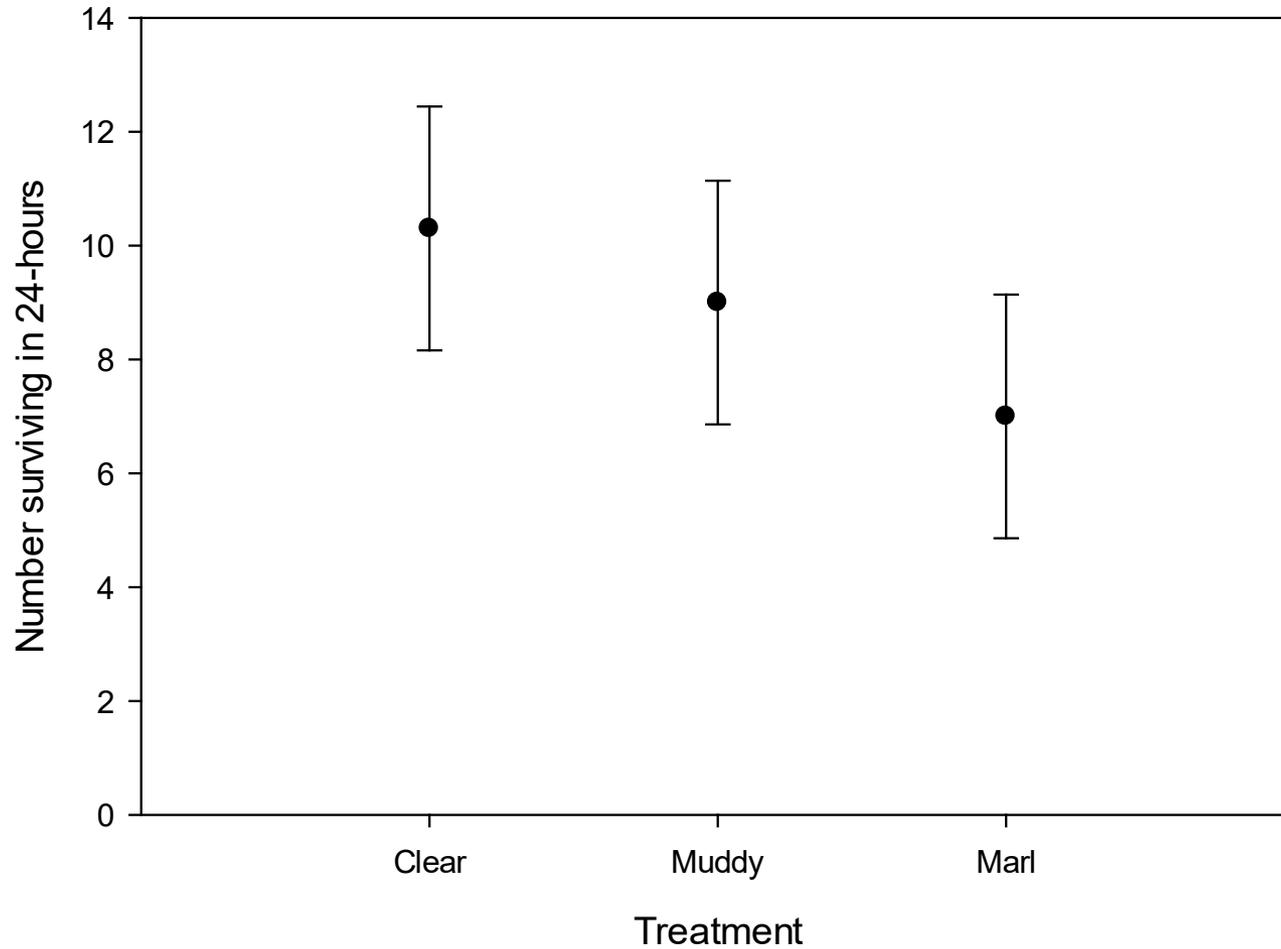
### D) Smallmouth bass



## A) Black Bullhead



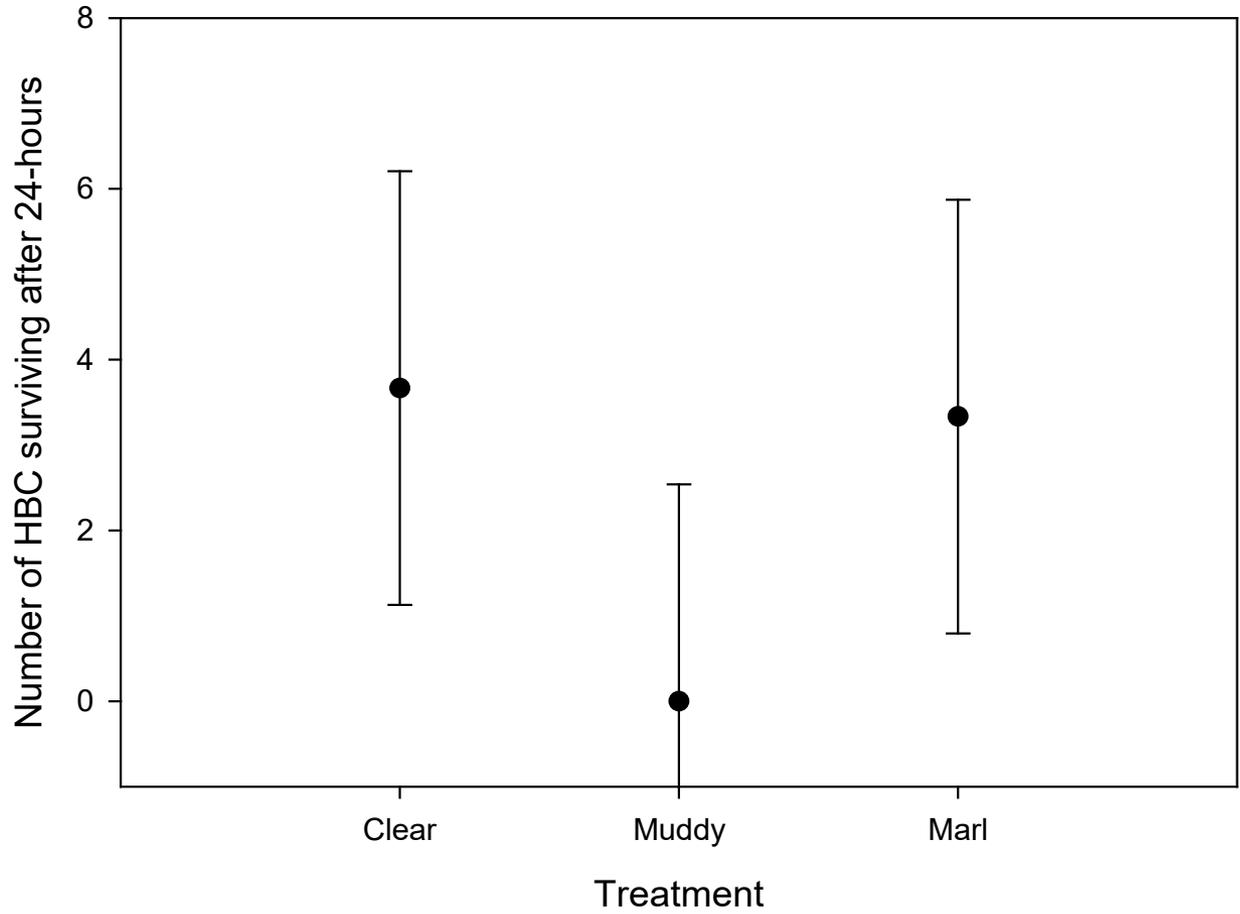
## CCF with Humpback chub



Channel Catfish Mean = 320 mm TL  
Razorback sucker 40-50-mm TL



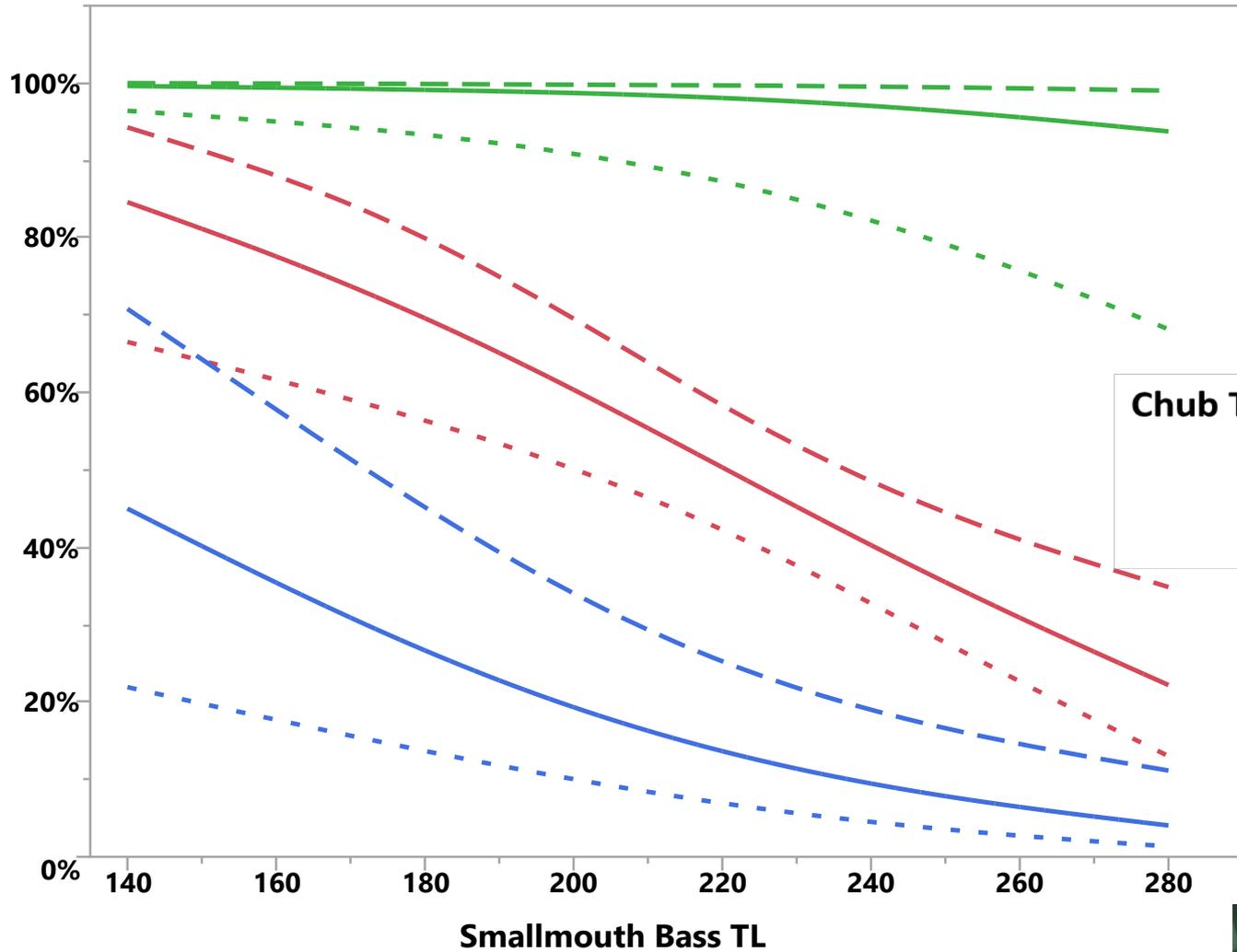
### Small CCF With Razorback sucker



Channel Catfish Mean = 260 mm TL  
Humpback chub 35-50-mm TL

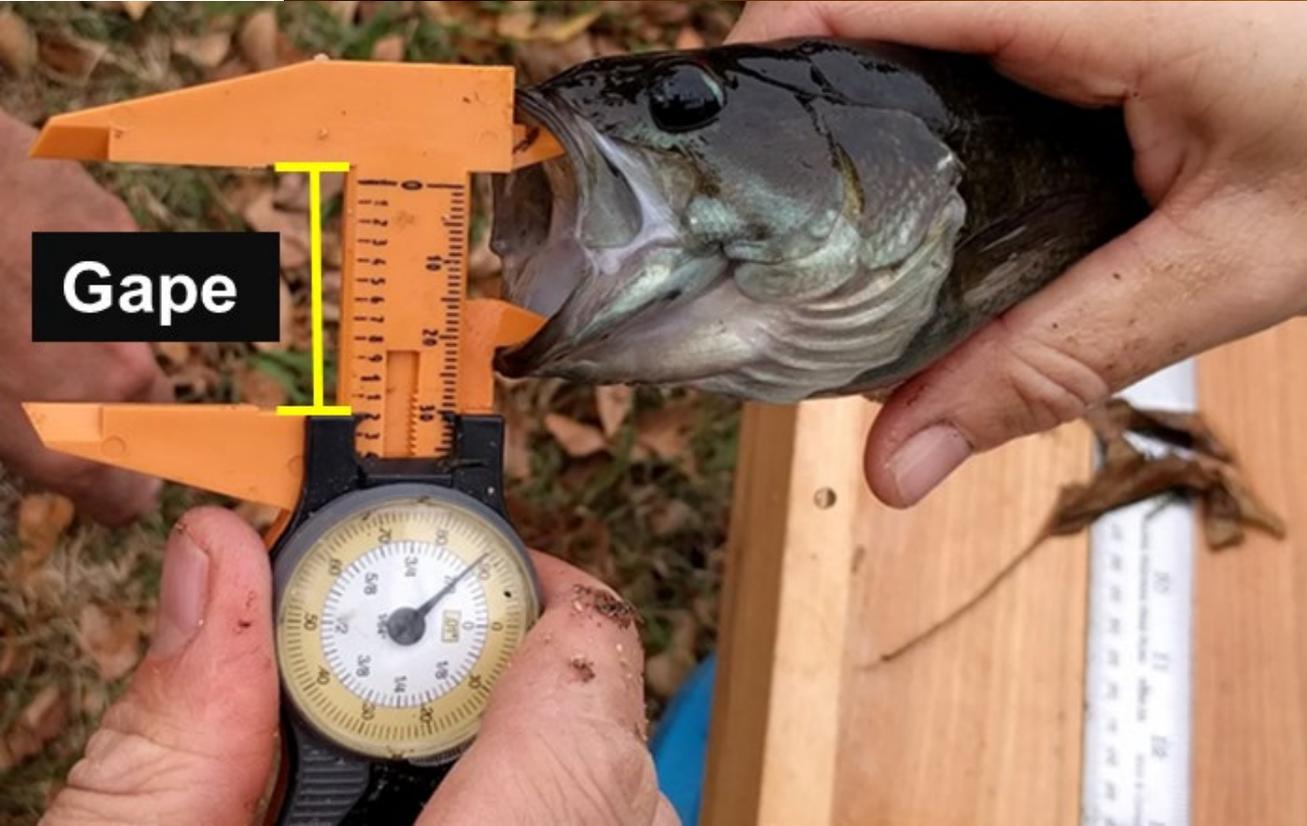
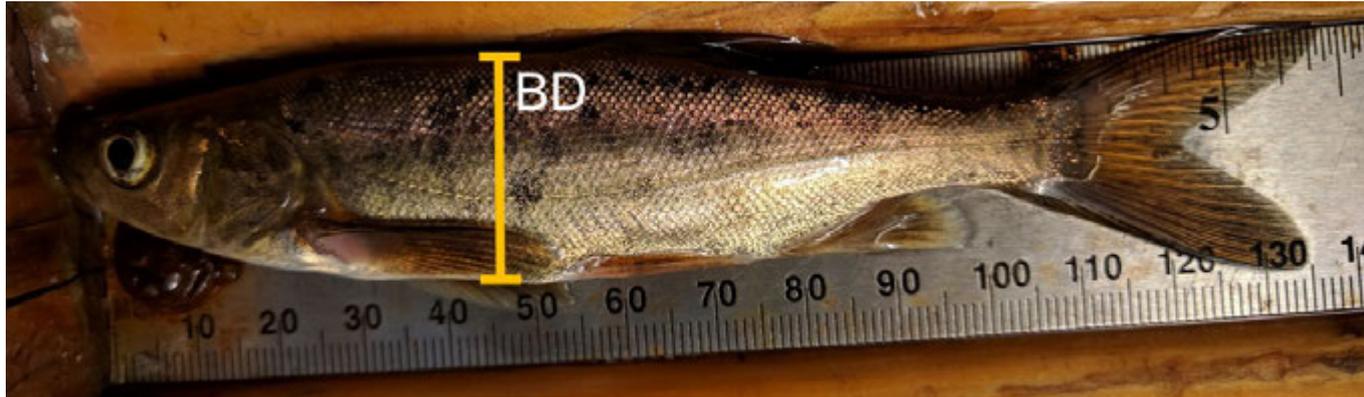


Probability of survival (%)



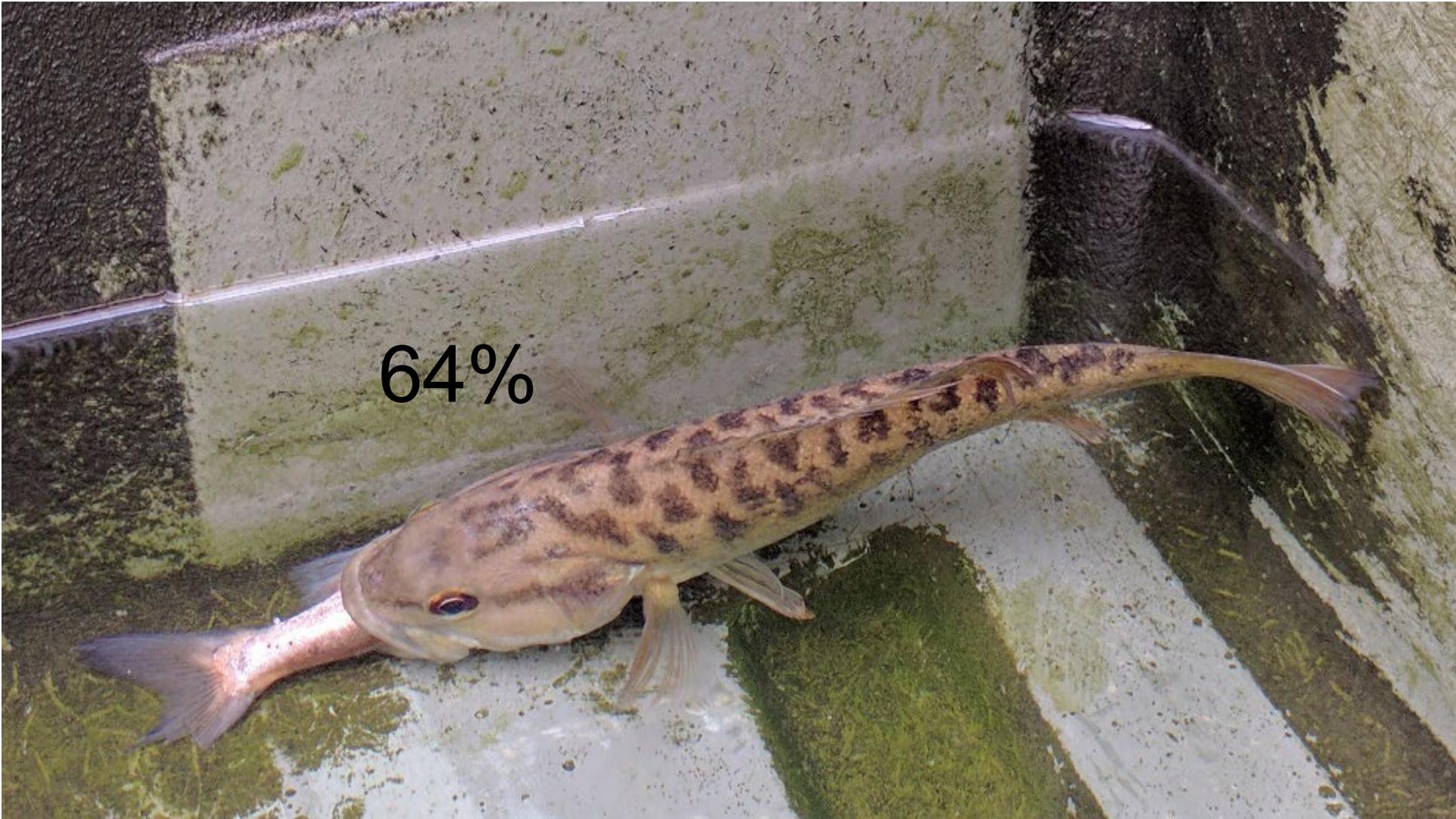
Probability that a juvenile chub will survive predation by smallmouth bass at 20 °C at 3 different sizes.

# BD/Gape: Able to calculate size of fish Smallmouth Bass consumed

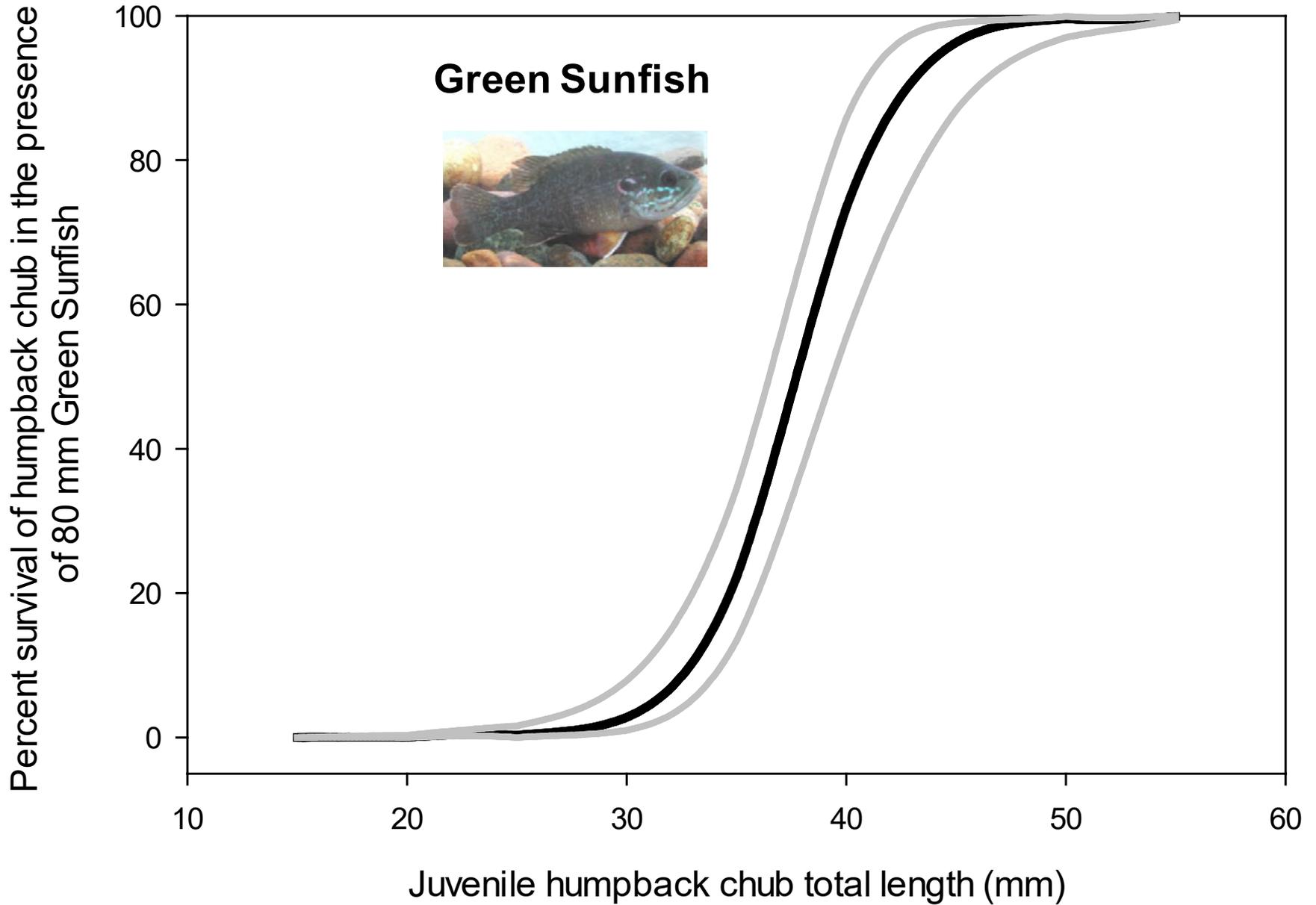


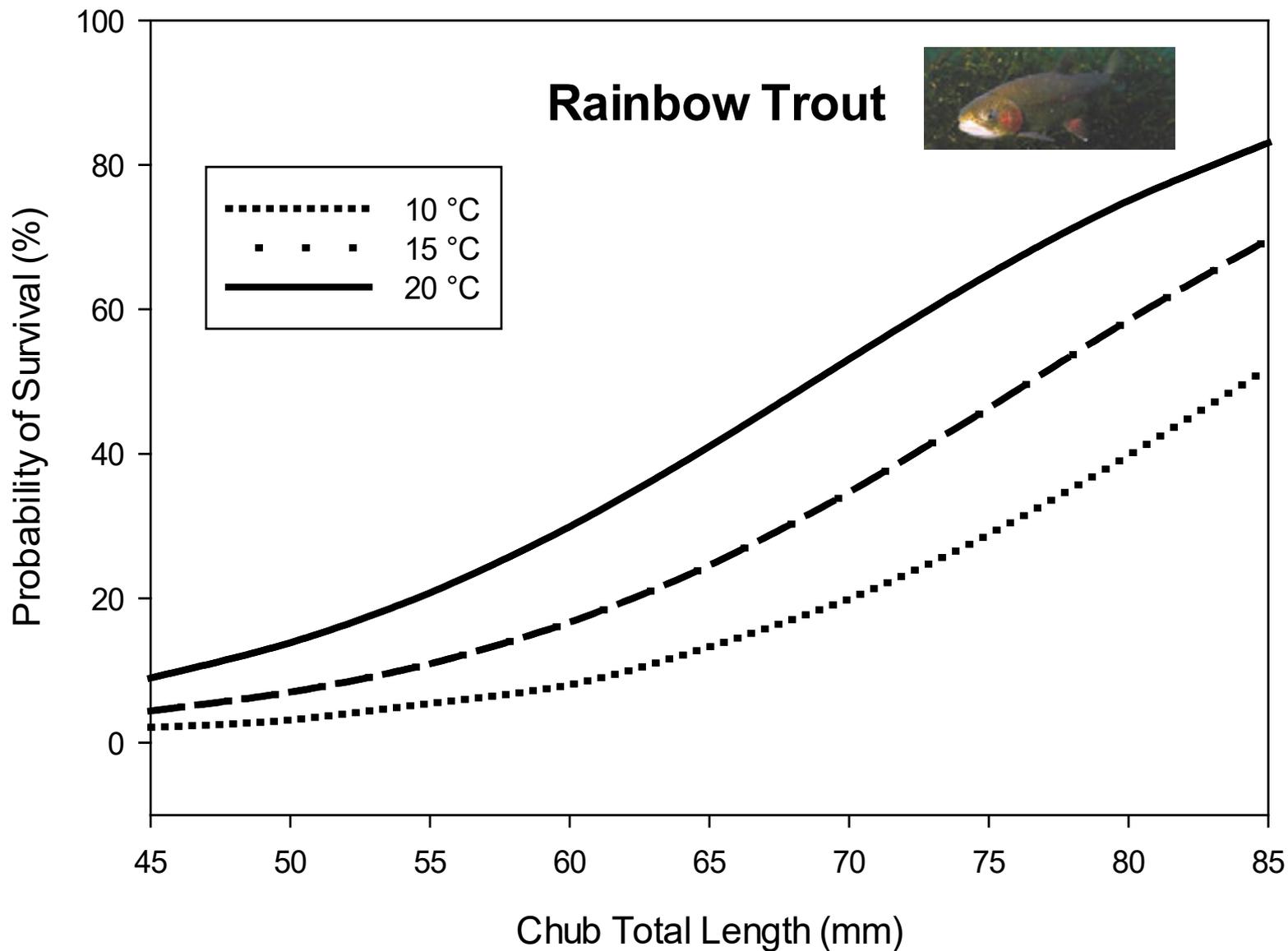
**Smallmouth bass on average will not consume chub with body depths more than 40% of their gape**

*Laura Tennant MS Thesis, NAU*



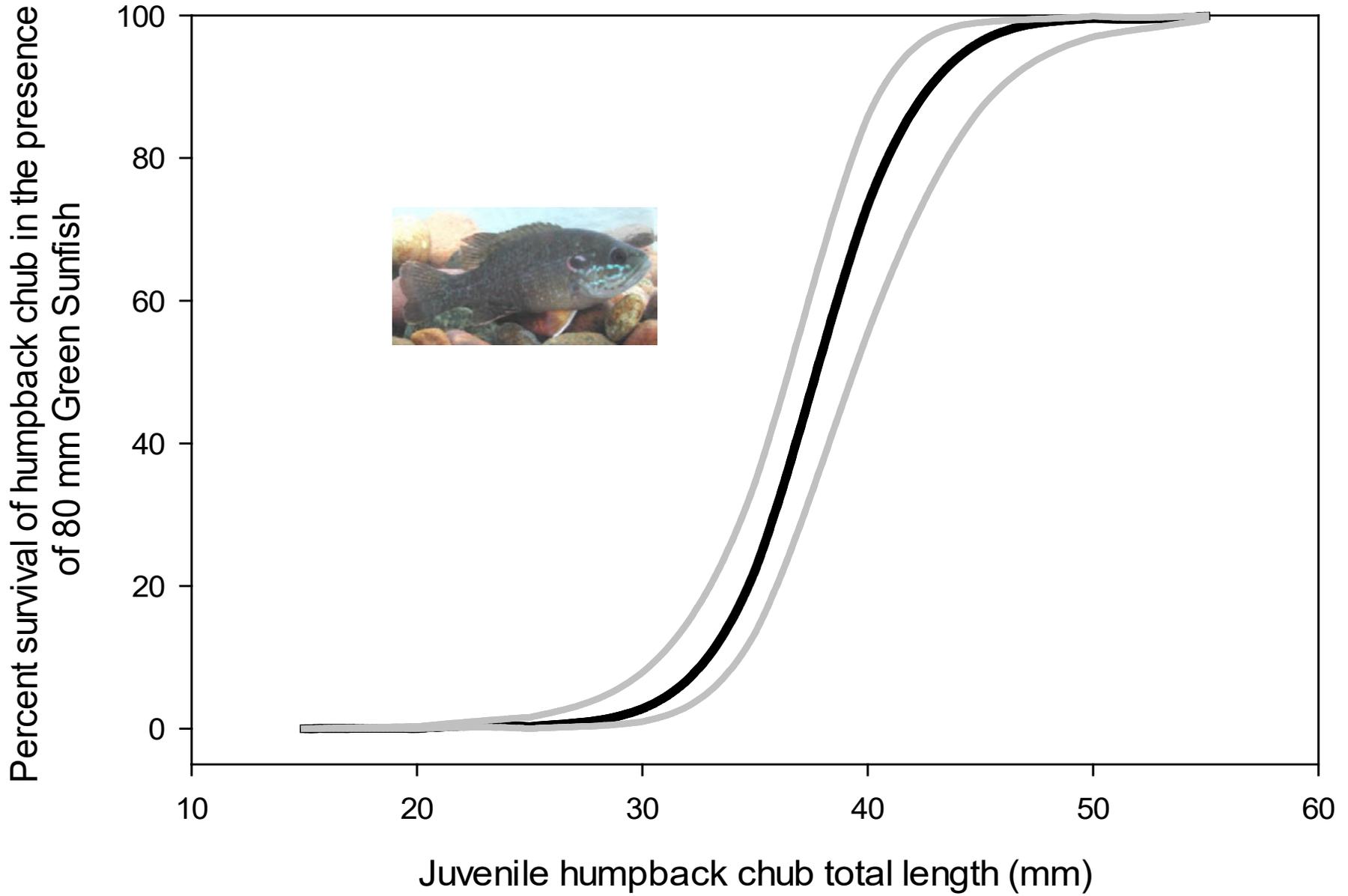
A graph showing percent survival of humpback chub in the presence of green sunfish

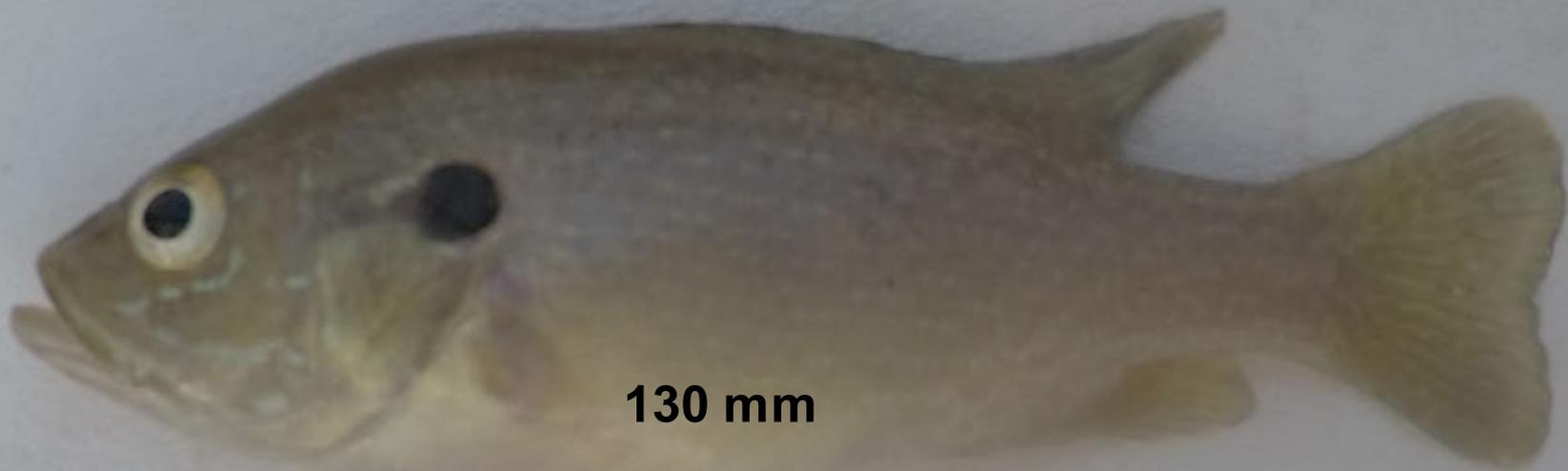




Percent (%) probability that a juvenile chub will survive predation by a 285 mm rainbow trout as chub size increases from 45-85 mm TL at 10, 15 and 20 °C, with trout size held constant at 285 mm TL.

# Green Sunfish consume chub with body depths more than 54% of their gape





130 mm



45 mm









# Why Green Sunfish?

- Group hunting behavior
- Aggressive predator
- Small size allows them to access prey
- Highly fecund
- Spread with flood events
- Typically overtake natural systems



# Why Channel Catfish?

- Incompatible with most native fish
  - Nocturnal, more effective in turbid water, large gape
- Live in Little Colorado River
- Highly vulnerable to predation
- Appears to be little recruitment



The background of the slide is a vibrant, deep blue underwater scene. It is filled with numerous bubbles of various sizes, some in sharp focus and others blurred, creating a sense of depth and movement. The lighting is bright, likely from above, causing some bubbles to appear as bright white or light blue spheres. The overall texture is bubbly and dynamic.

**Questions?**