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

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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
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

Body depth of Humpback Chub and Razorback Sucker
A Comparison of Predator Gapes

Body Depth/Gape Relationships

- Smallmouth Bass
- Brown Trout
- Rainbow trout
- Colorado Pikeminnow
- Flathead Catfish
- Striped Bass
- Black Bullhead Catfish

Maximum Anatomical Gape (mm) vs. Total Length (mm)
• Behavior
  ✔

• Morphology
  ✔

Let's 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
What Environmental Conditions Reduce Predation Vulnerability for Juvenile Colorado River Native Fishes?

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Journal of Fish and Wildlife Management
A) Black Bullhead

Number of surviving humpback chub

- Clear
- Turbid
- Colorant
- Rocks
- Weeds
- Trees

[Graph showing data with error bars and a star indicating statistical significance]
CCF with Humpback chub

Number surviving in 24-hours

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

Number of HBC surviving after 24-hours

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

64%
A graph showing percent survival of humpback chub in the presence of green sunfish.

Juvenile humpback chub total length (mm)

Percent survival of humpback chub in the presence of 80 mm Green Sunfish

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.
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
Questions?