Nonnative predation on razorback sucker larvae in Lake Mohave

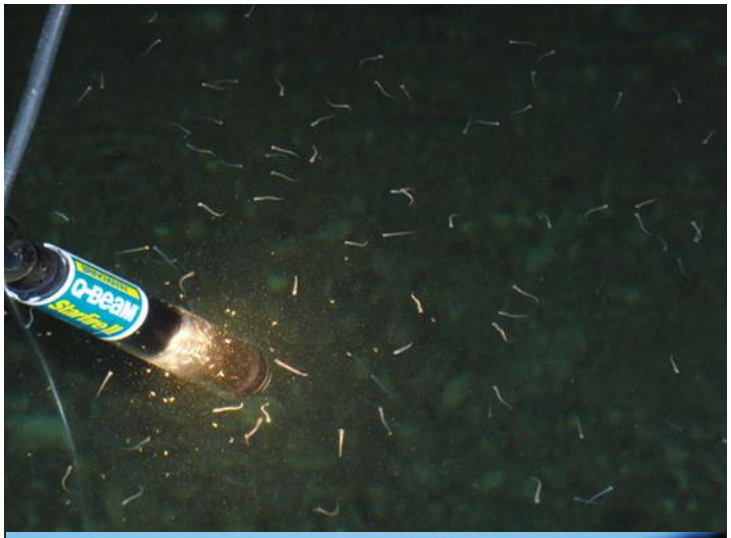
CHASE EHLO, MELODY SALTZGIVER, THOMAS DOWLING AND PAUL MARSH

MARSH & ASSOCIATES, LLC

Colorado River Aquatic Biologist Meeting
January 7– 8, 2015
Laughlin, NV

Funding for this project has been provided by the Lower Colorado River Multi-Species Conservation Program (LCR MSCP).

Larval Predation



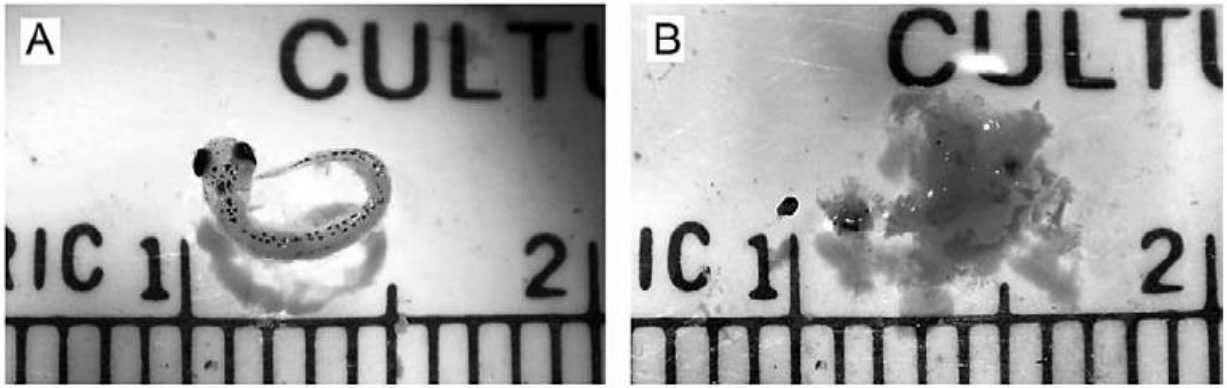
- Razorback sucker is federally endangered throughout its range
- Larval predation by nonnative fish can exacerbate declines
- Few observations of razorback larvae predation
  - Marsh and Langhorst (1988) positively identified larvae in the gut of green sunfish

Limitations to identification

- Prey items in stomachs (Marsh and Langhorst 1988)
  - Can become visually unrecognizable
  - Particularily after digestion has proceeded for periods of more than a few hours
- Detecting razorback sucker larval remains (Schooley et al. 2008)
  - Positive identification of razorback sucker larvae as only 50% 30 min post-consumption
  - Only 3% at 60 min post-consumption

15 min 60 min Schooley et al. 2008

Green Sunfish



Identification of larval DNA

- Advances in molecular techniques have enabled the identification of DNA of prey in stomachs

- Ley et al. (2014)
  - Utilized quantitative PCR (qPCR) to identify razorback DNA in stomachs of green sunfish and western mosquitofish
  - Able to identify razorback sucker DNA in 87.5% of stomachs 2 h post-feeding
  - 75% of stomachs 12 h post-feeding

- Visual identification of larvae in the stomach can significantly underestimate the extent of predation

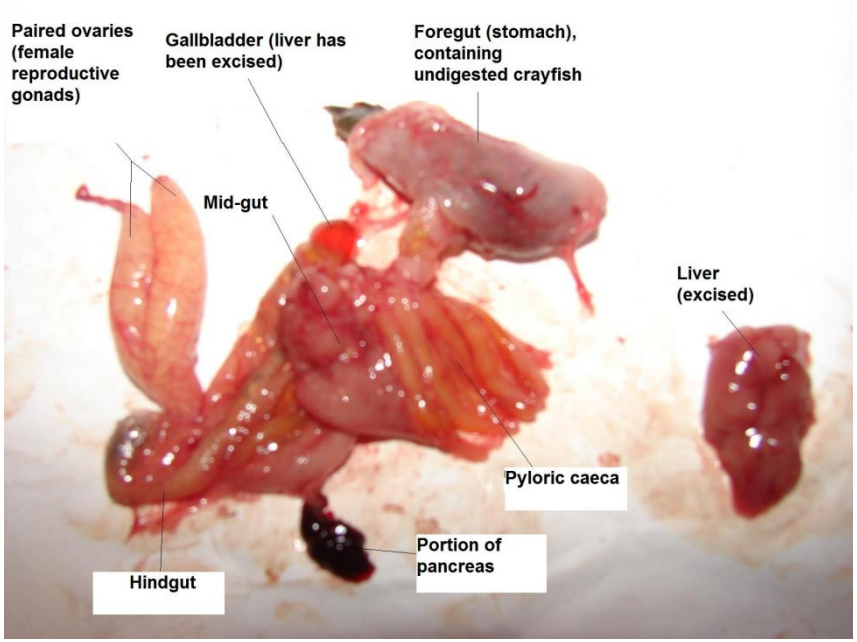
Study area and objectives

- Lake Mohave
  - Population once numbered over 100 thousand fish
  - Population now numbers ~3200 fish
- Tequila Cove
  - Spawning is prevalent
  - Larvae are found in abundance
  - Non-native fish are found in abundance
- Evaluate the extent of larval predation by non-native fish
  - Collect potential non-native fish predators in Tequila Cove and extract stomach contents
  - Use advanced molecular techniques to identify razorback sucker DNA in stomach contents.

Methods (field collections)

- Sampling was conducted on 2 April 2014
- Three types of gear: minnow traps (12), hoop nets (6), and boat electrofishing.
- Nets were set in the early evening and retrieved ~4 hours later
- ~1200 sec of electofishing
- All nonnative fish were euthanized (MS222) and preserved (70% isopropyl)

Methods (dissections)



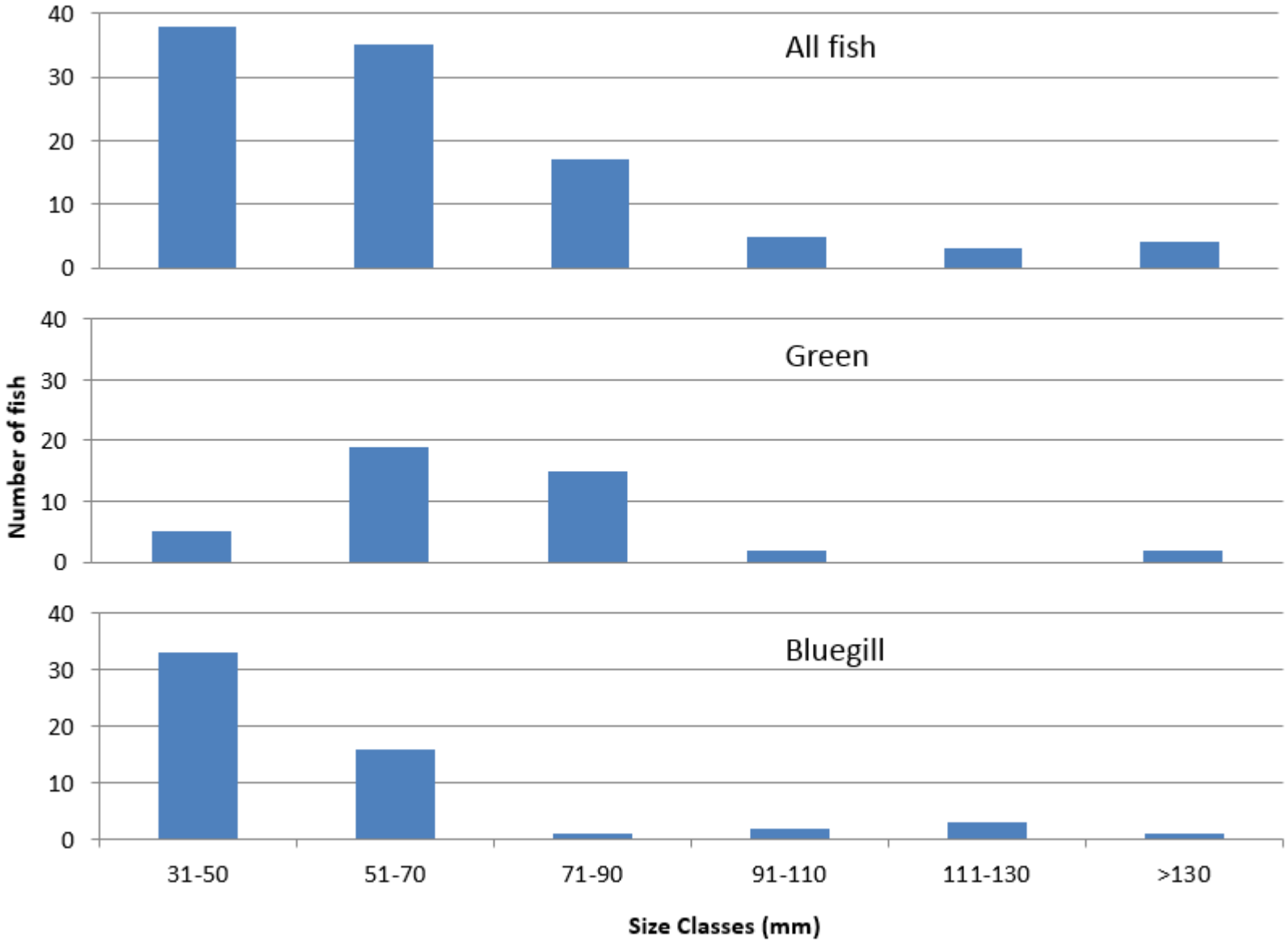
- Fish were transferred to 95% ethanol in the lab
- Identified to species and measured for total length
- Stomach contents were then dissected and stored in vials with 95% ethanol
- Vial was labeled with a unique numeric code

Methods (genetic techniques)

- Standard phenol-chloroform extraction
- Every sample and control ran in triplicate
- Standard control (pure razorback DNA) serially diluted over orders of magnitude (100, 10, 1, 0.1, 0.01 ng/µl)
- All gut samples ran at 100 ng/µl
- 40 cycles of 95 C° for 5 sec, 60 C° for 1 min
- MxPro QPCR System

Results

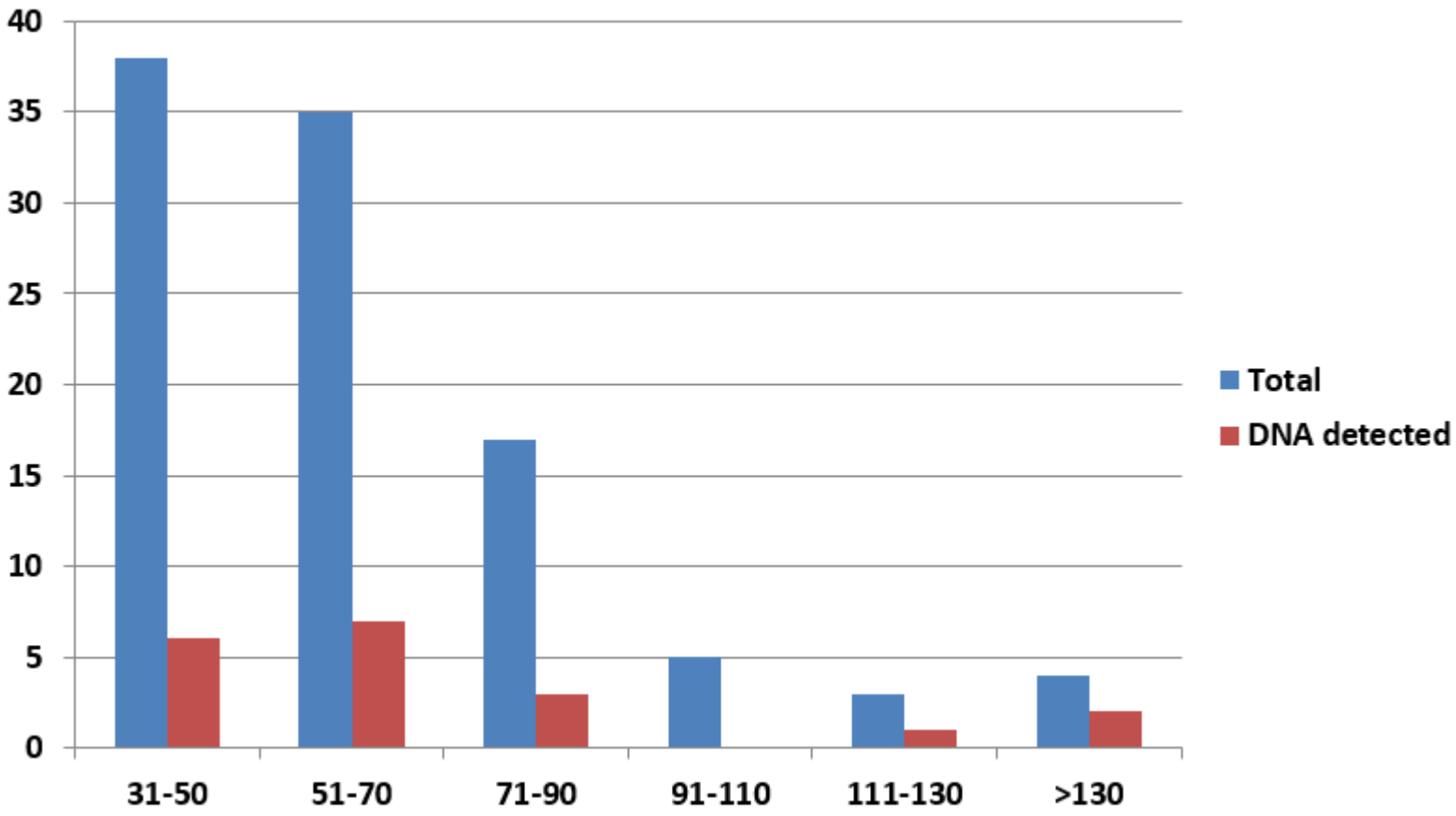
- Collected 4 species and 103 fish
  - Largemouth bass (2)
    - Mean length of 91 mm (76-106 mm)
  - Smallmouth bass (1)
    - 165 mm
  - Green sunfish (43)
    - 72 mm (41-174 mm)
  - Bluegill sunfish (56)
    - 58 mm (34-305 mm)


All fish
Green
Bluegill
Number of fish
0
10
20
30
40
31-50
51-70
71-90
91-110
111-130
>130
Size Classes (mm)

Results

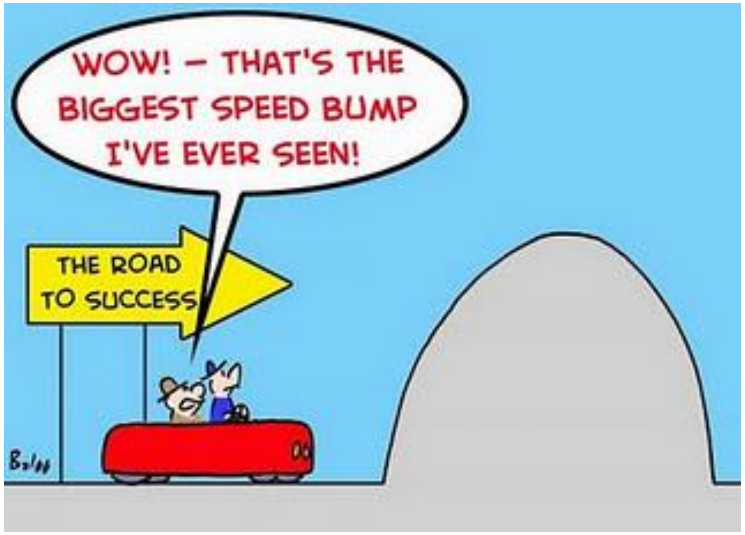
- 11 samples tested positive for razorback sucker DNA
  - 6 green sunfish, 4 bluegill, 1 smallmouth bass
  - 35 mm – 174 mm
  - 7 electrofishing, 4 nets
- 87 samples had no razorback sucker DNA
  - 9 samples were borderline
  - 5 green sunfish and 4 bluegill (41 mm – 80 mm)
- 4 samples could not be run

Size classes



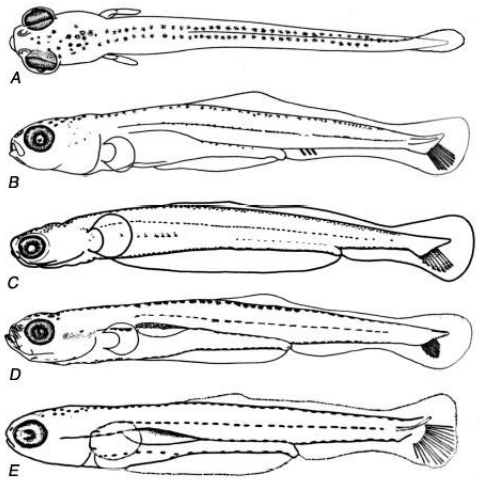
Implications?

- This is an obvious bump (or mountain?) in the road for razorback sucker recovery
- Are there any larvae surviving past the swim up stage?
  - Papoulias and Minckley (1990) found that larvae disappear at an average size of 10.6 mm
- Is it species specific?
- Are nonnative predators the only threat to larvae?
- At what extent is larvae predation occuring?



Is it species specific?

- 23% of green sunfish had razorback DNA in the gut
- Only 14% of bluegill sunfish had razorback DNA in the gut
- Werner and Hall (1977) found that bluegill shifts to feeding on smaller prey in the presence of green sunfish
- Something to note
  - The only smallmouth bass captured and analyzed had razorback DNA in its gut
  - Could that bass have eaten a sunfish that had razorback larvae in its gut?



Is predation the prime suspect?

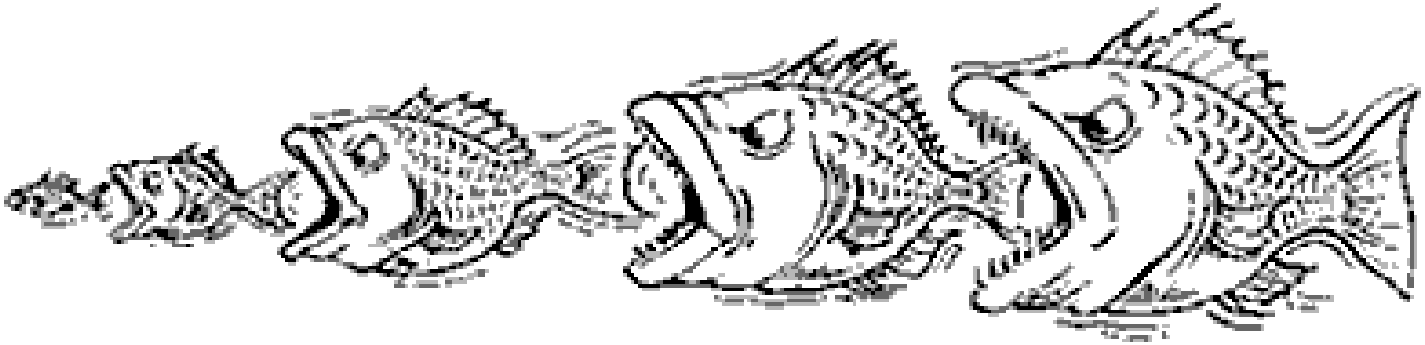
- Hypolimnetic withdrawals from Lake Mead
  - Cooler water temperature decreases both hatching success and growth rate of larval razorback sucker (Marsh 1985; Bestgen 2008)
  - Other papers of note on the subject (Bozek et al. 1990; Clarkson and Childs 2000)
- Food-limited mortality?
  - Papoulias and Minckley (1990) suggested that food limited mortality could contribute to the absence of larvae
- Lethal or Sub-lethal effects?

Whats next?

- Take another sample
  - Closer to peak spawning for razorback sucker
  - Preserve in ethanol rather than isopropyl
- At what extent is larval predation occurring?
  - Estimate the number of larvae in Tequila
  - Estimate the number of non-native predators in Tequila
  - Feeding rate of sunfish – Literature?
- In-situ experiment on food-limited mortality and thermal tolerance of razorback sucker larvae.

Conclusion

- The obvious thing to take away from this is that larvae are being preyed upon in Tequila Cove
- This just reiterates what we've discovered time and time again
- No chance at recruitment



Acknowledgements

- Jeff Lantow
- Julia Mueller
- Melody's lab minions

Bestgen, K.R. 2008. Effects of water temperature on growth of razorback sucker larvae. Western North American Naturalist 68(1):15-20.

Bozek, M.A., L.J. Paulson, and G.R. Wilde. 1990. Effects of ambient Lake Mohave temperatures on development, oxygen consumption, and hatching success of the razorback sucker. Environmental Biology of Fishes 27:255-263.

Clarkson, R.W. and M.R. Childs. 2000. Temperature effects of hypolimnial-release dams on early life stages of Colorado River basin big-river fishes. Copeia 2:402-412.

Ley, G., M.J. Saltzgiver, T.E. Dowling, A.P. Karam, B.R. Kesner, P.C. Marsh. 2014. Use of a molecular assay to detect predation on an endangered fish species. Transactions of the American Fisheries Society 143(1): 49-54

Marsh, P.C. 1985. Effect of incubation temperature on survival of embryos of native Colorado River fishes. The Southwestern Naturalist 30(1): 129-140.

Marsh, P. C., and D. R. Langhorst. 1988. Feeding and fate of wild larval razorback sucker. Environmental Biology of Fishes 21: 59-67.

Papoulias, D. and W.L Minckley. 1990. Food limited survival of larval razorback sucker, *Xyrauchen texanus*, in the laboratory. Environmental Biology of Fishes 29:73-78.

Schooley, J. D., A. P. Karam, B. R. Kesner, P. C. Marsh, C. A. Pacey, and D. J. Thornbrugh. 2008. Detection of larval remains after consumption by fishes. Transactions of the American Fisheries Society 137: 1044–1049.

Werner, E.E. and D.J. Hall. 1977. Competition and habtat shift in two sunfishes (Centrarchidae). Ecology 58: 869-876