

## Work Task C32: Determination of Salinity, Temperature, pH, and Oxygen Limits for Bonytail and Razorback Suckers

FY16 Estimate	FY16 Actual Obligations	Cumulative Expenditures Through FY16	FY17 Approved Estimate	FY18 Proposed Estimate	FY19 Proposed Estimate	FY20 Proposed Estimate
\$110,000	\$99,638.94	\$790,595.91	\$110,000	\$0	\$0	\$0

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**Start Date:** FY09

**Expected Duration:** FY17

**Long-Term Goal:** To develop and maintain high quality backwater habitats for native fishes

**Conservation Measures:** BONY2, BONY3, BONY5, RASU2, RASU3, RASU5, and RASU6

**Location:** LCR MSCP Native Fish Laboratory, Boulder City, Nevada

**Purpose:** To evaluate bonytail (*Gila elegans*) and razorback sucker (*Xyrauchen texanus*) early life stage thresholds of survival at varying levels of salinity, temperature, pH, and dissolved oxygen (DO)

**Connections with Other Work Tasks (Past and Future):** This work task began under Work Task G3 and is related to management of created fish habitat.

**Project Description:** Through laboratory testing, the threshold levels of various water quality parameters needed to sustain early life stages of bonytail and razorback suckers in backwater habitats developed by the LCR MSCP will be evaluated.

**Previous Activities:** Salinity concentrations evaluated during FY07 and FY08 indicated that upper salinity tolerances ranged from 11,000 to 12,000 microsiemens per centimeter ( $\mu\text{S}/\text{cm}$ ) for razorback sucker eggs and from 23,000 to 27,750  $\mu\text{S}/\text{cm}$  for razorback sucker larvae. From observations made during larval trials, it was documented that long-term survival may be possible at salinities as high as 23,000  $\mu\text{S}/\text{cm}$  when larval razorback suckers are properly acclimated.

The results from razorback sucker egg trials indicated that the lower DO limit for this early life stage is in the 2.5 to 3 milligrams per liter (mg/L) range. The limit observed for larvae was slightly lower, with increased mortality occurring at DO concentrations near 2 mg/L. The threshold levels for successful embryo development are between pH 9 and 10. The pH threshold observed for razorback sucker larvae was slightly higher; 98% survival was observed with short-term exposure (20 days) to pH 10.

The results from both the bonytail and razorback sucker trials indicated that the upper lethal limit for these species is near pH 10 at both 20 and 30 degrees Celsius (°C). While low levels of mortality were observed at both temperatures during the first 72 hours, mortality increased to 87–93% after 20 days of exposure at 20 °C and to 83–97% after 15 days of exposure at 30 °C. Increased survival was observed in lower pH treatments; bonytail exposed to pH 9 at 20 °C displayed zero mortality over 20 days and only 8% mortality after a 15-day exposure at 30 °C. Survival was also higher for razorback suckers exposed to pH 9.5 and below.

DO concentrations indicated that the lower lethal limit for fingerling bonytail was below 2 mg/L during short-term exposure at 20 °C. Only 17% mortality was recorded for bonytail exposed to the 2-mg/L treatment for 15 days. Trials at 30 °C indicated that the lower lethal DO limit is very near 2 mg/L. Sixty-seven percent mortality was observed at 72 hours, and 100% mortality was observed at 18 days. Mortality for the remaining 30 °C treatments decreased incrementally as DO concentrations increased.

While all DO treatments (2 to approximately 8 mg/L at 20 °C) produced swim-up larvae in egg trials, percent hatch was lowest at 2 mg/L (12%), highest at 8 mg/L (57%), and fairly uniform for the remaining treatments (39–46%). Larvae exposed to DO concentrations of 2 to approximately 7.25 mg/L for 20 days resulted in survival ranging from 93–100% and from 46–85% at 20 and 25 °C, respectively.

Eggs were exposed to salinity concentrations of 1,000 to 12,500  $\mu\text{S}/\text{cm}$  in triplicate at 20 °C. All treatments produced swim-up larvae, and percent hatch was similar among treatments (20–31%). Larvae were exposed to salinity concentrations of 12,500 to 20,000  $\mu\text{S}/\text{cm}$  in triplicate in two separate trials run at 20 and 25 °C for 15 days. Salinity concentrations of 12,500 and 15,000  $\mu\text{S}/\text{cm}$  resulted in larval mortality ranging from 4–14% at 20 °C, while observed mortality at higher salinity concentrations (17,500 and 20,000  $\mu\text{S}/\text{cm}$ ) ranged from 52–99%. For the 25 °C trial, mortality increased for all treatments. Larval mortality ranged from 13–70% at 12,500  $\mu\text{S}/\text{cm}$ , 29–88% at 15,000  $\mu\text{S}/\text{cm}$ , and from 98–100% for the remaining treatments. Larval mortality for control groups (1,000  $\mu\text{S}/\text{cm}$ ) was observed to be lower during both trials, ranging from 2–6% at 20 °C and 8–13% at 25 °C.

Fertilized eggs were exposed to a pH ranging from 7 to 10.5 in three replicate treatments at 20 °C until hatch was complete. The results indicate that successful development of bonytail eggs may be expected at pH levels as high as 9.5, little to no egg development should be expected at pH levels of 10 and above, and short-term survival of mesolarvae may be expected at pH levels as high as 10 at moderate temperatures.

**FY16 Accomplishments:** Research during this study year focused on evaluating threshold DO concentrations for fingerling razorback sucker survival. Fingerling razorback suckers were acquired from the Willow Beach National Fish Hatchery (B2) in late May and exposed to DO concentrations of 2 to 7.5 mg/L in three replicate treatments at 25 and 30 °C. Survival was evaluated at 72 hours and after 20 days of exposure.

Results from the 25 °C trial indicate that the lower DO limit for razorback sucker fingerlings may be below 2 mg/L with short-term exposure times at this temperature. Limited mortality (3%) was observed during the 20-day trial period, with all mortality occurring in the 2-mg/L treatment group. It should be noted that DO concentrations of 2 mg/L proved difficult to maintain during this trial. While the mean DO concentration was 1.94 mg/L for the three replicate treatments, concentrations did occasionally fluctuate within individual replicates and ranged from 0.99–2.56 mg/L during the 20-day trial. All observed mortality occurred in a single replicate treatment during a 48-hour period in which DO concentrations ranged from 1 to 1.5 mg/L. No mortality was observed within the remaining treatment groups.

Similar results were observed during the 30 °C trial, indicating that the lower DO limit for razorback sucker fingerlings is also near 2 mg/L at this temperature. Thirty-seven percent mortality was observed at 2 mg/L during the 20-day trial. Ten percent mortality was also observed within the 3-mg/L treatment group during this period. Mortality for the remaining treatments was less than 1%.

**FY17 Activities:** Research during this study year will evaluate threshold salinity concentrations for bonytail and razorback sucker fingerlings. Two multiple replicate trials, one at 25 °C and one at 30 °C, will be conducted for both species to evaluate the combined effects that salinity and temperature have on survival of this life stage. A final report on the research conducted will be prepared in FY17.

**Proposed FY18 Activities:** This work task will close in FY17.

**Pertinent Reports:** A final report will be posted on the LCR MSCP Web site upon completion.