

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

FY14 Estimate	FY14 Actual Obligations	Cumulative Expenditures Through FY14	FY15 Approved Estimate	FY16 Proposed Estimate	FY17 Proposed Estimate	FY18 Proposed Estimate
\$115,000	\$104,611.98	\$594,603.61	\$115,000	\$110,000	\$100,000	\$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:** RASU2, RASU3, RASU5, RASU6, BONY2, BONY3, and BONY5

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

**Purpose:** To determine razorback sucker and bonytail early life stage thresholds of survival for salinity, temperature, pH, and DO

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

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

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

During FY09, the results from 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 razorback sucker larvae was slightly lower, with increased mortality occurring at DO concentrations near 2 mg/L.

Research during the FY10 study year was focused on determining the threshold levels of pH for early life stage razorback sucker. The results from egg trials indicated that 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.

Research during FY11 focused on determining the threshold levels of pH for fingerling bonytail and razorback sucker survival. Results from both bonytail and razorback sucker trials indicated that the upper lethal limit for these species is near pH 10 at both 20 and 30 °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 sucker exposed to pH 9.5 and below.

Research during FY12 focused on determining the lower lethal DO concentration for fingerling bonytail. At 20 °C, the short-term, lower lethal DO limit was below 2 mg/L. 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.

Research during FY13 focused on determining threshold DO concentrations for successful bonytail egg development and larval survival. Fertilized eggs were exposed to DO concentrations of 2 to approximately 8 mg/L at 20 °C. While all DO treatments produced swim-up larvae, percent hatch was lowest at 2 mg/L (12%). Percent hatch for the remaining treatments was fairly uniform (39–46%), with the exception of oxygen-saturated tanks (approximately 8 mg/L) in which 57% of eggs produced swim-up larvae. Bonytail larvae were exposed to DO concentrations of 2 to approximately 7.25 mg/L in two separate trials run at 20 and 25 °C for 20 days. The 20 °C trial resulted high survival (93–100%), with little difference observed between treatments. Survival in the 25 °C trial averaged approximately 68% between nearly all treatments (range 46–85%). Results from the FY13 study year indicated that the success of bonytail egg development increased with increased DO concentrations, little to no egg development should be expected below 3 mg/L, and that short-term survival of bonytail larvae can be expected at DO concentrations as low as 2 mg/L at moderate temperatures.

**FY14 Accomplishments:** Research during FY14 focused on determining threshold salinity concentrations for successful bonytail egg development and larval survival. Fertilized 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 between 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. Control groups exposed to 1,000  $\mu\text{S}/\text{cm}$  were also observed at both temperatures during the 15-day trial periods. Larval mortality increased at higher salinity concentrations during the 20 °C trial. Salinity concentrations of 12,500 and 15,000  $\mu\text{S}/\text{cm}$  resulted in larval mortality ranging from 4 to 14%, while observed mortality at higher salinity concentrations (17,500 and 20,000  $\mu\text{S}/\text{cm}$ ) ranged from 52 to 99%. For the 25 °C trial, mortality increased for all treatments. Larval mortality ranged from 13 to 70% at 12,500  $\mu\text{S}/\text{cm}$ , 29 to 88% at 15,000  $\mu\text{S}/\text{cm}$ , and from 98 to 100% for the remaining treatments. Larval mortality for control groups was observed to be lower during both trials, ranging from 2 to 6% at 20 °C and 8 to 13% at 25 °C. Results from the FY14 study year indicated that the success of bonytail egg development may not be as limited by increased salinity concentrations as expected. Larval survival does however appear to have a correlation with salinity, with increased survival being observed at lower salinity concentrations. It should also be noted that increases in temperature may reduce larval survival at higher salinity concentrations.

**FY15 Activities:** Research during this study year will be focused on determining threshold pH levels for bonytail egg development and larval survival. It is anticipated that two trials, each with multiple replicate treatments, will be run to evaluate the combined effects of increased temperature and pH on survival of early life stage bonytail.

**Proposed FY16 Activities:** Research during the FY16 study year will focus on determining threshold salinity concentrations for bonytail and razorback sucker fingerlings. Two trials will be conducted for each species, one at 25 °C, and one at 30 °C, to mimic natural conditions that this life stage would be exposed to and evaluate the combined effects increased temperature and salinity have on survival. A comprehensive review of available, published literature will continue so that data gaps may be identified.

**Pertinent Reports:** Annual reports will be posted on the LCR MSCP Web site upon completion.