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

FY15 Estimate	FY15 Actual Obligations	Cumulative Expenditures Through FY15	FY16 Approved Estimate	FY17 Proposed Estimate	FY18 Proposed Estimate	FY19 Proposed Estimate
$115,000	$96,353.36	$690,956.97	$110,000	$110,000	$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: RASU2, RASU3, RASU5, RASU6, BONY2, BONY3, and BONY5

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

Purpose: To evaluate razorback sucker and bonytail early life stage thresholds of survival at varying levels of salinity, temperature, pH, and dissolved oxygen

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 suckers in backwater habitats developed under 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 (µS/cm) for razorback sucker eggs and from 23,000 to 27,750 µS/cm for razorback sucker larvae. Observations during larval trials also documented that long-term survival may be possible at salinities as high 23,000 µS/cm when larval razorback suckers are properly acclimated.

During FY09, the results from razorback sucker egg trials indicated that the lower dissolved oxygen 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.

Research during the FY10 study year was focused on evaluating the threshold levels of pH for early life stage razorback suckers. 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 evaluating 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 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 evaluated in FY12 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.

Research during FY13 focused on evaluating threshold DO concentrations for successful bonytail egg development and larval survival. 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. Results from this study year indicate that bonytail egg success will increase with increased DO concentrations, little to no egg development should be expected at 2 mg/L, and at least short-term survival of larvae can be expected at DO concentrations as low as 2 mg/L at moderate temperatures.

Research during FY14 focused on suggesting threshold salinity concentrations for successful bonytail egg development and larval survival. Eggs were exposed to salinity concentrations of 1,000 to 12,500 μS/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 μS/cm in triplicate in two separate trials run at 20 and 25 °C for 15 days. Salinity concentrations of 12,500 and 15,000 μS/cm resulted in larval mortality ranging from 4–14% at 20 °C, while observed mortality at higher salinity concentrations (17,500 and 20,000 μS/cm) ranged from 52–99%. For the 25 °C trial, mortality increased for all treatments. Larval mortality ranged from 13–70% at 12,500 μS/cm, 29–88% at 15,000 μS/cm, and from 98–100% for the remaining treatments. Larval mortality for control groups (1,000 μS/cm) was observed to be lower during both trials, ranging from 2–6% at 20 °C and 8–13% at 25 °C.

FY15 Accomplishments: Research during FY15 focused on threshold pH levels for successful bonytail egg development and larval survival. Results have been provided as a range of values to show the variability within treatments. Fertilized eggs were exposed to pH ranging from 7 to 10.5 in three replicate treatments at 20 °C until hatch was completed. Successful egg development, reported as percent hatch, was measured as the number of larvae surviving to swim-up stage. Greater success was observed at lower pH levels, with percent hatch ranging from 51–58% at pH 7, 8, and 9. Percent hatch was reduced at higher pH levels and ranged from 35–51% at pH 9.5, 6–12% at pH 10, and 0% at pH 10.5. Larvae were exposed to pH ranging from 8 to 10.5 in three replicate treatments through two separate trials run at 20 and 25 °C for up to 20 days. Mortality at 20 °C ranged from 7–15% at pH 8 to 10 and from 92–100% at pH 10.5. Mortality was slightly higher at 25 °C, ranging from 7–22% at pH 8 to 9.5, 39–53% at pH 10, and 100% at pH 10.5. Results from the FY15 study year 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 Activities: Evaluation of threshold salinity concentrations for bonytail and razorback sucker fingerlings was originally planned for FY16; however, this work has been rescheduled for FY17 when bonytail fingerlings will become available. Research during this study year will instead focus on determining the lower DO limit of razorback sucker fingerlings. Two multiple replicate trials, one at 25 °C and one at 30 °C, will be conducted to evaluate the combined effects of DO and temperature on survival of this life stage. A comprehensive review of available, published literature will continue so that data gaps may be identified.

Proposed FY17 Activities: Research during the FY17 study year will focus on suggesting threshold salinity concentrations for bonytail and razorback sucker fingerlings. It is anticipated that two trials will be conducted for each species to evaluate the combined effects salinity and temperature have on survival.

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