

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

FY13 Estimate	FY13 Actual Obligations	Cumulative Expenditures Through FY13	FY14 Approved Estimate	FY15 Proposed Estimate	FY16 Proposed Estimate	FY17 Proposed Estimate
\$115,000	\$108,597.79	\$489,991.63	\$115,000	\$115,000	\$115,000	\$100,000

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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, BONY5.

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

**Purpose:** To determine RASU and BONY early life stage thresholds of survival for salinity, dissolved oxygen, temperature, and pH.

**Connections with Other Work Tasks (past and future):** This work began under Adaptive Management Research Projects (G3). This work is related to management of fish habitat restoration sites.

**Project Description:** This study will determine through laboratory testing the threshold levels of various water quality parameters needed to sustain early life stages of BONY and RASU in backwater habitats developed by the LCR MSCP.

**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 RASU eggs, and from 23,000 to 27,750  $\mu\text{S}/\text{cm}$  for RASU larvae. Observations during larval trials also showed that long-term survival may be possible at salinities as high 23,000  $\mu\text{S}/\text{cm}$  when larval RASU are properly acclimated.

During FY09, research focused on determining dissolved oxygen limits for early life stage RASU. Results from egg trials indicated that the lower dissolved oxygen limit for this life stage is in the 2.5 to 3 mg/L range. The limit observed for RASU larvae was slightly lower, with increased mortality occurring at dissolved oxygen concentrations near 2 mg/L. Larvae exposed to concentrations of 3mg/L or greater showed low levels of mortality and displayed no behavioral abnormalities.

Research during the FY10 study year was focused on determining the threshold levels of pH for early life stage RASU. Results from egg trials indicated that the threshold levels for successful embryo development are between pH 9 and 10. The pH threshold observed for RASU larvae was slightly higher, with short-term exposure (20 days) to pH 10 resulting in 98% survival.

Research during FY11 focused on determining the threshold levels of pH for fingerling BONY and RASU survival. Trials for BONY and RASU were run separately, and both were exposed to pH ranging from 7 to 11 at 20 and 30°C. Results from both BONY and RASU trials indicated that the upper lethal limit for these species is near pH 10 at both 20°C 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, and it should be noted that BONY 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. Similar to these observations, survival was higher for RASU exposed to pH 9.5 and below.

Research during FY12 focused on determining the lower lethal dissolved oxygen concentration for fingerling BONY. Trials were run at both 20 and 30°C, and fish were exposed to dissolved oxygen concentrations of 2-6 mg/L in triplicate. Results from the 20°C trial indicated that the short-term, lower lethal dissolved oxygen limit is below 2 mg/L at this temperature. Only 17% mortality was recorded for BONY exposed to the 2 mg/L treatment for 15 days. Results from the 30°C trial indicated that the lower lethal dissolved oxygen limit is very near 2 mg/L at this temperature. Sixty-seven percent mortality was observed for this treatment at 72 hours, and 100 percent mortality was observed at 18 days. Mortality for the remaining 30°C treatments decreased incrementally as dissolved oxygen concentrations increased.

**FY13 Accomplishments:** Research during FY13 focused on determining threshold dissolved oxygen concentrations for successful BONY egg development and larval survival. Fertilized eggs were received from SNARRC in late April and exposed to dissolved oxygen concentrations of 2 to ~8 mg/L at 20°C. Egg hatch required 4 to 8 days, with peak hatch occurring on day 5. While all dissolved oxygen 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 (~8 mg/L) in which 57% of eggs produced swim-up larvae. Larval trials were initiated in mid-May following receipt of 4,500 BONY larvae from SNARRC. Larvae were exposed to dissolved oxygen concentrations of 2 to ~7.25 mg/L in two separate trials run at 20 and 25°C for 20 days. The 20°C trial resulted in unexpectedly high survival (93-100%), with little difference observed between treatments. Survival in the 25°C trial averaged ~68% between all treatments (range 46-85%), excluding one replicate in each the 5 mg/L and 7.25 mg/L treatments where extremely low survival was observed, 7 and 13%, respectively. This lower observed survival is potentially the result of handling, stress, or an unknown factor, as the remaining replicates from those treatments had survival ranging from 60 to 85%. Again, when looking at the treatments as a whole, no obvious difference in survival was observed. Results from the FY13 study

year indicate that success of BONY egg development increases with increased dissolved oxygen concentrations, little to no egg development should be expected below 3 mg/L, and that short-term survival of BONY larvae can be expected at dissolved oxygen concentrations as low as 2 mg/L at moderate temperatures.

**FY14 Activities:** Research during this study year will be focused on determining the upper salinity tolerances for BONY 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 salinity on survival of early life stage BONY.

**Proposed FY15 Activities:** Research quantifying the threshold water quality values needed to sustain early life stages of native fishes will continue. Research will build off findings from previous study years, but may also be tailored to address specific questions resulting from observations and measurements made during monitoring. A comprehensive review of available, published literature will continue so that data gaps may be identified.

**Pertinent Reports:** The 2013 report, *Dissolved Oxygen Tolerances for Egg and Larval Stages of Bonnytail* will be posted to the website.