

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

FY10 Estimates	FY10 Actual	Cumulative Accomplishment Through FY10	FY11 Approved Estimate	FY12 Proposed Estimate	FY13 Proposed Estimate	FY14 Proposed Estimate
\$85,000	\$85,228.77	\$173,121.81	\$100,000	\$125,000	\$125,000	\$125,000

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**Start Date:** FY09

**Expected Duration:** FY17

**Long-term Goal:** To establish water quality parameters to support backwater habitat management.

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

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

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

**Connections with Other Work Tasks (past and future):** This work began under Adaptive Management Research Projects (G3). This work is related to Imperial Ponds Conservation Area (E14), Backwater Site Selection (E15), and Post-Development Monitoring of Fish Restoration Sites (F5).

**Project Description:** This study will evaluate through laboratory testing the threshold levels of multiple water quality parameters needed to sustain various life stages of RASU and BONY in backwater habitats developed by the LCR MSCP. This study was originally planned to run through FY12 and look at single parameter thresholds (salinity, temperature, dissolved oxygen) of multiple life stages of native fish. This study has been extended for five years to allow for the completion of single parameter testing and to provide time for future multiple parameter tests on early life stages of native fish.

**Previous Activities:** Laboratory research began in March of FY07 under Adaptive Management Research Projects (G3). Salinity concentrations evaluated during this first study year indicated that upper salinity tolerances ranged from 10,000 to 15,000  $\mu\text{S}/\text{cm}$  and from 23,000 to 26,000  $\mu\text{S}/\text{cm}$  for RASU eggs and larvae respectively. Observations during larval trials 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.

Research to determine RASU early life stage salinity thresholds resumed in March of FY08. During this second study year, slight modifications were made to the experimental design to further test the role of acclimation as observed in FY07. Refined values for upper salinity tolerances were observed to range from 11,000 to 12,000  $\mu\text{S}/\text{cm}$  for eggs and from 27,300 to 27,750  $\mu\text{S}/\text{cm}$  for larvae.

In FY09, an apparatus for evaluating threshold levels of dissolved oxygen was developed and tested, and research to determine RASU early life stage dissolved oxygen limits was conducted. RASU eggs and larvae were evaluated through exposure to a full range of dissolved oxygen concentrations. Results from egg trials indicate that the lower dissolved oxygen limit for this life stage is in the 2.5 to 3 mg/L range. Egg development below this range was either totally disrupted or resulted in underdeveloped protolarvae. 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 (e.g. aquatic surface respiration). Comparative growth of larval RASU was also evaluated during this study year, and no significant differences in growth were observed over a twenty day period.

**FY10 Accomplishments:** Research during the FY10 study year was focused on determining the threshold levels of pH for early life stage RASU. Although this water quality parameter was not originally listed for evaluation, a need to understand what effect pH levels may have on RASU in backwater habitats does exist. Several of the native fish refugium ponds currently in use have had high pH levels recorded over the last few years. To determine if the current pH levels found in these habitats could be a limiting factor of successful recruitment, RASU eggs and larvae were exposed to a pH range that included those observed in these habitats.

Results from RASU egg trials indicate that the threshold levels for successful embryo development are between pH 9 and 10. While a large number of eggs were observed to hatch at pH 10, less than 2% of protolarvae survived past a few days and there was high incidence of deformity. Eggs hatched at pH 9 and below fared much better in terms of proper development and overall survival. The pH threshold observed for RASU larvae was slightly higher, with long-term exposure (20 days) to pH 10 resulting in 98% survival. An increase in mortality was not observed until pH was elevated above 10.4. Comparative growth of larval RASU was also evaluated during larval trials, but no significant differences in growth were observed for larvae exposed to pH 7 through 10.

**FY11 Activities:** Research during this study year will be focused on determining the threshold levels of pH for fingerling BONY. This work is being conducted ahead of schedule to take advantage of young BONY that have been made available from recent pond harvests at the Achii Hanyo Rearing Station (B3). This work is closely related to the work performed in FY10 and will further help determine if the current pH levels found in native fish habitats are a limiting factor of successful recruitment and survival. Currently no guidelines are in place for site or project managers to follow.

**Proposed FY12 Activities:** Research priorities will be evaluated based on findings from previous study years, observations and measurements made during monitoring activities, and the review of available literature. It is anticipated that evaluation of the lower dissolved oxygen limits for BONY will be completed in FY12 as fingerling BONY become available. Lower dissolved oxygen limits for fingerling RASU will also be evaluated as Mohave stock captured during the previous spring reach the appropriate size. Increased funding request is to cover costs of evaluating both species during FY12.

**Pertinent Reports:** A draft report summarizing the 2009 dissolved oxygen study has been completed, and a draft report detailing the 2010 pH study is in development.