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

FY09 Estimates	FY09 Actual	Cumulative Accomplishment Through FY09	FY10 Approved Estimate	FY11 Proposed Estimate	FY12 Proposed Estimate	FY13 Proposed Estimate
$85,000	$87,893.04	$87,893.04	$85,000	$100,000	$125,000	$125,000

Contact: Jim Stolberg, (702) 293-8206, jstolberg@usbr.gov

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: Native Fish Laboratory, Boulder City, Nevada

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

Connections with Other Work Tasks (past and future): This work began under G3. This work is related to management of fish habitat restorations sites (e.g., E14).

Project Description: This study will evaluate through laboratory testing the threshold levels 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 investigate single parameter thresholds (oxygen, pH, salinity). Reclamation has now extended the study for five years to allow investigation of double-parameter tests for eggs, larvae, and fingerlings.

Previous Activities: Laboratory research began in March of FY07 under G3. Salinity concentrations evaluated during this first study year indicated that upper salinity tolerances ranged from 10,000 to 15,000 µS/cm and from 23,000 to 26,000 µS/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 µS/cm when larval RASU are properly acclimated.

Research to determine RASU early life stage salinity thresholds continued in FY08 under G3. During this second study year, slight modifications were made to the experimental

design to further test the role of acclimation. Refined values for upper salinity tolerances were observed to range from 11,000 to 12,000 μS/cm for eggs and from 27,300 to 27,750 μS/cm for larvae.

Initial research, including a detailed review of available literature, was performed and a study design to evaluate threshold levels of dissolved oxygen was generated. Design concepts for an apparatus to control various levels of dissolved oxygen were also developed based on available information. Construction and testing of the apparatus were scheduled for the following year prior to experimental trials.

FY09 Accomplishments: FY09 was the first year this continuing research was accomplished under C32. Initially slated for investigating the salinity tolerance of fingerling RASU, work was continued with earlier life stages of RASU due to the current laboratory set up and the availability of spawning adults. 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 2.5-3 mg/L range. Egg development below this range was either totally disrupted or resulted in underdeveloped protolarvae. Some deformity of hatch larvae was also observed within this range, while larvae hatched at higher concentrations displayed none. These deformities suggest that although a percentage of eggs can develop and hatch at 2.5-3mg/L, these conditions are not ideal. 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).

In addition to determining threshold levels of dissolved oxygen, comparative growth of larval RASU was also evaluated. Larvae were exposed to different concentrations of dissolved oxygen for a 20-day period, and only concentrations that had been shown to support larval RASU (3-8mg/L) were evaluated. After 20 days of exposure, no significant differences in growth were observed.

FY10 Activities: Research during this study year will be 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 several years. To determine whether the current pH levels found in these habitats are a limiting factor for successful recruitment, RASU eggs and larvae will be exposed to a similar pH range in laboratory studies.

It was thought that FY10 may be the first year of research focused on determining the thermal limits of early life stage RASU. This research, however, has been postponed until

future study years for a number of reasons. The current pH levels found in many of the backwater habitats used to rear or support these fish are becoming a point of concern. There are currently no guidelines in place for site managers or project managers to follow, so the results obtained from laboratory testing of pH tolerances may be of great use in the near future.

As for testing thermal limits of RASU eggs and larvae, a considerable amount of literature is already available. Existing literature has focused primarily on the thermal tolerance of RASU eggs, and multiple authors have had similar results. Less information is available on larval tolerances, but various growth studies have exposed larvae to a wide range of temperatures. Many of these temperatures exceed those found naturally during the spawning season, so at this time defining thermal tolerances of early life stage RASU is a lower priority. Additional background information will be gathered to determine if and when this research will be performed.

Proposed FY11 Activities: Research actions will continue to build based on findings from previous study years, observations and measurements made during monitoring, and the review of available literature. Possible actions for this study year include defining thermal tolerances for early life stages of RASU, initiating salinity, dissolved oxygen, pH, or temperature research on fingerling RASU, or initiating research to define limits for early life stages of BONY. The increased funding request is to cover costs of evaluating more life stages of RASU and the addition of BONY to the investigations.

Pertinent Reports: The final report for the 2007-2008 research, *Salinity Tolerances for Egg and Larval Stages of Razorback Sucker*, has been completed. A report summarizing the 2009 dissolved oxygen study is in development.