Work Task C40: Genetic and Demographic Studies to Guide Conservation Management of Razorback Suckers and Bonytail in Off-Channel Habitats

FY15 Estimate	FY15 Actual Obligations	Cumulative Expenditures Through FY15	FY16 Approved Estimate	FY17 Proposed Estimate	FY18 Proposed Estimate	FY19 Proposed Estimate
$190,000	$186,066.42	$760,448.36	$275,000	$300,000	$300,000	$0

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Start Date: FY10

Expected Duration: FY18

Long-Term Goal: Effective fishery management of backwater habitats developed under the LCR MSCP

Conservation Measures: RASU2, RASU6, BONY2, and BONY5

Location: Backwater habitats (Reaches 2–5)

Purpose: To quantify genetic and demographic parameters that are necessary for informed, long-term management of razorback suckers and bonytail in off-channel habitats

Connections with Other Work Tasks (Past and Future): This work task is related to Work Tasks B7, C25, C31, C56 (closed), F5, and G3.

Project Description: In Lake Mohave and elsewhere, razorback suckers and bonytail demonstrate a group spawning behavior whereby a female will spawn with multiple partners many times over a period of a few weeks. These observations led biologists to believe that all possible genetic crosses were being made during the spawn. However, analyses of adult razorback suckers placed into the Yuma Cove backwater in 1991 and 1992, along with analyses of the larval razorback suckers produced each year, showed that not all of the adults contributed genetic material to the next generation. It is possible that individual adults do not spawn every year, or that even if they do, they do not always contribute genetic material to the next generation. This information needs to be verified in order to model a population structure within these isolated habitats over subsequent generations and to predict at what frequency genetic material needs to be exchanged between habitats to maintain the diversity of the overall razorback sucker and bonytail populations within the LCR MSCP area.

Demographic and genetic information will be collected that will lead to recommendations to optimize long-term management of off-channel habitats for these two critically endangered fishes. Genetic data will be captured from larval, juvenile, and adult razorback suckers and bonytail from at least two replicate groups from off-channel habitats. Characterization of DNA variation will be used to assign the parentage of individual larvae to specific adults. The data can then be compared and contrasted to: (1) determine the actual number of individuals that participate in annual spawning activities, (2) census the populations, and (3) quantify patterns of survivorship.

There are three phases to the study: field observations, laboratory analyses of genetic materials, and modeling of population dynamics. The study will require multiple years of data collection and analyses and stable populations for both razorback suckers and bonytail to allow for multiple years of censusing. Final recommendations will be provided at the end of this work task and included in the future management of LCR MSCP backwaters.

Previous Activities: Adults, larvae, and juveniles razorback suckers have been genotyped, and multiple iterations of in situ spawning have been completed in the AJ, Dandy, and Yuma Cove backwaters along Lake Mohave. Collections from FY10 to FY14 were analyzed, identifying considerable variability in individual reproductive success within and especially among different lake-side ponds.

In FY14, three Lake Mohave backwater ponds were no longer being used for razorback sucker production, so they were dedicated to bonytail genetic experiments. The North Nine Mile, Nevada Egg, and Nevada Larvae backwaters were all stocked with 80 male and female adult bonytail. The Nevada Larvae backwater experienced a fishkill shortly after stocking, and it was removed from the study. However, spawning was successful in the North Nine Mile and Nevada Egg backwaters. From these backwaters, 397 and 593 genetic samples of larvae and age-0 fish samples were collected from the North Nine Mile and Nevada Egg backwaters, respectively. Parentage was determined for almost all larvae and age-0 fish samples produced within these two backwaters. Variance in reproductive success differed dramatically among backwaters. Specifically, in Nevada Egg, certain males and females contributed disproportionate numbers of progeny. High variance in reproductive success acts to reduce the genetic effective size of the population, which in turn can increase the rate at which genetic diversity is lost from the population. Allelic diversity declined between the parental and progeny collections, although this decline was not statistically significant.

FY15 Accomplishments: The AJ backwater has typically produced razorback sucker offspring that remained viable into autumn, with generally consistent levels of individual contribution to larval production across years. This year was similar to FY13 and previous years, all of which have had greater individuals contributing than FY14. The Dandy backwater produced a few larvae and

juveniles in FY15, but they have yet to be analyzed. This was the third year of sampling from the Yuma Cove backwater; larvae were readily captured as in the previous two years, and parental contributions to larvae were comparable to the first year and AJ annual samples. Despite continued high survivorship of remaining resident adults, most individuals stocked into the Yuma Cove backwater this year again died shortly after stocking. This pattern was unexpected, as individuals from the same lot stocked into the AJ and Dandy backwaters at the same time did not exhibit similar patterns of mortality. Despite the high level of contribution of different stocked individuals to the larval pool, a small proportion of individuals seemed to be contributing a relatively large percentage of the total larvae in any given year in all ponds. This variation needs to be quantified in order to effectively generate a management strategy for backwater ponds.

FY15 represented the second year for bonytail backwater research. Two backwaters (North Nine Mile and Nevada Egg) were each stocked with 100 males and females. Genetic data were collected from these individuals as well as from 744 and 798 larvae and juveniles from North Nine Mile and Nevada Egg backwaters, respectively. Genetic diversity was preserved between parental and progeny generations, and reproductive success was similar between the two backwaters but slightly lower than in the previous year.

FY16 Activities: In the Yuma Cove backwater, the relative survival of the newly stocked razorback suckers verses the surviving razorback suckers from previous years will be monitored. Additional manipulations of this population may be required to maintain a genetically stable population. The number of individuals stocked in the AJ and Dandy backwaters will be reduced to examine the impacts of density on reproductive success.

FY16 will represent the third iteration of genetic monitoring of bonytail in the North Nine Mile and Nevada Egg backwaters. Both backwaters will be stocked and sampled similar to previous years, and the 3 years of research will be summarized in a report.

The addition of the two bonytail backwaters has resulted in an increased effort for backwater genetics work, and this increased effort is expected to impact budgets in subsequent years. Razorback suckers and bonytail spawn at different times of the year, and this limits the amount of cost sharing while collecting larvae. Sample collections and analyses similar to previous years will continue for both razorback suckers and bonytail dedicated backwaters.

Proposed FY17 Activities: Efforts will be expanded in FY17 to evaluate additional genetic research questions related to razorback suckers and bonytail in isolated backwater environments and to address challenges encountered in

previous study years. These efforts will include evaluating effects of stocking densities, use of additional genetic tools, and expansion/transition of the study area.

FY17 will mark the first year that this work will begin to transition to created disconnected backwaters, beginning with the Imperial ponds. Experiences from the first 7 years of this work will provide input for the initial stockings at these ponds. Fin clips will be collected from all stocked fishes, and genetic material from their offspring will be collected once they begin to reproduce. The projected work plan budget in FY17 has been adjusted to account for this expansion of effort. Stocking densities of razorback suckers will continue to be reduced in the AJ and Dandy backwaters (100 individuals per location) to replicate the assessment of the impact of reduced density on life history parameters. Additional genetic tools will be used to assess the differences in parental contributions among backwaters and attempt to identify the factors contributing to these differences. The adult razorback sucker population at the Yuma Cove backwater may also need to be manipulated again to re-establish the population there; reproduction and survivorship will also continue to be monitored. Additional years of sampling and analyses will be required to be able to draw inferences regarding the long-term genetic management of these backwaters.

For bonytail, work will continue for another year in the two Lake Mohave backwaters (North Nine Mile and Nevada Egg) and then transition to the Imperial ponds. Protocols for collections and analyses will continue similar to previous years; however, the number of stocked fishes, both for bonytail and razorback suckers, will likely be higher for the Imperial ponds not only due to their larger sizes but also due to increased initial genotyping efforts.

Pertinent Reports: A report titled *Development and Characterization of Microsatellite PCR Primers for Bonytail Chub for Use in Assessing Relatedness of Fishes Produced in Off-Channel Habitats* was completed under Work Task G3, and it will be posted on the LCR MSCP Web site.