COLORADO RIVER RECOVERY PROGRAM RECOVERY PROGRAM
FY 2003 ANNUAL PROJECT REPORT PROJECT NUMBER:XX

I. Project Title: An Interactive Model to Predict Floodplain Habitat Area Needed to Recover the Endangered Razorback Sucker in the Upper Colorado River Basin

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III. Project Summary:

A major element of the Recovery Program is Habitat Development, with the goal *"to improve and maintain sufficient habitat to support the endangered fish species; and to apply habitat development and enhancement techniques experimentally to determine if the rare fishes will use developed habitat and if such techniques contribute to recovery."* The Habitat Restoration Program (Nelson and Soker 2002; Irving and Burdick 1998) of the Recovery Program has determined that there are 11,265 potential acres of habitat in the 100-year floodplain in the Green River (Pariette Draw to Dinosaur National Monument, RM 238-320); 9,363 acres in the Colorado River (Westwater to Rifle, RM 127-240); and 3,225 acres in the Gunnison River (Colorado River confluence to North Fork of the Gunnison River, RM 0-75). The amount of floodplain habitat available on any given year is dependent on river stage. As of November, 2002, a total of 1,087.2 acres have been acquired by the Recovery Program for a total cost of $2,117,400. The Recovery Program is interested in knowing if sufficient floodplain habitats are available to recover the endangered razorback sucker and to support recovered populations.

The goal of this project was to determine the approximate area of floodplain habitat necessary to recover the endangered razorback sucker in the Upper Colorado River Basin. The objectives of the project were to:

1. Estimate egg production and larval emergence of razorback sucker from spawning sites;
2. Estimate riverine drift of larval razorback sucker and entrainment into floodplain habitats;
3. Estimate growth and survival of larval and juvenile razorback sucker in floodplain habitats; and
4. Estimate recruitment to adults of naturally-produced razorback sucker necessary to achieve and sustain recovery criteria, and relate to area of floodplain habitat.

This project will produce a computer interactive floodplain model to assist the Recovery Program in estimating the amount of floodplain habitat necessary to recovery the endangered razorback sucker. The model has been approved by the Biology Committee and will be finalized

in 2004.

IV. Study Schedule:

a. Initial year: 2002
b. Final year: 2004

V. Relationship to RIPRAP:

General Recovery Program Support Action Plan
II. Restore habitat
II.A. Restore flooded bottomland habitats

VI. Accomplishments of FY03 Tasks and Deliverables, Discussion of Initial Findings and Shortcomings:

A computer model called FLOODPLAIN was developed on an Excel worksheet platform. The Excel file includes three worksheets ("Model"," Drift"," and "Sensitivity") and eight charts that illustrate data used for internal model computations. The worksheet "Model" contains FLOODPLAIN. The model is user-interactive and consists of 31 numbered steps, including 17 user-specified input variables and 48 automated output variables. Input variables are the most important, but often lesser known, aspects of the life history of the species, including initial population size, sex ratio, average total length (TL) of females, percent hatching success, percent larval emergence, survival of larvae during drift, entrainment rate of larvae in floodplains at various river miles, time spent in floodplains, annual survival in floodplains and in the mainstem, and fish density. The model allows for any of the input variables to be changed with instant automated output. Output variables include intermediate computations, such as number of females based on initial number of adults and sex ratio, average fish weight, number of eggs produced, number of larvae emerging, number of larvae entrained, and number of fish surviving in floodplains. Output variables also include computations of total acres and hectares of floodplains necessary to support specified densities of fish, number of fish recruiting to maturity at 400 mm TL, and recruitment rate as a percentage of the initial adult population. Three figures included in the model provide graphic illustration of the effects of variable inputs on floodplain area, number of adults recruiting, and recruitment rate.

The worksheet "Drift" is a sub-model that allows the user to determine the percentage of larval drift that is entrained in floodplains, based on a mile-by-mile specification of entrainment rate. Results of the Drift sub-model are used to finish running the FLOODPLAIN model. The worksheet "Sensitivity" contains 16 tests of the input variables in the model that provide insight into the most sensitive variables (i.e., those that have the greatest effect on output with the smallest change), as well as the inter-relationships of the variables. Eight charts provide a visual representation and formulas of the mathematical relationships used in the model, including length-weight relationship, fish weight to fecundity relationship, larval entrainment, survival of drifting larvae, survival in floodplains, Von Bertalanfy growth curves, early age growth rates, and later age growth rates.

Sample model runs indicate that for a given set of input variables, total floodplain area necessary to support a population of 5,800 adult razorback sucker at an annual recruitment rate of 0.30 (Recovery Goals target population) ranges from 206 to 8,131 acres (average, 2,032), depending

on fish growth rate and density; i.e., at lowest growth rate and lowest fish density, total area required to produce 1,740 age-3 fish in a single year is 3,068 acres. Sample model runs also indicate that total floodplain area necessary to support a population of 10,000 adult razorback sucker ranges from 133 to 5,289 acres, given the same model assumptions. Reconnaissance for 1993-1994 shows that there are 132 sites with 18,430 potential acres of floodplain habitat along the Green River. High water flow of 18,200-20,000 cfs in May 1993 inundated 74 sites and 7,720 acres, including 6,093 acres from Pariette Draw to Dinosaur National Monument (RM 238-320), the reach occupied by the only remaining wild population in the upper basin.

VII. Recommendations:

Parameters (i.e., input variables) that determine floodplain area necessary to support a given population size of razorback sucker are largely unknown, and use of these parameters gives the model output varying degrees of uncertainty. However, a reasonable range of values for some parameters is known and can be used as a starting point to gauge the value of other lesser known parameters. This allows the user to "game" with the model in trying to better understand unknown variables and inter-relationships. Initially, the model may have limited utility, but as more is known about conservation of the razorback sucker and the population expands, there will be more opportunity to ground-truth and refine the model. The area of floodplain habitat necessary can be more precisely assessed as empirical data are collected from ongoing investigations that provide greater accuracy for model inputs. Empirical data needed for this model refinement include estimates of longitudinal survival/and retention of drifting larvae, percent entrainment of larvae into floodplains, and monthly survival of fish in floodplains and in the main river channel. I recommend that the Recovery Program maintain and refine this model as a tool in helping to understand those aspects of the Habitat Restoration Program that are most critical to the recovery of the razorback sucker.

Use of floodplains by razorback sucker depends on many factors external to species demography, including timing of availability, duration of connection with the mainstem, and ability of the floodplain to hold quality water for overwintering fish. It is also unknown if the inter-annual frequency of flooding is sufficient to establish and maintain a demographically and genetically viable population of razorback sucker. A recruitment model that simulates survival for the historic hydrographic record of the Green River may be necessary to provide insights into inter-annual flood frequency necessary to maintain a population of 5,800 adults.

VIII. Project Status: Ongoing through 2004

The Floodplain Model has been approved by the Biology Committee and is being tested in development of the Green River Floodplain Management Plan and the Upper Colorado River Floodplain Management Plan. These plans are helping to calibrate and refine the model. The model will be finalized with the floodplain management plans in 2004.

IX. FY03 Budget:

A. Funds budgeted:	$ 37,525
B. Funds expended/obligated:	$ 37,525
C. Difference:	$ 0.00
D. Percent FY2003 work completed:	100%
E. Recovery Program funds spent for publication charges:	$ 0

X. Status of data submission:

No data associated with this project.

XI. Signed: Rich Valdez Date: 1/6/2004