

**COLORADO RIVER RECOVERY PROGRAM
FY-2002 PROPOSED SCOPE OF WORK**

Project #: 50

Lead Agency: Fish and Wildlife Service
Colorado River Fishery Project

Submitted by: Frank K. Pfeifer, Project Leader
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Date: 20 April 2001
Revised Date: 21 September 2001

Category:

- Ongoing project
- Ongoing-revised project
- Requested new project
- Unsolicited proposal

Expected Funding Source:

- Annual funds
- Capital funds
- Other (explain)

I. Title of Proposal: A Five-Year Experimental Stocking Plan to Evaluate Survival of Various Sizes of Razorback Sucker

II. Relationship to RIPRAP:

Colorado River Action Plan: Mainstem and Gunnison River

- IV. Manage genetic integrity and augment or restore populations.
- IV.A. Augment or restore populations as needed.
- IV.A.1. Razorback sucker.
- IV.A.1.a. Develop experimental augmentation plan and seek Program acceptance.
- IV.A.1.b. Implement experimental augmentation plan.
- IV.A.1.b.(2). Monitor and evaluate results; make recommendations regarding further augmentation.

III. Study Background/Rationale and Hypotheses:

Factors limiting recruitment of razorback sucker in the riverine system must be determined before large-scale augmentation or re-introduction efforts are attempted. In the Upper Colorado River too few adult razorback sucker remain to re-establish or to sustain stable populations in the riverine system to evaluate experimental stocking.

A plan to evaluate stocking to augment or restore razorback sucker in the Upper Colorado River (Burdick 1992) was accepted by the Recovery Program. That plan proposed stocking small numbers (10-20 adults per experimental stocking site) of hatchery- or pond-reared fish. The purpose of that razorback sucker experimental stocking in the Upper Colorado River that was to, 1) answer specific research questions essential for recovery, and 2) evaluate the utility of stocking greater numbers of juvenile, sub-adult, or adult, hatchery-produced razorback sucker to achieve recovery goals.

That plan was partially implemented. In the spring of 1994, 41 adult razorback sucker were captured from Etter Pond near Debeque, Colorado, and implanted with 4.5-year radio transmitters. Twenty radio-tagged razorback sucker were stocked in historical habitat in the Upper Colorado River between Debeque and Rifle, Colorado, and 21 were stocked in the Gunnison River in the floodplain reach near Delta, Colorado. Preliminary results from this study indicated that post-stocking survival was less than anticipated. In March 1995, none of the 41 fish released one year prior were contacted during tracking efforts in both the Upper Colorado River and Gunnison River. An additional four adult razorback sucker collected from Etter Pond from previous investigations, were radiotagged March 1995 and released in the Gunnison River, September 1995.

The goal of stocking these adult radio-tagged fish was to obtain information that would aid in the understanding of the ecology and habitat requirements of the razorback sucker in the wild. The objectives of the study were to obtain information on, 1) dispersal, movement, and distribution following stocking, 2) survival, 3) habitat use, 4) potential spawning areas, and 5) growth.

Burdick (1992) addressed both the essential elements for an experimental stocking program to obtain fundamental information on the ecology of razorback sucker and steps to determine the feasibility of stocking as a recovery tool. The plan discussed the rationale and justification for experimental stocking, the genetic risks associated with experimental stocking, justification for selection of stocking areas, and the protocol and criteria to investigate the relation between size at stocking and survival and time of stocking. The plan also outlined research efforts and general procedures to monitor stocked fish and evaluate the stocking program. Recommendations for future stocking large numbers of smaller-sized razorback to evaluate their performance following stocking will be based on the results of the experimental stocking of the 41 fish stocked in 1994 and four fish stocked in the fall of 1995. Although the plan was comprehensive, it did not identify the number of smaller-sized razorback sucker that might be stocked to evaluate the relation of survival to size at release, and the number of adult fish that are eventually needed per river reach to attain recovery.

An additional stocking plan was developed and approved by the Recovery Program (Burdick et al. 1995) to obtain knowledge that would be needed to further evaluate stocking as a tool to re-establish razorback sucker in the Upper Colorado River. It will be difficult to estimate the number of captive-reared fish that will be available at the time of stocking. Therefore, the best approach would be to develop and agree upon ratios or

stocking rates of various size groups to be stocked by family lot. This plan identifies a target for the number of adult fish needed per river reach to achieve recovery. The plan will be modified, as necessary, based on the results and evaluation of field experiments using an adaptive management approach. It will be reviewed annually by the Biology Committee and Recovery Program participants.

The experimental stocking will investigate: 1) dispersal of stocked fish, 2) survival by size of fish, 3) habitat use of stocked fish, 4) the best sampling gear to sample fish following stocking, 5) time of year to release fish, 6) location of release, 7) need for physical conditioning prior to release, 8) feeding behavior, 9) native fish interaction, and 10) the role of imprinting in fidelity to spawning sites. Stocking large numbers of 4-, 8-, and 12-inch hatchery-reared fish produced from paired matings will be necessary in the Upper Colorado River to re-establish the razorback sucker. The factors to be investigated in the initial study include items 1 through 5. Factors 6 through 10 will be incorporated into the study design later, depending upon the results from the initial study.

This scope-of-work will determine the response and performance of stocked captive-reared razorback sucker that will aid in to successful re-introduction of razorback sucker and ultimate re-establishment and maintenance of self-sustaining populations in the Upper Colorado River.

Summary of Field Results to Date (1996-2000)

A total of 316, 4-6-inch pond-reared razorback sucker was stocked on 13 October 1995 at river mile 59.3 in the Gunnison River and a total of 282, 11-16-inch razorback sucker was stocked 4 October 1996 at river mile 57.0 in the Gunnison River (see Table 2). None of the razorback sucker stocked in 1995 have subsequently been recaptured during followup monitoring. Of fish stocked in 1996, seven sub-adult razorback sucker were collected and three others were positively sighted one week following stocking.

Additional sampling was conducted in late-July and early-August 1997. No razorback sucker were encountered in this sampling. One razorback sucker stocked in 1996 was captured by electrofishing in the Gunnison River 42 river miles downstream of the release site in late-August.

In 1997, a total of 3,732, 5- to 15-inch juvenile and sub-adult razorback sucker was stocked in the Gunnison River at river mile 57 on nine different dates from three different sources between 12 September and 14 October (see Table 2). A total of 10 days and 27 hours of electrofishing effort was expended over 60 miles of the Gunnison River and about 4 miles of the Colorado River near the confluence of the Gunnison River in September and October 1997 searching for razorback sucker previously stocked.

During the late-September/mid-October 1997 sampling, 16 razorback sucker were captured; four others were positively sighted but not netted. Fifteen of these fish were from the 1997 stocking and one was from the 1996 stocking. Of the fifteen fish captured

from the 1997 stocking, nine were from Wahweap and six from Clymer's Pond. None were captured that had been stocked from the 24-Road Hatchery. All razorback sucker were captured downstream from the stocking site except for two fish that moved upstream about 0.4-mile.

In 1998, a total of 482 razorback sucker were stocked in the Gunnison River near Delta, Colorado, at river mile 57. Two hundred thirty-three (mean TL=217 mm; range=75-323 mm) were stocked 23 June 1998 and 249 (mean TL=222 mm; range=107-334 mm) were stocked 1 September 1998 (see Table 2).

In 1999, a total of 30 F₁ broodfish razorback sucker were stocked in the Gunnison River (river mile 57) 10 May. An additional 2,742 juvenile razorback sucker were stocked on eight different dates between 3 August and 4 November. Three-thousand, four-hundred ninety-eight juvenile razorbacks were released on five different dates between 20 September and 29 October in the Upper Colorado River upstream from Parachute, Colorado, at river mile 227.

In 2000, juvenile razorback suckers were harvested from 14 different sources, one of these being the 24 Road Hatchery. Sixty-one percent of the fish stocked into two local rivers were from the 24 Road Hatchery. Juvenile razorback sucker were stocked at one location in the Gunnison River (RM 57) and three locations in the Colorado River (RM's 227.0, 220.9 [near Parachute, CO], and 177.4 [15-mile reach]).

A total of 6,587 juvenile razorbacks were stocked in the Gunnison River from mid-August through early-November during 2000. In the Colorado River, 25,859 juvenile razorback sucker were stocked in mid-April; and again from mid-August through late-November. The number of fish stocked per site in the Colorado River was: 2,085 fish at RM 227.0, 12,330 at RM 220.9, and 11,444 at RM 177.4. All fish stocked were PIT-tagged.

Overall, mean total length of fish stocked was 163 mm (6.4-inches) in 2000. Seventy-one percent of the fish harvested and stocked were between 100 and 200 mm (4 to 8 inches) and 32% were between 110 and 130 mm (4.3-5.1-inches). Twenty-two percent of the razorback sucker were between 200 and 300 mm (8 to 12 inches) and only 0.4% were greater than 300 mm (12 inches). The range of all razorback sucker stocked in 2000 was 77-345 mm. During monitoring in 2000, 115 domestic-reared razorback suckers that had been previously stocked in local rivers were recaptured.

To date, 14,322 juvenile, sub-adult, and adult razorback sucker have been stocked into the Gunnison River between April 1994 and November 2000. In the Colorado River, 29,377 juvenile and adult razorback sucker have been in the Upper Colorado River from October 1999 to November 2000.

To date, 181 razorback sucker stocked in the Gunnison and Colorado rivers have either been captured (174) from sampling or have been found dead (7) during other research

sampling efforts. This represents about 0.4% of all razorback suckers stocked to date in the Gunnison and Colorado rivers.

Fish dispersment following stocking has been predominantly downstream (mean: 61.6 miles for 103 fish) from the release site indicating that hatchery-produced razorback suckers are extremely susceptible to downstream drift. The highest percent (61) of razorbacks recaptured to date has been from fish stocked between 300 and 400 mm into local rivers; the lowest (8%) has been from fish stocked less than 200 mm.

Preliminary results from razorback sucker captured in the Upper Colorado and Gunnison rivers following stocking over the past 4 years strongly suggest that survival is related to the size of fish stocked. Razorback sucker stocked at sizes greater than 250-300 mm appear to have better short-term (up to 4 years) survival following release in the river than smaller fish stocked (< 250 mm).

IV. Study Goals, Objectives, End Product:

Study Goals

1. To evaluate the relation between survival of razorback sucker and size at release into the river, either by stocking captive-reared fish or by producing fish in enhanced flooded bottomland habitats.
2. To re-introduce razorback sucker in the Gunnison River that will result in 10 adult fish per river mile in suitable riverine habitat. The target is to re-establish a population of about 600 adult razorback sucker from Austin, Colorado downstream 68 river miles to the confluence with the Colorado River. The target number does not include off-channel habitats (e.g, gravel-pit ponds).

Objectives

1. To determine the relationship between the size of razorback sucker stocked at 4-inch, 8-inch, and 12-inch in total length and their subsequent survival in the wild.
2. To determine the dispersal of stocked fish of various sizes following release over time.
3. To determine habitat use of juvenile (4-inch) or sub-adult (8-12-inch) fish in the riverine environment.
4. To identify ways to reduce mortality of stocked fish.
5. To evaluate different gear for sampling juvenile and sub-adult razorback sucker that will be needed to develop a monitoring program for this species.

6. To provide recommendations for the optimum size(s) for stocking razorback sucker into Upper Colorado River Basin rivers.
- V. Study area: Upper Colorado River: Rifle downstream to Westwater Wash (river mile 241-125; Gunnison River: Austin to the confluence with the Colorado River (river mile 68.0-0.7).
- VI. Study Methods/Approach:

General

Greater numbers of progeny will be produced and reared for stocking as additional broodstock are established in captivity. Mating protocol will follow the procedures outlined in the Recovery Program's "Genetics Management Guidelines" (Williamson and Wydoski 1994) and approved by the ad hoc Genetics Panel. Fish from each family lot will be represented in each of the three size groups. Fish will be divided into three groups, either reared at different locations or released into rearing ponds at different times to produce fish of three different size groups (4-, 8-, and 12-inch) and stocked in the river at the same time and location, following the ratio in Plan 1 of Table 1. If enough progeny are available at the time of stocking, fish will be stocked at the same time at another location in the Upper Colorado River, near Rifle to populate this presently unoccupied reach. All fish stocked will be individually PIT-tagged prior to being released into rearing ponds. Marked fish will allow individual identification necessary to evaluate the performance of various pedigreed family lots and to determine if there is differential survival by size at release.

Approximately 30,000 larval razorback sucker produced from Lake Mohave adults during spring 1999 were transported from Willow Beach NFH near Boulder City, Nevada, and stocked in a Grand Valley pond near Grand Junction in the spring of 1999. The first priority will be to use these fish for broodstock; any fish that are left over will be available for stocking into the Gunnison or Colorado rivers or both if enough fish survive. Plans are to stock razorback sucker from these ponds at about 300 mm.

A standardized ratio method was developed to divide fish into groups equally among family lots. To produce two size groups for stocking, a 75 (± 10):25 (± 10) ratio was applied; for three size groups, a 75:20:5 ratio was applied. These ratios allocate captive-reared fish based on the expectation of survival. Smaller fish are not expected to survive as well as larger fish and will be more difficult to collect during the monitoring effort. The ratios represent reasonable estimates of survival and can be adjusted based on the results of the field experiment. The number of fish to be placed into rearing units will be based on this ratio. Because it will be difficult to estimate the number of fish that will be

Table 1. Proposed rate to determine the number of fish to release into rearing units and to stock in a stream reach to evaluate the performance of different sizes of fish following stocking into the Upper Colorado and Gunnison rivers for two hypothetical situations. Assume four family lots of equal number; both plans assume starting with 2,000 fish.

Plan 1: 3 size groups; 75:20:5 ratio		
Mean Size of Fish	Total No. of Fish 2,000	No. of Fish Per Family Lot
4-inch (4-6-inch range)	1,500	375
8-inch (7-9-inch range)	400	100
12-inch (10-14-inch range)	100	25

Plan 2: 2 size groups; 75:25 ratio		
Mean Size of Fish	Total No. of Fish	No. of Fish Per Family Lot
6-inch (4-8-inch range)	1,500	375
10-12-inch (10-14-inch range)	500	125

available at the time of stocking due to attrition, the rate or number of fish to stock per size group will be the same ratio used before placement in rearing units.

To date, fish have been released in the Gunnison River at 2 sites, in fall 1995 at RM 59.3 and all subsequent releases at RM 57.0. Past experience has shown that the fish move downstream. Following stocking, fish have been monitored each year with electrofishing. The entire Gunnison River from Hartland Diversion Dam downstream to the Colorado River confluence has been sampled twice using electrofishing during 1996, 1997, 1998, 1999, and 2000. Sampling to capture stocked razorback suckers was formerly initiated in 2000 in the Upper Colorado River upstream from the confluence of the Gunnison River. Sampling for hatchery-reared razorback sucker in the Upper Colorado River upstream from the confluence with the Gunnison River had not been conducted prior to 2000 because hatchery- and pond-reared razorback suckers had not been stocked prior to September 1999. Sampling for these stocked razorback sucker is discontinued during the winter.

Stocking of these various sizes of razorback sucker has been coordinated with other agencies and cooperators performing field work in the Upper Colorado River. The Colorado River from Palisade to Westwater Wash and from Cisco to the Colorado/Green River confluence was sampled by other station biologists during 1998, 1999, and 2000 as part of a riverwide program to obtain population estimates for Colorado pikeminnow. This effort along with sampling associated with the Interagency Standardized Monitoring Program in the spring provides adequate riverwide sampling to determine dispersal of stocked razorback sucker. Field workers that encounter razorback sucker during the spring and autumn ISMP for adult and young-of-the-year fish, respectively, spring and fall centrarchid removal (RIP project no. 89), small, nonnative cyprinid removal (RIP project no. 87b), monitoring of stocked bonytail, or during other sampling programs have been requested to inspect any razorback sucker encountered for PIT tags and record location of capture and vital statistics for each fish. All razorback sucker captured are to be weighed (g), measured (total length, mm), and checked for a PIT tag.

Experimental Assumptions

1. Razorback sucker that are a minimum of 4-inches should be able to escape most predation by non-native fishes and are large enough to feed on organisms larger than zooplankton that would decrease the potential for competition with non-native fishes.
2. The highest mortality is expected for 4-inch fish, less for 8-inch fish, and the lowest mortality for 12-inch fish.
3. The three size groups will be from of the same family lots. The variable will be stocking at different sizes. Stocking of different family lots will occur over several years to increase the genetic diversity from progeny of different parents. Fish will be grown in ponds at different latitudes and environments to obtain different growth rates and sizes for stocking.
4. Equal numbers of all family lots will be stocked following the recommendations of Allendorf (1993). Small numbers of stocked fish will be supplemented with additional fish when fish from that family lot are available to ensure that equal numbers of all captive-reared family lots are represented in the overall stocking effort.
5. Initially, the experiment will have to be conducted in one selected river reach to increase the probability of capture following release. As sufficient numbers of fish become available, additional fish will be released in other river reaches to compare performance of stocked fish between river reaches of different rivers (e. g., Upper Colorado River vs. Gunnison River).
6. Mortality is expected to be highest shortly after stocking. Intense sampling will have to be conducted shortly after stocking and decreased afterward.

7. This experiment should be conducted in a stream reach that contains non-native fish since Objective 1 is to determine the size at stocking that will produce the highest survival where non-native fish occur.
8. Fish would be stocked at the same time of the year and at the same location. An initial assumption is that fish would survive best if released after the spring runoff but before winter when water temperatures are low. If enough fish are available, fish could be stocked prior to spring runoff to compare the performance of fish to those stocked following runoff. But, at least for this initial 5-year evaluation, fish will be stocked after runoff (e. g., September to October) to allow fish to acclimate before winter.
9. Physically conditioning fish prior to release may be necessary to aid their ability to adapt to water velocities of the riverine environment. However, at this time, it is not known if physical conditioning is needed. Separate laboratory studies with razorback sucker are needed to determine if conditioning would benefit survival of stocked fish.
10. The mortality of these stocked fish is expected to be high and result in few adult fish surviving in the wild. Therefore, stocking will be made each year until the target number of adult razorback sucker are achieved. Stocking may be suspended when the goals are achieved. Progress will be reviewed annually when such decisions can be made.
11. When the desired family lots are developed as broodstock, and until they reach sexually maturity, stocking large numbers of progeny produced from the broodstock to evaluate performance and to stabilize a population may not be possible until FY98 when the fish attain sexual maturity.
12. To re-introduce and stabilize a population of razorback sucker in the Gunnison River, "saturation stocking" might be the appropriate initial strategy. No doubt the smaller-sized razorback sucker will be potential prey for non-native predator fish. If low numbers of small-sized fish are stocked, they may not survive predation by piscivorous fish inhabiting the river reach. This may decrease the likelihood of establishing and stabilizing a population of razorback sucker within a river reach.

Potential Risks

1. The razorback sucker to be used in the pilot study were hatched from fertilized eggs that were subjected to water from the Bellvue facility. Results from ongoing chemoreception studies are both incomplete and inclusive. The actual role that imprinting may have on fidelity of spawning or the mechanisms for imprinting have not been identified for this species at this time. It is also unclear whether razorback sucker will actually imprint to specific waters or substances at a later date when they become sexually mature and if imprinting is imperative for them to successfully spawn and to establish a self-sustaining population. It is possible that fidelity to a spawning site is a learned behavior that does not involve either imprinting nor olfactory cues.

Projected Number of Fish Needed for Stocking

Table 2. Projected number of fish by size group needed to evaluate the relation between survival of razorback sucker and size at release into the river, FY96 through FY2000 and actual numbers of razorback sucker stocked, 1996 through 2000, in the Gunnison and Colorado rivers, Colorado. (see "Summary of Field Results to Date (1996-2000)", Section III., for size ranges of razorback sucker stocked.)

Year Stocked	Stocking Location	Size of Fish	Mean Number of Fish ^a	Actual Number of Fish Stocked
FY95-FY96	Gunnison River	18-21-inch	---	25
	Colorado River	18-21-inch	---	20
FY96	Gunnison River near Delta	4-inch	10,000	316
		8-inch	2,500	
		12-inch	600	
FY97	Gunnison River near Delta	4-inch	10,000	3,732
		8-inch	2,500	
		12-inch	600	
FY98	Gunnison River near Delta	4-inch	20,000	608
		8-inch	5,000	
		12-inch	1,200	
FY99	Gunnison River near Delta	4-inch	30,000	2,742
		8-inch	7,500	
		12-inch	1,800	
FY99	Colorado River near Parachute	4-inch	30,000	3,498
		8-inch	7,500	
		12-inch	1,800	
FY2000	Gunnison River near Delta	4-inch	40,000	6,587
		8-inch	10,000	
		12-inch	2,400	
FY2000	Colorado River near Parachute & 15-Mile Reach	4-inch	40,000	25,859
		8-inch	10,000	
		12-inch	2,400	

2. Stocked fish may disperse considerably initially in search of adequate food resources and suitable habitat. When they reach sexual maturity, they may move considerably seeking olfactory cues to spawning sites if imprinting occurs in this species.
3. The greatest risk would be to have the fish migrate downstream from the point of stocking into the Green River sub-basin via the confluence of the Colorado River.

VII. Task Description and Schedule

Description

- Task 1. Stock three size groups of fish (FY96-FY2000).
- Task 2. Sample Gunnison and Colorado rivers for stocked fish using various gear types.
- Task 3. Analyze and evaluate data; prepare annual progress report.
- Task 4. Prepare draft and final report.

Schedule

- Task 1. 8/97-9/97; 8/98-9/98; 8/99-9/99; 8/2000-9/2000
- Task 2. 9/96-10/96 & 3/97-6/97; 9/97-10/97 & 3/98-6/98; 9/98-10/98 & 3/99-6/99; 9/99-10/99 & 3/2000-6/2000; 9/2000-10/2000 & 3/2001-9/2001
- Task 3. 1/97-9/97; 1/98-9/98; 1/99-9/99; 1/2000-9/2000; 1/2001-9/2001; 10/2001-01/2002
- Task 4. 10/2001-03/2002

VIII. FY-2002 Work

Deliverables/Due Dates:

Draft Report to coordinator	3/01/02
Draft Final Report to peer review	4/01/02
Draft Final Report to Biology Comm.	6/01/02
Final Report completed	8/15/02

Budget estimate

Tasks 3 & 4.

Labor	
Project Leader (1 week)	\$ 1,500
Project Biologist (7 weeks)	\$ 10,000
Other (Printing and distribution of final report)	\$ 1,500
Total	<hr/> \$ 13,000

IX. Budget Summary

FY-2002 \$ 13,000

Grand

Total: \$ 13,000

X. Reviewers:

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XI. References

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Prepared and compiled by: Bob D. Burdick, 8 May 1995

Updated: 22 April 1996

Modified: 29 April 1996 (FP)

Updated: 25 April 1997 (BDB & FP)

Updated: 24 April 1998 (BDB)

Updated: 7 October 1998 (BDB)

Updated: 19 April 1999 (BDB & FP)

Updated: 20 April 2001 (BDB)

Revised: 20 September 2001 (FP)

Revised: 21 September 2001 (TC)

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