Razorback sucker
(Xyrauchen texanus)

5-Year Review:
Summary and Evaluation

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U.S. Fish and Wildlife Service
Upper Colorado River Endangered Fish Recovery Program
Denver, Colorado

July 2012

5-YEAR REVIEW
Species reviewed: Razorback sucker (*Xyrauchen texanus*)

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1.0 GENERAL INFORMATION

1.1 Purpose of 5-year Reviews

The U.S. Fish and Wildlife Service (Service) is required by Section 4(c)(2) of the Endangered Species Act (ESA) to conduct a status review of each listed species at least once every 5 years. The purpose of a 5-year review is to evaluate whether or not the species' status has changed since it was listed (or since the most recent 5-year review). Based on the 5-year review, we recommend whether the species should be removed from the list of endangered and threatened species, be changed in status from endangered to threatened, or be changed in status from threatened to endangered. Our original listing as endangered or threatened is based on the species' status considering the five threat factors described in Section 4(a)(1) of the ESA. These same five factors are considered in any subsequent reclassification or delisting decisions. In the 5-year review, we consider the best available scientific and commercial data on the species, and focus on new information available since the species was listed or last reviewed. If we recommend a change in listing status based on the results of the 5-year review, we must propose to do so through a separate rule-making process including public review and comment.

1.2 Reviewers

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1.3 Methodology Used to Complete the Review

On April 18, 2007, we published a Notice of Review in the Federal Register (72 FR 19549) soliciting any new information on the razorback sucker that may have a bearing on its classification as endangered or threatened. Fewer than 20 people/agencies provided comments. All substantive comments and issues raised were considered. This 5-year review was primarily written by the Upper Colorado River Endangered Fish Recovery Program (UCREFRP) Office with substantive contributions and review by cooperating field and regional offices. It summarizes and evaluates information provided in the recovery goals, current scientific research, and surveys related to the species. All pertinent literature and

documents on file at the UCREFRP Office were used for this review (see References section below for cited documents). Interviews with individuals familiar with razorback sucker were conducted as needed to clarify or obtain specific information.

1.4 Background

1.4.1 Federal Register Notice Citation Announcing Initiation of This Review

72 FR 19549; April 18, 2007.

1.4.2 Listing History

Original Listing
FR notice: 56 FR 54957
Date listed: October 23, 1991
Entity listed: Sucker, razorback; *Xyrauchen texanus*
Classification: Endangered, rangewide.

1.4.3 Associated Rulemakings

59 FR 13374; March 21, 1994 - Critical Habitat Designated

1.4.4 Review History

This is the first 5-year review for razorback sucker conducted under Section 4(c)(2) of the ESA. However, the razorback sucker's status was considered in the 1998 recovery plan and the 2002 revision to the recovery goals (Service 1998; 2002).

1.4.5 Species' Recovery Priority Number at Start of 5-year Review

The razorback sucker has a recovery priority number (RPN) of 1C (see TABLE 1 below). This rank indicates the razorback sucker: is the only representative of a monotypic genus; faces a high degree of threat; has a high recovery potential; and is in conflict with development and other forms of the economic activity.

1.4.6 Recovery Plan

Name of plan: Razorback sucker (*Xyrauchen texanus*) Recovery Goals: amendment and supplement to the Razorback Sucker Recovery Plan.

Date approved: August 1, 2002

Dates of previous revisions, if applicable: December 23, 1998

TABLE 1. Recovery Priority Number Ranking System. The ranking system for determining RPNs was established in 1983 (48 FR 43098; September 21, 1983, as corrected in 48 FR 51985; November 15, 1983).

Degree of Threat	Recovery Potential	Taxonomy	Priority	Conflict
High	High	Monotypic Genus	1	1C
		Species	2	2C
		Subspecies/DPS	3	3C
	Low	Monotypic Genus	4	4C
		Species	5	5C
		Subspecies/DPS	6	6C
Moderate	High	Monotypic Genus	7	7C
		Species	8	8C
		Subspecies/DPS	9	9C
	Low	Monotypic Genus	10	10C
		Species	11	11C
		Subspecies/DPS	12	12C
Low	High	Monotypic Genus	13	13C
		Species	14	14C
		Subspecies/DPS	15	15C
	Low	Monotypic Genus	16	16C
		Species	17	17C
		Subspecies/DPS	18	18C

2.0 REVIEW ANALYSIS

2.1 Application of the 1996 Distinct Population Segment Policy

This section of the 5-year review is not applicable to this species because the razorback sucker was not listed as a Distinct Population Segment (DPS) nor is there relevant new information for this species regarding the application of the DPS policy. For the time being, we believe continued listing at the species level is the most appropriate way to manage this listed species under the ESA. This issue will be further evaluated in the recovery plan, including consideration of whether potential DPSs could be delisted independently once recovery is achieved in each unit.

2.2 Recovery Criteria

Recovery plans provide guidance to the Service, States, and other partners and interested parties on ways to minimize threats to listed species, and on criteria that may be used to determine when recovery goals are achieved. There are many paths to accomplishing the recovery of a species and recovery may be achieved without fully meeting all recovery plan criteria. For example, one or more criteria may have been exceeded while other criteria may not have been accomplished. In that instance, we may determine that, over all, the threats have been minimized sufficiently, and the species is robust enough, to downlist or delist the species. In other cases, new recovery approaches and/or opportunities unknown at the time the recovery plan was finalized may be more appropriate ways to achieve recovery. Likewise, new information may change the extent that criteria need to be met for recognizing recovery of the species. Overall, recovery is a dynamic process requiring adaptive management, and assessing a species' degree of recovery is likewise an adaptive process that may, or may not, fully follow the guidance provided in a recovery plan. We focus our evaluation of species status in this 5-year review on progress that has been made toward recovery since the species was listed (or since the most recent 5-year review) by eliminating or reducing the threats discussed in the five-factor analysis. In that context, progress towards fulfilling recovery criteria serves to indicate the extent to which threat factors have been reduced or eliminated.

Razorback sucker recovery is planned to occur basinwide within the Colorado River Basin, but Glen Canyon Dam separates the upper and lower basins into two recovery units. Five programs in the Colorado River Basin are working to recover or conserve razorback sucker. The UCREFRP is a coordinated effort of State and Federal agencies, water users, energy distributors, and environmental groups to recover four endangered fishes in the upper basin downstream to Glen Canyon Dam, excluding the San Juan River. The San Juan River Basin Recovery Implementation Program is a similar recovery program to conserve populations of Colorado pikeminnow and razorback sucker in the San Juan River Basin. The Glen Canyon Dam Adaptive Management Program was established to provide oversight on the operation of Glen Canyon Dam to protect and enhance development of the Colorado River ecosystem through Grand Canyon and protect humpback chub and razorback sucker. The Native Fish Work Group is a conservation program coordinating efforts of State and Federal agency biologists, as well as university staffs and volunteers, to conserve and protect the genetic pool of razorback sucker and bonytail primarily in Lake Mohave. The Lower Colorado River Multi-Species Conservation Program (LCRMSCP) is a conservation program aimed at protecting sensitive, threatened, and endangered species of fish, wildlife, and their habitat. The razorback sucker is one of many species covered by this program.

2.2.1 Does the species have a final, approved recovery plan containing objective, measurable criteria?

_X_ Yes
___ No

2.2.2 Adequacy of recovery criteria.

2.2.2.1 Do the recovery criteria reflect the best available and most up-to date information on the biology of the species and its habitat?

___ Yes
_X_ No

We recommend revising the Service's 2002 razorback sucker recovery goals (Service 2002) to recognize that re-established populations will likely fluctuate in the abundance of adults over time and to provide new information on the status of the species in the Lower Basin, particularly in Lake Mead and below Davis Dam.

2.2.2.2 Are all of the 5 listing factors that are relevant to the species addressed in the recovery criteria (and is there no new information to consider regarding existing or new threats)?

_X_ Yes
___ No

2.2.3 List the recovery criteria as they appear in the recovery plan, and discuss how each criterion has or has not been met, citing information.

The current status of razorback sucker is endangered. Only the downlisting criteria are considered in this 5-year status review to determine if status can be changed (downlisted) from endangered to threatened. The delisting criteria will be used when the species is removed from the list, i.e., from threatened to recovered. Analysis of each criterion is provided in italics directly below the criterion. Recovery of the species is considered basinwide, where extant populations exist (one each in Lakes Mead and Mohave) and where others are being re-established (Green, Colorado, and San Juan Rivers in the upper basin). The downlisting recovery criteria are from the 2002 revision to the species' recovery goals (Service 2002).

DEMOGRAPHIC DOWNLISTING CRITERIA FOR RAZORBACK SUCKER

Historically, the razorback sucker occupied the mainstem Colorado River and many of its tributaries from northern Mexico through Arizona and Utah into Wyoming, Colorado, and New Mexico. Razorback sucker are currently found in the Green River, upper Colorado River, and San Juan River Subbasins (Upper Colorado River Basin Recovery Unit). In the Lower Colorado River Basin Recovery Unit, razorback sucker are found in the lower Colorado River between Lake Havasu and Davis Dam; reservoirs of Lakes Mead and Mohave; and in small tributaries of the Gila River Subbasin (i.e., Verde River, Salt River, and Fossil Creek).

Upper Basin Recovery Unit Criterion 1a. In the Green River Subbasin (the Green River drainage and its associated tributaries), a self-sustaining population is maintained over a 5-year period, starting with the first point estimate acceptable to the Service, such that the trend in adult (age 4+; ≥ 400 millimeters [mm] total length [TL]) point estimates does not decline significantly.

Status of Upper Basin Recovery Unit Criterion 1a. ***This criterion has not been met.*** *No specified monitoring has begun for razorback sucker. However, anecdotal information has been collected through razorback sucker captures in other projects. These data are being examined to determine if annual estimates and trends can be determined (TABLE 2). This information indicates that we are beginning to see the development of populations through the reintroduction of stocked fish. A basinwide monitoring plan is being prepared for razorback sucker for the UCREFRP.*

TABLE 2. Number of razorback sucker recaptured per year and river basin, 1997–2008, (modified after Zelasko et al. 2009; 2011); recapture numbers in 2007–2008 were conservative as they represent only fish released since 2004. In 2004, a revised stocking plan (Nesler et al. 2003) was implemented that recommended stocking larger razorback sucker (≥ 300 mm TL). Shaded numbers are years when population estimates for Colorado pikeminnow (*Ptychocheilus lucius*) were occurring, i.e., years when sampling effort was substantially greater.

	YEAR											
RIVER BASIN	**1997**	**1998**	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**
Colorado	0	1	0	24	31	3	157	121	361	15	32	314
Green	3	0	31	10	41	20	13	32	101	412	225	330

Upper Basin Recovery Unit Criterion 1b. In the Green River Subbasin, mean estimated recruitment of age-3 (300–399 mm TL) naturally produced fish equals or exceeds mean annual adult mortality.

Status of Upper Basin Recovery Unit Criterion 1b. This criterion has not been met. *Captures of larvae in the Green (FIGURE 1), Gunnison, and Colorado Rivers document reproduction. Although good years of larval production have been seen recently, it is not known how larval production may translate to the recruitment of wild 3-year old fish to adulthood.*

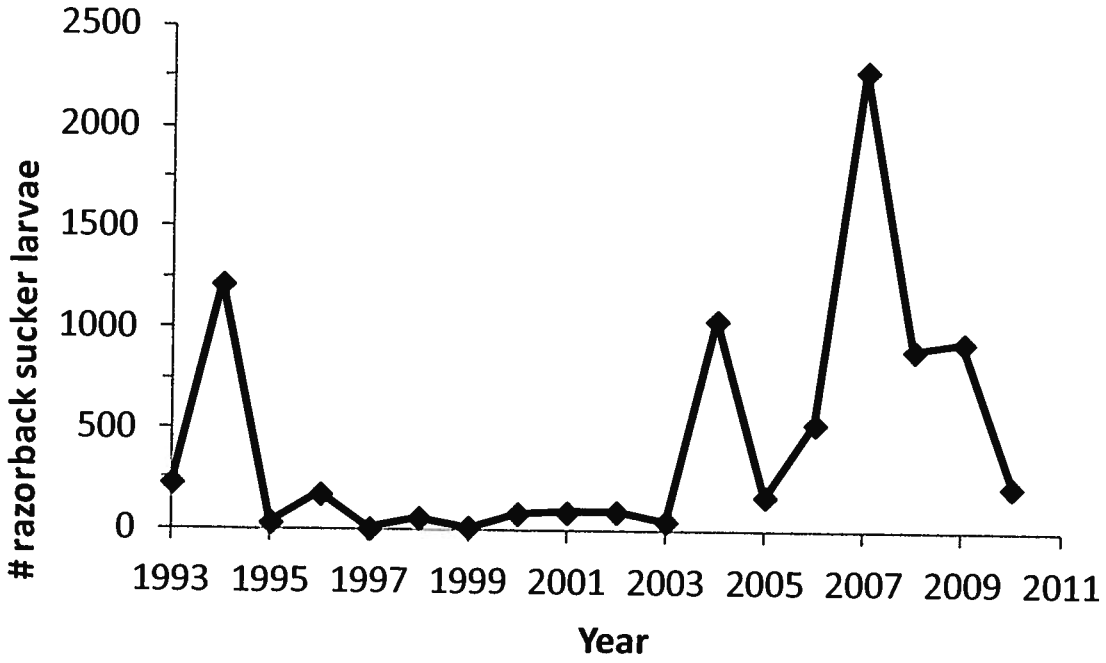

FIGURE 1. Number of razorback sucker larvae captured from 1993-2010 in the middle Green River, Utah, in light traps (after Bestgen et al. 2011a Annual Project Report).

Brunson and Christopherson (2005) investigated survival and growth of razorback sucker larvae in the presence of varying densities of nonnative fish in a Green River floodplain habitat. Their findings supported the contention that floodplain habitats would likely need to be reset (to get rid of nonnatives) to provide suitable habitat for early life stages of razorback sucker. In 2008, the Service (Webber 2008) stocked 43,400 razorback sucker larvae into the recently reset Baeser Bend floodplain. Approximately 9% of those larvae survived to their first fall and had grown to an average total length of 161 mm. Many of those fish were later salvaged from the habitat and released in the Green River. In subsequent years, the burden of nonnative cyprinids (red shiner, sand shiner, and fathead minnows) in Baeser Bend had increased (from the initial river pumping event) to the point that later larval stockings were no longer successful. Very rare captures of age-0 razorback sucker in the lower Green River and in the San Juan River indicate that at least some survival of wild produced larvae through their first summer is occurring in those areas.

Upper Basin Recovery Unit Criterion 1c. In the Green River Subbasin, each population point estimate exceeds 5,800 adults (Note: 5,800 is the estimated minimum viable population [MVP] number).

Status of Upper Basin Recovery Unit Criterion 1c. This criterion has not been met. *An integrated stocking plan (Nesler et al. 2003) was developed with the concept of trying to re-establish three self-sustaining razorback sucker populations in the Upper Colorado River Basin, two in the Green River, and one in the upper Colorado River. The Middle Green River (River Mile 302-249) has received 73,861 juveniles (≥ 300 mm TL) and the Lower Green River (River Mile 249–120) has been stocked with 71,639 juveniles since 2004. Survival was poorer*

than anticipated in the first year after stocking. Fish that were at large for 2 or more years survived better compared to the assumed survival rates in the integrated stocking plan (Zelasko et al. 2009; 2011). The second study focused on years when the integrated stocking plan was being implemented; it demonstrated similar survival rates. Aggregations of reproducing adults have been observed recently, but there is no estimate on the numbers of adults that are in the system.

Upper Basin Recovery Unit Criterion 2a. A self-sustaining population is maintained in EITHER the upper Colorado River Subbasin or the San Juan River Subbasin over a 5-year period, starting with the first point estimate acceptable to the Service, such that for either population the trend in adult (age 4+; ≥ 400 mm TL) point estimates does not decline significantly.

Status of Upper Basin Recovery Unit Criterion 2a. This criterion has not been met. *In the Colorado River Subbasin, no specified monitoring has begun for razorback sucker. However, anecdotal information has been collected through razorback sucker captures in other projects. These data are being examined to determine if annual estimates and trends can be determined. A basin-wide monitoring plan is being prepared for razorback sucker for the UCREFRP.*

In the San Juan River Subbasin, the number of razorback sucker captured in the San Juan River largely tracks the number of razorbacks stocked into the river and the increase in the catch rate of razorback sucker demonstrates the success of the stocking program (FIGURE 2, TABLE 3). In addition, recent surveys have been able to estimate the abundance of razorback sucker in the San Juan River Subbasin (TABLE 4) (from Duran et al. 2011). In 2011, many were detected in the San Juan arm of Lake Powell, below a water fall that was created when the lake level dropped during the 2000s. Whereas the accumulation of stocked razorback suckers in all three upper Colorado River Subbasins is encouraging, there have been far too few wild produced juvenile fish collected to indicate these groups are self-sustaining.

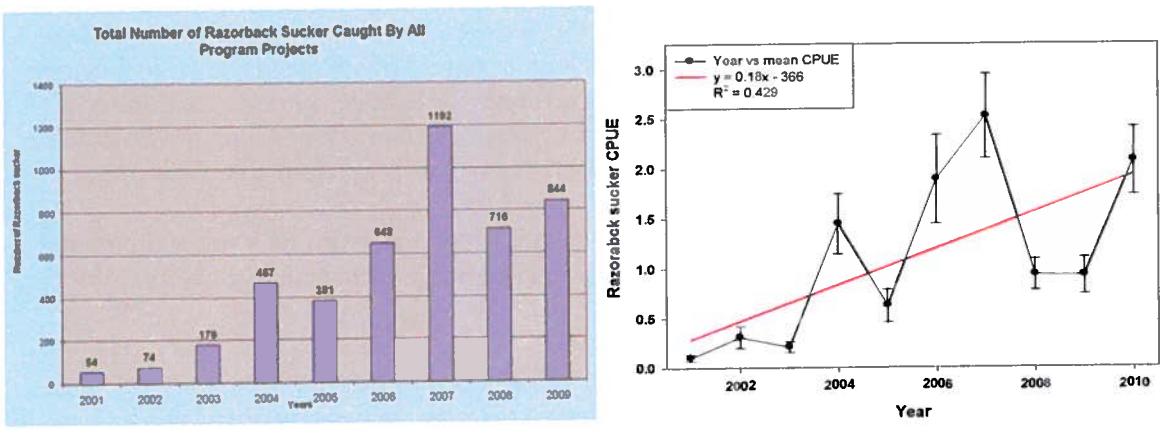

FIGURE 2. Catch rates of stocked razorback sucker in the San Juan River have increased since 2001.

TABLE 3. Summary of razorback sucker stocked into the San Juan River, 2002-2011 (Program documents and Furr 2011).

Year	Number Stocked	Mean Total Length (mm)	Range (mm)
2002	140	319	110–470
2003	887	327	100–495
2004	2,988	353	225–559
2005	1,996	355	223–534
2006	18,793	263	68–537
2007	22,836	268	110–573
2008	**4,444** 2,051 2,393	 297 307	 225–390 225–390
2009	3,997	419	300–511
2010	**16,347** 8,142 8,205	 461 366	 318–575 212–511

TABLE 4. San Juan River Subbasin riverwide (River Miles 166.6–2.9) razorback sucker population estimate, 2010. CI represents the profile likelihood interval. CV represents the coefficient of variation and p-hat represents the probability of capture.

Year	Estimate (model)	CI	CV	p-hat
2009	2,047	1,063–5,000	0.38	0.04
2010	3,021 (M_o)	2,007–4,940	0.23	0.04
2010	2,928 (M_t)	1,952–4,796	0.23	0.04

Upper Basin Recovery Unit Criterion 2b. A self-sustaining population is maintained in EITHER the upper Colorado River Subbasin or the San Juan River Subbasin over a 5-year period, starting with the first point estimate acceptable to the Service, such that for either population the mean estimated recruitment of age-3 (300–399 mm TL) naturally produced fish equals or exceeds mean annual adult mortality.

Status of Upper Basin Recovery Unit Criterion 2b. This criterion has not been met. *Although larval production has been demonstrated in the Colorado and Gunnison Rivers recently (Osmundson and Seal 2009), it is not known how larval production may translate to the recruitment of wild 3-year old fish to adulthood.*

Larval razorback sucker have been collected every year in the San Juan River since 1998. FIGURE 3 shows an increasing trend in the larval catches over that time period. It is not known how larval production may translate into recruitment of subadults to adults.

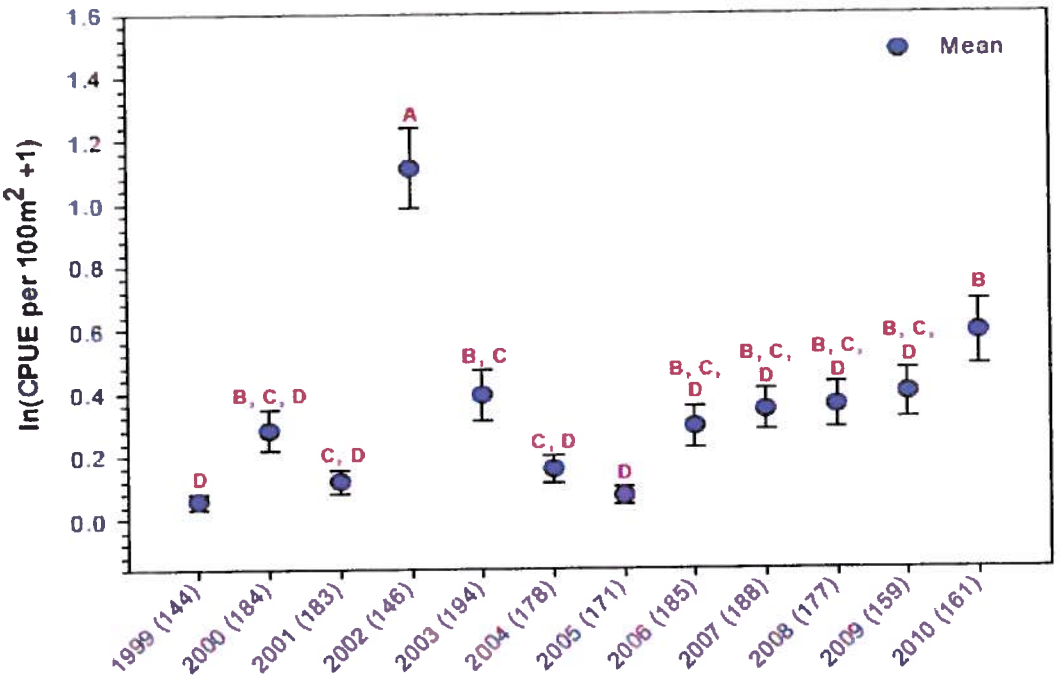

FIGURE 3. Mean number of larval razorback sucker observed over 12 years, San Juan River. Depicted by ln (CPUE per 100 m2 +1) [+1 SE] (April-June 1999-2010). Sample size reported on x-axis labels. Means not connected by the same letter are significantly different. From Brandenberg and Farrington 2010.

Upper Basin Recovery Unit Criterion 2c. A self-sustaining population is maintained in EITHER the upper Colorado River Subbasin or the San Juan River Subbasin over a 5-year period, starting with the first point estimate acceptable to the Service, such that for either population each point estimate exceeds 5,800 adults (MVP).

Status of Upper Basin Recovery Unit Criterion 2c. This criterion has not been met. *Under the integrated stocking plan (Nesler et al. 2003), the reintroduction of razorback sucker (≥ 300 mm TL) has occurred in the Colorado and Gunnison Rivers. These river reaches have been stocked with 70,472 juveniles since 2004. Survival was poor in the first year after stocking; however, better survival occurred when fish were at large for 2 or more years when compared to the assumed survival rates in the integrated stocking plan (Zelasko et al. 2009). An extension of that study for years when the integrated stocking plan was being implemented, demonstrated similar survival rates.*

The San Juan River Subbasin has had increasing abundance estimates since 2009 (TABLE 4). However, the population still falls approximately 3,000 short of the MVP. Therefore, although progress is being made, this criterion has not been met.

Lower Basin Recovery Unit Criterion 1. Genetic variability of razorback sucker in Lake Mohave is identified, and a genetic refuge is maintained over a 5-year period.

Status of Lower Basin Recovery Unit Criterion 1. This criterion has been met. *The razorback sucker in Lake Mohave displayed the highest degree of genetic diversity among populations of the Colorado River (Dowling et al. 1996; Dowling and Marsh 2010). Lake Mohave is being maintained as a genetic refuge through the collection of larvae and their subsequent grow out to 300 mm TL at various facilities prior to relocating back to the lake (repatriation). This work has been done by the Native Fish Work group since 1989 and continues under the auspices of the LCRMSCP (2011). In addition, a razorback sucker roundup was conducted each year to capture and spawn adults from Lake Mohave to produce larvae at local facilities that will later be stocked back into Lake Mohave as juveniles/adults. It has been postulated that because survival is too low for the repatriated fish in Lake Mohave, they need to be grown to 500 mm TL prior to being repatriated (Kesner et al. 2008; Schooley et al. 2009; LCRMSCP 2011). Size at release is strongly associated with post-stocking mortality, and the abundance of striped bass over 800 mm is linked to the variation in post-stocking mortality seen (LCRMSCP 2011). Thus, while size at time of stocking is important, the size and abundance of the predator community is an important factor, too.*

Lower Basin Recovery Unit Criterion 2a. Two self-sustaining populations (e.g., mainstem and/or tributaries) are maintained over a 5-year period, starting with the first point estimate acceptable to the Service, such that for each population the trend in adult (age 4+; ≥ 400 mm TL) point estimates does not decline significantly.

Status of Lower Basin Recovery Unit Criterion 2a. This criterion has been partially met. *Populations are being maintained and re-established in reaches of the lower Colorado River. Lake Mead has supported a relatively small (a few hundred adults) but stable, self-sustaining population of wild razorback sucker for over 20 years, with recruitment occurring every year in that time frame (Albrecht et al. 2010). However, the numbers of adults in these populations fall far short of the 5,800 as required for the MVP.*

Stocking through the LCRMSCP occurs in all reaches of the lower Colorado River, except for Lake Mead. The next most promising re-establishment site for razorback sucker appears to be the Lake Havasu Reach (Reach 3: Davis Dam to Parker Dam). In 2008, the population was estimated to be around 1,600 fish and catch rates of adults continue to increase. Spawning aggregations were found upstream of Needles, California, and in several other locations within the reach. Reaches 4/5 (Parker Dam to Imperial Dam) have received razorback through augmentation, but no spawning aggregations have been noted (LCRMSCP 2011).

Lower Basin Recovery Unit Criterion 2b. Two self-sustaining populations (e.g., mainstem and/or tributaries) are maintained over a 5-year period, starting with the first point estimate acceptable to the Service, such that for each population mean estimated recruitment of age-3 (300–399 mm TL) naturally produced fish equals or exceeds mean annual adult mortality.

Status of Lower Basin Recovery Unit Criterion 2b. This criterion has been partially met. *The Lake Mead population has demonstrated recruitment over the last 20 years (Albrecht et al. 2011), which strongly suggest this criterion has been met. However, lower basin researchers have not documented similar recruitment in a second location.*

Lower Basin Recovery Unit Criterion 2c. Two self-sustaining populations (e.g., mainstem and/or tributaries) are maintained over a 5-year period, starting with the first point estimate acceptable to the Service, such that for each population each point estimate exceeds 5,800 adults (MVP).

Status of Lower Basin Recovery Unit Criterion 2c. This criterion has not been met. *Population point estimates have not yet exceeded the MVP of 5,800 adults in any population.*

RECOVERY FACTOR DOWNLISTING CRITERIA FOR RAZORBACK SUCKER TO MINIMIZE OR REMOVE THREATS TO THE SPECIES

Upper Basin Recovery Unit

Factor A — Adequate habitat and range for recovered populations is provided. Streamflow regulation and associated habitat modification are identified as primary threats to the razorback sucker. The decline of the species throughout the basin is attributed largely to extensive habitat loss, modification, and fragmentation, and blocked fish passage associated with dam construction and operations. Razorback sucker were once abundant through most of the Colorado River System. A major cause of decline has been loss of a contiguous complement of habitats used by the various life history phases. Twelve barriers to fish passage have been identified in the upper basin upstream of Glen Canyon Dam within occupied habitat of razorback sucker.

Maintenance of streamflow is important to the ecological integrity of large western rivers. Flow recommendations have been developed for different reaches and rivers of the Upper Colorado River Basin that identify and describe flows with the necessary magnitude, frequency, duration, and timing to benefit the endangered fish species.

Criterion 1. Flow regimes to benefit razorback sucker populations in the Green River, upper Colorado River, and San Juan River Subbasins should be identified, implemented, evaluated, and revised, such that:

a) Adequate spawning habitat and appropriate spawning cues (e.g., flow patterns and water temperatures) are available to maintain self-sustaining populations.

b) Adequate nursery habitat is available to maintain self-sustaining populations.

c) Adequate juvenile and adult habitat (e.g., cover, resting, and feeding areas) are available to maintain self-sustaining populations.

Status of Criterion 1. Criterion 1 has been partially met. *Flow recommendations have been developed throughout the Green River Subbasin (Irving et al. 2004 [White River]; Muth et al. 2000 [Green River]; Modde and Keleher 2003 [Duchesne River]; Modde et al. 1999 [Yampa River]); and the upper Colorado River Subbasin (Osmundson et al. 1995 [15-mile reach]; McAda 2003 [upper Colorado and Gunnison Rivers]); and the San Juan River Subbasin (Holden 1999). These flow recommendations are being implemented and monitored. A study plan for the*

Green River has been developed (Green River Study Plan ad hoc Committee 2007) to determine the response of endangered fish to the implemented flow recommendations downstream of Flaming Gorge Dam. The UCREFRP collaborated with the Colorado River Water Conservancy District (District) and the City of Craig, Colorado, on the enlargement of Elkhead Reservoir in the Yampa River drainage and thereby secured 5,000 acre-feet of "fish water" (with the option to lease an additional 2,000 acre-feet annually) to augment Yampa River baseflows. Since the enlargement was completed in 2007, the "fish water" has been delivered every year. Although the necessary flows have been identified and implemented, they are still under evaluation and may need to be revised.

Since 1997, the District, Northern Colorado Water Conservancy District, Denver Water, and Bureau of Reclamation (BOR) have coordinated with the Service to deliver in excess of 1 million acre-feet of water to assist in the recovery of the endangered fish in the 15-mile reach of the Colorado River near Grand Junction during base flow (TABLE 5). These volumes of water have resulted in increased river flows on an average day of 282 cubic feet per second (cfs) to a maximum of 1,15 cfs during critical low flow and warm temperature periods of late summer.

TABLE 5. Coordinated water releases to benefit endangered fish in the 15-mile reach of the Colorado River near Grand Junction, Colorado, 1997–2011.

RESERVOIRS	ACRE-FEET
Windy Gap	3,718
Willow Creek	9,852
Granby	39,914
Palisade Bypass	93,038
Williams Fork	89,342
Wolford Mountain	137,879
Ruedi	272,287
Green Mountain	532,000
Total	**1,178,030**

Bestgen et al. (2011b) recently reviewed historical capture data of wild produced razorback sucker larvae, experimentation to determine larval razorback sucker larval transport and entrainment, and Green River hydrology and thermal conditions. The major conclusion from that synthesis was that the Upper Colorado River Program and BOR will need to time releases from Flaming Gorge Dam better to provide floodplain connection coincident with the presence of larval razorback sucker in the river.

Successful razorback sucker spawning has been documented every year sampling has occurred in the Green River (every year since 1992 (Bestgen 2011a)). Larval razorback sucker were collected in the Gunnison and Colorado Rivers from 2002 to 2007 when sampling occurred (Osmundson and Seal 2009). Razorback sucker spawning has been documented in all years

since 1998 in the San Juan River. As discussed above, researchers have documented periods of positive recruitment in both the Green and Colorado Rivers. However, lacking stronger indications of self-sustainability we cannot say this criterion has been fully met.

Criterion 2. Passage over Redlands Diversion and Grand Valley Diversion should be continued to allow adequate movement of razorback sucker in the upper Colorado and Gunnison Rivers.

Status of Criterion 2. Criterion 2 has been met. *A 350-foot long, U-shaped fish passage at the Redlands Water and Power Company Diversion Dam on the Gunnison River was completed in 1996. The passage restored access to 50 miles of critical habitat for the endangered fish. From 1996 to 2011, 110 Colorado pikeminnow, 28 razorback sucker, 8 bonytail (Gila elegans), 1 humpback chub (Gila cypha), and 104,775 other native fish have used the passage (Burdick 2011a). Colorado pikeminnow and razorback sucker reproduction has been documented in reaches upstream of the fish passage (Osmundson and Seal 2009).*

A 300-foot long, rock channel fish passage at the Grand Valley Irrigation Company Diversion Dam on the Colorado River became operational in 1998. Unlike the fish passage structure at the Redlands diversion, this fish passage is a "non-selective" passage, meaning that all fish species are allowed to move through it. A gate was installed in 2007 to remotely open and close the passage. The elevation of the pond can be adjusted and accurately maintained at user-selected set-points by adjusting the pressure in the bladders within the system control range (full inflation to full deflation). These passages continue to be operated and allow adequate movement of razorback sucker.

Criterion 3. Modification of Price-Stubb Dam and Government Highline Dam should be initiated to allow adequate movement of razorback sucker in the upper Colorado River.

Status of Criterion 3. Criterion 3 has been met. *Construction was completed on Price-Stubb Dam of a passive, non-selective (all fish pass) fish passage structure and began functioning on March 20, 2008.*

Construction of a 373-foot long concrete fish passage at the Grand Valley Project Diversion Dam (also referred to as the Government Highline Dam) on the Colorado River was completed in 2005. The structure provides selective passage of native fish at this historic roller dam across the Colorado River. During trial operations in 2005 and 2006, which consisted of a few weeks between June and September, 1 razorback sucker, 3 humpback chubs, and about 14,000 other native fish moved upstream. Beginning in 2008, the passage has operated from the spring through the fall, passing 1 razorback sucker, 22 bonytail, 3 humpback chub, and over 44,000 native fish through 2011 (Burdick 2011b). We suspect that with the completion of the Price-Stubb passage, located a few miles downriver, endangered fish use of the Grand Valley passage will increase in the future. A remote PIT tag antenna was installed in the Price-Stubb passage that is providing information on the use of the passage by tagged fish.

Criterion 4. Barriers on the San Juan River should be identified and evaluated, and modifications initiated to allow adequate movement of razorback sucker.

Status of Criterion 4. Criterion 4 has been met. *Fish access has been restored to 36 miles of critical habitat on the San Juan River with the construction of passages at the Public Service Company of New Mexico weir, the Hogback Diversion Dam, and removal of the Cudei Diversion Dam. The Hogback Diversion Dam was modified with a 500-foot long rock channel fish passage to provide nonselective fish passage in 2001. Construction of a fish screen in the diversion canal is being designed to prevent fish from entering the canal.*

Construction of a 400-foot long, selective fish passage at the Public Service Company of New Mexico was completed in 2003. Through 2009, 27 razorback sucker, 48 Colorado pikeminnow, and nearly 110,000 other native fish have used this passage, which is operated by the Navajo Nation. No new construction is required to prevent fish entrainment (incidental trapping of fish in waters being diverted for irrigation).

Additional projects beyond 2011 will include addressing the need for fish passage at Arizona Public Service Diversion and Fruitland Diversion Dam. Stamp and Golden (2005) concluded that the Arizona Public Service Diversion has the potential to impede passage at flows less than 5,000 cfs. This means that, in most years, there is the potential for razorback sucker to be impeded by the Arizona Public Service Diversion and unable to access 16 miles of upstream habitat. A selective fish barrier above Lake Powell also is being considered to prevent the upstream movement of nonnative fish species. These additional projects were not contemplated when the recovery goals were developed.

Criterion 5. Investigations should be initiated on the feasibility of modifying releases from Aspinall Unit dams to increase water temperatures in the Gunnison River that would allow for upstream range expansion of razorback sucker.

Status of Criterion 5. Criterion 5 has been partially met. *Osmundson (1999) recommended a feasibility study for increasing Gunnison River temperatures near Delta, Colorado, by modification of outlet structures on the Aspinall Unit dams. A 2-phased study that suggested temperature could be modified through the timing of release through Crystal Dam was completed in 2004 (Hydrosphere Resource Consultants 2001; 2004; Boyer and Cutler 2004). The results of this feasibility study indicated that the installation of a multi-level outlet would be needed at Blue Mesa Reservoir to create a measurable warming effect in the Gunnison River at Delta, Colorado. However, the authors recommended that additional temperature data be collected to address uncertainty associated with their results.*

Criterion 6. Measures should be identified to minimize entrainment of subadult and adult razorback sucker at problematic diversion structures.

Status of Criterion 6. Criterion 6 has been partially met. *Screens are in place and operated at Grand Valley Irrigation Company (since 2002), Grand Valley Project (since 2004), and Redlands Diversion (since 2007). The programs are still considering a screening option at the Tusher Wash Diversion on the lower Green River and constructing a fish screen in the Hogback Diversion Canal to prevent entrainment that has already been designed.*

Criterion 7. Appropriate bottomland sites should be identified and opportunities for land acquisition or easements assessed.

Status of Criterion 7. Recovery Factor Criterion 7 has been met. *A total of 2,700 acres of floodplain habitat (both in the Colorado and Green River Subbasins) that were obtainable were either acquired or had easements made in perpetuity. These sites are being managed to benefit the endangered fish (Valdez and Nelson 2004; 2006). To put this acquired / leased acreage into context, Muth et al. (2000) characterized "significant floodplain inundation" in the middle Green River at around 8,650 acres. Much of that inundation occurs on the Ouray National Wildlife Refuge – land already held in Federal ownership. Program acquisitions and leases represent a significant percentage of floodplains that were in private ownership.*

Factor B — Protection from overutilization for commercial, recreational, scientific, or educational purposes. Overutilization of razorback sucker for commercial, recreational, scientific, or educational purposes is not currently considered a threat to the species. Razorback sucker have no commercial or recreational value and are not sought by commercial fishermen or anglers. Collection of razorback sucker for scientific or educational purposes is regulated by the Service under the ESA.

Criterion 8. Overutilization of razorback sucker for commercial, recreational, scientific, or educational purposes should be re-evaluated and, if necessary, actions identified to ensure adequate protection.

Status of Criterion 8. Criterion 8 has been met. *No commercial or recreational activities exist. Educational activities are minimal and do not threaten razorback sucker. Snyder (2003) indicated that razorback sucker appeared sufficiently susceptible to warrant continued minimal use of electrofishing policy (i.e., not electroshocking over spawning bars during spawning or locations where and when larvae may be present, and cautious use of less harmful currents for monitoring).*

Factor C — Adequate protection from diseases and predation. Diseases and parasites are not considered to be significant by themselves in the decline of the razorback sucker. However, predation is a significant factor.

A large number of nonnative fishes are found in historic and currently occupied habitat of razorback sucker. Many researchers believe that nonnative species are a major cause for lack of recruitment in razorback sucker. There are numerous reports of predation of razorback sucker eggs and larvae by common carp (*Cyprinus carpio*), channel catfish (*Ictalurus punctatus*), smallmouth bass (*Micropterus dolomeiu*), largemouth bass (*Micropterus salmoides*), bluegill (*Lepomis macrochirus*), green sunfish (*Lepomis cyanellus*), and redear sunfish (*Lepomis microlophus*). A Strategic Plan for Nonnative Fish Control was developed for the Upper Colorado River and implemented in 1997. Control of the release and escapement of nonnative fishes into the main river, floodplain, and tributaries also is a necessary management action to stop the introduction of new fish species into occupied habitats and to thwart periodic escapement of highly predaceous nonnatives from riverside features. In the upper basin, annual flooding of the river can inundate riverside ponds potentially containing large numbers of green

sunfish, black bullhead (*Ameiurus melas*), largemouth bass, and other nonnative fishes that may escape to the river during high flows. Four management actions are identified to reduce the threat of nonnative fishes: high spring flows, nonnative fish control strategies, stocking agreements, and prevention of invasive species. Active control programs should be implemented or continued for problematic nonnative fishes in razorback sucker nursery habitats such as flooded bottomlands, northern pike in the middle Green River, and channel catfish in river reaches occupied by razorback sucker.

Criterion 9. Effects of diseases and parasites on razorback sucker populations should be re-evaluated and, if necessary, actions identified to ensure adequate protection.

Status of Criterion 9. Criterion 9 has not been met. *The effects of disease and parasites on razorback sucker populations have not been re-evaluated.*

Criterion 10. Procedures should be developed, implemented, evaluated, and revised for stocking nonnative fish species in the Upper Colorado River Basin (including the San Juan River Subbasin) to minimize negative interactions between nonnative fishes and razorback sucker.

Status of Criterion 10. Criterion 10 has been partially met. *Nonnative fish stocking procedures for the Green River and Colorado River Subbasins were initially developed in 1996, modified in 2009 (Service 1996, 2009a). Colorado Parks and Wildlife intend to implement the revised procedures in 2012. The San Juan River Subbasin is developing similar procedures. Both sets of procedures will need to be evaluated and revised, if necessary, for this criterion to be met.*

Criterion 11. Control programs for small-bodied nonnative fishes in backwater and flooded off-channel nursery habitats in river reaches occupied by young razorback sucker should be developed and implemented to identify levels of control that will minimize predation.

Status of Criterion 11. Criterion 11 has been partially met. *Small-bodied cyprinid control studies indicate that reduction in the numbers of small-bodied cyprinids only lasted for a short period of time (Trammell et al. 2004). Estimated larval razorback sucker survival in the presence of nonnative predators ranged from 0 to 58% and growth rates averaged 0.6 mm/day in 2003 and 0.6 mm/day in 2004 (Brunson and Christopherson 2005). Survival of larval razorback sucker following reset (dewatering or allowing winter-kill to occur for nonnative fish species) of a floodplain wetland has been documented (Brunson and Christopherson 2005; Modde and Haines 2005). These floodplains are often reset as a management action. Control through resetting of the floodplain wetland may not always be possible in high water years; for these years, other forms of control should be considered.*

Criterion 12. Channel catfish control programs in river reaches occupied by razorback sucker should be developed and implemented to identify levels of control that will minimize predation.

Status of Criterion 12. Criterion 12 has been partially met. *Channel catfish control has been implemented in the San Juan River, but levels of control necessary to minimize negative interactions have not been identified. Various attempts to mechanically remove channel catfish (Fuller 2009; Badame and Jones 2009) in the upper Colorado River Basin have had minimal*

effects on channel catfish populations. The Upper Colorado River program has shifted focus to nonnative smallmouth bass and northern pike, which were found to have a larger bioenergetic impact on native fish communities (Johnson et al. 2008).

Criterion 13. Northern pike control program in reaches of the middle Green River occupied by razorback sucker should be developed and implemented to identify levels of control that will minimize predation.

Status of Criterion 13. Criterion 13 has been partially met. *Interim Yampa River Nonnative Fish Removal Criteria have been developed and a Yampa River Nonnative Fish Control Strategy (Valdez et al. 2008) is being implemented. A control program for northern pike in the Yampa River was initiated in 1999 and removal of northern pike in the middle Green River was initiated in 2001. Based on trends in catch rates of subsequent years, removal efforts have been successful at significantly reducing the number of northern pike in the middle Green River. Control efforts since 2003 have resulted in the capture of less than 40 northern pike and as a result, total effort was reduced to only a maintenance level beginning in 2005 (Skorupski and Breen 2011). However, other sources of northern pike not being controlled continue to impact this reach.*

Northern pike control in the Yampa and Green Rivers is specifically implemented through four ongoing projects by the UCREFRP. Northern pike are removed whenever encountered during all other UCREFRP projects.

Factor D — Adequate existing regulatory mechanisms. Implementation of regulatory mechanisms is necessary for recovery of the razorback sucker and to ensure long-term conservation of the species. After removal from the list of threatened and endangered species and from protection by the ESA, the razorback sucker and its habitat will continue to receive consideration and some protection through the following Federal laws and related State statutes: National Environmental Policy Act; Clean Water Act; Organic Act; and Fish and Wildlife Coordination Act.

The need for conservation plans and agreements is identified in these revised recovery goals to provide reasonable assurances that recovered razorback sucker populations will be maintained.

Criterion 14. Mechanisms are determined for legal protection of adequate habitat.

Status of Criterion 14. Criterion 14 has been partially met. *Filing for legal rights to protect water for fish would be junior to the legal rights of others who have already claimed water for irrigation and power. Utah is currently reviewing the water rights from Flaming Gorge Reservoir and how they may be modified for fish protection. See also Recovery Factor downlisting Status of Criterion 1 above. The nonnative fish stocking procedures and development of the nonnative fish basinwide strategy are mechanisms developed to aid in the protection of habitat. Recognition of the problem is exemplified by Utah in instituting a "must kill" policy on smallmouth bass and burbot (Lota lota) that enlists the help of anglers to remove*

them if caught in the Green River. In addition, Wyoming increased the penalty for "stocking fish without consent to" $10,000 and the loss of fishing and hunting privileges for life. A comprehensive nonnative fish control strategy has not been completed.

Criterion 15. Elements of conservation plans are identified that are necessary to provide for the long-term management and protection of razorback sucker populations.

Status of Criterion 15. Criterion 15 has not been met. *Conservation plans and the necessary elements have not been developed.*

Factor E — Other natural or manmade factors for which protection has been provided. The present level of hybridization among razorback sucker and other catostomids has not been quantified, but this factor will be re-evaluated at downlisting and any necessary actions to reduce deleterious levels of hybridization will be implemented before and after delisting (see Criterion 16). White sucker was introduced into the Colorado River system in the late 1800s and has been becoming more prevalent in the Green and Colorado Rivers.

Many potential contaminants (e.g., petroleum products, radionuclides, selenium, pesticides, and heavy metals such as mercury) enter the Colorado River System from a variety of sources, but their role in suppressing populations is not always well understood. Potential spills of petroleum products threaten wild populations of razorback sucker. All States have hazardous materials spills emergency response plans that provide a quick cleanup response to accidental spills.

Another cause of degraded water quality is the Atlas Mills tailings pile located on the north bank of the Colorado River near Moab, Utah. There are two significant threats to endangered fish posed by the Atlas Mills tailings pile: toxic discharges of pollutants, particularly ammonia, and the risk of catastrophic pile failure.

Selenium is hypothesized to contribute to the decline of endangered fishes of the Colorado River Basin (Service 2009b) (see Criterion 20).

Criterion 16. Levels of hybridization with white sucker (*Catostomus commersonii*) are re-evaluated, effects on razorback sucker populations are assessed, and, if necessary, white sucker control programs in river reaches occupied by razorback sucker are developed and implemented to identify levels of control that will minimize hybridization.

Status of Criterion 16. Criterion 16 has been partially met. *Efforts are being made to characterize the incidence of white sucker hybridization throughout the Green River Subbasin. White sucker are being removed whenever they are encountered in the Green River. However, the level of hybridization with razorback sucker is not known. White sucker hybridize with other native suckers, i.e., flannelmouth sucker (Catostomus latipinnis) and bluehead sucker (Catostomus discobolus). Complementary efforts to control white sucker under the 3-species Rangewide Conservation Agreement (Utah Department of Natural Resources 2006) provide some protection against hybridization with razorback sucker. Fortunately, white sucker have not*

become established in the warm-water reaches of the San Juan River. However, precautions must be taken to ensure that the new Ben Nighthorse Campbell Reservoir does not become a source for this species.

Criterion 17. State and Federal hazardous-materials spills emergency-response plans are reviewed and modified to ensure adequate protection for razorback sucker populations from hazardous-materials spills.

Status of Criterion 17. Criterion 17 has not been met. *The hazardous-materials spills emergency-response plans have not been reviewed or modified.*

Criterion 18. Locations of all petroleum-product pipelines within the 100-year floodplain of critical habitat identified and the need for emergency shut-off valves are assessed.

Status of Criterion 18. Criterion 18 has partially been met. *Although some progress has been made in locating all petroleum-product pipelines, the determination of emergency shut-off valves has not been assessed. The Service now requires (via Section 7 consultation) that new pipelines crossing the rivers are equipped with emergency shut-off valves.*

Criterion 19. Actions are identified for remediation of groundwater contamination at the Atlas Mills tailings pile located near Moab, Utah.

Status of Criterion 19. Criterion 19 has been met. *Under the Moab Uranium Mill Tailings Remedial Action Project Site Record of Decision (70 FR 55358), the action identified for remediation of groundwater contamination (principally ammonia) at the Atlas Mills tailings pile located near Moab, Utah, was to remove the tailings pile to Crescent Junction, Utah. The pile is currently in the process of being moved and ground water remediation (a very long-term commitment) is underway.*

Criterion 20. Effects of selenium contamination on razorback sucker reproductive success and survival of young are re-evaluated, and, if necessary, actions are identified to reduce deleterious levels of selenium contamination.

Status of Criterion 20. Criterion 20 has been partially met. *Levels of selenium contamination in certain reaches of endangered fish critical and occupied river habitat exceed those shown to impact fish and wildlife elsewhere (e.g., Stephens et al. 1992; Stephens and Waddell 1998; Thomas et al. 1998; Simpson and Lusk 1999; BOR 2006; Thomas et al. 2008). Tissue samples from endangered fish in some of these areas (Simpson and Lusk 1999) had selenium concentrations greater than toxicity guidelines for fish muscle tissue suggested by Lemly (1996) and National Irrigation Water Quality Program (1998) for protection of reproductive health in freshwater fish. The BOR has committed to developing the Selenium Management Program (a remediation program) on the Gunnison River as a requirement of the Aspinall programmatic biological opinion (Service 2009b). Similarly, the BOR in coordination with the Service and the State of Utah has been reducing selenium loads in Stewart Lake in the middle Green River since*

1997. The Service recognizes the onset of adverse effects (i.e., growth, survival, reproductive impairment) of selenium at 4 µg/g dry weight in whole body razorback sucker (Lusk 2010, pers. comm.).

LOWER BASIN RECOVERY UNIT

Factor A — Adequate habitat and range for recovered populations is provided. Streamflow regulation and associated habitat modification are identified as primary threats to the razorback sucker. The decline of the species throughout the basin is attributed largely to extensive habitat loss, modification, and fragmentation, and blocked fish passage associated with dam construction and operations. Razorback sucker were once abundant through most of the Colorado River System and a major cause of decline has been loss of a contiguous complement of habitats used by the various life history phases. Maintenance of streamflow is important to the ecological integrity of large western rivers.

Criterion 1. Flow regimes that are necessary for establishment and maintenance of razorback sucker populations in the mainstem and/or tributaries are identified, implemented, evaluated, and revised, such that:

a) Adequate spawning habitat and appropriate spawning cues (e.g., flow patterns and water temperatures) are available to maintain self-sustaining populations.

b) Adequate nursery habitat is available to maintain self-sustaining populations.

c) Adequate juvenile and adult habitats (e.g., cover, resting, and feeding areas) are available to maintain self-sustaining populations.

Status of Criterion 1. Criterion 1 has not been met. *Flows on the lower Colorado River are determined through dam releases in accordance with agreements and interstate compacts that do not necessarily consider the habitat needs of razorback sucker. The ability of current and future river flow management to provide the needed habitat features without changes in flows will require additional research and monitoring. Flows on the Gila, Salt, and Verde Rivers in Arizona also are controlled by a series of large dams and diversions, and will require additional research and monitoring to determine if suitable flows can be established.*

Criterion 2. Measures are identified to minimize entrainment of subadult and adult razorback sucker at problematic diversion and/or out-take structures.

Status of Criterion 2. Criterion 2 has not been met. *Measures have not been identified to minimize entrainment of subadult or adult razorback sucker from problematic diversion or take out structures. Locations where such entrainment could occur on the lower Colorado River were identified in the LCRMSCP and a portion of the stocking of razorback suckers into the river is intended to offset any losses from entrainment.*

Criterion 3. Appropriate riverside sites are identified and opportunities for land acquisition or easements are assessed.

Status of Criterion 3. Criterion 3 has been partially met. *The Lower Colorado River Multi Species Conservation Program has identified the need to create and manage over 8,100 acres of riparian, marsh, and backwater habitats – to benefit a variety of native species including razorback sucker. Appropriate riverside sites have been identified and opportunities for acquisition or easements are being assessed (Service 2004; LCRMSCP 2011).*

Factor B — Protection from overutilization for commercial, recreational, scientific, or educational purposes. Overutilization of razorback sucker for commercial, recreational, scientific, or educational purposes is not currently considered a threat to the species. Razorback sucker have no commercial or recreational value and are not sought by commercial fishermen or anglers. Collection of razorback sucker for scientific or educational purposes is regulated by the Service under the ESA.

Criterion 4. Overutilization of razorback sucker for commercial, recreational, scientific, or educational purposes re-evaluated and, if necessary, actions identified to ensure adequate protection.

Status of Criterion 4. Criterion 4 has been met. *No commercial or recreational activities exist. Educational activities are minimal and do not threaten razorback sucker. Scientifically, reduced survival of adult razorback sucker as a result of handling has not been detected, and delayed mortality due to sampling has not been demonstrated.*

Factor C — Adequate protection from diseases and predation. Diseases and parasites are not considered to be significant by themselves in the decline of the razorback sucker. However, predation by nonnative fishes is a significant threat.

A large number of nonnative fishes are found in historic and currently occupied habitat of razorback sucker. Higher growth rates for larval razorback sucker occurred in the absence of predators in Lake Mohave. Channel catfish and flathead catfish (*Pylodictis olivaris*) were major predators of newly stocked razorback sucker in the Gila River and striped bass are a significant predator on the lower Colorado River particularly in Lake Mohave. Juvenile razorback sucker stocked in isolated coves along the Colorado River in California suffered extensive predation by channel catfish and largemouth bass.

Criterion 5. Effects of diseases and parasites on razorback sucker populations are re-evaluated and, if necessary, actions are identified to ensure adequate protection.

Status of Criterion 5. Criterion 5 has not been met. *The effects of diseases and parasites on razorback sucker populations have not been re-evaluated. The parasitic crustaceans, i.e., anchor worm (Lernaea sp.) and fish louse (Argulus sp.) may likely affect populations being re-established because the individuals come from clean facilities and hatchery fish need to develop an immunity once released to the wild.*

Criterion 6. Procedures are developed, implemented, evaluated, and revised for stocking and to minimize escapement of nonnative fish species into the mainstem, floodplain, and tributaries to minimize negative interactions between nonnative fishes and razorback sucker.

Status of Criterion 6. Criterion 6 has not been met. *No procedures have been developed for stocking or minimizing the escapement of nonnative fish species in the Lower Colorado River Basin.*

Criterion 7. Control programs for problematic nonnative fishes in the mainstem, floodplain, and tributaries are developed and implemented to identify levels of control that will minimize negative interactions between nonnative fishes and razorback sucker.

Status of Criterion 7. Criterion 7 has not been met. *No control programs have been developed for problematic nonnative fish to minimize negative interactions between nonnative fishes and razorback sucker in the Lower Colorado River Basin.*

Factor D — Adequate existing regulatory mechanisms. Implementation of regulatory mechanisms is necessary for recovery of the razorback sucker and to ensure long-term conservation of the species. After removal from the list of threatened and endangered species and from protection by the ESA, the razorback sucker and its habitat will continue to receive consideration and some protection through the following Federal laws and related State statutes: National Environmental Policy Act; Clean Water Act; Organic Act; and Fish and Wildlife Coordination Act.

The need for conservation plans and agreements is identified in these revised recovery goals to provide reasonable assurances that recovered razorback sucker populations will be maintained.

Criterion 8. Mechanisms are determined for legal protection of adequate habitat.

Status of Criterion 8. Criterion 8 has been met. *The LCRMSCP has focused on securing partnerships with resource agencies to ensure adequate land and water resources were available to create habitat and provide for its long-term maintenance. Eleven conservation areas are now in the program or being considered for inclusion into the program. These conservation areas are distributed over 276 river miles from Laughlin, Nevada, to the boundary with Mexico and include over 200 acres of marsh and 15 acres of backwater dedicated to native fish.*

Criterion 9. Elements of conservation plans are identified that are necessary to provide for the long-term management and protection of razorback sucker populations.

Status of Criterion 9. Criterion 9 has been met. *The Lower Colorado River Management Plan (Service 2005) provides for the long-term management and protection of razorback sucker populations in the lower Colorado River. This signatory document among the Service and the States of Arizona, California, and Nevada for the management of big-river fish in the Lower Colorado River Basin provides management strategies for genetic and habitat protection, along with population management.*

Factor E — Other natural or manmade factors for which protection has been provided. No other factors have been identified as threats.

2.3 Synthesis

Recovery is based on reduction or removal of threats and improvement of the demographic status of a species. Recovery is achieved when management actions and associated tasks have been implemented and/or completed to allow genetically and demographically viable, self-sustaining populations to thrive under minimal ongoing management and investment of resources. Achievement of recovery does not mandate returning a species to all or a significant portion of its historic range, nor does it mandate establishing populations in all possible habitats, or everywhere the species can be established or re-established.

Razorback sucker evolved in warm-water reaches of large rivers of the Colorado River Basin from Mexico to Wyoming. At the time of listing, habitat losses were documented but the threats to razorback sucker were poorly understood and distribution and abundance of the species were not well known. The decline of the species was probably due to a combination of threats, including direct loss of habitat, changes in flow and temperature, and blockage of migration routes by the construction of large reservoirs. In addition, interaction with nonnative fish may have decimated razorback sucker in many areas, including waters not affected by dams.

Recovery of razorback sucker is considered necessary basinwide with the basin being separated into an upper basin and lower basin recovery units. The analysis above of the demographic criteria has shown 1 of the 10 has been met, 2 have been partially met, and 7 have not been met (TABLE 6). Thus, the species has not yet achieved the demographic recovery goals we identified as likely to be indicative of healthy, viable, and sustainable population levels. From the above list of recovery factor criteria; nine of the 29 total have been met, 12 have been partially met, and 8 have not been met. Thus, the majority of the most meaningful threats remain unresolved including adequate protection from predation and protection from degraded water quality. These factors continue to act upon the species inhibiting the ability of the species to achieve its demographic goals and, thus, precluding achievement of recovery and delisting. Although the category "has been partially met" is identified, this is only to reflect that some progress is being made on that particular criterion. Since the majority of demographic (9 out of 10) and recovery factor downlisting criteria (20 out of 29) have not been completely met, threats remain and populations remain unsustainably low and the species still qualifies for the status of endangered ("any species which is in danger of extinction throughout all or a significant portion of its range," Section 3.6 of the ESA); no change in status of razorback sucker is recommended. The definition of endangered applies here until the demographic criteria are met and the threats minimized or removed.

TABLE 6. Summary of the downlisting demographic and recovery factor criteria in the Colorado River Basin and a determination if the criteria have been met, partially met, or not met for analyzing whether razorback sucker can be downlisted.

CRITERIA FOR DOWNLISTING	Has Been Met	Has Been Partially Met	Has Not Been Met
Demographic			
Upper Colorado River Subbasin			1a, 1b, 1c, 2a, 2b, 2c
Lower Colorado River Subbasin	1	2a, 2b	2c
Upper Basin Recovery Factors			
Recovery Factor A	2, 3, 4, 7	1, 5, 6	
Recovery Factor B	8		
Recovery Factor C		10, 11, 12, 13	9
Recovery Factor D		14	15
Recovery Factor E	19	16, 18, 20	17
Lower Basin Recovery Factors			
Recovery Factor A		3	1, 2
Recovery Factor B	4		
Recovery Factor C			5, 6, 7
Recovery Factor D	8, 9		
Recovery Factor E			

3.0 RESULTS

3.1 Recommended Classification:

_X_ **No change is needed**

3.2 New Recovery Priority Number:

Imminent threats of habitat modification, predation by nonnative fish, and potential spills or leaching of environmental contaminants still remain high for razorback sucker. The recovery potential of razorback sucker is high because its biological and ecological limiting factors along with the threats to the species are well understood, and the management techniques are well documented with a high probability of success. In addition, razorback sucker is a monotypic genus in the Colorado River basin, representing a highly distinctive gene pool. Under the 1983 "Endangered and Threatened Species Listing and Recovery Priority Guidance" (45 FR 43098) these three qualities result in a RPN of "1." Also, the razorback sucker, as with the other three endangered fish of the Colorado River basin are designated with a "C" as part of their RPN to indicate they are in conflict with development projects, such as water diversions or dam construction and affect economic activities within the basin. Hence, no change in the RPN of "1C" is recommended.

4.0 RECOMMENDATIONS FOR FUTURE ACTIONS

The UCREFRP, San Juan River Basin Recovery Implementation Program (SJRBRIP), and the LCRMSCP continue working to meet the recovery criteria to minimize or remove threats to the razorback sucker in their respective recovery units. These programs develop annual work plans through adaptive management (Recovery Implementation Program Recovery Action Plan, Annual Budget and Work Plan, and Work Plan and Budget, respectively), to minimize and remove threats to the razorback sucker and thus achieving the recovery criteria. Through continued stocking programs to re-establish populations and by meeting these recovery criteria, the demographics of the species should improve.

We recommend revising the Service's 2002 Razorback Sucker Recovery Goals to incorporate information on population dynamics and other relevant information gathered since 2002. More specifically, the as-written Recovery Goal requirement that these populations always display positive recruitment (i.e., recruitment that is greater than adult mortality) contradicts the best available information that indicates these re-established populations will fluctuate even when recovered. Population estimation should begin soon in order to determine the number of adults in the rivers and to increase our chances of detecting recruitment.

Also, researchers in the SJRBRIP have recently discovered concentrations of razorback suckers in the San Juan Arm of Lake Powell. Preliminary indications are that razorback sucker are spawning in this transition zone and juvenile fish may be recruiting. The Service will need to determine how these individuals contribute to meeting demographic recovery criteria and revise the recovery goals if appropriate.

In addition, the recovery goal revision should consider the impacts of mercury. Studies involving survival, growth, reproduction, and behavior recommend that 0.2 milligram per kilogram mercury in whole fish be viewed as protective; while adverse biological effects are more likely at higher concentrations (Beckvar et al. 2005). Based on this threshold, the razorback sucker may be experiencing some reproductive impairment through mercury exposure. Management strategies for controlling anthropogenic mercury emissions are necessary as atmospheric pollution can indirectly affect this endangered species, its critical habitat, and its recovery by ambient air exposure, deposition into aquatic habitat, and bioaccumulation in diet and in fish tissues.

Uncertainty surrounding the effects of climate change to the razorback sucker should be considered for each of the threats as those impacts are realized. For example, the potential for alteration of flows in the basin as a result of climate change should at least be mentioned in the recovery goals. Climate change could have large impacts on the basin's aquatic ecosystem, resulting in (but not limited to):

- Change in the timing of peak flows from an earlier snowmelt;
- Change in the size of peak flows because of altered snowpacks; and

- Higher water temperatures from increased air temperature.

Not only would climate change affect the ecology of the species because of the factors listed above, but it also would greatly affect the management of the programs through changes in politics and economics, such as:

- Greater evaporation losses in the larger reservoirs may reduce flexibility of operations; and

- Drier conditions in the basin may cause irrigators to call on their water rights more often or request more water rights.

Therefore, we recommend that the recovery programs collaborate with their respective Landscape Conservation Cooperatives as means to address the challenges associated with climate change on the appropriate scale.

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U.S. FISH AND WILDLIFE SERVICE
5-YEAR REVIEW of Razorback sucker

Current Classification: Endangered rangewide

Recommendation resulting from the 5-Year Review:

___ Downlist to Threatened
___ Uplist to Endangered
___ Delist
_X_ No change needed

Review Conducted By: Upper Colorado River Endangered Fish Recovery Program Office

FIELD OFFICE APPROVAL:

Upper Colorado River Endangered Fish Recovery Program Office

Approve _____ Date 9/7/12
Thomas Chart, Program Director

LEAD REGIONAL OFFICE APPROVAL:

Mountain-Prairie Region (Region 6)

Approve _____ Date 8/7/12
Michael Thabault, ARD-Ecological Services

COOPERATING REGIONAL OFFICES:

Southwest Region (Region 2)

✓ Concur _____ Do Not Concur

Signature _____ Date 8/24/12
Actg for Michelle Shaughnessy, ARD-Ecological Services

Pacific Southwest Region (Region 8)

/ Concur _____ Do Not Concur

Signature _____ Date 8/30/12
Michael Fris, ARD-Ecological Services