# United States Department of the Interior

FISH AND WILDLIFE SERVICE
Mountain-Prairie Region

IN REPLY REFER TO:
FWS/R6
ES

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134 Union Boulevard
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JUN 04 2010

Memorandum

To: Project Leaders, Ecological Services, Colorado, Utah, and Wyoming

From: Acting Assistant Regional Director - Ecological Services, Region 6

Subject: Reinitiation of Intra-Service Section 7 Consultation for Elimination of Fees for Water Depletions of 100 acre-feet or Less From the Upper Colorado River Basin

This document transmits the U.S. Fish and Wildlife Service's (Service/USFWS) intra-Service biological opinion (BO) exempting depletions of 100 acre-feet (af) or less from the depletion fee required by the "Recovery Implementation Program for Endangered Fish Species in the Upper Colorado River Basin" and fulfills reinitiation of section 7 consultation on this action. This BO was prepared in accordance with section 7 of the Endangered Species Act (ESA) of 1973, as amended (16 U.S.C. 1531 et seq.), the Interagency Cooperation Regulations (50 CFR 402), and complies with Service procedures for seeking modification of BOs and Incidental Take Statements.

We have determined that the proposed action may adversely affect the endangered Colorado pikeminnow (*Ptychocheilus lucius*), humpback chub (*Gila cypha*), bonytail (*Gila elegans*), and razorback sucker (*Xyrauchen texanus*) and their critical habitat.

CONSULTATION HISTORY

On January 21 and January 22, 1988, the Secretary of the Department of the Interior; the governors of Wyoming, Colorado, and Utah; and the administrator of the Western Area Power Administration, signed a Cooperative Agreement to implement the "Recovery Implementation Program for Endangered Fish Species in the Upper Colorado River Basin" (USFWS 1987). In 2009, the Recovery Program was extended until September 30, 2023. The objective of the Recovery Program is to recover the listed species while water development continues in accordance with Federal and state laws and interstate compacts.

In order to further define and clarify processes outlined in sections 4.1.5, 4.1.6, and 5.3.4 of the Recovery Program, a section 7 Agreement (Agreement) and a Recovery Implementation Program Recovery Action Plan (RIPRAP) were developed (USFWS 1993). The Agreement establishes a framework for conducting all future section 7 consultations on depletion impacts

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On July 5, 1994, and amended on December 6, 1994, we completed an intra-Service BO that exempted the depletion fee for projects depleting 100 af or less (small water depletions) and which result in a cumulative total of 1,000 af in the Upper Basin. On March 9, 1995, we reissued the intra-Service BO authorizing an additional 2,000 af of depletions for individual projects with either a new or historic depletion of 100 af or less. A new BO was issued on July 8, 1997, to allow us to raise the small water depletion total to 3,000 af for a period of 2 years. On May 2, 2000, the 1997 BO was amended to cover a cumulative total of 3,000 af for small water depletions, with no time limit. On June 27, 2002, over 2,800 af of depletions had been approved under the July 1997 BO. At that time, the BO was amended to cover an additional 4,500 af of depletions, raising the cumulative total to 7,500 af for small water depletion projects. As of March 31, 2010, 719 small water depletion projects have depleted a cumulative total of 9,731 af. We are reinitiating consultation and providing a new BO as the 7,500 af cap has been exceeded. Therefore, this BO is intended to increase the cap to 12,000 af and allow us to continue to exempt small depletions of 100 af or less.

We annually assess implementation of recovery actions to determine if progress toward recovery has been sufficient for the Recovery Program to serve as Conservation Measures (formally RPA) for projects that deplete water from the Upper Colorado River Basin. In the last review, we determined that the Program has made sufficient progress to offset water depletions from individual projects up to 4,500 af per year.

## BIOLOGICAL OPINION

### DESCRIPTION OF THE PROPOSED ACTION

This BO addresses the impact of individual projects with either a new or historic average annual water depletion of 100 af or less which will result in a cumulative total of an additional 4,500 af in the Upper Basin and the elimination of the depletion fee charged for those projects. If during its annual review of sufficient progress we determine that the Recovery Program is not making sufficient progress toward recovery, the 4,500-af threshold may be readjusted. Such readjustment, if necessary, would require an amendment to this BO.

Each Ecological Services field office will maintain a record of the consultations completed. A quarterly report detailing the total amount of depletion will be sent to the Colorado River Recovery Office. A standard letter will be sent to each consulting action agency in response to its request for consultation on small depletions.

This BO does not apply to individual projects included under a programmatic BO for specific types of projects (e.g., Bureau of Land Management and Forest Service Programmatic BOs) or to projects within the geographic areas of the Programmatic BOs on the Colorado, Gunnison, and Yampa Rivers.

Depletion fees are used to support the Recovery Program activities for the endangered Colorado River fish. From the beginning of the Recovery Program until 1994 (when the depletion fee was exempted for projects of 100 af or less), a total of $534,548 was collected. Of this amount, $12,000 came from depletions of 100 af or less. The cost of administering the consultations for the small depletions was $98,000, based on the approximate cost of $1,000 to process an individual opinion. Because the small depletion fees are not a significant contribution in support of the Recovery Program or in recovery actions for the endangered fish, termination of the fees for depletions for 100 af or less would not significantly impact the continuation of the Recovery Program or recovery of the endangered fish and would reduce the administrative expenditures of public funds.

We have determined that progress toward recovery is sufficient for the Recovery Program to serve as Conservation Measures (formally RPA) for project depletions of 100 af or less, up to an additional 4,500 af. This brings the cumulative total of allowable small water depletions since the start of the Recovery Program to 12,000 af. Our determination is based on progress made to date under the Recovery Program, which is described in the Service's annual assessment of progress as well as in the Recovery Program's annual Program Highlights document and the 2010 Report to Congress.

## STATUS OF THE SPECIES AND CRITICAL HABITAT

### COLORADO PIKEMINNOW

Species Description

The Colorado pikeminnow is the largest cyprinid fish (minnow family) native to North America and evolved as the main predator in the Colorado River system. It is an elongated pike-like fish that during predevelopment times may have grown as large as 6 feet in length and weighed nearly 100 pounds (Behnke and Benson 1983). Today, Colorado pikeminnow rarely exceed 3 feet in length or weigh more than 18 pounds; such fish are estimated to be 45-55 years old (Osmundson et al. 1997). The mouth of this species is large and nearly horizontal with long slender pharyngeal teeth (located in the throat), adapted for grasping and holding prey. The diet of Colorado pikeminnow longer than 3 or 4 inches, consists almost entirely of other fishes (Vanicek and Kramer 1969). Males become sexually mature earlier and at a smaller size than do females, though all are mature by about age 7 and 20 inches in length (Vanicek and Kramer 1969; Seethaler 1978; Hamman 1981). Adults are strongly countershaded with a dark, olive back, and a white belly. Young are silvery and usually have a dark, wedge-shaped spot at the base of the caudal fin.

Status and Distribution

Based on early fish collection records, archaeological finds, and other observations, the pikeminnow was once found throughout warm water reaches of the entire Colorado River Basin down to the Gulf of California, including reaches of the Upper Colorado River and its major tributaries, the Green River and its major tributaries, the San Juan River and some of its tributaries, and the Gila River system in Arizona (Seethaler 1978; Platania 1990). Pikeminnow apparently were never found in colder, headwater areas. Seethaler (1978) indicates that the species was abundant in suitable habitat throughout the entire Colorado River Basin prior to the 1850s. By the 1970s they were extirpated from the entire Lower Basin (downstream of Glen Canyon Dam) and from portions of the Upper Basin as a result of major alterations to the riverine environment. Having lost approximately 75-80% of its former range, the pikeminnow was federally listed as an endangered species in 1967 under the Endangered Species Preservation Act of 1966 (USFWS 1967; Miller 1961; Moyle 1976; Tyus 1991; Osmundson and Burnham 1998).

The Recovery Plan (USFWS 2002a, Table 4, Figure 4) provides a summary of habitat occupied by wild Colorado pikeminnow in the Upper Colorado River Basin and limits to its distribution.

Estimates of abundance summed for the 3 Colorado pikeminnow populations range from about 6,600-8,900 wild adults. Estimates of subadults are not currently available for all populations. Estimates of adults for the 3 subbasins are: Green River, 6,000–8,000; Upper Colorado River, 600–900 [includes some subadults]; and San Juan River, 19–50 (USFWS 2002a).

A more recent report on the status of Colorado pikeminnow in the Green River Basin (Bestgen et al. 2005) presented population estimates for adult (greater than 18 inches total length (TL)) and recruit-sized (16-18 inches TL) Colorado pikeminnow. The report suggested that numbers of adult pikeminnow declined in the Green River Basin from 3,300 in 2001 to 2,142 in 2003, a reduction of 35%. The 2003 population estimates for Colorado pikeminnow were: Yampa River, 224 adults; White River, 407 adults and 0 recruits (approximately 44 recruits were estimated for each year in 2000-2001); mainstem Green River (from the confluence with the Yampa River to the confluence with the Colorado River), 1,511 adults and 284 recruits.

Results of recent mark-recapture studies in the Upper Colorado River show 2005 river-wide abundance estimates for fish greater than or equal to18 inches in length to be 889 individuals (Osmundson and White 2009). These study results indicate that the Colorado River population may have increased substantially since 1991. Annual recruitment exceeded the estimated number of annual mortalities (for fish greater than or equal to 18 inches) in 6 of the 9 years of study and there was an estimated net gain of 332 fish over the study period (Osmundson and White 2009).

The species was extirpated from the Lower Colorado River Basin in the 1970s but has been reintroduced into the Gila River subbasin where it exists in small numbers in the Verde River (USFWS 2002a).

**TABLE 1. Locations and Limits to Distribution of Colorado Pikeminnow in the Colorado River System.**

| RIVER | OCCUPIED HABITAT | LIMITS TO DISTRIBUTION |
|---|---|---|
| **Green River Subbasin** | | |
| 1. Green River | Lodore Canyon to Colorado River confluence (360 miles) | Cold releases from Flaming Gorge Dam have been warmed and species has naturally expanded upstream into Lodore Canyon; species distributed continuously downstream to Colorado River confluence |
| 1a. Yampa River | Craig, CO, to Green River confluence (141 miles) | Present distribution similar to historic |
| 1b. Little Snake River | Wyoming to Yampa River confluence (50 miles) | Habitat is marginal; flows are reduced; historic distribution unknown |
| 1c. White River | Taylor Draw Dam to Green River confluence (62 miles) | Upstream distribution blocked by Taylor Draw Dam |
| 1d. Price River | Lower 89 miles above Green River confluence | Streamflow reduced; barriers occur above current distribution |
| 1e. Duchesne River | Lower 6 miles above Green River confluence | Streamflow reduced; barriers occur above current distribution |
| **Upper Colorado River Subbasin** | | |
| 2. Upper Colorado River | Palisade, CO, to Lake Powell inflow (185 miles) | Passage by Grand Valley Diversion completed in 1998;Grand Valley Project Diversion in 2005; Price-Stubb in 2008; upstream distribution Rifle, CO; downstream distribution Lake Powell inflow [1] |
| 2a. Gunnison River | Lower 34 miles above Colorado River confluence | Redlands Fishway allowed passage in 1996; upstream distribution is limited by Hartland Diversion Dam and possibly cold-water releases from Aspinall Unit |
| 2b. Dolores River | Lower 1.2 miles above Green River confluence | Streamflow altered; no barriers in potential historic habitat |
| **San Juan River Subbasin** | | |
| 3. San Juan River | Shiprock, NM, to Lake Powell inflow (150 miles) | Irrigation diversions block upstream movement; Lake Powell defines downstream distribution |

[1] Updated since 2002 Recovery Goals

The map below of wild Colorado pikeminnow in the Colorado River Basin was reproduced from the Colorado Pikeminnow Recovery Goals (USFWS 2002a, Figure 1).

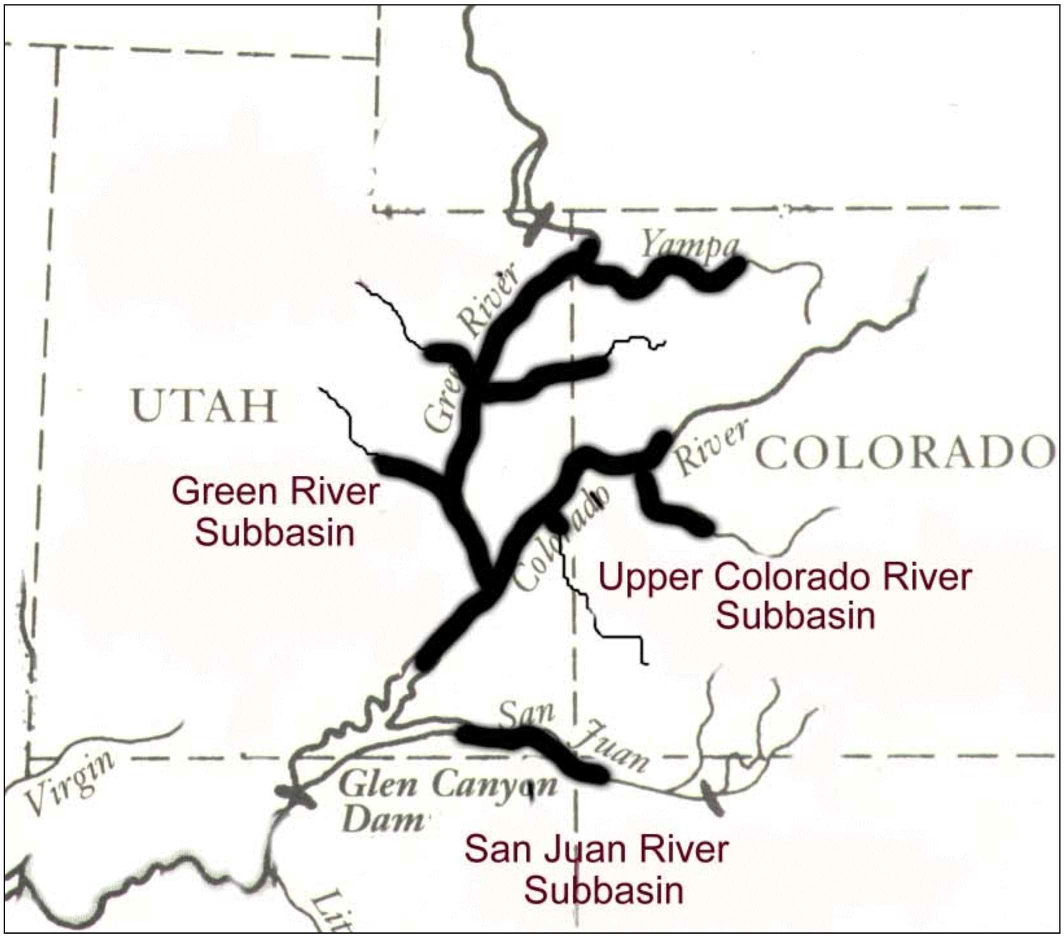


**FIGURE 1. Distribution of Colorado Pikeminnow in the Colorado River System.**

<u>Threats to the Species</u>
Because the pikeminnow was designated as endangered prior to passage of the ESA of 1973, a formal listing package identifying threats was not prepared. The pikeminnow recovery goals (USFWS 2002a) summarize threats to the species as follows: stream regulation, habitat modification, competition with and predation by nonnative fish, and pesticides and pollutants.

Major declines in pikeminnow populations occurred in the Lower Colorado River Basin during the dam-building era of the 1930s through the 1960s. Behnke and Benson (1983) summarized the decline of the natural ecosystem, pointing out that dams, impoundments, and water use practices drastically modified the river's natural hydrology and channel characteristics throughout the Colorado River Basin. Dams on the main stem fragmented the river ecosystem into a series of disjunct segments, blocked native fish migrations, reduced water temperatures downstream of dams, created lake habitat, and provided conditions that allow competitive and predatory nonnative fishes to thrive both within the impounded reservoirs and in the modified river segments that connect them. The highly modified flow regime in the Lower Basin coupled with the introduction of nonnative fishes decimated populations of native fish.

In the Upper Colorado River Basin, declines in pikeminnow populations occurred primarily after the 1960s, when the following dams were constructed:  Glen Canyon Dam on the main stem Colorado River, Flaming Gorge Dam on the Green River, Navajo Dam on the San Juan River, and the Aspinall Unit dams on the Gunnison River.  Some native fish populations in the Upper Basin have managed to persist, while others are nearly extirpated.  River reaches where native fish have declined more slowly, more closely resemble pre-dam hydrologic regimes, where adequate habitat for all life phases still exists, and where migration corridors allow connectivity among habitats used during the various life phases.

Stream flow regulation, which includes mainstem dams, cause the following adverse effects to the Colorado pikeminnow and its habitat:

- Block migration corridors,
- Changes in flow patterns, reduced peak flows and increased base flows,
- Release cold water, making temperature regimes less than optimal,
- Change river habitat into lake habitat, and
- Retain sediment that is important for forming and maintaining backwater habitats

In the Upper Basin, 435 miles of Colorado pikeminnow habitat has been lost by reservoir inundation from Flaming Forge Reservoir on the Green River, Lake Powell on the Colorado River, and Navajo Reservoir on the San Juan River.  Cold water releases from these dams have eliminated suitable habitat for native fishes, including Colorado pikeminnow, from river reaches downstream for approximately 50 miles below Flaming Gorge Dam and Navajo Dam.  In addition to main stem dams, many dams and water diversion structures occur in and upstream from critical habitat that reduce flows and alter flow patterns, which adversely affect critical habitat.  Diversion structures in critical habitat divert fish into canals and pipes where the fish are permanently lost to the river system.  It is unknown how many endangered fish are lost in irrigation systems, but in some years, in some river reaches, the majority of the river flow is diverted into unscreened canals.

At least 67 species of nonnative fishes have been introduced into the Colorado River Basin during the last 100 years (Tyus et al. 1982; Carlson and Muth 1989; Minckley and Deacon 1991; Tyus and Saunders 1996).  Tyus et al. (1982) reported that 42 nonnative fish species have become established in the Upper Basin, and Minckley (1985) reported that 37 nonnative fish species have become established in the Lower Basin.  Many of these species were intentionally introduced as game or forage fishes, whereas others were unintentionally introduced with game species or passively as bait fish.

Pikeminnow in the Upper Colorado River Basin live with about 20 species of warm-water nonnative fishes (Tyus et al. 1982; Lentsch et al. 1996) that are potential predators, competitors, and vectors for parasites and disease.  Researchers believe that nonnative fish species limit the success of pikeminnow recruitment (Bestgen 1997; Bestgen et al. 1997; McAda and Ryel 1999). Osmundson (1987) documented predation by black bullhead (*Ameiurus melas*), green sunfish

(*Lepomis cyanellus*), largemouth bass (*Micropterus salmoides*), and black crappie (*Pomoxis nigromaculatus*) as a significant mortality factor for young-of-year (YOY) and yearling pikeminnow stocked in riverside ponds along the Upper Colorado River. Adult red shiners (*Cyprinella lutrensis*) are known predators of larval native fish in backwaters of the Upper Basin (Ruppert et al. 1993).

High spatial overlap in habitat use has been documented among young pikeminnow, red shiner, sand shiner (*Notropis stramineus*), and fathead minnow (*Pimephales promelas*). In laboratory experiments on behavioral interactions, Karp and Tyus (1990) observed that red shiner, fathead minnow, and green sunfish shared activity schedules and space with young pikeminnow and exhibited antagonistic behaviors to smaller pikeminnow. They hypothesized that pikeminnow may be at a competitive disadvantage in an environment that is resource limited. Data collected indicates that during low water years, nonnative minnows capable of preying on or competing with larval endangered fishes greatly increased in numbers (Osmundson and Kaeding 1991, McAda and Ryel 1999).

Channel catfish (*Ictalurus punctatus*) has been identified as a threat to juvenile, subadult, and adult pikeminnow. Channel catfish were first introduced in the Upper Colorado River Basin in 1892 (Tyus and Nikirk 1990) and are now considered common to abundant throughout much of the Upper Basin (Tyus et al. 1982, Nelson et al. 1995). The species is one of the most prolific predators in the Upper Basin and, among the nonnative fishes, is thought to have the greatest adverse effect on endangered fishes due to predation on juveniles and resource overlap with subadults and adults (Hawkins and Nesler 1991; Lentsch et al. 1996; Tyus and Saunders 1996). Predation upon stocked juvenile Colorado pikeminnow by adult channel catfish has been documented in the San Juan River (Jackson 2006). Juvenile and adult pikeminnow that have preyed on channel catfish have been found choking on the pectoral spines (McAda 1983; Pimental et al. 1985; Ryden and Smith 2002; Lapahie 2003). Although mechanical removal (electrofishing, seining) of channel catfish began in 1995 on the San Juan River, intensive efforts (10 trips per year) did not begin until 2001. Mechanical removal has not yet led to a positive population response in pikeminnow (Davis 2003); however, because the pikeminnow population is so low in the San Juan River, documenting a population response would be extremely difficult.

Threats from pesticides and pollutants include accidental spills of petroleum products and hazardous materials; discharge of pollutants from uranium mill tailings; and high selenium concentration in the water and food chain (USFWS 2002a). Accidental spills of hazardous material into critical habitat, particularly when considering water of sufficient quality as a primary constituent element (PCE), can cause immediate mortality when lethal toxicity levels are exceeded. Pollutants from uranium mill tailings cause high levels of ammonia that exceed water quality standards. High selenium levels may adversely affect reproduction and recruitment (Stephens et al. 1992; Stephens and Waddell 1998; Osmundson et al. 2000).

<u>Recovery</u>
Colorado pikeminnow will be considered eligible to be reclassified from federally endangered to threatened when naturally self-sustaining populations are being maintained in the following areas (USFWS 2002a):

- The Green River from its confluence with the Colorado River to its confluence with the Yampa River, the lower 137 miles of the Yampa River, and the lower 150 miles of the White River. The population estimate for the Green River subbasin must exceed 2,600 adults (2,600 is the estimated minimum viable population (MVP) needed to ensure long-term genetic and demographic viability).

- The Colorado River from Palisade, Colorado, to Lake Powell. At least 700 adults (number based on inferences about carrying capacity) must be maintained in the Upper Colorado River subbasin.

- The San Juan River from Lake Powell upstream to the confluence of the Animas River. A target number of 1,000, age 5+ fish (number based on estimated survival of stocked fish and inferences about carrying capacity) must be established through augmentation and/or natural reproduction in the San Juan River subbasin.

This fish species will be eligible for removal from the Federal endangered species list when all of the following conditions have been met:

- Self-sustaining populations exist in the areas of the Green and Colorado Rivers identified above. A self-sustaining population of at least 800 adults also must exist in the San Juan River unless the Colorado River population is maintained above 1,000 adults.

- A population exists and habitat has been protected either in the Salt River or in the Verde River.

- The threat of significant "fragmentation" of the population has been removed. (Fragmentation refers to separation between fish populations caused by geographical distance or by physical barriers.)

- Essential habitats, including primary migration routes, required stream flows and necessary water quality, have been legally protected.

- Other identifiable threats that could significantly affect the population have been removed.

Life History

The life history phases that appear to be most limiting for pikeminnow populations include spawning, egg hatching, development of larvae, and the first year of life. These phases of pikeminnow development are tied closely to specific habitat requirements. Natural spawning of pikeminnow is initiated on the descending limb of the annual hydrograph as water temperatures approach the range of 60.8-68°F (Vanicek and Kramer 1969; Hamman 1981; Haynes et al. 1984; Tyus 1990; McAda and Kaeding 1991). Temperature at initiation of spawning varies by river. In the Green River, spawning begins as temperatures exceed 68-73°F; in the Yampa River, 61-68°F (Bestgen et al. 1998); in the Colorado River, 64-72°F (McAda and Kaeding 1991); in the San Juan River temperatures were estimated to be 61-72°F. Spawning, both in the hatchery and under natural riverine conditions, generally occurs in a 2-month period between late June and late August. However, sustained high flows during wet years may suppress river temperatures and extend spawning into September (McAda and Kaeding 1991). Conversely, during low-flow years, when the water warms earlier, spawning may commence in mid-June.

Temperature also has an effect on egg development and hatching success. In the laboratory, egg development was tested at five temperatures and hatching success was found to be highest at 68 F, and lower at 77°F. Mortality was 100% at 41, 50, 59, and 86°F. In addition, larval abnormalities were twice as high at 77°F than at 68°F (Marsh 1985). Experimental tests of temperature preference of yearling (Black and Bulkley 1985a) and adult (Bulkley et al. 1981) pikeminnow indicated that 77°F was the most preferred temperature for both life phases. Additional experiments indicated that optimum growth of yearlings also occurs at temperatures near 77°F (Black and Bulkley 1985b). Although no such tests were conducted using adults, the tests with yearlings supported the conclusions of Jobling (1981) that the final thermal preference of 77°F provides a good indication of optimum growth temperature for all life phases.

Males become sexually mature earlier and at a smaller size than do females, though all are mature by about age 7 and 20 inches in length (Vanicek and Kramer 1969; Seethaler 1978; Hamman 1981). Hatchery-reared males became sexually mature at 4 years of age and females at 5 years. After about 10 years of age, female pikeminnow typically grow to larger sizes than males (Osmundson 2002b). Average fecundity of 24, 9-year old females was 77,400 (range 57,766-113,341) or 55,533 eggs per kilogram, and average fecundity of 9, 10-year old females was 66,185 (range 11,977-91,040) or 45,451 eggs per kilogram (Hamman 1986).

Most information on pikeminnow reproduction has been gathered from spawning sites on the lower 20 miles of the Yampa River and in Gray Canyon on the Green River (Tyus and McAda 1984; Tyus 1985; Wick et al. 1985; Tyus 1990). Pikeminnow spawn after peak runoff subsides. Spawning is probably triggered by several interacting variables such as day length, temperature, flow level, and perhaps substrate characteristics. Known spawning sites in the Yampa River are characterized by riffles or shallow runs with well-washed coarse substrate (cobble containing relatively deep interstitial voids (for egg deposition)) in association with deep pools or areas of slow non-turbulent flow used as staging areas by adults (Lamarra et al. 1985; Tyus 1990). Recent investigations at a spawning site in the San Juan River by Bliesner and Lamarra (1995) and at one site in the Upper Colorado River (USFWS unpublished data) indicate a similar association of habitats. The most unique feature at the sites used for spawning, in comparison with otherwise similar sites nearby, is the lack of embeddedness of the cobble substrate and the depth to which the rocks are devoid of fine sediments; this appears consistent at the sites in all three rivers (Lamarra et al. 1985; Bliesner and Lamarra 1995).

Collections of larvae and YOY downstream of known spawning sites in the Green, Yampa, and San Juan Rivers demonstrate that downstream drift of larval pikeminnow occurs following hatching (Haynes et al. 1984; Nesler et al. 1988; Tyus 1990; Tyus and Haines 1991; Platania 1990; Ryden 2003a). Studies on the Green and Colorado Rivers found that YOY used backwaters almost exclusively (Holden 2000). During their first year of life, pikeminnow prefer warm, turbid, relatively deep (averaging 1.3 feet) backwater areas of zero velocity (Tyus and Haines 1991). After about 1 year, young are rarely found in such habitats, although juveniles and subadults are often located in large deep backwaters during spring runoff (USFWS unpublished data; Osmundson and Burnham 1998). Studies indicate that significant recruitment of Colorado pikeminnow may not occur every year, but occurs in episodic intervals of several years (Osmundson and Burnham 1998).

Pikeminnow often migrate considerable distances to spawn in the Green and Yampa Rivers (Miller et al. 1982; Archer et al. 1986; Tyus and McAda 1984; Tyus 1985, 1990), and similar movement has been noted in the main stem San Juan River. A fish captured and tagged in the San Juan arm of Lake Powell in April 1987, was recaptured in the San Juan River approximately 80 miles upstream in September 1987 (Platania 1990). Ryden and Ahlm (1996) report that a pikeminnow captured at River Mile (RM) 74.8 (between Bluff and Mexican Hat) made a 50- to 60-mile migration during the spawning season in 1994, before returning to within 0.4 river mile of its original capture location. In the Green River system, adult Colorado pikeminnow converge to reproduce at two known spawning areas, Yampa Canyon in the Lower Yampa River and Gray Canyon in the Green River (Tyus and McAda 1984; Tyus 1985, 1990, 1991; Irving and Modde 2000). Rates of movement for individuals are not precisely known, but two individuals made the approximately 249-mile migration from the White River below Taylor Draw Dam to the Yampa River spawning area in less than 2 weeks. Bestgen et al. (2007) state that adults migrate up to 463 river miles round-trip to spawning areas in Yampa Canyon and in Desolation–Gray Canyon.

In contrast to pikeminnow in the Green and Yampa Rivers, the majority of adult Colorado pikeminnow in the San Juan and Colorado Rivers reside closer to the area in which they spawn (McAda and Kaeding 1991; Osmundson et al. 1997; Ryden and Ahlm 1996; Miller and Ptacek 2000). During their study, Ryden and Ahlm (1996) found that pikeminnow in the San Juan River aggregated at the mouth of the Mancos River prior to spawning. Information on radio-tagged adult pikeminnow during the fall suggests that pikeminnow seek out deep water areas in the Colorado River (Miller et al. 1982; Osmundson and Kaeding 1989), as do many other riverine species. Pools, runs, and other deep water areas, especially in upstream reaches, are important winter habitats for pikeminnow (Osmundson et al. 1995).

Very little information is available on the influence of turbidity on the endangered Colorado River fishes. Osmundson and Kaeding (1989) found that turbidity allows use of relatively shallow habitats ostensibly by providing adults with cover; this allows foraging and resting in areas otherwise exposed to avian or terrestrial predators. Tyus and Haines (1991) found that young pikeminnow in the Green River preferred backwaters that were turbid. Clear conditions in these shallow waters might expose young fish to predation from wading birds or exotic, sight-feeding, piscivorous fish. It is unknown whether the river was as turbid historically as it is today. For now, it is assumed that these endemic fishes evolved under conditions of high turbidity. Therefore, the retention of these highly turbid conditions is probably an important factor in maintaining the ability of these fish to compete with nonnatives that may not have evolved under similar conditions.

<u>Critical Habitat</u>

Critical habitat for the Colorado pikeminnow was designated in 1994 within the 100-year floodplain of the Colorado pikeminnow's historical range in the following area of the Upper Colorado River (59 FR 13374). Colorado pikeminnow now only occur in the Upper Colorado

River Basin (upstream of Lee Ferry just below the Glen Canyon Dam). Most of Lake Powell is not suitable habitat for Colorado pikeminnow and is not designated critical habitat. The total designated miles is 1,148 and represents 29% of the historical habitat for the species:

> Moffat County, Colorado. The Yampa River and its 100-year floodplain from the State Highway 394 bridge in T. 6 N., R. 91 W., section 1 (6th Principal Meridian) to the confluence with the Green River in T. 7 N., R. 103 W., section 28 (6th Principal Meridian).
>
> Uintah, Carbon, Grand, Emery, Wayne, and San Juan Counties, Utah; and Moffat County, Colorado. The Green River and its 100-year floodplain from the confluence with the Yampa River in T. 7 N., R. 103 W., section 28 (6th Principal Meridian) to the confluence with the Colorado River in T. 30 S., R. 19 E., section 7 (Salt Lake Meridian).
>
> Rio Blanco County, Colorado; and Uintah County, Utah. The White River and its 100-year floodplain from Rio Blanco Lake Dam in T. 1 N., R. 96 W., section 6 (6th Principal Meridian) to the confluence with the Green River in T. 9 S., R. 20 E., section 4 (Salt Lake Meridian).
>
> Delta and Mesa Counties, Colorado. The Gunnison River and its 100-year floodplain from the confluence with the Uncompahgre River in T. 15 S., R. 96 W., section 11 (6th Principal Meridian) to the confluence with the Colorado River in T. 1 S., R. 1 W., section 22 (Ute Meridian).
>
> Mesa and Garfield Counties, Colorado; and Grand, San Juan, Wayne, and Garfield Counties, Utah. The Colorado River and its 100-year floodplain from the Colorado River Bridge at exit 90 north off Interstate 70 in T. 6 S., R. 93 W., section 16 (6th Principal Meridian) to North Wash, including the Dirty Devil arm of Lake Powell up to the full pool elevation, in T. 33 S., R. 14 E., section 29 (Salt Lake Meridian).
>
> San Juan County, New Mexico; and San Juan County, Utah. The San Juan River and its 100-year floodplain from the State Route 371 Bridge in T. 29 N., R. 13 W., section 17 (New Mexico Meridian) to Neskahai Canyon in the San Juan arm of Lake Powell in T. 41 S., R. 11 E., section 26 (Salt Lake Meridian) up to the full pool elevation.

The final critical habitat rule identified water, physical habitat, and the biological environment as the PCEs of critical habitat. The water PCE was further described as including a quantity of water of sufficient quality (i.e., temperature, dissolved oxygen, lack of contaminants, nutrients, turbidity, etc.) that is delivered to a specific location in accordance with a hydrologic regime that is required for the particular life stage for each species. The physical habitat includes areas of the Colorado River system that are inhabited or potentially habitable by fish for use in spawning, nursery, feeding, and rearing, or serve as corridors between these areas. In addition to river channels, these areas also include bottom lands, side channels, secondary channels, oxbows, backwaters, and other areas in the 100-year floodplain, which when inundated provide access to spawning, nursery, feeding, and rearing habitats. The biological environment PCE includes food supply predation, and competition. Food supply is a function of nutrient supply, productivity, and availability to each life stage of the species. Predation and competition, although considered normal components of this environment, are out of balance due to introduced nonnative fish species in many areas.

## RAZORBACK SUCKER

Species Description

Like all suckers (family Catastomidae, meaning "down mouth"), the razorback sucker has a ventral mouth with thick lips covered with papillae and no scales on its head. In general, suckers are bottom browsers, sucking up or scraping off small invertebrates, algae, and organic matter with their fleshy, protrusible lips (Moyle 1976). The razorback sucker is the only sucker with an abrupt sharp-edged dorsal keel behind its head. The keel becomes more massive with age. The head and keel are dark, the back is olive-colored, the sides are brownish or reddish, and the abdomen is yellowish white (Sublette et al. 1990). Adults often exceed 6 pounds in weight and 2 feet in length. Like Colorado pikeminnow, razorback suckers are long-lived, living 40+ years.

Status and Distribution

On March 14, 1989, the Service was petitioned to conduct a status review of the razorback sucker. Subsequently, the razorback sucker was designated as endangered under a final rule published on October 23, 1991 (56 FR 54957). The final rule stated "Little evidence of natural recruitment has been found in the past 30 years, and numbers of adult fish captured in the last 10 years demonstrate a downward trend relative to historic abundance. Significant changes have occurred in razorback sucker habitat through diversion and depletion of water, introduction of nonnative fishes, and construction and operation of dams" (56 FR 54957). Recruitment of razorback suckers to the population continues to be a problem.

Historically, razorback suckers were found in the main stem Colorado River and major tributaries in Arizona, California, Colorado, Nevada, New Mexico, Utah, Wyoming, and in Mexico (Ellis 1914; Minckley 1983). Bestgen (1990) reported that this species was once so numerous that it was commonly used as food by early settlers and that a commercially marketable quantity was caught in Arizona as recently as 1949. In the Upper Colorado River Basin, razorback suckers were reported to be very abundant in the Green River near Green River, Utah, in the late 1800s (Jordan 1891). An account in Osmundson and Kaeding (1989) reported that residents living along the Colorado River near Clifton, Colorado, observed several thousand razorback suckers during spring runoff in the 1930s and early 1940s. In the San Juan River drainage, the first razorback sucker from the river was documented in 1988 (Platania 1990); however, Platania and Young (1989) relayed historical accounts of alleged razorback suckers ascending the Animas River to Durango, Colorado, around the turn of the century.

The Recovery Goals (USFWS 2002b, Table 5; Figure 3) provides a summary of habitat occupied by the razorback sucker and limits to its distribution.

**TABLE 2. Locations and Limits to Distribution of Razorback Sucker in the Colorado River System.**

| RIVER | OCCUPIED HABITAT | LIMITS TO DISTRIBUTION |
|---|---|---|
| **Green River Subbasin** | | |
| Green River | Lodore Canyon to Colorado River confluence (360 miles); population being augmented | Cold-water releases from Flaming Gorge Dam previously restricted range, but warmed releases may allow for range expansion |
| Yampa River | Craig, CO, to Green River confluence (141 miles) | Present in low numbers in historic habitat |
| White River | Taylor Draw Dam to Green River confluence (62 miles) | Found in low numbers; upstream distribution blocked by Taylor Draw Dam |
| Duchesne River | Lower 1.2 miles above Green River confluence | Found as small aggregations during spring runoff at mouth |
| **Upper Colorado River Subbasin** | | |
| Upper Colorado River | Rifle, CO, to Lake Powell inflow (185 miles); population being augmented | Wild population considered extirpated from river, but fish are being stocked Passage by Grand Valley Diversion completed in 1998;Grand Valley Project Diversion in 2005; Price-Stubb in 2008; upstream distribution Rifle, CO; downstream distribution Lake Powell inflow [2] |
| Gunnison River | Lower 34 miles above Colorado River confluence; population being reestablished through stocking | Wild population considered extirpated from river, but fish are being stocked in lower 34 miles above Colorado River confluence to reestablish population; Redlands Fishway allows passage since 1996; upstream distribution limited by Hartland Diversion Dam and possibly cold-water releases from Aspinall Unit |
| **San Juan River Subbasin** | | |
| San Juan River | Shiprock, NM, to Lake Powell inflow (150 miles); population being reestablished through stocking | Wild population considered extirpated from river, but fish are being stocked between Shiprock, NM, and Lake Powell inflow (150 miles) to reestablish population; diversion structures block upstream movement; Lake Powell defines downstream distribution |
| **Lower Colorado River Subbasin** | | |
| Lake Mohave | Potential lake-wide distribution; population being augmented | Found only in reservoir |
| Lake Mead | Potential lake-wide distribution | Found only in reservoir but may extend upstream into lower Grand Canyon; cold-water releases from Glen Canyon Dam prevent expansion into upper Grand Canyon |
| Lower Colorado River | Lake Havasu to Davis Dam (60 miles) | Stocked fish have not remained in Lake Havasu, but have populated river between reservoir and Davis Dam; fish spawned and produced larvae in 2000 and 2001 |
| **Gila River Subbasin** | | |
| Verde River | Limited distribution of hatchery stocks | |
| Salt River | Limited distribution of hatchery stocks | |

[2] Updated since 2002 Recovery Goals

The map below of wild or stocked razorback sucker in the Colorado River Basin was reproduced from the Razorback Sucker Recovery Goals (USFWS 2002b, Figure 1).


**FIGURE 2. Distribution of Wild or Stocked Razorback Sucker in the Colorado River System.**

Currently, the largest concentration of razorback sucker remaining in the Colorado River Basin is in Lake Mohave on the border of Arizona and California. Estimates of the wild stock in Lake Mohave have fallen precipitously in recent years from 60,000 as late as 1991, to 25,000 in 1993 (Marsh 1993; Holden 1994), to about 9,000 in 2000 (USFWS 2002b). Until recently, efforts to introduce young razorback sucker into Lake Mohave have failed because of predation by nonnative species (Minckley et al. 1991; Clarkson et al. 1993; Burke 1994). While limited numbers of razorback suckers persist in other locations in the Lower Colorado River, they are considered rare or incidental and may be continuing to decline.

In the Upper Colorado River Basin, above Glen Canyon Dam, razorback suckers are found in limited numbers in both lentic (lake-like) and riverine environments. Small numbers of razorback suckers have been found in Lake Powell at the mouths of the Dirty Devil, San Juan and Colorado Rivers. The largest populations of razorback suckers in the Upper Basin are found in the Upper Green and Lower Yampa Rivers (Tyus 1987). Lanigan and Tyus (1989) estimated a population of 948 adults in the Upper Green River. Eight years later, the population was estimated at 524 adults and the population was characterized as stable or declining slowly with some evidence of recruitment (Modde et al. 1996). In the Colorado River, most razorback suckers occur in the Grand Valley area near Grand Junction, Colorado; however, they are increasingly rare. More recent accounts are less encouraging on the status of the razorback sucker in the Upper Colorado River Basin, "Less than 100 wild adults are estimated to still occur in the middle Green River of Utah and Colorado, and wild populations are considered gone from the Gunnison, Colorado, and San Juan Rivers" (Upper Colorado River Endangered Fish Recovery Program (UCREFRP) 2006).

Documented records of wild razorback sucker adults in the San Juan River are limited to two fish captured in a riverside pond near Bluff, Utah, in 1976, and one fish captured in the river in 1988, also near Bluff (Platania 1990). Large numbers were anecdotally reported from a drained pond near Bluff in 1976, but no specimens were preserved to verify the species. No wild razorback suckers were found during the 7-year research period (1991-1997) on the San Juan River (Holden 1999). However, hatchery-reared razorback sucker, especially fish greater than (13.8 inches), introduced into the San Juan River in the 1990s have survived and reproduced, as evidenced by recapture data and collection of larval fish (Ryden 2000b). Until 2003, there was very limited evidence indicating natural recruitment to any population of razorback sucker in the Colorado River system (Bestgen 1990; Platania 1990; Platania et al. 1991; Tyus 1987; McCarthy and Minckley 1987; Osmundson and Kaeding 1989; Modde et al. 1996). In 2003, two juvenile (age 2) razorback sucker (9.8 and 10.6 inches) thought to be wild-produced from stocked fish were collected in the Lower San Juan River (Ryden 2004).

The largest concentration of razorback suckers in the Upper Basin exists in low-gradient flat-water reaches of the middle Green River between and including the lower few miles of the Duchesne River and the Yampa River (Tyus 1987; Tyus and Karp 1990; Muth 1995; Modde and Wick 1997; Muth et al. 2000). This area includes the greatest expanse of floodplain habitat in the Upper Colorado River Basin, between Pariette Draw at River RM 238 and the Escalante Ranch at RM 310 (Irving and Burdick 1995).

Lanigan and Tyus (1989) used a demographically closed model with capture-recapture data collected from 1980-1988 and estimated that the middle Green River population consisted of about 1,000 adults (mean, 948; 95% confidence interval, 758-1,138). Based on a demographically open model and capture-recapture data collected from 1980-1992, Modde et al. (1996) estimated the number of adults in the middle Green River population at about 500 fish (mean, 524; 95% confidence interval, 351-696). That population had a relatively constant length frequency distribution among years (most frequent modes were in the 19-20 inches TL interval) and an estimated annual survival rate of 71%. Bestgen et al. (2002) estimated the population of wild razorback sucker in the middle Green River to be much lower than earlier estimates about

100 based on data collected in 1998 and 1999. There are no current population estimates of razorback sucker in the remainder of the Upper Colorado River Basin due to low numbers captured in recent years.

Substantial numbers of subadult razorback sucker have been stocked into the Upper Colorado River subbasin, including the Gunnison River, since implementing the stocking plan (Nesler et al. 2003). An evaluation of stocked razorback sucker concluded survival is low for the first year at large, fish stocked in the summer had lower survival, and larger fish at stocking had better survival (Zelasko et al. 2009); however, large numbers have survived to adulthood. Ripe fish have been collected in spawning aggregations and larvae have been collected in the Green (very large numbers in recent years), Colorado, and Gunnison Rivers. Annual augmentation of subadult and adult razorback sucker occurs in the San Juan River, with an annual goal of 11,400 fish greater than or equal to 12 inches (Ryden 2003b). Reproduction has been documented through the collection of larvae every year since 1998. Juvenile razorback sucker were found in the San Juan River in 2003 and 2004.

<u>Life History</u>

McAda and Wydoski (1980) and Tyus (1987) reported springtime aggregations of razorback suckers in off-channel habitats and tributaries; such aggregations are believed to be associated with reproductive activities. Tyus and Karp (1990) and Osmundson and Kaeding (1991) reported off-channel habitats to be much warmer than the mainstem river and that razorback suckers presumably moved to these areas for feeding, resting, sexual maturation, spawning, and other activities associated with their reproductive cycle. Reduction in spring peak flows eliminates or reduces the frequency of inundation of off-channel habitats. The absence of these seasonally flooded riverine habitats is believed to be a limiting factor in the successful recruitment of razorback suckers in their native environment (Tyus and Karp 1989; Osmundson and Kaeding 1991). Wydoski and Wick (1998) identified starvation of larval razorback suckers due to low zooplankton densities in the main channel and loss of floodplain habitats which provide adequate zooplankton densities for larval food as one of the most important factors limiting recruitment. Tyus and Karp (1990) and Modde and Wick (1997) suggested that use of warmer, more productive flooded habitats by adult razorback suckers during the breeding season is related to temperature preferences (73-77°F) (Bulkley and Pimental 1983) and abundance of appropriate foods (Jonez and Sumner 1954; Vanicek 1967; Marsh 1987; Wolz and Shiozawa 1995; Modde 1997; Wydoski and Wick 1998).

While razorback suckers have never been directly observed spawning in turbid riverine environments within the Upper Colorado River Basin, captures of ripe specimens, both males and females, have been recorded in the Yampa, Green, Colorado, and San Juan Rivers (Valdez et al. 1982; McAda and Wydoski 1980; Tyus 1987; Osmundson and Kaeding 1989; Tyus and Karp 1989, 1990; Osmundson and Kaeding 1991; Platania 1990; Ryden 2000b; Jackson 2003; Ryden 2005). Sexually mature razorback suckers are generally collected on the ascending limb of the hydrograph from mid-April through June and are associated with coarse gravel substrates. Because of the relatively steep gradient in the San Juan River and lack of a wide flood plain, razorback sucker are likely spawning in low velocity, turbid, main channel habitats. Aggregations of ripe adults have only been documented in a few locations.

Both sexes mature as early as age 4 (McAda and Wydoski 1980). Fecundity, based on ovarian egg counts, ranges from 75,000-144,000 eggs (Minckley 1983). McAda and Wydoski (1980) reported an average fecundity (N = 10) of 46,740 eggs/fish (27,614–76,576). Several males attend each female; no nest is built. The adhesive eggs drift to the bottom and hatch there (Sublette et al. 1990). Marsh (1985) reported that, in laboratory experiments, the percentage of egg hatch was greatest at 68°F and all embryos died at incubation temperatures of 41, 50, and 86°F.

Because young and juvenile razorback suckers are rarely encountered, their habitat requirements in the wild are not well known, particularly in native riverine environments. However, it is assumed that low-velocity backwaters and side channels are important for YOY and juveniles, as it is to the early life stages of most riverine fish. Prior to construction of large main stem dams and the suppression of spring peak flows, low velocity, off-channel habitats (seasonally flooded bottomlands and shorelines) were commonly available throughout the Upper Colorado River Basin (Tyus and Karp 1989; Osmundson and Kaeding 1991). Modde (1996) found that on the Green River, larval razorback suckers entered flooded bottomlands that are connected to the main channel during high flow. However, as mentioned earlier, because of the relatively steep gradient of the San Juan River and the lack of a wide flood plain, flooded bottomlands are probably much less important in this system than are other low velocity habitats such as backwaters and secondary channels (Ryden 2004a).

Spring migrations by adult razorback suckers were associated with spawning in historic accounts (Jordan 1891; Hubbs and Miller 1953; Sigler and Miller 1963; Vanicek 1967) and a variety of local and long-distance movements and habitat-use patterns have been subsequently documented. Spawning migrations (one-way movements of 19-66 miles) observed by Tyus and Karp (1990) included movements between the Ouray and Jensen areas of the Green River and between the Jensen area and the Lower Yampa River. Initial movement of adult razorback suckers to spawning sites was influenced primarily by increases in river discharge and secondarily by increases in water temperature (Tyus and Karp 1990; Modde and Wick 1997; Modde and Irving 1998). Flow and temperature cues may serve to effectively congregate razorback suckers at spawning sites, thus increasing reproductive efficiency and success. Reduction in spring peak flows may hinder the ability of razorback suckers to form spawning aggregations, because spawning cues are reduced (Modde and Irving 1998).

A few domestic-reared razorback suckers released into the wild have exhibited long-distance dispersals. One individual released into the Gunnison River was recaptured 3.5 years later 90 miles up the Green River, having traveled a minimum distance of 228 river miles. Another individual released into the Gunnison River was recaptured 205 river miles downstream in the Colorado River only 6.5 months later (Burdick 2003).

Outside of the spawning season, adult razorback suckers occupy a variety of shoreline and main channel habitats including slow runs, shallow to deep pools, backwaters, eddies, and other relatively slow velocity areas associated with sand substrates (Tyus 1987; Tyus and Karp 1989; Osmundson and Kaeding 1989; Valdez and Masslich 1989; Osmundson and Kaeding 1991; Tyus and Karp 1990).

<u>Threats to the Species</u>
A marked decline in populations of razorback suckers can be attributed to construction of dams and reservoirs, introduction of nonnative fishes, alteration of water quality, and removal of large quantities of water from the Colorado River system. Dams on the main stem Colorado River and its major tributaries have fragmented populations and blocked migration routes. Dams also have drastically altered flows, water temperatures, and channel geomorphology. These changes have modified habitats in many areas so that they are no longer suitable for breeding, feeding, or sheltering. Major changes in species composition have occurred due to the introduction of nonnative fishes, many of which have thrived due to man-induced changes to the natural riverine system. Habitat has been significantly degraded to a point where it impairs the essential life history functions of razorback sucker, such as reproduction and recruitment into the adult population. The threats to razorback sucker are essentially the same threats identified for Colorado pikeminnow.

The razorback sucker recovery goals identified streamflow regulation, habitat modification, predation by nonnative fish species, and pesticides and pollutants as the primary threats to the species (USFWS 2002b). Within the Upper Colorado River Basin, recovery efforts include the capture and removal of razorback suckers from all known locations for genetic analyses and development of brood stocks. In the short term, augmentation (stocking) may be the only means to prevent the extirpation of razorback sucker in the Upper Colorado River Basin. However, in the long term it is expected that natural reproduction and recruitment will occur. A genetics management plan and augmentation plan have been written for the razorback sucker (Crist and Ryden 2003; Ryden 2003a; Nesler et al. 2003).

Many species of nonnative fishes occur in occupied habitat of the razorback sucker. These nonnative fishes are predators, competitors, and vectors of parasites and diseases (Tyus et al. 1982; Lentsch et al. 1996; Pacey and Marsh 1999; Marsh et al. 2001). Many researchers believe that nonnative species are a major cause for the lack of recruitment and that nonnative fish are the most important biological threat to the razorback sucker (e.g., McAda and Wydoski 1980; Minckley 1983; Tyus 1987; Muth et al. 2000). There are reports of predation of razorback sucker eggs and larvae by common carp (*Cyprinus carpio*), channel catfish, smallmouth bass (*Micropterus dolomieui*), largemouth bass, bluegill (*Lepomis macrochirus*), green sunfish, and red-ear sunfish (*Lepomis microlophus*) (Jonez and Sumner 1954; Marsh and Langhorst 1988; Langhorst 1989). Marsh and Langhorst (1988) found higher growth rates in larval razorback sucker in the absence of predators in Lake Mohave, and Marsh and Brooks (1989) reported that channel catfish and flathead catfish were major predators of stocked razorback sucker in the Gila River. Juvenile razorback sucker stocked in isolated coves along the Colorado River in California suffered extensive predation by channel catfish and largemouth bass (Langhorst 1989). Predation upon a recently-stocked razorback sucker by an adult channel catfish was documented in the San Juan River (Jackson 2005). Aggressive behavior between channel catfish and adult razorback sucker has been inferred from the presence of distinct bite marks on the dorsal keels of four razorback suckers that match the bite characteristics of channel catfish (Ryden 2004).

Lentsch et al. (1996) identified six species of nonnative fishes in the Upper Colorado River Basin as threats to razorback sucker: red shiner, common carp, sand shiner, fathead minnow, channel catfish, and green sunfish. Smaller fish, such as adult red shiner, are known predators of larval native fish (Ruppert et al. 1993). Large predators, such as walleye (*Stizostedion vitreum*), northern pike, and striped bass (*Morone saxatilis*), also pose a threat to subadult and adult razorback sucker (Tyus and Beard 1990). Current nonnative fish management in the Upper Colorado River Basin has focused on three species: northern pike, smallmouth bass, and channel catfish, which compete with and prey on the endangered and native fish species (see the Threats section under Colorado pikeminnow above). In addition, the Recovery Program is experimenting with the removal of nonnative white sucker (*Catostomus commersoni*), which is known to hybridize with the razorback sucker and the other native suckers.

<u>Critical Habitat</u>

Critical habitat was designated in 1994 within the 100-year floodplain of the razorback sucker's historical range in the following area of the Upper Colorado River (59 FR 13374). The PCEs are the same as critical habitat for Colorado pikeminnow described previously, as is the status of the PCEs. We designated 15 reaches of the Colorado River system as critical habitat for the razorback sucker. These reaches total 1,724 miles as measured along the center line of the river within the subject reaches. The designation represents approximately 49% of the historical habitat for the species and includes reaches of the Green, Yampa, Duchesne, Colorado, White, Gunnison, and San Juan Rivers:

> <u>Moffat County, Colorado</u>. The Yampa River and its 100-year floodplain from the mouth of Cross Mountain Canyon in T. 6 N., R. 98 W., section 23 (6th Principal Meridian) to the confluence with the Green River in T. 7 N., R. 103 W., section 28 (6th Principal Meridian).
>
> <u>Uintah County, Utah; and Moffat County, Colorado</u>. The Green River and its 100-year floodplain from the confluence with the Yampa River in T. 7 N., R. 103 W., section 28 (6th Principal Meridian) to Sand Wash in T. 11 S., R. 18 E., section 20 (6th Principal Meridian).
>
> <u>Uintah, Carbon, Grand, Emery, Wayne, and San Juan Counties, Utah</u>. The Green River and its 100-year floodplain from Sand Wash at RM 96 at T. 11 S., R. 18 E., section 20 ($6^{th}$ Principal Meridian) to the confluence with the Colorado River in T. 30 S., R. 19 E., section 7 (6th Principal Meridian).
>
> <u>Uintah County, Utah</u>. The White River and its 100-year floodplain from the boundary of the Uintah and Ouray Indian Reservation at RM 18 in T. 9 S., R. 22 E., section 21 (Salt Lake Meridian) to the confluence with the Green River in T. 9 S., R 20 E., section 4 (Salt Lake Meridian).
>
> <u>Uintah County, Utah</u>. The Duchesne River and its 100-year floodplain from RM 2.5 in T. 4 S., R. 3 E., section 30 (Salt Lake Meridian) to the confluence with the Green River in T. 5 S., R. 3 E., section 5 (Uintah Meridian).

Delta and Mesa Counties, Colorado. The Gunnison River and its 100-year floodplain from the confluence with the Uncompahgre River in T. 15 S., R. 96 W., section 11 (6th Principal Meridian) to Redlands Diversion Dam in T. 1 S., R. 1 W., section 27 (Ute Meridian).

Mesa and Garfield Counties, Colorado. The Colorado River and its 100-year floodplain from Colorado River Bridge at exit 90 north off Interstate 70 in T. 6 S., R. 93 W., section 16 (6th Principal Meridian) to Westwater Canyon in T. 20 S., R. 25 E., section 12 (Salt Lake Meridian) including the Gunnison River and its 100-year floodplain from the Redlands Diversion Dam in T. 1 S., R. 1 W., section 27 (Ute Meridian) to the confluence with the Colorado River in T. 1 S., R. 1 W., section 22 (Ute Meridian).

Grand, San Juan, Wayne, and Garfield Counties, Utah. The Colorado River and its 100-year floodplain from Westwater Canyon in T. 20 S., R. 25 E., section 12 (Salt Lake Meridian) to full pool elevation, upstream of North Wash, and including the Dirty Devil arm of Lake Powell in T. 33 S., R. 14 E., section 29 (Salt Lake Meridian).

San Juan County; and Utah, San Juan County, New Mexico. The San Juan River and its 100-year floodplain from the Hogback Diversion in T. 29 N., R. 16 W., section 9 (New Mexico Meridian) to the full pool elevation at the mouth of Neskahai Canyon on the San Juan arm of Lake Powell in T. 41 S., R. 11 E., section 26 (Salt Lake Meridian).

Recovery

Objective, measurable criteria for recovery of razorback sucker in the Colorado River System are presented for each of two recovery units (i.e., the Upper Basin, including the Green River, Upper Colorado River, and San Juan River subbasins; the Lower Basin, including the mainstem and its tributaries from Glen Canyon Dam downstream to the southerly International Boundary with Mexico) because of different recovery or conservation programs and to address unique threats and site-specific management actions and tasks necessary to minimize or remove those threats. Recovery of the species is considered necessary in both the Upper and Lower Basins because of the present status of populations and existing information on razorback sucker biology. Self-sustaining populations will need to be established through augmentation. Without viable wild populations, there are many uncertainties associated with recovery of razorback sucker. These recovery goals are based on the best available scientific information, and are structured to attain a balance between reasonably achievable criteria and ensuring the viability of the species beyond delisting. These recovery criteria will need to be reevaluated and revised after self-sustaining populations are established and there is improved understanding of razorback sucker biology.

Downlisting can occur if, over a 5-year period: **1)** genetically and demographically viable, self-sustaining populations are maintained in the Green River subbasin and **EITHER** in the Upper Colorado River subbasin or the San Juan River subbasin such that--a) the trend in adult (age 4+; greater or equal to 16 inches TL) point estimates for each of the two populations does not decline significantly, and b) mean estimated recruitment of age 3 (12-16 inches TL) naturally produced fish equals or exceeds mean annual adult mortality for each of the two populations, and c) each point estimate for each of the 2 populations exceeds 5,800 adults (5,800 is the estimated

MVP needed to ensure long-term genetic and demographic viability); and **2)** a genetic refuge is maintained in Lake Mohave of the Lower Basin recovery unit; and **3)** two genetically and demographically viable, self-sustaining populations are maintained in the Lower Basin recovery unit (e.g., mainstem and/or tributaries) such that--a) the trend in adult point estimates for each population does not decline significantly, and b) mean estimated recruitment of age 3 naturally produced fish equals or exceeds mean annual adult mortality for each population, and c) each point estimate for each population exceeds 5,800 adults; and **4)** when certain site-specific management tasks to minimize or remove threats have been identified, developed, and implemented.

Delisting can occur if, over a 3-year period beyond downlisting: **1)** genetically and demographically viable, self-sustaining populations are maintained in the Green River subbasin and either in the Upper Colorado River subbasin or the San Juan River subbasin such that--a) the trend in adult point estimates for each of the two populations does not decline significantly; and b) mean estimated recruitment of age 3 naturally produced fish equals or exceeds mean annual adult mortality for each of the two populations; and c) each point estimate for each of the 2 populations exceeds 5,800 adults; and **2)** a genetic refuge is maintained in Lake Mohave; and **3)** two genetically and demographically viable, self-sustaining populations are maintained in the Lower Basin recovery unit such that--a) the trend in adult point estimates for each population does not decline significantly; and b) mean estimated recruitment of age 3 naturally produced fish equals or exceeds mean annual adult mortality for each population; and c) each point estimate for each population exceeds 5,800 adults; and **4)** when certain site-specific management tasks to minimize or remove threats have been finalized and implemented, and necessary levels of protection are attained.

Conservation plans will go into effect at delisting to provide for long-term management and protection of the species, and to provide reasonable assurances that recovered razorback sucker populations will be maintained without the need for relisting. Elements of those plans could include (but are not limited to) provision of flows for maintenance of habitat conditions required for all life stages, regulation and/or control of nonnative fishes, minimization of the risk of hazardous-materials spills, and monitoring of populations and habitats. Signed agreements among state agencies, Federal agencies, American Indian tribes, and other interested parties must be in place to implement the conservation plans before delisting can occur.

**Management Actions Needed:**

**1.** Re-establish populations with hatchery-produced fish.

**2.** Identify and maintain genetic variability of razorback sucker in Lake Mohave.

**3.** Provide and legally protect habitat (including flow regimes necessary to restore and maintain required environmental conditions) necessary to provide adequate habitat and sufficient range for all life stages to support recovered populations.

**4.** Provide passage over barriers within occupied habitat to allow unimpeded movement and, potentially, range expansion.

**5.** Investigate options for providing appropriate water temperatures in the Gunnison River.

**6.** Minimize entrainment of subadults and adults at diversion/out-take structures.

**7.** Ensure adequate protection from overutilization.

**8.** Ensure adequate protection from diseases and parasites.

**9.** Regulate nonnative fish releases and escapement into the main river, floodplain, and tributaries.

**10.** Control problematic nonnative fishes as needed.

**11.** Minimize the risk of hazardous-materials spills in critical habitat.

**12.** Remediate water-quality problems, such as selenium.

**13.** Minimize the threat of hybridization with white sucker.

**14.** Provide for the long-term management and protection of populations and their habitats beyond delisting (i.e., conservation plans).

### HUMPBACK CHUB

Species Description

The humpback chub is a medium-sized freshwater fish (less than 20 inches) of the minnow family. The adults have a pronounced dorsal hump, a narrow flattened head, a fleshy snout with an inferior-subterminal mouth, and small eyes. It has silvery sides with a brown or olive-colored back.

The humpback chub is endemic to the Colorado River Basin and is part of a native fish fauna traced to the Miocene epoch in fossil records (Miller 1946; Minckley et al. 1986). Humpback chub remains have been dated to about 4000 B.C., but the fish was not described as a species until the 1940s (Miller 1946), presumably because of its restricted distribution in remote white water canyons (USFWS 1990b). Because it was described only after considerable changes in the river system had occurred, the original distribution of this species is not known. The humpback chub was listed as endangered on March 11, 1967.

Status and Distribution

The humpback chub is listed as endangered under the ESA. The species is endemic to the Colorado River System of the southwestern United States. Adults attain a maximum size of about 19 inches TL and 2.7 pounds in weight. Six extant wild populations are known: **1)** Black Rocks, Colorado River, Colorado; **2)** Westwater Canyon, Colorado River, Utah; **3)** Yampa Canyon, Yampa River, Colorado; **4)** Desolation/Gray Canyons, Green River, Utah; **5)** Cataract Canyon, Colorado River, Utah; and **6)** Marble and Grand Canyons, Colorado River, and the Little Colorado River (LCR), Arizona. The first five populations are in the Upper Colorado River Basin (i.e., upstream of Glen Canyon Dam, Arizona) and the sixth population is in the Lower Colorado River Basin.

Historic abundance of the humpback chub is unknown, but is surmised from various reports and collections that indicate the species presently occupies about 68% of its historic habitat of about 470 river miles. The species exists primarily in relatively inaccessible canyons of the Colorado River System and was rare in early collections (Tyus 1998). Common use of the name “bonytail” for all six Colorado River species or subspecies of the genus *Gila* confounded an accurate early assessment of distribution and abundance (Holden and Stalnaker 1975a, 1975b; Valdez and Clemmer 1982; Minckley 1996). Of three closely related and sympatric *Gila* species, the roundtail chub (*G. robusta*) and bonytail (*G. elegans*) were described in 1853 by Baird and Girard (Sitgreaves 1853; Girard 1856), but the humpback chub was the last big river fish species to be described from the Colorado River System in 1946 (Miller 1946). Also, extensive human modifications throughout the system prior to faunal surveys may have depleted or eliminated the species from some river reaches before its occurrence was documented.

Earliest collections of humpback chub are anecdotal and related to early explorations of the Colorado River System that pre-date the species description of 1946. In 1911, Elsworth and Emory Kolb (Kolb and Kolb 1914) reported a large aggregation of "bony tail" in the Lower LCR in Grand Canyon; photographs show that the fish were humpback chub. A specimen in the fish collection at Grand Canyon National Park, caught in 1932 by angler N.N. Dodge at Bright Angel Creek, was examined in fall 1942 and used as the holotype for the species description (Miller 1946), along with a second specimen of unknown origin. In the 1940s, 5 specimens of humpback chub were collected from the Grand Canyon region along with 16 specimens of *G. elegans* and 6 *G. robusta* (Miller 1944; Bookstein et al. 1985). In 1950, juvenile humpback chub were reported from Spencer Creek in lower Grand Canyon (Wallis 1951; Kubly 1990), but icthyofaunal surveys in 1958–1959 (McDonald and Dotson 1960) failed to find humpback chub immediately upstream in the gentle meandering reaches of Glen Canyon.

Following completion of Glen Canyon Dam in 1963, humpback chub were consistently reported by Arizona Game and Fish Department creel surveys from Lees Ferry during 1963–1968 (Stone 1964, 1966; Stone and Queenan 1967; Stone and Rathbun 1968). However, Stone and Rathbun (1968) failed to find humpback chub in seven tributaries sampled between Lees Ferry and Lake Mead in 1968, excluding the LCR. Humpback chub were captured in July 1967 and August 1970 (Holden and Stalnaker 1975a), all within "...a few hundred meters downstream of Glen Canyon Dam" (pers. comm., P. Holden, Bio/West, Inc.). Humpback chub have not been captured in this reach since the dam began releasing cold hypolimnetic waters in about 1970. Humpback chub have consistently been reported in the LCR and Colorado River in Grand Canyon since 1967 as a result of better sampling gear and a better understanding of the life history of the species (Stone and Rathbun 1968; Miller and Smith 1972; Holden and Stalnaker 1975a; Suttkus et al. 1976; Minckley and Blinn 1976; Suttkus and Clemmer 1977; Carothers et al. 1981; Kaeding and Zimmerman 1983; Maddux et al. 1987; Valdez and Ryel 1995; Arizona Game and Fish Department 1996; Douglas and Marsh 1996; Coggins et al. 2006a, 2006b).

Humpback chub were first reported in the Upper Colorado River System in the 1940s from Castle Park, Yampa River, Colorado, in June and July 1948 (Tyus 1998). Pre-impoundment surveys of Flaming Gorge Dam on the Green River in 1958–1959 (Bosley 1960; Gaufin et al. 1960; McDonald and Dotson 1960) treated all *Gila* as "bonytail," which were common downstream of Green River, Wyoming. Humpback chub were reported from Hideout Canyon in the Upper Green River (Smith 1960), although a checklist of fish killed by a massive rotenone operation from Hideout Canyon to Brown's Park in September 1962 stated that "...no humpback chub were collected..." (Binns 1967). Post-impoundment investigations (Vanicek et al. 1970) reported three humpback chub from the Green River downstream of Flaming Gorge Dam; one each from Echo Park, Island Park, and Swallow Canyon. Specimens were collected in

Desolation Canyon on the Green River in 1967 (Holden and Stalnaker 1970), in Yampa Canyon in 1969 (Holden and Stalnaker 1975b), in Cross Mountain Canyon of the Yampa River in the 1970s (pers. comm., C. Haynes), and an individual specimen was reported from the White River in Utah in the 1950s (Sigler and Miller 1963). Seven suspected humpback chub were captured in the Little Snake River, a tributary of the Yampa River, in 1988 (Wick et al. 1991). Surveys downstream of Flaming Gorge Dam, including Lodore Canyon, have not yielded humpback chub in that region of the Green River, despite warmer dam releases (Holden and Crist 1981; Bestgen and Crist 2000; Bestgen et al. 2005, 2006). Eight humpback chub were captured in Whirlpool Canyon, downstream of the Yampa River confluence, from 2002-2004 (Bestgen et al. 2006a).

Five specimens were reported from Lake Powell in the late 1960s (Holden and Stalnaker 1970) following completion of Glen Canyon Dam in 1963 and impoundment of the Upper Colorado River through Glen, Narrow, and Cataract Canyons. Reproducing populations of humpback chub were first reported from Black Rocks, Colorado, in 1977 (Kidd 1977), and from Westwater and Cataract Canyons, Utah, in 1979 (Valdez et al. 1982; Valdez and Clemmer 1982).

Six humpback chub populations are currently identified: **1)** Black Rocks, Colorado; **2)** Westwater Canyon, Utah; **3)** LCR and Colorado Rivers in Grand Canyon, Arizona; **4)** Yampa Canyon, Colorado; **5)** Desolation/Gray Canyons, Utah; and **6)** Cataract Canyon, Utah (Valdez and Clemmer 1982; USFWS 1990a). Each population consists of a discrete group of fish, geographically separated from the other populations, but with some exchange of individuals. River length occupied by each population varies from 2 miles in Black Rocks to 46 miles in Yampa Canyon.

The Recovery Goals (USFWS 2002c; Figure 3) provide a summary of habitat occupied by humpback chub and limits to its distribution.

Population estimates for humpback chub using mark-recapture estimators began in 1998 with the Black Rocks and Westwater Canyon populations (Figure A-1). A frequency pattern of 3 years of annual estimates followed by 2 years with no estimates was recommended at two population estimates workshops to minimize excessive handling of fish (Upper Colorado River Recovery Plan (UCRRP) 2006). Hence, population estimates in Black Rocks and Westwater Canyon were conducted during 1998-2000 and 2003-2005. These estimates show the Black Rocks population between about 1,000 and 2,000 adults (age 4+) and the Westwater Canyon population between about 1,700 and 5,100 adults (McAda 2002, 2004, 2006; Hudson and Jackson 2003; Jackson 2004). Population estimates for Desolation/Gray Canyon in 2001-2003 show the population between about 1,000 and 2,600 adults (Jackson and Hudson 2005). The Cataract Canyon and Yampa Canyon populations were estimated at about 100 and 400 adults, respectively (Valdez and Badame 2005; Finney 2006).

Population estimates for humpback chub in Grand Canyon are based on an age-structured mark-recapture analysis (ASMR) that uses capture histories from PIT-tagged fish dating to 1989. These estimates are based on constant mortality and variable mortality models for age 4+ fish (greater than or equal to 8 inches TL) (Coggins et al. 2006a, 2006b; Coggins 2008). Earliest estimates are based on small numbers of marks and recaptures and have wide confidence intervals. These estimates show a decline in the population with the lowest estimate of between

2,400 and 4,400, age 4+ fish in 2001. Recent estimates suggest that the population of adults may be stabilizing and improving after more than a decade of decline (U.S. Geological Survey(USGS) 2006, 2007). Between 2001 and 2005, the number of adult fish appears to have stabilized at an estimated 5,000 adults. In 2005, scientists also detected more juveniles (age 1-4) and YOY than previous years indicating good future recruitment. Based on this ASMR analysis and the earliest independent mark-recapture estimates of PIT-tagged humpback chub in Grand Canyon (Valdez and Ryel 1995; Douglas and Marsh 1996), the population associated with the LCR Inflow was probably stabilized at around 6,000 adults (Coggins 2008). A population of 5,000 to 6,000 means this core population far exceeds the MVP of 2,100. Further minimization of threats to the species in Grand Canyon should allow this population to increase.


**FIGURE 3. Distribution of Humpback Chub in the Colorado River System.**

<u>Life History</u>

Unlike Colorado pikeminnow and razorback sucker, which are known to make extended migrations of up to several hundred miles to spawning areas in the Green and Yampa Rivers, humpback chubs in the Green River do not appear to make extensive migrations (Karp and Tyus 1990). Generally, humpback chub show fidelity for canyon reaches and move very little (Miller et al. 1982; Valdez and Clemmer 1982; Archer et al. 1985; Burdick and Kaeding 1985; Kaeding et al. 1990; Chart and Lentsch 1999a; Chart and Lentsch 1999b). Movements of adult humpback chub in Black Rocks on the Colorado River were essentially restricted to a 1-mile reach. These results were based on the recapture of Carlin-tagged fish and radiotelemetry studies conducted from 1979-1981 (Valdez et al. 1982) and 1983 to 1989 (Archer et al. 1985; Kaeding et al. 1990). However, a few fish have moved between Black Rocks and Westwater Canyon, a distance of 14 miles (Valdez and Clemmer 1982; Kaeding et al. 1990; Chart and Lentsch 1999a).

Karp and Tyus (1990) found that in the Yampa and Green Rivers in Dinosaur National Monument, humpback chubs spawn during spring and early summer following peak flows at water temperatures of about 68°F. They estimated that the spawning period for humpback chub ranges from May into July, with spawning occurring earlier in low-flow years and later in high-flow years; spawning was thought to occur only during a 4- to 5-week period (Karp and Tyus 1990). Similar to the Yampa and Green Rivers, peak hatch of *Gila* larvae in Westwater Canyon on the Colorado River appears to occur on the descending limb of the hydrograph following spring runoff at maximum daily water temperatures of approximately 68-70°F (Chart and Lentsch 1999a). Tyus and Karp (1989) reported that humpback chubs occupy and spawn in and near shoreline eddy habitats and that spring peak flows were important for reproductive success because availability of these habitats is greatest during spring runoff.

High spring flows that simulate the magnitude and timing of the natural hydrograph provide a number of benefits to humpback chubs in the Yampa and Green Rivers. Bankfull and overbank flows provide allochthonous energy input to the system in the form of terrestrial organic matter and insects that are utilized as food. High spring flows clean spawning substrates of fine sediments and provide physical cues for spawning. High flows also form large recirculating eddies used by adult fish. High spring flows (50% exceedance or greater) have been implicated in limiting the abundance and reproduction of some nonnative fish species under certain conditions (Chart and Lentsch 1999a, 1999b) and have been correlated with increased recruitment of humpback chubs (Chart and Lentsch 1999b).

In the Green River and Upper Colorado River, humpback chubs spawned in spring and summer as flows declined shortly after the spring peak (Valdez and Clemmer 1982; Valdez et al. 1982; Kaeding and Zimmerman 1983; Tyus and Karp 1989; Karp and Tyus 1990; Chart and Lentsch 1999a, 1999b). Similar spawning patterns were reported from Grand Canyon (Kaeding and Zimmerman 1983; Valdez and Ryel 1995, 1997). Little is known about spawning habitats and behavior of humpback chub. Although humpback chub are believed to broadcast eggs over mid-channel cobble and gravel bars, spawning in the wild has not been observed for this species.

Gorman and Stone (1999) reported that ripe male humpback chubs in the LCR aggregated in areas of complex habitat structure (i.e., matrix of large boulders and travertine masses combined with chutes, runs, and eddies, 1.6-6.6 feet deep) and were associated with deposits of clean gravel.

Muth et al. (2000) summarized flow and temperature needs of humpback chub in the Green River subbasin as:

> "…The habitat requirements of the humpback chub are incompletely understood. It is known that fish spawn on the descending limb of the spring hydrograph at temperatures greater than 17$^{o}$C. Rather than migrate, adults congregate in near-shore eddies during spring and spawn locally. They are believed to be broadcast spawners over gravel and cobble substrates. Young humpback chubs typically use low-velocity shoreline habitats, including eddies and backwaters, that are more prevalent under base-flow conditions. After reaching approximately 40-50 mm TL, juveniles move into deeper and higher-velocity habitats in the main channel.
>
> Increased recruitment of humpback chubs in Desolation and Gray Canyons was correlated with moderate to high water years from 1982 to 1986 and in 1993 and 1995. Long, warm growing seasons, which stimulate fish growth and a low abundance of competing and predatory nonnative fishes also have been implicated as potential factors that increase the survival of young humpback chubs.
>
> High spring flows increase the availability of the large eddy habitats utilized by adult fish. High spring flows also maintain the complex shoreline habitats that are used as nursery habitat by young fish during subsequent base flows. Low-velocity nursery habitats that are used by young fish are warmer and more productive at low base flows."

Newly hatched larvae average 0.25-0.30 inch TL (Snyder 1981; Behnke and Benson 1983; Muth 1990), and 1-month old fish are approximately 0.8 inch long (Hamman 1982). Unlike Colorado pikeminnow and razorback sucker, no evidence exists of long-distance larval drift (Miller and Hubert 1990; Robinson et al. 1998). Upon emergence from spawning gravels, humpback chub larvae remain in the vicinity of bottom surfaces (Marsh 1985) near spawning areas (Chart and Lentsch 1999a).

Backwaters, eddies, and runs have been reported as common capture locations for YOY humpback chub (Valdez and Clemmer 1982). These data indicate that in Black Rocks and Westwater Canyon, young utilize shallow areas. Habitat suitability index curves developed by Valdez et al. (1990) indicate YOY prefer average depths of 2.1 feet with a maximum of 5.1 feet. Average velocities were reported at 0.2 feet per second. In the Grand Canyon, nearly all fish smaller than 4 inches TL were captured near shore, whereas most fish larger than this were captured in offshore habitats (Valdez and Ryel 1995).

Valdez et al. (1982) and Wick et al. (1981) found adult humpback chub in Black Rocks and Westwater Canyons in water averaging 50 feet in depth with a maximum depth of 92 feet. In these localities, humpback chub were associated with large boulders and steep cliffs. Valdez and Ryel (1997) captured or located adults most often in large recirculating eddies.

Threats to the Species

Although historic data are limited, the presumed range-wide decline in humpback chub is likely due to a combination of factors including alteration of river habitats by reservoir inundation, changes in stream discharge and temperature, competition with and predation by introduced fish species, and other factors such as changes in food resources resulting from stream alterations (USFWS 1990a).

The primary threats to humpback chub are stream flow regulation and habitat modification (affecting constituent elements: water and physical habitat); competition with and predation by nonnative fishes; parasitism; hybridization with other native *Gila* species; and pesticides and pollutants (USFWS 2002c) (all affecting constituent element: biological environment). The existing habitat, altered by these threats, has been modified to the extent that it impairs essential behavior patterns, such as breeding, feeding, and sheltering. The threats to humpback chub in relation to flow regulation and habitat modification, predation by nonnative fishes, and pesticides and pollutants are essentially the same threats identified for Colorado pikeminnow.

The humpback chub population in the Grand Canyon is threatened by predation from nonnative trout in the Colorado River below Glen Canyon Dam. This population also is threatened by the Asian tapeworm reported in humpback chub in the LCR (USFWS 2002c). No Asian tapeworms have been reported in the Upper Basin populations. In Grand Canyon, brown trout (*Salmo trutta*), channel catfish (*Ictalurus punctatus*), black bullhead (*Ameiurus melas*), and rainbow trout (*Oncorhynchus mykiss*) have been identified as principal predators of juvenile humpback chub, with consumption estimates that suggest loss of complete year classes to predation (Marsh and Douglas 1997; Valdez and Ryel 1997). Valdez and Ryel (1997) also suggested that common carp (*Cyprinus carpio*) could be a significant predator of incubating humpback chub eggs in the lower Colorado River. In the Upper Basin, Chart and Lentsch (2000) identified channel catfish as the principal predator of humpback chub in Desolation and Gray Canyons. The UCRRP identified channel catfish as the principal predator of humpback chub in Yampa Canyon and is pursuing development and implementation of a control program (USFWS 2002c). Current nonnative fish management in the Upper Colorado River Basin has focused on three species: northern pike, smallmouth bass, and channel catfish, which compete with and prey on the endangered and native fish species (see the Threats section under Colorado pikeminnow above).

Survival rates are extremely low and believed to be less than 1 in 1,000 to 2 years of age. Low water temperatures and predation are believed to be the primary factors. Valdez and Ryel (1995) estimate that 250,000 young humpback chub are consumed by brown trout, rainbow trout, and channel catfish.

Hybridization with roundtail chub (*Gila robusta*) and bonytail, where they occur with humpback chub, is recognized as a threat to humpback chub. A larger proportion of roundtail chub have been found in Black Rocks and Westwater Canyon during low-flow years (Kaeding et al. 1990, Chart and Lentsch 2000), which increase the chances for hybridization.

Critical Habitat

Critical habitat was designated in 1994 within humpback chub historical range in the following sections of the Upper Colorado River (59 FR 13374). The PCEs are the same as those described for the Colorado pikeminnow, as is the status of the PCEs. We designated seven reaches of the Colorado River system for a total of 379 miles as measured along the center line of the subject reaches. The designation represents approximately 28% of the suspected historical habitat of the species and includes reaches in the Colorado, Green, and Yampa Rivers in the Upper Basin:

> Moffat County, Colorado. The Yampa River from the boundary of Dinosaur National Monument in T. 6 N., R. 99 W., section 27 (6th Principal Meridian) to the confluence with the Green River in T. 7 N., R. 103 W., section 28 (6th Principal Meridian).
>
> Uintah County; and Colorado, Moffat County, Utah. The Green River from the confluence with the Yampa River in T. 7 N., R. 103 W., section 28 (6th Principal Meridian) to the southern boundary of Dinosaur National Monument in T. 6 N., R. 24 E., section 30 (Salt Lake Meridian).
>
> Uintah and Grand Counties, Utah. The Green River (Desolation and Gray Canyons) from Sumner's Amphitheater in T. 12 S., R. 18 E., section 5 (Salt Lake Meridian) to Swasey's Rapid in T. 20 S., R. 16 E., section 3 (Salt Lake Meridian).
>
> Grand County; and Colorado, Mesa County, Utah. The Colorado River from Black Rocks in T. 10 S., R. 104 W., section 25 (6th Principal Meridian) to Fish Ford in T. 21 S., R. 24 E., section 35 (Salt Lake Meridian).
>
> Garfield and San Juan Counties, Utah. The Colorado River from Brown Betty Rapid in T. 30 S., R. 18 E., section 34 (Salt Lake Meridian) to Imperial Canyon in T. 31 S., R. 17 E., section 28 (Salt Lake Meridian).

Recovery

Objective, measurable criteria for recovery of humpback chub in the Colorado River System are presented for each of two recovery units (i.e., the Upper Basin, including the Green River and Upper Colorado River Sub-basins; the Lower Basin, including the mainstem and its tributaries from Glen Canyon Dam downstream to Lake Mead National Recreation Area). These recovery units have different recovery or conservation programs and need to address unique threats and site-specific management actions and tasks necessary to minimize or remove threats to the species. Recovery of the species is considered necessary in both the Upper and Lower Basins because of the need for multiple, redundant populations. The humpback chub was listed prior to the 1996 distinct population segment (DPS) policy, and the Service may conduct an evaluation to designate DPS in a future rule-making process. If DPS are designated, criteria for recovery of humpback chub will need to be reevaluated. These recovery goals are based on the best available scientific information, and are structured to attain a balance between reasonably achievable criteria (which include an acceptable level of uncertainty) and ensuring the viability of the species beyond delisting. Additional data and improved understanding of humpback chub biology may prompt additional revision of these recovery goals.

Downlisting can occur if, over a 5-year period: **1)** the trend in adult (age 4+ ; greater or equal to 8 inches TL) point estimates for each of the six extant populations does not decline significantly; and **2)** mean estimated recruitment of age 3 (6-8 inches TL) naturally produced fish equals or exceeds mean annual adult mortality for each of the six extant populations; and **3)** two genetically and demographically viable, self-sustaining core populations are maintained, such that each point estimate for each core population exceeds 2,100 adults (2,100 is the estimated MVP needed to ensure long-term genetic and demographic viability); and **4)** when site-specific management tasks to minimize or remove threats have been identified, developed, and implemented.

Delisting can occur if, over a 3-year period beyond downlisting: **1)** the trend in adult point estimates for each of the six extant populations does not decline significantly; and **2)** mean estimated recruitment of age 3 naturally produced fish equals or exceeds mean annual adult mortality for each of the six extant populations; and **3)** three genetically and demographically viable, self-sustaining core populations are maintained, such that each point estimate for each core population exceeds 2,100 adults; and **4)** when certain site-specific management tasks to minimize or remove threats have been finalized and implemented, and necessary levels of protection are attained.

Conservation plans will go into effect at delisting to provide for long-term management and protection of the species, and to provide reasonable assurances that recovered humpback chub populations will be maintained without the need for relisting. Elements of those plans could include (but are not limited to) provision of flows for maintenance of habitat conditions required for all life stages, regulation and/or control of nonnative fishes, minimization of the risk of hazardous-materials spills, and monitoring of populations and habitats. Signed agreements among state agencies, Federal agencies, American Indian tribes, and other interested parties must be in place to implement the conservation plans before delisting can occur.

**Management Actions Needed:**

**1.** Provide and legally protect habitat (including flow regimes necessary to restore and maintain required environmental conditions) necessary to provide adequate habitat and sufficient range for all life stages to support recovered populations.

**2.** Investigate and clarify the role of the mainstem Colorado River in maintaining the Grand Canyon population.

**3.** Investigate the anticipated effects of and options for providing warmer water temperatures in the mainstem Colorado River through Grand Canyon.

**4.** Ensure adequate protection from overutilization.

**5.** Ensure adequate protection from diseases and parasites.

6. Regulate nonnative fish releases and escapement into the mainstem, floodplain, and tributaries.
7. Control problematic nonnative fishes as needed.
8. Minimize the risk of increased hybridization among *Gila* spp.
9. Minimize the risk of hazardous-materials spills in critical habitat.
10. Provide for the long-term management and protection of populations and their habitats beyond delisting (i.e., conservation plans).

## BONYTAIL

Species Description

Bonytail are medium-sized (less than 24 inches) fish in the minnow family. Adult bonytail are gray or olive-colored on the back with silvery sides and a white belly. The adult bonytail has an elongated body with a long, thin caudal peduncle. The head is small and compressed compared to the rest of the body. The mouth is slightly overhung by the snout and there is a smooth low hump behind the head that is not as pronounced as the hump on a humpback chub.

Status and Distribution

The bonytail is listed as endangered under the ESA. The species is endemic to the Colorado River System of the southwestern United States. Adults attain a maximum size of about 22 inches TL and 2.4 pounds in weight. An unknown, but small number of wild adults exist in Lake Mohave on the mainstem Colorado River of the Lower Colorado River Basin (i.e., downstream of Glen Canyon Dam, Arizona), and there are small numbers of wild individuals in the Green River and Upper Colorado River subbasins of the Upper Colorado River Basin.

The bonytail is endemic to the Colorado River Basin and was historically common to abundant in warm-water reaches of larger rivers of the basin from Mexico to Wyoming. The species experienced a dramatic, but poorly documented, decline starting in about 1950, following construction of several mainstem dams, introduction of nonnative fishes, poor land-use practices, and degraded water quality (USFWS 2002d).

The bonytail is the rarest native fish in the Colorado River. Little is known about its specific habitat requirements or cause of decline, because the bonytail was extirpated from most of its historic range prior to extensive fishery surveys. It was listed as endangered on April 23, 1980. Currently, no self-sustaining populations of bonytail are known to exist in the wild, and very few individuals have been caught anywhere within the basin. Since 1977, only 11 wild adults have been reported from the Upper Basin (Valdez et al. 1994).

Formerly reported as widespread and abundant in mainstem rivers (Jordan and Evermann 1896), its populations have been greatly reduced. Remnant populations presently occur in the wild in low numbers in Lake Mohave and several fish have been captured in Lake Powell and Lake Havasu (USFWS 2002d). The last known riverine area where bonytail were common was the Green River in Dinosaur National Monument, where Vanicek (1967) and Holden and Stalnaker (1970) collected 91 specimens during 1962-1966. From 1977-1983, no bonytail were collected from the Colorado or Gunnison Rivers in Colorado or Utah (Wick et al. 1981; Valdez et al.

1982; Miller et al. 1984). However, in 1984 a single bonytail was collected from Black Rocks on the Colorado River (Kaeding et al. 1986). Several suspected bonytail were captured in Cataract Canyon in 1985-1987 (Valdez 1990).

Bonytail were extirpated between Flaming Gorge Dam and the Yampa River, primarily because of rotenone poisoning and cold-water releases from the dam (USFWS 2002c). Surveys from 1964-1966 found large numbers of bonytail in the Green River in Dinosaur National Monument downstream of the Yampa River confluence (Vanicek and Kramer 1969). Surveys from 1967-1973 found far fewer bonytail (Holden and Stalnaker 1975). Few bonytail have been captured after this period, and the last recorded capture in the Green River was in 1985 (USFWS 2002d). Bonytail are so rare that it is currently not possible to conduct population estimates.

The map below of the recent distribution of wild bonytail in the Colorado River Basin was reproduced from the Bonytail Recovery Goals (USFWS 2002d, Figure 4).


**FIGURE 4. Recent Distribution of Wild Bonytail in the Colorado River System.**

Approximately 130,000 hatchery-produced $F_1$ and $F_2$ fish were released into Lake Mohave between 1981 and 1987 as part of an effort by the Service to prevent extinction and promote eventual recovery of the species. Younger bonytail of adult size and spawning ability have been collected from the reservoir in the 1990s along with the old adults of the founder population. It is unknown whether these younger adults are from the original stockings or a result of natural reproduction. Releases of hatchery-reared adults into riverine reaches in the Upper Basin have resulted in low survival (Chart and Cranney 1991), with no evidence of reproduction or recruitment.

The current stocking plan (Nesler et al. 2003) calls for bonytail to be stocked in the middle Green, lower Yampa and Colorado Rivers. The middle Green River and the Yampa River in Dinosaur National Monument have been identified as the highest priority for stocking. The only known bonytail that presently occur in the Yampa River are the individuals recently reintroduced at Echo Park, near the confluence with the Green River.

Life History

The bonytail is considered a species that is adapted to mainstem rivers, where it has been observed in pools and eddies (Vanicek 1967; Minckley 1973). Of five specimens captured most recently in the Upper Basin, four were captured in deep, swift, rocky canyons (Yampa Canyon, Black Rocks, Cataract Canyon, and Coal Creek Rapid), but the fifth was taken in Lake Powell. Since 1974, all bonytails captured in the Lower Basin were caught in reservoirs. It has been suggested that the large fins and streamlined body of the bonytail is an adaptation to torrential flows (Miller 1946).

Little is known of the food habits of the bonytail. McDonald and Dotson (1960) reported that “Colorado chub” were largely omnivorous with a diet of terrestrial insects, plant matter, and fish. Several chubs were observed feeding on floating masses of debris washed by heavy rainfall. Vanicek (1967) reported that “Colorado chubs” fed mainly on terrestrial insects (mostly adult beetles and grasshoppers), plant debris, leaves, stems, and woody fragments.

Spawning of bonytail has never been observed in a river, but ripe fish were collected in Dinosaur National Monument during late June and early July suggesting that spawning occurred at water temperatures of about 64°F (Vanicek and Kramer 1969). Similar to other closely related *Gila* species, bonytail probably spawn in rivers in spring over rocky substrates; spawning has been observed in reservoirs over rocky shoals and shorelines. It has been recently hypothesized that flooded bottomlands may provide important bonytail nursery habitat.

In the Green River, Vanicek (1967) reported that bonytails were generally found in pools and eddies in the absence of, although occasionally adjacent to, strong current and at varying depths generally over silt and silt-boulder substrates. Adult bonytail captured in Cataract, Desolation, and Gray Canyons were sympatric with humpback chub in shoreline eddies among emergent boulders and cobble, and adjacent to swift current (Valdez 1990). The diet of the bonytail is presumed similar to that of the humpback chub (USFWS 2002d).

Although sufficient information on physical processes that affect bonytail habitats was not available to recommend specific flow and temperature regimes in the Green River to benefit this species, Muth et al. (2000) concluded that flow and temperature recommendations made for Colorado pikeminnow, razorback sucker, and humpback chub would presumably benefit bonytail and would not limit their its future recovery potential. The species is being reintroduced into the Colorado, Green, and Yampa Rivers, and into Lake Havasu and Lake Mojave.

Threats to the Species

The primary threats to bonytail are stream flow regulation and habitat modification (affecting constituent elements: water and physical habitat); competition with and predation by nonnative fishes; hybridization with other native *Gila* species; and pesticides and pollutants (USFWS 2002d) (affecting constituent element: biological environment). The existing habitat, altered by these threats, has been modified to the extent that it impairs essential behavior patterns, such as breeding, feeding, and sheltering. The threats to bonytail in relation to flow regulation and habitat modification, predation by nonnative fishes, and pesticides and pollutants are essentially the same threats identified for Colorado pikeminnow. Threats to bonytail in relation to hybridization are essentially the same threats identified for humpback chub.

Critical Habitat

Critical habitat was designated in 1994 within the bonytail's historical range in the following sections of the Upper Colorado River (59 FR 13374). The PCEs are the same as those described for the Colorado pikeminnow, as is the status of the PCEs. We designated seven reaches of the Colorado River system as critical habitat for the bonytail chub. These reaches total 312 miles as measured along the center line of the subject reaches, representing approximately 14% of the historical habitat of the species. Critical habitat includes portions of the Colorado, Green, and Yampa Rivers in the Upper Basin:

> Moffat County, Colorado. The Yampa River from the boundary of Dinosaur National Monument in T. 6 N., R. 99 W., section 27 (6th Principal Meridian) to the confluence with the Green River in T. 7 N., R. 103 W., section 28 (6th Principal Meridian).
>
> Uintah County; and Colorado, Moffat County, Utah. The Green River from the confluence with the Yampa River in T. 7 N., R. 103 W., section 28 (6th Principal Meridian) to the boundary of Dinosaur National Monument in T. 6 N., R. 24 E., section 30 (Salt Lake Meridian).
>
> Uintah and Grand Counties, Utah. The Green River (Desolation and Gray Canyons) from Sumner's Amphitheater in T. 12 S., R. 18 E., section 5 (Salt Lake Meridian) to Swasey's Rapid (RM 12) in T. 20 S., R. 16 E., section 3 (Salt Lake Meridian).
>
> Grand County, Utah; and Mesa County, Colorado. The Colorado River from Black Rocks (RM 137) in T. 10 S., R. 104 W., section 25 (6th Principal Meridian) to Fish Ford in T. 21 S., R. 24 E., section 35 (Salt Lake Meridian).

Garfield and San Juan Counties, Utah. The Colorado River from Brown Betty Rapid in T. 30 S., R. 18 E., section 34 (Salt Lake Meridian) to Imperial Canyon in T. 31 S., R. 17 E., section 28 (Salt Lake Meridian).

Recovery

Objective, measurable criteria for recovery of bonytail in the Colorado River System are presented for each of two recovery units (i.e., the Upper Basin, including the Green River and Upper Colorado River subbasins; the Lower Basin, including the mainstem and its tributaries from Lake Mead downstream to the southerly International Boundary with Mexico) because of different recovery or conservation programs and to address unique threats and site-specific management actions and tasks necessary to minimize or remove those threats. Recovery of the species is considered necessary in both the Upper and Lower Basins because of the present status of populations and existing information on bonytail biology. Self-sustaining populations will need to be established through augmentation. Without viable wild populations, there are many uncertainties associated with recovery of bonytail. The bonytail was listed prior to the 1996 DPS policy, and the Service may conduct an evaluation to designate DPSs in a future rule-making process. These recovery goals are based on the best available scientific information, and are structured to attain a balance between reasonably achievable criteria and ensuring the viability of the species beyond delisting. These recovery criteria will need to be reevaluated and revised after self-sustaining populations are established and there is improved understanding of bonytail biology.

Downlisting can occur if, over a 5-year period: **1)** genetically and demographically viable, self-sustaining populations are maintained in the Green River subbasin and Upper Colorado River subbasin such that--a) the trend in adult (age 4+; greater or equal to 10 inches TL) point estimates for each of the two populations does not decline significantly, and b) mean estimated recruitment of age 3 (6-10 inches TL) naturally produced fish equals or exceeds mean annual adult mortality for each of the two populations, and c) each point estimate for each of the 2 populations exceeds 4,400 adults (4,400 is the estimated MVP needed to ensure long-term genetic and demographic viability); and **2)** a genetic refuge is maintained in a suitable location (e.g., Lake Mohave, Lake Havasu) in the Lower Basin recovery unit; and **3)** two genetically and demographically viable, self-sustaining populations are maintained in the Lower Basin recovery unit (e.g., mainstem and/or tributaries) such that--a) the trend in adult point estimates for each population does not decline significantly, and b) mean estimated recruitment of age 3 naturally produced fish equals or exceeds mean annual adult mortality for each population, and c) each point estimate for each population exceeds 4,400 adults; and **4)** when certain site-specific management tasks to minimize or remove threats have been identified, developed, and implemented.

Delisting can occur if, over a 3-year period beyond downlisting: **1)** genetically and demographically viable, self-sustaining populations are maintained in the Green River subbasin and Upper Colorado River subbasin such that--a) the trend in adult point estimates for each of the two populations does not decline significantly, and b) mean estimated recruitment of age 3 naturally produced fish equals or exceeds mean annual adult mortality for each of the two populations, and c) each point estimate for each of the 2 populations exceeds 4,400 adults; and **2)** a genetic refuge is maintained in the Lower Basin recovery unit; and **3)** two genetically and demographically viable, self-sustaining populations are maintained in the Lower Basin recovery unit such that--a) the trend in adult point estimates for each population does not decline significantly, and b) mean estimated recruitment of age 3 naturally produced fish equals or exceeds mean annual adult mortality for each population, and c) each point estimate for each population exceeds 4,400 adults; and **4)** when certain site-specific management tasks to minimize or remove threats have been finalized and implemented, and necessary levels of protection are attained.

Conservation plans will go into effect at delisting to provide for long-term management and protection of the species, and to provide reasonable assurances that recovered bonytail populations will be maintained without the need for relisting. Elements of those plans could include (but are not limited to) provision of flows for maintenance of habitat conditions required for all life stages, regulation and/or control of nonnative fishes, minimization of the risk of hazardous-materials spills, and monitoring of populations and habitats. Signed agreements among state agencies, Federal agencies, American Indian tribes, and other interested parties must be in place to implement the conservation plans before delisting can occur.

**Management Actions Needed:**

**1.** Reestablish populations with hatchery-produced fish.

**2.** Identify genetic variability of bonytail and maintain a genetic refuge in a suitable location in the Lower Basin.

**3.** Provide and legally protect habitat (including flow regimes necessary to restore and maintain required environmental conditions) necessary to provide adequate habitat and sufficient range for all life stages to support recovered populations.

**4.** Provide passage over barriers within occupied habitat to allow unimpeded movement and, potentially, range expansion.

**5.** Investigate options for providing appropriate water temperatures in the Gunnison River.

**6.** Minimize entrainment of subadults and adults at diversion/out-take structures.

**7.** Investigate habitat requirements for all life stages and provide those habitats.

**8.** Ensure adequate protection from overutilization.

**9.** Ensure adequate protection from diseases and parasites.

**10.** Regulate nonnative fish releases and escapement into the main river, floodplain, and tributaries.

**11.** Control problematic nonnative fishes as needed.

**12.** Minimize the risk of increased hybridization among *Gila* spp.

**13.** Minimize the risk of hazardous-materials spills in critical habitat.

**14.** Remediate water-quality problems.

**15.** Provide for the long-term management and protection of populations and their habitats beyond delisting (i.e., conservation plans).

# ENVIRONMENTAL BASELINE

The environmental baseline includes the past and present impacts of all Federal, state, and private actions and other human activities in the action area; the anticipated impacts of all proposed Federal projects in the action area that have already undergone formal section 7 consultation; and the impact of State or private actions contemporaneous with the consultation process.

In formulating this BO, the Service considered adverse and beneficial effects likely to result from cumulative effects of future state and private activities that are reasonably certain to occur within the Upper Colorado River Recovery Program area in Colorado, Wyoming, and Utah, along with the direct and indirect effects of the Project and impacts from actions that are part of the environmental baseline (50 CFR 402.02 and 402.14 (g)(3)).

## Colorado Pikeminnow

The Colorado pikeminnow is a year-round resident of the Yampa and Green Rivers, and occurs seasonally in the Little Snake River (Marsh et al. 1991; Wick et al. 1991). Spawning habitat in the Yampa River below the confluence with the Little Snake River is one of the known spawning sites in the Green River subbasin and has been identified as important habitat for Colorado pikeminnow (Bestgen et al. 1998; Tyus 1990). The estimate of adult Colorado pikeminnow associated with the spawning site in Yampa Canyon in the lower 20 miles of the Yampa River is approximately 1,400 fish. The estimate for the Three Fords spawning site in Gray Canyon in the lower Green River is approximately 1,000 adults (Crowl and Bouwes 1998). Because some Colorado pikeminnow from the Green River migrate into the Yampa River to spawn, the Colorado pikeminnow in the Yampa River are considered part of the Green River subbasin population. The Yampa River spawning area consistently produces more larvae than the spawning area in the lower Green River (Bestgen et al. 1998).

As stated in the Status of the Species section, estimates of adults within the action area are: Green River subbasin, 6,000–8,000, and Upper Colorado River subbasin, 600–900 (USFWS 2002a).

The Colorado pikeminnow population has been augmented by stocking both in the Colorado and Gunnison Rivers. The integrated stocking plan (Nesler et al. 2003) calls for 1,125, age 3+ fish to be stocked into each of 2 river reaches for 8 successive years: **1)** Colorado River (Rifle to Debeque Canyon), and **2)** Gunnison River (Hartland to Redland dams). During the period from 2000-2004, over 2,800 Colorado pikeminnow were stocked into the Upper Colorado River. During 2003-2004, approximately 2,250 Colorado pikeminnow were stocked into the Gunnison River. During 2005 surveys, recaptures of these stocked pikeminnow in both reaches led to an estimate of 185 remaining individuals, or 3.6% of those that were stocked (Osmundson and White 2009). Most, if not all, pikeminnow ultimately moved downstream and out of the Upper Colorado and Gunnison River reaches where they were stocked (Osmundson and White 2009). Despite the goals of the integrated stocking plan, no further Colorado pikeminnow stocking has taken place since 2004. In the Green River, Colorado pikeminnow were only stocked in 1999 when 36 were released.

<u>Razorback Sucker</u>

Prior to 1991, the last confirmed documentation of a razorback sucker juvenile in the Upper Basin was a capture in the Colorado River near Moab, Utah (Taba et al. 1965). In 1991, two early juvenile razorback suckers were collected in the lower Green River near Hell Roaring Canyon (Gutermuth et al. 1994). Between 1992 and 1995 larval razorback suckers were collected in the middle and lower Green River and within the Colorado River inflow to Lake Powell (Muth 1995).

No current population estimates of razorback sucker in the Upper Colorado or Yampa Rivers are available due to low numbers captured in recent years. The lower Yampa River provides adult habitat, spawning habitat, and potential nursery areas occur downstream in the Green River (USFWS 1998a). Modde and Smith (1995) reported that adult razorback suckers were collected between RM 13 and RM 0.1 of the Yampa River, but just one juvenile. The single fish (15 inches) was collected at RM 39 in June 1994. Razorback suckers are rarely found upstream as far as the confluence with the Little Snake River (McAda and Wydoski 1980; Lanigan and Tyus 1989). Tyus and Karp (1990) located concentrations of ripe razorback suckers at the mouth of the Yampa River during the spring in 1987-1989. Ripe fish were captured in runs associated with bars of cobble, gravel, and sand substrates in water averaging 2 feet deep and mean velocity of 2.43 feet per second.

Osmundson and Kaeding (1991) reported that the number of razorback sucker captures in the Grand Junction area has declined dramatically since 1974. Between 1984-1990, intensive collecting effort captured only 12 individuals in the Grand Valley (Osmundson and Kaeding 1991). In 1991-1992, 28 adult razorback suckers were collected from isolated ponds adjacent to the Colorado River near De Beque, Colorado (Burdick 1992). No young razorback suckers have been collected in recent times in the Colorado River. The wild population of razorback sucker is considered extirpated from the Gunnison River (Burdick and Bonar 1997).

The population is being augmented by stocking both in the Colorado and Gunnison Rivers. Nearly 50,000 juvenile, sub-adult, and adult razorback sucker were stocked in both the Upper Colorado (approx. 31,500) and Gunnison (approx. 18,500) Rivers in Colorado between 1994-2001. However, despite regular sampling, only 84 of these fish were recaptured 6 months or more following stocking (Burdick 2003). Many of the stocked fish were less than 8 inches; Burdick (2003) determined that it may be futile to stock individuals of this size or smaller due to their very low survival rate. Since fish passage was constructed in 1996 at the Redlands Diversion Dam on the Gunnison River (after 80 years of blocked fish passage), 26 razorback suckers have used the passage and reproduction has recently been documented upstream of the diversion dam (McAda 2003; Burdick 2009). Sampling for larval fish was done in the Gunnison River for the first time in 2002; eight larval razorback suckers were collected that year (Osmundson 2002a), seven were collected in 2003, and two were collected in 2005.

Twenty radiotagged razorback suckers also were stocked in 1994 into historical habitat in the Upper Colorado River between DeBeque and Rifle. This is above the Price-Stubb Diversion Dam near Palisade, which at that time was a barrier to upstream fish passage. Twenty razorback suckers also were stocked into the Gunnison River near Delta in 1994, and five more in 1995. Unfortunately, post-stocking survival for all of these stocked fish was less than anticipated, with mortality possibly as high as 85% within approximately 1 year (Burdick and Bonar 1997).

The integrated stocking plan (Nesler et al. 2003) calls for 3,310, age 2+ fish to be stocked into each of 3 river reaches in Colorado for 6 successive years: **1)** Colorado River (Rifle to Debeque Canyon), **2)** Colorado River (Palisade to Stateline), and **3)** Gunnison River (Hartland to Redland dams). Additionally, 19,860 razorback suckers are to be stocked into the Green River each year, split between the middle and lower reaches.

After the release of the integrated stocking plan (Nesler et al. 2003), the numbers of razorback suckers stocked into each river has been relatively high, although the stocking targets have not always been met. Combining all years from 1995-2005, the total number of razorback suckers stocked into each of the main rivers approximately totals: Green River = 39,462; Colorado River = 61,282; Gunnison River = 18,385 (Zelasko et al. 2009). Recapture rates of these stocked fish are typically quite low. River-wide and localized sampling efforts from 2000-2004 recaptured only approximately 1% of the razorback suckers stocked into the Colorado River prior to sampling, and approximately 8% of the razorback suckers stocked into the Green River prior to sampling. However, some of these razorbacks have persisted and have been captured 4 years after stocking and fish from earlier stocking efforts have been recaptured up to 9 years after stocking (UCREFRP 2006). Additionally, some of these stocked fish have moved long distances; razorbacks stocked in the Green River have been captured in the Colorado River and some stocked in the Gunnison River have been captured in the Green River (UCREFRP 2006). Stocked razorback suckers also have been recaptured or observed in reproductive condition at spawning sites in the Green and San Juan Rivers, larval razorbacks have been captured in the Green, Gunnison, Colorado, and San Juan Rivers, and razorback larvae are surviving through the first year based on the capture of juveniles in the Green and San Juan Rivers (UCREFRP 2007).

Humpback Chub

Five of the six populations of humpback chub are located within the action area. Recent population estimates put the approximate number of humpback chub in the combined Westwater-Black Rocks population at 3,000 adults, Desolation-Gray Canyons at 1,000 adults, and a few hundred adults each in Cataract Canyon and Yampa Canyon populations (UCREFRP 2007).

The integrated stocking plan (Nesler et al. 2003) does not call for any captive rearing or stocking of humpback chub in Utah or Colorado.

Bonytail

The only known bonytail that presently occur in the action area are those that have been stocked. Experimental stocking of bonytail began in the Colorado River in 1996 and in the Green River in 1998. Combining all years from 1996-2007, the number of bonytail stocked into the Colorado River totals approximately 47,700, and into the Green River the total is approximately 63,800 (T. Francis, Fisheries Biologist, in litt., 2008).

Bonytail also were recently reintroduced in the Yampa River at Echo Park, near the confluence with the Green River. In July 2000, approximately 5,000 juveniles (2-4 inches) were stocked. The integrated stocking plan (Nesler et al. 2003) calls for 2,665, age 2+ fish to be stocked into each of 5 river reaches for 6 successive years: **1)** Colorado River (RM 110.5), **2)** Colorado River (Palisade to Loma), **3)** Middle Green/Yampa Rivers (Dinosaur N.P.), **4)** Middle Green River (RM 302-249), and **5)** Lower Green River (RM 120-249). Bonytail stocking has occurred close to or at these levels since that time (Francis 2008).

Relatively few hatchery-produced bonytail have been recaptured from the Green or Colorado Rivers since the integrated stocking plan was implemented. Despite thousands of released fish, only about two dozen bonytail have been recaptured from the Green River (through 2004), and only about three dozen have been recaptured from the Colorado River (through 2004). None of the recaptured bonytail from either river were recaptured more than a full year after stocking (T. Francis, Fisheries Biologist, in litt., 2008).

<u>Changes in Fish Passage</u>
Fish passage structures were installed at the Price-Stubb Diversion Dam in the Colorado River above Palisade in the summer of 2008. Fish passage structures and a fish trap also had been installed a few years earlier at the Government Diversion Dam, approximately 5 miles further upstream. Endangered fish may now move upstream beyond Palisade and reach the upper end of critical habitat at Rifle; however, none have been found in the Government Diversion Dam trap to date.

<u>Water Depletions and Changes in the Timing and Magnitude of Flows</u>
Typical of rivers in the Southwest, the Colorado River and its tributaries were originally characterized by large spring snowmelt peak flows, low summer and winter base flows, and high-magnitude, short-duration summer and fall storm events. However, during the 20th century, over 140 main-stem and tributary dams and reservoirs have been installed in the Colorado River Basin. As a result, the Colorado River Basin is one of the most tightly controlled water supplies in the world (Bestgen et al. 2007). Peak spring-time flood flows have typically been reduced and late summer-time minimum flows have been elevated resulting in a generally flatter hydrograph.

Major upstream dams altering flows on the Colorado River as it flows through critical habitat include Granby, Dillon, Green Mountain, Williams Fork, and Ruedi. Major upstream dams altering flows through critical habitat on the Gunnison River include Blue Mesa, Morrow Point, Crystal and Taylor Park. Additionally, flows through critical habitat along the Yampa River are affected by reservoirs such as Elkhead, Steamboat, and Stagecoach, and flows through critical habitat along the White River are affected by Taylor Draw Dam. Taylor Draw Dam, installed within the White River itself, also lacks fish passage facilities and is an absolute barrier to any upstream fish movement.

Osmundson and Kaeding (1991) showed that average peak runoff along the Colorado River near Cameo in recent times (1954-1989) had declined by 44% from earlier times (1902-1942), which preceded the construction of major dams (but also included a portion of the 20th century that is considered to have been relatively wet). Similarly, Pitlick et al. (1999) found that peak flows on the Gunnison River declined 38% after construction of the large Blue Mesa (1966) and Morrow Point (1968) Dams. However, average annual flows did not change, demonstrating that the change in average peak flow was not due to differing precipitation amounts. Flooding streamflows were reduced over 40% in the White River downstream from Taylor Draw Dam, which was constructed in 1984 (Lentsh et al. 2000).

Not only do dams change the timing and magnitude of river flows, but they also allow for trans-mountain water diversions via tunnels through the Continental Divide. There are 19 points where water is diverted out of the Colorado and Gunnison River Basins into the South Platte, Arkansas, and Rio Grand River Basins. Unlike some water diversions where a percentage of return flows can be expected (e.g., irrigation), trans-mountain diversions are forever lost from the Colorado River system. During the 5-year period from 1986-1990, these trans-mountain diversions ranged from approximately 226,000 to 422,000 af of water (McAda 2003). In 1986, a reasonably wet year, the trans-mountain diversions were approximately 5% of the total water that ultimately flowed out of, or would have flowed out of, the state in the Colorado River. However, in 1989-1990 (relatively dry years), approximately 12-13% of the water entering the Upper Colorado River watershed (above the state line) was diverted out of the system to Front-Range users. There also is a trans-mountain water diversion from the headwaters of the Little Snake River, a tributary to the Yampa River, where 15,800 af of water is removed annually to augment the municipal water supply for the City of Cheyenne, Wyoming.

Considering trans-mountain diversions along with other water projects, the Green and Colorado Rivers have been depleted approximately 20% (at Green River) and 32% (at Cisco), respectively (Holden 1999). In the Yampa River Basin, depletions are estimated to average about 125,000 annually in Colorado and roughly 43,000 af per year in Wyoming. In total, these depletions represent about 10% of the average annual undepleted yield of the Yampa River at its confluence with the Green River (~1.7 M af). Projections of water demand through the year 2045 indicate that additional depletions will bring the basin-wide total to about 221,000 af or about 13% of the average annual undepleted yield of the Yampa River. And in the White River, annual water depletions amount to between 8 and 12%, although with return flows, water consumption totals approximately 5% (Lentsh et al. 2000).

These depletions have likely contributed to the decline in pikeminnow and razorback sucker populations (USFWS 1998a). To the extent that water is exported out of the basin or consumptively used (e.g., evaporation from fields, irrigation canals, reservoir surface, road surfaces), it is not available to maintain flows within the river. Maintenance of streamflow is essential to the ecological integrity of large western rivers (USFWS 1998a).

<u>Flow Recommendations</u>

Flow recommendations have been developed for reaches within endangered fish critical habitat along the Yampa River (USFWS 2005), three reaches of the Colorado River (Osmundson and Kaeding 1991; Osmundson et al. 1995; Osmundson 2001; McAda 2003), and the Gunnison River (McAda 2003). Recommended flows vary by season and by water availability for a given year (e.g., flow recommendations are reduced for drought years). In general, spring flows recommended for dry years provide small peaks used as spawning cues by endangered fish, but contribute little to habitat maintenance; spring flows recommended for average years promote scouring of cobble and gravel bars and provide localized flooding of short duration; and spring flows for wet years promote wide-spread scouring of cobble and gravel bars, flushing of side channels, removal of encroaching vegetation, and inundation of floodplain habitats (McAda 2003).

For the Yampa River, the Service recommends that summer flows not drop below 93 cubic feet per second (cfs) (at Maybell) with any greater frequency, magnitude, or duration than has occurred historically (1916-1995). Historically, flows have dropped below 93 cfs approximately 38% of the years of record with an average duration of about 9 days. Winter flows are typically somewhat higher; these should not drop below 124 cfs beyond what has occurred historically. The Service has established a water augmentation protocol and entered into agreements with other governmental agencies to provide the recommended flows in 90% of the years, and partially satisfy the flow recommendation during the driest 10% of years. Water from the recently expanded Elkhead Reservoir will be used to meet these goals. Water would be delivered at a rate of 50 cfs until augmented water flow at Maybell surpasses flow recommendations. During drought years, water would be delivered at a rate of 33 cfs (see USFWS 2005 for further details).

For the Palisade-to-Rifle reach along the Colorado River, Osmundson (2001) recommended that base-flow levels be between 1,600 and 2,500 cfs as measured at the USGS gage at Cameo (09095500). However, due to the need to provide the recommended base flows in the 15-mile reach, provide minimum flows through the DeBeque Canyon, and allow local diversion canals to continue operating, additional water must pass by the Cameo gage. Given this, the mean monthly recommended base flow levels range as high as 3,280 cfs (above average and wet years during August-October) and as low as 1,555 cfs (dry years during November-March). Mean monthly flows in excess of 3,280 cfs at Cameo during August to March is considered detrimental to endangered fish habitat and Osmundson (2001) recommended that it be stored in upstream reservoirs if possible. Since 2001 when the flow recommendations were established, baseline flows (monthly means) have never exceeded 3,280 cfs (data through 2007-2009). However, from 2001-2007, baseline flows fell below 1,555 cfs for at least 1 month in every year except 2006. During the drought of 2002, mean monthly base line flows were below 1,555 every month from August-March, with February 2003 averaging the lowest flows at 1,073 cfs (USGS Surface-Water Monthly Statistics at http://nwis.waterdata.usgs.gov/co/nwis).

Osmundson (2001) recommended that peak flows at the Cameo gage reach 25,000 cfs during wet years (wettest 25%, or 5 in 20 years) and reach 14,400 cfs during dry years (driest 20%, or 4 in 20 years). Intermediate peak flows were recommended for years of intermediate precipitation; mean monthly flows for each month were provided as well. Peak flows during wet years should be maintained for at least 3 weeks to give razorback sucker larvae adequate time to feed and grow in flooded bottomlands before being compelled to migrate to the main channel. Since 2001 when the flow recommendations were established, daily mean peak flows at the Cameo gage have ranged from 4,260 cfs (during the drought of 2002) to 22,500 cfs in 2008 (USGS Surface-Water for Colorado: Peak Streamflow and Daily Data at http://nwis.waterdata.usgs.gov/co/nwis).

As stated previously, one of the most important reaches within the Colorado River for Colorado pikeminnow and razorback sucker is the 15-mile reach within the Grand Valley. It has experienced major agricultural water depletions for many years and during late summer and early fall this reach can be severely dewatered. Water depletions in the 15-mile reach have been identified as a limiting factor for Colorado pikeminnow. Osmundson et al. (1995) provided recommendations for summer flows through the 15-mile reach. They state that in years with above average winter precipitation levels, a flow of 1,630 cfs is recommended for summer months. In years of somewhat below average precipitation, when the ideal flow of 1,630 cfs would be difficult to meet, the recommendation could be relaxed to 1,240 cfs. In years of drought (20% lowest precipitation years), when even 1,240 cfs would be difficult to meet, flows should not fall below 810 cfs. The assumption and hope is that at this low level the fish that remain in the reach can wait out the dry period until more favorable conditions return with the end of the irrigation season. Mean monthly flows have, nevertheless, dropped below 810 cfs for at least 1 of the summer-time months during 7 of the last 17 years (1991-2007). The lowest monthly mean occurred during the drought of 2002 when only 115 cfs flowed through the 15-mile reach in August of that year (USGS Surface-Water Monthly Statistics at http://nwis.waterdata.usgs.gov/co/nwis).

Numerous approaches are being taken to restore flows in the 15-mile reach immediately upstream of from the confluence of the Gunnison River to levels recommended by the Service. The Bureau of Reclamation has made available 5,000 af of water annually plus an additional 5,000 af in 4 of every 5 years from Ruedi Reservoir to augment flows in the 15-mile reach during July, August, and September. In addition, water is available from the lease of 10,825 af a year of water from Ruedi Reservoir and permanent commitment of 10,825 af a year from East and West slope water users. The East and West slope commitments were secured in 2000 by a Memoranda of Agreement (MOA) with the Colorado River Water Conservation District (CRWCD) and Denver Water for delivery of 5,412 af of water from Wolford Mountain Reservoir and 5,412 af from Williams Fork Reservoir, respectively. By 2009, CRWCD and Denver Water will have a plan in place to permanently replace the water now being delivered by Wolford and Williams Fork reservoirs. Additional water is being provided through an MOA with CRWCD for delivery of up to 6,000 af of water from Wolford Mountain Reservoir.

Osmundson and Kaeding (1991) stated that the availability of good winter habitat has probably not been a limiting factor for adult Colorado pikeminnow or razorback sucker in the Upper Colorado River. Unlike spring flows, recent (1954-1989) mean monthly winter flows have increased to approximately 112-134% of historic flows (1902-1942). It is not apparent that these increased winter flows have had any negative effects on the endangered fishes. Given this, Osmundson and Kaeding (1991) recommended that mean monthly winter flows through the 15-mile reach simply not drop below historic levels, averaging approximately 1,470 cfs. From 1996-2006 mean monthly winter flows have averaged higher than historic levels, with flows dropping somewhat below historic flows on occasion (USGS Surface-Water Monthly Statistics at http://nwis.waterdata.usgs.gov/co/nwis).

Flow recommendations during spring run-off call for high spring flows that are critical for shaping the river channel, determining substrate composition, and influencing the abundance of various species for the remainder of the year. Recommended peak flows (1-day average) in the

15-mile reach are: **1)** 20,500 to 23,500 cfs in at least 1 of 4 years, **2)** greater than 23,500 cfs in at least 1 of 4 years, and **3)** 14,800 cfs to 20,500 cfs to occur no more often than 2 of 4 years. See Osmundson and Kaeding (1991) for more details, including state-line peak flow and 15-mile reach mean monthly flow recommendations. Osmundson et al. (1995) updated the minimum recommended peak flows to be greater than 12,900 cfs rather than 14,800 in 2 of 4 years. Since the publication of the spring flow recommendations in 1991, peak 1-day average flows through the 15-mile reach have been below 12,900 cfs approximately one-third of the years through 2006 and these targets have not been met (USGS Surface-Water for Colorado: Peak Streamflow at http://nwis.waterdata.usgs.gov/co/nwis).

Peak flow recommendations for the Colorado River at the USGS gage near the Colorado-Utah state line (09163500) were provided by McAda (2003). Flow recommendations vary by hydrologic category; summarized excerpts are presented here. During wet years, instantaneous peak flow should fall between 39,300 and 69,800 cfs, should exceed 35,000 cfs for 30-35 days, and should exceed 18,500 cfs for 80-100 days. During dry years, instantaneous peak flows should range between 5,000 and 12,100 cfs. Intermediate peak flows are recommended for the four hydrologic categories between wet and dry. From 2003-2006, peak flows have ranged between 9,450 and 31,000 cfs (USGS Surface-Water for Colorado: Peak Streamflow at http://nwis.waterdata.usgs.gov/co/nwis).

Baseflow recommendations for the Colorado River at the USGS gage near the Colorado-Utah State line (09163500) also were provided by McAda (2003). The base-flow period begins after spring runoff is completed and continues through initiation of spring runoff the following year. A minimum flow of 3,000-6,000 cfs should be maintained at the state-line USGS gage (09152500) in wet years. During dry years, flows should remain above 1,800 cfs, which will make backwaters available for YOY Colorado pikeminnow, although not at a maximum number or surface area. Intermediate base flow levels are recommended for the four hydrologic categories between wet and dry. From 2003 to 2008, flows at this gage dropped below 1,800 cfs in 2003 and 2004 (USGS Surface-Water for Colorado: Daily Data at http://nwis.waterdata.usgs.gov/co/nwis)

Flow recommendations for the Gunnison River apply to the USGS gage at Whitewater (09152500), which is within critical habitat for the Colorado pikeminnow and razorback sucker. Detailed flow recommendations can be found in McAda (2003); summarized excerpts are presented here. During wet years, peak flow should fall between 15,000 and 23,000 cfs for 1 day, should exceed 14,350 cfs for 15 to 25 days, and should exceed 8,070 cfs for 60 to 100 days.

During dry years, flows should peak between 900 and 4,000 cfs for a day. Intermediate peak flows are recommended for the four hydrologic categories between wet and dry. From 2003-2006, peak flows have ranged between 3,790 and 12,300 cfs (USGS Surface-Water for Colorado: Peak Streamflow at http://nwis.waterdata.usgs.gov/co/nwis).

Similarly, baseflow recommendations for the Gunnison River are provided by McAda (2003). A minimum flow of at least 1,050 cfs should be maintained at the USGS gage (09152500) in all but dry and moderately dry years. This flow maximizes the amount of pool habitat in the Gunnison

River, which is preferred by adult Colorado pikeminnow and razorback sucker. Also, flows exceeding 950 cfs prevent fine sediments from settling in riffles, which might smother eggs and larvae of endangered fishes. Additionally, flow of 1,050 cfs roughly corresponds to providing a minimum of 300 cfs downstream from Redlands Diversion Dam (based on senior water rights of 750 cfs) and provides access for migrating fish to the fishway there. During dry and moderately dry years, flows may decrease below 1,050 cfs after the Colorado pikeminnow migration period and only after consultation with Service biologists. The 2.5-mile reach downstream from Redlands Diversion Dam could experience severe dewatering at this level and endangered fish may be forced to leave this reach of critical habitat. From 2003-2008, flows at this gage have dropped below 1,050 cfs in 3 of the 6 years (USGS Surface-Water for Colorado: Daily Data at http://nwis.waterdata.usgs.gov/co/nwis).

## EFFECTS OF THE ACTION

### Effects to Endangered Species

Individual projects with either a new or historic average annual water depletion of 100 af or less up to a cumulative total of an additional 4,500 af in the Upper Basin may adversely affect Colorado pikeminnow, razorback sucker, bonytail, and humpback chub. In general, the proposed action would adversely affect the four listed fish by reducing the amount of water available to them, increasing the likelihood of water quality issues, increasing their vulnerability to predation, and reducing their breeding opportunities by shrinking the amount of breeding habitat within their range.

Removing water from the Colorado Rivers would change the natural hydrological regime that creates and maintains important fish habitats, such as spawning habitats, and reduces the frequency and duration of availability of these habitats of the four endangered fish. The reduction of available habitats will directly affect individuals of all four species by decreasing reproductive potential and foraging and sheltering opportunities. Many of the habitats required for breeding become severely diminished when flows are reduced. In addition, reduction in flow rates lessens the ability of the river to inundate bottomland, a source of nutrient supply for fish productivity. To the extent that the proposed project will reduce flows, the ability of the river to provide these functions will be reduced. This reduction of water affects habitat availability and habitat quality.

Depletions affect water quality by increasing concentrations of heavy metals, selenium, salts, pesticides, and other contaminants. Increases in water depletions will cause associated reductions in assimilative capacity and dilution potential for any contaminants that enter the river. An increase in contaminant concentrations in the river would likely result in an increase in the bioaccumulation of these contaminants in the food chain which could adversely affect the endangered fishes, particularly the predatory Colorado pikeminnow.

To the extent that it would reduce flows and contribute to further habitat alteration, water depletions actions contribute to an increase in nonnative fish populations. The modification of flow regimes, water temperatures, sediment levels, and other habitat conditions caused by water depletions has contributed to the establishment of nonnative fishes. Endangered fishes within the action area would experience increased competition and predation as a result.

Effects to Critical Habitat
All four of the listed Colorado River fish require the same PCEs essential for their survival. Therefore, we are combining our analysis of all four species into one section. Because the amount of designated critical habitat varies for each of the four species, the amount of habitat will vary; however, the effects would be the same for all critical habitat within the action area.

The Service identified water, physical habitat, and the biological environment as PCEs of critical habitat. This includes a quantity of water of sufficient quality that is delivered to specific habitats in accordance with a hydrologic regime that is required for the particular life stage for the species. The physical habitat includes areas of the Colorado River system that are inhabited or potentially habitable for use in spawning and feeding, as a nursery, or serve as corridors between these areas. In addition, oxbows, backwaters, and other areas in the 100-year floodplain, which when inundated provide access to spawning, nursery, feeding, and rearing habitats, are included. Food supply, predation, and competition are important elements of the biological environment.

***Primary Constituent Element - Water***

Removing water from the river system changes the natural hydrological regime that creates and maintains important fish habitats, such as spawning habitats, and reduces the frequency and duration of availability of these habitats of the four endangered fish. In addition, reduction in flow rates lessens the ability of the river to inundate bottomland, a source of nutrient supply for fish productivity and important nursery habitat for razorback sucker. Water depletions change flow and temperature regimes toward conditions that favor nonnative fish, thus adding to pressures of competition and predation by these nonnative fishes as discussed above.

Changes in water quantity would affect water quality, which is a PCE of critical habitat. Contaminants enter the Colorado River from various point and non-point sources, resulting in increased concentrations of heavy metals, selenium, salts, pesticides, and other contaminants. Increases in water depletions will cause associated reductions in assimilative capacity and dilution potential for any contaminants that enter critical habitat in the Colorado River.

Depletions may cause a proportionate decrease in dilution, which in turn would cause a proportionate increase in heavy metal, selenium, salts, pesticides, and other contaminant concentrations in the Colorado River to Lake Powell. An increase in contaminant concentrations in the river would likely result in an increase in the bioaccumulation of these contaminants in the food chain which could adversely affect the endangered fishes, particularly the predatory Colorado pikeminnow. Selenium is of particular concern due to its effects on fish reproduction and its tendency to concentrate in low velocity areas that are important habitats for Colorado pikeminnow and razorback suckers.

***Primary Constituent Element - Physical Habitat***

The subject action would affect the physical condition of habitat for the four listed fish by resulting in a reduction of water. This reduction would contribute to the cumulative reduction in high spring flows, which are essential for creating and maintaining complex channel geomorphology and suitable spawning substrates, creating and providing access to off-channel habitats, and possibly stimulating Colorado pikeminnow spawning migrations. Adequate summer and winter flows are important for providing a sufficient quantity of preferred habitats for a duration and at a frequency necessary to support all life stages of viable populations of all endangered fishes. To the extent that the subject action will reduce flows, the ability of the river to provide these functions will be reduced. This reduction of water affects habitat availability and habitat quality.

***Primary Constituent Element - Biological Environment***

To the extent that it would reduce flows and contribute to further habitat alteration, the Project would contribute to an increase in nonnative fish populations. The modification of flow regimes, water temperatures, sediment levels, and other habitat conditions caused by water depletions has contributed to the establishment of nonnative fishes. Endangered fishes within the action area would experience increased competition and predation as a result.

## SUMMARY OF EFFECTS

Because water depletions are a major factor in the decline of the endangered fish, we have determined that any depletion may affect listed species and their critical habitat. Included in these depletions are numerous small depletions of 100 af or less. Even though the cumulative impact of all these small depletions causes an adverse impact, the experience of the Service since implementation of the Recovery Program (see “Recovery Implementation Program for Endangered Fish Species in the Upper Colorado River Basin” (USFWS 1987)) has shown that the individual depletions in and of themselves are minimal because of their size and scattered locations.

In light of these minimal impacts and when considering the cost of staff and funds to administer small depletion section 7 consultations, the Service has determined that it would be more efficient and economical to exempt depletions of 100 af or less from the depletion fee. The fees derived from the small depletions do not cover the cost of their administration, thereby requiring staff and funds which could be directed to on-the-ground activities to recover the endangered fish.

## CUMMULATIVE EFFECTS

Cumulative effects include the effects of future state, tribal, local, or private actions that are reasonably certain to occur in the action area considered in this BO. Future Federal actions that are unrelated to the proposed action are not considered in this section because they require separate consultation pursuant to section 7 of the ESA.

Reasonably foreseeable future activities that may affect river-related resources in the area include oil and gas exploration and development, irrigation, urban development, industrial development, recreational activities such as angling, and activities associated with the UCREFRP. Implementation of these projects may affect both water quantity and quality.

Cumulative effects to these endangered fish species would likely include the following types of impacts:

- Changes in land use patterns that would further fragment, modify, or destroy potential spawning sites or designated critical habitat;

- Shoreline recreational activities and encroachment of human development that would remove upland or riparian/wetland vegetation and potentially degrade water quality;

- Competition with, and predation by, exotic fish species introduced by anglers or other sources.

- Non-Federal fluid mineral development. Various reasonable foreseeable development scenarios project that 880 wells to access private minerals may be drilled annually during the next 15 years in western Colorado (excluding the San Juan River Basin). The drilling and production of these private minerals are estimated to require 1,052 af per year from the primary basins draining this area.

- Water depletions for activities other than fluid mineral development, including the construction of ponds, reservoirs, ditches, and water diversion structures for activities such as irrigation, stock watering, power production, municipal use, and industrial needs.

CONCLUSION

After reviewing the current status of the Colorado pikeminnow, humpback chub, bonytail, and razorback sucker, the environmental baseline for the action area, the effects of the proposed action, and the cumulative effects, it is the Service’s BO that the project is not likely to jeopardize the continued existence of endangered fish and the project is not likely to destroy or adversely modify designated critical habitat.

## INCIDENTAL TAKE STATEMENT

Section 9 of the ESA and Federal regulation pursuant to section 4(d) of the ESA prohibit the take of endangered and threatened species, respectively, without special exemption. Take is defined as to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture or collect, or to attempt to engage in any such conduct. Harm is further defined by the Service to include significant habitat modification or degradation that results in death or injury of listed species by significantly impairing essential behavioral patterns, including breeding, feeding, or sheltering. Harass is defined by the Service as intentional or negligent actions that create the likelihood of injury to listed species to such an extent as to significantly disrupt normal behavior patterns which include, but are not limited to breeding, feeding or sheltering. Incidental take is defined as take that is incidental to, and not the purpose of, carrying out of an otherwise lawful activity. Under the terms of section 7(b)(4) and section 7(o)(2), taking that is incidental to and not intended as part of the agency action is not considered to be prohibited taking under the ESA provided that such taking is in compliance with the terms and conditions of this Incidental Take Statement.

Colorado pikeminnow, humpback chub, bonytail, and razorback sucker are harmed from the reduction of water in their habitats resulting from the subject action in the following manner: **1)** individuals using habitats diminished by the proposed water depletions could be more susceptible to predation and competition from nonnative fish; and **2)** habitat conditions may be rendered unsuitable for breeding because reduced flows would impact habitat formulation and maintenance as described in the BO.

Estimating the number of individuals of these species that would be taken as a result of water depletions is difficult to quantify for the following reasons: **1)** determining whether an individual forwent breeding as a result of water depletions versus natural causes would be extremely difficult to determine; **2)** finding a dead or injured listed fish would be difficult, due to the large size of the action area and because carcasses are subject to scavenging; **3)** natural fluctuations in river flows and species abundance may mask depletion effects, and **4)** effects that reduce fecundity are difficult to quantify. However, we believe the level of take of these species can be monitored by tracking the level of water reduction and adherence to the Recovery Program. Specifically, if the Recovery Program (and relevant RIPRAP measures) is not implemented, or if the current anticipated level of water depletion is exceeded, we fully expect the level of incidental take to increase as well. Therefore, we exempt all take in the form of harm that would occur from the removal of 100 af or less of water up to a cumulative total of an additional 4,500 af. Water depletions above the amount addressed in this BO would exceed the anticipated level of incidental take and are not exempt from the prohibitions of section 9 of the ESA.

## REASONABLE AND PRUDENT MEASURES

The Service believes that implementation of the Recovery Program will minimize impacts of incidental take due to small water depletion activities. This includes monitoring the extent of incidental take that occurs on a project-by-project basis.

MONITORING

The implementing regulations for incidental take require that Federal agencies must report the progress of the action and its impact on the species (50 CFR 402.14(i)). To meet this mandate, we will monitor and report small water depletion actions as follows:

**1.** As individual projects are proposed under this programmatic small water depletion biological opinion, the field office will track project-specific information that includes: 1) a description of the proposed action and the area to be affected, and 2) number of acre-feet to be depleted. The field office will provide this information to the Recovery Program on a quarterly basis.

**2.** On a quarterly basis, the Recovery Program will track depletions that are tiered under this programmatic small water depletion to ensure the extent of incidental take anticipated under this biological opinion has not been exceeded.

REINITIATION NOTICE

This concludes formal consultation on the action outlined in the request. As provided in 50 CFR 402.16, reinitiation of formal consultation is required where discretionary Federal agency involvement or control over the action has been retained (or is authorized by law) and if: **1)** the amount or extent of incidental take is exceeded; **2)** new information reveals effects of the agency action that may affect listed species or critical habitat in a manner or to an extent not considered in this opinion; **3)** the action is subsequently modified in a manner that causes an effect to the listed species or critical habitat not considered in this opinion; or **4)** a new species is listed or critical habitat designated that may be affected by the action.

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