APPENDIX Q2: BIOLOGICAL OPINION

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United States Department of the Interior

FISH AND WILDLIFE SERVICE

Ecological Services
5353 Yellowstone Road, Suite 308A
Cheyenne, Wyoming 82009

DEC 29 2014

In Reply Refer To:
06E13000-2013-F-0044

Memorandum

To: Field Manager, Bureau of Land Management, Rawlins Field Office, Rawlins, Wyoming

From: Field Supervisor, U.S. Fish and Wildlife Service, Wyoming Field Office, Cheyenne, Wyoming

Subject: Final Biological Opinion for the Continental Divide-Creston Natural Gas Project, Carbon and Sweetwater Counties, Wyoming

In accordance with section 7 of the Endangered Species Act (ESA) of 1973, as amended (16 U.S.C. 1531 *et seq.*), and the Interagency Cooperation Regulations (50 CFR 402), this document transmits the U.S. Fish and Wildlife Service's (Service) biological opinion based on our review of the proposed Continental Divide-Creston Natural Gas Project located in Carbon and Sweetwater Counties, Wyoming, and its effects on the endangered Colorado pikeminnow (*Ptychocheilus lucius*), humpback chub (*Gila cypha*), bonytail (*Gila elegans*), and razorback sucker (*Xyrauchen texanus*) and their designated critical habitats.

This biological opinion is in response to your October 27, 2014, request to initiate consultation for the Continental Divide-Creston Natural Gas Project (CD-C Project; Project). The Service concurs that the proposed Project may adversely affect the endangered Colorado pikeminnow (*Ptychocheilus lucius*), humpback chub (*Gila cypha*), bonytail (*Gila elegans*), and razorback sucker (*Xyrauchen texanus*) and their designated critical habitat.

Additionally, in sections 8.1 and 8.3 of the biological assessment, you requested concurrence on your determinations that the proposed Project may affect, but is not likely to adversely affect, the federally threatened Canada lynx (*Lynx canadensis*) and Ute ladies'-tresses orchid (*Spiranthes diluvialis*), respectively. Based on the information provided in your Biological Assessment we concur that the Project, as currently proposed, is not likely to adversely affect the Canada lynx because of (1) the lack of suitable habitat for the snowshoe hares, the primary prey of lynx, and (2) the implementation of conservation measures to protect riparian habitats that could serve as migration corridors for lynx dispersing from occupied habitats to the south and northwest. Based on the information provided in your Biological Assessment we concur that the Project, as currently proposed, is not likely to adversely affect the Ute ladies'-tresses orchid because of

(1) the lack of known occupied habitat (2) the limited amount of potential habitat within the action area, and (3) the commitment by the BLM to implement conservation measures to avoid adverse effects, such as spatial buffers and timing restrictions.

CONSULTATION HISTORY

On January 21-22, 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 2001, the Recovery Program was extended until September 30, 2013. 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) was developed (USFWS 1993). The Agreement establishes a framework for conducting all future section 7 consultations on depletion impacts related to new projects and all impacts associated with historic projects in the Upper Basin. Procedures outlined in the Agreement are used to determine if sufficient progress is being accomplished in the recovery of the endangered fishes to enable the Recovery Program to serve as a reasonable and prudent alternative (RPA) to avoid jeopardy. The RIPRAP was finalized on October 15, 1993, and has been reviewed and updated annually.

In accordance with the 1993 Agreement, the Service annually assesses progress of the implementation of recovery actions to determine if progress toward recovery has been sufficient for the Recovery Program to serve as a RPA for projects that deplete water from the Colorado River. In the last review the Service determined that the Program has made sufficient progress to offset water depletions from individual projects up to 4,500 acre-feet/year. Therefore, it is appropriate for the Recovery Program actions to serve as Conservation Measures in the project description for projects up to 4,500 acre-feet/year.

After many years of successful implementation of the Recovery Program and Agreement, Federal action agencies have come to anticipate Recovery Program activities and a requirement of a financial contribution (for new depletions greater than 100 acre-feet) toward these activities serving as RPAs that must be included in their project planning to avoid jeopardy to listed species. Thus, the RPA has essentially become part of the proposed action. The Recovery Program activities will now serve as conservation measures within the proposed action and minimize adverse effects to listed species or critical habitat. The following excerpts summarize portions of the Recovery Program that address depletion impacts, section 7 consultation, and Project proponent responsibilities:

> "All future section 7 consultations completed after approval and implementation of this program (establishment of the Implementation Committee, provision of congressional funding, and initiation of the elements) will result in a one-time contribution to be paid to the Service by water project proponents in the amount

> of $10.00 per acre-foot based on the average annual depletion of the project . . . This figure will be adjusted annually for inflation [the current figure for FY2015 is $20.54 per acre-foot] . . . Concurrently with the completion of the Federal action which initiated the consultation, e.g., . . . issuance of a 404 permit, 10 percent of the total contribution will be provided. The balance . . . will be . . . due at the time the construction commences . . . ."

It is important to note that these provisions of the Recovery Program were based on appropriate legal protection of the instream flow needs of the endangered Colorado River fishes. The Recovery Program further states:

> ". . . it is necessary to protect and manage sufficient habitat to support self-sustaining populations of these species. One way to accomplish this is to provide long term protection of the habitat by acquiring or appropriating water rights to ensure instream flows. Since this program sets in place a mechanism and a commitment to assure that the instream flows are protected under State law, the Service will consider these elements under section 7 consultation as offsetting project depletion impacts."

BIOLOGICAL OPINION

This biological opinion addresses an average annual depletion of approximately 650 acre-feet of water from the Upper Colorado River Basin. Water depletions in the Upper Basin have been recognized as a major source of impact to endangered fish species. Continued water withdrawal has restricted the ability of the Colorado River system to produce flow conditions required by various life stages of the fishes.

Critical habitat has been designated for the Colorado pikeminnow, humpback chub, bonytail, and razorback sucker within the 100-year floodplain in portions of their historic range (59 FR 13374). This biological opinion does not rely upon the regulatory definition of "destruction or adverse modification" of critical habitat at 50 CFR 402.02. Instead, we have relied upon the statutory provisions of the ESA to complete the following analysis with respect to critical habitat. In considering the biological basis for designating critical habitat, the Service focused on the primary physical and biological elements that are essential to the conservation of the species without consideration of land or water ownership or management. The Service has identified water, physical habitat, and biological environment as the primary constituent elements. This includes a quantity of water of sufficient quality that is delivered to a specific location in accordance with a hydrologic regime that is required for the particular life stage for each species. Water depletions reduce the ability of the river system to provide the required water quantity and hydrologic regime necessary for recovery of the fishes. 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 flood plain, when inundated, provide access to spawning, nursery, feeding, and rearing habitats

DESCRIPTION OF THE PROPOSED ACTION

ACTION AREA

Our regulations define the action area as all areas directly or indirectly affected by the Federal action and not merely the immediate area involved in the action (50 CFR 402.02). Water depletions associated with the Project will result in a loss of water from the Upper Colorado River Basin.

PROJECT DESCRIPTION

The CD-C Project involves drilling up to 8,950 natural gas wells in a Project area of about 1.1 million acres (1,672 square miles) located in Townships 14 through 24 North, Ranges 91 through 98 West, Sixth Principal Meridian, Carbon and Sweetwater Counties. The Rawlins Field Office (RFO) manages BLM surface lands and the Federal mineral estate in the Project area. The CD-C Project is an infill project in a region that has seen extensive natural gas exploration and development. More than 4,700 wells have already been drilled in the Project area, including the Continental Divide, Wamsutter, Creston/Blue Gap and Continental Divide/Wamsutter II projects. Although operations are subject to change as conditions warrant, the long-term plan of development is to drill at the average rate of approximately 600 wells per year until the resource is fully developed (about 15 years).

Wells may be drilled conventionally (vertically) or directionally from single or multiple well pads. The Project also includes construction and operation of ancillary facilities such as: roads; gas, water, and condensate-gathering pipelines; overhead and buried power lines; and separation, dehydration, metering, and fluid-storage facilities. The average life of a well is expected to be 30 to 40 years. Combining average well life with a 15-year field development period produces a potential Project life of 45 to 55 years.

Up to 25 drilling-rigs will be used at any particular time in order to achieve development objectives. Wells will be drilled using conventional, mechanically powered mobile drilling rigs. Drilling each gas well will take from 7 to 10 days, with additional time likely for directional wells and wells deeper than 10,000 feet. Completion and testing operations typically require approximately 10 to 20 (up to 30) days to perform. Drilling will occur year-round subject to environmental considerations.

Approximately 24,000 to 42,000 barrels (3.1 to 5.4 acre-feet) of water are needed to perform drilling and completion operations for each well. Fresh water will be used for drilling the first 5,000–7,000 feet of each well, and water-based muds will be used for the remainder of the drilling operation. Water will come from existing and new water-supply wells within the project area and from produced-water sources. Using produced water to the greatest extent possible will conserve fresh-water aquifers and reduce the amount of water depleted from the Colorado River system. Estimated annual freshwater use within the CD-C Project area will range from 1,856 to 3,248 acre-feet per year and will average 2,552 acre-feet per year. All freshwater will be withdrawn from groundwater sources; no freshwater will be withdrawn from surface waters.

Water needed for drilling and completion activities will come from new and existing State Engineer's Office (SEO)-approved local water wells, as well as from produced-water sources.

Most (96 percent) SEO-approved wells are completed in Tertiary age aquifers, particularly the Wasatch Formation. According to Mason and Miller (2005), the Wasatch Formation has the potential to lose groundwater to the southeast and ultimately to the Colorado River system. Roughly 20 percent of the Wasatch Formation within the CD-C project area is within that portion of the Washakie Structural Basin that loses groundwater to the southeast toward the Little Snake River, a tributary of the Colorado River. As such, an interruption of this groundwater flow could lead to depletions to the Colorado River system, although the proportion of flow in the Little Snake River that comes from groundwater discharge from the Wasatch Formation has not been quantified.

The Project's estimated annual freshwater use ranges from 1,856 to 3,248 acre-feet per year, averaging 2,552 acre-feet per year. Assuming groundwater use from the Wasatch Formation is evenly distributed across the Project area, approximately 20 percent of the groundwater will come from that portion of the Wasatch Formation that could contribute water to the Little Snake River. Therefore, between 371 and 650 acre-feet of groundwater, averaging 510 acre-feet, will be removed from the Wasatch Formation in this area each year.

The BLM has determined that all CD-C groundwater withdrawals from that portion of the Washakie Structural Basin that loses groundwater toward the Little Snake River will be considered depletions for purposes of the RIP. Furthermore, the BLM is consulting on the maximum estimated annual usage, 650 acre-feet per year, in order to address the maximum effects to listed Colorado River species and their designated critical habitat.

The CD-C draft environmental impact statement (DEIS) provides a detailed description and analysis of the Proposed Action and alternatives, including the agency preferred alternative (alternative F). Alternative F limits development to no more than eight well pads per section to minimize surface disturbance and reduce impacts to the area's resources, including federally listed and proposed species. The alternative emphasizes transportation planning, development pre-planning, and a fugitive dust control plan. Under this alternative, well pads, access roads, pipelines, and ancillary facilities located within 0.5 mile of Muddy Creek, Red Wash, and Bitter Creek and within 0.25 mile of playas in the Chain Lakes Wildlife Habitat Management Area will be subject to controlled surface use stipulations in order to address salt and sediment impacts to sensitive fish species and general water quality.

CONSERVATION MEASURES

Conservation measures are actions that the action agency and applicant agree to implement to further the recovery of the species under review. The beneficial effects of conservation measures are taken into consideration for determining both jeopardy and adverse modification analyses. As explained in the Consultation History section, the Recovery Program is intended to implement actions that are needed to recover the endangered fishes and avoid jeopardy and adverse modification of critical habitat. Included in the Recovery Program is a requirement for project proponents of projects that cause water depletions greater than 100 acre-feet per year to make monetary contributions to the Recover Program. The BLM agrees to incorporate any required contribution as a condition of any issued permit or authorization. The conservation measures for this project are below:

The Recovery Program will serve as conservation measures to minimize adverse affects to the endangered fishes and their critical habitat caused by the project's water depletions. Depletion impacts can be offset by accomplishment of activities necessary to recover the endangered fishes as specified under the RIPRAP and the water Project proponent's one-time contribution to the Recovery Program for new depletions greater than 100 acre-feet per year.

New Depletion

As the project's average annual new depletion of 650 acre-feet is below the current sufficient progress threshold of 4,500 acre-feet, the Recovery Program will serve as conservation measures to minimize adverse affects to the Colorado pikeminnow, razorback sucker, humpback chub, and bonytail and designated critical habitat caused by the project's new depletion.

With respect to the depletion contribution the applicant will make a one-time payment which has been calculated by multiplying the Project's average annual depletion (acre-feet) by the depletion charge in effect at the time payment is made. For Fiscal Year 2015 (October 1, 2014, to September 30, 2016), the depletion charge is $20.54 per acre-foot for the average annual depletion which equals a total payment of $13,351 for this Project. Ten percent of the total payment (i.e., $1,350) will be provided to the Service's designated agent, the National Fish and Wildlife Foundation (Foundation), at the time of issuance of the Federal approvals from the BLM. The balance will be due at the time the construction commences. The payment will be included by the BLM as a condition of approval. The amount payable will be adjusted annually for inflation on October 1 of each year based on the Composite Consumer Price Index. All payments should be made to the Foundation:

National Fish and Wildlife Foundation
Attn: Donna McNamara, Finance Department
1133 15th Street, NW, Suite 1100
Washington DC 20005

The payment will be accompanied by a cover letter that identifies the project and biological opinion number **(06E13000-2013-F-0044)** that requires the payment, the amount of payment enclosed, check number, and the following notation on the check – "Upper Colorado Fish Recovery Program, NA.1104." The cover letter also shall identify the name and address of the payor, the name and address of the Federal agency responsible for authorizing the Project, and the address of the Service office issuing the biological opinion. This information will be used by the Foundation to notify the BLM and the Service that payment has been received. The Foundation is to send notices of receipt to these entities within five (5) working days of its receipt of payment.

STATUS OF THE SPECIES AND CRITICAL HABITAT

The purpose of this section is to summarize the best available information regarding the current range wide status of the listed fish species. Additional information regarding listed species may be obtained from the sources of information cited for these species[1].

COLORADO PIKEMINNOW

SPECIES DESCRIPTION

The Colorado pikeminnow (*Ptychocheilus lucius*) is the largest cyprinid fish (minnow family) native to North America and evolved as the main predator in the Colorado River system. Individuals begin consuming other fish for food at an early age and rarely eat anything else (Sigler and Sigler 1996). It is a long, slender, cylindrical fish with silvery sides, greenish back, and creamy white belly (Sigler and Sigler 1996). Historically, individuals may have grown as large as 6 feet long and weighed up to 100 pounds (estimates based on skeletal remains) (Sigler and Miller 1963), but today individuals rarely exceed 3 feet or weigh more than 18 pounds (Osmundson et al. 1997).

The species is endemic to the Colorado River Basin, where it was once widespread and abundant in warm water rivers and tributaries from Wyoming, Utah, New Mexico, and Colorado downstream to Arizona, Nevada, and California (multiple citations in U.S. Fish and Wildlife Service 2002b). Currently, wild populations of pikeminnow occur only in the Upper Colorado River Basin (above Lake Powell) and the species occupies only 25 percent of its historic range-wide habitat (U.S. Fish and Wildlife Service 2002b). Colorado pikeminnow are long distance migrators, moving hundreds of miles to and from spawning areas, and requiring long sections of river with unimpeded passage. They are adapted to desert river hydrology characterized by large spring peaks of snow-melt runoff and low, relatively stable base flows.

The Office of Endangered Species first included the Colorado pikeminnow (as the Colorado squawfish) in the List of Endangered Species on March 11, 1967 (32 FR 4001). It is currently protected under the Endangered Species Act of 1973 as an endangered species throughout its range, except the Salt and Verde River drainages in Arizona. The Service finalized the latest recovery plan for the species in 2002 (U.S. Fish and Wildlife Service 2002b) but is currently drafting an updated revision.

The Service designated six reaches of the Colorado River System as critical habitat for the Colorado pikeminnow on March 21, 1994 (59 FR 13374). These reaches total 1,148 miles (mi) as measured along the center line of each reach. Designated critical habitat makes up about 29 percent of the species' historic range and occurs exclusively in the Upper Colorado River Basin. Portions of the Colorado, Gunnison, Green, Yampa, White, and San Juan Rivers are designated critical habitat. The primary constituent elements of the critical habitat are water, physical habitat, and the biological environment (59 FR 13374).

[1] The latest recovery goals for all four endangered fish, which provide information on species background, life history, and threats, can be found on the internet at: http://www.coloradoriverrecovery.org/documents-publications/foundational-documents/recovery-goals.html

Water includes a quantity of water of sufficient quality delivered to a specific location in accordance with a hydrologic regime required 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. This includes oxbows, backwaters, and other areas in the 100-year floodplain that provide access to spawning, nursery, feeding, and rearing habitats when inundated. The biological environment includes food supply, predation, and competition from other species.

Recovery of Colorado pikeminnow in the Colorado River Basin is considered necessary only in the Upper Colorado River Basin (above Glen Canyon Dam, including the San Juan, and Green River sub-basins) because of the present status of populations and because existing information on Colorado pikeminnow biology supports application of the metapopulation concept to extant populations (U.S. Fish and Wildlife Service 2002b). As a result, this biological opinion will focus on the status of the Colorado pikeminnow in that unit.

LIFE HISTORY

The Colorado pikeminnow requires relatively warm waters for spawning, egg incubation, and survival of young. Males become sexually mature at approximately 6 years of age, which corresponds to a length of about 400 millimeters (mm) (17 inches (in.)), and females mature one year later (Sigler and Sigler 1996).

Mature adults migrate to established spawning areas in late spring as water temperatures begin to warm, with migration events up to 745 river kilometers (km) round-trip on record (463 miles) (Bestgen et al. 2005). Spawning typically begins after peak flows have subsided and water temperatures are above 16° Celsius (°C) (60.8° Fahrenheit (°F)) (multiple references in Bestgen et al. 2005). Mature adults deposit eggs over gravel substrate through broadcast spawning and eggs generally hatch within 4 to 6 days (multiple references in Bestgen et al. 2005). River flows then carry emerging larvae fish (6.0 to 7.5 mm long (0.2 to 0.3 in.)) downstream 40 to 200 km (25 to 125 mi), to nursery backwaters, where they remain for the first year of life (U.S. Fish and Wildlife Service 2002b).

Colorado pikeminnow reach lengths of approximately 70 mm by age 1 (juveniles) (2.8 in.), 230 mm by age 3 (subadults) (9 in.), and 420 mm by age 6 (adults) (16.5 in.), with mean annual growth rates of adult and subadult fish slowing as fish become older (Osmundson et al. 1997). The largest fish reach lengths between 900 and 1000 mm (35 to 39 in.); these fish are quite old, likely being 47 to 55 years old with a minimum of 34 years (Osmundson et al. 1997).

Reproductive success and recruitment of Colorado pikeminnow is pulsed, with certain years having highly successful productivity and other years marked by failed or low success (U.S. Fish and Wildlife Service 2002b). The most successful years produce a large cohort of individuals that is apparent in the population over time. Once individuals reach adulthood, approximately 80 to 90 percent of adults greater than 500 mm (20 in.) survive each year (Osmundson et al. 1997; Osmundson and White 2009). Strong cohorts, high adult survivorship, and extreme longevity are likely life history strategies that allow the species to survive in highly variable ecological conditions of desert rivers.

POPULATION DYNAMICS

Population dynamics of the Colorado pikeminnow are measured separately in the Green, upper Colorado, and San Juan River basins, because distinct recovery criteria are delineated for each of these three basins (U.S. Fish and Wildlife Service 2002b). In the 2002 recovery plan, initial abundance estimates for wild adults in the basins were: upper Colorado River, 600 to 900; Green River, 6,000 to 8,000; and San Juan River, 19 to 50 (circa 2000 references for individual rivers found in U.S. Fish and Wildlife Service 2002b).

UPPER COLORADO RIVER – To monitor recovery of the Colorado pikeminnow, the Recovery Program conducts multiple-pass, capture-recapture sampling on two stretches of the upper Colorado River which are roughly above and below Westwater Canyon (Osmundson and White 2009). In the most recent summary of the data (Osmundson and White 2013, in draft) the principal investigators conclude that during the 19-year study period [1992-2010], the population remained self-sustaining. The current downlisting demographic criteria for Colorado pikeminnow (USFWS 2002b) in the Upper Colorado River Subbasin is a self-sustaining population of at least 700 adults maintained over a 5-year period, with a trend in adult point estimates that does not decline significantly. Secondarily, recruitment of age-6 (400–449 mm Total Length (TL)), naturally produced fish must equal or exceed mean adult annual mortality (estimated to be about 20 percent). The average of all adult estimates (1992 – 2010) is 644. The average of the five most recent annual adult population estimates is 658. Osmundson and White (2013) determined that recruitment rates were less than annual adult mortality in six years and exceeded adult mortality in the other six years when sampling occurred. The estimated net gain for the 12 years studied was 32 fish >450 mm TL. Whereas the Colorado River population appears to meet the trend or 'self-sustainability' criterion, it has not met the abundance criteria of 'at least 700 adults' during the most recent five year period (Figure 1).

GREEN RIVER – Population estimates for adult Colorado pikeminnow in the Green River subbasin began in 2000. Sampling occurs on the mainstem Green River from the confluence with the Yampa River to the confluence with the Colorado River and includes the Yampa and White Rivers (Bestgen et al. 2005). The initial year of sampling did not include the lower Green River (near the confluence of the White River to the confluence with the Colorado River). Beginning in 2001, the sampling regime has consisted of three years of estimates followed by two years of no estimates (Bestgen et al. 2005). The first set of estimates showed a declining trend; however, estimates collected in 2006–2008 showed an increasing trend approaching the level of the estimate made in 2000 (Figure 2) (Bestgen et al. 2010). Data from the third round of population estimates for years 2011–2013 for the Green River sub-basin are still being analyzed (thus no confidence intervals are shown for the 2011–2013 estimates in Figure 2). Preliminary results from this analysis indicate adults and sub-adults are in decline throughout the entire Green River sub-basin.

The downlisting demographic criteria for Colorado pikeminnow in the Green River subbasin require that separate adult point estimates for the middle Green River and lower Green River do not decline significantly over a 5-year period, and each estimate for the Green River subbasin exceeds 2,600 adults (estimated minimum viable population [MVP] number) (USFWS 2002b). The average of the first two sets of adult estimates was 3,020 (between 2000 – 2008).

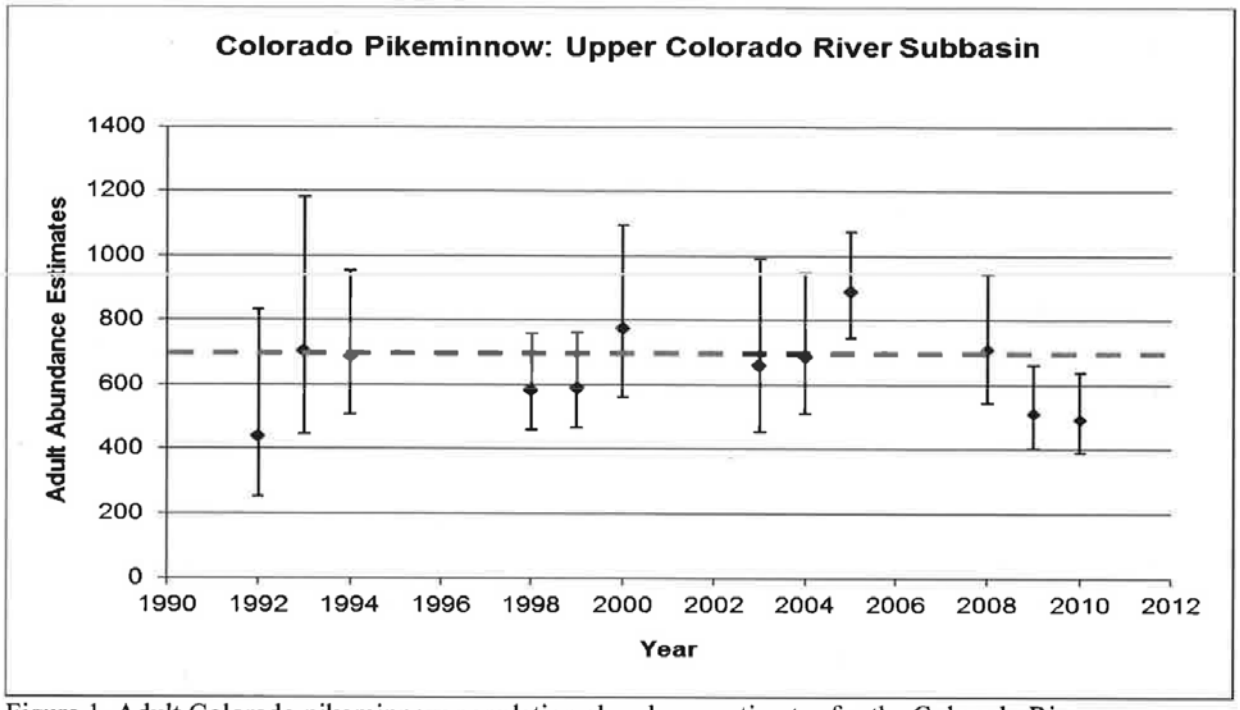

Figure 1. Adult Colorado pikeminnow population abundance estimates for the Colorado River (Osmundson and Burnham 1998; Osmundson and White 2009; 2013). Error bars represent the 95% confidence intervals. Dashed horizontal line represents the current population size downlist criterion.

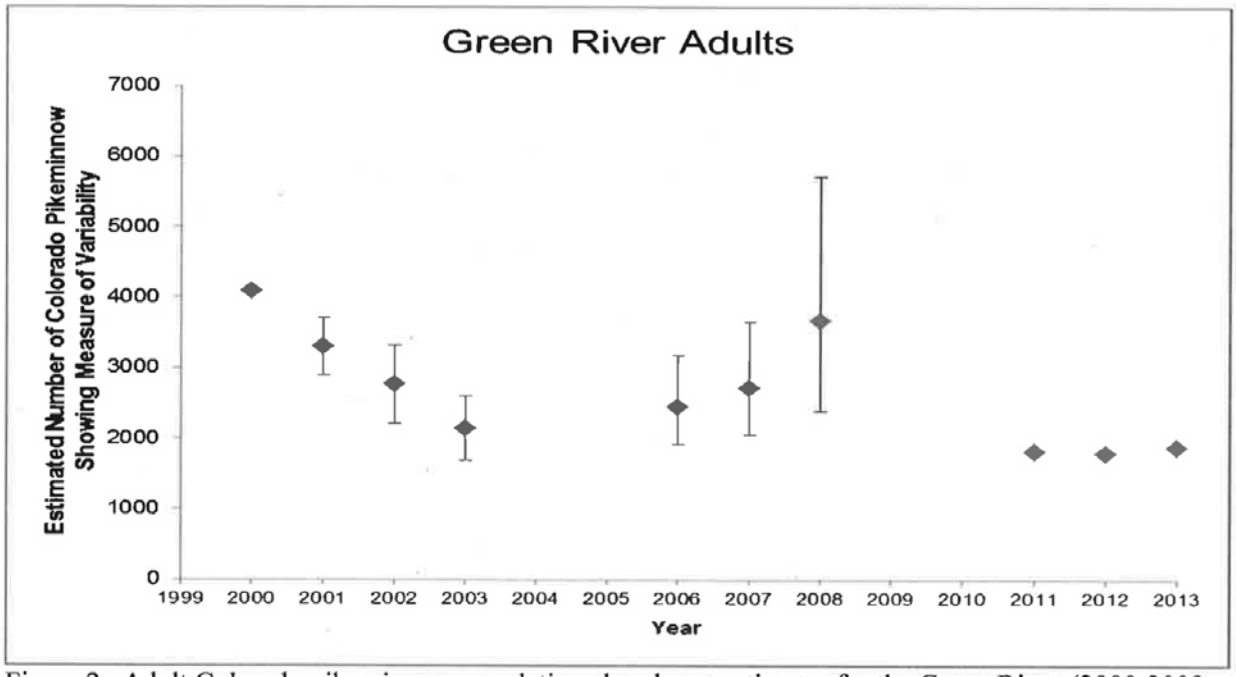

Figure 2. Adult Colorado pikeminnow population abundance estimates for the Green River (2000-2008 estimates from Bestgen et al. 2010; preliminary estimates from 2011-2013 (Bestgen, personal communication). Error bars represent the 95% confidence intervals. In 2000, the lower Green River was not sampled. Data depicted for 2000 incorporates an extrapolated lower Green River contribution to the overall population estimate and therefore lacks a confidence interval.

The downlisting demographic criteria for Colorado pikeminnow in the Green River subbasin also require that recruitment of age-6, naturally produced fish must equal or exceed mean annual adult mortality (USFWS 2002b). In general, the estimates of recruitment age fish have averaged 455 and have had a positive trend (Figure 3). Beginning in 2006, recruitment has exceeded the annual adult mortality of about 20 percent.

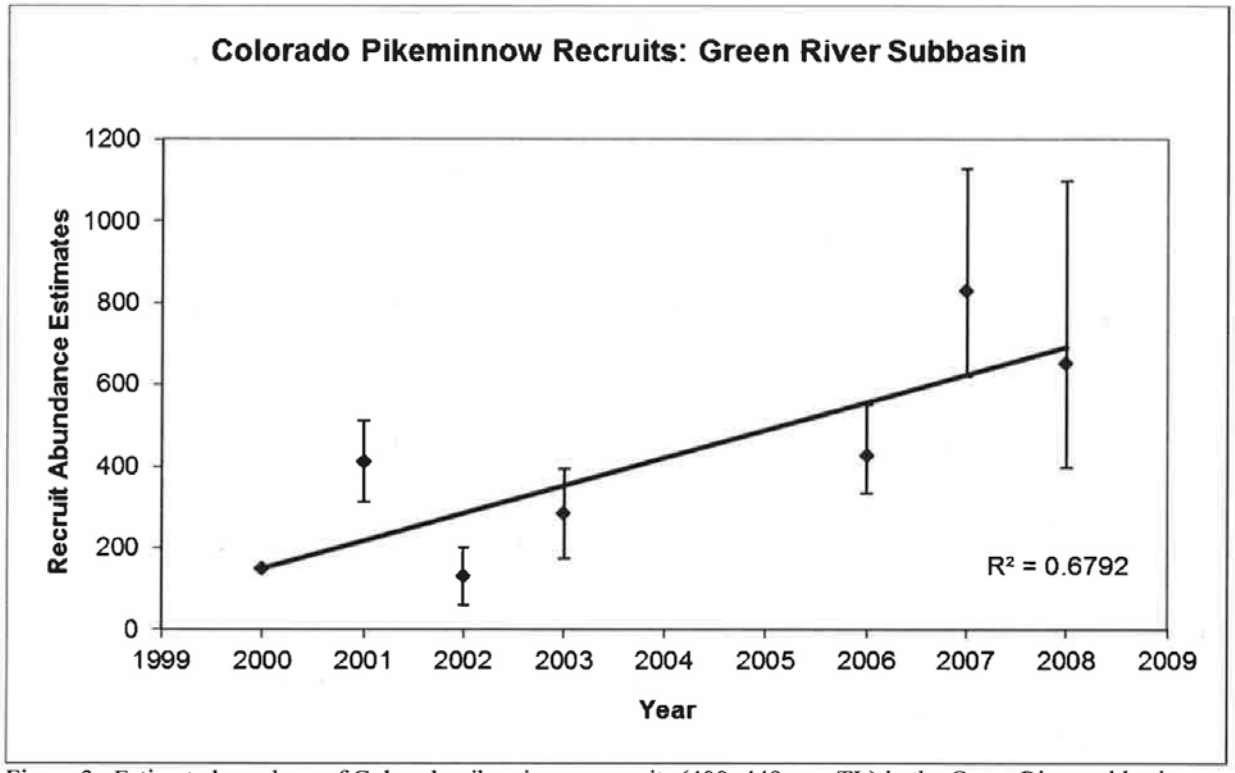

Figure 3. Estimated numbers of Colorado pikeminnow recruits (400–449 mm TL) in the Green River subbasin (Yampa, White, Middle Green, Desolation-Gray Canyons, and Lower Green) for 2001–2003 and 2006–2008. Error bars represent the 95% confidence intervals. Data from Bestgen et al. (2010). Estimates of recruitment for the most recent 2011-2013 sampling period are pending.

Bestgen et al. 2010 recognized that the mechanism driving frequency and strength of recruitment events was likely the strength of age-0 Colorado pikeminnow production in backwater nursery habitats. Osmundson and White (2013, in draft) saw a similar relationship between a strong age-0 cohort in 1986 and subsequent recruitment of late juveniles five years later, but that relationship was more tenuous in later years. Researchers are particularly concerned with what appears to be very weak age-0 representation in the Middle Green reach (1999 thru 2008) and in the lower Colorado River (2001 thru 2008) (Figure 4).

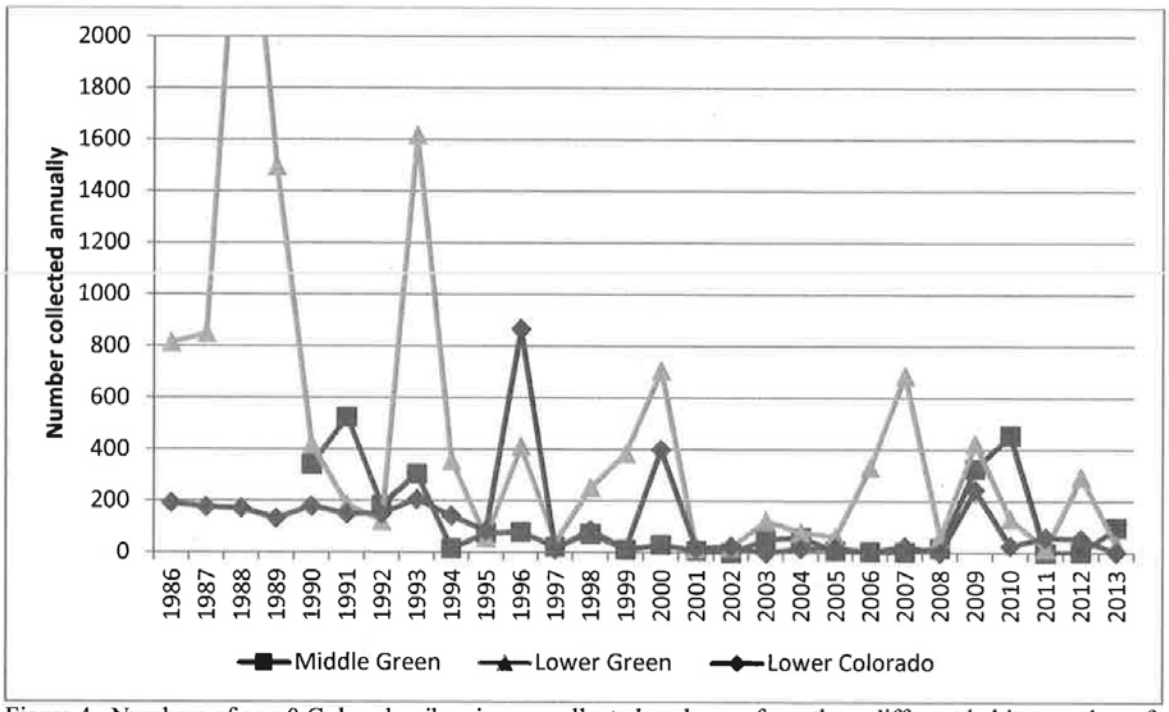

Figure 4. Numbers of age-0 Colorado pikeminnow collected each year from three different habitat reaches of river. A total of 2,892 Age-0 were collected in the lower Green River in 1988; the significance of strong Age-0 cohorts collected in the late 1980's was discussed in Bestgen et al. 2010. Data from Harding et al. 2013.

SAN JUAN RIVER – Unlike the Green and upper Colorado River Basins, wild Colorado pikeminnow are extremely rare in the San Juan River. The majority of individuals come from hatchery reared stocks supported by the San Juan River Recovery Implementation Program. This program has stocked more than 2 million age 0 and age 1+ fish in the San Juan River since 2002 (Furr and Davis 2009). No wild adults were collected since 2000 (Elverud 2008) and only five wild-spawned pikeminnow larvae were collected since 2002 (two in 2004; three in 2007) (Brandenburg and Farrington 2009).

In addition, adult Colorado pikeminnow collections in the San Juan River are extremely rare (Elverud 2008), indicating that many stocked fish do not reach sexual maturity. From 2002 to 2004, sampling conducted by the Utah Division of Wildlife Resources (UDWR) revealed low numbers of Colorado pikeminnow adults—presumably fish from the 1996 and 1997 stocking efforts—using the lower San Juan River in the spring and summer (Elverud 2008). No adult Colorado pikeminnow were collected between 2005 and 2008 in the lower San Juan River despite yearly sampling efforts (Elverud 2008).

River-wide population estimates for Colorado pikeminnow do not exist for the San Juan River (personal communication, Scott Durst 2009), but population estimates of individuals greater than 150 mm were generated after 2004 for the lower San Juan River (Elverud 2008). However, the observed variation in the population estimates within and among years makes identifying trends in the number Colorado pikeminnow difficult (Elverud 2008). In 2008, population estimates of Colorado pikeminnow greater than 150 mm in the lower San Juan River ranged from 270-572, depending on the model used (Elverud 2008).

BASIN-WIDE STATUS AND DISTRIBUTION

The Colorado pikeminnow was designated as an endangered species prior to enactment of the ESA, and therefore a formal listing package identifying threats was not assembled. Construction and operation of mainstem dams, nonnative fish species, and local eradication of native minnows and suckers in advance of new human-made reservoirs in the early 1960's were recognized as early threats (references in U.S. Fish and Wildlife Service 2002b). According to the 2002 Recovery Goals for the species, the primary threats to Colorado pikeminnow populations are streamflow regulation and habitat modification (including cold-water dam releases, habitat loss, and blockage of migration corridors); competition with and predation by nonnative fish species; and pesticides and pollutants (U.S. Fish and Wildlife Service 2002b). No new threats have emerged since the completion of this document.

As described in previous sections, Colorado pikeminnow are restricted to a portion of their historical range. Within currently occupied habitat, population trends are variable, with periods of noticeable decline, such as the early 2000s, and periods of population increase, such as the late 2000s. The current estimated population numbers in all three upper Colorado sub-basins are below estimates from the late 1990s, indicating that populations have not fully rebounded from the early 2000 population decline.

Major declines in Colorado pikeminnow populations occurred 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 mainstem broke the natural continuum of the river ecosystem into a series of disjunct segments, blocking native fish migrations, reducing temperatures downstream of dams, creating lacustrine habitat, and providing conditions that allowed 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.

Major declines of native fishes first occurred in the lower basin where large dams were constructed from the 1930s through the 1960s. In the Upper Basin, the following major dams were not constructed until the 1960s: Glen Canyon Dam on the mainstem 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. To date, some native fish populations in the Upper Basin have managed to persist, while others have become nearly extirpated. River segments where native fish have declined more slowly than in other areas are those where the hydrologic regime most closely resembles the natural condition, such as the Yampa River, where adequate habitat for important life phases still exists, and where migration corridors are unblocked and allow connectivity among life phases.

RAZORBACK SUCKER

SPECIES DESCRIPTION

The largest native sucker to the western United States, the razorback sucker (*Xyrauchen texanus*) is a robust, river catostomid endemic to the Colorado River Basin (Sigler and Sigler 1996; U.S. Fish and Wildlife Service 2002d). The species feeds primarily on algae, aquatic insects, and other available aquatic macroinvertebrates using their ventral mouths and fleshy lips (Sigler and Sigler 1996). Adults can be identified by olive to dark brown coloration above, with pink to reddish brown sides and a bony, sharp-edged dorsal keel immediately posterior to the head, which is not present in the young (Sigler and Sigler 1996). The species can reach lengths of 3 feet and weights of 16 pounds (7.3 kg), but the maximum weight of recently captured fish is 11 to 13 pounds (5 to 6 kg) (Sigler and Sigler 1996; U.S. Fish and Wildlife Service 2002d). Taxonomically, the species is unique, belonging to the monotypic genus Xyrauchen, meaning that razorback sucker is the only species in the genus (U.S. Fish and Wildlife Service 2002d).

Historically, the razorback sucker occupied the mainstem Colorado River and many of its tributaries from northern Mexico through Arizona and Utah into Wyoming, Colorado, and New Mexico (U.S. Fish and Wildlife Service 2002d). In the late 19th and early 20th centuries, it was abundant in the Lower Colorado River Basin and common in parts of the Upper Colorado River Basin, with numbers apparently declining with distance upstream (references in U.S. Fish and Wildlife Service 2002d). Distribution and abundance of razorback sucker declined throughout the 20th century across its historic range, and the species now exists naturally only in a few small, unconnected populations or as dispersed individuals. Specifically, razorback sucker are currently found in small numbers in the Green River, upper Colorado River, and San Juan River sub-basins; the lower Colorado River between Lake Havasu and Davis Dam; Lakes Mead and Mohave; in small tributaries of the Gila River sub-basin (Verde River, Salt River, and Fossil Creek); and in local areas under intensive management such as Cibola High Levee Pond, Achii Hanyo Native Fish Facility, and Parker Strip (U.S. Fish and Wildlife Service 2002d).

The razorback sucker is listed as endangered under the Endangered Species Act of 1973, as amended (ESA; 16 U.S.C. 1531 et. seq.), under a final rule published on October 23, 1991 (56 FR 54957). The Service finalized the latest recovery plan for the species in 2002 (U.S. Fish and Wildlife Service 2002d) but is currently drafting an updated revision.

Fifteen reaches of the Colorado River system were designated as critical habitat for the razorback sucker on March 21, 1994 (59 FR 13374). These reaches total 2,776 km (1,724 mi) as measured along the center line of the river within the subject reaches. Designated critical habitat makes up about 49 percent of the species' original range and occurs in both the Upper and Lower Colorado River Basins. In the Upper Basin, critical habitat is designated for portions of the Green, Yampa, Duchesne, Colorado, White, Gunnison, and San Juan Rivers. Portions of the Colorado, Gila, Salt, and Verde Rivers are designated in the Lower Basin. The primary constituent elements are the same as those described for Colorado pikeminnow.

Separate, objective recovery criteria were developed for each of two recovery units (the Upper Colorado and Lower Colorado River Basins as delineated at Glen Canyon Dam) to address unique threats and site specific management actions necessary to minimize or remove those

threats. This biological opinion's focus is on the Upper Colorado River Basin recovery unit and will therefore describe the status of the razorback sucker in that unit.

LIFE HISTORY

Except during periods before and after spawning, adult razorback sucker are thought to be relatively sedentary and have high fidelity to overwintering sites (U.S. Fish and Wildlife Service 2002d). Adults become sexually mature at approximately 4 years and lengths of 400 mm (16 in.) (Zelasko et al. 2009), at which time they travel long distances to reach spawning sites (U.S. Fish and Wildlife Service 2002d). Mature adults breed in spring (mostly April–June) on the ascending limb of the hydrograph, congregating over cobble/gravel bars, backwaters, and impounded tributary mouths near spawning sites (multiple references in U.S. Fish and Wildlife Service 2002d; Snyder and Muth 2004; Zelasko et al. 2009). Flow and water temperature cues may play an important role prompting razorback adults to aggregate prior to spawning (Muth et al. 2000).

Razorback sucker have high reproductive potential, with reported average female fecundity of approximately 50,000 to 100,000 eggs per fish (U.S. Fish and Wildlife Service 2002d). They are broadcast spawners that scatter adhesive eggs over gravel-cobble substrate (Snyder and Muth 2004). High springs flows are important to egg survival because they remove fine sediment that can otherwise suffocate eggs. Hatching is limited at temperatures less than 10°C (50° F) and best around 20°C (68° F) (Snyder and Muth 2004). Eggs hatch 6 to 11 days after being deposited and larval fish occupy the sediment for another 4 to 10 days before emerging into the water column. Larval fish occupy shallow, warm, low-velocity habitats in littoral zones, backwaters, and inundated floodplains and tributary mouths downstream of spawning bars for several weeks before dispersing to deeper water (U.S. Fish and Wildlife Service 2002d; Snyder and Muth 2004). It is believed that low survival in early life stages, attributed to loss of nursery habitat and predation by non-native fishes, causes extremely low recruitment in wild populations (Muth et al. 2000).

Razorback sucker in the Upper Basin tend to be smaller and grow slower than those in the Lower Basin, reaching 100 millimeters (4 in.) on average in the first year (U.S. Fish and Wildlife Service 2002b). Based on collections in the middle Green River, typical adult size centers around 510 mm (20 in.) (Modde et al. 1996). Razorback suckers are long-lived fishes, reaching 40+ years via high annual survival (U.S. Fish and Wildlife Service 2002d). Adult survivorship was estimated to be 71 to 73 percent in the Middle Green River from 1980-1992 (Modde et al. 1996; Bestgen et al. 2002) and 76 percent from 1990 to 1999 (Bestgen et al. 2002).

POPULATION DYNAMICS

Population estimates during the 1980 to 1992 period were on average between 300 and 600 wild fish (Modde et al. 1996). By the early 2000s, the wild population consisted of primarily aging adults, with steep decline in numbers caused by extremely low natural recruitment (U.S. Fish and Wildlife Service 2002d). Although reproduction was occurring, very few juveniles were found (U.S. Fish and Wildlife Service 2002d).

In the early part of the 2000s, population numbers were extremely low. Population estimates from sampling efforts in the Middle Green River had declined to approximately 100 by 2002, with researchers hypothesizing that wild fish in the Green River Basin could become extirpated

because of lack of recruitment (Bestgen et al. 2002). Similarly, in the upper Colorado River, razorback sucker were exceedingly rare. In the 2002 recovery plan, razorback sucker were considered extirpated in the Gunnison River, where fish were last captured in 1976 (U.S. Fish and Wildlife Service 2002d). Similarly, in the Grand Valley, only 12 fish were collected from 1984 to 1990, despite intensive sampling (Osmundson and Kaeding 1991 in U.S. Fish and Wildlife Service 2002d). No young razorback sucker were captured in the Upper Colorado River since the mid-1960s (Osmundson and Kaeding 1991 in U.S. Fish and Wildlife Service 2002d). In the San Juan River we know of only two wild razorback suckers that were captured in 1976 in a riverside pond near Bluff, Utah, and one fish captured in the river in 1988, also near Bluff (Ryden 2006). No wild razorback suckers were found during the 7-year research period (1991–1997) of the San Juan River Basin Recovery Implementation Program (Ryden 2006).

Because of the low numbers of wild fish and lack of recruitment, augmenting the remaining wild populations with hatchery-raised fish is a key step to creating self-sustaining populations. The Recovery Program is rebuilding razorback sucker populations with hatchery stocks. As populations increase, the Program expects to generate mark-recapture population estimates on adult razorback sucker comparable to the data reported for Colorado pikeminnow and humpback chub. Many stocked razorback sucker are being recaptured as part of other studies. Razorback sucker stocked in the Green and Colorado Rivers have been recaptured in reproductive condition and often in spawning groups. Captures of larvae in the Green, Gunnison, and Colorado Rivers document reproduction is occurring. Survival of larvae through their first year remains rare, largely due to a decrease in the availability of warm, food-rich floodplain areas and predation by a suite of nonnatives when the flood plain nursery habitats are available (Bestgen et al. 2011). However, occasional captures of juveniles (just over age-1) in the Green and Gunnison Rivers suggest that survival of early life stages is occurring. Collections of larvae by light trap in the middle Green River have generally increased since 2003; in 2012, the largest collection of light trapped larvae occurred (4,196; Figure 5). In 2011, researchers documented spawning by razorback sucker in the White River for the first time.

Since 1995, over 334,000 subadult razorback suckers have been stocked in the Green and upper Colorado River subbasins. Two reports on survival estimates of stocked razorback sucker recommended stocking larger fish during spring, fall and winter (Zelasko et al. 2009; 2011). From 2004–2007 approximately 96,400 fish were stocked and 1,511 recapture events from 1,470 unique individuals were encountered from 2005–2008. In 2012, tag-reading antennae were placed on a spawning bar in the middle Green River near Dinosaur National Monument in northeast Utah. Fifty-two unique razorback sucker stocked between 2004 and 2010 were detected, 88 percent of which had not been seen since stocking. During sampling for Colorado pikeminnow estimates, 938 and 765 razorback sucker were captured in 2011 and 2012, respectively, for the Ouray to Green River, Utah reach of the main channel of the Green River. In a monitoring plan (Bestgen et al. 2012), estimates of large juvenile to adult razorback sucker in three reaches of the Green River ranged from 474 to over 5,000 within a reach. Although these estimates are highly imprecise, they provide further confirmation that stocked fish are surviving in the wild.

Three razorback sucker stocked in the San Juan River near Farmington, New Mexico for the San Juan Recovery Program were captured between Moab, Utah and the state line with Colorado in

2008. This demonstrates that exchange of stocked razorback sucker between the San Juan River and the Upper Colorado River is certain, and may have ramifications for recovery.

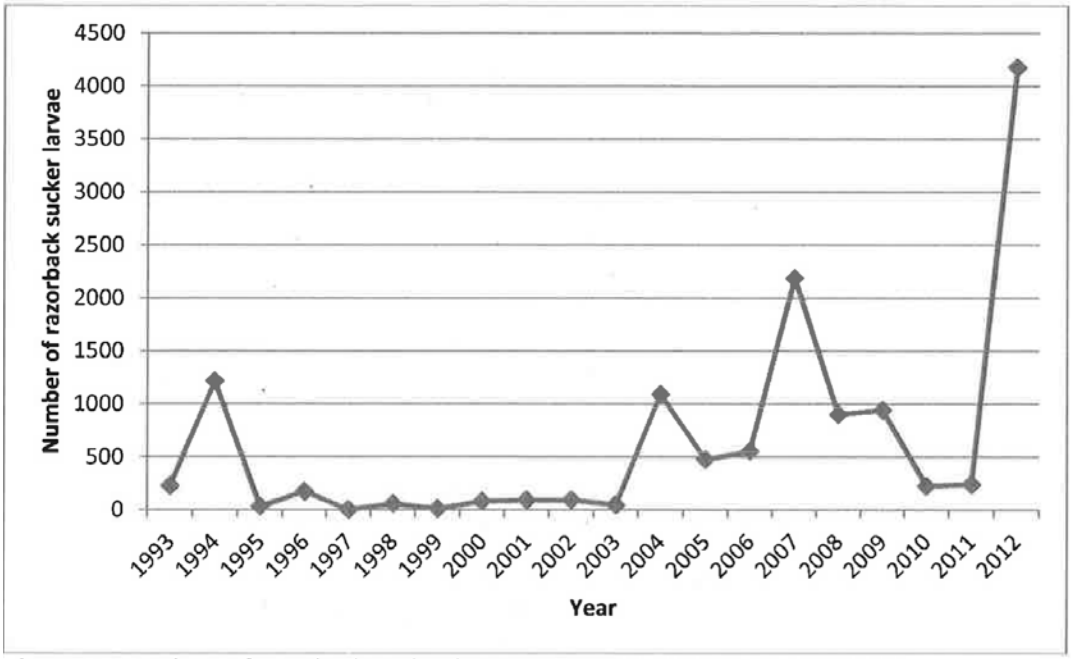

Figure 5. Numbers of razorback sucker larvae collected in light traps since 2000.

BASIN-WIDE STATUS AND DISTRIBUTION

The razorback sucker was designated as endangered under a final rule published on October 23, 1991 (56 FR 54957). Population conditions cited in the rule include little evidence of natural recruitment over the previous 30 years and a downward trend relative to historic abundance over the previous 10 years. Threats to species centered on significant changes to natural habitat conditions, including diversion and depletion of water, introduction of nonnative fishes, and construction and operation of dams.

Monitoring of wild razorback sucker in the Upper Colorado River Basin shows continued declines in abundance, hypothesized to be from a lack of recruitment. Therefore, recovery of the species has focused on augmentation of populations through hatchery-raised fish and habitat improvements.

According to the 2002 Recovery Goals for the species, the primary threats to razorback sucker populations are streamflow regulation and habitat modification (including cold-water dam releases, habitat loss, and blockage of migration corridors); competition with and predation by nonnative fish species; and pesticides and pollutants (U.S. Fish and Wildlife Service 2002d). No new threats have emerged since the completion of this document. The Service's status review of razorback sucker completed in 2012 (USFWS 2012b) reported that 85 percent of the downlisting recovery factor criteria (USFWS 2002c) have been addressed to varying degrees; however, nonnative fish species continue to be problematic.

HUMPBACK CHUB

SPECIES DESCRIPTION

The humpback chub (*Gila cypha*) is a medium-sized freshwater fish of the minnow family endemic to the Colorado River basin. The species evolved around 3 to 5 million years ago (Sigler and Sigler 1996). The pronounced hump behind its head gives the humpback chub a striking, unusual appearance. It has an olive-colored back, silver sides, a white belly, small eyes, and a long snout that overhangs its jaw (Sigler and Sigler 1996). This fish can grow to nearly 500 mm (20 in.) and may survive more than 30 years in the wild (U.S. Fish and Wildlife Service 2002c). The humpback chub does not have the swimming speed or strength of species such as the Colorado pikeminnow. Instead, it uses its large fins to "glide" through slow-moving areas, feeding on insects.

Historic distribution is surmised from various reports and collections that indicate the species inhabited canyons of the Colorado River and four of its tributaries: the Green, Yampa, White, and Little Colorado Rivers. Presently the species occupies about 68 percent of its historic habitat (U.S. Fish and Wildlife Service 2002c). Historic to current abundance trends are unclear because historic abundance is unknown (U.S. Fish and Wildlife Service 2002c).

Currently, five wild populations occur upstream of Glen Canyon Dam (Figure 6) and two downstream (U.S. Fish and Wildlife Service 2002c). In the Upper Colorado River Basin the two most stable populations are found near the Colorado/Utah border: one at Westwater Canyon in Utah; and one in an area called Black Rocks, in Colorado (Upper Colorado River Endangered Fish Recovery Program and San Juan River Basin Recovery Implementation Program 2010). Smaller numbers in the Upper Basin were found in the Yampa and Green Rivers in Dinosaur National Monument, Desolation and Gray Canyons on the Green River in Utah, and Cataract Canyon on the Colorado River in Utah (U.S. Fish and Wildlife Service 2002c). The two populations in the Lower Colorado River Basin occur in the mainstem Colorado and Little Colorado Rivers. The Little Colorado River population, found in the Grand Canyon, is the largest known population, harboring up to 10,000 fish (U.S. Fish and Wildlife Service 2002c).

The Office of Endangered Species first included the humpback chub in the List of Endangered Species on March 11, 1967 (32 FR 4001). Subsequently, it was considered endangered under provisions of the Endangered Species Conservation Act of 1969 (16 U.S.C. 668aa) and was included in the United States List of Endangered Native Fish and Wildlife issued on June 4, 1973 (38 FR No. 106). It is currently protected under the Endangered Species Act of 1973 as an endangered species throughout its range (ESA; 16 U.S.C. 1531 et. seq.). The Service finalized the latest recovery plan for the species in 2002 (U.S. Fish and Wildlife Service 2002d), but is currently drafting an updated revision.

The Service designated seven reaches of the Colorado River System as critical habitat for the humpback chub on March 21, 1994 (59 FR 13374). These reaches total 610 km (379 mi) as measured along the center line of each reach. Designated critical habitat makes up about 28 percent of the species' original range and occurs in both the Upper and Lower Colorado River Basins. In the Upper Colorado River Basin, critical habitat includes portions of the Yampa, Green, and Colorado Rivers, primarily including canyon habitats, such as Yampa, Desolation

and Gray, Westwater, and Cataract Canyons. Although humpback chub life history and habitat use differs greatly from the other endangered Colorado River fish, the primary constituent elements (water, physical habitat, and biological environment) of their critical habitat are the same (see above).

Figure 6. Locations of humpback chub populations in the Upper Colorado River Basin. Taken from Page 12 of Upper Colorado River Endangered Fish Recovery Program and San Juan River Basin Recovery Implementation Program 2010).

Separate, objective recovery criteria were developed for each of two recovery units (the Upper Colorado and Lower Colorado River Basins as delineated at Glen Canyon Dam) to address unique threats and site-specific management actions necessary to minimize or remove those threats. This biological opinion's focus is on the Upper Colorado River Basin recovery unit and will therefore describe the status of the humpback chub in that unit.

LIFE HISTORY

Like other large desert river fishes, the humpback chub is an obligate warm-water species that requires relatively warm temperatures for spawning, egg incubation, and survival of larvae. Unlike Colorado pikeminnow and razorback sucker, which are known to make extended migrations of up to several hundred miles to spawning areas, humpback chubs do not appear to make extensive migrations. Instead, humpback chub live and complete their entire life cycle in canyon-bound reaches of the Colorado River mainstem and larger tributaries characterized by deep water, swift currents, and rocky substrates (U.S. Fish and Wildlife Service 2002c). Individuals show high fidelity for canyon reaches and move very little.

Mature humpback chub typically spawn on the descending hydrograph between March and July in the Upper Basin (Karp and Tyus 1990). Humpback chub are broadcast spawners who may mature as young as 2 to 3 years old. Eggs incubate for three days before swimming up as larval fish (U.S. Fish and Wildlife Service 2002c). Egg and larvae survival are highest at temperatures close to 19 to 22 degrees Celsius (U.S. Fish and Wildlife Service 2002c). Unlike larvae of other Colorado River fishes (e.g., Colorado pikeminnow and razorback sucker), larval humpback chub show no evidence of long-distance drift (Robinson et al.1998).

Recruitment appears to be successful in all known Upper Basin populations (U.S. Fish and Wildlife Service 2002c). Survival of humpback chub during the first year of life is low, but increases through the first 2 to 3 years of life with decreased susceptibility to predation, starvation, and environmental changes. Survival from larvae to adult life stages was estimated at 0.1 percent (0.001) (Valdez and Ryel 1995, 1997 in U.S. Fish and Wildlife Service 2002c). Survival of adults is high, with estimates approximating 75 percent based on Grand Canyon adults (U.S. Fish and Wildlife Service 2002c).

Growth rates of humpback chub vary by populations, with fish in the Upper Basin growing slower than those in the Grand Canyon (U.S. Fish and Wildlife Service 2002c). Individuals in Cataract Canyon were 50, 100, 144, 200, 251, and 355 mm total length from 1 to 6 years, respectively (Valdez 1990 in U.S. Fish and Wildlife Service 2002c). Based on sexual maturity and age-to-length ratios, adults are classified as those fish 200 mm or longer. Maximum life span is estimated to be 30 years in the wild.

Humpback chub move substantially less than other native Colorado River fishes, and studies consistently show high fidelity by humpback chub for specific riverine locales occupied by respective populations. Despite remarkable fidelity for given river regions, individual humpback chub adults are known to move between populations. Movement by juveniles is not as well documented but is also believed to be limited in distance. For example, no out-migration by young fish is seen from population centers such as Black Rocks and Westwater Canyon.

POPULATION DYNAMICS

Five wild populations of humpback chub inhabit canyon-bound sections of the Colorado, Green, and Yampa Rivers: Yampa Canyon; Desolation and Gray Canyons; Cataract Canyon; Black Rocks; and Westwater Canyon. Recovery goal downlisting demographic criteria (USFWS 2002c) for humpback chub require each of five populations in the upper Colorado River basin to be self-sustaining over a 5-year period, with a trend in adult point estimates that does not decline significantly. Secondarily, recruitment of age-3 (150–199 mm TL) naturally produced fish must equal or exceed mean adult annual mortality. In addition, one of the five populations (e.g., Black Rocks/Westwater Canyon or Desolation/Gray Canyons) must be maintained as a core population such that each estimate exceeds 2,100 adults (estimated minimum viable population number).

The Yampa River humpback chub population exists in the lower Yampa River Canyon and into the Green River through Split Mountain Canyon. This population is small, with an estimate of about 400 wild adults in 1998 2000. Sampling during 2003–2004 caught only 13 fish, too few to estimate population size (Finney 2006). In 2007, the Recovery Program brought 400 young-of-year *Gila* spp. caught in Yampa Canyon into captivity as a research activity to determine the best methods for capture, transport, and holding at two different hatchery facilities. Approximately 15 percent of the *Gila* species were tentatively identified as humpback chub by physical characteristics. Geneticists at Southwest Native Aquatic Resources and Recovery Center (SNARRC), Dexter, NM, have since provided preliminary results indicating that the Yampa fish in captivity were hybrids between humpback chub and roundtail chub (Wade Wilson, U.S. Fish and Wildlife Service, personal communication). These fish were considered unsuitable for broodstock and were released into the Green River in Dinosaur National Monument. Currently, it is not known if pure humpback chubs occur in Yampa Canyon.

The Desolation/Gray Canyons population of wild adults was estimated at 1,300 in 2001, 2,200 in 2002, and 940 in 2003 (Jackson and Hudson 2005). Sampling in 2001 and 2002 was conducted in summer, whereas beginning in 2003, sampling was shifted to fall to avoid capturing Colorado pikeminnow that use Desolation Canyon for spawning. In a report on 2006–2007 estimates, researchers (Badame 2012; Figure 7) indicated that this population was trending downward. The declining catch of humpback chub in the upper portions of Desolation Canyon in the 2006–2007 estimates was linked to increasing densities of nonnative smallmouth bass (Badame 2012). Researchers recommended securing a representative sample of adults in captivity. In 2009, 25 adults were taken to Ouray National Fish Hatchery. In 2011, six sites throughout Desolation Canyon were monitored for adults, 55 individual adults were encountered, but recaptures were too few to calculate a population estimate.

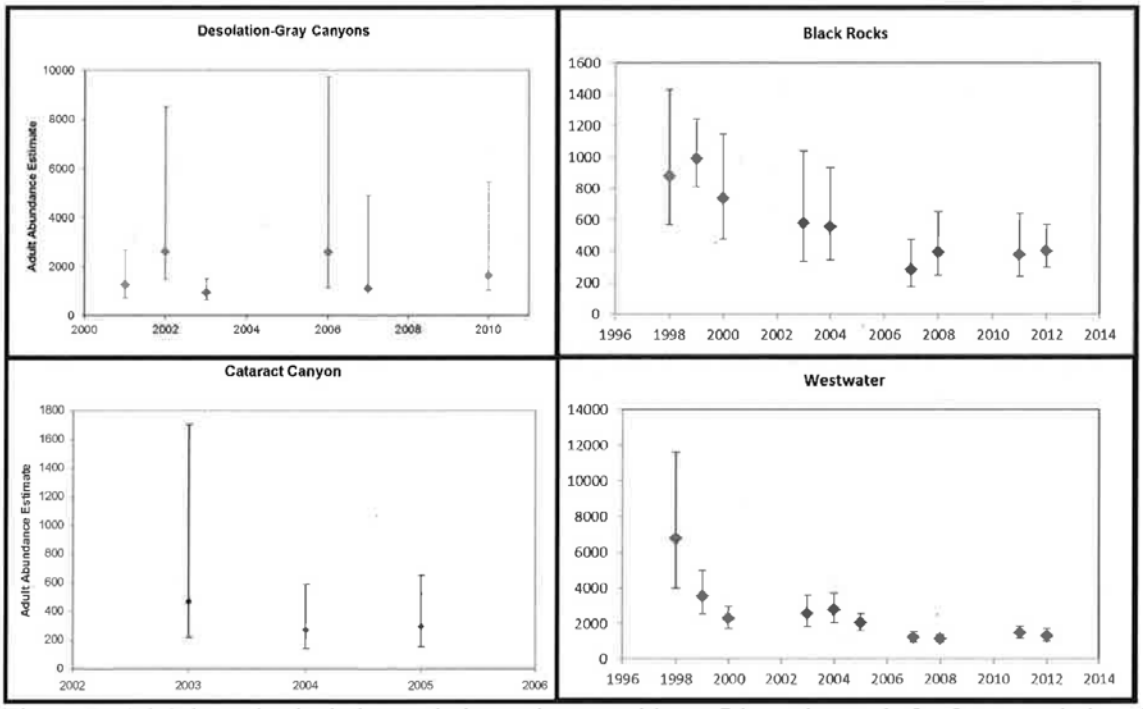

Figure 7. Adult humpback chub population estimates with confidence intervals for four populations in the upper Colorado River Basin (note: the scale differs among the graphs for the different populations). Clockwise from upper left: Desolation-Gray Canyons (Badame 2011, 2012); Black Rocks (Francis and McAda 2011); Westwater Canyon (Elverud 2011); and Cataract Canyon (Badame 2008).

On the Colorado River of the upper Colorado River basin, three humpback chub populations are recognized. Black Rocks and Westwater Canyon have enough exchange of individuals that they are considered a single core population. In Black Rocks, estimates of wild adults have varied from about 800 in 1998, 900 in 1999, and 500 in 2000 and 2003 (Figure 7) (McAda 2007). The most recent estimates, in 2007–2008 were 345 and 287, respectively. During the fall of 2011 and 2012, 78 and 112 individual adult humpback chub were caught respectively - similar to the numbers caught in 2007 and 2008 (61 and 74, respectively). Population estimates for Black Rocks for 2011 and 2012 were 379 and 403, respectively. Unfortunately, 78 largemouth bass were collected in Black Rocks in 2012, a ten-fold increase over the 2011 catch. The Westwater

Canyon estimates of wild adults range from about 4,700 in 1998 to 2,500 in 1999, 2000, and 2003 (Jackson and Hudson 2005). The 2007–2008 estimates were about 1,750 and 1,300. The large declines in humpback chub densities in both Black Rocks and Westwater Canyons occurred in the late 1990's and are not attributed to more recent increases of nonnative predators in the Colorado River.

In 2008, the core population (Black Rocks / Westwater combined) dropped below the population size downlist criterion (MVP = 2,100 adults) for the first time. In 2011, populations recovered slightly in Westwater Canyon where the adult estimate was 1,467; however, UDWR reported 1,315 adults in 2012. The core population estimates in 2011 and 2012 were 1846 and 1718, respectively (Figure 8). Population estimates in both Black Rocks and Westwater canyons declined dramatically during the first population estimation rotation in the late 1990s, but have remained relatively stable since that time. Colorado State University's recent robust population estimate analysis more clearly indicated that declines in the Westwater and Black Rock humpback chub populations are due to lapses in recruitment (i.e. adult survival rates have remained stable). Principle investigators agree that reinitiating an age-0 monitoring component is advisable. It should be noted that whatever is affecting humpback chub recruitment has not affected sympatric populations of native roundtail chub; populations of roundtail chub in both canyons have remained stable or have increased since population estimation started. In addition to the potential and recent negative interactions between humpback chub and nonnative predators discussed above, both the Westwater and Black Rocks populations are at risk of potential chemical contamination due to the proximity of a railroad located on the right bank of the Colorado River which at times transports toxic substances.

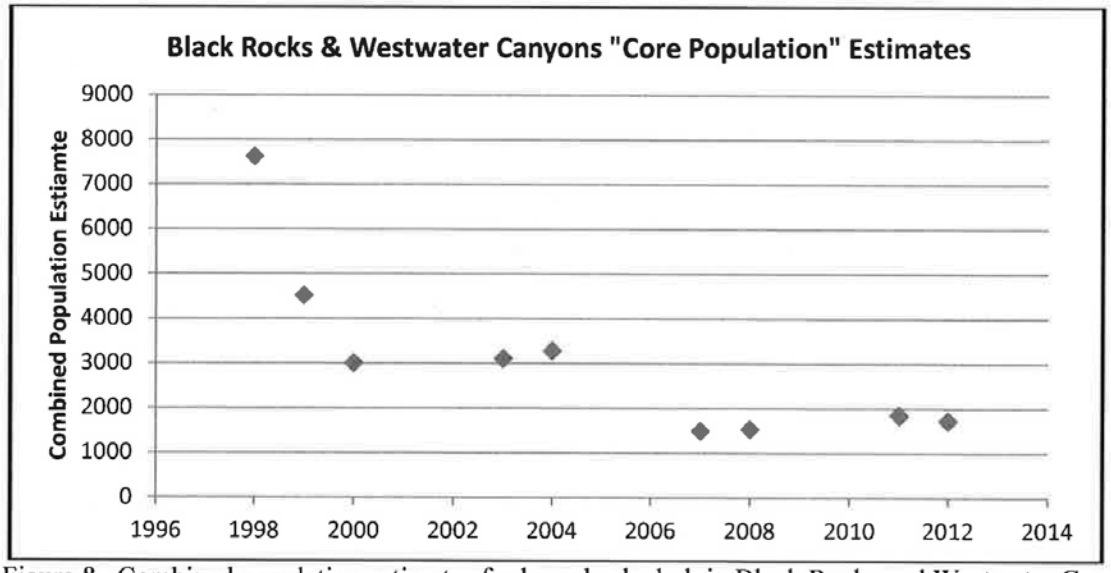

Figure 8. Combined population estimates for humpback chub in Black Rocks and Westwater Canyon based on a robust open model created by Dr.'s Bestgen and White, Colorado State University. The 2002 Recovery Goal downlist criteria for these combined ("core population") estimates is 2,100 adults.

The Cataract Canyon humpback chub population is small, with estimates of about 150 wild adults in 2003 and 66 in 2005 (Badame 2008). Estimates are difficult to obtain in Cataract; therefore, catch-per-unit-effort (CPUE) has been determined to be an effective replacement (began in 2008 on a 2 years on, 2-years-off sampling regime). In 2011, UDWR reported that the Cataract population appears to be stable with CPUE ranging between 0.010 and 0.035 fish/net-hour. Despite additional effort to sample below Big Drop Rapid, no additional humpback chub were encountered in the new riverine habitat created by low Lake Powell levels.

BASIN-WIDE STATUS AND DISTRIBUTION

The humpback chub was designated as an endangered species prior to enactment of the ESA, and therefore, a formal listing package identifying threats was not assembled. Construction and operation of mainstem dams, nonnative fish species, and local eradication of native minnows and suckers in advance of new human-made reservoirs in the early 1960's were recognized as early threats (U.S. Fish and Wildlife Service 2002c). According to the 2002 Recovery Goals for the species, the primary threats to humpback chub are streamflow regulation, habitat modification, predation by non-native fish species, parasitism, hybridization with other native *Gila* species, and pesticides and pollutants (U.S. Fish and Wildlife Service 2002c). No new threats have emerged since the completion of this document. The Service's status review of humpback chub completed in 2011 (USFWS 2011b) reported that 60 percent of the recovery factor criteria (USFWS 2002c) have been addressed to varying degrees; however, nonnative fish species and issues dealing with the potential chemical contamination of the river from spills and pipelines continue to be problematic.

As described in previous sections, humpback chub are restricted to a portion of their historical range. Within currently occupied habitat in the Upper Basin, population trends are variable, with one core population remaining quite robust, but other populations threatened with extirpation.

BONYTAIL

SPECIES DESCRIPTION

The bonytail (*Gila elegans*) is a medium-sized freshwater fish in the minnow family, endemic to the Colorado River Basin. The species evolved around 3 to 5 million years ago (Sigler and Sigler 1996). Individuals have large fins and a streamlined body that typically is very thin in front of the tail. They have a gray or olive-colored back, silver sides, and a white belly (Sigler and Sigler 1996). 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. A very close relative to the roundtail chub (*Gila robusta*), bonytail can be distinguished by counting the number of rays in the fins, with bonytail having 10 dorsal and anal fin rays (Sigler and Sigler 1996). The fish can grow to be 600 mm (24 in.) and are thought to live as long as 20 to 50 years (Sigler and Sigler 1996). Little is known about the specific food and habitat of the bonytail because the species was extirpated from most of its historic range prior to extensive fishery surveys, but it is considered adapted to mainstem rivers, residing in pools and eddies, while eating terrestrial and aquatic insects (U.S. Fish and Wildlife Service 2002a).

Bonytail were once widespread in the large rivers of the Colorado River Basin (multiple historic references in U.S. Fish and Wildlife Service 2002a). The species experienced a dramatic, but

poorly documented, decline starting in about 1950, following construction of mainstem dams, introduction of nonnative fishes, poor land-use practices, and degraded water quality (U.S. Fish and Wildlife Service 2002a). Population trajectory over the past century and reasons for decline are unclear because lack of basin-wide fishery investigations precluded accurate distribution and abundance records.

Bonytail are now rarely found in the Green and Upper Colorado River sub-basins and are the rarest of all the endangered fish species in the Colorado River Basin. In fact, no wild, self-sustaining populations are known to exist upstream of Lake Powell; this fish is nearly extinct. In the last decade only a handful of bonytail were captured on the Yampa River in Dinosaur National Monument, on the Green River at Desolation and Gray canyons, and on the Colorado River at the Colorado/Utah border and in Cataract Canyon. In the lower basin, bonytail exist in Lake Mohave and Lake Havasu.

The bonytail is currently listed as endangered under the Endangered Species Act of 1973, as amended (ESA; 16 U.S.C. 1531 et. seq.), under a final rule published on April 23, 1980 (45 FR 27710). The Service finalized the latest recovery plan for the species in 2002 (U.S. Fish and Wildlife Service 2002a), but is currently drafting an updated revision.

The Service designated seven reaches of the Colorado River as critical habitat for the bonytail on March 21, 1994 (59 FR 13374). These reaches total 499 km (312 mi) as measured along the center line of each reach. Portions of the Green, Yampa, and Colorado Rivers are designated as critical habitat, representing about 14 percent of the species' historic range. The primary constituent elements are the same as those described for Colorado pikeminnow, razorback sucker, and humpback chub.

Separate, objective recovery criteria were developed for each of two recovery units (the Upper Colorado and Lower Colorado River Basins as delineated at Glen Canyon Dam) to address unique threats and site specific management actions necessary to minimize or remove those threats. This biological opinion's focus is on the Upper Colorado River Basin recovery unit and will therefore describe the status of the humpback chub in that unit.

LIFE HISTORY

Natural reproduction of bonytail was last documented in the Green River in 1959, 1960, and 1961 at water temperatures of 18°C (U.S. Fish and Wildlife Service 2002a). Similar to other closely related *Gila* species, bonytail in rivers probably spawn during spring over rocky substrates. While age at sexually maturity is unknown, they are capable of spawning at 5 to 7 years old. Recruitment and survival estimates are currently unknown because populations are not large enough for research to occur.

Individuals in Lake Mohave have reached 40 to 50 years of age (U.S. Fish and Wildlife Service 2002a), but estimates for river inhabiting fish are not available.

POPULATION DYNAMICS

Bonytail are so rare that it is currently not possible to conduct population estimates. In response to the low abundance of individuals, the Recovery Program is implementing a stocking program