NARROWS PROJECT
SUPPLEMENTAL DRAFT
ENVIRONMENTAL IMPACT STATEMENT

APPENDIX C

BIOLOGICAL OPINION FOR THE PROPOSED NARROWS PROJECT – A SMALL RECLAMATION PROJECT ACT (SRPA) LOAN

United States Department of the Interior

FISH AND WILDLIFE SERVICE
Mountain-Prairie Region

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August 24, 2000

Memorandum

To: Area Manager, Upper Colorado Region
Bureau of Reclamation
Provo, Utah

From: Regional Director, Region 6
U.S. Fish and Wildlife Service
Denver, Colorado

Subject: Biological Opinion for the Proposed Narrows Project - A Small Reclamation Project Act Loan

In accordance with section 7 of the Endangered Species Act of 1973, as amended (16 U.S.C. 1531 et seq.), and the Interagency Cooperation Regulations (50 CFR Part 402), this transmits the Fish and Wildlife Service's biological opinion on the proposed Narrows Project and its effects on the endangered Colorado pikeminnow (*Ptychocheilus lucius*), razorback sucker (*Xyrauchen texanus*), humpback chub (*Gila cypha*), and bonytail (*Gila elegans*).

This Opinion is the result of reinitiation of an extended consultation including two biological opinions (March 1992, January 1995), one amended biological opinion (October 1995), the original biological assessment (October 1991), and three amended biological assessments (July 1994, March 1997, February 1999), the Draft Environmental Impact Statement (DEIS, March 1998), and the Price River Cumulative Hydrology Study (November 1998). We also considered other materials on file such as technical memoranda, project plans, various reports, and other relevant information. A complete administrative record of this consultation is on file in this office.

The reinitiation of consultation and resultant issuance of this Opinion was prompted by the most recent two amended biological assessments. The first of these was received on March 7, 1997, based on new information on the status of Colorado pikeminnow in the Lower Price River. The second amended biological assessment dated February 5, 1999, was based on the presence of willow flycatcher (*Empidonax traillii* sp.) preliminarily identified as the endangered subspecies of southwestern willow flycatcher (*E. t. extimus*) (Service memorandum dated October 13, 1998) in the proximity of the proposed Project.

We concur that the project as proposed is not likely to adversely affect the bald eagle for reasons described by the Bureau of Reclamation in the biological assessments and EIS for the proposed Project, and is likely to adversely affect the Colorado pikeminnow, razorback sucker, humpback chub, and bonytail.

Based on more recent information which has become available on the subspecies of willow flycatcher found within the affected project area, at this time we do not believe this willow flycatcher to be the endangered subspecies, the southwestern willow flycatcher. Therefore no discussion is offered specifically in reference to the endangered subspecies, *E. t. extimus* in this Opinion. The basis for this finding follows.

In an October 13, 1998, memorandum, we notified Reclamation that State of Utah surveys had discovered the endangered southwestern willow flycatcher present in the proximity of the Narrows Project, and that an amendment to the biological assessment would be necessary. The memorandum further stated that genetic and vocal sampling was being conducted to verify the willow flycatcher subspecies. To date, we have the following preliminary information of subspecies identification.

- The willow flycatcher subspecies inhabiting the riparian corridor in the Project proximity is located at the extreme northern boundary of *E. t. extimus* but within the range of *E. t. adastus, an unlisted subspecies*. Experts suggest that the central part of the State of Utah is more likely an area of intergradation between *E. t. adastus* and *E. t. extimus* (Behle 1985).

- Genetic analysis to date has shown that the willow flycatcher population does not have the genetic markers of *E. t. extimus* and is more closely related to *E. t. adastus* (Memorandum from Evan Paxton and Dr. Mark Sogge, Biological Resources Division, October 1, 1999). A final report is expected on this analysis.

- Vocalization analysis has determined the population to be *E. t. adastus* (Dr. Jim Sedgwick, USGS, Midcontinent Ecological Science Center, Ft. Collins, pers. comm; Spring 1999). However, these results have yet to be published or peer-reviewed.

Therefore, the following Opinion only addresses the Colorado pikeminnow, razorback sucker, humpback chub, and bonytail. If further analysis determines that the willow flycatcher subspecies population is the *E. t. extimus* subspecies or some significant intercross gradation between *E. t. adastus* and *E. t. extimus,* reinitiation of formal consultation will be required and a new biological opinion which includes the southwestern willow flycatcher will be issued. This opinion does, however, include recommendations to protect the willow flycatcher subspecies population in the Project proximity because of our interest in neo-tropical migratory birds as a

trust resource and because of the potential for identifying a biologically significant intercross gradation between *E. t. extimus* and *E. t. adastus* in the Project proximity. Protection of the riparian habitats within the project area could also be important to assist in recovery of *E. t. extimus*.

CONSULTATION HISTORY

We have been involved with Reclamation in an extended consultation on the proposed Project. The following documents the consultation history.

- October 1991 - We receive the first biological assessment on the proposed Narrows Project from Reclamation.

- March 25, 1992 - We issue the initial biological opinion.

- July 7, 1994 - Reclamation requests reinitiation of consultation based on an anticipated increase in average annual depletion and based on newly designated critical habitat for the four endangered Colorado River fish species.

- January 9, 1995 - We issue a second biological opinion on the proposed Project.

- July 18, 1995 - Reclamation provides information to us on capture of one juvenile Colorado pikeminnow in the Price River but indicates that reinitiation of formal consultation may not be necessary.

- October 5, 1995 - We concur that formal consultation is not necessary but amend the January 1995 biological opinion with an additional reasonable and prudent alternative to avoid jeopardy to the Colorado pikeminnow. This reasonable and prudent alternative calls for a 2-year study of fish composition and water quality in the Price River to assess the recovery potential of the Price River.

- We also recommend the Price River be prioritized within the Recovery Implementation Program for Upper Colorado River basin endangered fish species (RIP) Recovery Action Plan (RIPRAP).

- March 7, 1997 - Reclamation issues an amendment to the biological assessment for the proposed Narrows Project which describes new-found information on the status of Colorado pikeminnow and suggests specific items to be included into the RIPRAP. These items include: 1) the RIP depletion charge be applied to the Narrows Project, 2) additional years of study to identify year-round use of the Price River by Colorado pikeminnow, and 3) legal protection of instream flows. This letter also requested reinitiation of consultation.

- October 13, 1998 - We identify southwestern willow flycatcher as an additional endangered species present in the proximity of the proposed Project and advise Reclamation to provide an amendment to the biological assessment addressing southwestern willow flycatcher.

- February 5, 1999 - Reclamation provides an amended biological assessment that includes southwestern willow flycatcher.

BIOLOGICAL OPINION

I. DESCRIPTION OF PROPOSED ACTION

The Sanpete Water Conservancy District has applied to Reclamation for a Small Reclamation Project Act loan to help finance construction of the proposed Narrows Project. Such loans are made available by Reclamation to assist with construction of non-Federal projects. The Sanpete Water Conservancy District has also applied to use lands for the Narrows Project that were withdrawn from the public domain by Reclamation. The proposed Narrows Project would include a 120-foot high dam and 7,900 acre-foot total storage capacity reservoir to be constructed on Gooseberry Creek, a tributary to Fish Creek in the Price River drainage (there are no threatened or endangered species in this drainage). This proposed Project would also include a trans-basin diversion of water through an existing tunnel that would be rehabilitated (3,100 feet in length; 36 inch diameter; 60 cfs capacity) into Cottonwood Creek in the San Pitch/Sevier River drainage. The proposed Narrows Project will result in an average annual depletion of 5,717 acre-feet of water in the Price River. The Narrows Dam and Reservoir site are located approximately 9 miles northeast of the town of Fairview, Utah. Affected downstream water storage projects include the existing Lower Gooseberry Reservoir (small pass-through reservoir) approximately 5 miles downstream and the existing Scofield Dam and Reservoir (approximately 45,000 acre-foot total storage capacity) approximately 20 miles downstream of the proposed Narrows Project site.

The proposed Narrows Project would involve construction of features and facilities to develop a supplemental water supply to be used on presently irrigated lands and by municipal water users in the north part of Sanpete County, Utah. The proposed Project would divert water from Gooseberry Creek in the upper Price River drainage through an existing tunnel to Cottonwood Creek in the San Pitch/Sevier River drainage for delivery to lands and water users in the Sanpete Valley area surrounding Fairview, Utah. Water stored in the Narrows Reservoir would be diverted and delivered trans-basin through the existing Narrows Tunnel to Cottonwood Creek. The Narrows Tunnel would be rehabilitated as part of the proposed Project. Proposed Project water would then be diverted from Cottonwood Creek to a pipeline delivery system constructed as part of the project. This pipeline would then deliver the proposed Project water to existing water distribution systems in northern Sanpete County where it would be used by agricultural and municipal water users. Recreation facilities would be developed at Narrows Reservoir and a 2,500 acre-foot minimum pool for a reservoir fishery would be established. Specific mitigation measures would be implemented to offset wetland, terrestrial wildlife and stream fishery impacts.

Water conservation measures would be implemented as part of the proposed Project (BOR 1998).

Operation of the Narrows Project would affect stream flows in Gooseberry Creek, Fish Creek, Price River, and that portion of the Green River downstream of its confluence with the Price River within the Colorado River Basin, and would also affect stream flow in Cottonwood Creek within the San Pitch/Sevier River Basin. The proposed Project water supply would come from upper Gooseberry Creek and its tributaries. Impacts to lower Gooseberry Creek and Fish Creek would occur primarily during the spring snow melt period as water is stored in the Narrows Reservoir for release later in the summer. Impacts to Scofield Reservoir would be reduced inflows, resulting in lowering of reservoir storage. Impacts downstream of Scofield Dam would include reduced spring peak flows and overall water depletions affecting approximately 130 to 150 miles of the Price River as it flows between Scofield Dam and the Price/Green River confluence and an overall depletion from the Green River. Scofield Dam would spill less frequently and for shorter durations, lowering the volume of peak flows in the Price River below the dam and in the Green River below the mouth of the Price River (138 miles upstream of the Green/Colorado rivers confluence). Depletions to the Price River drainage would average 5,717 acre-feet per year. This amount consists of 5,324 acre-feet of trans-basin diverted water and 393 acre-feet of increased evaporation.

II. BASIS FOR BIOLOGICAL OPINION

The biological opinion addresses an average annual depletion of approximately 5,717 acre-feet 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 flood plain in portions of their historic range (59 FR 13374). Destruction or adverse modification of critical habitat is defined in 50 CFR 402.02 as a direct or indirect alteration that appreciably diminishes the value of critical habitat for both the survival and recovery of a listed species. In considering the biological basis for designating critical habitat, we focused on the primary constituent elements that are essential to the conservation of the species without consideration of land or water ownership or management. We have 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 survival and recovery of the fishes. The physical habitat includes areas of the Colorado River system that are inhabited or potentially inhabitable 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.

III. STATUS OF THE SPECIES/CRITICAL HABITAT

Information on Colorado pikeminnow, razorback sucker, humpback chub, and bonytail presented in this Opinion are considered the best scientific and commercial biological information available on these species. Sources of information include previous biological opinions concerning these species, technical reports, published scientific manuscripts, unpublished data, and working knowledge of the species. The most comprehensive compilation of information on these species to date was conducted by the Flaming Gorge Technical Team in their efforts to develop Green River and Flaming Gorge flow recommendations to benefit endangered fishes. The team consists of Reclamation and Service personnel and technical experts from Argonne National Laboratory (contracted through Western Area Power Administration) and Colorado State University Larval Fish Laboratory. Although the report from which this information was taken is in draft form and not approved for citation, the biological information is considered the most recently compiled and accurate comprehensive review of the status and biology of the endangered Colorado River fish species and is therefore used in this Opinion.

COLORADO PIKEMINNOW

A. Species description

The Colorado pikeminnow evolved as the dominant predator in the Colorado River system. Historically, adult Colorado pikeminnow attained lengths in excess of one meter and individuals in excess of 20 kg were common (Minckley 1973; Tyus 1991a). Individuals in excess of 0.8 meter in length and 10 kg in weight are now very uncommon and are likely older than 40 years (Tyus 1991a; Osmundson et al. 1997). Habitat of adult Colorado pikeminnow consists of deep, low-velocity eddies, pools, and runs, or seasonally flooded lowlands (Tyus 1990; Tyus 1991a). Adults mature at total lengths exceeding 400 mm and at 5 to 7 years of age (Vanicek and Kramer 1969; Hamman 1981; Tyus 1991a).

Based on early fish collection records, on archaeological finds, and on other observations, the Colorado pikeminnow was once found throughout warm water reaches of the entire Colorado River Basin, including reaches of the upper Colorado River and its major tributaries, the Green River and its major tributaries, and the Gila River system in Arizona (Seethaler 1978). Colorado 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 1850's. Historically, Colorado pikeminnow have been collected in the upper Colorado River as far upstream as Parachute Creek, Colorado (Kidd 1977).

A marked decline in Colorado pikeminnow populations can be closely correlated with the construction of dams and reservoirs between the 1930's and the 1960's, with introduction of nonnative fishes, with overwhelming water pollution, and with removal of water from the

Colorado River system. Behnke and Benson (1983) summarized the decline of the natural ecosystem. They pointed out that dams, impoundments, and water use practices are probably the major reasons for drastically modified natural river flows and channel characteristics in the Colorado River Basin. Dams on the mainstream essentially have segmented the Colorado River system, blocking Colorado pikeminnow spawning migrations and drastically changing river characteristics, especially flows and temperatures.

In addition, major changes in species composition were caused by introduction of nonnative fishes, many of which have thrived as a result of changes in the natural riverine system (i.e., flow and temperature regimes). The decline of endemic Colorado River fishes seems to be at least partially related to competition or other behavioral interactions with nonnative species, which have perhaps been exacerbated by alterations in the natural fluvial environment. In addition, water pollution, which went virtually unchecked until passing of environmental legislation in the 1960's and 1970's, could in extreme cases cause fish kills. The extent to which pollution affected the status of Colorado River fish is unknown but one example of water pollution noted in a 1953 Utah Fish and Game Bulletin which cited 'heavy losses of fish, particularly Colorado River salmon (*Ptychocheilus lucius*)' suggests impacts may have been spatially and temporally devastating to Colorado pikeminnow populations.

Throughout most of the year, juvenile, subadult, and adult Colorado pikeminnow utilize relatively deep, low-velocity habitats that occur in nearshore areas of main river channels (Tyus 1991a). In spring, however, when discharge is high due to snow-melt runoff, Colorado pikeminnow adults utilize flood plain wetlands, flooded tributary mouths, flooded side canyons, and eddy habitats that are accessible only during high flows (Tyus 1990). Such environments may be particularly beneficial for Colorado pikeminnow because other riverine fishes gather in flood plain habitat to exploit food and temperature resources, and may serve as prey for all life stages. Such low-velocity environments may also serve as resting areas for Colorado pikeminnow.

B. Life history

Adults undergo spawning migrations that may involve long-distance movements. Round-trip distances of over 500 miles (Irving and Modde in press) have been reported and individuals may migrate to natal areas using cues that were imprinted during the larval stage (Tyus 1985; Tyus 1990; Irving and Modde in press). As an integral part of the natural flow regime, peak spring flows aid formation of habitat for all life stages of Colorado pikeminnow and may also provide an important cue to prepare adults for migration. Other factors such as water temperature, photoperiod, and conspecific odors may also be important to cue reproduction (Nesler et al. 1988; Tyus and Karp 1989; Tyus and Karp 1991; Bestgen et al. 1998). Environmental cues used by the fish to complete their life cycle are needed in all areas occupied by adults including tributaries and the mainstem Green River.

Colorado pikeminnow reproduce during late spring and summer after discharge from snow-melt runoff peaks and when water temperatures are increasing and generally greater than 16° C

(Haynes et al. 1984; Tyus 1990; Tyus 1991a; Bestgen et al. 1998). Following spawning, most adults return by late August or September to home ranges occupied the previous spring (Tyus 1990; Irving and Modde in press).

Although direct observation of Colorado pikeminnow spawning is not possible in the Green and Yampa rivers because of high turbidity, radiotelemetry indicates spawning occurs over cobble-bottomed riffles (Tyus 1990). If adhesive eggs are deposited in interstitial spaces of spawning substrate they likely require clean cobble surfaces for secure attachment (Hamman 1981; Tyus and Karp 1989).

Laboratory studies suggested that wild embryos may incubate in the spawning substrate for 4–7 days, with duration inversely related to water temperature (Hamman 1981; Marsh 1985; Bestgen and Williams 1994). Temperatures from 18° to 26° C produced similar and relatively high rates of hatching (54–79 percent) and survival to 7 days posthatch (52–88 percent). Survival was only 13 percent at 30° C, which may be near the upper lethal limit for embryos. Hatching success at 16° C, the lowest temperature at which Colorado pikeminnow were known to spawn in the wild (Bestgen et al. 1998), is unknown. Hatching success averaged about 10 percent higher in fluctuating (5° C diel range) than in constant temperatures (18° to 26° C).

Eggs deposited in spawning gravel hatch within 5–7 days, and larvae swimup 5–7 days later. At swimup, larvae are 6–9 mm (implied total length) and are immediately swept downstream, sometimes long distances, from spawning areas (Hamman 1981; Haynes et al. 1984; Nesler et al. 1988; Bestgen and Williams 1994; Bestgen et al. 1998). Larvae drift to relatively low-gradient river reaches where low-velocity, shallow, channel-margin habitats (e.g., backwaters) are common, and they remain there throughout the summer (Vanicek and Kramer 1969; Tyus and Haines 1991; Muth and Snyder 1995).

The exact mechanism by which Colorado pikeminnow larvae drift downstream and inhabit backwater habitat is not completely understood. Larvae are probably carried near shorelines by prevailing river currents and eventually encounter backwaters with a probability that depends on availability of such habitat. Because swimming in relatively swift main-river currents is energetically costly and mortality risks are high, larvae that quickly encounter a suitable backwater are more likely to survive. Based on tests of swimming performance in a velocity tube, larvae of a size typically captured in drift nets (8–10 mm) were often capable of maintaining position for nearly 30 seconds in water flowing 15 cm/s (K. Bestgen, unpublished data). Thus, active locomotion may play an important role when Colorado pikeminnow larvae move from the main channel into backwaters.

Early life stages of Colorado pikeminnow in backwaters feed on a variety of small invertebrates, of which chironomids are particularly important (Muth and Snyder 1995). As in other fishes, the growth rate of Colorado pikeminnow is dependent on food abundance and water temperature (Bestgen 1996). Seasonal food abundance in Green River backwaters is most likely a function of backwater stability, nutrient levels, primary production, and "maturity", which affects the time

invertebrates have to colonize and build populations. Benthic assemblages may be an even more important food source for early life stages of fishes in the Green River (Muth and Snyder 1995).

Nighttime temperature fluctuations may cool backwaters to well below 22° C and create sub-optimal growth conditions. In a laboratory study, growth of Colorado pikeminnow larvae was optimal at 31° C and high at all temperature treatments that were 22° C or warmer (Bestgen 1996). At the highest food abundance, growth of Colorado pikeminnow larvae was 36 percent less at 18° C compared to that observed at 22° C (Bestgen 1996). In the wild, Colorado pikeminnow may move to acquire more optimal habitat. For example, Tyus (1991b) found that early life stages of Colorado pikeminnow moved out of backwaters at night, presumably in response to water temperatures that were colder than the main channel, and moved back in as temperatures warmed during the day. Such a strategy would allow Colorado pikeminnow to maximize degree-day accumulation and growth in a diel period.

The abundant nonnative fishes that co-occur with Colorado pikeminnow in backwaters are potential predators on fish larvae. Of particular concern is the most abundant species, red shiner, a known predator on fish larvae in the wild (Ruppert et al. 1993). In laboratory tests, red shiners averaging about 60 mm were able to capture and consume Colorado pikeminnow as large as 22 mm (Bestgen et al. 1997). Larger Colorado pikeminnow were not vulnerable to red shiners because they could not be physically ingested.

Energy reserves, particularly lipids, are thought to influence overwinter survival of age-0 fish (Thompson et al. 1991). Because lipid stores are generally positively correlated with body size and condition of fish, biotic and abiotic conditions in summer and autumn that affect growth may influence overwinter survival. Thompson et al. (1991) found that smaller Colorado pikeminnow with lower amounts of lipid were in poorer condition and survived at lower rates than larger fish over a simulated winter period in the laboratory, and they concluded that overwinter survival of wild fish may be size-dependent.

Comparison of catch-effort data collected in fall and then again in spring from 1979 to 1988 showed negligible overwinter mortality of age-0 Colorado pikeminnow relative to other seasons (Tyus and Haines 1991). However, other studies in other years (Converse et al. 1998b) or those using capture-recapture estimation techniques (Haines et al. 1998) have demonstrated substantial overwinter mortality, especially for small-bodied Colorado pikeminnow. Converse et al. (1998b) suggested that size-dependent overwinter mortality was important in some years, but in others, abundance of Colorado pikeminnow in spring was mostly a function of autumn abundance. Haines et al. (1998) reported overwinter survival of 56 to 62 percent in three estimates but only 6 percent overwinter survival of a cohort in the Green River that had small body size. They suggested that low overwinter survival in that high flow year was partially due to lack of energy reserves.

Juveniles also occupy backwaters and other low-velocity nearshore areas; older and larger subadults tend to use habitat similar to that of adults. Subadults then disperse and recruit to upstream reaches where they establish home ranges (Osmundson et al. 1998).

The ability to feed in turbid waters of the Colorado River system and lack of teeth in jaws are unusual features of piscivorous Colorado pikeminnow. Colorado pikeminnow less than 50 mm eat primarily invertebrates, the diet of those between 50 and 200 mm is a combination of invertebrates and fish, and those greater than 200 mm are mainly piscivorous (Vanicek and Kramer 1969; Muth and Snyder 1995). Large adults also occasionally consume other vertebrates including birds and mammals (Tyus 1991a).

C. Population Dynamics

All life stages of Colorado pikeminnow in the Green River demonstrate wide variations in abundance at seasonal, annual, or longer time scales, but reasons for shifts in abundance are poorly understood. The population structure of the Colorado pikeminnow is thought to resemble a metapopulation in that several somewhat spatially distinct populations are centered around specific spawning locations; however some interchange of individuals between populations occurs (Gilpin 1993). Colorado pikeminnow occupy life-stage specific habitats that are distributed over a broad spatial scale in the Green River system. Adults migrate to canyon-bound spawning areas distant from home ranges, embryos incubate and hatch in spawning gravel, newly emerged larvae drift downstream and into low-velocity nursery habitats, and subadults move back upstream.

In alluvial valley reaches of the Green River where most nursery habitat occurs, age-0 and age-1 Colorado pikeminnow occupy shallow, channel-margin backwaters. Juveniles and adults eventually disperse from nursery-habitat areas and into tributaries or the mainstem Green River up- or downstream of spawning localities. Because factors that affect survival of various Colorado pikeminnow life stages are imposed over a spatially extensive area, a variety of biological and physical factors may interact to influence recruitment success of individual year classes.

A. Status and distribution

The endangered Colorado pikeminnow is endemic to the Colorado River basin and was formerly widespread and abundant in warmwater streams and rivers (Jordan and Evermann 1896). Historic accounts suggest that Colorado pikeminnow were especially abundant in the lower Colorado River basin downstream of Lee's Ferry, Arizona (Minckley 1973; Tyus 1991a; Maddux et al. 1993). Lower basin populations remained abundant until the 1930's (Miller 1961) but declined soon thereafter presumably due to the combined effects of river regulation by dams and introduced fishes (Minckley and Deacon 1968; Minckley 1973). The last Colorado pikeminnow collected in the Gila River system was in 1950; scattered individuals were captured in the lower mainstem Colorado River and reservoirs in the 1960's (Minckley 1973), but by the early 1970's the species was extirpated from the lower Colorado River basin (Tyus 1991a).

In the upper Colorado River basin, historic accounts also report the presence of large populations of Colorado pikeminnow (Tyus 1991a; Quarterone 1993). Populations persist in all three major river and tributary systems of the upper Colorado River basin (i.e., San Juan, Colorado, and Green river systems), but they are severely reduced in all but the latter (Platania et al. 1991; Tyus 1991a; Osmundson and Burnham 1996). There may be less than 100 wild adult Colorado pikeminnow remaining in the San Juan River system based on the few recent captures and relatively high recapture rates (D. Propst, New Mexico Department of Game and Fish, personal communication). Osmundson and Burnham (1996) recently estimated that about 600 to 650 adult Colorado pikeminnow occur in the Colorado River upstream of the Green River confluence. Although no abundance estimates have been calculated, populations in the Green River system are thought to be substantially larger than those in the Colorado River based on relative capture-rate data collected annually in the Interagency Standardized Monitoring Program (ISMP) and capture rates of marked fish (Tyus 1991a; McAda et al. 1994a, 1994b, 1995, 1996, 1997).

Although historic accounts are sketchy, most described Colorado pikeminnow as widespread and abundant in the Green River system (Tyus 1991a; Quarterone 1993). Based on those accounts and habitat tolerances described in more recent studies, it is reasonable to assume that Colorado pikeminnow were found throughout lower reaches of most tributary streams in warm and cool water, and extended far upstream in the mainstem Green River to near Green River, Wyoming (Ellis 1914; Baxter and Simon 1970). In the vicinity of the Flaming Gorge Dam site, an aggregation of ripe male Colorado pikeminnow was discovered in early August 1961 (Vanicek et al. 1970), suggesting that this area once supported a reproducing population.

By the time the first comprehensive surveys were conducted during 1967–1973 (Holden and Stalnaker 1975a, 1975b), the Colorado pikeminnow was considered rare and endangered throughout the upper Colorado River basin, including the Green River system. Holden and Stalnaker (1975a) identified the lower Yampa River in Yampa Canyon and the middle and lower Green River as potential spawning areas based on aggregations of ripe adults and presence of early life stages. These inferences later proved mostly correct as spawning areas have been found in the lower Yampa River and Green River in Gray Canyon (Haynes et al. 1984; Tyus 1990; Tyus and Haines 1991; Bestgen et al. 1998).

The Colorado pikeminnow currently occupies approximately 1,100 river miles in the Colorado River system (25 percent of its original range) and is presently found only in the upper Colorado River basin above Glen Canyon Dam. The Colorado pikeminnow inhabits about 390 miles of the mainstem Green River from its confluence with the Colorado River upstream to the Gates of Ladore (Kevin Bestgen pers.comm.). Colorado pikeminnow have also been observed in the lower 49 miles of the Duchesne River and the lower 88.5 miles of the Price River. The Colorado pikeminnow's range also extends 160 miles up the Yampa River and 104 miles up the White River, the two largest tributaries of the Green River. In the mainstem Colorado River, it is currently found from Lake Powell extending about 201 miles upstream to Palisade, Colorado

(Tyus et al. 1982), and in the lower 60 miles of the Gunnison River, a tributary to the mainstem Colorado River (Burdick 1995).

During most of the year, distribution patterns of adults in the Green River system are stable, and from late summer to the following spring, adults are widely distributed and thought to occupy distinct home ranges (Tyus 1990; Tyus 1991a; Irving and Modde in press). Distribution of adults changes in late spring and early summer when most mature fish migrate to spawning areas in the lower Yampa River in Yampa Canyon and the lower Green River in Gray Canyon (Tyus and McAda 1984; Tyus 1985; Tyus 1990; Tyus 1991a; Irving and Modde in press). Those fish remain in spawning areas for 3–8 weeks before returning to their individual home ranges. Some radio-tagged fish did not migrate to spawning areas each year. These may have been immature or non-spawning individuals, or fish that moved to other areas for spawning (Tyus 1990). Although additional spawning sites may exist (Tyus 1990), recent movement patterns of adults (Irving and Modde in press) and capture rates of larvae at drift-net sites downstream of principal spawning areas (Bestgen et al. 1998) suggest that other sites are rarely used.

Historically, Echo and Island parks in the upper Green River supported nursery habitat for Colorado pikeminnow (Vanicek et al. 1970; Holden and Stalnaker 1975a; Holden and Crist 1981). Early life stages of Colorado pikeminnow in that area remain rare (Holden and Crist 1981; Tyus and Haines 1991; Bestgen and Crist 1998). No larvae or juveniles of Colorado pikeminnow have been collected from the Green River upstream of the Yampa River confluence since initial post-impoundment studies of Flaming Gorge Dam ended in 1966 (Vanicek and Kramer 1969; Vanicek et al. 1970; Holden and Crist 1981; Bestgen and Crist 1998; Bestgen et al. 1998).

Presently, there are two primary reaches of Colorado pikeminnow nursery habitat in the Green River system. One occurs in the middle Green River from near Jensen, Utah, downstream to the Duchesne River confluence. The other is in the lower Green River from near Green River, Utah, downstream to the Colorado River confluence (Tyus and Haines 1991; McAda et al. 1994a; McAda et al. 1994b-1997). The reach of the Green River defined mostly by Desolation and Gray canyons also provides nursery habitat for Colorado pikeminnow (Tyus and Haines 1991; Day et al. 1999).

Juvenile Colorado pikeminnow 80–400 mm have the most restricted distribution of any life stage in the Green River system. Juveniles are most common in the lower portion of the Green River, downstream of Green River, Utah, with fewer in the middle Green River (McAda et al. 1994a). Juveniles are found in the White River and other tributaries (McAda et al. 1994b, 1995, 1996, 1997; Cavalli 1998), but few have ever been caught in the Yampa River upstream of Yampa Canyon. A few age-0 and juvenile Colorado pikeminnow were captured in recent years from the lower Yampa River and the Green River in the Island-Rainbow Park reach (Bestgen and Crist 1998; K. R. Bestgen, unpublished data).

The Colorado pikeminnow was listed as endangered on March 11, 1967. Full protection under the Endangered Species Act of 1973, as amended, occurred on January 4, 1974.

Critical Habitat Description for Colorado pikeminnow

Critical habitat, as defined in section 3(5)(A) of ESA, means: "(i) the specific areas within the geographical area occupied by the species at the time it is listed in accordance with section 4 of the Act, on which are found those physical or biological features (I) essential to the conservation of the species and (II) which may require special management considerations or protection; and (ii) specific areas outside the geographic area occupied by a species at the time it is listed in accordance with section 4 of the Act, upon a determination by the Secretary that such areas are essential for the conservation of the species."

Critical habitat was designated for four endangered Colorado River fishes on March 21, 1994, including the Colorado pikeminnow. Designated critical habitat for the endangered Colorado River fishes includes those portions of the 100-year flood plain that contain constituent elements. The constituent elements are those physical and biological features that the Service considers essential for the conservation of the species and include, but are not limited to, the following items: (1) space for individual and population growth, and for normal behavior; (2) food, water, air, light, minerals, or other nutritional or physiological requirements; (3) cover or shelter; (4) sites for breeding, reproduction, rearing of offspring, germination, or seed dispersal; and generally (5) habitats that are protected from disturbance or are representative of the historical, geographical, and ecological distributions of the species.

The primary constituent elements determined necessary for the survival and recovery of four endangered Colorado River fishes include (59 FR 13374), but are not limited to:

(1) Water

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;

(2) Physical Habitat

Areas of the Colorado River system that are inhabited or potentially habitable by fish for use in spawning, nursing, feeding, and rearing, or 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 flood plain, which when inundated provide spawning, nursery, feeding, and rearing habitats, or access to these habitats;

(3) Biological Environment

Food supply, predation, and competition are important elements of the biological environment and are considered components of this constituent element. 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.

Destruction or adverse modification of critical habitat is defined at 50 CFR 402.02 as a direct or indirect alteration that appreciably diminishes the value of critical habitat for both the survival and recovery of a listed species. In evaluating actions, we consider the action's impact on factors used to determine critical habitat of the Colorado River endangered fishes. These factors include the primary constituent elements of water, physical habitat, and biological environment. The ability of an area to provide these constituent elements into the future and the reaches' capability to contribute to the recovery of the species will also be considered.

Activities which may disturb or remove the primary constituent elements within designated critical habitat include, among others, actions that would reduce the volume and timing of water, destroy or block off spawning and nursery habitat, prevent recruitment, adversely impact food sources, contaminate the river, or increase predation by and competition with nonnative fish. Examples of activities that may destroy or adversely modify critical habitat are listed at 59 FR 13387, and include construction and operation of hydroelectric facilities, irrigation, flood control, bank stabilization, oil and gas drilling, mining, grazing, stocking or introduction of nonnative fishes, municipal water supplies, and resort facilities.

Critical habitat has been designated within the 100-year flood plain of the Colorado pikeminnow's historical range in the following sections of the Upper Basin and the San Juan River (59 FR 13374).

Colorado, Moffat County. The Yampa River and its 100-year flood plain 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).

Utah, Uintah, Carbon, Grand, Emery, Wayne, and San Juan Counties; and Colorado, Moffat County. The Green River and its 100-year flood plain 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).

Colorado, Rio Blanco County; and Utah, Uintah County. The White River and its 100-year flood plain 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).

Colorado, Delta and Mesa Counties. The Gunnison River and its 100-year flood plain 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).

Colorado, Mesa and Garfield Counties; and Utah, Grand, San Juan, Wayne, and Garfield Counties. The Colorado River and its 100-year flood plain 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).

New Mexico, San Juan County; and Utah, San Juan County. The San Juan River and its 100-year flood plain from the state route 371 bridge in T.29N., R.13W., 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.

RAZORBACK SUCKER

A. Species description

The razorback sucker is a member of the sucker family, *Catostomidae,* and is endemic and unique to the Colorado River system. Females are larger than males of the same age. The moderate sized ventral mouth has a cleft lower lip, with lateral margins continuous and rounded. Razorback sucker coloration ranges from dark brown to olive dorsally and yellow to white ventrally, but color and morphology differ due to a sexual dimorphism that is especially obvious during reproductive seasons.

Adults are distinguished by a pronounced bony dorsal keel ("razor") arising immediately posterior to the occiput and may attain maximum total length of about one meter (commonly 400 -700 mm), weigh 5-6 kg (commonly less than 3 kg), and exceed 40 years of age (Minckley 1983; McCarthy and Minckley 1987). Larvae are generally 7-9 mm at hatching, 9-11 mm at swimup, and consume most of their yolk and begin exogenous feeding by 10-11 mm (Minckley and Gustafson 1982; Marsh and Langhorst 1988; Papoulias and Minckley 1990; Snyder and Muth 1990). Transition to the juvenile period (sensu Snyder 1976) occurs at 27-30 mm (Snyder and Muth 1990), and, generally, fish greater than 350 mm are sexually mature (Minckley 1983; Hamman 1985).

B. Life History and population dynamics

The razorback sucker is adapted to the various habitats and greatly fluctuating, unpredictable hydrologic conditions of the pristine Colorado River system (Minckley 1973, 1983; Holden and Stalnaker 1975a; Behnke and Benson 1983; Carlson and Muth 1989; Lanigan and Tyus 1989; Bestgen 1990; Minckley et al. 1991a) and apparently has a life strategy that includes use of inundated flood plain habitats as growth and conditioning areas (Tyus 1987; Tyus and Karp 1989, 1990, 1991; Modde 1996, 1997; Modde et al. 1995, 1996; Wydoski and Wick 1998). The razorback sucker has a multi-phase life cycle, with larvae and early juveniles representing several life-intervals that are morphologically and ecologically distinct from each other and from later juvenile and adult stages (Snyder and Muth 1990).

Habitats used by adult razorback suckers in rivers of the upper Colorado River basin include deeper runs, eddies, backwaters, and, at higher discharges, flooded off-channel environments in spring (the latter apparently including movements from the colder main channel into warmer habitats, a behavior called "staging", before spawning); runs and pools often in shallow water associated with submerged sandbars in summer; and low-velocity runs, pools, and eddies in winter (Tyus 1987; Osmundson and Kaeding 1989a; Valdez and Masslich 1989; Tyus and Karp 1990; Modde 1997; Modde and Wick 1997; Modde and Irving 1998). Young razorback suckers require nursery environments with quiet, warm, shallow water such as tributary mouths, backwaters, or inundated flood plain habitats in rivers (Smith 1959; Taba et al. 1965; Gutermuth et al. 1994; Modde 1996, 1997; Muth et al. 1998) and coves or shorelines in reservoirs (Minckley et al. 1991a). The diet of all life stages is varied and includes insects, zooplankton, phytoplankton, algae, and detritus (Taba et al. 1965; Vanicek 1967; Hamman 1987; Marsh 1987; Marsh and Langhorst 1988; Muth et al. 1998). Growth to adult size is rapid in warm, food-rich environments (Osmundson and Kaeding 1989b; Minckley et al. 1991a; Mueller 1995).

Minckley (1973) stated that razorback suckers in riverine environments make annual spawning runs to specific river areas. Razorback suckers in the Green River system spawn over bars of cobble, gravel, and sand substrates during spring-runoff flows at widely ranging discharges and water temperatures (McAda and Wydoski 1980; Tyus 1987; Tyus and Karp 1989, 1990; Muth et al. 1998). Reproduction in the lower Colorado River basin generally occurs during January through April (Medel-Ulmer 1983; Minckley 1983; Langhorst and Marsh 1986; Mueller 1989) but may extend from November into May (Bozek et al. 1991). Estimates of the total fecundity of wild females ranged up to 144,000 ova/fish (Minckley 1983). Presumably, long life and high fecundity allow the species to persist through several consecutive seasons of no or low reproduction and recruitment (Bestgen 1990).

Direct observation of spawning behavior and release of gametes in the Green River is prevented by high water turbidity (Tyus 1987; Tyus and Karp 1990). However, Mueller (1989) observed razorback suckers spawning in the clear Colorado River downstream of Hoover Dam, Arizona-Nevada, and reported behavior similar to that reported for populations in lower Colorado River basin reservoirs. In Lake Mohave, spawning groups of one female and several male razorback suckers congregate over coarse cobble in water 0.5-5 m deep. The males press against the female, and spawning convulsions (a few seconds in duration) sweep the substrate clear of fine materials and create depressions 20 cm or more deep. Individual females have been observed spawning hourly and daily on successive days within a week. The number of eggs released by a female with each spawning act is apparently only a small fraction of her total complement (Minckley et al. 1991a). McAda and Wydoski (1980) estimated the total fecundity of 10 razorback suckers (446-534 mm) caught in the Green River during autumn at 27,614 to 76,576 ova/fish, whereas estimates of total fecundity for five razorback suckers (391-570 mm standard length) collected from Lake Mohave during spring ranged from 74,600 to 144,000 ova/fish (Minckley 1983).

Incubation time and hatching success of razorback sucker embryos are temperature dependent. Marsh (1985) evaluated the effects of temperatures ranging from 5° to 30° C on incubation and hatch of captive razorback sucker embryos acclimated at 18° C. Among his treatments, total mortality of embryos occurred at 5°, 10°, and 30° C. Of those treatments with surviving embryos, hatch duration was longest (204 h) and percent hatch was highest (35 percent) at 20° C, hatch duration was shortest (96 h) at 25° C, and percent hatch was lowest (19 percent) at 15° C. Bozek et al. (1990) reported that hatching success of captive razorback sucker embryos acclimated to experimental temperatures ranged from 22 to 57 percent at 10° C, 32 to 65 percent at 15° C, and 34 to 65 percent at 20° C; total mortality occurred at 8° C. They concluded that optimal hatching temperatures were 12°-20° C. Hatching time for 50 percent of the eggs was 420-556 h at 10° C, 256-298 h at 15° C, and 15-168 h at 20° C.

Haines (1995) evaluated the effects of temperature (12°, 16°, and 20° C) on the developmental rate and hatching success of captive embryos of razorback and flannelmouth suckers. Mean number of days between fertilization and peak hatch decreased as temperature increased for both species and ranged from 6.5 to 12.5 days for razorback sucker and 6.0 to 16.5 days for flannelmouth sucker. The period from first to last hatch averaged 2.0 days longer for razorback sucker than for flannelmouth sucker over all temperatures. Percent hatch of flannelmouth embryos was independent of temperature and, at each temperature, was greater (83-91 percent) than for razorback sucker embryos (48-67 percent); hatching success of razorback sucker embryos increased as temperature increased.

Several factors may limit the survival of razorback sucker embryos in the Green River system. These factors include reduced water temperatures caused by operation of Flaming Gorge Dam (Tyus and Karp 1991), sedimentation of cobble and gravel spawning substrates associated with high releases from Flaming Gorge Dam occurring too early in the spring-runoff period (Wick 1997), predation on eggs by nonnative fishes (Hawkins and Nesler 1991; Lentsch et al. 1996c; Tyus and Saunders 1996), and selenium contamination of adults and embryos (Hamilton and Waddell 1994).

Before 1992 (Muth et al. 1998), direct evidence of reproduction by razorback suckers in the Upper Colorado River basin or information on the species' natural early life history in riverine environments were limited to those larvae collected by Tyus (1987) and captures of a few early juveniles from backwaters (e.g., Smith 1959; Taba et al. 1965; Gutermuth et al. 1994). However, diagnostic characters for distinguishing larval razorback suckers from larvae of sympatric suckers were only recently developed (Snyder and Muth 1990) and previous sampling for riverine razorback suckers did not target early life stages. Razorback sucker larvae are generally 7-9 mm at hatching and 9-11 mm at swimup; at 15° C, larvae swimup 13 days after hatching (Minckley and Gustafson 1982; Marsh 1985; Snyder and Muth 1990; R. T. Muth, personal observation). In rivers, larval razorback suckers presumably enter the drift after emerging from spawning substrates (Mueller 1989; Paulin et al. 1989) and are transported downstream into off-channel nursery environments with quiet, warm, shallow water (e.g., tributary mouths, backwaters, and inundated flood plain habitats).

Food-limited growth and survival of razorback sucker larvae has been postulated as contributing to the low or nonexistent recruitment (Minckley 1983; Marsh and Langhorst 1988; Papoulias and Minckley 1990, 1992; Modde 1997). Muth et al. (1998) reported that mean and maximum total length of larval razorback suckers in collections from the middle or lower Green River generally increased as sampling progressed each year, and approximately 20 percent of all larvae captured were larger than 12 mm; the two largest specimens were 20 and 24 mm. They estimated that mean daily growth (posthatching) of larvae less than 35 days old collected from either river section during 1993-1996 was lowest in 1994 (0.31 and 0.27 mm TL/d for the middle and lower Green River, respectively) and greatest in 1996 (0.35 and 0.33 mm TL/d). Over all years, specimens from the middle Green River grew 6-21 percent faster than those from the lower Green River.

Muth et al. (1998) noted that, although food abundance in existing Green River nursery habitats appeared adequate to meet the minimum nutritional requirements for larval survival, growth of razorback sucker larvae was not optimal. Relatively minor differences in growth rates can be biologically significant if size-dependent processes, such as predation by small, gape-limited predators, are important regulators of larval survival. Predation by adult red shiners on larvae of native catostomids in flooded and backwater habitats of the Yampa, Green, or Colorado rivers was documented by Ruppert et al. (1993) and Muth and Wick (1997). Horn (1996) concluded that although nutritional limitations in Lake Mohave may directly contribute to the high mortality of larval razorback suckers, a greater problem is reduced growth, which keeps larvae at a size vulnerable to predation for a longer period of time. He further stated that apparently all razorback sucker larvae in Lake Mohave, starving or not, are consumed by nonnative fish predators.

Predation by nonnative fishes on young razorback suckers is considered a serious threat to populations (Bestgen 1990; Minckley et al. 1991a; Horn 1996; USFWS 1998). Ruppert et al. (1993) and Wydoski and Wick (1998) reported that because razorback suckers in the Green River system spawn on the ascending limb of the hydrograph and their larvae disperse into low-velocity habitats during May and June when invertebrate numbers are low in riverine nursery habitats, razorback sucker larvae would be highly susceptible to predation by nonnative fishes at that time because other food organisms are scarce. Extremely low survival of larval razorback suckers in the Green River during 1992-1996 was suggested by Muth et al. (1998) based on the apparent disappearance of larvae from nursery habitats by early or mid-July each year. Thus it appears that low survival of early life stages is responsible for the low or nonexistent recruitment in wild populations.

Historically, flood plain habitats inundated and connected to the main channel by overbank flooding during spring-runoff discharges would have been available as nursery areas for young razorback suckers in the Green River. Tyus and Karp (1990) associated low recruitment with reductions in flood plain inundation since 1962, and Modde et al. (1996) associated years of high spring discharge and flood plain inundation in the middle Green River (1983, 1984, and 1986) with subsequent suspected recruitment of young adult razorback suckers. Flood plain habitats are typically warmer and substantially more productive than the adjacent river and have abundant

vegetative cover (Mabey and Shiozawa 1993; Wolz and Shiozawa 1995; Modde 1997; Wydoski and Wick 1998). Spawning at increasing and highest runoff flows provides drifting razorback sucker larvae maximum access to flooded habitats, and enhanced growth of larvae in those habitats may increase overall survival by shortening the period of vulnerability to predation (Lentsch et al. 1996b).

Little is known about the biology of juvenile razorback suckers, but the few collected from rivers were found in quiet-water habitats. In 1950, about 6,600 larval or early juvenile razorback suckers were seined along warm, shallow margins of the Colorado River at Cottonwood Landing, Nevada (Sigler and Miller 1963). Smith (1959) caught two juveniles (both about 38 mm long) in the Glen Canyon area of the Colorado River before inundation by Lake Powell, one from a backwater and one from a flooded tributary mouth. Taba et al. (1965) collected eight razorback sucker juveniles (90–115 mm long) from backwaters on the Colorado River near Moab, Utah, 1962–1964. The digestive tracts of those fish contained "algae and bottom ooze." Juvenile razorback suckers have been caught in lateral canals off the lower Colorado River (Marsh and Minckley 1989; Maddux et al. 1993), and stocked, hatchery-produced young have been observed along shorelines, in embayments, along sandbars, or in tributary mouths, eventually moving into river channels or larger backwaters (Minckley et al. 1991a).

Outside the breeding season, adult razorback suckers tend to utilize deeper eddies, backwaters, and pool-type habitats (Minckley et al. 1991a), and their movements are generally reduced (Tyus 1987; Tyus and Karp 1990). Summer or autumn habitat use in rivers of the upper Colorado River basin includes submerged mid-channel sandbars, pools, eddies, and runs (Tyus 1987; Osmundson and Kaeding 1989a; Modde and Wick 1997). Tyus (1987) reported that Green River fish during summer occupied uneven mid-channel sandbars in water less than 2 m deep with an mean velocity of 0.5 m/s. Habitat use in the middle Green River during spring and summer 1993 included runs, eddies, or run-eddy interfaces in water 1–3 m deep over sand, cobble, and gravel substrates (Modde and Wick 1997; Modde and Irving 1998). Although turbulent canyon reaches are not considered preferred habitat for razorback suckers (Tyus 1987; Lanigan and Tyus 1989; Minckley et al. 1991a), Modde and Wick (1997) and Modde and Irving (1998) reported that six radio-tagged adults moved into or near the vicinity of Split Mountain Canyon (Reach 2) during summer or autumn in 1993 and 1994, and possibly remained there over winter. Ryden and Pfeifer (1998) reported that large juvenile and adult razorback suckers stocked in the San Juan River, New Mexico-Utah, preferred fast, mid-channel habitats during the summer–autumn base-flow period.

C. Status and distribution

The endangered razorback sucker is an endemic catostomid of the Colorado River basin (Miller 1959; Minckley et al. 1986) and was once widely distributed in warmwater reaches of larger rivers from Mexico to Wyoming (Jordan and Evermann 1896; Minckley 1973; Behnke and Benson 1983; Bestgen 1990; USFWS 1994). Historic records indicate that the lower Colorado River basin supported the largest numbers of razorback sucker; the species was most abundant in the mainstem Colorado River downstream of present-day Lake Mead, the Salton Sea area, and the lower Gila River drainage in Arizona (Kirsch 1888; Gilbert and Scofield 1898; Minckley

1973, 1983; Bestgen 1990; Minckley et al. 1991a). In the upper Colorado River basin, razorback suckers historically occurred in the Colorado, Green, and San Juan river drainages but apparently were common only in calm, flat-water reaches of the mainstem Colorado and Green rivers and lower sections of their major tributaries (Jordan 1891; Evermann and Rutter 1895; Ellis 1914; Simon 1946; Hubbs and Miller 1953; Koster 1960; Sigler and Miller 1963; Baxter and Simon 1970; Vanicek et al. 1970; Holden and Stalnaker 1975a, 1975b; Wiltzius 1978).

Bestgen (1990) reported that this species was once so numerous that it was commonly used as food by early settlers and, further, that commercially marketable quantities were caught in Arizona as recently as 1949. In the Upper Basin, razorback suckers were reported in the Green River to be very abundant near Green River, Utah, in the late 1800's (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 1930's and early 1940's. In the San Juan River drainage, Platania and Young (1989) relayed historical accounts of razorback suckers ascending the Animas River to Durango, Colorado, around the turn of the century.

Declines in the abundance and distribution of razorback suckers were first noted in the early 1940's (Dill 1944; Wiltzius 1978). Today, the species is one of the most imperiled fishes in the Colorado River basin and exists naturally as only a few disjunct, aging populations or scattered individuals (Minckley et al. 1991a). Although there is evidence of reproduction in the two largest extant populations, natural survival of fish beyond the larval period appears low or nonexistent. Wild stocks are primarily composed of older fish and continue to decline in abundance (Lanigan and Tyus 1989; Marsh and Minckley 1989). Lack of recruitment sufficient to sustain populations has been mainly attributed to the cumulative effects of habitat loss and modification (including reductions in river-flood plain connectivity) caused by water and land development, and predation on early life stages by nonnative fishes (Tyus and Karp 1990; Hawkins and Nesler 1991; Modde et al. 1995; Horn 1996; Lentsch et al. 1996c; Tyus and Saunders 1996; Hamilton 1998; USFWS 1998a).

Remaining wild populations of razorback sucker are in serious jeopardy. The largest extant population is found above Davis Dam in Lake Mohave on the lower mainstem Colorado River, Arizona-Nevada, but little or no natural recruitment has occurred since completion of the dam in 1954 (McCarthy and Minckley 1987; Minckley et al. 1991a). Estimated numbers of adult razorback suckers in Lake Mohave declined 68 percent (from 73,500 to 23,000) during 1980–1993 (Marsh 1994), and further steep declines in the population are expected within the next decade (Minckley et al. 1991a; Mueller 1995). Most razorback suckers occupying exclusively riverine habitat are now limited to the upper Colorado River basin and populations are small. Lanigan and Tyus (1989) estimated that from 758 to 1,138 razorback suckers inhabit the upper Green River. More recent studies of this Green River population of razorback suckers indicate that this population consists of a precariously small but dynamic population that appears to be stable or declining slowly and may consist only of about 500 individuals (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. Osmundson and Kaeding (1991) report that the number of razorback sucker captures in the Grand Junction area has declined dramatically since 1974. Modde et al. (1996) characterized the middle Green River population as "precariously" small but dynamic, with at least some recruitment.

In the San Juan River subbasin, small concentrations of razorback suckers have been reported at the inflow area in the San Juan arm of Lake Powell, Utah and one specimen was captured in the San Juan River near Bluff, Utah in 1988 (Platania 1990, Platania et al. 1991). In Bestgen (1990) additional captures of small numbers of razorback suckers were reported from the Dirty Devil and Colorado River arms of Lake Powell.

The razorback sucker was listed as endangered, pursuant to the Act, on October 23, 1991.

Critical habitat description for Razorback sucker

Critical habitat has been designated within the 100-year flood plain of the razorback sucker's historical range in the following sections of the Upper and Lower Basin and the San Juan River (59 FR 13374). The critical elements are the same as those listed above under Colorado pikeminnow.

Colorado, Moffat County. The Yampa River and its 100-year flood plain 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).

Utah, Uintah County; and Colorado, Moffat County. The Green River and its 100-year flood plain 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).

Utah, Uintah, Carbon, Grand, Emery, Wayne, and San Juan Counties. The Green River and its 100-year flood plain from Sand Wash at river mile 96 at T. 11 S., R. 18 E., section 20 (6th Principal Meridian) to the confluence with the Colorado River in T. 30 S., R. 19 E., section 7 (6th Principal Meridian).

Utah, Uintah County. The White River and its 100-year flood plain from the boundary of the Uintah and Ouray Indian Reservation at river mile 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).

Utah, Uintah County. The Duchesne River and its 100-year flood plain from river mile 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).

Colorado, Delta and Mesa Counties. The Gunnison River and its 100-year flood plain 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).

Colorado, Mesa and Garfield Counties. The Colorado River and its 100-year flood plain 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 flood plain 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).

Utah, Grand, San Juan, Wayne, and Garfield Counties. The Colorado River and its 100-year flood plain 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).

New Mexico, San Juan County; and Utah, San Juan County. The San Juan River and its 100-year flood plain 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.

Arizona, Cococini and Mohave Counties; and Nevada, Clark County. The Colorado River and its 100-year flood plain from the confluence with the Paria River in T. 40 N., R. 7 E., section 24 (Gila and Salt River Meridian) to Hoover Dam in T. 30 N., R. 23 W., section 3 (Gila and Salt River Meridian) including Lake Mead to full pool elevation.

HUMPBACK CHUB

A. Species description

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 1955, 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 1940's (Miller 1946), presumably because of its restricted distribution in remote white water canyons (USFWS 1990a). Because of this, its original distribution is not known.

The humpback chub is a relatively large North American minnow reaching a maximum length of 480 mm and a weight of 1,165 g (Valdez and Ryel, 1995). Humpback chub have a laterally-compressed and tapering fusiform body, short narrow caudal peduncle with deeply forked tail fin, and large falcate paired fins. Adults have a narrow flattened head, with small eyes and a long fleshy snout and inferior subterminal mouth. Subadults are olivaceous above with silvery sides fading to a creamy-white belly, while adults are light olivaceous and slate-gray dorsally and laterally, with a white belly tinged with light orange and yellow (Valdez and Ryel, 1995).

Although historic data are limited, the apparent range-wide decline in humpback chubs 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).

B. Life history

The humpback chub evolved in seasonally warm and turbid water and is highly adapted to the unpredictable hydrologic conditions that occurred in the pristine Colorado River system. It is extraordinarily specialized for life in torrential water, with an enlarged stabilizing nuchal hump and large falcate fins (Minckley 1991). Although not strong swimmers (Bulkley et al. 1982), humpback chubs are apparently so well adapted to canyon environments that populations appear to have always occupied a specialized niche in canyon-bound segments of the river system (Carlson and Muth 1989) where individual adults exhibit high fidelity to particular locales (Valdez and Clemmer 1982; Valdez and Ryel 1995).

Little is known about the specific spawning requirements of the humpback chub. The fish is known to spawn soon after the highest spring flows when water temperatures approach 20° C (Kaeding et al. 1990, Karp and Tyus 1990a, USFWS 1990b). The collection of ripe and spent fish indicated that spawning occurred in Black Rocks during June 2-15, 1980, at water temperatures of 10° to 15° C; in 1981, spawning occurred on May 15-25 at water temperatures of approximately 15° C (Valdez et al. 1982b). Humpback chub spawned in Black Rocks on the Colorado River in 1983 when maximum daily water temperatures were between 12° and 17° C (Archer et al. 1986).

The humpback chub is an obligate warmwater fish that requires relatively warm temperatures for spawning, egg incubation, and survival of larvae. Optimum growth temperatures range from 16° to 22° C (Hamman 1982; Lechleitner 1992). Little else is known about reproduction except that spawning occurs on the descending limb of annual spring hydrographs, most likely over gravel substrates (Valdez and Clemmer 1982; Valdez et al. 1982; Kaeding and Zimmerman 1983; Tyus and Karp 1989; Valdez and Ryel 1995).

Unlike larvae of Colorado pikeminnow and razorback sucker, emerging larval humpback chubs do not appear to drift extensively and remain in the general vicinity of spawning areas. Extensive sampling for larvae and young-of-year immediately downstream of Black Rocks and Westwater Canyon yielded very low numbers of young humpback chubs (Valdez et al. 1982; Chart and Lentsch 1999a). Robinson et al. (1998) documented drift of larval humpback chubs from the Little Colorado River and into the mainstem Colorado River in Grand Canyon; they noted lower abundance at more downstream stations, which suggested that humpback chub larvae may drift shorter distances than speckled dace, bluehead sucker, and flannelmouth sucker. Young-of-year fish in the Little Colorado River were noted to distribute themselves downstream in the main Colorado River within several months of hatching, however it is not known if this emigration is passive or active (Valdez and Ryel 1995).

Backwaters, eddies, and runs have been reported as common capture locations for young-of-year 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 young-of-year prefer average depths of 2.1 feet with a maximum of 5.1 feet. Average velocities were reported at 0.2 feet per second. Subadult humpback chub (under 200 mm) occupied shoreline habitats within two meters of the shore and were specifically more abundant in talus and vegetated shorelines which provided more cover compared to sand or cobble bars in the Grand Canyon (Converse et al. 1998a). Humpback chubs mature in 2-3 years at approximately 200 mm and may live 20-30 years (Valdez et al. 1992; Hendrickson 1993).

Adults are thought to be negatively phototactic and are more active in turbid water or at night (Valdez et al. 1992; Valdez and Ryel 1995, 1997). Valdez et al. (1982b) 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. In Grand Canyon, adult humpback chub were specifically associated with geomorphic reaches of the river characterized by large eddy hydraulic habitat. Humpback chub appear to have a high fidelity for particular eddies in some reaches of the river (Valdez and Ryel 1995).

Generally, humpback chub show fidelity for canyon reaches and move very little (Miller et al. 1982c, Archer et al. 1985; Burdick and Kaeding 1985, Kaeding et al. 1990). 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 to 1981 (Valdez et al. 1982) and 1983 to 1985 (Archer et al. 1986; Kaeding et al. 1990).

Diet of humpback chubs in the upper Colorado River basin has not been described. In Grand Canyon, humpback chubs primarily consumed aquatic invertebrates (e.g., midges, blackflies, and amphipods), green algae, terrestrial invertebrates, and occasionally fish and reptiles (Kaeding and Zimmerman 1983; Kubly 1990; Valdez and Ryel 1997). Tyus and Minckley (1988) reported that migrating Mormon crickets (*Anabrus simplex*) were an important food source for humpback chubs in the Green and Yampa rivers.

Two species of non-indigenous parasites infect humpback chubs; the external parasitic copepod (*Lernaea cyprinacea*) has been reported from all populations (Valdez et al. 1982) and the internal Asian tapeworm (*Bothriocephalus acheilognathi*) is found in humpback chubs of Grand Canyon (Brouder and Hoffnagle 1997; Clarkson et al. 1997). Infection by the Asian tapeworm may cause stress or death to the host and widespread infestation during periods of stress. This parasite can complete its life cycle only where water temperatures are greater than 20° C but is apparently able to survive in a fish host at colder temperatures.

C. Status and distribution

The humpback chub is endemic to the Colorado River basin, with ancestral fossil evidence of a *Gila* complex dating back to the Miocene epoch (Miller 1955). *Gila cypha* is believed to be a more recent, specialized derivative that evolved in response to conditions in large, erosive Colorado River habitats during the mid-Pliocene and early Pleistocene epochs, 3–5 million years ago (Minckley et al. 1986). Skeletal remains of humpback chubs were found in 4,000-year-old flood deposits in Stanton's Cave in Marble Canyon, Arizona, as well as at an archeological site in Catclaw Cave, now inundated by Lake Mead (Miller 1955).

Records documenting distribution and abundance of the species in modern time are incomplete, and factors associated with its decline are scarce or poorly understood (Tyus 1998). The lack of early information on humpback chub is due to several factors. Humpback chubs occur primarily in remote canyon areas and apparently were rare in most early collections because of inaccessibility and difficulty in sampling these areas (Tyus 1998). In addition, there has been some uncertainty over nomenclature and taxonomy of species in the genus *Gila*. For example, during the 1950's, two forms of bonytail (a common name for morphotypes of the Colorado River *Gila* complex) were taxonomically recognized as subspecies, roundtail chub *Gila robusta robusta* and bonytail chub *Gila robusta elegans*.

A third form, the humpback chub *Gila cypha*, was described by Miller (1946) and was not universally recognized as a valid taxon (Holden and Stalnaker 1970; Holden 1991). Although many researchers recognized the presence of morphological variants, a common nomenclature has not been accepted. As a result, many early fish surveys of the Colorado River system assigned the vernacular "bonytail" to all three closely-related *Gila* species (*G. cypha*, *G. elegans*, and *G. robusta*), thereby confounding confirmation of humpback chub localities prior to approximately 1970 (Banks 1964; Vanicek and Kramer 1969; Holden and Stalnaker 1970; Valdez and Clemmer 1982; Douglas et al. 1989; Rosenfeld and Wilkinson 1989; Minckley 1991; Dowling and DeMarais 1993; Quartarone 1993).

Despite sparse historic records and taxonomic confusion, strong evidence exists that the historic range of the humpback chub included most canyon-bound reaches of the Colorado River system. Known historic distribution of humpback chubs includes portions of the mainstem Colorado River and four of its tributaries: the Green, Yampa, White, and Little Colorado rivers (USFWS 1990a). However, the species may have been extirpated from some river reaches, in both the lower and upper Colorado River basins, as a result of water development and other human-related alterations prior to complete documentation of its range.

Description of the present distribution of humpback chubs in the Colorado River basin is based on collection records from widely separated locations since approximately 1980. The Humpback Chub Recovery Plan (USFWS 1990a) described the present distribution of the species as:

1. Little Colorado River, Arizona, from its mouth to 13 km upstream;
2. Colorado River in Marble and Grand canyons, Arizona;
3. Colorado River in Cataract Canyon, Utah;

4. Colorado River in Black Rocks, Colorado, and Westwater Canyon, Utah;
5. Green River in Desolation and Gray canyons, Utah;
6. Green River in Whirlpool and Split Mountain canyons, Dinosaur National Monument, Colorado and Utah; and
7. Yampa River in Yampa Canyon, Dinosaur National Monument, Colorado.

The largest and most stable humpback chub population is presently thought to reside in the Little Colorado River and Colorado River near their confluence in Marble and Grand canyons, Arizona (1 and 2 from list above). Valdez and Ryel (1995) estimated that 3,750 adult humpback chubs larger than 200 mm occurred in the mainstem river during 1990–1993, and Douglas and Marsh (1996) reported 4,346 humpback chubs larger than 150 mm in the Little Colorado River in 1992. In addition, several other aggregations of humpback chub are found in the Grand Canyon, always in association with reaches characterized by large eddy complexes. In one aggregation at approximately river mile 30 in Grand Canyon, larval humpback chub were identified in association with springs expressed from local limestone geology; however it is not believed that any recruitment occurs as a result of this spawning activity. Rather the aggregation appears to be a relict group from the pre-dam era, that are prompted to spawn by relatively warmer spring water compared to the cold hypolimnetic river water (Valdez and Ryel 1995).

Of the five locations in the upper Colorado River basin (3–7 from list above), self-sustaining populations occur in Cataract Canyon (Valdez 1990; Valdez and Williams 1993), Black Rocks (Kaeding et al. 1990), Westwater Canyon (Chart and Lentsch 1999a), Desolation and Gray canyons (Chart and Lentsch 1999b), and Yampa Canyon (Karp and Tyus 1990b). A few humpback chubs also have been reported from the Green River in Dinosaur National Monument, primarily in Whirlpool Canyon (Holden and Stalnaker 1975a; Karp and Tyus 1990b) and Split Mountain Canyon (Vanicek 1967; Holden and Stalnaker 1975). Estimates of humpback chub population size in the Green and Colorado rivers have been difficult to obtain because of low numbers of fish and low recapture rates. Chart and Lentsch (1999a) sampled for humpback chubs at three locations in Westwater Canyon and derived abundance estimates ranging from 572 to 5,880 individuals larger than 175 mm; however, confidence intervals about the estimates were typically greater than the estimate means due to low recapture rates. Catch rates of humpback chubs in Black Rocks indicate a relatively large concentration (Maddux et al. 1993), but no abundance estimates have been attempted.

The humpback chub was included in the first List of Endangered Species issued by the Office of Endangered Species on March 11, 1967 (32 FR 4001). The humpback chub was classified as endangered because of declines in distribution and abundance throughout its range. It was afforded full protection under ESA of 1973, as amended.

Critical Habitat for humpback chub

Critical habitat has been designated within the humpback chub's historical range in the following sections of the Upper Basin (59 FR 13374):

Colorado, Moffat County. 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).

Utah, Uintah County; and Colorado, Moffat County. 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).

Utah, Uintah and Grand Counties. The Green River (Desolation and Gray Canyons) from Sumners 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).

Utah, Grand County; and Colorado, Mesa County. 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).

Utah, Garfield and San Juan Counties. 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).

Bonytail

A. Species description, life history and distribution

Bonytail have an elongated fusiform body, small flattened head with small eyes, subterminal mouth, long slender caudal peduncle, and large deeply forked tail fin. Subadults are olivaceous above with silvery sides fading to creamy-white belly, while adults are greenish to gray dorsally and laterally, with a white belly and irregular black lateral spots (Valdez and Ryel 1995).

Formerly reported as widespread and abundant in mainstem rivers (Jordan and Evermann 1896), bonytail populations have been greatly reduced. The fish is presently represented in the wild by a low number of old adult fish in Lake Mohave and perhaps other lower Colorado River basin reservoirs (USFWS 1990a). 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 to 1983, no bonytail were collected from the Colorado or Gunnison rivers in Colorado or Utah (Wick et al.1981; Valdez et al. 1982). 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). Researchers continue to capture suspected bonytail individuals or potential hybrid combinations of bonytail, roundtail chub and humpback chub; however it is difficult to determine the extent of hybridization in the

Field or if certain individuals represent the bonytail species because of the complexity of *Gila* morphometric.

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). 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 l7° C (Vanicek and Kramer 1969).

Early stocking efforts which placed hatchery-raised adult bonytail into the Green River at Split Mountain and near the Jensen, Utah area proved unsuccessful. Currently, the State of Utah has an experimental stocking progmm in place through which thousands of subadult bonytail have been stocked into the Colorado River in the Moab area in the past 5 years. This experimental stocking also includes investigations into muscle fitness of stocked fish (Lentsch et al. 1996a).

The bonytail is the rarest native fish in the Colorado River. Fewer than 10 individuals have been caught in the upper Colorado River basin in the last decade and small numbers of adults persist in Lake Mohave, Nevada-Arizona (Kaeding et al. 1986). Bonytail was listed as an endangered species in 1980.

Critical llabitat for Bonytail

Critical habitat has been designated within the bonytail's historical range in the following sections of the Upper Basin (59 FR 13374):

Colorado. Moffat County. 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).

Utah, Uintah County; and Colorado, Moffat County. 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).

Utah, Uintah and Grand Counties. The Green River (Desolation and Gray Canyons) from Sumner's Amphitheater (river mile 85) in T. 12 S., R. 18 E., section 5 (Salt Lake Meridian) to Swasey's Rapid (river mile 12) in T.20 S., R. 16 E., section 3 (Salt Lake Meridian).

Utah, Grand County; and Colorado, Mesa Countv. 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).

Utah, Garfield and San Juan Counties. 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.

E. Analysis of the species/critical habitat likely to be affected

It is anticipated that the Colorado pikeminnow that occupy 88.5 miles of the Price River will be directly affected, as will their habitat, by flow depletions and instream habitat modifications. In addition, flow depletions in the Price River will deplete flows in the Green and Colorado rivers and affect critical habitat for the four endangered fish species from the confluence of the Price and Green rivers downstream to Lake Powell. Depletions on Green and Colorado rivers within the affected area are herein considered in accumulation with other small tributary depletions as a net change to the sediment and flow regimes and lost potential for creation and maintenance of habitat characteristics crucial to various life-stages of these fish. For example, lower peak flows prevent interconnection of the 100-year flood plain and flood plain inundation and also decreases capacity for creation of backwaters in downstream reaches. Lower peak flows may also affect Colorado pikeminnow spawning habitat in Gray Canyon and other species spawning habitat as yet unidentified.

IV. ENVIRONMENTAL BASELINE

A. Status of the species within the action area

Colorado pikeminnow are found in the Price River from Farnham Diversion near Wellington at river mile 88.5 down to the confluence of the Price and Green rivers. Wellington is located approximately 50 to 70 miles downstream of the proposed Narrows Dam.

The collection of 21 Colorado pikeminnow in the Price River and seven additional individuals positively identified but not captured during a 2-year seasonal study indicates that some suitable habitat for juvenile and adult Colorado pikeminnow is available during April through September although the quality or quantity is unknown. No data has been collected during late fall or winter, so it is not known whether the Price River is used by Colorado pikeminnow during those seasons.

Although spawning of the Colorado pikeminnow has not been documented in the Price River, the potential for Colorado pikeminnow spawning in the Price River is unknown. The Price River warms earlier than the Green River which may attract Colorado pikeminnow from the Green River that are searching for suitable spawning and/or feeding areas in the spring. A ripe male Colorado pikeminnow was captured at river mile 10.5, which suggests that the fish may attempt to spawn in the Price River, however one ripe male may also be anomalous. The availability and quality of spawning habitat is unknown other than observation of some riffle habitat in the canyon reaches. Minimal quality and quantity of nursery habitat (defined as low-velocity shoreline pockets or backwaters) has been noted within the Price River. The nursery habitat present within the Price River is suspected to be completely dewatered during low water periods. It is not clear if the year-round flow and sediment regimes are adequate to maintain spawning or nursery habitat.

Despite anecdotal accounts of abundant Colorado pikeminnow in the early part of the century (Hardy 1964 in reference to early 1900s), most biologists including biologists from the State of Utah Division of Wildlife Resources (UDWR) did not believe Colorado pikeminnow occupied the Price River at any appreciable level before recent findings from surveys in 1996 and 1997. In fact, McAda et al. (1977) reported that no endangered species were identified at any of three locations within the Price River; however this survey represented minimal effort during 1 year, which happened to be a severe drought year.

It is possible that Colorado pikeminnow have been present in the Price River at varying or low densities but only recently detected, or Colorado pikeminnow may have only recently recolonized the Price River. In either case, juvenile and adult Colorado pikeminnow appear to use as much of the Price River that is available (88.5 miles from the confluence of the Price and Green rivers to the Farnham Diversion, an upstream barrier to fish movement) at least from April through September. In contrast, if Colorado pikeminnow were in fact, locally extirpated, recent note of more than twenty juveniles and adults in the Price River may indicate that Colorado pikeminnow are recolonizing the Price River after years of absence. Recolonization of tributaries may exemplify an increasing trend for Colorado pikeminnow in the Green River system.

The Price River may play an important role to the overall Green River system both biologically and physically. The proportion of native species is much higher in the Price River than in the Green River, and the number of nonnative predators and competitors, such as channel catfish and green sunfish, in the Price River is relatively low. The dominant native fish community in the Price River may be one reason why Colorado pikeminnow are found there. Water temperatures within the Price River warm earlier than the Green River, which may attract the endangered fish from the Green River searching for suitable spawning and/or feeding areas (Cavalli 1999). The Price River may also provide better growing conditions, food supply, and nutrients needed by the endangered fishes; however, further studies are needed to determine the importance of these relationships to the overall recovery of the species in the upper Colorado River basin.

Outside of the Price River basin, Colorado pikeminnow, humpback chub, razorback sucker and to some extent, bonytail, are present and utilize the Green River from the confluence of the Price and Green rivers downstream to Lake Powell; this area will be affected by depleted flows in the Price River. Various life-stages of these species occur within this area including: 1) spawning adult Colorado pikeminnow, humpback chub and most likely razorback sucker; 2) young-of-year Colorado pikeminnow, humpback chub and razorback sucker; 3) juvenile Colorado pikeminnow, humpback chub and razorback sucker; and 4) migrating and feeding adults of all four species. In addition, the critical habitat that is affected by the proposed Project is within several areas of focus for recovery efforts for these species. Any factor detrimentally affecting these species is expected to hinder recovery efforts to some unknown extent.

B. Factors affecting species environment within the action area

The Colorado pikeminnow, razorback sucker, humpback chub, and bonytail are adversely affected by the following project activities or consequences:

1. Depletions to instream flows and resultant degradation of instream habitat as well as direct influences on various life-stages and the food-base of Colorado pikeminnow within 88.5 miles of occupied habitat in the Price River.

2. Depletions to the Green River and Colorado River basin including direct impacts on all four endangered fish species and their critical habitat, cumulative depletion impacts on the sediment and flow regimes, and adverse modification of habitat downstream from the confluence of the Price and Green rivers to Lake Powell.

V. EFFECTS OF THE ACTION

A. Factors to be considered

Water depletions in the upper Colorado River basin have been long recognized as a major source of impact to the endangered fish species native to this basin. Continued water withdrawal has restricted the ability of the Colorado River system to produce flow conditions required to create and maintain habitat for various life stages of these species. Impoundments and diversions, like the proposed Narrows Project, have substantially reduced peak discharges in the Colorado River basin while increasing base flows in some reaches. These depletions along with a number of other factors have resulted in such drastic reductions in the populations of the Colorado pikeminnow, humpback chub, bonytail, and razorback sucker that the Service has listed these species as endangered and has implemented programs to prevent extinction and recover the species. Both direct and indirect effects of depletions that will occur as a result of the proposed Narrows Project as well as cumulative effects within the Price River drainage were considered in the formulation of this Opinion.

The fact that the project depletes flows during peak runoff period is of concern to us because this hydrologic characteristic is geomorphically and ecologically significant to the endangered fish species. Spring runoff is the most extreme parameter of the hydrologic cycle, and it precedes and influences the very critical spawning period of the endangered fishes. Observations clearly demonstrate that migration and spawning activities of these fishes are synchronized with and undoubtedly influenced by the runoff period (Archer et al. 1986; Archer and Tyus 1984). The Service further believes that peak spring flows are crucial for creating and maintaining in-channel habitats, such as spawning habitat and backwaters, and for providing access to off-channel habitats, such as inundated floodplains.

Also, we are generally concerned about the base-flow condition. Minimum instream flows have not been identified or secured for the Price River. It is not clear what minimum flows and what time of year such flows would be required to protect and maintain habitat for endangered fish species. Further depletions from the system could affect the base-flow condition which would impact instream habitat quality and quantity.

B. Analysis for effects of the action

The Price River is a tributary to the Green River that drains approximately 1,892 square miles of southeastern Utah. Past and ongoing impacts to the Price River include water development projects for irrigation, industrial, and culinary purposes. Two existing Federal projects impact the Price River Basin. The Price-San Rafael River Salinity Control Project results in an annual depletion of 25,310 acre-feet, and diversions associated with Scofield Reservoir were reported to have an annual depletion of approximately 55,345 acre-feet (based on 63 percent consumptive use) for an average water year (19,161 acre-feet for a dry year and 55,703 acre-feet for a wet year) (Bureau of Reclamation 1998). Appendix A (Tables 1.1 to 1.4) summarizes the cumulative hydrology study.

The historical volume of water available in the Price River was estimated to be approximately 157,249 acre-feet (Bureau of Reclamation 1998). Depletions resulting from the two existing Federal projects have been estimated to be approximately 82,412 AF, resulting in a flow volume that is approximately 47.6 percent of historical flows. Much of the Price River has been channelized for highway and railroad construction. As a result of instream flow and physical channel modifications, instream habitat has shifted from a pool, riffle, run complex to extensive reaches of homogeneous habitat (riffles with large substrates or runs with fine substrates depending on gradient), although some reaches of the lower Price River retain elements of the natural physical habitat.

Subtracting the annual depletion of the Price-San Rafael River Salinity Control Project and Scofield Reservoir Project (82,412 AF) from historic flows (157,249 AF), results in the existing condition or average monthly flows without the Narrows Project of 74,837 AF (Table 1.4). Subtracting the depletion for the Narrows Project (5,717 AF) results in 69,120 AF of water remaining in the Price River. The overall depletion of all Federal projects including the proposed Narrows project will be 88,129 AF. This is a depletion of 56% of historic flows.

C. Species' response to the proposed action

It is expected that the proposed action would detrimentally impact Colorado pikeminnow and result in a decline in the number of individuals using the Price River or possibly inhibiting use altogether. Also, the unknown importance of the Price River as winter or spawning habitat prevents protection of these important life-history elements, if, in fact, they are present. Furthermore, adverse modification of critical habitat for all four endangered fish species from the confluence of the Price and Green rivers downstream to Lake Powell is expected to result in detriment and overall harm to the populations, thereby offsetting recovery efforts elsewhere in the basin.

VI. CUMULATIVE 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 Opinion. 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 Act.

We are not aware of any known cumulative effects at this time.

VII. CONCLUSION

The Narrows Project, in association with existing Federal projects, will further reduce peak discharge within the Price River. Annual depletions of the Narrows Project is 5,717 AF. Total depletion within the Price River Basin is 88,129 AF. It is our biological opinion that the effects of the Narrows Project, as proposed, are likely to jeopardize the continued existence of the Colorado pikeminnow, humpback chub, razorback sucker, and bonytail through water depletions from the Green and Colorado rivers and is likely to destroy or adversely modify designated critical habitat in the Green and Colorado rivers from the confluence of the Price and Green rivers downstream to Lake Powell. In addition, the proposed Narrows Project is likely to jeopardize Colorado pikeminnow currently occupying the Price River and detrimentally impact instream habitat conditions of the Price River.

VIII. REASONABLE AND PRUDENT ALTERNATIVES

Regulations (50 CFR 402.02) implementing section 7 of ESA define reasonable and prudent alternatives as alternative actions, identified during formal consultation, that: (1) can be implemented in a manner consistent with the intended purpose of the action; (2) can be implemented consistent with the scope of the action agency's legal authority and jurisdiction; (3) are economically and technologically feasible; and (4) would, we believe, avoid the likelihood of jeopardizing the continued existence of listed species or resulting in the destruction or adverse modification of critical habitat.

On January 21-22, 1988, the Secretary of the Interior; Governors of Wyoming, Colorado, and Utah; and the Administrator of the Western Area Power Administration were cosigners of a Cooperative Agreement to implement the RIP (USFWS, 1987). An objective of the RIP was to recover the listed species while providing for new water development in the Upper Colorado River Basin.

In order to further define and clarify processes outlined in sections 4.1.5, 4.1.6, and 5.3.4 of the RIP, a section 7 agreement and a 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 will be used to determine if sufficient progress is being accomplished in the recovery of endangered fishes to enable the RIP to serve as a reasonable and prudent alternative to avoid jeopardy. The RIPRAP was finalized on October 15, 1993, and has been reviewed and updated annually.

In accordance with the agreement, the Service assesses the impacts of projects that require section 7 consultation and determines if progress toward recovery has been sufficient for the RIP to serve as a reasonable and prudent alternative. If sufficient progress is being achieved, biological opinions are written to identify activities and accomplishments of the RIP that support it as a reasonable and prudent alternative. If sufficient progress towards the recovery of the endangered fishes has not been achieved by the RIP, actions from the RIPRAP are identified which must be completed to avoid jeopardy to the fishes. For historic projects, these actions serve as the reasonable and prudent alternative as long as they are completed according to the schedule identified in the RIPRAP. For new projects, these actions serve as the reasonable and prudent alternative as long as they are completed before the impact of the project occurs.

In determining if sufficient progress has been achieved, the Service considers: (a) actions which result in a measurable population response, a measurable improvement in habitat for the fishes, legal protection of flows needed for recovery, or a reduction in the threat of immediate extinction; (b) status of fish populations; (c) adequacy of flows; and (d) magnitude of the project impact. In addition, we consider support activities (funding, research, information, and education, etc.) of the RIP if they help achieve a measurable population response, a measurable improvement in habitat for the fishes, legal protection of flows needed for recovery, or a reduction in the threat of immediate extinction. We evaluate progress separately for the Colorado River and the Green River sub-basins; however, we gives due consideration to progress throughout the Upper Basin in evaluating progress towards recovery.

In the amended Biological Assessment from Reclamation to the Service (March 7, 1997), Reclamation suggested the following actions be developed into RIPRAP items to offset the proposed Narrows Project impacts to the Price River and endangered fish species:

1) 'Project sponsors . . . pay the depletion charge for the entire depletion caused by the Narrows Project.'

2) 'The Recovery Program would agree to provide funding for the continuance of the [Price River endangered fish] study for . . . additional . . . year(s) . . . this study could include . . . data . . . to provide a better understanding of the year-round utilization of the Price River by Colorado squawfish (sic); . . . identifying flow needs and potential sources of water . . . for in stream flows needed by endangered fish [in the Price River].'

3) 'The Recovery Program would secure water rights on the Price River that could be used to maintain instream flows during critical times of the year for squawfish (sic) in the Price River.'

The Service agrees that these activities will assist in providing the necessary protection and conservation of listed fishes in the Price River. These items have been incorporated into the following reasonable and prudent alternative and have been identified in the FY2001 RIPRAP finalized March 8, 2000.

The purpose of the following reasonable and prudent alternative is to avoid the likelihood of jeopardy to listed species and destruction or adverse modification of their critical habitats while also allowing the proposed Narrows Project to be constructed and operated for its purposes including water development.

The Service has determined, based on the analysis of the hydrological and biological information that currently exists, that if Reclamation and the Sanpete Water Conservancy District, in cooperation with RIP participants and responsible Federal agencies, agree to carry out all the following elements then these actions will avoid the likelihood of jeopardizing the continued existence of endangered fishes and avoid the likelihood of destruction or adverse modification of critical habitats for the proposed Project.

The following items, numbers 1, 2 and 3 combined, will serve as the reasonable and prudent alternative for the proposed Narrows Project:

1) The following excerpts are pertinent to the consultation because they summarize portions of the RIP 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 is $14.36 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 . . . ." (Specific figures are listed below)

It is important to note that these provisions of the RIP were based on appropriate legal protection of the instream flow needs of the endangered Colorado River fishes. The RIP 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."

The Sanpete Water Conservancy District has applied to Reclamation for a Small Reclamation Project Act loan to help finance construction of the proposed Narrows Project. Such loans are made available by Reclamation to assist with construction of non-federal projects. The Sanpete Water Conservancy District has also applied to use lands for the Narrows Project that were withdrawn from the public domain by Reclamation. Reclamation has a regulatory responsibility to comply with the National Environmental Policy Act and requirements of the Small Reclamation Project Act. A repayment contract and a Management Agreement between Reclamation and the Sanpete Water Conservancy District will include any stipulations to meet environmental commitments of the project including those contained in this biological opinion.

Thus, we have determined that project depletion impacts, which the Service has consistently maintained are likely to jeopardize the listed fishes, can be offset by (a) the water project proponent's one-time contribution to the RIP in the amount of $14.13 per acre-foot of the project's average annual depletion, (b) appropriate legal protection of instream flows pursuant to State law, and (c) accomplishment of activities necessary to recover the endangered fishes as specified under the RIP RAP. We believe it is essential that protection of instream flows proceed expeditiously, before significant additional water depletions occur.

With respect to (a) above (i.e., depletion charge), the Sanpete Water Conservancy District will make a one-time payment which has been calculated by multiplying the project's average annual depletion of 5,717 acre-feet by the depletion charge in effect at the time payment is made. For Fiscal Year 2000 (October 1, 1999, to September 30, 2000), the depletion charge is $14.36 per acre-foot for the average annual depletion which equals a total payment of $82,096.12 for this project. We will notify the Sanpete Water Conservancy District of any change in the depletion charge by September 1 of each year. Ten percent of the total contribution, $8,210, or total payment, will be provided to our designated agent, the National Fish and Wildlife Foundation (Foundation), at the time of issuance of any funding or authorization from Reclamation. The balance will be due at the time the construction commences. The payment will be included by Reclamation as a stipulation in any agreement or authorization provided by Reclamation to the District. All payments should be made to the Foundation at the following address:

> National Fish and Wildlife Foundation
> 1120 Connecticut Avenue, N.W.
> Suite 900
> Washington, D.C. 20036

In a letter dated November 11, 1999, the Sanpete Water Conservancy District agreed to this payment (Appendix B). They also noted that on July 13, 1995, the Sanpete Water Conservancy District sent a check for $7,063 to the National Fish and Wildlife Foundation to cover what was then 10 percent of the depletion charge. As soon as Reclamation approves the loan for the proposed Project, the Sanpete Water Conservancy District will send an additional $1147.00 to bring the contribution up to 10 percent of the current depletion charge (Appendix B).

Payment is to be accompanied by a cover letter that identifies the project and biological opinion that requires the payment, the amount of payment enclosed, check number, and any special conditions identified in the biological opinion relative to disbursement or use of the funds (there are none in this instance). 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 our office issuing the biological opinion. This information will be used by the Foundation to notify the payor, the lead Federal agency, and us that payment has been received. The Foundation is to send notices of receipt to these entities within 5 working days of its receipt of payment.

2) An objective of the RIP is to quantify and provide a process for the legal protection of instream flows pursuant to State law, and accomplish activities necessary to recover the endangered fishes as specified under the RIPRAP. To date, flow requirements have not been determined although a RIPRAP item has been developed specifically for the Price. Currently the RIP is evaluating tributary importance and overall contribution to the Green River and Colorado River system and the recovery of its endangered fish species. As part of the RPA to offset impacts from the proposed narrows project, the RIP will fund a study to determine the following:

- Seasonal endangered fish use in the Price River, particularly winter.

- Recommendation of year-round, instream flows requirements for Colorado pikeminnow.

The following background information provides a rationale for this element of the RPA. Historically, the Price River was inhabited by large numbers of native fish including Colorado pikeminnow, flannelmouth suckers, bluehead suckers, speckled dace, roundtail chubs, and possibly razorback suckers (Cavalli, 1999). However, due to impacts resulting from development (i.e., dams, water diversions, highways, railroads, etc.), habitat for the endangered Colorado River fishes now appears to be limited. The channel has been altered and instream habitat is structurally less complex; in addition, flows are substantially lower than historical flows with some periods of complete dewatering in parts of the system. The extent of these instream habitat and flow alterations are not well understood, nor is the effect on fish populations.

Fish surveys from the late 1970's indicated that no endangered fish occupied the Price River. Overall, most biologists familiar with the system believed that endangered fish had been

completely extirpated from this river. In 1995, Trout Unlimited sponsored a single, 5-day sampling trip which resulted in the capture of one juvenile Colorado pikeminnow 2.2 miles above the confluence of the Green River. With pending water development projects, it became important to determine the extent of endangered fish use of the Price River. The single capture in 1995 was enough to prompt an additional 2 year study directed at determining endangered fish use of the Price River and examining potential habitat conditions in the lower 50 miles.

The 2-year study, conducted from April through October in 1996 and 1997, unexpectedly showed that the Price River is utilized by juvenile and adult Colorado pikeminnow. Over 20 Colorado pikeminnow were captured ranging in size from under 200 mm to nearly 600 mm. One large adult was captured (and several others were reported to be caught by anglers) at the most upstream possible point for fish movement, at the base of a diversion structure 88.5 miles above the confluence of the Price and Green rivers. These findings suggest the Price River may be hydrologically and biologically important to the Green River and the overall recovery and persistence of Colorado pikeminnow populations in the Upper Colorado River Basin.

The Price River system appears to be important not only in providing an additional 88.5 miles of occupied habitat to Colorado pikeminnow but also in its abundance and high percentage of natives in the fish community. The plentiful forage available in flannelmouth and bluehead suckers may attract the predaceous Colorado pikeminnow. It is unclear whether Colorado pikeminnow have been present in the Price River since the late 1970's but simply elusive to capture. Alternatively, recolonization of the Price River in the recent decade may represent a response to a recovering and increasing metapopulation in the main Green River system.

In the most dire case, the Price River may only provide seasonal, sub-optimal habitat for foraging adults. However, it may not be entirely serendipitous that the presence of Colorado pikeminnow in the Price River represent a recent range expansion in light of the extensive recovery efforts and environmental protection occurring throughout the last three decades. If newly located tributary occupation of Colorado pikeminnow is a response to recovery efforts, it is crucial to document and understand the role of tributaries to overall system recovery and persistence. In either case, 88.5 miles of river occupation by this endangered species should be better understood before it is dismissed and possibly lost during this time of great recovery strides.

In particular, it is important to know if Colorado pikeminnow use the Price River year-round and potentially spawn, thereby comprising a possibly new, contributing population. Instream flow requirements should be identified that will protect this enclave through upcoming water development. Although the 2-year Price River study provided a wealth of new and important information, it was not sufficient to determine year-round or accurate seasonal instream flow requirements. Some cursory data are available from the 2-year study; however, this information contains crucial gaps and does not sufficiently describe the potential for spawning activity and habitat use or year-round use of the river by Colorado pikeminnow (Cavalli 1999).

3) The discharge gage station located at Woodside in the lower Price River will be recommissioned so that flows in the lower river can be evaluated and instream flows can be identified and monitored.

Based on newly acquired and past information, we and Reclamation should determine the flows needed to maintain or improve the biological requirements of the Colorado pikeminnow in the Price River by the year 2003. This field effort should be closely monitored by the Utah Field Office to ensure that study objectives and data collected allow development of flow recommendations and understand year-round use. Funding for these actions should be the responsibility of the RIP and not Reclamation or the Sanpete Water Conservancy District.

INCIDENTAL TAKE STATEMENT

Section 9 of the Act and Federal regulations pursuant to section 4(d) of the Act prohibit the take of endangered and threatened species, respectively, without special exemption. Take is defined as to harass, harm, pursue, shunt, shoot, wound, kill, trap, capture or collect, or to attempt to engage in any such conduct. Harm is further defined to include significant habitat modification or degradation that results in death or injury to listed species by significantly impairing essential behavioral patterns, including breeding, feeding, or sheltering. Harass is defined 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, the carrying out of an otherwise lawful activity. Under the terms of sections 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 Act provided that such taking is in compliance with the terms and conditions of this Incidental Take Statement.

We do not anticipate the proposed action will incidentally take any endangered Colorado River fishes by construction of the proposed Project and water depletion from the Price, Green or Colorado rivers. As such, no incidental take is authorized.

CONSERVATION RECOMMENDATIONS

Section 7(a)(1) of the Act directs Federal agencies to utilize their authorities to further the purposes of the Act by carrying out conservation programs for the benefit of endangered and threatened species. Conservation recommendations are discretionary agency activities to minimize or avoid adverse effects of a proposed action on listed species or critical habitat, to help implement recovery plans, or to develop information.

A. Conservation Recommendations for Willow Flycatcher subspecies.

As previously stated the Service has not included the endangered subspecies southwestern willow flycatcher (*Empidonax traillii extimus*) in this Opinion. However, further analysis may

determine that the willow flycatcher population affected by the proposed Narrows Project is *E. t. extimus* or some significant intercross gradation between *E. t. extimus* and *E. t. adastus* (a non-endangered subspecies of willow flycatcher) in which case Reclamation may need to reinitiate formal consultation. Because proposed Project impacts on riparian vegetation cannot be anticipated, and considering the unknown information regarding the status of the flycatcher population in the project area, the following conservation actions are recommended to provide a basis for determining impacts of the project and developing mitigation strategies for riparian vegetation and willow flycatcher subspecies.

1) Develop and implement, in coordination with us and the UDWR: a) a monitoring plan for willow flycatcher subspecies in the proposed Project area, surrounding drainages and mitigation sites; and b) a habitat analysis plan of current and potential willow habitat for the project area, surrounding drainages and mitigation sites.

    A) Develop and implement, in coordination with us and UDWR, a monitoring plan that estimates willow flycatcher subspecies populations and habitat availability.

        A qualified biologist with appropriate training and permits should conduct willow flycatcher surveys following the most recent protocol within the project area, surrounding drainages, and mitigation sites for breeding flycatchers, territories, nest locations, and habitat availability.

        Establish a database for the Narrows Project area and surrounding area and update the database annually.

        Determine pre-project willow flycatcher population levels that will help to detect any post-project changes in populations and willow habitat.

        Maintain records for each nest site or territory habitat patch, the location, size, structure, vegetative species composition, hydrology, and vulnerability to erosion.

        Record the use of newly established willow habitats developed as a result of the proposed Project for nesting and report this information to us and UDWR.

    B) Develop and implement, in coordination with us and UDWR, a habitat analysis plan of riparian habitats that includes specific monitoring of suitable nesting habitat. In general, the habitat analysis plan should be designed to detect changes in suitable nesting habitat quantity and quality. The level of detail of suitable nesting habitat monitoring should be commensurate with the population of willow flycatchers determined by initial surveys.

The habitat analysis plan should include an initial inventory of pre-project suitable nesting habitat patches and post-construction monitoring of suitable nesting habitat patches, both pre-project and newly established.

Information that should be collected includes location, size, structure, vegetative species composition, and hydrology of pre-project and established habitat patches. Changes in these characteristics should also be monitored.

Hydrology analysis should determine the importance of spring run-off, inundation frequency, inundation intervals, groundwater influences, beaver activity, and standing water to the willow regeneration process and willow habitat.

2) Develop and implement, in coordination with us and the UDWR, a contingency plan for full replacement of willow habitat suitable for nesting if monitoring reveals that habitat is being impacted or full replacement of this habitat is not occurring at mitigation sites.

    A) Develop and implement, in coordination with us and the UDWR, a technically and economically feasible contingency plan to replace willow habitat and reduce delays in establishing lost habitat later if it becomes necessary to do so.

3) Project mitigation measures for lost sport fish included 300 AF of water that could be used for stream flow maintenance. Develop and implement, in coordination with us and the UDWR, a hydrology plan that includes the 300 AF of sport fish mitigation water to be used in conjunction with natural spring flows to support riparian habitat suitable for willow flycatcher subspecies.

    A) Develop and implement, in coordination with us and the UDWR, a hydrology plan that includes the 300 AF of sport fish mitigation water to be used in conjunction with natural spring flows to support potential riparian or willow habitat. The plan should include measures to store and use this water approximately every four or five years or in conjunction with wet year flows to increase the spring peak flows to inundate more riparian habitat to help regeneration of willows.

4) Coordinate on a regular basis with us on willow flycatcher subspecies plans, monitoring, and study results.

    A) Annual reports for Terms and Conditions 1 - 3 listed above should be submitted to the Service detailing monitoring and study results. Impacts of the project and future measures that would be needed to avoid or reduce impacts to the willow flycatcher should be determined and monitored.

5) A qualified biologist with southwestern willow flycatcher survey certification should conduct nest monitoring to determine nest success and presence of cowbird parasitism.

6) If Reclamation documents cowbird parasitism higher than 50 percent on willow flycatchers, it will initiate a cowbird trapping program within the immediate nesting area. Cowbird trapping will be conducted until the larger issues of cowbird presence (i.e., local foraging sites and concentration areas) are identified and addressed.

7) Reclamation should evaluate livestock concentration sites within and adjacent to the project area that may act as likely foraging sources of cowbirds. Once these sources have been identified, Reclamation should work to eliminate or manage these sites administratively to limit their benefits to cowbirds.

REINITIATION NOTICE

This concludes formal consultation of the action outlined in the Draft Environmental Impact Statement, biological assessment, three amended biological assessments, Price River Cumulative Hydrology Study, and the accompanying request for formal consultation. 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 agency 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 specifically if new information indicates that the subspecies of willow flycatcher present near the proposed Project site is the endangered southwestern willow flycatcher subspecies. In instances where the amount or extent of incidental take is exceeded, any operations causing such take use cease pending reinitiation.

We appreciate the assistance and cooperation of your staff throughout this consultation process and your interest in conserving threatened and endangered species. If you have any questions regarding this biological opinion or would like to discuss it in more detail, please call Reed Harris, Field Supervisor, Utah Ecological Services Field Office, at 801-524-5001.

Sincerely,

Ralph O. Morgenweck

Regional Director

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Table 1.1
Theoretical Virgin Flows
Price River at Woodside

	Average Year 1968		Wet Year 1984		Dry Year 1977	
Month	(cfs)	(ac-ft)	(cfs)	(ac-ft)	(cfs)	(ac-ft)
October	14.4	886	368.0	22,622	28.7	1,765
November	6.8	404	77.5	4,761	20.0	1,227
December	15.0	924	65.4	4,017	23.5	1,443
January	2.0	126	38.2	2,350	9.3	571
February	13.2	735	33.7	2,069	7.4	452
March	40.9	2,514	3.9	238	16.1	987
April	301.5	17,934	570.5	35,070	80.6	4,952
May	514.6	31,632	1,842.6	113,267	85.9	5,282
June	655.0	38,969	1,211.6	74,482	68.0	4,183
July	481.1	29,573	458.3	28,175	184.6	11,346
August	291.1	17,896	463.5	28,492	93.9	5,774
September	263.2	15,657	372.9	22,921	72.5	4,455
Annual Total (ac-ft)		157,249		338,467		42,437

Table 1.2
Environmental Baseline Flows
Price River at Woodside

	Average Year 1968		Wet Year 1984		Dry Year 1977	
Month	(cfs)	(ac-ft)	(cfs)	(ac-ft)	(cfs)	(ac-ft)
October	0.0	0	0.0	0	0.0	0
November	0.0	0	0.0	0	0.0	0
December	0.0	0	0.0	0	0.0	0
January	0.0	0	0.0	0	0.0	0
February	0.0	0	0.0	0	0.0	0
March	0.0	0	0.0	0	0.0	0
April	160.0	9,517	155.8	9,579	56.3	3,295
May	154.8	9,517	155.8	9,579	53.6	3,295
June	266.3	15,844	258.7	15,906	156.5	9,622
July	257.7	15,844	258.7	15,906	156.5	9,622
August	257.7	15,844	258.7	15,906	156.5	9,622
September	266.3	15,844	258.7	15,906	156.5	9,622
Annual Total (ac-ft)		82,412		82,782		45,080

Table 1.3*

Average Monthly Flows with Narrows Project
Price River at Woodside

	Average Year 1968		Wet Year 1984		Dry Year 1977	
Month	(cfs)	(ac-ft)	(cfs)	(ac-ft)	(cfs)	(ac-ft)
October	6.7	410	360.3	22,147	21.0	1,289
November	-1.2	-72	69.7	4,286	12.2	751
December	7.3	448	57.6	3,542	15.7	967
January	-5.7	-350	30.5	1,875	1.5	95
February	4.7	259	25.9	1,594	-0.4	-2.4
March	33.2	2,038	-3.9	-237	8.3	511
April	133.5	7,942	406.9	25,016	19.2	1,181
May	352.0	21,639	1,679.0	103,213	24.6	1,511
June	380.7	22,649	945.1	58,100	-96.2	-5,915
July	215.6	13,253	191.8	11,793	20.3	1,248
August	25.6	1,576	197.0	12,110	-70.3	-4,324
September	-11.1	-663	106.4	6,539	-91.8	-5,643
Annual Total (ac-ft)		69,128		249,976		-8,352

Table 1.4
Average Monthly Flows without Narrows Project
Price River at Woodside

	Average Year 1968		Wet Year 1984		Dry Year 1977	
Month	(cfs)	(ac-ft)	(cfs)	(ac-ft)	(cfs)	(ac-ft)
October	14.4	886	368.0	22,622	28.7	1,765
November	6.8	404	77.5	4,761	20.0	1,227
December	15.0	924	65.4	4,017	23.5	1,443
January	2.0	126	38.2	2,350	9.3	571
February	13.2	735	33.7	2,069	7.4	452
March	40.9	2,514	3.9	238	16.1	987
April	141.5	8,417	414.7	25,492	27.0	1,657
May	359.7	22,115	1,686.7	103,689	32.3	1,987
June	388.7	23,124	952.9	58,576	-88.5	-5,440
July	223.3	13,729	199.6	12,269	28.0	1,723
August	33.4	2,052	204.7	12,586	-62.6	-3,849
September	-3.1	-187	114.1	7,015	-84.1	-5,168
Annual Total (ac-ft)		74,837		255,685		2,643

*It is important to note that the depletion for the Narrows Project used in table 1.3 of the Bureau of Reclamation Price River Hydrology Report is 5,709 AF. This depletion was corrected in November 1999 to be 5,717 AF, therefore numbers in the table does not accurately reflect this new depletion estimate. (K. Schwarz, Bureau of Reclamation; personal communication)

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SANPETE WATER CONSERVANCY DISTRICT

November 11, 1999

Mr. Reed Harris
Field Supervisor, U.S. Fish
and Wildlife Service
Lincoln Plaza
145 East 1300 South, Suite 404
Salt Lake City, Utah 84115

Subject: Draft Amended Biological Opinion – Narrows Project

Dear Mr. Harris:

The Sanpete Water Conservancy District (District) has reviewed the draft, Amended Biological Opinion on the Narrows Project, as transmitted to the Bureau of Reclamation in October 1999.

The District hereby agrees to pay the $14.13 per acre-foot depletion charge (current fiscal year value) which will be used in accomplishment of the Recovery Implementation Program Recovery Action Plan for the endangered fishes of the Colorado River System. Based on the estimated 5,717 acre-foot depletion, the total depletion charge would be $80,781,21.

On July 13, 1995, the District sent a check for $7,063 to the National Fish and Wildlife Foundation to cover what was then 10 percent of the depletion charge. As soon as Reclamation approves the loan for the project, the District will send an additional $1,015.12 to bring the contribution up to 10 percent of the current depletion charge.

Sincerely,

David L. Peterson
President

cc: Mr. Bruce Barrett
Bureau of Reclamation
Attn: PRO-405
302 East 1860 South
Provo, UT 84606

Mr. Richard Noble
Franson-Noble & Associates, Inc.
776 East Utah Valley Drive
American Fork, UT 84003