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Memorandum

To: Regional Director, Bureau of Reclamation, Upper Colorado Regional Office, Salt Lake City, Utah

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

Subject: Final Biological Opinion for the Animas-La Plata Project, Colorado and New Mexico

INTRODUCTION

The Bureau of Reclamation (Reclamation), after its February 6, 1990, determination that the Animas-La Plata Project (Project) may affect the endangered Colorado squawfish, reinitiated Section 7 consultation and provided the Fish and Wildlife Service with an update of the biological assessment of Project impacts on the Colorado squawfish. On February 15, 1990, the Service concurred with Reclamation's determination that the Project "may affect" the endangered Colorado squawfish, and also advised it of our ongoing review of potential Project effects on listed plants and terrestrial wildlife. Upon conclusion of that review, the Service and Reclamation jointly determined that, based on new information, the proposed Project also "may affect" bald eagles. Subsequently, on March 2, 1990, Reclamation provided the Service with an updated biological assessment and a draft management plan for bald eagles. No new information existed regarding the peregrine falcon, nor were there any listed plant species within the area impacted by the Project; therefore, additional species have not been included in the updated consultation. In a letter dated March 4, 1991, Reclamation requested a conference on the razorback sucker for the Project. The Service issued a draft Conference Opinion dated March 21, 1991, that addresses the razorback sucker, a species proposed for listing as endangered on May 22, 1990. In a memorandum dated April 15, 1991, Reclamation concurred with the draft Conference Opinion and recommended that it be incorporated into the final Biological Opinion for the Animas-La Plata Project. A final rule to list the razorback sucker as endangered was published in the October 23, 1991, Federal Register and will go into effect 30 days thereafter. By letter dated June 6, 1991, Reclamation requested extension of consultation to June 21, 1991. The Service agreed to the extension by letter dated June 14, 1991.

In keeping with the Secretary of the Interior's trust responsibility to the Indian tribes of the San Juan River Basin, the Bureau of Indian Affairs requested to be a party to the formal Section 7 consultation process (memorandum dated December 21, 1990). After interagency discussions with the Bureau of Indian Affairs, Reclamation and the Service agreed that it would be appropriate for the Bureau of Indian Affairs to be party to the formal consultation process. The Bureau of Indian Affairs requested that Reclamation assume the role as the lead Federal Agency.

On May 7, 1990, the Service issued a draft biological opinion concluding that the Project would jeopardize the continued existence of the Colorado squawfish. No reasonable and prudent alternatives were identified at that time. Since then, Reclamation and the Service have been actively seeking reasonable and prudent alternatives. Reclamation's March 4, 1991, letter proposed a reasonable and prudent alternative to preclude the likelihood of jeopardy from the Project.

In accordance with Section 7 of the Endangered Species Act (16 U.S.C. 1531 et seq.) and the Interagency Cooperation Regulations (50 CFR 402 et seq.), this transmits the Service's biological opinion for the Project on federally listed endangered species. While Region 6 assumed the lead for this updated consultation, recommendations contained herein have the concurrence of the Regional Director of Region 2 in Albuquerque, New Mexico.

Background

Existing water developments have redistributed and reduced streamflows in the San Juan River to a critical level for the endangered fish. Most of these have not gone through Section 7 consultation. At the current level of development, average annual flows at Bluff, Utah, already have been depleted by 27 percent. Further depletions associated with the Project would raise that figure to 34 percent. By comparison, the Green and Colorado Rivers have been depleted approximately 20 percent (at Green River) and 32 percent (at Cisco), respectively.

The Project has been in the planning process since the early 1960's and resulted in the preparation of a Definite Plan Report in 1979. At that time, Region 2 entered into formal Section 7 consultation with Reclamation and rendered a biological opinion on December 28, 1979 (2-2-80-F-13). The 1979 biological opinion concerned the potential effects of the proposed Project on the endangered Colorado squawfish (Ptychocheilus lucius), bald eagle (Haliaeetus leucocephalus), and peregrine falcon (Falco peregrinus). Based on the capture of a single juvenile Colorado squawfish in the San Juan River at the mouth of McElmo Creek near Aneth, Utah, it was concluded that ". . . the proposed project is likely to further degrade the San Juan River to a point that this population will be lost. However, because of the apparent small size of the San Juan River squawfish population and its already tenuous hold on survival, its possible loss should have little impact on the successfully reproducing Green and Colorado Rivers squawfish populations and, therefore, the species itself."

A wintering population of approximately 20 bald eagles and the presence of an active nest site along the Animas River led to the 1979 conclusion that reductions in streamflow would neither significantly affect the food base of the Animas River nor deter eagle use of the area. While a historical aerie for peregrine falcons exists within the Project area, it has been unoccupied since 1963, and there was no evidence of breeding activity or sightings in or around the immediate Project area. In addition, the Colorado Division of Wildlife determined that the surrounding hunting habitat is of marginal quality (Jerry Craig, Colorado Division of Wildlife, Personal Communication).

The 1979 biological opinion found the Project was unlikely to jeopardize the continued existence of any of the three species identified above; however, several recommendations were made regarding Colorado squawfish and bald eagles in furtherance of their conservation. It was recommended that a Bald Eagle Management Plan be developed for Project reservoirs. For Colorado squawfish, it was recommended that:

1. native fish populations of the San Juan River be thoroughly surveyed,

2. environmental needs of Colorado squawfish be determined,

3. an attempt be made to meet the above needs by adjusting projects on the San Juan River drainage, and

4. provide and fund artificial facilities in which to spawn and rear Colorado squawfish until such time that suitable habitats in the San Juan River can be developed and maintained.

Fishery surveys of the San Juan River since 1979 (Platania 1990) have documented the presence of adult Colorado squawfish and evidence of reproduction. In addition, wintering bald eagle populations along the Animas, La Plata, Mancos, and San Juan Rivers have increased substantially and communal winter roost sites (essential habitat), as defined in the Bald Eagle Recovery Plan, may exist in the area affected by the Project. Three nest sites are known in the general area, two of which are active. It is anticipated that newly created Project reservoirs will attract wintering eagles, possibly encouraging the establishment of another nest site. Water quality in the Animas, La Plata, Mancos, and San Juan Rivers drainages has become a significant concern. Potential hydrocarbon, heavy metal, and/or selenium contamination and subsequent bioaccumulation in the food chain could become a problem for the predatory Colorado squawfish and bald eagle.

BIOLOGICAL OPINION

Based upon the best scientific and commercial information currently available, it is the Service's biological opinion that the Project, as described below, is likely to jeopardize the continued existence of the Colorado squawfish by appreciably reducing the likelihood of both the survival and recovery of the species in the wild by further reducing its numbers, reproduction, and distribution.

A reasonable and prudent alternative that, in the opinion of the Service, would avoid the likelihood of jeopardy to the Colorado squawfish includes: (1) an Animas-La Plata Project that results in an initial depletion of 57,100 acre-feet, (2) 7 years of research to determine endangered fish habitat needs, (3) operation of the Navajo Dam to provide a wide range of flow conditions for the endangered fish, (4) a guarantee that the Navajo Reservoir will be operated for the life of the Project to mimic a natural hydrograph based on the research, and (5) legal protection for the reservoir releases to and through the endangered fish habitat to Lake Powell and a commitment to develop and implement a Recovery Implementation Program for the San Juan River. A Memorandum of Understanding to implement the reasonable and prudent alternative was executed on October 24, 1991 (Appendix A).

It is the Service's biological opinion that the Project, as described herein, is not likely to jeopardize the continued existence of the bald eagle. Implementation of the Bald Eagle Management Plan, developed jointly by Reclamation, the Service, and the States of Colorado, New Mexico, and Utah will aid in the conservation of the species.

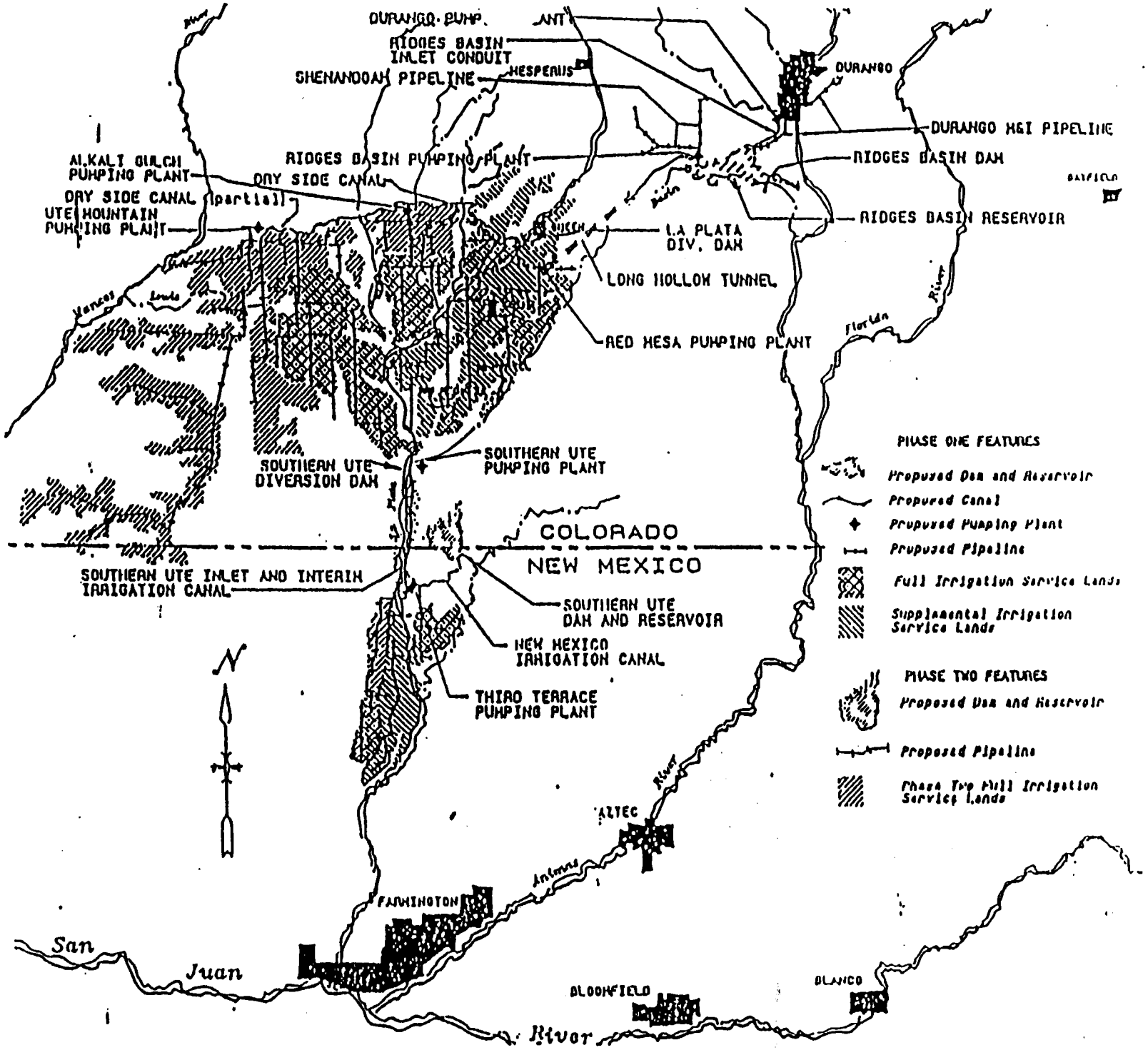
Reclamation and the Bureau of Indian Affairs have agreed that all elements of the reasonable and prudent alternative must be implemented to avoid the likelihood of jeopardy to the endangered fishes. They also have agreed that the conservation recommendation for the bald eagle is appropriate.

PROJECT DESCRIPTION

The following updated Project description is based on information provided to the Service in Reclamation's Draft Hydrology Report for the Animas-La Plata consultation (February 23, 1990). The Project, located in southwest Colorado in La Plata and Montezuma Counties and northwest New Mexico in San Juan County, would divert water from the Animas and La Plata Rivers to annually provide 118,100 acre-feet for full-service and supplemental irrigation use and 80,100 acre-feet for municipal and industrial uses. Project water would be delivered to non-Indians and the Southern Ute, Ute Mountain Ute, and Navajo Indian Tribes in both States. Project features include two storage reservoirs, seven pumping plants, and over 200 miles of conveyance canals, conduits, and laterals (Figure 1).

The Project water designated for the two Colorado Ute Tribes is a part of the settlement of their reserved water rights claims. Under the Colorado Ute Indian Water Rights Final Settlement Agreement of December 10, 1986, water to be supplied from the Project in the amounts set out in the Project's Definite Plan Report is to be provided to the tribes in partial settlement of their reserved water rights.

Ridges Basin Reservoir, the primary storage facility, would be located on Basin Creek, an intermittent tributary to the Animas River, southwest of Durango, Colorado. The reservoir would have a maximum capacity of 280,000 acre-feet--130,000 acre-feet of active, usable capacity and 150,000 acre-feet of inactive, dead storage. Evaporation from Ridges Basin Reservoir is estimated at


DURANGO PUMP. PLANT
RIDGES BASIN INLET CONDUIT
SHENANDOAH PIPELINE
HESPERUS
DURANGO
DURANGO M&I PIPELINE
RIDGES BASIN DAM
RIDGES BASIN RESERVOIR
ALKALI GIRCH PUMPING PLANT
DRY SIDE CANAL (partial)
UTE MOUNTAIN PUMPING PLANT
RIDGES BASIN PUMPING PLANT
DRY SIDE CANAL
L.A PLATA DIV. DAM
LONG HOLLOW TUNNEL
RED MESA PUMPING PLANT
SOUTHERN UTE DIVERSION DAM
SOUTHERN UTE PUMPING PLANT
COLORADO
NEW MEXICO
SOUTHERN UTE INLET AND INTERIM IRRIGATION CANAL
SOUTHERN UTE DAM AND RESERVOIR
NEW MEXICO IRRIGATION CANAL
THIRD TERRACE PUMPING PLANT
PHASE ONE FEATURES
Proposed Dam and Reservoir
Proposed Canal
Proposed Pumping Plant
Proposed Pipeline
Full Irrigation Service Lands
Supplemental Irrigation Service Lands
PHASE TWO FEATURES
Proposed Dam and Reservoir
Proposed Pipeline
Phase Two Full Irrigation Service Lands
AZTEC
FARMINGTON
BLOOMFIELD
BLANCO
San Juan River

3,300 acre-feet annually. Secondary storage would be provided at Southern Ute Reservoir, an offstream facility located about 2 miles east of the La Plata River on the Colorado-New Mexico State line. Southern Ute Reservoir would have a maximum capacity of 70,000 acre-feet--40,000 acre-feet of active, usable capacity and 30,000 acre-feet of inactive, dead storage. Evaporation from Southern Ute Reservoir is estimated at 3,200 acre-feet annually. None of the above depletions will occur until completion of the Ridges Basin Dam and Durango Pumping Plant, which is currently estimated to occur in approximately 5 to 6 years. Upon completion of the Project, full development and operations would result in a net average annual depletion of 154,800 acre-feet of water.

The Project would pump water from the Animas River via the Durango Pumping Plant, through Ridges Basin inlet conduit to Ridges Basin Reservoir for storage. Stored water would be used for irrigation and industrial needs of the Southern Ute and Ute Mountain Ute Indian Tribes; other Colorado and New Mexico irrigators; and municipal and industrial uses for Durango, surrounding communities, and northwestern New Mexico. During low-flow periods, stored water would be released back to the Animas River through the inlet conduit to meet Aztec, Farmington, and other municipal and industrial needs in New Mexico. Additionally, stored water would be pumped through Ridges Basin Pumping Plant on the west end of the reservoir, into Dry Side Canal for delivery to Project lands as depicted in Figure 1.

Southern Ute Reservoir would store La Plata River water, diverted by the Southern Ute Diversion Dam and conveyed to the reservoir through the inlet canal. Water stored in Southern Ute Reservoir would be used for irrigation and municipal and industrial needs for the Southern Ute Indian Tribe in New Mexico.

Basis for Opinion

This biological opinion is based on the full Project development scenario as requested by Reclamation. Reclamation estimates that the Project would result in a net average annual depletion of 154,800 acre-feet of water from the two rivers. The Animas and La Plata Rivers are tributaries to the San Juan River, which is inhabited by a reproducing population of Colorado squawfish.

Water depletions in the Upper Colorado River Basin (Upper Basin) have long been recognized as a major source of impact to endangered fish species. The Service believes that continued withdrawal of water throughout the Upper Basin has restricted the ability of the Colorado River system to produce flow conditions required during various life stages of the fish. Numerous impoundments and diversions have altered the shape of natural hydrographs by reducing peak discharges as much as 50 percent in some reaches, while doubling base flows in others. The San Juan River has fared no better than the rest of the Upper Basin. Significant depletions and redistribution of flows of the San Juan River have occurred as a result of water development projects.

Because of drastic reductions of Colorado squawfish populations, the Service listed this species as endangered throughout its entire range, with the exception of the Salt and Verde Rivers drainages in Arizona where attempted reintroductions of endangered fishes have been classified as nonessential, experimental populations.

COLORADO SQUAWFISH

Status

The Colorado squawfish evolved as the main predator in the Colorado River system. The diet of Colorado squawfish longer than 3 or 4 inches consists almost entirely of other fishes (Vanicek and Kramer 1969). The Colorado squawfish, the largest cyprinid fish (minnow family) native to North America, growing as large as 6 feet in length, and weighing nearly 100 pounds, lived to 25 to 50 years of age (Behnke and Benson 1983).

Based on early fish collection records, archaeological finds, and other observations, the Colorado squawfish once was found throughout the warmwater reaches of the entire Colorado River Basin, including the San Juan River and, possibly, its major tributaries. Colorado squawfish apparently were never found in colder headwater areas. Seethaler (1978) concluded that the species was abundant in suitable habitats throughout the Colorado River Basin prior to the 1850's. Specific to the San Juan River, Seethaler's review of the literature identified the following reports:

> Minckley reported that each spring, just after closure of Glen Canyon Dam, squawfish moved into the San Juan arm of Lake Powell in presumed breeding aggregations.
>
> Three young squawfish were taken on 21 August 1960 by R.R., G.H., and F.L. Miller at Mexican Hat, Utah, and Lemons took a 12-lb (5.4-kg) squawfish in the Four Corners area of Colorado.
>
> Historical accounts by Koster of undocumented records of 5- to 10-lb (2.3- to 4.5-kg) squawfish as being fairly common in New Mexico with occasional individuals weighing 25 to 30 lb (11.3 to 13.6 kg). However, in June 1959, a 415-mm adult male was taken, and later a 590-mm adult female was captured on August 29, 1959. Both were captured in the same pool of the San Juan River about 3 miles (4.8 km) below the town of Rosa, New Mexico. A fisherman told Koster that squawfish were usually caught by persons angling for catfish, but persistent anglers caught no more than two or three a year. The largest caught in the area weighed 20 lb (9 kg). Koster reported that:
>
> "Salmon" have been caught in the San Juan River from the Navajo Dam Site which is just below the mouth of Los Pinos River, to the mouth of Las Piedras River in extreme southern Colorado. Although all are good-sized streams, "salmon" have not been taken in the Los Pinos, Las Piedras, or the San Juan above its junction with Las Piedras. . . . The future of the Ptychocheilus population in the San Juan River is uncertain because the Navajo Dam, now under construction, will flood the entire portion of the river from which the species has been recorded.
>
> Olson reported that four squawfish were taken in the San Juan River in preimpoundment surveys of the Navajo Dam area. Together they weighed 12.0 lb (5.4 kg), or 12.8 percent of the total weight of all species collected.

According to Conway, the most recent report of squawfish from New Mexico was from the San Juan River near Bloomfield in 1965. But Parrish stated that the species is currently suspected to be in the San Juan River and its tributaries in northwestern New Mexico, and cited the most recent known occurrence to be near Castlerock, New Mexico, in the San Juan River in 1965 as verified by New Mexico Game and Fish personnel.

In April 1978, Minckley captured a 177-mm, 36-g squawfish near Aneth, Utah. The fish was captured in the Four Corners Region, just below the confluence of McElmo Creek. This catch is significant because it is the only record of a squawfish from the San Juan River proper since 1965. The fish was caught among carp and red shiners (Notropis lutrensis) in water 0.7- to 1.0-m deep. The size of the fish is evidence of recent reproduction in the San Juan River since it seems unlikely that a fish of that size would move upstream from Lake Powell and even more unlikely that spawning occurred in the reservoir.

Perhaps most notable of historical accounts is Koster's report of 5- to 10-lb Colorado squawfish as "fairly common" in New Mexico with individuals reaching weights of 25 to 30 lb. Colorado squawfish are large, long-lived fish and specimens of this size indicate they were quite old and likely had inhabited the San Juan River for many years. More recent captures of Colorado squawfish throughout the entire Upper Basin yielded a few specimens of only 14 lb that were estimated to be approximately 15 years old (Chuck McAda, Colorado River Fishery Project, Grand Junction, Personal Communication). Also notable is the capture of adult male and female Colorado squawfish from the same pool of the San Juan River approximately 3 miles below the town of Rosa, New Mexico. They were both captured during the period normally associated with migration and spawning, suggesting a historical spawning run as far upstream as River Mile (RM) 267. Platania and Young (1989) summarized historical fish collections in the San Juan River drainage, confirming that Colorado squawfish once inhabited reaches above what is now the Navajo Dam and Reservoir near Rosa, New Mexico, at RM 270. In 1961, the New Mexico Department of Game and Fish conducted a preimpoundment fishery study within the area to be inundated by the Navajo Reservoir in New Mexico. Olson (1962a) reported a predominance of nongame species with fathead minnow, flannelmouth sucker, bluehead sucker, and roundtail chub the most numerous. Olson also reported the collection of four specimens of Colorado squawfish.

Coincident with the preimpoundment study in September 1961, the San Juan River and tributaries upstream from the Navajo Dam were treated with rotenone to eliminate "trash fish" (Olson 1962b). Approximately 70 miles of the San Juan River, 15 miles of the Pine River (Los Pinos), and 6 miles of the Navajo River were treated. Olson (1962b) reported extensive fish kills in all three rivers, especially the San Juan River, where lethal concentrations of rotenone carried approximately 40 miles below the Navajo Dam site to near Fruitland, New Mexico. Olson reported a total of 14 different species collected, including Colorado squawfish; however, because of the project size, it was impossible to determine total numbers or weight of fish killed. It is important to note that the eradication project was accomplished long before the passage of the Endangered Species Act and/or the subsequent listing of rare native fishes throughout the Upper Basin.

In addition to the eradication project, the physical changes (flow and temperature) associated with operation of the Navajo Project since closure of the dam in 1962 have eliminated Colorado squawfish in the upper San Juan River, from both the reservoir basin as well as several miles of river downstream of the dam.

A marked decline in Colorado squawfish populations can be closely correlated with the construction of dams and reservoirs during the 1960's, the introduction of nonnative fishes, and the removal of water from the Colorado River system. Behnke and Benson (1983) summarized the decline of the natural ecosystem, pointing out that dams, impoundments, and water-use practices are probably the major reasons for greatly modified natural river flows and channel characteristics in the Colorado River Basin. Dams on the mainstems have essentially segmented the river system, blocking Colorado squawfish spawning migrations and drastically altering river characteristics, especially flows, temperatures, and channel geomorphology. These alterations, which have allowed nonnative fishes to thrive, caused major changes in species composition. Haynes et al. (1984) reported that fish species, such as Colorado squawfish, that evolved under highly fluctuating flow conditions, were better able to survive and successfully recruit under those conditions than the introduced species. Valdez (1990) reported that densities of three nonnative cyprinids (red shiner, sand shiner, and fathead minnow) in the Colorado River were much lower following high-flow years and increased three to four times in a 2-year period during normal- and low-water years.

Extreme fluctuations occurring within the framework of a natural annual hydrograph may enhance spawning success of native species and inhibit exotic species. The decline of endemic Colorado River fishes seems to be partially related to competition or other behavioral interactions with nonnative species, which perhaps have been exacerbated by alterations in the natural fluvial environment. Platania (1990) noted that, during the 3 years of studies on the San Juan River, spring flows and Colorado squawfish reproduction were highest in 1987. He further noted catch rates for channel catfish were lowest in 1987. Appendix B, Figure 2, compares the 1987 flow of record to historical conditions for dry, average, and wet years.

The Colorado squawfish currently occupies less than 1,000 river miles in the entire Colorado River system (25 percent of its original range) and natural populations are presently found only in the Upper Basin above Glen Canyon Dam. It inhabits about 350 miles of the mainstem Green River from its confluence with the Colorado River to the mouth of the Yampa River. Its range also extends 140 miles up the Yampa River and 104 miles up the White River, the two major tributaries of the Green River. In the mainstem Colorado River, it is currently found in the 201 miles upstream from Lake Powell to Palisade, Colorado, and in the lower 33 miles of the Gunnison River, a tributary to the mainstem Colorado River (Tyus et al. 1982). Recent investigation (Platania 1990) found that adult Colorado squawfish currently inhabit the San Juan River as far upstream as 163.3 miles above Lake Powell.

The Colorado River subbasin population shows particular signs of further decline. Catch-per-unit effort rates for larvae, young-of-year, and adult Colorado squawfish are low (Archer et al. 1986). Slow growth and increased early-life mortality in upstream reaches due to much lower temperatures than occur in the lower basin (the demarcation between the Upper and Lower Colorado Basins is Lees Ferry, just downstream of Glen Canyon Dam), compounded with predation by introduced fishes and other man-induced causes, may be important factors affecting recruitment (Kaeding and Osmundson 1988). Osmundson and Kaeding (1990) reported a continued decline in populations of Colorado squawfish in the Colorado River near Grand Junction, Colorado, and cited the nearly 50 percent reduction in spring flows as a detrimental factor.

The Green River subbasin currently supports the largest population of Colorado squawfish anywhere in the wild; however, during the past 10 years of intensive study, at least 3 years of reproduction have been lost due to extremes in flow releases from Flaming Gorge Dam and other man-induced problems (Harold Tyus, Personal Communication). In 1983, and again in 1984, extended high releases well into the summer months inundated backwater nursery habitats and flushed larvae downstream. In 1989, extreme drought conditions and extended low-flow releases from Flaming Gorge Dam, coupled with an oil pipeline break and subsequent spill into the Yampa River, may have resulted in a total loss of reproduction in the upper Green River subbasin for that year. Additional projects that would result in significant depletions are planned for the Green River subbasin.

The San Juan River has been developed through several projects, including the Navajo Reservoir, Navajo Indian Irrigation Project, and San Juan-Chama Project. None of these projects have undergone Section 7 consultation under the Endangered Species Act. The current level of development on the San Juan River results in a net depletion of streamflows of approximately 600,000 acre-feet of the mean annual flow. Additional projects are being planned in the San Juan River subbasin that would significantly increase that annual depletion to 1.1 million acre-feet (MAF), or approximately 50 percent of the mean annual flow of the San Juan River at Bluff, Utah. A once healthy (predevelopment) population of Colorado squawfish has been reduced to a mere few fish that are further threatened by continued development.

Biology

The life-history phases that appear to be most critical for the Colorado squawfish include spawning, egg fertilization, and development of larvae through the first year of life. These phases of Colorado squawfish development are tied closely to specific flow events and habitat requirements.

A natural hydrograph with a large spring peak; a gradually declining/descending limb into early summer; and low, stable flows through summer, fall, and winter are thought to create the best habitat conditions for endangered fishes while maintaining the integrity of the channel geomorphology. Tyus and Karp (1989) pointed out the importance of peak flows (spring runoff) associated with

reproductive activities of Colorado squawfish. They further stated that alteration of this hydrological event may affect initiation of Colorado squawfish migration and spawning. Additionally, maintenance of low stable flows in summer and fall are necessary for growth and survival of young Colorado squawfish.

Migration of the Colorado squawfish is cued to the ascending limb and natural spawning is initiated on the descending limb of the annual hydrograph as water temperatures approach 20° C (Tyus and Karp 1989). Spawning, both in the hatchery and in the field, generally occurs in a 2-month timeframe between July 1 and September 1, although high-flow water years may suppress river temperatures and extend spawning in the natural system into September.

Temperature also has an effect on egg development and hatching. In the laboratory, egg mortality was 100 percent in a controlled test at 13° C. At 16° to 18° C, development of the egg is slightly retarded, but hatching success and survival of larvae was higher. At 20° to 26° C, development and survival through the larval stage was up to 59 percent (Hamman 1981). Juvenile temperature tests showed that preferred temperatures ranged from 21.9° to 27.6° C. The most preferred temperature for juveniles and adults was estimated to be 24.6° C. Temperatures near 24° C also are needed for optimal development and growth of young (Miller et al. 1982).

Limited temperature data exist for the San Juan River; however, water temperatures in occupied habitats (as measured at Shiprock and Bluff) currently are well within an acceptable range to expect successful spawning, egg development, and hatching, assuming other habitat/flow conditions are available to the fish.

While consistent temperature data for pre- and post-Navajo Dam conditions do not exist, some important changes can be noted by a review of available data. Olson (1962a), during his preimpoundment study, recorded temperatures as high as 25° C during July and August 1961 near Rosa, New Mexico, on the San Juan River. A short distance downstream near Blanco, New Mexico, Olson measured temperatures in excess of 26° C during the same time period. (Tables 1, 2, and 3, Appendix C)

Recent temperature readings document a significant change since the closure of the Navajo Dam. In July 1989, the New Mexico Department of Game and Fish measured 13° C on the San Juan River at the Highway 64 bridge crossing, just upstream of Blanco, New Mexico. Cold-water releases from the Navajo Dam and their effect on water temperature in the San Juan River can be seen as far downstream as Farmington, New Mexico, and the confluence with the Animas River. Downstream of Farmington, ambient air temperature and, to a lesser extent, the warmer water from the Animas River tend to ameliorate the effect of cold-water releases from the Navajo Dam throughout currently occupied Colorado squawfish habitat. Post-Navajo water temperatures on the San Juan River at Farmington, New Mexico, and particularly at Bluff, Utah, are still warmer for a longer period of time than anywhere else in the Upper Basin. (Tables 4 and 5, Appendix C)

Only two Colorado squawfish confirmed spawning sites have been located in the Upper Basin--RM 16.5 of the Yampa River and RM 156.6 of the Green River. These areas have the common characteristics of coarse cobble or boulder substrates that form rapids or riffles associated with deeper pools or eddies. It is believed that this combination of habitats and a stable, clean substrate is necessary for spawning and incubation. Substrates are swept clean of finer sediments by high flows during spring runoff scouring the bed prior to the spawning period. Suitable spawning habitats appear to be present throughout the portion of the San Juan River inhabited by Colorado squawfish.

O'Brien (1984) studied the hydraulic and sediment transport dynamics of the cobble bar within the Yampa River spawning site and duplicated some of its characteristics in a laboratory flume study. Based on field observations, he reported:

> On the rising limb of the hydrograph, sands are deposited in the cobble interstices. These sands are interchanged between the bed and the suspended zone for discharges less than bankfull. Depending on the supply-capacity relationship, either deposition or scour could be occurring. When the cobbles move, the sand, of course, is washed from the interstices and may be completely removed from around the cobbles. Rearrangement of the cobbles will result in more stability of the armor layer. On the falling limb, the armor layer becomes a trap for sands until, finally, the sand reservoir is again filled. Without cobble movement, sand will be scoured only to a depth of one-half to one median cobble diameter below the cobble bed surface.
>
> In the flume experiments, the sand level was observed approximately one-half to one cobble diameter below the surface of the cobble bed, which compared to field observations of sand depth at approximately one-half to one median cobble diameter. O'Brien reported a cobble size range of 50 to 100 mm with a median size of 75 mm at the spawning site. Milhous (1982) reported that discharges of approximately one-half that required to initiate cobble movement would be capable of extracting sands and fines from the cobble substrate. Thus, after the supply of sand diminishes, flows of sufficient magnitude and duration are required to scour the cobble bed in preparation for spawning and incubation.

Although the location of spawning areas in the San Juan River are not well defined, the capture of young-of-year specimens in 1987 and 1988 documents that successful Colorado squawfish reproduction does occur when conditions are favorable (Platania 1990). Miller et al. (1982) and Archer et al. (1986) demonstrated that Colorado squawfish often migrate considerable distances to spawn in the Green and Yampa Rivers and similar movement has been noted in the mainstem San Juan River. A fish captured and tagged in the San Juan Arm of Lake Powell in April 1987 was later recaptured in the San Juan River approximately 90 miles upstream in September 1987.

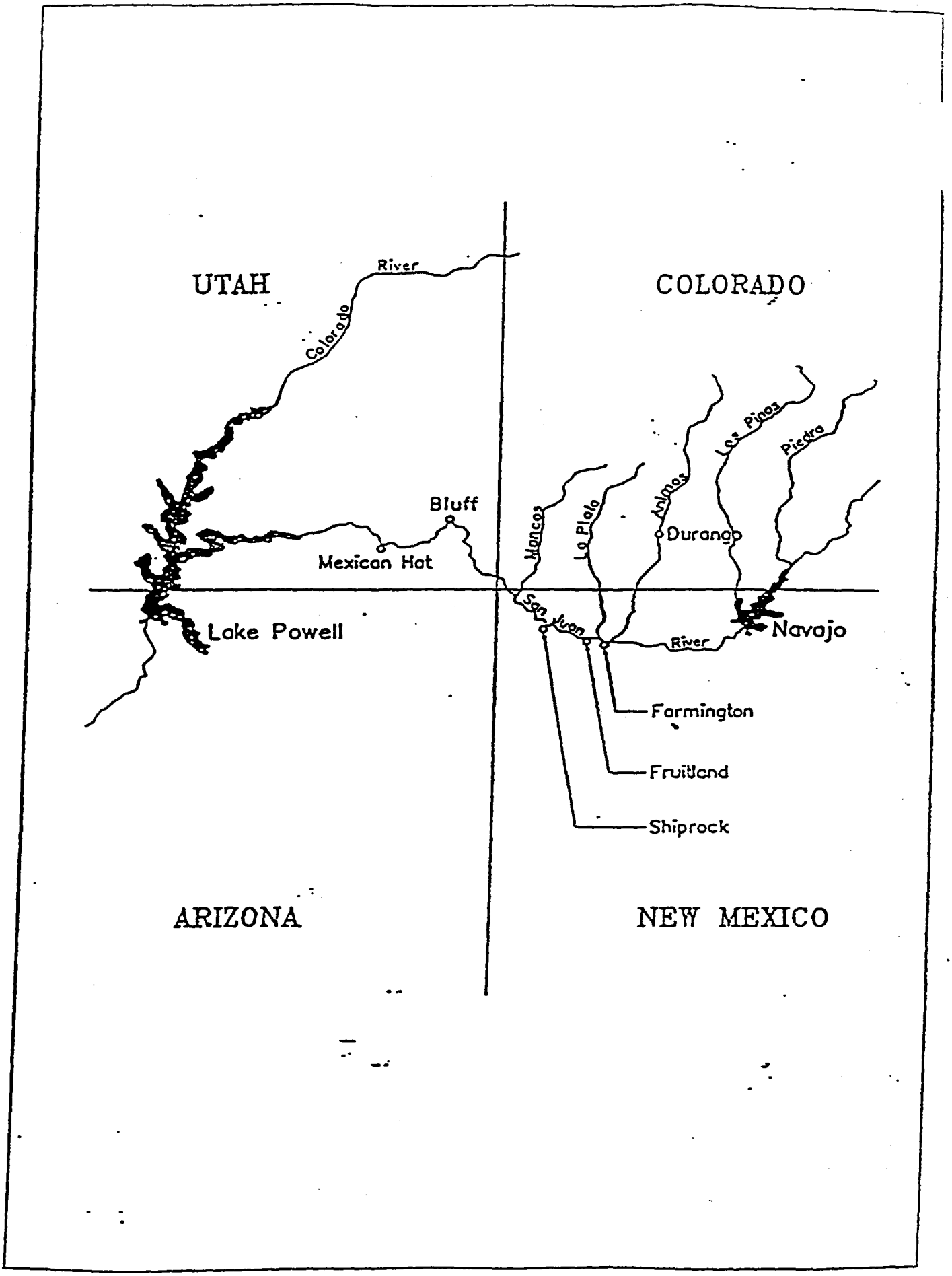
Miller et al. (1982) concluded from collections of larvae and young-of-year below known spawning sites that there is a downstream drift of larval Colorado squawfish following hatching. Extensive studies in the Yampa and upper Green Rivers have demonstrated downstream distribution of young Colorado squawfish from known spawning areas (Archer et al. 1986, Haynes et al. 1985). Miller et al. (1982) also found that young-of-year Colorado squawfish, from late summer through fall, preferred natural backwater areas of 0 velocity and less than 1.5-foot depth over a silt substrate. Juvenile Colorado squawfish habitat preferences are similar to that of young-of-year fish, but they appear mobile and more tolerant of lotic conditions away from the sheltered backwater environment. While specific spawning locations have not yet been identified in the San Juan River, larval drift is presumed to occur. Adult Colorado squawfish were captured as far upstream as RM 163.3, while most young-of-year specimens were collected from backwaters in lower reaches of the San Juan River in the Utah portion of the study area (Platania 1990).

Colorado squawfish were captured within the San Juan River in all seasons during which ichthyofaunal surveys were performed (spring, summer, and fall) and are presumed to remain there during winter. A silt plug at the mouth of the San Juan into Lake Powell has impeded passage of Colorado squawfish since 1989. Within the rest of the Upper Basin, winter habitat for adult Colorado squawfish is generally characterized as relatively deep areas with slow-water velocity. Pools, backwaters, runs, shorelines, and eddies are all commonly used habitats during winter (Osmundson and Kaeding 1989, Tyus and Karp 1989, Valdez and Masslich 1989). Wick and Hawkins (1989) reported that during low-flow years on the Yampa River, pools and runs were used most frequently, suggesting that habitat availability influenced habitat selection by adult Colorado squawfish. The fish are largely sedentary during winter and exhibit only localized movement suggesting feeding activity.

Very little information is available on the influence of turbidity on the endangered Colorado River fishes. It is assumed, however, that turbidity is important, particularly as it affects the interaction between introduced fishes and the endemic Colorado River fishes. Since these endemic fishes have evolved under natural conditions of high turbidity, it is presumed that the retention of these highly turbid conditions is an important factor for these endangered fishes. Reduction of turbidity may enable introduced species to gain a competitive edge, which could further contribute to the decline of the endangered Colorado River fishes.

Areas of Impact and Concern

The San Juan River originates in the mountains of southwestern Colorado and flows southwesterly into the Navajo Reservoir situated on the Colorado/New Mexico border (Figure 2). Downstream of the Navajo Dam, the San Juan River continues westerly, flowing through the towns of Archuleta, Blanco, Bloomfield, Farmington, Fruitland, and Shiprock, New Mexico. It then turns north and


UTAH
COLORADO
ARIZONA
NEW MEXICO
Colorado River
Bluff
Mexican Hat
Lake Powell
Blancos
La Plata
Animas
Durango
Los Pinos
Piedra
San Juan River
Navajo
Farmington
Fruitland
Shiprock

eventually reenters the extreme southwest corner of Colorado near Four Corners. Downstream of Four Corners, the San Juan River enters Utah and continues northwesterly through the towns of Aneth, Montezuma Creek, Bluff, and Mexican Hat, Utah, and empties into Lake Powell near Piute Farms Trading Post.

The San Juan River flows approximately 234 river miles from the Navajo Dam downstream to Lake Powell. Of the 234 miles, about 177 are potentially available to the Colorado squawfish. A diversion structure near Fruitland, New Mexico (the Hogback at RM 177), and a weir at RM 183 span the entire river channel and are believed to be effective blocks to upstream fish migrations (Platania 1990).

The reach of currently known occupied habitat extends from Lake Powell upstream to approximately RM 168 and will be significantly impacted due to upstream water withdrawals associated with the Project. The mainstem San Juan River above RM 168 to near Fruitland, New Mexico (RM 177), is available to Colorado squawfish and may be occupied habitat now, or in the future. Observations of 700-800 mm squawfish at approximately RM 168 were made in June 1991 by personnel from the New Mexico Department of Game and Fish (Propst 1991). The Animas River, from which a majority of Project water will be diverted, is the largest perennial tributary to the San Juan River and affects the entire length of occupied Colorado squawfish habitat. Historically, flows in the San Juan River prior to the Navajo Dam were highly variable. The change in flows at three locations in the San Juan River are listed in Table 1.

Table 1

Change in Mean Monthly Flow After the Navajo Dam

Units = cfs	Pre-Navajo		Post-Navajo		Percent Change	
	Low	High	Low	High	Low	High
Farmington	170	13,471	418	9,803	+145%	-27%
Shiprock	44	19,790	213	9,045	+384%	-54%
Bluff	65	15,380	250	10,334	+284%	-48%

Since 1963, the Navajo Dam has significantly altered the flow of the San Juan River by storing spring peak flows and releasing water in summer, fall, and winter months. The result is a 45 percent decrease in spring peak flows and doubled winter base flows at the Bluff gage in Utah. Similar comparisons can be made at the upstream gages at Shiprock and Farmington, New Mexico.

Additional depletions to occupied Colorado squawfish habitats associated with the Project will further reduce monthly average flows at Bluff from 5 percent in a wet year to as much as 70 percent in a dry year (Table 4). Depletions caused by the Project will result in some alteration of physical habitats in occupied reaches of the San Juan River from near Fruitland, New Mexico, downstream 177 river miles to Lake Powell. The specific habitat impacts on this reach of the San Juan River are unquantified at this time; however, depletions caused by the Project (154,800 acre-feet annually) would be compounded by those associated with the operation of the Navajo Dam, San Juan-Chama Project, Navajo Indian Irrigation Project, and other existing uses.

Adverse changes in water quality and contamination of associated biota are known to occur in similar Reclamation projects in the San Juan River drainage (i.e., irrigated lands on the Los Pinos and Mancos Rivers) where return flows from irrigation make up a portion of the river flow or other downstream aquatic sites (Sylvester et al. 1988). Increased loading of the San Juan River and its tributaries with soil salts, elemental contaminants, and pesticides from irrigation return flows degrade water quality.

In a cooperative Department of the Interior evaluation of irrigation drainage for the San Juan County, New Mexico, water quality data for the San Juan River area indicated the presence of 2-4-D and diazinon in the water in the San Juan River at Shiprock, New Mexico. The Department study concluded that further investigations into point sources of the contamination and a more thorough coverage of the San Juan River drainage appears necessary. Recent water and tissue sample data are currently being compiled and analyzed. Residual values of chromium copper, lead, and selenium were all above national averages. Selenium concentrations in fish tissue were high enough to suggest the reproductive impairment might already be occurring. The Department study concluded that further investigations into point sources of contamination and a more thorough coverage of the San Juan River Basin appears necessary (Department of Interior Intensive Desk Evaluation of Irrigation Drainage 1989). The extent of the problem is not known, but research studies planned for the San Juan River Basin will address water quality issues associated with the endangered fish.

Colorado Squawfish Activity: San Juan River

In 1986, Reclamation initiated investigations of the San Juan River in response to recommendations in the original 1979 biological opinion (Items 1-4, page 2). An ichthyofauna investigation of the San Juan River in New Mexico and Utah began during the spring of 1987 and finished in 1989 (Platania 1990), producing the following salient biological findings:

1. Colorado squawfish were captured in the San Juan River at several locations between Shiprock, New Mexico, and the inflow area of Lake Powell in Utah. No squawfish were captured upstream of the Hogback Diversion Dam located at RM 177 near Fruitland, New Mexico.

2. Successful reproduction of Colorado squawfish in the San Juan River was documented in 1987 and 1988 through the capture of young-of-year specimens (Table 2).

TABLE 2

Fish Capture Information

San Juan River

	Colorado Squawfish (CS)
1987*	3a, 18y
1988	4a, 1y
1989	1a

San Juan Arm Lake Powell

1987	1a
1988	0
1989	0

a = adult

y = young-of-year. Young were captured at three separate locations: RM 0-23.6, 94.5-101.7, and 139.5-143.0.

*In 1987, two additional Colorado squawfish were observed but eluded capture. The CS captured in the San Juan Arm of Lake Powell at RM-0.5 in April was recaptured approximately 90 river miles upstream in September.

3. Highest documented reproduction for Colorado squawfish occurred in 1987 concurrently with high spring flows.

4. Suitable Colorado squawfish spawning habitat appeared to be present throughout occupied reaches of the San Juan River.

5. Young-of-year squawfish were collected from three main areas: in the vicinity of the Mancos River confluence in New Mexico; in the vicinity of the Montezuma Creek confluence near Bluff, Utah; and the upstream portion of the San Juan River inflow to Lake Powell.

6. Upstream migrational movement of Colorado squawfish was documented in 1987. A Colorado squawfish captured and tagged in April 1987 in the upper terminus of the San Juan Arm in Lake Powell was recaptured approximately 90 river miles upstream in the San Juan River in September. No other tagged Colorado squawfish were recaptured during this 3-year study.

7. Colorado squawfish were captured in all seasons during ichthyofaunal surveys (spring, summer, and fall) and are believed to inhabit the San Juan River year round.

Within the San Juan River subbasin, the San Juan River supports a small population of reproducing Colorado squawfish; however, the extent of annual recruitment and/or survival of young fish has not been determined. Recent field studies (Platania 1990) document a greater number of Colorado squawfish (adults and young-of-year) in the San Juan River than was previously known to occur. The San Juan River is one of only three remaining areas where a wild, reproducing population of Colorado squawfish still persists. As the southernmost tributary in the Upper Basin, the San Juan River peaks earlier in the year, attaining warmer water temperatures than other Upper Basin streams and promoting longer and better growth potential for young Colorado squawfish.

Any additional losses or further degradation of remaining San Juan River habitats, resulting in further reductions in distribution and abundance of Colorado squawfish, will exacerbate problems the species is currently experiencing in the San Juan River and throughout the remainder of the Upper Basin. Protection and enhancement of the San Juan River is needed to provide additional protection against possible extinction of the Colorado squawfish while reducing total dependency on the Colorado and Green Rivers systems for survival and recovery. The San Juan River subbasin, isolated from the Colorado and Green Rivers subbasins, provides a third population of wild fish, contributing an additional essential buffer against a catastrophic event (such as an oil spill) elsewhere in the basin.

Furthermore, the Colorado River Fishes Recovery Team (consisting of scientists from the entire Colorado River Basin, including representatives from State wildlife agencies of California, Arizona, New Mexico, Utah, and Colorado, as well as Federal representatives from the National Park Service, Reclamation, and the Service) recommended to the Service in September of 1985 that ". . . the San

Juan River be considered an integral part of the Upper Colorado River Basin in its recovery efforts . . ." and ". . . that the Service encourage participation by the State of New Mexico and other appropriate entities so that the San Juan can be more fully incorporated into the Recovery Plans, and subsequently, in Implementation Plans." The Recovery Team met in March 1990 and once again reaffirmed its position and recommended to the Service, in a memorandum dated April 16, 1990, that the San Juan River be considered as essential to recovery of Colorado squawfish and that it be added to both downlisting and delisting criteria. The Recovery Team arrived at its conclusions based upon the following rationale:

1. Colorado squawfish were collected during all three seasons from Lake Powell upstream 154 miles and, therefore, are presumed to inhabit the river year round.

2. The San Juan River represents one of only three reproductive areas documented in the Upper Basin; recruitment to the population is unknown.

3. New hydrology data indicates flexibility exists within the river system to maintain/enhance flows (habitat) that appear to have direct correlation with successful downstream reproduction. The last 3-year study produced few fish collections during drier years (1988-1989).

4. One adult squawfish migrated upstream from Lake Powell some 90 miles. The river has a total of 177 miles that are currently barrier free.

5. Suitable habitat appear available for all life stages.

6. Status of existing populations appears depressed in the Colorado River subbasin and is not secure in the Green River subbasin.

7. The vulnerability of existing populations to such impacts as oil spills and natural catastrophic events (e.g., Yampa and West Water Canyon) poses a continued threat to recovery of the fishes.

8. Compared to other Upper Basin rivers, the San Juan River contains larger numbers of native fishes with fewer species of exotic fish.

9. In spite of past water quality problems (oil spills and fish eradication), opportunities exist to improve the water quality in the San Juan River.

10. As the southern most tributary in the Upper Basin, water temperature characteristics appear to favor long-term growth.

11. The squawfish population, though small in number, may be important as unique genetic stock in a separate subbasin.

12. The enhancement of San Juan River fish numbers and habitat increases the recovery potential over a larger portion of the fish's historical range.

The team recommended that the Service address the demonstrated recovery potential of the San Juan River according to the following:

1. A comprehensive management plan for directing all recovery and other related resource activities should be developed by an interagency team as soon as possible.

2. All appropriate protection measures presently afforded to Colorado squawfish populations in other portions of the Upper Basin should be applied to the San Juan River population.

3. Any anticipated recovery activities for Colorado squawfish in the San Juan River should be closely coordinated with ongoing recovery activities conducted in the Lower Colorado River Basin and those directed by the Recovery Implementation Program.

4. Given existing opportunities for recovery of Colorado squawfish in the San Juan River, the Service should evaluate the potential for operation of the Navajo Dam and Reservoir to realize those opportunities.

After considering the Recovery Team's recommendations, the Service updated the Colorado Squawfish Revised Recovery Plan, released August 6, 1991, that includes the San Juan River Basin in both downlisting and delisting criteria.

Effects of the Proposed Action

To determine the effects of the proposed action, an analysis of flow changes was conducted in accordance with the final rule implementing Section 7 of the Endangered Species Act (50 CFR 402 et seq.). This analysis compared the effects of the Project to a pre-Project Section 7 baseline at the Bluff Gage located near Mexican Hat, Utah. Three levels of development were simulated using a spreadsheet analysis of the hydrological data. The three levels were (1) historical gage, (2) Section 7 environmental baseline (baseline), and (3) baseline plus the Project (post-Project). The period of record selected for the analysis was 1935 to 1962. From this period, wet, dry, and average years were selected for analysis based upon water volumes during the spring runoff. The wet year selected was 1949, the dry year was 1951, and the average year was 1945.

The analysis began by securing information on historical flow conditions from the Geological Survey gages. Streamflow records for the Bluff Gage at Mexican Hat, Utah, on the San Juan River were chosen because the gage is located within occupied habitat and has a long record. The Bluff Gage also reflects most of the tributary inflow between the Navajo Reservoir and Lake Powell.

Secondly, projects for inclusion in the baseline for the San Juan River were identified. Pursuant to Section 7 regulations, the baseline for the Project included: (1) the past and present impacts of Federal, State, and private actions in the basin; (2) the anticipated impacts of all Federal projects having previously undergone formal Section 7 consultation in the area; and (3) the

impact of State or private actions contemporaneous with this consultation. There are no Federal projects in the area that have undergone formal Section 7 consultations nor any contemporaneous State or private projects that would affect the baseline. The baseline for the Project includes all historical depletions in the San Juan River Basin. Additionally, cumulative effects of future State or private projects, not requiring any Federal action, that are reasonably certain to occur are to be considered in the baseline; however, the Service is not aware of any such future projects. Table 3 identifies each project in the baseline and its associated depletions.

Included in the baseline, along with a number of other smaller water projects, are existing operational portions of the Navajo Indian Irrigation Project, which was authorized on June 13, 1962, to provide irrigation water for 110,630 acres of Navajo-owned land in northwest New Mexico, generally south of Farmington. Construction of the Navajo Indian Irrigation Project began in 1973, and limited operation began in 1976 and 1977. The Navajo Indian Irrigation Project was constructed in blocks of 8,000 to 10,000 acres, based on congressional appropriations. Since construction began, 6 blocks have been completed and, as of 1990, a total of 54,500 acres have been developed, representing a net annual depletion of 132,980 acre-feet. Blocks 7 through 11, which have not yet diverted water for irrigation, are not included in the baseline. Existing depletions caused by the San Juan-Chama Project and evaporation losses from the Navajo Reservoir also are included in the baseline.

Finally, the analysis quantified the post-Project condition by adding the full Animas-La Plata depletions of 154,800 acre-feet to the baseline of 566,000 acre-feet (a depletion of 591,000 acre-feet upstream of the Mancos River, with a return flow of 25,000 acre-feet from the Dolores Project) identified in Table 3. This results in a post-Project depletion in the San Juan River Basin of 720,800 acre-feet, or 37 percent of the 1.9 MAF mean annual yield.[1]

The depletion numbers used in the analysis were provided by Reclamation for the wet, average, and dry years described above. The changes in river flow, based upon this full development, were quantified for the Project effects analysis. These changes were analyzed and a summary of the changes between baseline and post-Project flows is presented in Table 4.

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[1] A mean annual yield of 1.9 MAF for the San Juan River Basin has been used throughout this report and is consistent with the period of record used in the hydrological analysis. Reclamation has estimated that the long-term mean annual yield of the San Juan River Basin is 2.2 MAF.

Table 3

San Juan Section 7 Baseline
Units = KAF

New Mexico Depletions		Depletions	Totals
San Juan-Chama		110.0*	
NIIP Blocks 1-6		133.0	
Navajo Reservoir Evaporation		26.0	
Hammond Canal		10.0	
Hogback Extention		10.0	
Utah International		39.0	
Existing Private Rights			
Citizen's Ditch	15.0		
Industrial Diversioin	3.0		
Fruitland	7.0		
Jewitt Valley	2.0		
Municipal and Industrial Diversions	5.0		
Hogback	30.7		
Additional Depletions	38.3		
		101.0	
Municipial and Industrial Contracts from Navajo			
San Juan Powerplant		16.0	
Total New Mexico Depletions			445.0
Colorado Depletions			
Upstream of Navajo			
Upper San Juan	7.8		
Navajo-Blanco	6.5		
Piedra	6.5		
Pine River	58.1		
		78.9	
Downstream of Navajo			
Florida	18.1		
PL Animas and La Plata Rivers	32.8		
Mancos	16.2		
		67.1	
Total Colorado Depletions			146.0
Total San Juan River Depletions			591.0
Return flows from Dolores River Imports		25.0	
Net depletions measures at Bluff Utah			566.0

* San Juan-Chama diversions have historically averaged 104,000 acre-feet for the 1929-1974 period of record; 110,000 acre-feet for the 1925-1985 period of record

Table 4

Post-Project Conditions for the Animas-La Plata Project
at Bluff, Utah

DRY

Water Year 1951 (Units = cfs)

Month	Section 7 Baseline	Animas-La Plata Depletions	Post-Project Conditions	Percent Change
October	910	-42	868	-5
November	885	-42	843	-5
December	977	-70	907	-7
January	937	-82	855	-9
February	873	-67	807	-8
March	752	-92	660	-14
April	472	-107	365	-23
May	607	-423	183	-70
June	1,952	-462	1,490	-24
July	1,182	-180	1,002	-15
August	1,030	-8	1,022	-1
September	1,208	59	1,267	5

AVERAGE

Water Year 1945 (Units = cfs)

Month	Section 7 Baseline	Animas-La Plata Depletions	Post-Project Conditions	Percent Change
October	1,217	-137	1,080	-11
November	1,148	-108	1,040	-9
December	1,057	-102	955	-10
January	1,015	-113	902	-11
February	1,182	-142	1,040	-12
March	1,055	-195	860	-18
April	1,142	-368	773	-32
May	5,265	-548	4,717	-10
June	4,425	-405	4,020	-9
July	1,675	-395	1,280	-24
August	1,643	-225	1,418	-14
September	602	40	642	7

Table 4 Cont.

Post-Project Conditions for the Animas-La Plata Project
at Bluff, Utah

WET

Water Year 1949 (Units = cfs)

Month	Section 7 Baseline	Animas-La Plata Depletions	Post-Project Conditions	Percent Change
October	1,435	-123	1,312	-9
November	1,278	-83	1,195	-7
December	1,027	-77	950	-7
January	1,333	-108	1,225	-8
February	1,388	-142	1,247	-10
March	1,638	-228	1,410	-14
April	2,917	-470	2,447	-16
May	6,653	-428	6,225	-6
June	10,521	-481	10,040	-5
July	4,365	-305	4,060	-7
August	1,198	-203	995	-20
September	778	40	818	5

Project Impacts

When Project depletions are considered (Table 4), impacts occur under all conditions with further reduction in flow virtually every month. The months of April, May, June, July, and August of dry and average years displayed the greatest impact from the Project. Mean monthly flow reductions range from 7 to 32 percent in an average year (1945), and wet year reductions are in the range of 5 to 20 percent (1949). Dry years tend to reflect the most significant changes where flow reductions range between 1 and 70 percent (1951).[2]

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2 The calculation of changes in flow between baseline and post-Project was accomplished using Reclamation's model of the San Juan River. The modeled depletions at Bluff may vary somewhat from the Animas-La Plata depletions shown in Appendix B due to reservoir and diversion operations. The model is the best available, but has some limitations and may not reflect all current operational objectives for the Navajo Reservoir. The major difference lies in the way flood releases are treated. Present operations call for releases in anticipation of spring floods, while the model does not (i.e., spills occur). The changes between baseline and post-Project were modeled as they occur in the Project operation plan and accurately reflect the change in flow expected to occur.

The Project will cause discrete, identifiable, additive, adverse impacts to the San Juan River endangered fishes. As shown in the flow analysis, the Project will cause flow depletions which, in addition to existing projects, will further alter historical flow regimes.

Since 1963, the operation of all existing projects, especially the Navajo Dam, has significantly altered flows of the San Juan River resulting in a decrease in average spring peaks and a doubling of average winter base flows. The Project would further reduce the remaining spring runoff within occupied habitat. Not coincidentally, as shown in Tables 1 and 2 of Appendix B, in 1987, when spring peaks were similar to historical levels (pre-Navajo), the highest reproduction ever documented during the 3 years of study for Colorado squawfish occurred in the San Juan River (Platania 1990). In 1988, when only one young-of-year squawfish was captured, and in 1989 when no young-of-year squawfish were captured, spring peaks as well as other flows were even lower than the current (post-Navajo) average conditions.

The fact that the Project would further deplete flows during peak runoff is of concern to the Service because this period is of great significance geomorphically and ecologically. This is the most dynamic period in the cycle, and it precedes the very critical spawning period of the endangered fishes. Observations clearly demonstrate that the spawning activities of these fish are synchronized with and are undoubtedly influenced by the spring runoff period (Archer et al. 1986, Archer and Tyus 1984, Tyus and Karp 1989). The Service believes that peak spring flows are very important for maintaining channel geomorphology, providing access to off-channel habitats, stimulating spawning migrations, and preserving suitable spawning substrates.

While the precise volume and duration of flows required for maintaining and/or improving important physical and biological needs are unknown, it appears that spawning and recruitment are limiting to the survival and recovery of Colorado squawfish in the San Juan River and throughout the Upper Basin. Furthermore, enhancement of existing conditions is necessary to enhance or promote spawning and recruitment. Given that existing projects have significantly dewatered the San Juan River, the annual removal of an additional 154,800 acre-feet of water associated with the Project further reduces the probability of ever achieving necessary streamflow for future maintenance and recovery of the physical and biological integrity of the San Juan River.

High concentrations of heavy metals, selenium, and hydrocarbons have been found in the fish and birds collected by the Service in the San Juan River Basin (Department of Interior Intensive Desk Evaluation of Irrigation Drainage 1989). The knowledge of the effect of the Project on the concentration of these elements is limited and needs to be studied as part of the research. Of particular concern to the Service is the potential for increased bioavailability of heavy metals and selenium associated with the San Juan River Basin.

In summary, without actions taken to offset their impacts, further flow reductions in the San Juan River are likely to jeopardize the continued existence of the Colorado squawfish. In addition to existing and potential impacts to the San Juan River described herein, there are existing reports by recognized species experts suggesting that wild populations of Colorado squawfish in the Colorado River subbasin are continuing to decline (Kaeding and Osmundson 1988, Osmundson and Kaeding 1990). The Service believes that the last remaining stronghold for the species is in the Green River subbasin; however, even there they do not appear to be increasing in number. Any catastrophic event there could result in severe impacts to the Green River subbasin population to the point of extirpation. The San Juan River is an essential component of the Colorado River Basin and is needed to ensure maintenance of a population of Colorado squawfish in the event populations are lost in the Green River subbasin and/or Colorado River subbasin.

Considerations in Developing a Reasonable and Prudent Alternative

The Endangered Species Act requires the Service to work with the Federal Agency to develop a reasonable and prudent alternative to the project under consultation in the event of a determination that the project is likely to jeopardize the continued existence of the listed species. As defined by 50 CFR, Part 402, Final Rule, Federal Register, June 3, 1986, an alternative is deemed reasonable and prudent only if:

1. It can be implemented by the lead Federal Agency in a manner consistent with the intended purpose of the project.

2. The Service believes it would avoid the likelihood of jeopardizing the continued existence of listed species.

3. It can be formulated in such a way that it can be implemented by the lead Federal Agency consistent with the scope of its legal authority and jurisdiction.

4. It is economically and technically feasible.

The process to identify a reasonable and prudent alternative occurred in three phases: (1) the period prior to the May 7, 1990, draft biological opinion; (2) the activities led by Reclamation during the summer of 1990 which ended with its September 28, 1990, memorandum reviewing the draft biological opinion; and (3) the process established in the September 28, 1990, memorandum that resulted in Reclamation's proposed reasonable and prudent alternative as described in a March 4, 1991 letter. Finally, after independent evaluation, the Service utilized the results of this process in writing this biological opinion and the Service's reasonable and prudent alternative. Each step in the process is described below.

Activities Prior to May 7, 1990 Draft Biological Opinion

In attempting to identify reasonable and prudent alternatives to the proposed Project, the Service, in cooperation with Reclamation, examined several options during the formulation of the first draft biological opinion that was issued on May 7, 1990. Initially, the Service queried Reclamation as to existing flexibility within the Project features and/or potential design changes that would allow for operation of Project storage facilities to benefit Colorado squawfish in the San Juan River. Reclamation responded that there was not any Project flexibility and that, if they released water from storage, it would necessitate pumping additional water out of the Animas River to refill Project reservoirs.

The use of the Navajo Dam and Reservoir was considered as a possible means of offsetting Project impacts since it is a Reclamation-operated facility and is situated on the San Juan River upstream of occupied habitat. Three options were considered: (1) the Service took the preliminary position that, because the Project would annually deplete 154,800 acre-feet of water from the San Juan River subbasin, Reclamation should provide that same amount of water back to the San Juan River via releases from the Navajo Dam; (2) Reclamation proposed an alternative to the Service position which would replace Project depletions, totaling 90,800 acre-feet of water in April, May, June, and July only. During the remaining 8 months of the year (August-March) Reclamation would not release water from the Navajo Dam to offset Project depletions; and (3) phasing Project depletion replacements consistent with the construction schedule. Because the Project would be constructed in phases (i.e., Phase 1: Ridges Basin Dam, Reservoir, and associated conveyance facilities; and Phase 2: Southern Ute Dam, Reservoir, and associated conveyance facilities), an additional option considered was offsetting Project depletions associated with Phase 1 (approximately 111,200 to 138,300 acre-feet) which would be completed by the year 2000; and then use the results of continued biological studies which would be done concurrently with construction of Phase 1 to formulate any additional needs that may accrue as a result of Phase 2.

As the biological and hydrological ramification of the three options were discussed, it was realized that none were biologically defensible. The Service believes that in most years the river regime is already at or below the threshold for minimum flows (particularly during the spring months) whereby the fish could survive and reproduce in the river. Any further depletions to the river system without a complete redistribution of the annual hydrograph could render the San Juan River unusable by the Colorado squawfish. Reproduction appears to be occurring only during years of high spring flows. Under current operation of the Navajo Dam and Reservoir, spring peaks are severely reduced in all but wet years, while summer and winter flows are substantially increased. Merely replacing the amount of water depleted as a result of the Project with water stored in the Navajo Reservoir still results in a net depletion in the San Juan River subbasin and would further reduce flows in the San Juan River commensurate with Project depletions, and, therefore, within occupied habitat for Colorado squawfish. Additional discussions continued; however, no solutions or additional alternatives were identified by the time the May 7, 1990, draft biological opinion was completed.

As a result, the Service concluded that there were no reasonable and prudent alternatives that could be implemented in a manner consistent with the intended purposes of the Project that were within Reclamation's legal authority and jurisdiction, that were economically and technically feasible, and that would avoid the likelihood of jeopardizing the continued existence of the Colorado squawfish. The first draft biological opinion was released for review on May 7, 1990. However, discussions continued in an effort to find a reasonable and prudent alternative.

Reclamation's Review of May 7, 1990 Draft Biological Opinion

After release of the May 7, 1990, draft biological opinion, Reclamation assembled fishery biologists from Federal, State, and private agencies during the summer of 1990 and solicited their review of the findings contained in the draft biological opinion to help Reclamation formulate its response. On September 28, 1990, Reclamation sent a memorandum (Appendix D) to the Service with its review of the draft biological opinion for the Project. Based on additional hydrological analyses, discussions with the fishery biologists, and discussions with the Service since the release of the draft biological opinion, Reclamation concluded that:

1. New hydrological information suggested that there is additional flexibility in the operation of the Navajo Dam. By reducing late fall and winter releases, water could be made available to increase spring peaks and return the San Juan River to a more natural hydrograph that would mimic historical flow conditions.

2. Updated hydrology modeling indicated that approximately 300,000 acre-feet of water could be made available from the Navajo Reservoir operation to re-create the spring peak flows in the San Juan River.

3. The San Juan River population of endangered fish is important to the survival and recovery of the species.

4. In addition to flow depletions, other conditions presently occurring in the San Juan River, including proliferation of nonnative species, water quality degradation, the blocking of migration routes, and loss of riparian areas, are extremely detrimental to the survival and recovery of the endangered fish.

In addition, Reclamation's memorandum stated that the fishery biologists had determined that:

1. They were in consensus that the May 7, 1990, draft biological opinion accurately reflected the current or known status of the Colorado squawfish in the San Juan River.

2. They supported the jeopardy conclusion of the May 7, 1990 draft biological opinion.

3. They believed that there may be a potential for developing a reasonable and prudent alternative which could offset impacts caused by certain further depletions to the San Juan River.

Reclamation also stated that it was willing to consider a reasonable and prudent alternative that would be limited to construction of Ridges Basin Reservoir, Durango Pumping Plant, and inlet pipeline. Approximately 80,000 acre-feet of water for municipal and industrial purposes would be developed with a net depletion of 50,000 acre-feet (subsequently corrected to 57,100 acre-feet).

Process Set Forth in Reclamation's September 28 Memorandum

In its September 28, 1990, memorandum, Reclamation identified a process by which Reclamation, States, tribes, environmental interests, and water users would work together regarding the feasibility of developing a reasonable and prudent alternative that would be both hydrologically and biologically supportable. The Service provided biological and hydrological assistance to that process. As a result of Reclamation's proposal, a meeting was held in Salt Lake City on October 9, 1990, with all interests represented. At that meeting three committees (Biology, Hydrology, and Legal) were established to collect additional information from experts in the areas of biology, hydrology, and law relating to the Project. A fourth group, the Management Task Force, was established to oversee the entire process and track progress. During the ensuing months, numerous technical committee meetings were held while discussions between the Service and Reclamation continued. Products from these committees were used to provide Reclamation with additional data and opinions regarding the development of a proposed reasonable and prudent alternative to the Project. This phase ended with Reclamation's March 4, 1991, letter (Appendix D) to the Service with its proposed reasonable and prudent alternative. A summary of the pertinent hydrological and biological information that formulated the basis for Reclamation's, and subsequently the Service's, reasonable and prudent alternative follows.

The Biology Committee held three meetings between October 22 and December 7, 1990. One of the first priorities of the group was to develop a list of major assumptions/hypotheses that apply to the San Juan River. The hydrological analysis contained in Appendix B was provided to and considered by the Biology Committee.

Appendix B compares historic (pre- and post-Navajo Dam) hydrographs and flows to existing capabilities through operation of the Navajo Dam (assuming current levels of depletion) for representative average, wet, and dry years at Bluff, Utah. The predevelopment mean annual flow of the San Juan River is approximately 1.95 MAF. The current level of development on the San Juan River accounts for consumptive uses of about 0.566 MAF, reducing the mean annual flow to approximately 1.38 MAF. The Navajo Dam currently redistributes this remaining water as shown in Figure 1, Appendix B. As can be seen from the figure, spring peaks are severely reduced while flows throughout the remainder of the year are elevated above historic levels. Figure 2, Appendix B, illustrates pre-Navajo Dam hydrographs for average (1945), wet (1949), and dry (1951) years, which demonstrates the natural variability of the San Juan River depending on the hydrological cycle. It is important to note that in each case (average, wet, or dry) the overall shape of the hydrograph remains the same (i.e., spring peaks, gradually descending limb, and low stable flows) the remainder of the year.

Having reached consensus that altered flows were the number one issue on the San Juan River, the Biology Committee agreed on the following major assumptions/ hypotheses:

1. Late spring and early summer flows are important for spawning and recruitment (flow and temperature) of Colorado squawfish.

2. Seasonally flooded lowlands may be important for razorback sucker spawning.

3. The abundance of native species is directly related to predation and competition by nonnative species.

4. Elimination of instream migration barriers would increase access to spawning areas and decrease impacts on drifting larvae of Colorado squawfish and razorback sucker.

5. The San Juan River during certain hydrological conditions appears to have suitable habitat for successful spawning, nursery, and rearing of native species.

6. Various life history stages of the native fish species may be adversely affected by water quality impacts on the San Juan River.

7. Historic flow conditions (discharge volume, timing, duration, water quality, and habitat availability) in the San Juan River were good for native fish, including the rare and endangered fish species.

8. Operation of the Navajo Dam and Reservoir to mimic a natural historic hydrograph will be physically and biologically beneficial.

9. A natural hydrograph with large spring peaks, a gradually declining/ descending limb into early summer, and low stable flows through summer, fall, and winter may be the best flow/habitat conditions for rare and endangered fishes in the San Juan River while maintaining the geomorphology of the river channel.

10. High spring peaks with a gradually descending limb may be necessary for the formation and maintenance of important nursery habitats in the San Juan River.

11. Operation of the Navajo Dam and Reservoir for native species can be accomplished without negative impacts on the tailwater salmonid populations and fishery (under current depletion levels).

In addition to these 11 major assumptions/hypotheses, the Biology Committee also agreed to three "critical assumptions," which included:

1. The San Juan River population of Colorado squawfish, while representing a reproducing population, is in danger of becoming extirpated. However, with appropriate management, the status of the populations might be enhanced.

2. The present conditions of the San Juan River have been significantly altered or impacted by the operation of the Navajo Dam and other man-caused impacts along the river.

3. There is an urgent need to collect indepth biological, physical, and chemical information on the fish and their habitat and to assimilate and assess all other existing information.

The next major issue that the Biology Committee investigated was the hydrological basis for operating the Navajo Dam to improve river conditions for the endangered fish (Appendix E, Figures 1-6). The hydrological analysis went through several iterations and concluded that the Navajo Dam can best be operated to provide approximately 300,000 acre-feet of water for a large spring peak release to provide a gradually ascending limb followed by a gradually descending recession limb lasting into early summer, while maintaining a minimum release of 300 cfs during all other periods of the year. This flow scenario would be available in 96 percent of the years under present conditions (Section 7 baseline). It also would be available 96 percent of the time with the Project (depletion of 57,100 acre-feet). The purpose of the operations of the Navajo Dam would be to mimic a historical hydrograph, thus returning the San Juan River to a more natural state, similar to that under which the endangered fish evolved. It is very important that the water management decisions underlying the reasonable and prudent alternative be described accurately and completely, because they have a direct, major effect on the magnitude and timing of the flows that are available to provide habitat in the San Juan River for endangered fish. These key elements were presented to the Biology Committee as an explanation of the hydrological basis underlying the proposed reasonable and prudent alternative and are presented in Appendix E.

Reclamation asked the members of the Biology Committee if, in their professional judgment, the operation of the Navajo Dam could form the beginning of a biologically supportable reasonable and prudent alternative that would allow for survival of the endangered fish and development of the Project. After considering all the assumptions it had previously agreed to, the Biology Committee concluded that returning the San Juan River to more natural conditions, with the reduced depletions by the Project, was biologically supportable as long as additional protective provisions similar to those included in Reclamation's September 28, 1990, memorandum were included and guaranteed. The members of the Biology Committee believed that additional research on the San Juan River and its tributaries is needed to quantify and refine specific flow/habitat requirements, test hypotheses, and identify other

limiting factors for listed fishes. Further, they believed that a long-term commitment to operate the Navajo Dam to mimic the natural hydrograph under current levels of depletion was essential such that maximum flexibility be maintained into the future so operational scenarios could be better quantified and refined consistent with the research effort. Future depletions, if any, and/or an identified need for additional water would be based on results of ongoing research. The Biology Committee also believed that a long-term recovery implementation program should be developed and implemented for the San Juan River Basin. After much debate and discussion, the members of the Biology Committee agreed in principle that a reasonable and prudent alternative, fully implemented, would offset a net annual depletion of 57,100 acre-feet from the construction and operation of the Project.

The conclusions reached by the Biology Committee are contained in Reclamation's March 4, 1991, letter (Appendix D) to the Service and in written minutes which Reclamation prepared for each of the meetings and has on file.

REASONABLE AND PRUDENT ALTERNATIVE

The Service believes, based on the analysis of the hydrological and biological information, that implementation of all the following elements will avoid the likelihood of jeopardizing the continued existence of Colorado squawfish. Reclamation and the Bureau of Indian Affairs have agreed that all of the elements of the reasonable and prudent alternative must be implemented to avoid the likelihood of jeopardy.

1. After reviewing current hydrological conditions and how Reclamation could operate the Navajo Dam to mimic the natural hydrograph, the Service determined that an initial depletion of 57,100 acre-feet for the Project is not likely to jeopardize the continued existence of the Colorado squawfish, assuming the implementation of all elements of the reasonable and prudent alternative. This depletion is that portion of the Project available from the construction of the Ridges Basin Dam and Reservoir, Durango Pumping Plant, and inlet pipeline, as those features are defined in the 1979 Definite Plan Report. Therefore, only those Project facilities which result in a net annual depletion not to exceed 57,100 acre-feet will be constructed and operated pursuant to this biological opinion.

2. Reclamation has agreed to fund approximately 7 years of research effort on the San Juan River and its tributaries with emphasis on observing a biological response in the endangered fish population and habitat conditions. This research will be conducted by knowledgeable endangered species and habitat experts and will allow for testing of hypotheses. The ultimate goal of this research is to characterize those factors which limit native fish populations in the San Juan River and to provide management options to conserve and restore the endangered fish community. Approval for study design shall jointly rest with the Service and Reclamation.

3. Reclamation will operate the Navajo Dam under study guidelines developed under element 2 for the research period so that releases mimic a natural hydrograph. Test flows will be provided to re-create a wide range of flow conditions including high flows similar to 1987, which are hypothesized to benefit reproduction and recruitment in the endangered fish community. Release schedules will be determined by the Service and Reclamation based on research studies and with the available water supply after meeting baseline depletions. These release schedules shall meet the limitations on the outlet works facilities and safe routing of hydrological events in the Upper Colorado River Basin. The Bureau of Reclamation also has requested initiation of Section 7 consultation on the operation of Navajo Dam, including a commitment to operate the dam for the conservation of the endangered fish.

4. At the end of the approximately 7-year research period, the Navajo Dam would be operated to mimic a natural hydrograph for the life of the Project based on the research.

5. There shall be a binding agreement(s) that the reservoir releases (for both the study period and for the life of the Project) are legally protected to and through the endangered fish habitat to Lake Powell. This agreement will include a commitment for the appropriate parties to develop and implement a Recovery Implementation Program for the San Juan River within 1 year.

Discussion

The following discussion describes why the Service believes that the five elements of the reasonable and prudent alternative, if fully implemented, would avoid the likelihood of jeopardy to Colorado squawfish associated with initial depletions from development of the Project. The Service agrees with the consensus of the Biology Committee that altered flows are the most important impact on the continued existence of endangered fishes based on the best information currently available.

The jeopardy conclusion in this biological opinion is based on full Project development which would result in a net annual depletion of 154,800 acre-feet of water. To offset the likelihood of jeopardy, the reasonable and prudent alternative presented herein includes construction and operation of the Project, which would result in a net annual depletion of 57,100 acre-feet, a considerably smaller depletion. However, even this smaller depletion is biologically acceptable only if all elements of the reasonable and prudent alternative are fully implemented. The operation of the full scale Project (Figure 3, Appendix B) would result in a significant reduction of spring peak flows through the endangered fish habitat in the San Juan River, while the operation of the Project in accordance with the reasonable and prudent alternative takes much less water on a fairly steady basis throughout the year. When one compares the initial depletion of the Project to the hydrograph of existing conditions with the Navajo Dam operated to mimic a natural hydrograph (Figures 1-6, Appendix E), there is negligible change to the hydrograph shape and/or timing of spring peak flows with the operation of the Navajo Dam. This is important in order to provide the gradual ascending and descending limbs of the spring peaks. The water from the Navajo Reservoir storage is still available 96 percent of the

years to provide the same shape, timing, volume, and frequency. This information, when presented to the Biology Committee by Reclamation, resulted in agreement that the additional depletion of 57,100 acre-feet caused by the Project would be biologically acceptable so long as all other features of the reasonable and prudent alternative were fully implemented. The Service concurs.

Future research is an important feature of the reasonable and prudent alternative. It was sufficient new information from research conducted as a result of the 1979 biological opinion that led to the reinitiation of Section 7 consultation for the Project. It is the implementation of research which will provide the Service with further information about the biological needs of the fish specific to the San Juan River Basin and how these needs can best be met. The future development of water in the San Juan River Basin, including the proposed remaining depletions of the Project, will be highly dependent on the outcome of the biological studies which are being required as part of the reasonable and prudent alternative. In making future decisions about endangered species, the Service must use the best scientific and commercial data available.

The minimum study period necessary to conduct the studies was determined by the Biology Committee, Reclamation, and the Service to be 7 years. Any inability to deliver the flows under the third element of the reasonable and prudent alternative would likely prolong the research period. A study plan is being developed to address the conduct of the research. This study plan will focus on a biological response to the operational changes of the Navajo Dam (Element 3), but also will address other impacts such as water quality, water temperatures, and migration barriers.

During the research study period, the Navajo Dam will be operated under a variety of scenarios (wet, average, and dry) to mimic a natural hydrograph to re-create a high spring peak flow providing a gradually ascending limb followed by a gradually declining recession limb to low, stable flows throughout the summer, fall, and winter. The Service and the biological experts believe that this is the best opportunity available to bring the endangered fish back from the brink of extirpation in the San Juan River. By returning the river to a more natural hydrograph and raising the spring peak flows, the Service believes there will be an increase in reproduction and recruitment of the endangered fish in the San Juan River. This operation of the Navajo Dam is the most important feature of the reasonable and prudent alternative both for the research period and for the long term.

In order for there to be an additional permanent depletion of 57,100 acre-feet of water from the Project, there must be a guarantee that the Navajo Dam will be operated to mimic the natural hydrograph based on research for the life of the Project. Releases for the endangered fish will be legally protected to and through the endangered fishes habitat to Lake Powell. However, until the research is completed, the required water delivery schedule for the life of the Project (in terms of hydrograph shape, timing, volume, and frequency) is unknown.

Under present conditions, computer simulations predict that 300,000 acre-feet would be available 96 percent of the time, thus providing maximum flexibility to re-create a natural hydrograph (shape, timing, volume, and frequency). However, under full depletions (adding in all future proposed projects up to each State's full compact allotment), the 300,000 acre-feet of water from the Navajo Reservoir would be available only 33 percent of the time, which indicates that the ability to provide all four elements of a natural hydrograph (shape, timing, volume, and frequency) would be severely restricted. The research, therefore, will be directed towards determining how the Navajo Reservoir releases can best be used in terms of mimicking the natural hydrograph. This information will be utilized by the Service in coordination with Reclamation to determine reservoir releases needed for the endangered fishes. The Service will solicit input from all interested parties.

The fifth element is legal protection of reservoir releases from the Navajo Dam to and through the endangered fish species habitat. It is not enough to only release water from the Navajo Dam. There also must be guaranteed delivery of the water so that it provides the habitat improvement necessary to maintain and increase the endangered fish population in the San Juan River. Without such legal protection, there would be no guarantee that the water would get to or through the endangered species habitat in the San Juan River. Reclamation, however, cannot itself protect the flows because legal protection of water is under the jurisdiction of the States of New Mexico, Colorado, and Utah and the Navajo Nation.

To ensure legal protection of releases for listed fish, a Memorandum of Understanding and Supplemental Agreement have been developed and executed (Appendix A). The Memorandum of Understanding commits all the signatories to the development of a Recovery Implementation Program for the San Juan River within 1 year. The Memorandum of Understanding does not purport to affect any potential water right claims by the concerned Indian Tribes. In the event that a future court determination on such rights which adversely impacts the implementation of the reasonable and prudent alternative, consultation must be reinitiated immediately. The provisions of the Memorandum of Understanding will be incorporated into the reasonable and prudent alternative. The Recovery Implementation Program should provide for the long-term recovery of the endangered fish by (1) protecting and enhancing the native fish community, specifically the endangered fish; (2) outlining a process for future Section 7 consultations in the San Juan River Basin; (3) conducting long-term research and monitoring of the native fish community; and (4) protecting reservoir releases and instream flows and sharing of water shortages resulting from releases for the endangered fish. Once the flows needed for the endangered fish have been determined, based upon the research effort, projections can be made as to shortages. A separate agreement will need to be developed at that time on how and which entities will share shortages. If agreement cannot be reached through the Recovery Implementation Program process, consultation will be initiated or reinitiated, based on new information, on all projects subject to Section 7 consultation in the San Juan River Basin. It is the intent of the Department that all such projects share shortages.

When a Recovery Implementation Program for the San Juan River is developed and implemented, Reclamation may direct funding for the research effort through the Recovery Implementation Program. Funding of the research and all other recovery activities for the endangered fish of the San Juan River could then be a shared responsibility of the participating parties in the Recovery Implementation Program.

Incidental Take

Section 9 of the Endangered Species Act, as amended, prohibits any taking (harass, harm, pursue, hunt, shoot, wound, kill, trap, capture or collect, or attempt to engage in any such conduct) of listed species without a special exemption. Harm is further defined to include significant habitat modification or degradation that results in death or injury to endangered fish and wildlife by significantly impairing behavioral patterns such as breeding, feeding, or sheltering. Under the terms of Section 7(b)(4) and Section 7(o)(2), taking that is incidental to and not intended as part of the agency action is not considered taking within the bounds of the Endangered Species Act provided that such taking is in compliance with the incidental take statement.

With protective provisions included in the reasonable and prudent alternative contained herein, the Service does not anticipate that construction and operation of the proposed Project will result in any incidental take of Colorado squawfish. The Service anticipates that a small but presently unquantifiable number of endangered fish could be taken as a result of the research program which is part of the reasonable and prudent alternative to preclude jeopardy. The take would be associated with activities, such as capture, holding, or transporting fish, required by the research program.

The following reasonable and prudent measure and resultant terms and conditions to reduce the amount of incidental take shall be implemented.

1. A permit which will include measures to reduce take will be obtained in accordance with 50 CFR 17.22 and 32 from the Fish and Wildlife Service.

If during the course of the action the amount or extent of the incidental take as permitted in item 1 above is exceeded, Reclamation must reinitiate formal consultation with the Service and provide detailed circumstances surrounding the take.

BALD EAGLE

The bald eagle is listed as endangered in the conterminous United States, except for Washington, Oregon, Minnesota, Wisconsin, and Michigan where it is listed as threatened. Its overall decline has been attributed to the loss of breeding habitat, illegal shooting, and the occurrence of chlorinated hydrocarbon pesticides in its food supply which caused egg deterioration and reproduction failures. In recent years, the national bald eagle population has been increasing. The bald eagle is a wide-ranging migratory bird species most often associated with and dependent upon water. Its food base includes fish, waterfowl, small mammals, and carrion.

The Animas, La Plata, Mancos, and San Juan Rivers in Colorado, New Mexico, and Utah currently support a large concentration of wintering bald eagles. Survey reports from the tri-State area indicate well over 100 birds overwintering in the area. While the number of birds in the area is somewhat variable, depending on the severity of the winter, their numbers have increased considerably in the last several years. Bald eagles also nest in the general area. There are two active nest sites associated with area reservoirs and a third historic site (currently inactive) along the Animas River.

In 1989, Reclamation reported that approximately 70 bald eagles overwintered near the Navajo Reservoir, its associated tailwaters, and along the lower Animas River. The Colorado Division of Wildlife (Kevin Ellis, District Wildlife Manager, Durango, Colorado) estimates that the wintering population of bald eagles along the Animas River has nearly tripled in the past 5 years. Survey results show similar trends on the La Plata, Mancos, and San Juan Rivers in Colorado, New Mexico, and Utah. With such a large winter concentration of bald eagles within the Project area, it is probable that one or more communal roosts exist. Additional surveys and a concerted effort to locate and protect these "essential habitats" are integral to an eagle management plan.

It is anticipated that the creation of the Ridges Basin Reservoir and associated fisheries in the area will attract wintering bald eagles, and it is conceivable that a new nest site could be established in the area. As with the endangered fish, the Service is concerned about potential water quality problems that may affect the bald eagles, both in the rivers and Ridges Basin Reservoir.

Because the Ridges Basin Reservoir will be filled by water pumped out of the Animas River and it is situated in a location where selenium contamination could occur, a monitoring program should be developed to determine if heavy metals and/or selenium contamination become bioaccumulated in the food chain and become deleterious to bald eagles. If biomonitoring of food chain organisms within Project-affected rivers and the Ridges Basin Reservoir identifies contaminant levels of concern, then corrective measures would need to be implemented.

It is the Service's biological opinion that the Project, as described herein, is not likely to jeopardize the continued existence of the bald eagle.

Conservation Recommendations for the Bald Eagle

The Service recommends that a Bald Eagle Management Plan be developed and implemented, concurrent with Project design and construction. Such a plan should be developed jointly by Reclamation, the Service, and the affected States. Specific surveys should be aimed at identifying possible communal roost sites and nest sites and methods to protect them. Potential contaminant bioaccumulation in the food chain should be assessed and monitored with corrective measures implemented as necessary.

Results of ongoing Departmental contaminant studies on the San Juan River as well as results from biomonitoring of Project reservoirs and affected streams should be used to identify and correct any contamination problems that may arise as a result of Project construction and operation.

Potential degradation of water quality resulting from Project action that compromises conditions essential to the health, reproduction, and survival of endangered bald eagles and Colorado squawfish should be assessed and monitored and are a part of the research that will be a part of the reasonable and prudent alternative for endangered fish. Corrective measures designed to restore water quality to the conditions required by endangered species should be implemented. If new information becomes available, new species listed, or should there be any changes to the Project which alter the operation of the Project from that which is described in this biological opinion and which may affect any endangered or threatened species in a manner or to an extent not considered in this biological opinion (see 50 CFR, Part 402.16), formal Section 7 consultation should be reinitiated.

Incidental Take

Section 9 of the Endangered Species Act, as amended, prohibits any taking (harass, harm, pursue, hunt, shoot, wound, kill, trap, capture or collect, or attempt to engage in any such conduct) of listed species without a special exemption. Harm is further defined to include significant habitat modification or degradation that results in death or injury to listed species by significantly impairing behavioral patterns such as breeding, feeding, or sheltering. Under the terms of Section 7(b)(4) and Section 7(o)(2), taking that is incidental to and not intended as part of the agency action is not considered taking within the bounds of the Endangered Species Act provided that such taking is in compliance with the incidental take statement.

Because Reclamation and the Bureau of Indian Affairs have agreed to the implementation of the conservation recommendations contained herein, the Service does not anticipate that the proposed Project will result in any incidental take of bald eagles. Accordingly, no incidental take is authorized. Should any take occur, Reclamation must reinitiate formal consultation with the Service and provide detailed circumstances surrounding the take.

CONCLUSION

This concludes our biological opinion on the impacts of the proposed Project. The Service has determined that the impacts of the Project are likely to jeopardize the continued existence of the Colorado squawfish; however, a reasonable and prudent alternative which offsets jeopardy to the Colorado squawfish has been identified as a result of this consultation.

The reasonable and prudent alternative includes: (1) an Animas-La Plata Project that results in an initial depletion of 57,100 acre-feet, (2) 7 years of research to determine endangered fish habitat needs, (3) operation of the Navajo Dam to provide a wide range of flow conditions for the endangered fish, (4) a guarantee that the Navajo Reservoir will be operated for the life of the Project to mimic a natural hydrograph based on the research, and (5) legal protection for the reservoir releases instream to and through the endangered fish habitat to Lake Powell. In order to preclude jeopardy, all five elements must be implemented.

The Service has further determined that the proposed Project is not likely to jeopardize the continued existence of the bald eagle.

Because the San Juan River populations of the Colorado squawfish are already at a critical level, the Endangered Species Act requires that no further Federal actions which would result in delivery of additional water from projects in the San Juan River Basin be made until Section 7 consultation has been completed for such delivery.

This opinion was based upon the best scientific and commercial data available as described herein. If new information becomes available, new species listed, or should there be any changes to the Project which alter the operation of the Project from that which is described in this biological opinion and which may affect any endangered or threatened species in a manner or to an extent not considered in this biological opinion (see 50 CFR, Part 402.16), formal Section 7 consultation shall be reinitiated. Section 7 consultation also must be reinitiated if there is failure to carry out any portion of the reasonable and prudent alternative upon which this opinion is based.

While the razorback sucker (Xyrauchen texanus) was not specifically included in this opinion, consistent with 50 CFR, Part 402.10, a Conference Opinion was completed and is attached (Appendix F).

Section 7(d) of the Endangered Species Act requires that Reclamation shall not make any irreversible or irretrievable commitment of resources which would preclude the formulation of reasonable and prudent alternatives until consultation on listed species is completed. Therefore, adoption of the reasonable and prudent alternative described above is not a violation of Section 7(d) of the Endangered Species Act.

Thank you for your cooperation in the formulation of this opinion and your interest in conserving endangered species.

Galen L. Buterbaugh

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