COPY

United States Department of the Interior

FISH AND WILDLIFE SERVICE
Ecological Services
755 Parfet Street, Suite 361
Lakewood, Colorado 80215

RECEIVED
JUN 22 2000
6177
USFWS-NMESFO

IN REPLY REFER TO:
ES/GJ-6-CO-00-F-016
MS 65412 LK

JUN 19 2000

Memorandum

To: Area Manager, Western Colorado Area Office, Bureau of Reclamation, Grand Junction, Colorado

From: Colorado Field Supervisor, Fish and Wildlife Service, Ecological Services, Lakewood, Colorado

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

In accordance with section 7 of the Endangered Species Act of 1973, as amended (16 U.S.C. 1531 et seq.), and the Interagency Cooperation Regulations (50 CFR 402), this transmits the Fish and Wildlife Service's final biological opinion for impacts to federally listed threatened and endangered species for the Animas-La Plata Project.

This biological opinion is in response to your December 22, 1999, memorandum and biological assessment for the Animas-La Plata Project. This is a reinitiation of consultation for the Animas-La Plata Project based on changes to the proposed project and new information on the species that was not considered in 1996. This biological opinion supercedes all previous biological opinions on the Animas-La Plata Project. The Service concurs with your conclusion that the proposed project may affect, but is not likely to adversely affect the Southwestern willow flycatcher (*Empidonax traillii extimus*). The Service also concurs with your "no effect" determination for the following listed and proposed species: Mexican spotted owl (*Strix occidentalis lucida*), black-footed ferret (*Mustela nigripes*), Canada lynx (*Lynx canadensis*), mountain plover (*Charadrius montanus*), Mancos milk-vetch (*Astragalus humillimus*), Mesa Verde cactus (*Sclerocactus mesae-verdae*), and Knowlton's cactus (*Pediocactus knowltonii*). The Service appreciates your evaluation of candidate species and concurs with your "no effect"determination for the boreal toad (*Bufo boreas boreas*) and Sleeping Ute milk-vetch (*Astragalus tortipes*). The Service concurs that the proposed project may affect the Colorado squawfish[1] (*Pychocheilus lucius*), razorback sucker (*Xyrauchen texanus*), and bald eagle (*Haliaeetus leucocephalus*).

Consultation History

The Animas-La Plata 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

---

[1]The American Fisheries Society has changed the common name of the Colorado squawfish to Colorado pikeminnow (Nelson et al. 1998), therefore, it will be referred to as the Colorado pikeminnow in this document.

December 28, 1979 (2-22-80-F-13). The 1979 biological opinion addressed the potential effects of the proposed Project on the endangered Colorado pikeminnow, bald eagle, and peregrine falcon (*Falco peregrinus*). Based on the capture of a single juvenile Colorado pikeminnow 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 pikeminnow population and its already tenuous hold on survival, its possible loss should have little impact on the successfully reproducing Green and Colorado Rivers pikeminnow populations and, therefore, the species itself."

During the 1979 consultation, there was a wintering population of approximately 20 bald eagles and one active nest site along the Animas River, and the Service concluded that reductions in streamflow would not significantly affect the eagle's food base of the Animas River or 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, CDOW, pers. comm.).

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 pikeminnow and bald eagles in furtherance of their conservation. It was recommended that a Bald Eagle Management Plan be developed for project reservoirs. For Colorado pikeminnow, it was recommended that:

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

2. environmental needs of Colorado pikeminnow be determined,

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

4. artificial facilities be provided and funded, in which to spawn and rear Colorado pikeminnow until such time that suitable habitats in the San Juan River can be developed and maintained.

Fishery surveys conducted from May 1987 to October 1989, found ten adult and 18 young-of-year Colorado pikeminnow and the presence of adult razorback sucker in the San Juan River (Platania et al. 1991). Based on this new biological information, Reclamation reinitiated section 7 consultation on February 6, 1990, and provided the Service with an updated biological assessment of project impacts on Colorado pikeminnow. On May 7, 1990, the Service issued a draft biological opinion concluding that the project would jeopardize the continued existence of the Colorado pikeminnow. No reasonable and prudent alternatives were identified at that time. Reclamation and the Service began actively seeking reasonable and prudent alternatives and in a March 4, 1991, letter Reclamation proposed a reasonable and prudent alternative to preclude the likelihood of jeopardy from the project. On August 6, 1991, the Service issued an updated Recovery Plan for the Colorado pikeminnow that identified the San Juan River from Farmington, New Mexico, to Lake Powell as a recovery area. The Service issued a final biological opinion for the Animas-La Plata Project on October 25, 1991, that concluded the project as proposed would likely jeopardize the continued existence of the Colorado pikeminnow and razorback sucker. The reasonable and prudent alternative in that opinion included: (1) an Animas-La Plata Project that was scaled back so that its initial stage would result in an initial depletion[2] of 57,100

[2]The Service defines a depletion as the amount of water that is not returned to a river system due to project implementation, i.e., the amount diverted minus return flows, plus evaporation loss from new reservoirs or ponds, equals the depletion.

acre-feet, (2) 7 years of research to determine endangered fish habitat needs, (3) operation of the Navajo Dam to provide 300,000 acre-feet/year of water for a wide range of flow conditions for the endangered fish 96 percent of the time, (4) a guarantee that the Navajo Reservoir will be operated for the life of the project to mimic a natural hydrograph and such operation would be based on the research, (5) legal protection for the reservoir releases to and through the endangered fish habitat to Lake Powell, and (6) a commitment to develop and implement a Recovery Implementation Program for the San Juan River. A Memorandum of Understanding and Supplemental Agreement to protect the releases for endangered fishes made from the Navajo Reservoir to and through the endangered fish habitat of the San Juan River to Lake Powell was signed in October 1991.

The 1991 opinion also concluded that the project was not likely to jeopardize the continued existence of the bald eagle. Development and implementation of a Bald Eagle Management Plan was included as a conservation recommendation.

As a result of the reasonable and prudent alternative in the 1991 biological opinion, the San Juan River Basin Recovery Implementation Program was formulated in 1992.

During informal consultation the Service determined that no threatened or endangered plant species would be impacted by the project. Also, after surveys were conducted, the Service concurred with Reclamation's no affect determination for the Mexican spotted owl.

In 1991, the razorback sucker was listed as endangered (56 FR 54957) and in 1994 critical habitat was designated for the Colorado pikeminnow and razorback sucker (59 FR 13374). The critical habitat designation includes the San Juan River from Farmington, New Mexico to Lake Powell. Based on these new listings, Reclamation reinitiated section 7 consultation on the Animas-La Plata Project. A biological opinion issued by Region 6 of the Service on February 26, 1996, for the Animas-La Plata Project found that the proposed development and subsequent depletion of 149,220 acre-feet of the San Juan River's flow would jeopardize the continued existence of the endangered Colorado pikeminnow and razorback sucker and adversely modify or destroy their critical habitat. A reasonable and prudent alternative that removed jeopardy and adverse modification to critical habitat was identified. The reasonable and prudent alternative includes: (1) an Animas-La Plata Project that scaled back to only result in an initial depletion of 57,100 acre-feet (Phase 1, Stage A only), (2) research to determine endangered fish habitat needs, (3) operation of the Navajo Dam to provide 300,000 acre-feet/year and a wide range of flow conditions for the endangered fish, including low winter flows, (4) a procedure to implement flow recommendations, (5) a commitment to release peak flows out of Navajo Dam as agreed upon with the Biology and Navajo Dam Operating Committees, (6) a guarantee that, based on the results of the research program and dependent upon the prevailing hydrology, Navajo Dam will be operated for the life of the Animas-La Plata Project to mimic a natural hydrograph (Bureau of Reclamation had agreed under section 7(a)(1) to reoperate Navajo Dam for recovery of endangered fishes), and (7) legal protection for the reservoir releases instream to and through the endangered fish habitat to Lake Powell.

In the 1996 opinion, the Service also determined that the proposed project "may affect" the bald eagle; and concurred that the proposed project was not likely to adversely affect the peregrine falcon, the southwestern willow flycatcher, or the black-footed ferret. Impacts to bald eagles were related to potential impacts to riparian vegetation associated with later stages of the proposed project not authorized under the Reasonable and Prudent Alternatives and potential bioaccumulation of contaminants in the prey base associated with Ridges Basin Reservoir.

Conservation Recommendations included in the 1996 opinion were developed to address the following concerns related to bald eagles:

1. A cooperative management plan be developed and implemented that emphasizes habitat management and protection.

2. Flow management strategies be implemented on the La Plata River to reduce impacts to future cottonwood recruitment areas.

3. Identification of canals that support important bald eagle habitat (cottonwood trees) and develop a strategy to avoid loss of the trees.

4. Develop a long term monitoring program that evaluates water quality in the Animas, La Plata and Mancos Rivers, including a determination whether heavy metals and selenium contamination become bioaccumulated in the food chain and become deleterious to bald eagles.

The Service also recommended a comprehensive environmental contaminant sampling and monitoring program be implemented by Reclamation at a number of sites.

Related Project Consultations

The San Juan River Recovery Implementation Program was initiated in October 1992 to address recovery needs for the two endangered fish, while allowing for water development in the basin in compliance with Federal and State laws, interstate compacts, Supreme Court decrees, and Federal trust responsibilities to the Southern Utes, Ute Mountain Utes, Jicarillas, and the Navajos. At the inception of the cooperative effort to formulate the Program, participants agreed that a relatively small amount of water was to be set aside to accommodate small individual requests for its use. That amount was fixed at an annual aggregate of 3,000 acre-feet. For 6 years, requests for these minor depletions were consulted on individually until the fall of 1998, when the 3,000 acre-feet ceiling was reached. The Service then, based on the information gained by the research activities of the Program and on a review of the types and amounts of depletions that have comprised the projects encompassed by the previous 3,000 acre-feet block of water, consulted on the aggregate, rather than the individual depletions for another block of 3,000 acre-feet. Since that time, it has been determined that some of the depletions included in the original 3,000 acre-feet block were double counted or were historical depletions and should not have been counted toward the original 3,000 acre-feet block. Recent investigations by the State of New Mexico and Colorado have determined that only 1,500 acre-feet of new minor depletion occurred during the 6 year period.

The 3,000 acre-feet block of water discussed above is intended to address minor depletions of up to approximately 100 acre-feet/year. Projects with larger depletions require individual consultations. In 1997, the Corps of Engineers initiated consultation for a new intake structure for the City of Durango on the Animas River. On March 17, 1998, the Service issued a biological opinion (GJ-6-CO-97-F-026) to the Corps of Engineers. The consultation involved an average annual water depletion of 1,439 acre-feet. A new depletion of 1,051 acre-feet/year and a historic depletion of 388 acre-feet/year. The City of Durango described the water supply that is currently provided by the new Gateway Pump Station as the same water supply as the Durango Municipal and Industrial Pipeline feature of the proposed Animas-La Plata Project. The City of Durango plans to abandon the new pump station when the Animas-La Plata Project is completed and obtain their water supply from Ridges Basin Reservoir through the proposed pipeline. Because section 7 consultation has been completed for 1,439 acre-feet/year, the hydrological analysis for the Animas-La Plata Project includes this amount in the environmental baseline for the proposed Animas-La Plata Project. However, because the City of Durango intends to use Animas-La Plata project water in the future, instead of the new Gateway Pump Station, the description of the Animas-La Plata Project states the project would deplete 57,100 acre-feet/year. Describing the water for the City of Durango is a unique situation, because it is part of the environmental baseline, yet it is also part of the proposed Animas-La Plata Project. Of the 57,100 acre-feet/year for the Animas-La Plata Project, 1,439 acre-feet/year is an existing depletion by the City of Durango.

The Service consulted with the Bureau of Indian Affairs on Blocks 1 through 8 of the Navajo Indian Irrigation Project in 1991 and again in 1994 after critical habitat was designated for the

Colorado pikeminnow and razorback sucker. Blocks 1 through 8 involved an average annual depletion of 149,420 acre-feet. In May 1999, the Biology Committee for the Program, issued flow recommendations for the San Juan River (Holden 1999). Mimicry of the natural hydrograph is the foundation of the flow recommendations. The recommendations provide information on the specific frequency and duration of flows recommended for spring peak releases from Navajo Reservoir. Recommendations for the base flow period are also provided. In 1999, after analyzing the flow recommendations and considering project elements designed to support recovery of the endangered fishes, the Service concurred with a determination of the Bureau of Indian Affairs that the completion of the NIIP (Blocks 9-11 with an average annual depletion of 120,580 acre-feet/year and a total depletion for all Blocks of 270,000 acre-feet/year) may affect but is not likely to adversely affect the endangered Colorado pikeminnow and razorback sucker, and is not likely to adversely modify or destroy designated critical habitat within the San Juan River Basin for the two fish.

BIOLOGICAL OPINION

DESCRIPTION OF THE PROPOSED ACTION

The project analyzed in this biological opinion is the preferred alternative identified as "Refined Alternative 4" in the 2000 Draft Supplemental Environmental Impact Statement and described in the biological assessment. This alternative includes both structural and nonstructural components designed to achieve the fundamental purpose of securing the Colorado Ute Tribes an assured water supply in satisfaction of their water rights as determined by the 1986 Settlement Agreement and the 1988 Settlement Act and by providing for identified M&I water needs in the Project area. The Project area is located in southwestern Colorado and northwestern New Mexico and includes portions of La Plata and Montezuma Counties, Colorado and portions of San Juan County, New Mexico. The Southern Ute, Ute Mountain Ute, and portions of the Navajo Indian Reservation are included in the project area.

The structural component includes an off-stream storage reservoir (approximately 120,000 acre-feet total capacity) with a conservation pool of approximately 30,000 acre-feet; a pumping plant (up to approximately 280 cubic feet per second of capacity); and a reservoir inlet conduit, all designed to pump and store water from the Animas River. The proposed project would also include a pipeline designed to transport treated municipal water from Farmington, New Mexico to the Shiprock area in New Mexico (Navajo Nation Municipal Pipeline). The proposed reservoir would be located in Ridges Basin, near Durango, Colorado. The annual average water depletion from these project components is 57,100 acre-feet. A portion of this depletion (1,439 acre-feet/year) is an existing depletion by the City of Durango.

Consumptive use of water from Ridges Basin Reservoir will be restricted to M&I uses only and will be allocated in approximately the following manner[3]:

Southern Ute Tribe (M&I)	19,980 acre-feet/year depletion
Ute Mountain Ute Tribe (M&I)	19,980 acre-feet/year depletion
Navajo Nation (M&I)	2,340 acre-feet/year depletion
A-LP Water Conservancy District (M&I)	2,600 acre-feet/year depletion
San Juan Water Commission (M&I)	10,400 acre-feet/year depletion

Under the allocation shown above, the Colorado Ute Tribes are still approximately 13,000 acre-feet short of the total quantity of depletion recognized in the settlement agreement. Therefore, the proposed action includes a nonstructural element which would establish and utilize a water acquisition fund which the Tribes could use to acquire water rights on a willing buyer/willing seller basis in an amount sufficient to allow the Tribes approximately 13,000 acre-feet/year of depletions in addition to the depletions available from the structural component

[3]The balance of 57,100 acre-feet/year is lost to evaporation.

of the project. Water could be acquired in the Pine, Florida, Animas, La Plata and Mancos Rivers and McElmo Creek. Preliminary cost estimates indicate that a one-time fund of approximately $40,000,000 would be required to purchase the additional rights. However, to provide flexibility in the use of the fund, authorization would allow some or all of the funds to be redirected for on-farm development, water delivery infrastructure, and other economic development activities.

The proposed Durango Pumping Plant would pump water from the Animas River and lift it through the Ridges Basin inlet conduit over the ridge above Bodo Creek into Ridges Basin Reservoir. The pumping plant would be located on the west side of the river across from Santa Rita Park, 1.6 miles downstream from the center of Durango, Colorado. The intake structure would conduct water from the river through control gates and to a fish screen, then into a covered basin that serves as a forebay for the pumping plant. The entrance to the intake structure would consist of a sloping grate, 48 feet long, situated to conform to the riverbank and designed to exclude the entry of debris into the control gates. The fish screen, 80 feet back from the river, would be designed to keep fish greater than 2 inches long from passing, and all fish would be channeled back to the river by the velocity in a bypass pipe at the base of the screen. The intake structure would be covered except for the fish screen area that would be open to facilitate cleaning and maintenance. Five pumps would provide a maximum of 280 cfs and four smaller pumps would handle lower flows, trim flows between the large pumps, and provide backup in case one of the large pumps went out of service

Ridges Basin Reservoir, would be formed following construction of Ridges Basin Dam on Basin Creek, approximately 3 miles upstream from its confluence with the Animas River. To retain 120,000 acre-feet, and provide for flood storage, requires a dam with a crest elevation of 6,892 feet. Ridges Basin Dam will be a rolled earthfill structure with a height of about 217 feet above the streambed. The dam site is defined by narrowing of the downstream end of Ridges Basin with a prominent sandstone ridge to the northeast of Basin Creek and two sandstone, and siltstone ridges about 500 feet apart. A tunnel through the left abutment would serve as the reservoir outlet. The outlet works include an intake approach channel, intake structure, an upstream pressurized tunnel, gate chamber with access tunnel, open channel flow downstream tunnel, and stilling basin and discharge channel. The main gates would have an emergency release capacity of 1,500 cfs while secondary jet-flow valves would control releases of up to 100 cfs and 150 cfs. Flanges would be provided to connect future distribution pipelines. Basin Creek drops about 420 feet elevation along its 3.2-mile course from the dam to the Animas River.

The reservoir formed behind the dam is expected to flood an area of approximately 1,500 acres and extend about 2.4 miles up Basin Creek, with a capacity of 120,000 acre-feet. The reservoir would include useable storage of 90,000 acre-feet with a conservation pool of 30,000 acre-feet for recreation, water quality, and to maintain a fishery. The reservoir is expected to be drawn to or slightly below the 30,000 acre-feet level during extended periods of drought. The only mode of water release from Ridges Basin Reservoir identified at this time, is through the dam outlet works (i.e., left abutment tunnel and spillway) down Basin Creek.

Reclamation proposes to use Basin Creek as a means to convey project water from Ridges Basin Reservoir to the Animas River for future project demand. The conveyance system is designed for releases of up to 250 cfs, but the periodicity and timing of releases are undefined at this time. Since historic high flows in Basin Creek are only 65 cfs, channel modification will be required. Reclamation proposes to reduce the impact to Basin Creek channel wetlands and riparian vegetation by means of erosion and siltation controls that use a series of check and drop structures, or vortex weirs. According to Reclamation, the implementation of these controls would produce an increase in silt transport initially but would stabilize with use. Some wetlands could be created over time. The creek bed would be realigned into gentle curves and graded to create relatively flat slopes.

The Navajo Nation Municipal Pipeline will deliver 4,560 acre-feet (2,340 acre-feet of depletion) of M&I water from the ALP. The 4,560 acre-feet of water represents about one-half of the M&I requirements of the eight Navajo chapters located along the route of the pipeline. These eight chapters include: Shiprock, Cudei, Hogback, Nenahnezad, Upper Fruitland, San Juan, Sanostee, and Beclaibito. The Farmington to Shiprock pipeline will be approximately 29 miles long, and will replace an existing ductile iron line. The new pipeline will follow the same alignment as the old pipeline. The replacement pipeline will begin at the western boundary of the City of Farmington on the north side of the San Juan River and terminate at the Cortez storage tanks in Shiprock. The pipeline would cross the San Juan River twice. The diameter of the pipeline will be 24 inches at its beginning and decrease to 20 inches at its terminus in Shiprock.

Future use of most of the project water has not been identified, therefore, Reclamation developed non-binding scenarios to model potential future water use as shown in Table 1. The Service is not consulting on the individual projects listed in Table 1, but on a block of water resulting in an average annual depletion of 57,100 acre-feet. As individual projects are developed that use Animas-La Plata Project water or facilities, Reclamation or another appropriate Federal agency will analyze the project and determine if any threatened or endangered species may be affected in a manner that was not considered in this biological opinion. If the determination is "may affect" for any listed species, Reclamation or another designated lead Federal agency will consult with the Service on the individual project proposal.

Table 1. Water Supply by Non-binding potential Uses for the Preferred Alternative.

Water Supply by Use for the Preferred Alternative				
Category	**Diversion (acre-feet)**	**Depletion (acre-feet)**	**Diversion Location**	**Return Flow Location**
Southern Ute				
Florida Mesa housing	140	70	Ridges Basin	Animas at Florida Confluence
Animas River Basin housing	140	70	Ridges Basin	Animas at Florida Confluence
La Plata River Basin housing	140	70	Ridges Basin	La Plata at Farmington
Animas Ind. Park M&I	40	20	Ridges Basin	Animas at Florida Confluence
Ridges Basin golf course	796	398	Ridges Basin	Ridges Basin
Ridges Basin Resort	44	22	Ridges Basin	Ridges Basin
Coal mine	830	415	Ridges Basin	La Plata at state line
Coal fired power plant	27,000	13,500	Ridges Basin	La Plata at state line
Livestock + wildlife	30	15	Ridges Basin	La Plata at state line
Southern Ute Total	**29,160**	**14,580**		
Ute Mountain Ute				
La Plata housing	280	140	Ridges Basin	La Plata at state line
Mancos Canyon Golf Course	978	489	Ridges Basin	Mancos River
Mancos Canyon Resort	33	17	Ridges Basin	Mancos River
Gas power plant	4,600	2,300	San Juan at SJPP	San Juan above Shiprock
Livestock & wildlife	40	20	Ridges Basin	La Plata at state line
La Plata Basin Resort	30	15	Ridges Basin	La Plata at state line
La Plata Basin Golf Course	626	313	Ridges Basin	La Plata at state line
La Plata Basin Dude Ranch	10	5	Ridges Basin	La Plata at state line
Ute Mountain Ute Total	**6,597**	**3,299**		
Regional Water Supply				
Durango	15,338	7,669[4]	Ridges Basin	Animas R. below pump
Bloomfield & Upstream uses	4,533	2,267	San Juan-Cit. Ditch	San Juan at Farmington
Farmington	28,373	14,187	Farmington M&I Div	San J. below Animas Confluence
Florida Mesa	7,016	3,508	Ridges Basin	Animas at Florida Confluence
Red Mesa Plateau	2,105	1,052	Ridges Basin	La Plata at state lines
Kirtland, NM	7,016	3,508	Farmington M&I Div	San Juan above Hogback
Aztec, NM	4,911	2,456	Aztec M&I Div	Animas R. at Farmington
Less - ALP Water Cons. Allocat.	-5,200	-2,600		
San J. Water Comm. Allocat.	-20,800	-10,400		
Total Regional Water Supply	**43,292**	**21,646[5]**		
Total Ute Settlement	***79,050***	***39,525***		
Other Uses				
Navajo Nation	4,680	2,340	Farmington M&I Div	Shiprock below gage
ALP water conservancy	5,200	2,600	See Regional Water Supply	
San Juan Water Commission	20,800	10,400	See Regional Water Supply	
Ridges Basin Evaporation	2,235	2,235	Ridges Basin	none
Total Other Uses	**32,915**	17,575		
			Range of depletions at Four Corners, New Mexico 8,200 - 100,500 acre-feet/year	
Total Water Use	***111,965***	***57,100***		
Design total	***111,965***	***57,100***		
Design - Calculated Use	***(0)***	***(0)***		

[4]Includes water supply for Durango already consulted on between Durango/Corps of Engineers/Service.

[5]The Colorado Ute Tribes acknowledge that they have not satisfied the present legal requirements necessary to serve regional needs in New Mexico.

Conservation Measures

Conservation measures are actions that the action agency agrees to implement to further the recovery of the species under review. The beneficial effects of conservation measures were taken into consideration for determining both jeopardy and incidental take analyses and all hydrology analyses considered in this biological opinion assume implementation of these conservation measures, including the reoperation of Navajo Dam. Reclamation agrees that failure to implement the conservation measures will be grounds for reinitiation of consultation.

1. Under this conservation measure, Reclamation is committing to operate Navajo Reservoir to mimic the natural hydrograph of the San Juan River to benefit endangered fishes and their critical habitat. Mimicry of the natural hydrograph will be achieved by following the San Juan River flow recommendations (Holden 1999, see Tables 2 and 3) and subject to completion of the Navajo Operations EIS and execution of a Record of Decision. The flow recommendations provide recommended reservoir operating rules that were developed in cooperation with Reclamation (see Tables 4 and 5, and Figure 1). Reclamation is in the process of preparing an EIS addressing the operation of Navajo Reservoir to meet the flow recommendations. After completion of the Navajo Reservoir EIS, if Reclamation determines that the existing or future revised flow recommendation cannot be met, reinitiation of section 7 consultation will be required on the Animas-La Plata Project[6] (see reinitiation notice). The San Juan River Basin Recovery Implementation Program uses an adaptive management process that involves annual monitoring and continued research, so the flow recommendations may be refined in response to new information. The Service will periodically review operation of Navajo Dam to determine if the flow recommendations are being met.

The Service anticipates that flows provided through the implementation of the existing or future revised flow recommendations and other recovery actions (such as, but not limited to, fish passage, nonnative fish control, habitat restoration as described in the San Juan River Recovery Implementation Program's Long Range Plan) will provide a positive population response for Colorado pikeminnow and razorback sucker. The Service is currently developing recovery goals for the Colorado pikeminnow and razorback sucker. Information from the recovery goals will be used to determine a positive population response. If a population meets or exceeds the recovery goals for the San Juan River, it will be considered to exhibit a positive population response. However, prior to meeting recovery goals, criteria for determining a positive population response must be established. Therefore, before construction of Ridges Basin Reservoir or within one year of the date of this biological opinion (which ever comes first), Reclamation will develop criteria to determine a positive population response for concurrence by the Service. Reclamation will consult with the Biology Committee of the San Juan River Recovery Implementation Program in developing the criteria.

A monitoring plan is being developed by the Program and will be used to track the status and trends of endangered fishes. The monitoring plan will determine the relative annual reproductive success of Colorado pikeminnow and razorback sucker, determine size-structure of adult and juvenile fishes, track changes in abiotic parameters (water quality, channel morphology, and habitat) and provide detailed analyses of data collected to help determine progress toward recovery in 2003 and every 5 years thereafter. Information from the San Juan River Monitoring Program will be used to determine population responses. If the flow recommendations or other recovery actions do not result in a positive population response for both species within the time frames established in the criteria and as determined by the Service, reinitiation of section 7 consultation will be required[6] (see reinitiation notice).

---

[6]Numerous section 7 consultations in the San Juan River Basin rely on the operation of Navajo Dam to remove jeopardy; therefore, this requirement would apply to many section 7 consultations.

2. Conservation measure number one and many other projects in the San Juan River Basin rely on the hydrology modeling that was done for the San Juan flow recommendations (Holden, 1999) and for the Animas-LaPlata Project. RiverWare was selected as the model to simulate flows in the San Juan River and to model the effects of water development in the basin. Modification of the model to simulate the effects of the Animas-La Plata Project was an extension of the RiverWare model. The San Juan River Recovery Implementation Program recently designated the responsibility of maintaining and updating the model to Reclamation. Reclamation is now the "keeper" of the model. As such, Reclamation would be responsible for maintaining the model and its data, within the guidelines provided by the Recovery Program's committees.

The model is also one of the tools being used in preparation of the Navajo Operation EIS. A Modeling Group, consisting of people trained and experienced in hydrology, has been established to help on the operation EIS and includes the Corps of Engineers, New Mexico Interstate Stream Commission, San Juan Water Commission, Bureau of Indian Affairs, City of Farmington, Jicarilla Apache Tribe, the Navajo Nation, Southwestern Water Conservation District, Fish and Wildlife Service, and the Colorado Water Conservation Board. Many of the same people serve on the Recovery Program committees. This group of hydrologists provides the expertise and appropriate forum to continually peer review the model and its results from many perspectives.

In order to insure the accuracy of the model, Reclamation will take actions necessary to have an independent review of the model conducted. Reclamation will coordinate the review with the Service and seek the Service's concurrence with the model results. The review and the coordination will be completed within one year of the date of this biological opinion.

3. A Memorandum of Understanding and Supplemental Agreement to protect the releases for endangered fishes made from the Navajo Reservoir to and through the endangered fish habitat of the San Juan River to Lake Powell was signed in October 1991. This MOU remains in effect.

4. The Durango Pumping Plant will be operated in a manner that insures that its operations do not interfere with meeting the target flows recommended for the San Juan River. Pumping would be decreased or stopped during certain periods in order to meet the recommended target flows. If there have been no endangered fish releases from Navajo Dam for two consecutive years and the planned release for the current year is the minimum release specified in the flow recommendation report, the Durango pumping plant would be turned off during June, allowing an additional 280 cfs to help meet flow recommendations for endangered fish in the San Juan River. After satisfying all downstream senior water rights demands and downstream Animas-La Plata Project water demands, pumping will be further limited to allow the following bypass flows in the Animas River at the pumping Plant intake; October through November - 160 cfs, December through March - 125 cfs, and April through September - 225 cfs.

5. Reclamation will implement all actions necessary to prevent escapement of nonnative fishes from Ridges Basin Reservoir in any water leaving the reservoir. Reclamation will consider the escapement of eggs and larvae in the design of a escapement devise or method. Reclamation will monitor any water leaving Ridges Basin Reservoir to determine if escapement of nonnative fishes is occurring. If escapement is occurring, Reclamation will develop and implement a plan to stop escapement. The plan will be approved by the Service prior to implementation.

6. Reclamation will develop and implement a monitoring program for potential adverse bioaccumulation of trace elements in bald eagle food items in Ridges Basin Reservoir. If the monitoring program identifies a problem with trace elements, Reclamation will develop and implement an action plan to minimize impacts to bald eagles.

7. Reclamation will incorporate bypass flows into ALP project operations to promote natural recruitment of cottonwood trees along the Animas River. These flows are compatible with the San Juan River flow recommendations for endangered fishes. This should avoid impacts to future bald eagle habitat.

8. All electrical transmission lines associated with the project will be designed to avoid injury to raptors, including bald eagles.

Table 2
Summary of flow recommendation for critical habitat of the endangered fish in the San Juan River (see Holden 1999 for full recommendations).

A.	Category:	Flows > 10,000 cfs during runoff period (March 1 to July 31)
	Duration:	**5 days minimum**, natural variability maintained by meeting the conditions in Table 3.
	Frequency:	**20 percent on average.** Minimum frequency for other durations listed in Table 3. Maximum period without meeting at least 97 percent of the specified conditions is 10 years.
B.	Category:	Flow > 8,000 cfs during runoff period.
	Duration:	**10 days minimum**, natural variability maintained by meeting the conditions in Table 3.
	Frequency:	**33 percent on average.** Minimum frequency for other durations listed in Table 3. Maximum period without meeting at least 97 percent of the specified conditions is 6 years.
C.	Category:	Flow > 5,000 cfs during runoff period.
	Duration:	**21 days minimum**, natural variability maintained by meeting the conditions in Table 3.
	Frequency:	**50 percent on average**, minimum frequency for other durations listed in Table 3. Maximum period without meeting at least 97 percent of the specified conditions is 4 years.
D.	Category:	Flow >2,500 cfs during runoff period.
	Duration:	**10 days** minimum, natural variability maintained by meeting the conditions in Table 3.
	Frequency:	**80 percent on average**, minimum frequency for other durations listed in Table 3. Maximum period without meeting at least 97 percent of the specified conditions is 2 years.
E.	Category:	Peak timing similar to historical conditions, including variability.
	Timing:	Mean peak with operation to be within 5 days ± of historical period mean.
	Variability:	Standard deviation of date of peak to be 14 to 25 days.
F.	Category:	Target Base Flow (mean weekly non-spring runoff flow).
	Level:	500 cfs from Farmington (measured as the average of any two of the following gages: Farmington, Shiprock, Four Corners, and Bluff) to Lake Powell, with 250 cfs minimum from Navajo Dam. The target flow should be maintained between 500 and 600cfs in critical habitat, attempting to maintain target flow closer to 500 cfs.
G.	Category:	Flood Control Releases (incorporated in operating rule).
	Control:	Handle flood control releases as a spike (high magnitude, short duration) and release when flood control rules require, except that the release shall not occur earlier than September 1. If an earlier release is required, extend the duration of the peak of the release hydrograph. A ramp up and ramp down of 1,000 cfs per day should be used to a maximum release of 5,000 cfs. If the volume of water to release is less than that required to reach 5,000 cfs, adjust the magnitude of the peak accordingly, maintaining the ramp rates. Multiple releases may be made each year. These spike releases shall be used in place of adjustments to base flow.

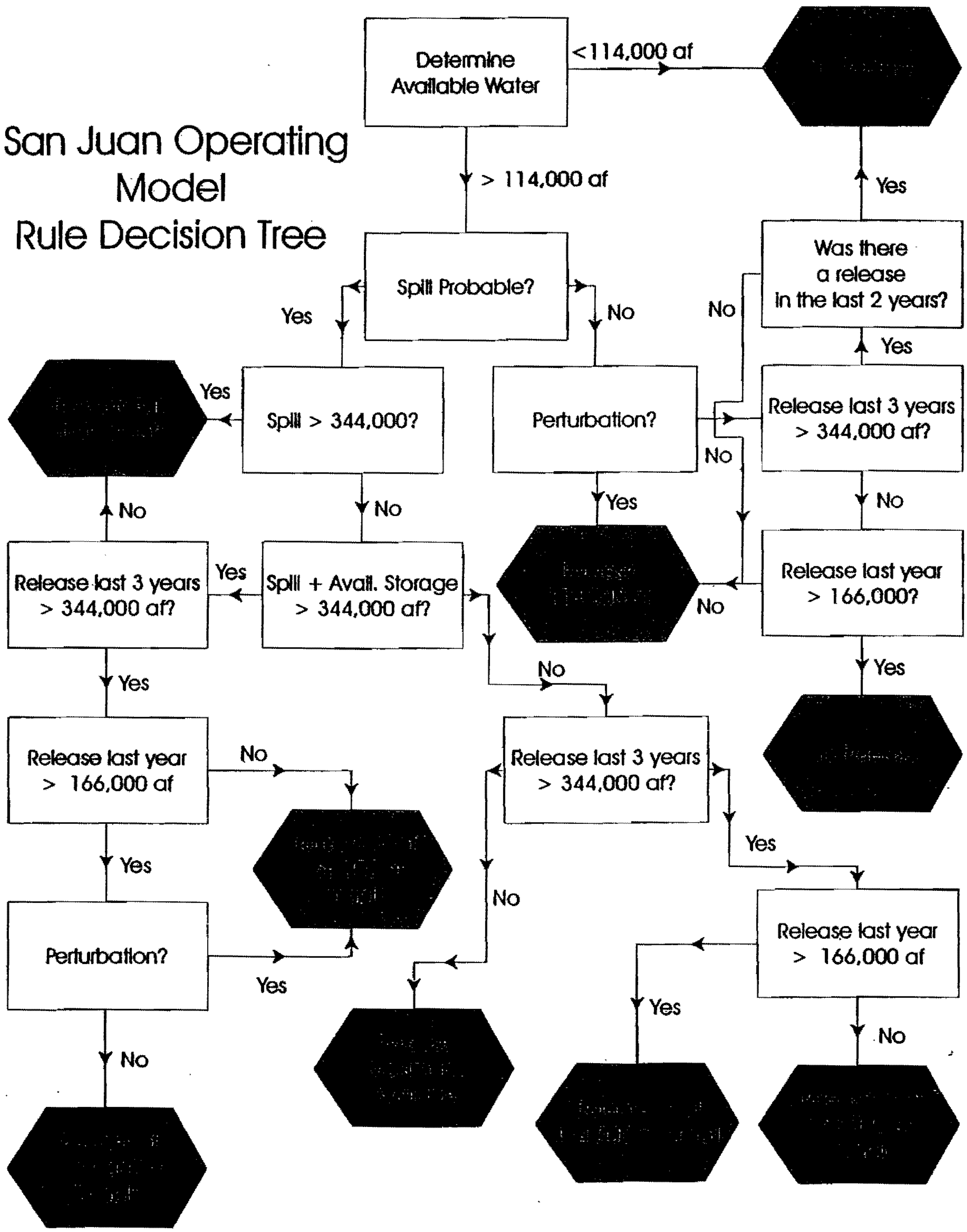
Table 3 Frequency Distribution Table for Flow/duration Recommendations				
	Discharge			
	>10,000 cfs	**>8,000 cfs**	**>5,000 cfs**	**>2,500 cfs**
Duration	**Average Frequency**			
1 day	30%	40%	65%	90%
5 days	[redacted]	35%	60%	82%
10 days	10%	[redacted]	58%	[redacted]
15 days	5%	30%	55%	70%
20 days	[redacted]	20%	[redacted]	65%
30 days		10%	40%	60%
40 days			30%	50%
50 days			20%	45%
60 days			15%	40%
80 days			5%	25%
Note: Primary criteria shown in shaded cells.				

Table 4. Flow Recommendation Operating Rules - 5,000 cfs Peak (See Holden 1999 for 6,000 acre-feet peak)
Minimum peak release consists of 1 week ramp up to 5,000 cfs, 1 week at 5,000, and 1 week ramp down. Daily flow rates for ramping are given in Table 5. Volume is 114,000 acre-feet above average base release of 600 cfs.
Primary peak release hydrograph consists of 4 week ramp up to 5,000 cfs, 3 weeks at 5,000 cfs, and 2 weeks ramp down. Ramp rates are given in Table 5. Volume is 344,000 acre-feet above average base release of 600 cfs.
The peak release is to be centered on June 4 of each year.
Use the decision tree shown in Figure 1 to determine magnitude of release. Available water on the chart is defined as: *"predicted inflow less base release plus available storage,"* where available storage is reduced from full storage by the amount of carry over storage necessary to prevent shortages in future years. *"Release last 3 years > 344,000 acre-feet,"* means that a release of at least 344,000 acre-feet occurred at least once out of the last 3 years.

Table 5
Recommended Daily Ramp Rates for 1-week, 2-week, 3-week, and 4-week Ramps for 5,000 cfs Peak Release

Day	Flow Rate (cfs)			
	1 Week	2-week	3 Week	4 Week
1	1,000	1,000	1,000	1,000
2	1,500	1,000	1,000	1,000
3	2,000	1,500	1,000	1,000
4	2,500	1,500	1,000	1,000
5	3,000	2,000	1,500	1,000
6	3,500	2,000	1,500	1,000
7	4,000	2,500	1,500	1,000
8	5,000	2,500	2,000	2,000
9		3,000	2,000	2,000
10		3,000	2,000	2,000
11		3,500	2,000	2,000
12		4,000	3,000	2,000
13		4,000	3,000	2,000
14		4,500	3,000	2,000
15		5,000	3,000	3,000
16			4,000	3,000
17			4,000	3,000
18			4,000	3,000
19			4,000	3,000
20			4,000	3,000
21			4,000	3,000
22			5,000	4,000
23				4,000
24				4,000
25				4,000
26				4000
27				4,000
28				4,000
29				5,000

Figure 1.


San Juan Operating Model
Rule Decision Tree
Determine Available Water
<114,000 af
> 114,000 af
Spill Probable?
Yes
No
Was there a release in the last 2 years?
Yes
No
Spill > 344,000?
Perturbation?
Release last 3 years > 344,000 af?
No
Yes
Release last 3 years > 344,000 af?
Spill + Avail. Storage > 344,000 af?
Release last year > 166,000?
Release last year > 166,000 af
Release last 3 years > 344,000 af?
Perturbation?
Release last year > 166,000 af

STATUS OF THE SPECIES AND CRITICAL HABITAT

Colorado Pikeminnow

Species/Critical Habitat Description

The Colorado pikeminnow is the largest cyprinid fish (minnow family) native to North America and it evolved as the main predator in the Colorado River system. It is an elongated pike-like fish that during predevelopment times, may have grown as large as 1.8 meters (6 feet) in length and weighed nearly 45 kilograms (100 pounds) (Behnke and Benson 1983). Today, fish rarely exceed one meter (approximately 3 feet) in length or weigh more than 8 kilograms (18 pounds); such fish are estimated to be 45-55 years old (Osmundson et al. 1997). The mouth of this species is large and nearly horizontal with long slender pharyngeal teeth (located in the throat), adapted for grasping and holding prey. The diet of Colorado pikeminnow longer than 80 to 100 mm (3 or 4 inches) consists almost entirely of other fishes (Vanicek and Kramer 1969). Males become sexually mature earlier and at a smaller size than do females, though all are mature by about age 7 and 500 mm (20 inches) in length (Vanicek and Kramer 1969, Seethaler 1978, Hamman 1981). Adults are strongly countershaded with a dark, olive back, and a white belly. Young are silvery and usually have a dark, wedge-shaped spot at the base of the caudal fin.

Critical habitat is defined as the areas that provide physical or biological features that are essential for the recovery of the species. Critical habitat has been designated within the 100-year floodplain of the Colorado pikeminnow's historical range in the following section of the San Juan River Basin (59 F.R. 13374) (Fish and Wildlife Service 1993 and 1994).

> New Mexico, San Juan County; and Utah, San Juan County. The San Juan River from the State Route 371 Bridge in T. 29 N., R. 13 W., section 17 to Neskahai Canyon up to the full pool elevation in the San Juan arm of Lake Powell in T. 41 S., R. 11 E., section 26.

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

Status and Distribution

Based on early fish collection records, archaeological finds, and other observations, the Colorado pikeminnow was once found throughout warmwater reaches of the entire Colorado River Basin down to the Gulf of California, and including reaches of the Upper Colorado River and its major tributaries, the Green River and its major tributaries, the San Juan River and the Gila River system in Arizona (Seethaler 1978). Colorado pikeminnow apparently were never found in colder, headwater areas. Seethaler (1978) indicates that the species was abundant in suitable habitat throughout the entire Colorado River Basin prior to the 1850's. By the 1970's they were extirpated from the entire lower basin (downstream of Glen Canyon Dam) and from portions of the upper basin as a result of major alterations to the riverine environment. Having lost some 75-80 percent of its former range, the Colorado pikeminnow was federally listed as an endangered species in 1967 (Miller 1961, Moyle 1976, Tyus 1991, Osmundson and Burnham 1998). Platania and Young (1989) summarized historic fish collections in the San Juan River drainage which indicate that Colorado pikeminnow once inhabited reaches above what is now the Navajo Dam and Reservoir near Rosa, New Mexico. Since closure of the dam in 1962 and the accompanying fish eradication program, physical changes (flow, temperature, and the impoundment of water) associated with operation and presence of the Navajo Project have eliminated Colorado pikeminnow in the upper San Juan River, both from the reservoir basin as well as from several miles of river downstream of the dam. Habitat has been significantly degraded to where it injures Colorado pikeminnow by impairing the essential functions such as reproduction and recruitment into the adult population.

Major declines in Colorado pikeminnow populations occurred during the dam-building era of the 1930's through the 1960's. Behnke and Benson (1983) summarized the decline of the natural ecosystem, pointing out that dams, impoundments, and water use practices drastically modified the river's natural hydrology and channel characteristics throughout the Colorado River Basin. Dams on the mainstem broke the natural continuum of the river ecosystem into a series of disjunct segments, blocking native fish migrations, reducing temperatures downstream of dams, creating lacustrine habitat, and providing conditions that allowed competitive and predatory nonnative fishes to thrive both within the impounded reservoirs and in the modified river segments that connect them. The highly modified flow regime in the lower basin coupled with the introduction of nonnative fishes decimated populations of native fish.

Major declines of native fishes first occurred in the lower basin where large dams were constructed from the 1930's through the 1960's. In the upper basin, the following major dams were not constructed until the 1960's; Glen Canyon Dam on the mainstem Colorado River, Flaming Gorge Dam on the Green River, Navajo Dam on the San Juan River, and the Aspinall Unit Dams on the Gunnison River. To date, some native fish populations in the upper basin have managed to persist, while others have become nearly extirpated. River segments where native fish have declined more slowly than in other areas are those where the hydrologic regime most closely resembles the natural condition, where adequate habitat for all life phases still exists, and where migration corridors are unblocked and allow connectivity among habitats used during the various life phases.

Life History

The life-history phases that appear to be most critical for the Colorado pikeminnow include spawning, egg hatching, development of larvae, and the first year of life. These phases of Colorado pikeminnow development are tied closely to specific habitat requirements. Natural spawning of Colorado pikeminnow is initiated on the descending limb of the annual hydrograph as water temperatures approach or exceed 20 °C (Vanicek and Kramer 1969, Hamman 1981, Haynes et al. 1984, Tyus 1990, McAda and Kaeding 1991). Temperature at initiation of spawning varies somewhat by river: in the Green River, spawning begins as temperatures exceed 20-23 °C; in the Yampa River, 16-23 °C (Bestgen et al. 1998); in the Colorado River, 18-22 °C (McAda and Kaeding 1991); in the San Juan River temperatures were estimated to be 16-22 °C. Spawning, both in the hatchery and under natural riverine conditions, generally occurs in a 2-month time frame between late June and late August. However, in the natural system, sustained high flows during wet years may suppress river temperatures and extend spawning into September (McAda and Kaeding 1991). Conversely, during low flow years, when the water warms earlier, spawning may commence in mid-June.

Temperature also has an effect on egg development and hatching success. In the laboratory, egg development was tested at five temperatures and hatching success was found to be highest at 20 °C, lower at 25 °C, and mortality was 100 percent at 5, 10, 15, and 30 °C. In addition, larval abnormalities were twice as high at 25 °C than at 20 °C (Marsh 1985).

Experimental tests of temperature preference of yearling (Black and Bulkley 1985a) and adult (Bulkley et al. 1981) Colorado pikeminnow indicated that 25 °C was the most preferred temperature for both life phases. Additional experiments indicated that optimum growth of yearling Colorado pikeminnow also occurs at temperatures near 25 °C (Black and Bulkley 1985b). Although no such tests were conducted using adults, the tests with yearlings supported the conclusions of Jobling (1981) that the final thermal preferendum provides a good indication of optimum growth temperature, i.e., 25 °C.

Most information on Colorado pikeminnow reproduction was gathered from spawning sites on the lower 20 miles of the Yampa River and in Gray Canyon on the Green River (Tyus and McAda 1984; Tyus 1985; Wick et al 1985; Tyus 1990). Colorado pikeminnow spawn after peak runoff subsides and is probably triggered by several interacting variables such as photoperiod, temperature, flow level, and perhaps substrate characteristics. Spawning generally occurs from late June to mid-August with peak activity occurring when water temperatures are between 18 ° and 23 °C (Haynes et al. 1984; Archer et al. 1985; Tyus 1990, Bestgen et al. 1998).

Known spawning sites in the Yampa River are characterized by riffles or shallow runs with well-washed coarse substrate (cobble containing relatively deep interstitial voids (for egg deposition) in association with deep pools or areas of slow nonturbulent flow used as staging areas by adults (Lamarra et al. 1985, Tyus 1990). Recent investigations at a spawning site in the San Juan River by Bliesner and Lamarra (1995) and at one in the upper Colorado River (USFWS unpublished data) indicate a similar association of habitats. The most unique feature at the sites actually used for spawning, in comparison with otherwise similar sites nearby, is the degree of looseness of the cobble substrate and the depth to which the rocks are devoid of fine sediments; this appears consistent at the sites in all three rivers (Lamarra et al. 1985, Bliesner and Lamarra 1995).

Data indicates that clean cobble substrates that provide interstitial spaces for eggs are necessary for spawning and egg incubation (Tyus and Karp 1989). Several studies on the cobble cleaning process have been conducted at a known spawning location in Yampa Canyon. 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. O'Brien (1984) concluded that incipient motion of the cobble bed is required to clean cobbles for spawning and estimated that this takes discharges of about 21,500 cfs. However, Harvey et al.(1993) concluded that since flows required for incipient motion of bed material are rare (20 year return period event) and spawning occurs annually, another process must be cleaning the cobbles. Their study found that in Yampa Canyon recessional flows routinely dissect gravel bars and thereby produce tertiary bars of clean cobble at the base of the riffles. These tertiary bars are used by Colorado pikeminnow for spawning. The importance of high magnitude, low frequency discharges is in forming and maintaining the midchannel bars. Dissection of bars without redeposition by high magnitude flows would lead to conditions where spawning habitat is no longer available (Harvey et al. 1993).

Collections of larvae and young-of-year downstream of known spawning sites in the Green and Yampa Rivers indicates that downstream drift of larval Colorado pikeminnow occurs following hatching (Haynes et al. 1984; Nesler et al. 1988; Tyus 1990, Tyus and Haines 1991). During their first year of life, Colorado pikeminnow prefer warm, turbid, relatively deep (averaging 1.3 feet) backwater areas of zero velocity (Tyus and Haines 1991). After about 1 year, young are rarely found in such habitats, though juveniles and subadults are often located in large deep backwaters during spring runoff (USFWS, unpublished data; Osmundson and Burnham 1998).

Colorado pikeminnow often migrate considerable distances to spawn in the Green and Yampa Rivers (Miller et al.1982, Archer et al.1986, Tyus and McAda 1984, Tyus 1985, Tyus 1990), and similar movement has been noted in the main stem San Juan River. A fish captured and tagged in the San Juan Arm of Lake Powell in April 1987, was later recaptured in the San Juan River approximately 80 miles upstream in September 1987 (Platania 1990).

Two locations in the San Juan River have been identified as potential spawning areas based on radio telemetry and visual observations (Ryden and Pfeifer 1994; Miller and Ptacek 2000). Both locations occur within the "Mixer" (river mile133 to 129.8), a geomorphically dynamic reach of the San Juan River. The upper spawning location is located at RM 132. The lower spawning location is located at approximately RM 131.1. Both locations consist of complex habitat associated with cobble bar and island complexes. Habitat at these locations was similar to spawning habitats described for the Yampa River and is composed of side channels, chutes, riffles, slow runs, backwaters and slackwater areas near bars and islands. Substrate in the riffle areas is clean cobbles. Specific spawning habitat at the lower spawning area, based on radio telemetry and visual observations, is a fast narrow chute with a small adjacent eddy. Cobble was primary 3 to 4 inches in diameter (Miller and Ptacek 2000).

During 1993, radio tagged Colorado pikeminnow were observed moving to suspected spawning locations in the "Mixer" beginning around July 1. Fish were on suspected spawning areas between approximately July 12 to July 25. During this period flows in the San Juan River were on the descending limb of the spring runoff. Temperatures increased from approximately 20 ° to 25 °C (68 ° to 77 °F) during the same time period. Observations in other years show a similar pattern. However, specific spawning times and duration of the spawning period appear to vary from year to year.

Information on radio-tagged adult Colorado pikeminnow during fall suggests that fish seek out deep water areas in the Colorado River (Miller et al. 1982, Osmundson and Kaeding 1989), as do many other riverine species. River pools, runs, and other deep water areas, especially in upstream reaches, are important winter habitats for Colorado pikeminnow (Osmundson et al. 1995).

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

Population Dynamics

Due to the low numbers of Colorado pikeminnow collected in the San Juan River, it is not possible to quantify population size or trends.

The ability of the Colorado pikeminnow as a species to withstand adverse impacts to its populations and its habitat is difficult to discern given the longevity of individuals and their scarcity within the San Juan River Basin. Effects to reproduction and recruitment of young may be masked by the presence of older specimens more capable of withstanding impacts. At this stage of the investigations on the San Juan River, the younger life stages of the species is considered the most vulnerable to predation, competition, and habitat degradation through contamination. Response times to rebound from these impacts at a population level are lengthy.

Tissue samples from Colorado pikeminnow caught during research conducted under the Program have been analyzed as part of a basin-wide analysis of endangered fish genetics. The results of that analysis indicated that the San Juan River fish exhibited less genetic variability than the Green River and Colorado River populations, likely due to the small population size in the San Juan (Morizot in litt. 1996), but were very similar to Colorado pikeminnow from the Green, Colorado, and Yampa Rivers, suggesting that the San Juan population is probably not a separate stock (Holden and Masslich 1997).

Analysis of Species/Critical Habitat Likely to be Affected

The San Juan River currently flows approximately 225 river miles from the Navajo Dam downstream to Lake Powell. The reach of known occupied Colorado pikeminnow habitat extends from Lake Powell upstream to RM 158.4. Of the 225 miles, about 159 of those are potentially available to the Colorado pikeminnow. Ryden and Pfeifer (1993) identified five diversion structures between Farmington, New Mexico, and the Utah state line that potentially act as barriers to fish passage at certain flows (Cudei, Hogback, Four Corners Power Plant, San Juan Generating Station, and Fruitland Irrigation Canal diversions). Since radio telemetry studies were initiated on the San Juan River in 1991, only one radio-tagged fish has been recorded moving upstream past one of the diversions. In 1995, an adult Colorado pikeminnow moved above the Cudei Diversion and then returned back downstream (Miller 1995). Other native fish have been found to move either upstream or downstream over all five of the weirs (Buntjer and Brooks 1997, Ryden 2000a).

Colorado pikeminnow adults primarily use the San Juan River between RM 119 (Four Corners) and RM 148 (Cudei Diversion) (Ryden and Pfeifer 1993, 1994, 1995a, 1996). The multi-threaded channel, habitat complexity, and mixture of substrate types in this area of the river appear to provide a diversity of habitats favorable to Colorado pikeminnow on a year-round basis (Holden and Masslich 1997).

Based on radio telemetry studies and visual observations, two potential spawning areas have been located at RM 132.0 and 131.15 (Miller 1994, Ryden and Pfeifer 1995a). Both of these sites are located in an area of the river known as the "Mixer" (RM 133.4 to RM 129.8). Ryden and Pfeifer (1995a) report that a Colorado pikeminnow captured at RM 74.8 (between Bluff and Mexican Hat) made a 50-60 mile migration to the Mixer during the suspected spawning season in 1994. The fish then returned to within 0.4 river miles of its original capture location.

Successful reproduction was documented in the San Juan River in 1987, 1988, 1992, 1993, 1994, 1995, and 1996 by the collection of larval and young-of-year Colorado pikeminnow. Majority of the young-of-year pikeminnow were collected in the San Juan River inflow to Lake Powell (Archer et al. 1995, Buntjer et al. 1994, Lashmett 1994, Platania 1990). Some young-of-year pikeminnow have been collected from the vicinity of the Mancos River confluence in New Mexico and in the vicinity of the Montezuma Creek confluence near Bluff, Utah, and at a drift station near Mexican Hat, Utah (Buntjer et al. 1994, Snyder and Platania 1995). The collection of such young fish (only a few days old) at Mexican Hat during 2 years suggests that perhaps another spawning area for Colorado pikeminnow exists somewhere below the Mixer (Platania 1996). Capture of a larval Colorado pikeminnow at RM 128 during August 1996 was the first larvae collected below the suspected spawning site in the Mixer (Holden and Masslich 1997).

Platania (1990) noted that, during the 3 years of studies on the San Juan River (1987-1989), spring flows and Colorado pikeminnow reproduction were highest in 1987. He further noted catch rates for channel catfish were lowest in 1987. Subsequent studies (Brooks et al 1994) found declines in channel catfish in 1993; declines that have been attributed to a successive series of higher than normal spring runoffs beginning in spring 1991 through 1993. Recent studies also found catch rates for young-of-year Colorado pikeminnow to be highest in high water years, such as 1993 (Buntjer et al. 1994, Lashmett 1994).

Between 1991 and 1995 nineteen (17 adult and 2 juvenile) wild Colorado pikeminnow were collected in the San Juan River by electrofishing (Ryden 2000a). Adult Colorado pikeminnow are most abundant between Cudei Diversion and Four Corners.

Experimental stocking of 100,000 young-of-year Colorado pikeminnow was conducted in November 1996 to test habitat suitability and quality for young life stages of this species (Lentsch et al. 1996). Monitoring in late 1996 and 1997 found these fish scattered in appropriate habitats from just below the upstream stocking site at Shiprock, New Mexico, to Lake Powell. During the fall of 1997, the fish stocked in 1996 were caught in relatively high numbers and exhibited good growth rates as well as good survival rates (Holden and Masslich 1997). In August 1997, an additional 100,000 young-of-year Colorado pikeminnow were stocked in the river. In October 1997, the young-of-year stocked two months previously were found distributed below stocking sites and relatively large numbers also nearly 10 miles above the Shiprock stocking location. The 1997 stocked fish were smaller than those stocked in 1996, but apparently could move about the river to find acceptable habitats (Holden and Masslich 1997).

Razorback Sucker

Species/Critical Habitat Description

The razorback sucker, an endemic species unique to the Colorado River Basin, was historically abundant and widely distributed within warmwater reaches throughout the Colorado River Basin. The razorback sucker is the only sucker with an abrupt sharp-edged dorsal keel behind its head. It has a large fleshy subterminal mouth that is typical of most suckers. Adults often exceed 3 kg (6lbs) in weight and 600 mm (2 ft) in length.

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

A marked decline in populations of razorback suckers can be attributed to construction of dams and reservoirs, introduction of nonnative fishes, and removal of large quantities of water from the Colorado River system. Dams on the main stem Colorado River and its major tributaries have segmented the river system, blocking migration routes. Dams also have drastically altered flows, temperatures, and channel geomorphology. These changes have modified habitats in many areas so that they are no longer suitable for breeding, feeding or sheltering. Major changes in species composition have occurred due to the introduction of numerous nonnative fishes, many of which have thrived due to man-induced changes to the natural riverine system. Habitat has been significantly degraded to where it injures razorback sucker by impairing the essential functions such as reproduction and recruitment into the adult population.

Critical habitat was designated in 1994 within the 100-year floodplain of the razorback sucker's historical range in the following area of the Upper Colorado River (59 F.R. 13374). The primary constituent elements are the same as critical habitat for Colorado pikeminnow described above.

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

Status and Distribution

The current distribution and abundance of the razorback sucker have been significantly reduced throughout the Colorado River system, due to lack of recruitment to the adult population (McAda 1987; McAda and Wydoski 1980; Holden and Stalnaker 1975; Minckley 1983; Marsh and Minckley 1989; Tyus 1987). The only substantial population exists in Lake Mohave with a current estimated population of less than 9,000 adults (Chuck Minckley, pers. comm.) down from the estimated 25,000 adult razorback suckers in 1995 (Chuck Minckley, pers. comm.) which is down from an earlier estimate of 60,000 adult razorback suckers (Minckley et al. 1991). They do not appear to be successfully recruiting. While limited numbers of razorback suckers persist in other locations in the lower Colorado River, they are considered rare or incidental and may be continuing to decline.

In the upper basin, above Glen Canyon Dam, razorback suckers are found in limited numbers in both lentic and lotic environments. The largest population of razorback suckers in the upper basin is found in the upper Green River and lower Yampa River (Tyus 1987). Lanigan and Tyus (1989) estimated that from 758 to 1,138 razorback suckers inhabit the upper Green River. Modde et al. (1996) report no significant decrease in the population between 1982 and 1992, and the continued presence of fish smaller than 480 mm during the study period suggest some level of recruitment. In the Colorado River, most razorback suckers occur in the Grand Valley area near Grand Junction, Colorado; however, they are increasingly rare. Osmundson and Kaeding (1991) report that the number of razorback sucker captures in the Grand Junction area has declined dramatically since 1974. In 1991 and 1992, 28 adult razorback suckers were collected from isolated ponds adjacent to the Colorado River near De Beque, Colorado (Burdick 1992). The existing habitat has been modified to the extent that it impairs essential behavior patterns, such as breeding, feeding, and sheltering.

Razorback suckers are in imminent danger of extirpation in the wild. The razorback sucker was listed as endangered October 23, 1991 (56 FR 54957). As Bestgen (1990) pointed out:

> "Reasons for decline of most native fishes in the Colorado River Basin have been attributed to habitat loss due to construction of mainstream dams and subsequent interruption or alteration of natural flow and physio-chemical regimes, inundation of river reaches by reservoirs, channelization, water quality degradation, introduction of nonnative fish species and resulting competitive interactions or predation, and other man-induced disturbances (Miller 1961, Joseph et al. 1977, Behnke and Benson 1983, Carlson and Muth 1989, Tyus and Karp 1989). These factors are almost certainly not mutually exclusive, therefore it is often difficult to determine exact cause and effect relationships."

Extremely limited recruitment suggests a combination of biological, physical, and/or chemical factors that may be affecting the survival and recruitment of early life stages of razorback suckers. Within the upper basin, recovery efforts include the capture and removal of razorback suckers from all known locations for genetic analyses and development of discrete brood stocks if necessary. These measures have been undertaken to develop refugia populations of the razorback sucker from the same genetic parentage as their wild counterparts such that, if these fish are genetically unique by subbasin or individual population, then separate stocks will be available for future augmentation. Such augmentation may be a necessary step to prevent the extinction of razorback suckers in the upper basin.

Life History

McAda and Wydoski (1980) and Tyus (1987) reported springtime aggregations of razorback suckers in off-channel habitats and tributaries; such aggregations are believed to be associated with reproductive activities. Tyus and Karp (1990) and Osmundson and Kaeding (1991) reported off-channel habitats to be much warmer than the main stem river and that razorback suckers presumably moved to these areas for feeding, resting, sexual maturation, spawning, and other activities associated with their reproductive cycle. Prior to construction of large main stem dams and the suppression of spring peak flows, low velocity, off-channel habitats (seasonally flooded bottomlands and shorelines) were commonly available throughout the upper basin (Tyus and Karp 1989; Osmundson and Kaeding 1991). Large main stem dams changed riverine ecosystems into lakes by impounding water, which eliminated these off-channel habitats within the inundated areas created by the reservoirs. Reduction in spring peak flows eliminates or reduces the frequency of inundation of off-channel habitats. The absence of these seasonally flooded riverine habitats is believed to be a limiting factor in the successful recruitment of razorback suckers in their native environment (Tyus and Karp 1989; Osmundson and Kaeding 1991). Wydoski and Wick (1998) identified starvation of larval razorback suckers due to low zooplankton densities in the main channel and loss of floodplain habitats which provide adequate zooplankton densities for larval food as one of the most important factors limiting recruitment.

While razorback suckers have never been directly observed spawning in turbid riverine environments within the upper basin, captures of ripe specimens, both males and females, have been recorded (Valdez et al. 1982; McAda and Wydoski 1980; Tyus 1987; Osmundson and Kaeding 1989; Tyus and Karp 1989; Tyus and Karp 1990; Osmundson and Kaeding 1991; Platania 1990, Ryden 2000b) in the Yampa, Green, Colorado, and San Juan Rivers. Sexually mature razorback suckers are generally collected on the ascending limb of the hydrograph from mid-April through June and are associated with coarse gravel substrates.

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

Habitat requirements of young and juvenile razorback suckers in the wild are not well known, particularly in native riverine environments. Prior to 1991, the last confirmed documentation of a razorback sucker juvenile in the upper basin was a capture in the Colorado River near Moab, Utah (Taba et al. 1965). In 1991, two early juvenile (36.6 and 39.3 mm TL) razorback suckers were collected in the lower Green River near Hell Roaring Canyon (Gutermuth et al. 1994). Juvenile razorback suckers have been collected in recent years from Old Charley Wash, a wetland adjacent to the Green River (Modde 1996). Between 1992 and 1995 larval razorback suckers were collected in the middle and lower Green River and within the Colorado River inflow to Lake Powell (Muth 1995). No young razorback suckers have been collected in recent times in the Colorado River.

<u>Population Dynamics</u>

There are no population estimates of razorback sucker in the San Juan River because of the low number of wild fish. Between March of 1994 and October 1996 a total of 939 hatchery raised razorback suckers were stocked in the San Juan River (Ryden 2000b). Some fish that were stocked in 1994 are still being collected during annual sampling (Ryden 2000b). Larval razorback suckers were collected in 1998 and 1999, indicating that the stocked fish are successfully spawning in the San Juan River (Ryden 2000c).

<u>Analysis of Species/Critical Habitat Likely to be Affected</u>

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

Beginning in May 1987 and continuing through October 1989, complementary investigations of fishes in the San Juan River were conducted in Colorado, New Mexico, and Utah (Platania 1990;

Platania et al. 1991). In 1987, a total of 18 adult razorbacks (six recaptures) were collected on the south shore of the San Juan arm of Lake Powell (Platania 1990; Platania et al. 1991). These fish were captured near a concrete boat ramp at Piute Farms Marina and were believed to be either a spawning aggregation or possibly a staging area used in preparation for migration to some other spawning site. Of the 12 individual razorbacks handled in 1987, eight were running ripe males while the other four specimens were females that appeared gravid.

In 1988, a total of 10 razorback suckers were handled at the same general location, 5 of which were in reproductive condition (Platania et al. 1991). Six of the ten individual specimens in the 1988 samples were recaptures from 1987. Also, in 1988, a single adult tuberculate male razorback sucker was captured at approximately RM 80 on the San Juan River near Bluff, Utah. Particularly noteworthy is that this is the first confirmed record of this species from the main stem San Juan River. The presence of this reproductively mature specimen suggests that the razorback may be attempting to spawn in some unknown location within the riverine portion of the San Juan drainage. No razorback suckers were captured in 1989.

The existing scientific literature and historic accounts by local residents strongly suggests that razorback suckers were once a viable, reproducing member of the native fish community in the San Juan River drainage. Currently, the razorback sucker is rare throughout its historic range and extremely rare in the main stem San Juan River. There is no evidence from anywhere in the Colorado River system that indicates significant recruitment to any population of razorback sucker (Bestgen 1990, Platania 1990, Platania et al. 1991, Tyus 1987, McCarthy and Minckley 1987, Osmundson and Kaeding 1989).

Because razorback sucker are so rare in the San Juan River, an experimental stocking program was initiated. In March 1994, fifteen radio-tagged razorback sucker were stocked in the San Juan River at Bluff, Utah (RM 79.6); near Four Corners Bridge (RM 117.5); and above the Mixer in New Mexico (RM 136.6). In November 1994 an additional 15 radio-tagged adults were stocked as well as 656 PIT-tagged fish in the same locations as well as an additional site just below the Hogback Diversion in New Mexico (RM 158.5). Monitoring found that these razorback suckers used slow or slackwater habitats such as eddies, pools, backwaters, and shoals in March and April and fast water 92.2 percent of the time in June and August (Ryden and Pfeifer 1995b). During 1995, both radio-tagged fish and PIT tagged fish were contacted or captured. Razorback suckers were found in small numbers from the Hogback Diversion (RM 158.6) to 38.1 river miles above Lake Powell (Dale Ryden, USFWS, pers. comm.). Results of the monitoring efforts indicate that the San Juan River provides suitable habitat to support subadult and adult razorback sucker on a year-round basis (Ryden and Pfeifer 1996). Four ripe male razorback sucker were found in spring 1997 that appeared similar to a spawning aggregation. Several of the fish had moved up or down the river to the general location of the aggregation, suggesting some focus, such as spawning, for the aggregation (Ryden 2000b). In 1998, two larval razorback sucker were collected between Montezuma Creek and Bluff, Utah, downstream of the 1997 aggregation site (Ryden 2000c). In April of 1999, two ripe male razorback sucker and one gravid female were collected within a few feet of the 1997 aggregation. All three fish were from the November 1994 stocking. Between May 4 and June 14, 1999, 7 larval razorback sucker were collected below the suspected spawning site (Ryden 2000c).

The results of the experimental stocking discussed above led the Program to initiate a 5-year augmentation program for the razorback sucker in 1997 (Ryden 1997). In September 1997, as the initial step of that augmentation program, 2,885 subadult razorback sucker were stocked below Hogback Diversion Dam.

Bald Eagle

Species/Critical Habitat Description

The bald eagle is the only species of sea eagle native to North America. Adults are distinguished by a white head and tail and a dark brown body. Immature bald eagles are dark brown with white mottling, with the white head and tail apparent by age five. No critical habitat has been designated for the bald eagle.

Status and Distribution

The bald eagle south of the 40th parallel was listed as endangered under the Endangered Species Act of 1966 on March 11, 1967 (Federal Register 32(48):4001). It was reclassified to threatened status on July 12, 1995 (Federal Register 50(17):35999-36010). On July 6, 1999, the bald eagle was proposed for removal from the list of endangered and threatened wildlife (Federal Register 64 (128) 36454-36464). A final decision on the delisting proposal is expected in July of 2000. The bald eagle historically ranged throughout North America except Hawaii, extreme northern Alaska and Canada and central and southern Mexico. Bald eagles nested on both coasts of the United States, from Florida to Baja California in the south and from Labrador, Newfoundland, to the Aleutian Islands, Alaska, in the north.

There were an estimated one-quarter to one-half million bald eagles on the North American continent when Europeans first arrived. Initial population declines probably began in the late 1800s, and coincided with declines in the number of waterfowl, shorebirds, and other prey species. Direct killing of bald eagles was also prevalent. Additionally, there was a loss of nesting habitat. These factors reduced bald eagle numbers until the 1940s when protection for the bald eagle was provided through the Bald Eagle Protection Act (16 U.S.C. 668). This act accomplished protection and slowed decline in bald eagle populations by prohibiting numerous activities adversely affecting bald eagles and increasing public awareness of bald eagles. The widespread use of dichloro-diphenyl-trichloroethane and other organochlorine compounds in the 1940s for mosquito control and as a general insecticide caused additional declines in bald eagle populations. DDT accumulated in individual birds following ingestion of contaminated food. DDT breaks down into dichlorophenyl-dichloroethylene and accumulates in the fatty tissues of adult females, leading to impaired calcium release necessary for egg shell formation. Thinner egg shells led to reproductive failure, and is considered a primary cause of declines in the bald eagle population. DDT was banned in the United States in 1972 (Service 1995).

There are five recovery regions in the lower 48 States: Chesapeake, Northern States, Pacific, Southeastern, and Southwestern. Each recovery region has its own recovery plan, with recovery goal specific to that region. Since development and implementation of the recovery plans, population growth has exceeded most of the goals established. From 1974 to 1994, the number of occupied breeding areas increased by 462 percent. In the last 10 years, nesting populations have increased at an average rate of 8 percent per year. These dramatic increases in populations are what prompted the Service to propose removing the bald eagle from the list of endangered and threatened wildlife.

Life History

Bald eagles are often found in association with open water along seacoasts, large lakes and rivers. Their diet consists largely of fish and waterfowl, but also includes upland birds, small mammals, and carrion. In southwest Colorado, castings from one nest were made up of entirely prairie dog remains (Jerry Craig, CDOW, pers. comm.). Bald eagles are skilled hunters but also have been observed stealing prey captured by other raptors.

Survival of individual eagles, particularly those in their first year of life, probably depends heavily on conditions they encounter during the wintering period. The physiological condition of adults at the beginning of each breeding season, an important factor influencing reproductive success, is also affected by how well their energy demands are met in wintering areas. Thus, the survival and recovery of nesting populations depend on eagles having suitable wintering areas with an adequate prey base (U.S. Fish and Wildlife Service 1983). During the primary wintering period of December to March, suitable roosting and foraging habitat is important to eagles (U.S. Fish and Wildlife Service 1992, Harmata 1984, Stalmaster et al. 1979, U.S. Fish and Wildlife Service 1983).

Population Dynamics

Since listing, bald eagles have increased in number and expanded in range due to the banning of DDT and other persistent organochlorine compounds, habitat protection, and recovery efforts. Surveys in 1963 indicated 417 active nests in the lower 48 states with an average of 0.59 young produced per nest. In 1994, 4,450 occupied breeding areas were reported with an estimated average of 1.17 young produced per occupied nest (Service 1995). In 1998, the Service estimated the breeding population in the lower 48 States exceeded 5,748 occupied breeding areas (Service 1999). The bald eagle population has essentially doubled every 7 to 8 years during the past 30 years.

In the Northern States Recovery Region, including Colorado, bald eagle nesting activity has increased from fewer than 700 occupied breeding areas in 1985 to more than 2,204 areas in 1998. In Colorado, the Colorado Division of Wildlife reported 8 or 9 nesting pairs in the late 1980's, and 29 pairs in 1999 (Jerry Craig, CDOW, pers. comm.). Of those 29 pairs, 17 are located west of the continental divide.

In the Southwestern Recovery Region, including New Mexico, 40 breeding territories were occupied in 1998; four were in New Mexico.

Analysis of the Species likely to be affected

Colorado is a popular wintering area for bald eagles (U.S. Fish and Wildlife Service 1992, Harmata 1984). In 1993-1994, 1,235 bald eagles were counted by the Colorado Division of Wildlife during midwinter counts, and 969 were counted in 1999 (Jerry Craig and Lyn Stevens, CDOW, pers. comm.). In New Mexico, during the winter of 1994-1995, the New Mexico Department of Fish and Game counted 402 bald eagles state wide, with 35 occurring in the San Juan Basin (John Pittenger, NMDFG, pers. comm.). Winter surveys have not been conducted by the New Mexico Department of Fish and Game since 1995 (Nick Medley NMDFG, pers. comm.).

As part of the conservation recommendations of the 1991 biological opinion, Reclamation has conducted wintering bald eagle surveys since1993. Results of the surveys show that the Animas and La Plata Rivers are important wintering areas for bald eagles. Bald eagles arrive in the floodplain areas in mid-November and leave by late March or early April. Numbers of wintering eagles fluctuate from year to year depending on weather patterns. Reclamation found most bald eagles in mature cottonwood stands in areas relatively free from human disturbance. Reclamation surveys documented two communal roosts on the La Plata River and one in the San Juan Arm of Navajo Reservoir. Bald eagles in the project vicinity rely on mammalian carrion, especially deer.

There are currently no known active nests within the project area, however, there are two nest sites on the Animas River downstream of Basin Creek.

ENVIRONMENTAL BASELINE

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

In formulating this opinion, the Service considered adverse and beneficial effects likely to result from cumulative effects of future State and private activities that are reasonably certain to occur within the Project area, along with the direct and indirect effects of the Project and impacts from actions that are part of the environmental baseline (50 CFR 402.02 and 402.14 (g)(3)).

Status of the Species Within the Action Area

An action area is defined as the entire area that is affected by the action. For the Animas-La Plata Project the action area includes all of the designated habitat critical habitat on the San Juan River for the Colorado pikeminnow and razorback sucker. Therefore, the status of the Colorado pikeminnow and razorback sucker within the action area is described above under the analysis of species and critical habitat likely to be affected are part of the baseline. The status of the bald eagle within the action area is also described above under the analysis of species likely to be affected are part of the baseline.

Factors Affecting Species Environment Within the Action Area

Critical habitat has been designated for the Colorado pikeminnow and razorback sucker within the 100-year floodplain in portions of their historic range (59 F.R. 13374). Destruction or adverse modification of critical habitat is defined in 50 CFR 402.02 as a direct or indirect alteration that appreciably diminishes the value of critical habitat for both the survival and recovery of listed species. In considering the biological basis for designating critical habitat, the Service focused on the primary physical and biological elements that are essential to the conservation of the species without consideration of land or water ownership or management. The Service has identified water, physical habitat, and biological environment as the primary constituent elements. This includes a quantity of water of sufficient quality that is delivered to a specific location in accordance with a hydrologic regime that is required for the particular life stage for each species. Water depletions reduce the ability of the river system to provide the required water quantity and hydrologic regime necessary for recovery of the fishes. The physical habitat includes areas of the San Juan River system below Farmington, New Mexico, that are inhabited or potentially habitable for use in spawning and feeding, as a nursery, or serve as corridors between these areas. In addition, oxbows, backwaters, and other areas in the 100-year floodplain, when inundated, provide access to spawning, feeding, and nursery habitats. Water depletions reduce the ability of the river to create and maintain these important habitats. Food supply, predation, and competition are important elements of the biological environment. Food supply is a function of nutrient supply and productivity, which could be limited by reduction of high spring flows brought about by water depletions. Predation and competition from nonnative fish species has been identified as a factor in the decline of the endangered fishes. Water depletions contribute to alterations in flow regimes that favor nonnative fishes.

Water Quantity

In the San Juan River, the magnitude of spring flows has declined by 45 percent since Navajo Dam was built. Such flow reductions negatively affect Colorado pikeminnow and razorback sucker in four ways: (1) reducing the river's ability to build and clean cobble bars for spawning; (2) reducing the dilution effect for waterborne contaminants from urban and agricultural sources that may interfere with reproductive success; (3) reducing the connectivity of main-channel and bottomland habitats needed for habitat diversity and productivity; and (4) providing a more benign environment for nonnative fish and invasive, nonnative, bank-stabilizing shrubs (salt cedar) to persist and flourish (Osmundson and Burnham 1998). In general, the existing habitat has been modified to the extent that it significantly impairs essential behavior patterns, such as breeding, feeding, and sheltering and injures the endangered fish species.

Water depletions in the San Juan River Basin have been recognized as a major source of impact to endangered fish species. Continued water withdrawal has restricted the ability of the San Juan River system to produce flow conditions required by various life stages of the fishes. In 1963, the Navajo Dam was closed, and Navajo Reservoir began to fill with water from the San Juan River. Historically, flows in the San Juan River prior to the Navajo Dam were highly variable and ranged from a low of 44 cubic feet per second (cfs) in September 1956 to a high of 19,790 cfs in May 1941 (mean monthly values) at the U.S. Geological Survey Station 93680000, Shiprock, New Mexico. Conversely, post-Navajo Dam flows in the San Juan River have ranged from a low of 185 cfs in July 1963, while the reservoir was filling, to a high of 9,508 cfs in June 1979. Since 1963, Navajo Dam has significantly altered flow of the San Juan River by typically storing spring peak flows and releasing water in summer, fall, and winter months resulting in an average decrease in spring peak flows of 45 percent, while approximately doubling winter base flows at the Bluff gauge in Utah. Similar comparisons can be made at the upstream gauges at Shiprock and Farmington, New Mexico. Significant depletions and redistribution of flows of the San Juan River also have occurred as a result of other major water development projects, including Navajo Indian Irrigation Project and the San Juan-Chama Project. At the current level of development, average annual flows at Bluff, Utah, already have been depleted by 30 percent. By comparison, the Green and Colorado Rivers have been depleted approximately 20 percent (at Green River) and 32 percent (at Cisco), respectively. These depletions, along with a number of other factors, have resulted in such drastic reductions in the populations of Colorado pikeminnow and razorback sucker throughout their ranges that the Service has listed these species as endangered and has implemented programs to prevent them from becoming extinct.

The environmental baseline for water depletions for the Animas-La Plata Project is shown in Table 6. As explained above, the environmental baseline includes the past and present impacts of all Federal, State, and private actions and other human activities in the action area; the anticipated impacts of all proposed Federal projects in the action area that have already undergone formal section 7 consultation; and the impact of State or private actions contemporaneous with the consultation process.

Table 6. Environmental Baseline for the Animas-La Plata Project

DEPLETIONS BY STATE	AVERAGE ANNUAL DEPLETION(AC-FT)	DEPLETION RANGE (1929 TO 1993) (MAX AC-FT)	(MIN AC-FT)
New Mexico Depletions			
Navajo Lands Irrigation Depletion			
Navajo Indian Irrigation Project	280,600[7]	297,203	224,796
Hogback	12,100	14,216	9,592
Fruitland	7,898	9,279	6,432
Cudei	900	1,058	687
Subtotal	**301,499**		
Non-Navajo Lands Irrigation Depletion			
Above Navajo Dam - Private	738	1,040	504
Above Navajo Dam - Jicarilla	2,190	3,086	1,494
Animas River	36,711	42,671	29,418
La Plata River	9,739	11,272	7,516
Upper San Juan	9,137	10,735	7,347
Hammond Area	10,268	12,063	8,256
Farmers Mutual Ditch	9,532	11,272	5,894
Jewett Valley	3,088	3,757	2,604
Westwater	110		
Subtotal	**81,513**		
Total NM Irrigation Depletion	**383,012**		
Non-Irrigation Depletions			
Navajo Reservoir Evaporation	27,694	32,099	19,733
Utah International	39,000	39,000	39,000
San Juan Power Plant	16,200	16,200	16,200
Industrial Diversions near Bloomfield	2,500		
M&I Uses	8,454		
Scattered Rural Domestic Uses	1,400[8]		
Scattered Stockponds & Livestock Uses	2,200[8]		
Fish and Wildlife	1,400[8]		
Total NM Non-Irrigation Depletion	**98,848**		
San Juan Project Exportation	107,514	201,047	23,457
Unspecified Minor Depletions	4,488[9]		
Total NM Depletions	**593,863 (Excluding ALP)**		

[7]Includes 10,600 acre-feet of annual groundwater storage, which drops the depletion figure to 270,000 acre-feet at equilibrium.

[8]Indicates offstream depletion accounted for in calculated natural gains.

[9]1,500 acre-feet of depletion from minor depletions approved of SJRIP in 1992. 3,000 acre-feet from 1999 intra-service consultation, a portion of which may be in Colorado.

Table 6. Environmental Baseline for the Animas-La Plata Project (continued)

DEPLETIONS BY STATE	AVERAGE ANNUAL DEPLETION(AC-FT)	DEPLETION RANGE (1929 TO 1993) (MAX AC-FT)	(MIN AC-FT)
Colorado Depletions			
Upstream of Navajo			
Upper San Juan	10,858	13,905	7,341
Navajo-Blanco	7,865	10,345	5,015
Piedra	8,098	13,196	2,935
Pine River	71,664	96,692	53,174
Subtotal	**98,485**		
Downstream of Navajo			
Florida	28,538	33,137	15,688
Animas	25,113[10]	32,354	19,659
La Plata	13,049	23,647	1,548
Mancos	19,530	24,339	14,257
Subtotal	**86,032**		
Total CO Depletions	**184,714 (Excluding ALP)**		
CO & NM Combined Depletions	778,577		
Subtotal	778,577		
McElmo Basin Imports	-11,990	-17,969	7,756
Utah Depletions	9,140[11]	1,705	1,705
Arizona Depletions	10,010[8]		
NET NM, CO, UT, AZ Depletion	**785,736**		
NM Off River Depletions			
Chaco River	2,832[8]		
Whiskey Creek	523[8]		
GRAND TOTAL	**789,091**		

Water Quality

Surface and ground water quality in the Animas, La Plata, Mancos, and San Juan River drainages have become significant concerns (Brogden et al. 1979). Changes in water quality and contamination of associated biota are known to occur in Reclamation projects in the San Juan drainage (i.e., irrigated lands on the Pine and Mancos Rivers) where return flows from irrigation make up a portion of the river flow or other aquatic sites downstream (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 has degraded water quality of the San Juan River in critical habitat.

[10]Includes 1,439 acre-feet for the City of Durango pumping station biological opinion (GJ-6-CO-97-F-026).

[11]1,705 acre-feet San Juan River depletion, 9,224 acre-feet offstream depletion.

Information on existing water quality, summarized in Abell (1994), in the San Juan River has been derived from data gathered by the Department of the Interior as part of its National Irrigation Water Quality Program investigation of the San Juan River area in northeastern New Mexico (Blanchard et al. 1993), results from Reclamation's water quality data for the Animas-La Plata project, and ongoing contaminant monitoring and research conducted as part of the Program.

Concentrations of selenium in water samples collected from the mainstem of the San Juan River exhibited a general increase in concentration levels with distance downstream from Archuleta, New Mexico, to Bluff, Utah, (<1 µg/l to 4 µg/l) (Wilson et al 1995). The safe levels of selenium concentrations for protection of fish and wildlife in water are <2µg/l and toxic levels are considered >2.7 µg/l (Lemly 1993, Maier and Knight 1994, Wilson et al. 1995). Tributaries to the San Juan carry higher concentrations of selenium than found in the mainstem river immediately upstream from their confluence with the San Juan; although these levels are diluted by the flow of the San Juan, the net effect is a gradual accumulation of the element in the river's flow as it travels downstream. Increased selenium concentrations may also result from the introduction of ground water to the mainstem of the river along its course.

Sediments and biota associated with the San Juan River have also showed elevated selenium levels. Composite fish samples were collected during the DOI study from six reaches of the San Juan River in spring 1990 and from seven reaches in fall 1990. Each composite sample typically consisted of five individuals of a single species. Composite samples of common carp (*Cyprinus carpio*) and flannelmouth sucker (*Catostomus latipinnis*) were collected from each reach during each sampling period. In addition, six channel catfish (*Ictalurus punctatus*) composite samples were collected during the two sampling periods in reaches where the species was encountered. The highest concentrations of selenium in common carp and flannelmouth sucker occurred in the river from Bloomfield to Farmington, New Mexico (Blanchard et al. 1993). Subsequent investigations (Wilson et al. 1995) have detected elevated levels of selenium in habitats associated with irrigation drainage returns and in the Mancos River. Selenium levels in whole body fish occasionally exceeded concentrations reported to be associated with reproductive failure and may pose a threat to predatory fish that consistently feed in the regions with elevated selenium.

The other contaminants of concern are polycyclic aromatic hydrocarbons (PAHs), also known as polynuclear aromatic hydrocarbons (PNAs). These compounds may reach aquatic environments in domestic and industrial sewage effluents, in surface runoff from land, from deposition of airborne particulates, and particularly from spillage of petroleum and petroleum products into water bodies (Eisler 1987). PAHs were the first compounds known to be associated with carcinogenesis (Lee and Grant 1981). Wilson et al. (1995) reported that concentrations of PAHs were elevated in the Animas River, but no identification of source location or activity has been made. The San Juan River below Montezuma Creek also had elevated levels of PAHs; and seasonal increases in PAH concentrations were detected in the "Mixer" area of the river. PAH levels in the bile of common carp and channel catfish sampled were high in one fish captured below Cudei Diversion and moderate in several fish captured near Bluff, Utah, above Cudei Diversion, and near Mexican Hat, Utah. The presence of PAH metabolites in bile of every fish sampled suggested some level of exposure to hydrocarbons (Wilson et al. 1995). Service analyses of PAH contamination of aquatic biota of the San Juan River and hepato-histological examinations of fish in the river raised concerns regarding the exposure of these organisms to contaminants introduced into the basin through the intensive development of energy resources in the area. Analyses of bile samples taken from fish in the San Juan River in 1991 indicated that these organisms were being exposed to high levels of three PAH compounds.

Physical Habitat

The quantity and timing of flows influence how various habitats are formed and maintained. Water depletions reduce the ability of the river to create and maintain backwaters, secondary channels, and cobble bars; degradation of water quality lessens the ability of endangered species to survive in these habitats.

Osmundson and Kaeding (1991) reported observations on the Colorado River (15-mile reach) during the drought years of 1988 -1990, that backwaters were filling in with silt and sand because spring flows were not sufficient to flush out the fine sediment. Also they reported that tamarisk colonized sand and cobble bars, stabilizing the river banks. On the San Juan River, lack of flooding since Navajo Dam was completed has caused establishment of exotic riparian vegetation (tamarisk and Russian olive) that has armored the channel banks resulting in a narrowing of the channel with reduced flood capacity (Bliesner and Lamarra 1994).

As previously stated, Colorado pikeminnow spawn July 1 to September 1 in cobble/gravel areas typically found in riffle/run habitats. Following hatch, larval Colorado pikeminnow drift downstream to low velocity habitats. Important habitats during summer low flow (August) are the San Juan's backwaters and secondary channels, used by larvae and young Colorado pikeminnow. Razorback sucker spawning aggregations have been observed in the San Juan River on the ascending limb of the hydrograph over cobble bars.

Biological Environment

Food supply, predation, and competition are important elements of the biological environment. Food supply is a function of nutrient supply and productivity, which could be limited by the presence of contaminants. Predation and competition from nonnative fishes has been identified as a factor in the decline of the endangered fishes. Depending upon species-specific tolerance levels, nonnative fishes may have competitive advantages in habitats damaged by the presence of contaminants and altered flow regimes.

Riparian Habitat

Bald eagles winter in the riparian corridors of the rivers in the project vicinity. The primary habitat used for perching, roosting, and nesting are the mature cottonwood trees associated with the riparian corridors of these rivers. Reduction in spring flows can affect recruitment of cottonwood trees, and over the long term affect bald eagle habitat.

Human disturbance has increased in the Animas and La Plata River corridors in recent years. During Reclamation's bald eagle surveys, it was noted that houses are being constructed and cottonwood trees are being cut down in the floodplains of the Animas and La Plata Rivers. Reclamation's surveys found bald eagles avoid areas where human disturbance is greatest.

EFFECTS OF THE ACTION

<u>Factors to be Considered</u>

The Service believes that water depletions are a major factor contributing to the reductions in the populations of the Colorado pikeminnow and razorback sucker. Other major factors include impacts of dams, competition from and predation by nonnative fishes, changes in flow and temperature regimes, and changes in river channel (which are also related to water depletions). These reductions in population and loss of habitat have caused the Service to list these species as endangered and to implement programs to conserve the species. The operation of Navajo Dam to mimic the natural hydrograph by following the San Juan River flow recommendations, as a conservation measure, is expected to provide flows needed for the survival and recovery of the Colorado pikeminnow and razorback sucker. However, until a biological response is detected according to the criteria that will be developed by the Biology Committee, this will not be known.

Analyses for Effects of the Action

Water Quantity

Water depletions cause discrete, identifiable, additive, adverse impacts to the Colorado River endangered fishes. As shown in the following flow analysis, the action subject to consultation will cause flow depletions that alter baseline flow regimes. The proposed action will result in a new average annual depletion of 57,100[12] acre-feet of water from the San Juan River at Four Corners. Depletions are greater upstream of Four Corners before all return flows enter the San Juan River. Between the confluence of the Animas and La Plata Rivers depletions could be up to 80,700 acre-feet/year. The implementation of the San Juan River flow recommendations, and modeling shows that the minimum flow targets for endangered fishes will be met under all project conditions. The hydrological analysis of the project is based on the conditions with the flow recommendations in place. Table 7 and Figure 2 show modeled flow conditions at Shiprock, New Mexico, with and without the proposed project for the period 1929-1993. The greatest reduction in flows occurs during September when maximum mean monthly flows are reduced by less than 9 percent. During the driest conditions (minimum mean monthly flows), there is no change in flow conditions at Shiprock because the project would not be pumping water from the Animas River under these conditions. Table 8 and Figure 3 show modeled flow conditions at Four Corners for the 1929-1993 period. The greatest reduction in flows at Four Corners is in June when the minimum mean monthly flows are reduced by more than 13 percent. The Figures show that there is some reduction in spring peak flow, but there is still a mimicry of a natural hydrograph. Table 9 compares the following flow scenarios with the flow recommendations: pre-Navajo Dam conditions (1929-1961), post-Navajo Dam conditions (1962-1991), current conditions (the amount of water in the river today), Animas-La Plata Project environmental baseline (includes water for projects that have completed section 7 consultation), and conditions with the Animas-La Plata Project in place. With the Animas-La Plata Project in place, the flow recommendations can be met. There are only small changes in flow conditions between the environment baseline and with the Animas-La Plata Project in place.

[12] 1,439 acre-feet/year is an existing depletion by the City of Durango.

	Minimum Mean Monthly CFS				Average Mean Monthly CFS				Maximum Mean Monthly CFS			
	Without ALP	With ALP	Change	Change %	Without ALP	With ALP	Change	Change %	Without ALP	With ALP	Change	Change %
Oct	535.6	535.6	0.0	0.0	786.6	739.4	-47.2	-6.0	4,216.4	3,929.3	-287.1	-6.8
Nov	541.9	541.9	0.0	0.0	736.2	701.1	-35.1	-4.8	2,793.2	2,723.1	-70.1	-2.5
Dec	541.9	541.9	0.0	0.0	676.1	662.8	-13.3	-2.0	2,253.0	2,235.4	-17.7	-0.8
Jan	541.9	541.9	0.0	0.0	596.4	590.2	-6.1	-1.0	980.5	949.3	-31.2	-3.2
Feb	541.9	541.9	0.0	0.0	638.3	628.6	-9.6	-1.5	1,420.1	1,384.7	-35.4	-2.5
Mar	541.7	541.7	0.0	0.0	1,130.7	1,077.2	-53.4	-4.7	5,599.9	5,464.9	-135.0	-2.4
Apr	530.7	530.7	0.0	0.0	2,226.7	2,054.4	-172.2	-7.7	6,872.4	6,800.8	-71.6	-1.0
May	525.0	525.0	0.0	0.0	4,328.6	4,133.4	-195.2	-4.5	10,472.6	10,329.4	-143.2	-1.4
Jun	525.0	525.0	0.0	0.0	4,895.9	4,639.2	-256.6	-5.2	9,999.8	9,652.5	-347.2	-3.5
Jul	525.0	525.0	0.0	0.0	1,231.2	1,131.6	-99.6	-8.1	4,572.0	4,372.6	-199.5	-4.4
Aug	525.0	525.0	0.0	0.0	708.3	675.8	-32.6	-4.6	2,280.6	2,130.5	-150.1	-6.6
Sep	525.0	525.0	0.0	0.0	690.4	666.7	-23.7	-3.4	2,278.5	2,091.0	-187.6	-8.2

Table 7. Mean monthly flows for the San Juan River at Shiprock, NM, with and without the Animas-La Plata Project. Minimum, Average and Maximum Mean Monthly CFS for the modeled period 1929-1993.

	Minimum Mean Monthly CFS					Average Mean Monthly CFS					Maximum Mean Monthly CFS			
	Without ALP	With ALP	Change	Change %		Without ALP	With ALP	Change	Change %		Without ALP	With ALP	Change	Change %
Oct	536.5	536.5	0.0	0.0		953.9	907.4	-46.4	-4.9		6,423.0	6,136.7	-286.3	-4.5
Nov	541.7	541.7	0.0	0.0		763.6	729.1	-34.5	-4.5		3,147.8	3,078.4	-69.5	-2.2
Dec	541.9	541.9	0.0	0.0		723.5	710.3	-13.2	-1.8		2,346.2	2,328.7	-17.5	-0.7
Jan	541.9	541.9	0.0	0.0		654.1	648.1	-6.0	-0.9		1,085.2	1,041.4	-43.8	-4.0
Feb	541.9	541.9	0.0	0.0		781.8	772.5	-9.3	-1.2		2,001.3	2,012.5	11.3	0.6
Mar	541.5	541.0	-0.5	-0.1		1,218.6	1,165.5	-53.0	-4.4		6,053.8	5,919.3	-134.6	-2.2
Apr	564.1	592.4	28.4	5.0		2,319.5	2,147.8	-171.6	-7.4		7,401.2	7,330.2	-71.0	-1.0
May	755.0	737.9	-17.1	-2.3		4,408.9	4,214.5	-194.4	-4.4		12,261.3	12,118.8	-142.4	-1.2
Jun	945.8	814.6	-131.1	-13.9		5,078.5	4,823.3	-255.3	-5.0		9,761.9	9,416.0	-345.9	-3.5
Jul	636.8	630.7	-6.1	-1.0		1,496.0	1,397.4	-98.5	-6.6		4,833.2	4,634.8	-198.4	-4.1
Aug	540.1	540.1	0.0	0.0		1,026.2	994.8	-31.4	-3.1		4,229.6	4,080.7	-148.9	-3.5
Sep	538.4	538.4	0.0	0.0		903.1	880.4	-22.7	-2.5		3,558.6	3,424.5	-134.1	-3.8

Table 8. Mean monthly flows for the San Juan River at Four Corners, NM, with and without the Animas-La Plata Project. Minimum, Average and Maximum Mean Monthly CFS for the modeled period 1929-1993.

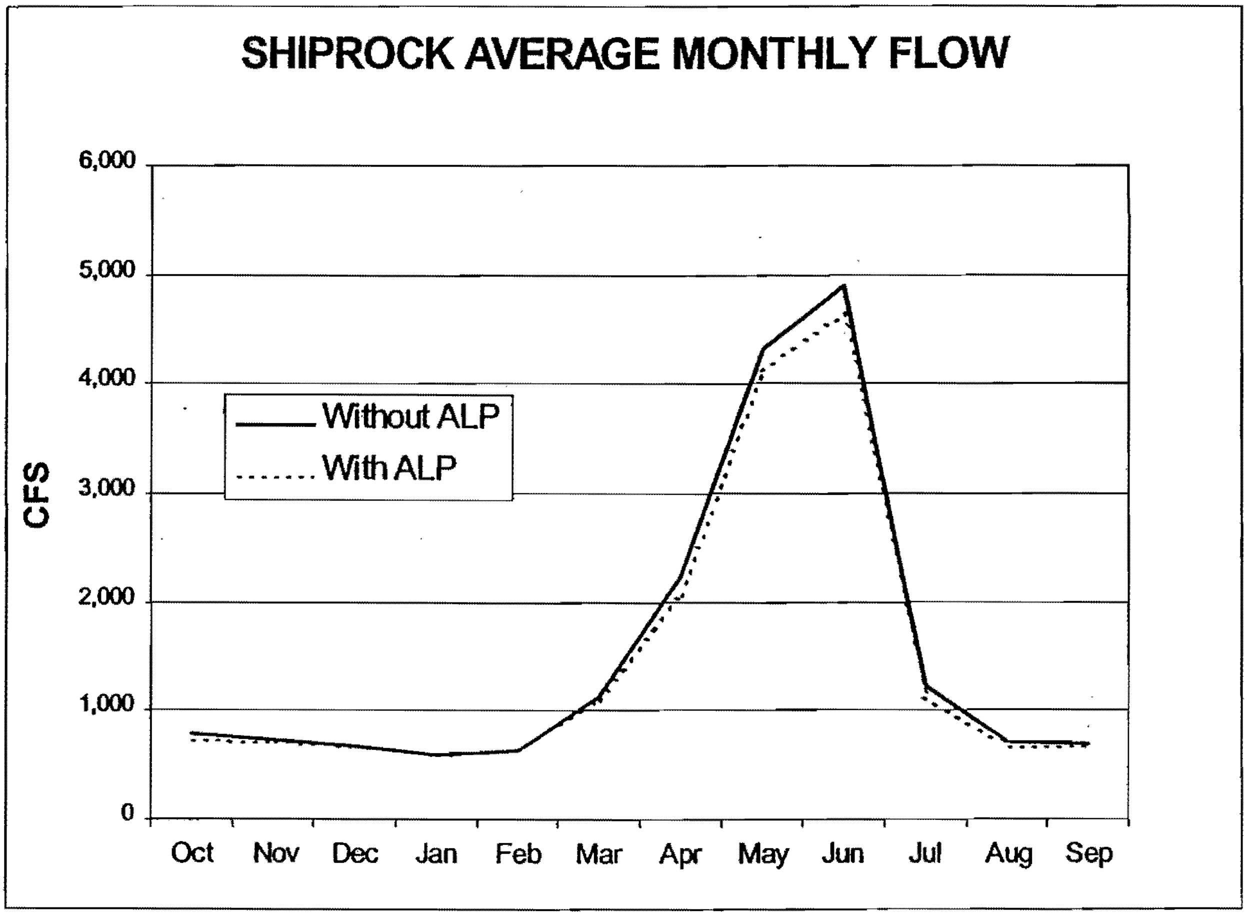


Figure 2. Average monthly flows at Shiprock, New Mexico, with and without the Animas-La Plata Project for the modeled period 1929-1993.

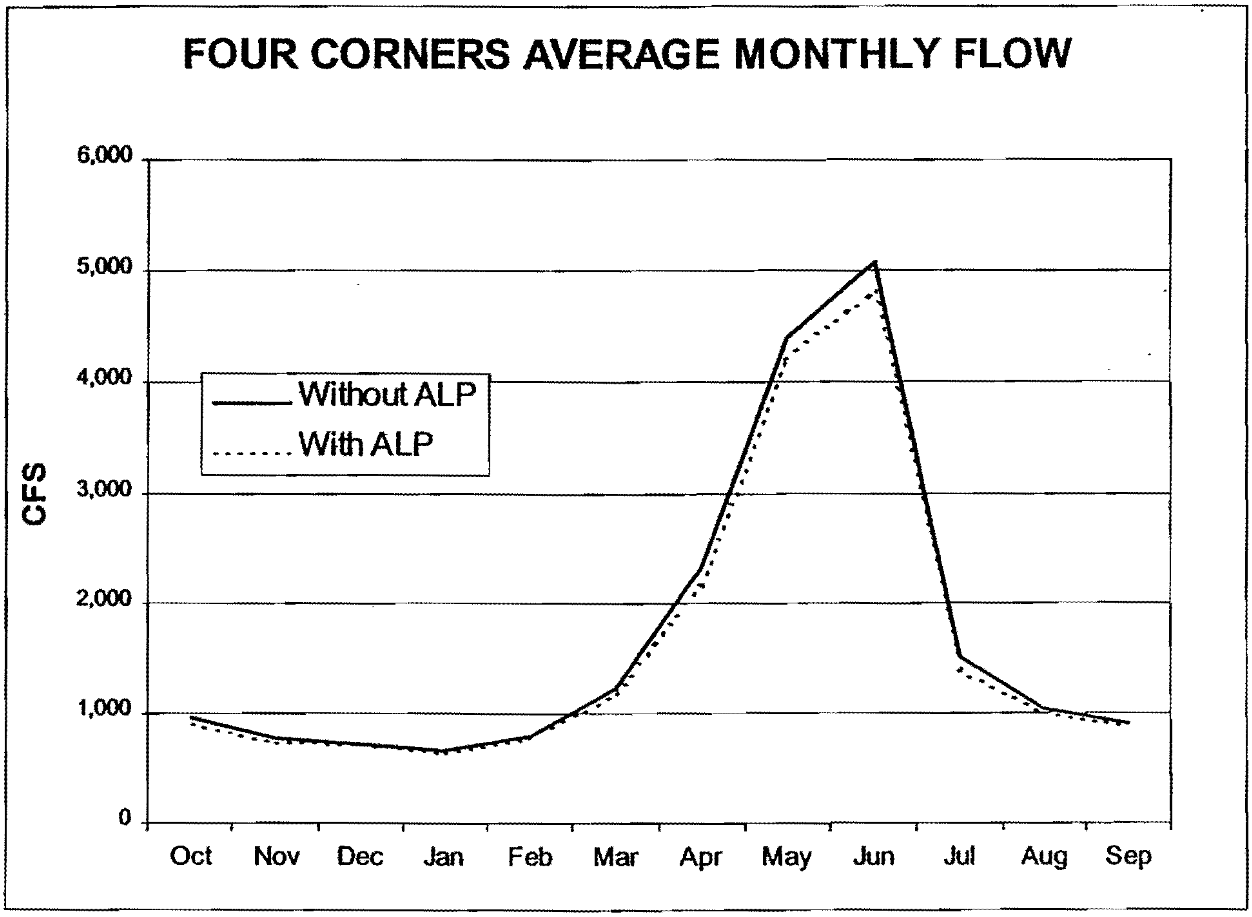


Figure 3. Average monthly flows at Four Corners, with and without the Animas-La Plata Project for the modeled period 1929-1993.

Table 9. San Juan River Flow Statistics by Flow scenario for the period 1929-1993[13]

Summary of Flow Statistics for San Juan River at Four Corners, NM for Pre-and Post Dam Historic Flow Current Development Level and Current With ALP Project

Parameters	Pre-Dam 1929-1961	Post-Dam 1962-1991	Current Condition	ALP Baseline	With ALP	Flow Recommendation Threshold
Average Peak Daily Runoff - CFS	12,409	6,749	9,803	8,822	8,375	
Average Runoff - Acre-feet	1,263,890	891,712	968,296	876,681	830,085	
Peak>10,000 - frequency	55%	20%	42%	38%	34%	
Peak>8,000 - frequency	67%	37%	75%	60%	55%	
Peak>5000 - frequency	91%	53%	94%	75%	72%	
Peak>2,500 - frequency	100%	90%	100%	98%	95%	
AF>1,000,000 - frequency	55%	40%	42%	32%	34%	
AF>750,000 - frequency	67%	47%	58%	51%	48%	
AF>5,000,00 - frequency	91%	67%	72%	66%	66%	
AF>10,000 CFS for 5 days - frequency	39%	13%	29%	29%	28%	20%
AF>8,000 CFS for 10 days - frequency	45%	17%	43%	42%	38%	33%
AF>5,000 CFS for 21 days - frequency	64%	37%	60%	58%	52%	50%
AF>2,500 CFS for 21 days - frequency	100%	83%	94%	86%	80%	80%
Maximum years between flow events for minimum duration						
Peak>10,000 for 5 days	4	14	9	9	9	10
Peak>8,000 for 10 days	4	7	6	6	6	6
Peak>5000 for 21 days	4	7	4	4	4	4
Peak>2,500 for 10 days	0	1	1	1	2	2
Non-corrected Perturbation	12%	27%	20%	20%	23%	
Average Date of Peak	31–May	01-Jun	05-Jun	03-Jun	04-Jun	
Standard Deviation of Peak	23	35	12	13	14	
Days>10,000 CFS	14	3	5	4	4	
Days>8,000 CFS	23	8	14	13	12	
Days>5,000 CFS	46	28	38	33	31	
Days>2,500 CFS	82	67	63	57	53	
Meets Recommendation			Yes	Yes	Yes	

Note: Values in bold indicate non-compliance with Standard

[13]Source Animas-La Plata Project Water Resources Report 1999

Water Quality

Irrigated agriculture is no longer part of the Animas-La Plata Project, therefore, impacts to water quality from leaching of contaminants from irrigation are no longer anticipated impacts associated with the proposed project. However, water depletions cause existing contaminants to become more concentrated.

Potential heavy metal and/or selenium contamination in the Animas River could be transported to the newly created Ridges Basin Reservoir and bioaccumulation in the food chain could occur. Ridges Basin Reservoir could expand the food base for wintering bald eagles when it is not covered with ice. Studies conducted indicate mercury and selenium levels could impact eagles if they bioaccumulate through the food chain and contaminate fish that bald eagles may feed on. Selenium concentrations in soil and water samples may be of concern, but concentrations in fish tissue did not indicate levels high enough to affect fish-eating birds.

Physical Habitat

Water depletions during spring runoff affect physical habitat in several ways. High spring flows are very important for creating and maintaining complex channel geomorphology and suitable spawning substrates, and in creating and providing access to off-channel habitats. Adequate summer and winter flows are important for providing a sufficient quantity of preferred habitats. The flow targets outlined in the San Juan River flow recommendations are designed to provide sufficient spring flows to create and maintain important habitats including: cobble bar construction; scouring of fine sediment from the interstitial spaces from the cobble so it is suitable for spawning; flushing sediments from backwaters; maintaining channel complexity; overbank flows to provide nursery habitat for razorback sucker; and appropriate water temperatures for spawning.

Biological Environment

Research to date on the San Juan River does not indicate that implementation of the flow regimes outlined in the San Juan River flow recommendations will reduce numbers of nonnative fishes. Implementation of physical means to prevent escapement of nonnative fishes from Ridges Basin Reservoir is part of the proposed project, therefore, there would not be a contribution of nonnatives fishes to the San Juan River from this newly created water body.

Riparian Habitat

While the project will change river flows in the Animas River and potentially in the La Plata River, studies show that these changes are not great enough to affect the riparian habitat (McKee et al. 1995). Also, Reclamation has incorporated bypass flows into the operation of the project to promote natural recruitment of cottonwood trees along the Animas River.

<u>Species and Critical Habitat Response to the Proposed Action</u>

The operation of Navajo Dam to mimic the natural hydrograph by following the San Juan River flow recommendations will result in flow patterns similar to those that occurred prior to 1962. The Animas-La Plata Project would cause water depletions to the San Juan River; however, the target flows outlined in the flow recommendations would still be met with operation of the proposed project. Therefore, the anticipated response of the Colorado pikeminnow and the razorback sucker would be increased population size. The Service anticipates the response of designated critical habitat would be improved habitat conditions, including clean spawning bars, more backwater habitat, and the maintenance of channel complexity.

The Service anticipates that the bald eagle population in the project area would remain the same or increase due to an increased food base provided by Ridges Basin Reservoir. Bald eagle habitat along the Animas and La Plata Rivers is not anticipated to be affected by the proposed project. The Service is concerned that bioaccumultation of trace elements in bald eagle food items in Ridges Basin Reservoir may impact birds that select food items from the reservoir. However, Reclamation will develop and implement a monitoring program for potential adverse bioaccumulation of trace elements. If the monitoring program identifies a problem with trace elements, Reclamation will develop and implement an action plan to minimize impacts to bald eagles.

CUMULATIVE EFFECTS

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

Coalbed Methane Development

The San Juan Basin in southwestern Colorado and northwestern New Mexico is rich in coalbed methane and development of this resource has increased rapidly in the last ten years. There are currently more than 3,000 coalbed methane wells in the San Juan Basin in the Fruitland coal formation. Currently, one well per 320 acres is allowed; however, the industry has recently filed two applications with the Colorado Oil and Gas Commission to increase the well spacing to one well per 160 acres. If these are approved, potentially more than 700 additional wells may be drilled, approximately 250 could occur on private or State land.

Coalbed methane development requires the extraction of groundwater to induce gas flow. A study was initiated in 1998 to determine the effects of groundwater extraction from the Fruitland formation. The study is called the 3M Project (mapping, modeling, and monitoring) and it is being conducted by the Colorado Oil and Gas Conservation Commission in cooperation with the Southern Ute Indian Tribe, the Bureau of Land Management, the Forest Service and the industry.

Recent data show that coalbed methane wells located within 1.5 miles of the Fruitland coal formation outcrop (located in the northern region of the San Juan Basin) are in hydraulic communication with the shallow groundwater system at the outcrop. The hydraulic communication is likely to extend deeper into the basin in the northern region of the San Juan Basin than in other areas of the Fruitland formation. In general terms, groundwater produced from near-outcrop coalbed methane wells is recent recharge water that would, under pre-coalbed methane conditions, discharge to local rivers and ultimately provide flow to the San Juan River.

Coalbed methane wells occur on Federal, State, tribal, and private lands. The BLM is currently preparing an EIS to address coalbed methane development on the Southern Ute Indian Reservation and they are also preparing a separate EIS to address coalbed methane development on Federal lands. Water depletions associated with coalbed methane development on tribal and Federal lands will be addressed during future section 7 consultation with the BLM. There will not be future section 7 consultations for coalbed methane development on private or State lands if there is no Federal action associated with the wells. Therefore, water depletions associated with coalbed methane development on private and State lands are considered a cumulative effect that is reasonably certain to occur within the Animas-La Plata Project action area.

The 3M Project is using a ground water model and a reservoir model to determine water budgets and therefore, depletions associated with coalbed methane development. The ground water model is relatively simple, accounting for groundwater discharge from the Fruitland formation. The reservoir model is much more complex, as it incorporates two-phase flow characteristics of the geologic and hydrologic reservoir of the Fruitland formation. One of the intended uses is to predict potential impacts from infill drilling and to quantify the current overproduction of water in the northen portion of the basin. Preliminary results of the ground water model is the best scientific information available to date. Results of the reservoir model are not yet available. The preliminary results of the groundwater model show that prior to coalbed methane development, the Fruitland formation discharged approximately 280 acre-feet/year to the San Juan River. Considering current conditions where the wells are extracting approximately 1,200 acre-feet per year in the near-outcrop areas, the 280 acre-feet of recharge at the outcrop have been effectively cut off from discharging to the rivers. The worst case scenario may see a reversal of flow, where the rivers and alluvial aquifers provide the water to the coalbed methane wells. Depletions as high as 2,000 acre-feet/year are plausible, as a worst case. Most water depletions come from the wells north of the Southern Ute Indian Reservation. Approximately 25 percent of the coalbed methane development north of the Reservation is on Federal lands. Therefore, if one assumes the worst case scenario, current and future depletions from State and private lands could deplete 75 percent of the 2,000 acre-feet/year or 1,500 acre-feet/year. New wells would deplete some number less than 1,500 acre-feet/year, since existing wells currently deplete some of this total.

The RiverWare model, which is used to evaluate hydrologic conditions on the San Juan River and its tributaries, requires a defined project to determine project compatibility with the San Juan River flow recommendations. Because future coalbed methane development on State and private land is not a defined project and the depletions associated with it are relatively small and not specifically quantified, the RiverWare model is not an appropriate tool to use to determine the compatibility with the flow recommendations. However, on May 21, 1999, the Service issued a biological opinion that addressed the impacts of future Federal projects that individually involve small water depletions that total 3,000 acre-feet/year. It was determined in this biological opinion that these small depletions would not diminish the capability of the system to meet the flow levels, durations, or frequencies outlined in the San Juan River flow recommendations. While the coalbed methane development on State and private lands was not addressed in the small depletion biological opinion, because this development does not involve future Federal actions, coalbed methane development does involve small individual depletions similar to the projects addressed by the small depletion biological opinion. Therefore, the Service concludes that an additional future depletion of less than 1,500 acre-feet/year from the San Juan River associated with coalbed methane development on State and private land, would not significantly impact the ability to met the San Juan River flow recommendations.

Future section 7 consultations in the San Juan River Basin will need to consider the cumulative effects of coalbed methane development on State and private land using the best scientific information available to determine the water depletions associated with development.

Bald Eagles

The Service anticipates that future development of private property in the floodplain of the Animas and La Plata Rivers could impact bald eagle habitat. Habitat could be affected by removal of all age classes of cottonwood trees and by increase human disturbance.

CONCLUSION

After reviewing the current status of the Colorado pikeminnow, razorback sucker, and bald eagle, the environmental baseline for the action area, the effects of the proposed action and the cumulative effects, it is the Service's biological opinion that the Animas-La Plata Project, as described in this biological opinion, is not likely to jeopardize the continued existence of the Colorado pikeminnow or razorback sucker, and the proposed project is not likely to destroy or adversely modify designated critical habitat. The Service also concludes that the proposed project is not likely to jeopardize the continued existence of the bald eagle. This conclusion is based on the description of the proposed action contained in this biological opinion, with full implementation of the conservation measures.

INCIDENTAL TAKE STATEMENT

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

Incidental take is considered with full implementation of the conservation measures outlined in the description of the proposed action and considering the cumulative effects. The Service does not anticipate that the proposed Animas-La Plata Project will incidentally take any threatened or endangered species.

REINITIATION NOTICE

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

Because Reclamation has committed to operate Navajo Reservoir to benefit endangered fishes as a conservation measure, the Service would consider the inability to met the flow recommendations as a significant modification of the conservation measure that would affect the Colorado pikeminnow and razorback sucker and their designated critical habitat on the San Juan River. Therefore, upon completion of the Navajo Reservoir EIS, the Service in coordination with Reclamation will determine if the San Juan River flow recommendations can be met. If it is determined that the flow recommendations cannot be met, Reclamation is required to reinitiate section 7 consultation on the Animas-La Plata Project.

Following the San Juan River flow recommendations is expected to result in a positive population response for the Colorado pikeminnow and razorback sucker in the San Juan River. If a positive population response for both species is not realized as measured by the criteria developed by Reclamation within the next year, this would be considered new information that may affect listed species or critical habitat in a manner or to an extent not considered in this opinion. Therefore, if the flow recommendations do not result in a positive population response, Reclamation will be required to reinitiate section 7 consultation.

cc: BR, Salt Lake City
BR, Durango
FWS/ES, Denver RO
FWS/ES, Grand Junction
FWS/ES, Albuquerque FO
FWS/ES, Albuquerque RO (Attn: San Juan River Basin Recovery Implementation Program Coordinator)
Area Director, Bureau of Indian Affairs, PO Box 26567, Albuquerque, New Mexico 87125-6567
Jessica Aberly, Aberly, Nordhaus, Haltom, Taylor, Taradash & Frye, 500 Marquette Avenue North West, Suite 1050, Albuquerque, New Mexico 87102
President Rodger Vicenti, Jicarilla Apache Indian Tribe, PO Box 507, Dulce, New Mexico 87528
Ernest House, Chairman, Ute Mountain Ute Indian Tribe, General Delivery, Towaoc, Colorado 81334
John Baker, Chairman, Southern Ute Indian Tribe, P.O. Box 737, Ignacio, Colorado 81137
Kelsey Begaye, President, The Navajo Nation, Presidents Office, PO Box 9000, Window Rock, Arizona 86515
Dan Israel, 6403 East Willow Spring Lane, Cave Creek, Arizona 85331
Scott McElroy, Greene, Meyer & McElroy, 1007 Pearl Street, Suite 220, Boulder, Colorado 80302
Stan Pollack, Special Counsel for Water Rights, Navajo Nation Department of Justice, P.O. Box 2010, Window Rock, Arizona 86515

PSGelatt:FBORI.wpd:061900

bcc: AES/TE, Washington D.C.
FWS/EA, Denver RO (Attn: David Redhorse)

LITERATURE CITED

Abell, R. 1994. San Juan River Basin Water Quality Contaminants Review. Volume 1. Unpublished report prepared by the Museum of Southwestern Biology, University of New Mexico for the San Juan Recovery Implementation Program. 316 pp.

Archer, D. L., L. R. Kaeding, B. D. Burdick, and C. W. McAda. 1985. A study of the endangered fishes of the Upper Colorado River. Final Report - Cooperative Agreement 14-16-0006-82-959. U.S. Department of the Interior, Fish and Wildlife Service, Grand Junction, Colorado. 134 pp.

Archer, D.L., H.M. Tyus, and L.R. Kaeding. 1986. Colorado River fishes monitoring project, final report. U.S. Fish and Wildlife Service, Colorado River Fishery Project, Lakewood, Colorado. 64 pp.

Archer, E., T. Crowl, T. Chart, and L. Lentsch. 1995. Early Life History Fisheries Survey of the San Juan River, New Mexico and Utah, 1994. Unpublished report prepared for the San Juan Recovery Implementation Program. 29 pp.

Behnke, R.J., and D.E. Benson. 1983. Endangered and threatened fishes of the Upper Colorado River Basin. Ext. Serv. Bull. 503A, Colorado State University, Fort Collins. 38 pp.

Bestgen, K.R. 1990. Status Review of the Razorback Sucker, Xyrauchen texanus. Larval Fish Laboratory #44. Colorado State University, Fort Collins.

Bestgen, K.R., R.T. Muth, and M.A. Trammell. 1998. Downstream transport of Colorado squawfish larvae in the Green River drainage: temporal and spatial variation in abundance and relationships with juvenile recruitment. Colorado State University, Ft. Collins. Recovery Program Project Number 32.

Black, T., and R.V. Bulkley. 1985a. Preferred temperature of yearling Colorado squawfish. Southwestern Naturalist 30:95-100.

Black, T., and R.V. Bulkley. 1985b. Growth rate of yearling Colorado squawfish at different water temperatures. Southwestern Naturalist 30:253-257.

Blanchard, P.J., R.R. Roy, and T.F. O'Brien. 1993. Reconnaissance investigation of water quality, bottom sediment, and biota associated with irrigation drainage in the San Juan River Area, San Juan County, northwestern New Mexico, 1990-91. U.S. Geologic Survey Water Resources Investigations Report 93-4065.

Bliesner, R., and V. Lamarra. 1994. San Juan River Habitat Studies. Annual Report 1993. Unpublished report prepared for the San Juan Recovery Implementation Program. 68 pp.

Bleisner, R., and V. Lamarra. 1995. San Juan River Habitat Studies. Annual Report 1994. Unpublished report prepared for the San Juan Recovery Implementation Program. 139 pp.

Brogden, R.E., E.C. Hutchinson, and D.E. Hillier. 1979. Availability and quality of ground water, Southern Ute Indian Reservation, Southwestern Colorado. U.S. Geological Survey Water Supply Paper 1576-J.

Brooks, J.E., E.M. Williams, and C. Hoagstrom. 1994. San Juan River investigations of nonnative fish species - 1993 Annual Report. Unpublished report prepared for the San Juan River Recovery Implementation Program. 32 pp.

Bulkley, R.V., C.R. Berry, R. Pimental, and T. Black. 1981. Tolerance and Preferences of Colorado River Endangered Fishes to Selected Habitat Parameters: Final Completion Report. Logan, UT, Utah State University. Utah Cooperative Fishery Research Unit: 83.

Buntjer, M.J., and J.E. Brooks. 1997. San Juan River investigations of non-native fish species, preliminary 1996 results. New Mexico Fishery Resources Office, U.S. Fish and Wildlife Service, Albuquerque, New Mexico

Buntjer, M J., T. Chart, L. Lentsch. 1994. Early Life History Fisheries Survey of the San Juan River, New Mexico and Utah. Annual Report 1993. Unpublished report prepared for the San Juan Recovery Implementation Program. 48 pp.

Burdick, B.D. 1992. A plan to evaluate stocking to augment or restore razorback suckers in the Upper Colorado River. U.S. Fish and Wildlife Service, Final Report, Grand Junction, Colorado. 56 pp.

Carlson, C.A., and R.T. Muth. 1989. The Colorado River: lifeline of the American Southwest. Pages 220-239 <u>in</u> D.P. Dodge, ed. Proceedings of the International Large River Symposium. Canadian Special Publication of Fisheries and Aquatic Sciences 106, Ottawa.

Eisler, R. 1987. Polycyclic aromatic hydrocarbon hazards to fish, wildlife, and invertebrates: a synoptic review. U.S. Fish and Wildlife Service Biological Report 85(1.11). 81 pp.

Ellis, N.M. 1914. Fishes of Colorado. University of Colorado Studies. Vol. 11(1).

Gutermuth, F.B., L.D. Lentsch, K.R. Bestgen. 1994. Collection of Age-0 Razorback Suckers (*Xyrauchen texanus*) in the Lower Green River, Utah. Southwestern Naturalist, Vol 39(4), pp 389-391.

Hamman, R.L. 1981. Spawning and culture of Colorado squawfish <u>Ptychocheilus lucius</u> in a raceway. <u>In</u> Miller et al. Colorado River Fishery Project Final Report.

Harmata, A.R. 1984. Bald eagles of the San Luis Valley, Colorado: their winter ecology and spring migration. Ph.D. Thesis, Montana State University. 222 pp.

Harvey, M.D., R.A. Mussetter, and E.J. Wick. 1993. Physical process-biological response model for spawning habitat formation for the endangered Colorado squawfish. Rivers 4:114-131.

Haynes, C.M., T.A. Lytle, E.J. Wick, and R.T. Muth. 1984. Larval Colorado squawfish in the Upper Colorado River Basin, Colorado 1979-1981. The Southwestern Naturalist 29(1):21-33.

Holden, P.B. (Ed.) 1999. Flow recommendations for the San Juan River. San Juan River Basin Recovery Implementation Program, USFWS, Albuquerque, NM.

Holden, P.B., and W. Masslich. 1997. Summary Report 1991-1997, San Juan River Recovery Implementation Program. Unpublished report of the San Juan River Recovery Implementation Program. 87 pp.

Holden, P.B., and C.B. Stalnaker. 1975. Distribution and abundance of mainstream fishes of the middle and upper Colorado River Basins, 1967-1973. Transactions of the American Fisheries Society 104(2):217-231.

Jobling, M. 1981. Temperature tolerance and the final preferendum - rapid methods for the assessment of optimum growth temperatures. J. Fish Biol. 19:439-455.

Jordan, D.S. 1891. Report of explorations in Colorado and Utah during the summer of 1889 with an account of the fishes found in each of the river basins examined. Bulletin of the United States Fish Commission 9:24.

Joseph, T.W., J.A. Sinning, R.J. Behnke, and P.B. Holden. 1977. An evaluation of the status, life history, and habitat requirements of endangered and threatened fishes of the Upper Colorado River system. U.S. Fish and Wildlife Service, Office of Biological Services, Fort Collins, Colorado, FWS/OBS 24, Part 2:183.

Lanigan, S.H., and H.M. Tyus. 1989. Population size and status of the razorback sucker in the Green River Basin, Utah and Colorado. North American Journal of Fisheries Management 9:1.

Lamarra, V., M. Lammarra, et al. 1985. Ecological Investigation of a Suspected Spawning Site of Colorado Squawfish on the Yampa River, Utah. Great Basin Naturalist 45: 127-140.

Lashmett, K. 1994. Young-of-the-Year Fish Survey of the Lower San Juan River. 1993 Annual Report. Prepared for San Juan Recovery Implementation Program. 11 pp.

Lee, S.D., and L. Grant (eds.). 1981. Health and ecological assessment of polynuclear aromatic hydrocarbons. Pathotex Publ., Park Forest South, Illinois. 364 pp.

Lemly, A.D. 1993. Guidelines for evaluating selenium data from aquatic monitoring and assessment studies: Environmental Monitoring and Assessment, v. 28, pp. 83-100.

Lentsch, L.D., Y. Converse, and P.D. Thompson. 1996. Evaluating Habitat Use of Age-0 Colorado Squawfish in the San Juan River through Experimental Stocking. Utah Division of Natural Resources, Division of Wildlife Resources. Publication No. 96-11, Salt Lake City, Utah.

Maier, K.J., and A.W. Knight. 1994. Exotoxicology of selenium in freshwater systems, Reviews of environmental contamination and toxicology, V.134, pp. 31-48.

Marsh, P.C., and W.L. Minckley. 1989. Observations on recruitment and ecology of razorback sucker: lower Colorado River, Arizona-California. Great Basin Naturalist 49(1):71-78.

Marsh, P.C. 1985. Effect of Incubation Temperature on Survival of Embryos of Native Colorado River Fishes. Southwestern Naturalist 30(1):129-140.

McAda, C.W. 1987. Status of the razorback sucker Xyrauchen texanus in the Colorado River upstream from Lake Powell. Proceedings of the Desert Fishes Council 17(1985):185.

McAda, C. . and L.R. Kaeding. 1991. Movements of adult Colorado squawfish during the spawning season in the Upper Colorado river. Transactions of the American Fisheries Society 120:339-345.

McAda, C.W., and R.S. Wydoski. 1980. The razorback sucker, Xyrauchen texanus, in the upper Colorado River Basin, 1974-76. U.S. Fish and Wildlife Service Technical Paper 99. 50 pp.

McCarthy, C.W., and W.L. Minckley. 1987. Age estimation for razorback sucker (Pisces: Catostomidae) from Lake Mohave, Arizona and Nevada. Journal Arizona-Nevada Academy of Science 21:87-97.

McKee, J.P., G.D. Patton, K.B. Wille, and J.R. Carlson. 1995. The Animas-La Plata Project, Assessment of Project Impacts to Riparian Corridor Vegetation Communities. Technical Memorandum No. 8260-95-10. Bureau of Reclamation, Denver, Colorado.

Meyer, C.W., and M. Moretti. 1988. Fisheries Survey of the San Juan River, Utah, 1987. Utah Division of Wildlife Resources 1:1-53.

Miller, R.R. 1961. Man and the changing fish fauna of the American southwest. Papers of the Michigan Academy of Science, Arts, Letters 46:365-404.

Miller, W.J. 1994. San Juan River Colorado squawfish habitat use. 1993 Annual Report. Unpublished report prepared by W.J. Miller & Associates, for the San Juan River Recovery Implementation Program, 31 pp.

Miller, W.J. 1995. San Juan River Colorado squawfish habitat use. 1994 Annual Report. Unpublished report prepared by W.J. Miller & Associates, for the San Juan River Recovery Implementation Program, 28 pp.

Miller, W.J., and J. Ptaček.2000. Final report. Colorado pikeminnow habitat use in the San Juan River. Prepared by W.J. Miller & Associates, for the San Juan River Recoveruy Implementation Program. pp 64

Miller, W.H., J.J. Valentine, D.L. Archer, H.M. Tyus, R.A. Valdez, and L.R. Kaeding. 1982. Colorado River Fishery Project Final Report Summary. U.S. Fish and Wildlife Service, Salt Lake City, Utah. 42 pp.

Minckley, W.L. 1983. Status of the razorback sucker, Xyrauchen texanus (Abbott), in the lower Colorado River Basin. Southwestern Naturalist 28(2):165-187.

Minckley, W.L., P.C. Marsh, J.E. Brooks, J.E. Johnson, and B.L. Jensen. 1991. Management toward recovery of razorback sucker (Xyrauchen texanus). in W.L. Minckley and J.E. Deacon, Eds. Battle Against Extinction. University of Arizona Press, Tucson.

Modde, T. 1996. Juvenile razorback sucker (Xyrauchen texanus) in a managed wetland adjacent to the Green River. Great Basin Naturalist 56:375-376.

Modde, T., K.P. Burnham, and E.J. Wick. 1996. Population Status of the Razorback Sucker in the Middle Green River (U.S.A.). Conservation Biology 10 #1: 110-119.

Morizot, D.C. 1996. September 11, 1996, Letter to Tom Czapla, U.S. Fish and Wildlife Service, Denver, Colorado, on Genetic Analysis of Upper Basin Colorado Squawfish samples.

Moyle, P.B. 1976. Inland fishes of California. University of California Press, Berkeley.

Muth, R.T. 1995. Conceptual-framework document for development of a standardized monitoring program for basin-wide evaluation of restoration activities for razorback sucker in the Green and Upper Colorado River systems. Colorado State University Larval Fish Laboratory final report to the Recovery Implementation Program for Endangered Fish Species in the Upper Colorado River Basin, Denver, Colorado.

Nelson, J. S., and five coauthors. 1998. Recommended Changes in Common Fish Names: Pikeminnow to Replace Squawfish (*Ptychocheilus spp.*). Fisheries 23 (9):37.

Nesler, T.P., R.T. Muth, et al. 1988. Evidence for Baseline Flow Spikes as Spawning Cues for Colorado Squawfish in the Yampa River, Colorado. American Fisheries Society Symposium. 5:68-79.

O'Brien, J.S. 1984. 1983 Yampa River cobble reach morphology investigation. Final Report. U.S. Fish and Wildlife Service, Denver, Colorado. 79 pp.

Odell, S. 1995. 1994 Annual report on data collection activities concerning suspected contributions of polynuclear aromatic hydrocarbons by oil and gas leasing on public lands in the San Juan Basin, New Mexico. Unpublished report prepared for the San Juan River Recovery Implementation Program. 16 pp.

Osmundson, D.B., and K.P. Burnham. 1998. Status and Trends of the Endangered Colorado squawfish in the Upper Colorado River. Transaction of the American Fisheries Society 127:959-972.

Osmundson, D.B., and L.R. Kaeding. 1989. Studies of Colorado squawfish and razorback sucker use of the "15-mile reach" of the Upper Colorado River as part of conservation measures for the Green Mountain and Ruedi Reservoir water sales. Final Report. U.S. Fish and Wildlife Service, Grand Junction, Colorado.

Osmundson, D.B., and L.R. Kaeding. 1991. Flow recommendations for maintenance and enhancement of rare fish habitat in the 15-mile reach during October-June. Final Report. U.S. Fish and Wildlife Service, Grand Junction, Colorado.

Osmundson, D.B., P. Nelson, K. Fenton, and D.W. Ryden. 1995. Relationships between flow and rare fish habitat in the 15-Mile Reach of the Upper Colorado River. Final Report. U.S. Fish and Wildlife Service, Grand Junction, Colorado.

Osmundson, D.B., M.E. Tucker, B.D. Burdick, W.R. Elmblad and T.E. Chart. 1997. Non-spawning Movements of Subadult and Adult Colorado Squawfish in the Upper Colorado River. Final Report. U.S. Fish and Wildlife Service, Grand Junction, CO.

Platania, S.P. 1990. Biological summary of the 1987 to 1989 New Mexico-Utah ichthyofaunal study of the San Juan River. Unpublished report to the New Mexico Department of Game and Fish, Santa Fe, and the U.S. Bureau of Reclamation, Salt Lake City, Utah, Cooperative Agreement 7-FC-40-05060.

Platania, S.P. 1996. San Juan River Larval Fish Passive Drift-Netting Study. 1995 Annual Report. Unpublished report prepared for the San Juan Recovery Implementation Program. 19 pp.

Platania, S.P., and D.A. Young. 1989. A Survey of the Icthyofauna of the San Juan and Animas Rivers from Archuleta and Cedar Hill (respectively) to their Confluence at Farmington, New Mexico. Department of Biology, University of New Mexico, Albuquerque.

Platania, S.P., K.R. Bestgen, M.A. Moretti, D.L. Propst, and J.E. Brooks. 1991. Status of Colorado Squawfish and Razorback Sucker in the San Juan River, Colorado, New Mexico and Utah. Southwest. Nat. 36:369-377.

Ryden, D.W. 1997. Five year Augmentation Plan for Razorback Sucker in the San Juan River. U.S. Fish and Wildlife Service, Colorado River Fishery Project Office, Grand Junction, Colorado. 41 pp.

Ryden, D.W., and F.K. Pfeifer. 1993. Adult Fish Community Monitoring on the San Juan River. 1991-1992 Annual Report. Unpublished report prepared for the San Juan Recovery Implementation Program. 69 pp.

Ryden, D.W., and F.K. Pfeifer. 1994. Adult Fish Community Monitoring on the San Juan River. 1993 Annual Report. Unpublished report prepared for the San Juan Recovery Implementation Program. 84 pp.

Ryden, D.W., and F.K. Pfeifer. 1995 a. Adult Fish Community Monitoring on the San Juan River. 1994 Annual Report. Unpublished report prepared for the San Juan Recovery Implementation Program. 94 pp.

Ryden, D.W., and F.K. Pfeifer. 1995 b. Monitoring of Experimentally Stocked Razorback Sucker in the San Juan River. Unpublished report prepared for the San Juan River Recovery Implementation Program. 30 pp.

Ryden, D.W., and F.K. Pfeifer. 1996. Adult Fish Community Monitoring on the San Juan River. 1995 Annual Report. Unpublished report prepared for the San Juan Recovery Implementation Program.

Ryden, D.W. 2000a. Final Report. Adult fish community monitoring on the San Juan River, 1991-1997. U. S. Fish and Wildlife Service, Grand Junction, CO. 269 pp.

Ryden, D.W. 2000b. Final Report. Monitoring of experimentally stocked razorback sucker in the San Juan River: March 1994 through October 1997. U. S. Fish and Wildlife Service, Grand Junction, CO. 132pp.

Ryden, D.W. 2000c. Monitoring of Razorback Sucker Stocked into the San Juan River as Part of a Five-year Augmentation Effort: 1997-1999 Interim Progress Report. U. S. Fish and Wildlife Service, Grand Junction, CO.

Seethaler, K. 1978. Life History and Ecology of the Colorado Squawfish (Ptychocheilus lucius) in the upper Colorado River Basin. Thesis, Utah State University, Logan.

Snyder, A.M., and S.P. Platania. 1995. Summary of San Juan River Collection Identifications and Curation for Collection Year 1994. Unpublished report prepared for the San Juan Recovery Implementation Program. 21 pp.

Stalmaster, M.V., J.R. Newman and A.J. Hansen. 1979. Population dynamics of wintering bald eagles on the Noodsak River, Washington. Northwest Scientist 53:126-131.

Sylvester, M.A., J.P. Deason, H.R. Feltz, and R.A. Engberg. 1988. Preliminary Results of Department of Interior Drainage Studies.

Taba, S.S., J.R. Murphy, and H.H. Frost. 1965. Notes on the fishes of the Colorado River near Moab, Utah. Proc. Utah Acad. Sci., Arts and Letters 42(2):280-283.

Tyus, H.M. 1985. Homing behavior noted for Colorado squawfish. Copeia 1985: 213-215.

Tyus, H.M. 1987. Distribution, reproduction, and habitat use of the razorback sucker in the Green River, Utah, 1979-1986. Transactions of the American Fisheries Society 116:111-116.

Tyus, H.M. 1990. Potamodromy and Reproduction of Colorado Squawfish in the Green River Basin, Colorado and Utah. Transactions of the American Fisheries Society 119:6, 1035-1047.

Tyus, H.M. 1991. Ecology and management of Colorado squawfish (Ptychocheilus lucius). Pages 379-402 in W.L. Minckley and S. Deacon, editors. Battle against extinction: management of native fishes in the American southwest. University of Arizona Press, Tucson. 517 pp.

Tyus, H.M., and G.B. Haines. 1991. Distribution, habitat use, and growth of age-0 Colorado squawfish in the Green River Basin, Colorado and Utah. Transactions of the American Fisheries Society 119:1035-1047.

Tyus, H.M., and C.A. Karp. 1989. Habitat Use and Streamflow Needs of Rare and Endangered Fishes, Yampa River, Colorado. U.S. Fish and Wildlife Service, Biology Report 89(14). 27 pp.

Tyus, H.M., and C.A. Karp. 1990. Spawning and movements of razorback sucker, Xyrauchen texanus, in the Green River Basin of Colorado and Utah. Southwestern Naturalist 35. (In Press).

Tyus, H.M. and C.W. McAda. 1984. Migration, movements and habitat preferences of Colorado squawfish, Ptychocheilus lucius, in the Green, White, and Yampa Rivers, Colorado and Utah. Southwestern Naturalist 29:289-299.

U.S. Fish and Wildlife Service. 1983. Northern states bald eagle recovery plan. U.S. Fish and Wildlife Service, Denver, CO. 76 pp.

U.S. Fish and Wildlife Service. 1992. The potential effects of Rocky Mountain Arsenal cleanup and Denver Metropolitan transportation development on bald eagles. U.S. Fish and Wildlife Service, Rocky Mountain Arsenal, Final Biological Report, Brighton, CO. 76 pp.

U.S. Fish and Wildlife Service. 1993. Colorado River Endangered Fishes Critical habitat Draft Biological Support Document. Salt Lake City, Utah. 225 pp.

U.S. Fish and Wildlife Service. 1994. Final Rule: Determination of Critical Habitat for Four Colorado River Endangered Fishes. Federal Register Vol. 59(54): 13374-13400.

U.S. Fish and Wildlife Service. 1995. Endangered and threatened species; bald eagle reclassification; final rule. Federal Register 50(17):35999-36010. July 12, 1995.

U.S. Fish and Wildlife Service. 1999. Endangered and Threatened Wildlife and Plants; Proposed Rule to Remove the Bald Eagle in the Lower 48 States from the List of Endangered and Threatened Wildlife; proposed rule. Federal Register 64(128): 36454-36464.

Valdez, R.A., P.G. Mangan, R.P. Smith, and B.C. Nilson. 1982. Upper Colorado River investigation (Rifle, Colorado to Lake Powell, Utah). U.S. Fish and Wildlife Service and Bureau of Reclamation, Final Report, Part 2, Colorado River Fishery Project, Salt Lake City, Utah.

Valdez, R.A., and W.J. Masslich. 1989. Winter habitat study of endangered fish - Green River. Wintertime movement and habitat of adult Colorado squawfish and razorback suckers. Report No. 136.2. BIO/WEST Inc., Logan, Utah. 178 pp.

Vanicek, C.D., and R.H. Kramer. 1969. Life history of the Colorado squawfish Ptychocheilus lucius and the Colorado chub Gila robusta in the Green River in Dinosaur National Monument, 1964-1966. Transactions of the American Fisheries Society 98(2):193.

Wick, E.J., J.A. Hawkins and C.A. Carlson. 1985. Colorado squawfish population and habitat monitoring 1983-1984. Final Report SE-3-7. Colorado Division of Wildlife and Colorado State University, Larval Fish Laboratory, Fort Collins. 48 pp.

Wilson, R.M., J.D. Lusk, S. Bristol., B. Waddell, and C. Wiens. 1995. Environmental contaminants in biota from the San Juan River and selected tributaries in Colorado, New Mexico, and Utah. U.S. Fish and Wildlife Service, Regions 2 and 6. 66 pp.

Wydoski, R.S. and E.J. Wick. 1998. Ecological Value of Flooplain Habitats to Razorback Suckers in the Upper Colorado River Basin. Upper Colorado River Basin Recovery Program, Denver, Colorado.