FINAL PROGRAMMATIC BIOLOGICAL OPINION

FOR BUREAU OF RECLAMATION'S OPERATIONS AND DEPLETIONS, OTHER DEPLETIONS, AND FUNDING AND IMPLEMENTATION OF RECOVERY PROGRAM ACTIONS IN THE UPPER COLORADO RIVER ABOVE THE CONFLUENCE WITH THE GUNNISON RIVER

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United States Department of the Interior

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Memorandum

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

Subject: Final Programmatic Biological Opinion for Bureau of Reclamation's Operations and Depletions, Other Depletions, and Funding and Implementation of Recovery Program Actions In the Upper Colorado River Above the Gunnison River.

This is the Fish and Wildlife Service's final programmatic biological opinion on the following Federal actions, hereinafter referred to as the "Federal action:"

- The continuation of all of the Bureau of Reclamation's operations, including all existing and authorized depletions, in the Upper Colorado River Basin above the confluence with the Gunnison River;

- Reclamation's portion of 120,000 acre-feet/year of new depletions in the Upper Colorado River Basin above the confluence with the Gunnison River; and

- Actions undertaken by the Service, Reclamation, and the Western Area Power Administration in the funding and carrying out of recovery actions for the Recovery Implementation Program for Endangered Fish Species in the Upper Colorado River Basin that affect the Colorado River from Rifle, Colorado, to Lake Powell, Utah, including the 15-Mile Reach of the Colorado River.

Treated as interrelated for purposes of this biological opinion in the analysis of the Federal action is the continuation of all non-Federal existing depletions in the Upper Colorado River Basin above the confluence with the Gunnison River, and the non-Reclamation portion of 120,000 acre-feet/year of new depletions in the Upper Colorado River Basin above the confluence with the Gunnison River. The 15-Mile Reach is a river reach that extends from the confluence of the Gunnison River upstream 15 miles to the Grand Valley Irrigation Company Diversion Dam near Palisade, Colorado. The subject water depletions occur above the confluence with the Gunnison River, but they affect flows in critical habitat from Rifle to Lake Powell. This biological opinion was prepared 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).

Reclamation, WAPA, and the Service contribute Federal funds to the Recovery Program which may affect listed species, therefore, section 7 consultation is required on such agencies' funding and implementation of the Recovery Program. However, all Recovery Program participants are both individually and collectively responsible for implementing the recovery actions identified in this biological opinion. While all Recovery Program participants and other entities who are responsible for actions identified in this biological opinion are committed to implementing the recovery actions, nothing contained in this opinion alters or amends the voluntary and discretionary nature of the Recovery Program as described in the document that initiated the Recovery Program (September 29, 1987), the 1988 Cooperative Agreement implementing the Recovery Program and the Section 7 Sufficient Progress and Historic Projects Agreement (USFWS 1993). If the Recovery Program fails to carry out any activities which are part of the proposed action or the terms and conditions of the Incidental Take Statement, it will not become the Service, Reclamation, nor WAPA's responsibility to do so. If this opinion becomes invalid because the Recovery Program were to cease to exist and consultation was reinitiated, the Service, Reclamation and WAPA's only responsibility will be that which results from section 7 consultations on their individual Federal actions. However, section 7 (a)(1) of the Endangered Species Act provides that the Secretary shall review programs administered by him and utilize such programs in furtherance of the purposes of the Act and requires Federal agencies to utilize their authorities to carry out programs for the conservation of endangered species; therefore, if the Recovery Program fails, the Federal Agencies are still obligated to take measures to conserve the endangered fishes. The participation in the Recovery Program and the facilitation of implementing the recovery actions as discussed in this biological opinion address the participating Federal Agencies' application of section 7 (a)(1). This biological opinion is not a precedent for

determining the degree of agency discretion in the operations of Federal water projects in other subbasins that are subject to review for compliance with the Act or for the combination of recovery actions needed to achieve such compliance.

The Service received three requests for initiation of section 7 consultation on the subject action from the following offices: 1) Bureau of Reclamation, Eastern Colorado Area Office (September 24, 1999), 2) Bureau of Reclamation, Western Colorado Area Office (September 27, 1999), and 3) Western Area Power Administration (October 15, 1999). The Service concludes that the implementation of the recovery actions identified herein and all existing and some new depletions of water from the Upper Colorado River Basin above the confluence of the Gunnison River "may affect" the endangered Colorado squawfish[1] (*Ptychocheilus lucius*), humpback chub (*Gila cypha*), bonytail (*Gila elegans*), and razorback sucker (*Xyrauchen texanus*) and their critical habitat. The Service concludes that the subject action is not likely to adversely affect the bald eagle (*Haliaeetus leucocephalus*) or the southwestern willow flycatcher (*Empidonax traillii extimus*). In recent years, the number of wintering and nesting bald eagles have increased in the Colorado River within the action area, with historic water depletions in place. It is not likely that any of the proposed actions will adversely affect bald eagles. The Service does not believe that historic water depletions on the Colorado River have adversely affected the southwestern willow flycatcher because in many areas there is more habitat (riparian vegetation - willow, tamarisk, cottonwood) now than there was historically. Graf (1978) used photographic evidence, map analysis, and field surveys to show the spread of tamarisk throughout the Colorado River system and described its effects of enlarging and stabilizing islands, bars, and restricting channel width. Many islands and shoreline habitats were not historically vegetated when spring flows were higher and prior to the establishment of tamarisk along the Colorado River.

Consultation History

Implementation of the Endangered Species Act in the Colorado River Basin started with section 7 consultation on Reclamation projects in the late 1970's. At this time, the Service determined that a jeopardy situation existed for the subject endangered fishes. Subsequently, the Act was amended to direct Federal Agencies to work with State and local agencies to resolve water resource issues in concert with conservation of endangered species.

In 1984, the Department of the Interior, Colorado, Wyoming, Utah, water users, and environmental groups formed a coordinating committee to discuss a process to recover the endangered fishes while new and existing water development proceeds in the Upper Colorado River Basin in compliance with Federal and State law and interstate compacts. After 4 years of negotiations, the Recovery Implementation Program for the Endangered Fish Species in the Upper Colorado River Basin was developed.

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

On January 21-22, 1988, the Secretary of the Interior; Governors of Wyoming, Colorado, and Utah; and the Administrator of the Western Area Power Administration cosigned a Cooperative Agreement to implement the Recovery Implementation Program for Endangered Fish Species in the Upper Colorado River Basin (USFWS 1987). Current participants in the Recovery Program include: the Service, Reclamation, WAPA, Colorado, Utah, Wyoming, Environmental Defense Fund, The Nature Conservancy, Colorado Water Congress, Utah Water Users Association, Wyoming Water Development Association, and the Colorado River Energy Distributors Association. The goal of the Recovery Program is to recover the listed species while providing for new and existing water development in the Upper Colorado River Basin. All participants agreed to cooperatively work toward the successful implementation of a recovery program that will provide for recovery of the endangered fish species, consistent with Federal law and all applicable State laws and systems for water resource development and use. Each signatory assumed certain responsibilities in implementing the Recovery Program.

In order to further define and clarify processes outlined in sections 4.1.5, 4.1.6, and 5.3.4 of the Recovery Program, a Section 7 Agreement and a Recovery Implementation Program Recovery Action Plan were developed (USFWS 1993). The Agreement established a framework for conducting section 7 consultations on depletion impacts related to new projects and impacts associated with existing projects in the Upper Basin. Procedures outlined in the Agreement are used to determine if sufficient progress is being accomplished in the recovery of endangered fishes to enable the Recovery Program to serve as a reasonable and prudent alternative to avoid the likelihood of jeopardy and/or adverse modification of critical habitat. The Recovery Action Plan was finalized on October 15, 1993, and has been reviewed and updated annually.

Since the implementation of the Recovery Program, over 200 biological opinions have been issued on water depletions to the Upper Colorado River Basin. The Recovery Program and implementation of the Recovery Action Plan have served as the reasonable and prudent alternative for these jeopardy opinions.

On March 11, 1996, the Recovery Program's Implementation Committee directed the Management Committee to develop a strategy to provide and protect flows in the 15-Mile Reach of the Colorado River. The Service's Regional Director then provided a letter (April 5, 1996) to the chair of the Management Committee detailing the request from the Implementation Committee. The letter requested that the strategy contain a discussion of how the flow and nonflow activities in the Colorado River sub-basin work together. At the same time there were discussions on whether the Section 7 Agreement was working in the 15-Mile Reach and on legislation for long-term funding of recovery actions. The Management Committee formed a workgroup to further identify the issues and recommend a strategy for their resolution. By the end of 1996, the workgroup recommended that the issues could be best resolved through a biological opinion on Recovery Program activities in the 15-Mile Reach. However, many issues regarding flow needs, options for providing and legally protecting water, the importance of nonflow actions in recovering the fish, and a framework for conducting future section 7 consultations remained unresolved. To resolve these issues, the State of Colorado convened a

larger workgroup of interested parties in August of 1997. The workgroup included water users, environmental groups, and State and Federal agencies. This programmatic biological opinion represents the Service's consideration of the Federal action described on page 1.

Scope of the Biological Opinion

The Federal action described on page 1 is addressed in this biological opinion. This biological opinion addresses impacts related to water depletions that occur above the confluence with the Gunnison River and impact critical habitat from Rifle to Lake Powell and recovery actions designed to offset these impacts. Therefore, the subject recovery actions affect the Colorado River between Rifle and Lake Powell. Impacts related to water depletions and recovery actions in the Green River are addressed in the consultations for Flaming Gorge Dam and the Duchesne River. Programmatic consultations for the Gunnison and Yampa Rivers are planned to address similar issues. Issuance of this programmatic biological opinion does not create an administrative priority concerning Upper Colorado River Basin depletions. The opinion neither prejudices nor determines the amount of depletions allowable under the Colorado River Compact or under the Endangered Species Act in other subbasins of the Upper Colorado River Basin.

The Recovery Program does not cover direct physical impacts of new actions (projects constructed after January 22, 1988); effects of transbasin diversions on Platte River endangered species; introduction of nonnative fish species; or discharges of pollutants and therefore, this biological opinion does not address such impacts. This biological opinion does not address impacts of future actions authorized by the participating Federal Agencies that are not associated with water depletions or operation of Reclamation facilities to carry out recovery actions.

BIOLOGICAL OPINION

DESCRIPTION OF THE PROPOSED ACTION

The proposed action is described on page 1. The Reclamation projects included in this consultation are the past, existing, and continued operation of the Colorado-Big Thompson Project, Fryingpan-Arkansas Project, Collbran Project, Grand Valley Project, and Silt Project, including all existing, historic, and authorized depletions associated with these projects. These projects are operated in accordance with various laws and policies such as the authorizing legislation for each project, operating policies, criteria, and principles, and various court decrees. For detailed descriptions of the physical features of each projects, see Appendix A.
Non-Reclamation projects associated with the continuation of existing depletions and 120,000 acre-feet/year of new depletions above the confluence with the Gunnison River which have or are likely to have a Federal nexus are anticipated to choose to rely on the implementation of the Recovery Action Plan, which is the responsibility of all of the Program participants, to avoid the likelihood of jeopardy and adverse modification of critical habitat. Therefore, this biological opinion is treating these projects as interrelated. The participating Federal Agencies contribute approximately $3.3 million annually for implementation of recovery actions under the base

funding component of the Recovery Program. Additionally, Reclamation contributes approximately $7 million annually for Capital Projects. However, to complete the actions described in this project description it will require the cost sharing by non-Federal partners. Capital Projects consist of construction of facilities and acquisition of land and water interests required to recover the endangered fish. These recovery actions are described below and in the most recent Recovery Action Plan (April 1,1999). The purpose of the Recovery Program and its Recovery Action Plan is to recover the four listed fish species and provide a means to avoid the likelihood of jeopardy and adverse modification of critical habitat for new and existing water projects. Recovery actions within the Recovery Program fall under five elements: 1) habitat protection; 2) habitat development and maintenance; 3) native fish stocking; 4) nonnative fish control; and 5) research, monitoring, and data management. Recovery (downlisting and delisting under ESA) of the fish species is dependent upon implementation of Recovery Program elements in the various river basins (USFWS 1987). Recovery in a single river would not achieve full recovery of the species, rather full recovery is dependent on self-sustaining populations in various locations as described in the Recovery Plans for each species (USFWS 1990a, 1990b, 1991, 1998). The Recovery Program " . . . is intended to go considerably beyond offsetting water depletion impacts by providing for the full recovery of the four endangered fishes in the Upper Colorado River Basin, excluding the San Juan River Basin" (USFWS 1993).

Under the Recovery Program, the Recovery Program Director's office annually sends a request to all participants for recommended changes to the Recovery Program's Recovery Action Plan. These changes include revised due dates, additions and deletions of recovery actions, additional steps to complete a recovery action, or a change in the lead agency responsible for ensuring completion of a recovery action item. Once the recommended changes are received, they are consolidated and sent to the technical committees for review and recommendations. Justifications for making the change are also provided. The Recovery Program's Management Committee then prepares a recommendation for the Implementation Committee, based on input from the Program Director's office and the technical committees. Final changes to the Recovery Action Plan require consensus by all Implementation Committee members. If consensus is not reached on a proposed change, the subject item in the Recovery Action Plan remains unchanged. The Implementation Committee routinely makes changes to the schedule for completing recovery actions when the delay is due to uncontrollable circumstances.

As described in the Federal action on page 1, this biological opinion addresses certain Reclamation operations and new and existing depletions, and treats as interrelated certain other depletions.

Existing depletions, as of September 30, 1995, have been estimated by modeling. Model results show existing depletions to be approximately 1-million acre-feet/year. This estimate is the approximate average annual depletion value modeled for water years 1975 to 1991. The minimum depletion value was approximately 877,000 acre-feet/year for 1983 and the maximum was approximately 1,172,000 acre-feet/year for 1978.

The 120,000 acre-feet/year of new depletions represents the amount of additional Reclamation and non-Reclamation water that the Service believes could be depleted from the Upper Colorado River Basin above the confluence with the Gunnison River using new or existing facilities (including depletions that have already occurred since September 1995) and not result in the likelihood of jeopardy or adverse modification of critical habitat so long as the recovery actions are implemented as described herein.

The 120,000 acre-feet/year depletion includes non-Reclamation projects and/or facilities that have current biological opinions but have not yet depleted the full amount covered by those biological opinions and water that could be depleted in the near future from facilities without a current Federal nexus. However, non-Reclamation facilities are treated as interrelated because of the likelihood that they will have a Federal nexus at some future point and want to rely on the Recovery Program to avoid the likelihood of jeopardy and adverse modification of critical habitat. The Federal nexus will likely come in the form of facility repairs requiring Army Corps of Engineers permits, Federal Energy Regulatory Commission relicensing, Federal agency authorization of right-of-ways, or some other Federal involvement. This 120,000 acre-foot reduction in flows is expected to have the same effect on endangered fish and their critical habitat if removed by existing or new projects. However, we cannot make a judgement on exactly where this 120,000 acre-feet/year of depletion will come from and anticipate that some of it will come from facilities that have yet to be constructed.

In recognition of the extreme variability of hydrology and water use demand patterns, the 120,000 acre-feet of new depletions will be calculated as a 10 year moving average as determined by the Colorado Water Conservation Board in consultation with Reclamation and concurred with by the Service (Appendix B).

The following elements of the Recovery Action Plan are measures completed, ongoing, or future actions which are part of the action subject to this consultation. As part of the action, the beneficial effects of these recovery actions are taken into consideration in the jeopardy and incidental take analysis. It is the Recovery Program's responsibility to ensure that all elements of the Recovery Action Plan affecting the Colorado River and other rivers are completed and/or implemented consistent with Recovery Program schedules (contained in the April, 1999, "Section 7 Consultation, Sufficient Progress, and Historic Projects Agreement and Recovery Action Plan" and subsequent revisions).

The following elements of the Recovery Action Plan address the biological and habitat needs of the endangered fishes, each element involves several recovery actions. These needs are described in the "Status of the Species and Critical Habitat" section of this document.

1. Habitat Protection Element

General protection

The Service and the Colorado Water Conservation Board entered into a Memorandum of Agreement on September 21, 1993, wherein the Board agreed to ". . . take such actions under state law, including requesting administration by the State Engineer and the appropriate division engineer and initiating water court proceedings, as may be necessary to fully exercise its water rights or to obtain delivery of acquired water or interest in water. Such water shall be protected within the entire stream reach for which the appropriation or acquisition is made." This agreement (commonly called the Enforcement Agreement) provided a legal mechanism to protect water obtained for the endangered fish under the Recovery Program. Categories of water this could apply to include contract deliveries, water leases, and acquired water rights.

Late Summer and Fall Base flow period augmentation

On September 2, 1997, the Colorado Water Court granted the CWCB an instream flow decree for 581 cfs in the 15-Mile Reach during July, August, and September. This decree protects the Orchard Mesa Pumping and Power Plant return flows that enter the river at the top of the 15-Mile Reach. In addition, the Colorado Water Court has granted the CWCB a 300 cfs instream flow right for water accretions occurring in the 15-Mile Reach during July, August, and September. These two instream flow rights provide protection from future diversions of water in the 15-Mile Reach. Additionally, 5,000 acre-feet annually plus an additional 5,000 acre-feet, 4 out of 5 years, is made available from Ruedi Reservoir by Reclamation, in consultation with the Service and the CWCB when needed by the fish. Protection of these releases is accomplished pursuant to the terms of an agreement between Reclamation, the CWCB, and the Service, which provides for the delivery and protection of that water in stream to and through the 15-Mile Reach. Typically the Service requests deliveries during July, August, and September.

In accordance with a 1995 biological opinion for Ruedi Reservoir Round II Water Sales, which was amended January 6, 1999, Reclamation, Colorado Water Conservation Board and the Service have signed 1-year agreements for 21,650 acre-feet/year of water (in addition to the 5,000 acre-feet/year plus 5,000 acre-feet 4 out of 5 years mentioned above) from Ruedi Reservoir. Under the amended Ruedi opinion, Reclamation is to provide the 21,650 acre-feet of water from Ruedi Reservoir for a period of 15 years through short- or long-term agreements beginning the first year the Recovery Program pays associated operation and maintenance costs, which costs were first paid for water released in 1998. Also, under the amended opinion, Reclamation proceeded with immediately contracting for up to 6,135 acre-feet of 17,000 acre-feet of Ruedi Round II water sales.

This programmatic biological opinion will take precedence over the amended Ruedi opinion, but does not require additional commitments of water from Ruedi Reservoir. Reclamation's 21,650 acre-foot/year commitment is reduced by half, when the water users provide 10,825

acre-feet/year. Reclamation's reduced commitment (21,650 minus 10,825) will continue for the 15-year period referenced in the Ruedi amendment (through the year 2012). Once Reclamation provides the reduced commitment through a long-term agreement (rather than the 1-year agreements), and this programmatic biological opinion is finalized, Reclamation may, as demand materializes, contract for the remainder of the 17,000 acre-feet of Ruedi Round II water (17,000 minus 6,135 equals 10,865) discussed in the Service's opinion dated May 26, 1995, as amended on January 6, 1999. A long term agreement will be finalized five months from the date of this final biological opinion or by a later date if it is specified in modifications to the Recovery Action Plan.

The water users' commitment for 10,825 acre-feet/year is divided equally between east and west slope water user entities. The water users' commitment was formalized in a letter dated September 16, 1998, and through the proposed Agreements for the Interim Provision of Water to the 15-Mile Reach of the Colorado River (Appendix C). Reclamation will participate in the process of deciding how to meet this commitment.

Once this programmatic biological opinion is finalized and the water users have provided their 10,825 acre-feet/year, Reclamation may contract under this consultation for the other half (10,825 acre-feet/year subtracted from its 21,650 acre-feet/year commitment equals 10,825 acre-feet/year), described above, provided the demand materializes and new depletions allowable under this programmatic biological opinion will not be exceeded. Under this consultation Reclamation may contract for the Ruedi water, which was committed in the long-term agreement through the year 2012, beginning in the year 2013, provided the demand materializes and new depletions covered by this programmatic biological opinion will not be exceeded.

The east and west slope water users' commitment of 10,825 acre-feet annually, referred to in the previous paragraph, will be dedicated by water user entities from existing or new Colorado Water Division Number 5 Facilities. Initially, this water will be provided on an interim basis as described in the proposed Agreements for the Interim Provision of Water, and then, it will be provided on a permanent basis for delivery, as needed by the fish. The water user entities will determine which facilities the water will be released from and will execute any necessary agreements. Until the permanent source(s) of this water are determined by the water user entities, 10-year Agreements for the Interim Provision of Water to the 15-Mile Reach of the Colorado River will be entered into by the Colorado River Water Conservation District, the City and County of Denver, acting by and through its Board of Water Commissioners, and the Service. Denver Water and the River District have agreed to provide the water for 10 years. This programmatic opinion does not restrict the water user entities from securing for Ruedi Reservoir water as a source for meeting their commitment. These leases and agreements are for delivery of water to be used in late summer/early fall beginning in 2000 to meet base flow needs. The agreements are to be signed concurrently with this final programmatic biological opinion. No later than the end of the 10 years, an agreement is to be executed by the water entities and the Service to furnish a permanent source of water to be provided annually to the 15-Mile Reach to benefit endangered fishes.

Also, the Service and the Colorado River Water Conservation District executed a Memorandum of Understanding in January 1998, pursuant to the Wolford Mountain biological opinion for storage and delivery of water to the 15-Mile Reach. Each year the River District makes available up to 6,000 acre-feet of water from Wolford Mountain Reservoir to benefit endangered fish habitat in the 15-Mile Reach of the Colorado River. The Wolford water is released by the River District at the discretion and direction of the Service. Protection of the releases is accomplished pursuant to the terms of an agreement between the River District, the CWCB, and the Service which provides for the delivery and protection of that water instream to and through the 15-Mile Reach pursuant to the Enforcement Agreement.

Additionally, the Recovery Program will construct features of the Grand Valley Water Management Project by the dates specified in the Recovery Action Plan. A study of canal operations from 1992-1994 showed the amount of water spilled from the Government Highline Canal in August, September, and October averaged 31,400 acre-feet. Once this project is completed, canal spills will be reduced by 19,400 acre-feet and approximately 9,000 acre-feet will be redirected to return to the Colorado River, through the Palisade Pipeline, above the 15-Mile Reach. In average and below average runoff years, the majority of the reduced canal spills will contribute to an increased surplus storage condition in Green Mountain Reservoir's Historic User Pool. "Surplus HUP water" is water in excess of the needs of the HUP beneficiaries as defined in paragraph 8 of the Green Mountain Reservoir Operating Policy (Federal Register, Volume 48, Number 247, December 22, 1983, as amended in Federal Register, Volume 52, Number 176, September 11, 1987) and the Stipulation and Agreement of the Orchard Mesa Check Case (Colorado Water Division 5, 91CW247). Surplus HUP water can be released from Green Mountain Reservoir and legally protected to indirectly improve flow conditions in the 15-Mile Reach. Therefore, implementation of the Grand Valley Water Management Project will result in up to 28,400 acre-feet (19,400 plus 9,000) of additional flows in the 15-Mile Reach. The project consists of adding 7 new check structures to the canal system, automation of the new and existing check structures, construction of the 1,000-foot Palisade Pipeline and the construction of the Highline Lake Pumping Station. Construction is to begin when this biological opinion is finalized and contracts with the Grand Valley Water Users Association have been completed. The August 2002 construction completion date is dependent on finalization of the biological opinion in December 1999.

Recovery Program participants have agreed to execute contracts, agreements, or other acceptable legal protection mechanism for delivery of surplus HUP water, including surplus water made available by Grand Valley Water Management Plan, to and through the 15-Mile Reach. Protection will occur in two phases. The first phase will protect water to and through the 15-Mile Reach up to the excess capacity of the Grand Valley Power Plant pursuant to the Orchard Mesa Check Settlement and will be completed in accordance with the schedule in the current RAP. The second phase will legally release and protect additional surplus HUP water to the degree it is deemed available and needed for enhancement of flows in the 15-Mile Reach. The amount of available surplus HUP water will be increased through improvements to the Grand Valley Project accomplished under Grand Valley Water Management Plan, as described in the above paragraph.

These improvements will reduce releases from the HUP to the Grand Valley Project for irrigation and result in additional surplus in the HUP. Additional surplus HUP water to be delivered and protected in the second phase is in excess of the capacity of the Grand Valley Power Plant canal system. This protection will be in place by the end of April 2000, or by a later date if subsequently modified in the RAP. The Recovery Program is working with Reclamation, the State of Colorado, and water users to legally protect and deliver additional surplus HUP water for nonconsumptive municipal/recreational uses and thereby indirectly benefit endangered fish habitat in the 15-Mile Reach. Recent studies for the Grand Valley Water Management Plan biological assessment have demonstrated that substantial water could be made available if flow protection agreements are put in place (Table 1). This water may not be available every year and it would not be released in years when it is not needed for the fish.

Spring peak enhancement

The Recovery Program implemented Coordinated Reservoir Operations for the Colorado River in 1997 and augmented spring peak flows by 2,000 cfs. In 1998, Coordinated Reservoir Operations added 2,500 cfs to the peak. Augmentation of the peak is to occur in all but extremely dry or extremely wet years or when peak flows are between 12,900 cfs and 26,600 cfs in the 15-Mile-Reach. During extremely wet years the peak exceeds this range without augmentation. Current plans are to augment spring peak flows by as much as possible for up to 10 days, by bypassing reservoir inflows during the peak. Although Coordinated Reservoir Operations is required to meet Recovery Program goals, participation by individual facility operators on a year-to-year basis is voluntary. A goal of Coordinated Reservoir Operations is to increase both the magnitude and duration of the spring peak.

This year, the Recovery Program initiated Phase II of spring peak augmentation through a "Coordinated Management of Colorado Water Division Number 5 Facilities - Phase II Study." The study is intended to assess water management facilities and operations that can be coordinated to benefit fish habitat primarily during the spring peak. The goal is for project sponsors to satisfy project purposes, but to utilize any flexibility that may exist to enhance spring flows for endangered fish. Possible options include new projects, long- and short-term leases or delivery agreements and using or moving winter water in excess of fish needs to meet water demand or fish needs during the spring. The intent is to provide additional water up to approximately 20,000 acre-feet/year of water for spring peak flow enhancement, without diminishing project yield or causing project sponsors to incur significant costs. When additional water of approximately 20,000 acre-feet is available, it could provide 1,008 cfs per day for a 10 day period.

2. Habitat Development and Maintenance Element

Floodplain habitats have been identified as important for endangered fishes, especially the razorback sucker. These habitats have been lost over time due to channelization, dikes, bank

Table 1. The estimated benefits in acre-feet made available from the Grand Valley Water Management Project and the Orchard Mesa Check Settlement (Grand Valley Water Management Project Environmental Assessment, September 1998).

Years Hydrologic Type	Water provided at Palisade Pipeline - not protected	Legally protected up to canal capacity	Made available through Municipal/ Recreation Agreements	Natural flow water not protected
Normal	9,000	16,257	28,779	1,803
Wet	9,000	0	65,500	6,827
Dry	9,000	19,551	37,348	4,640

stabilization, and lower spring flows. One element of the Recovery Program involves enhancing, restoring, and protecting natural floodplain habitats. An inventory of these habitats was completed for 871 miles of the Colorado, Green, Gunnison, Yampa, and White Rivers. Floodplain habitats are being restored along the Colorado River to prepare the ecosystem for reintroduction and reestablishment of razorback sucker populations. Two sites along the Colorado River have been restored by connecting bottomland habitat to the river and shaping the habitat to facilitate draining during low flow periods to avoid harboring nonnative fishes. One project, at 29⅝ Road (also known as Gardner Pond) involved partially filling in an old gravel pit and constructing a connection to the Colorado River. Ongoing studies are evaluating the use of gravel pit ponds that have been reshaped to drain and behave as ephemeral floodplain habitats for adult Colorado pikeminnow and razorback sucker. The spring of 1998 was the first of a 3-year evaluation period. Intensive sampling was done at Gardner Pond and an adjacent pond, known as Pickup Pond. A total of 376 native fish including adult Colorado pikeminnow were captured in these two ponds.

The second project is a partnership effort between the Recovery Program, the Service, the City of Grand Junction, the Riverfront Commission, and the Mesa County Soil Conservation District located near the confluence with the Gunnison River at the Jarvis site. Prior to the 1950's this site was a northern side channel to the Colorado River. In the 50's it was diked off from the river and mined for gravel, then the gravel pit was used as a municipal dump and disposal site for uranium mill tailings. After the pit was filled in, the site was used as an auto salvage yard. In the late 1980's, the City of Grand Junction purchased the site and removed all the junk cars, then the Department of Energy removed all the radiological contaminated waste, leaving the site close to the original river elevation. To restore the site, a notch has been constructed in the dike between the river and the excavated area and the site has been shaped to drain during low water. A set back dike was constructed to protect adjacent property. During high water, the site is inundated with water from the river and provides habitat for endangered fishes, and as the river drops, the

site drains, so it is not a year round pond that supports nonnative fishes. This site will provide shallow warm water habitat for prespawning conditioning for Colorado pikeminnow and razorback sucker. It provides a quiet water refuge and an abundant food supply during spring runoff.

Adobe Creek and Walter Walker State Wildlife Area are two floodplain sites used in an evaluation of contaminant impacts on razorback sucker reproduction. Water control structures were constructed in a tertiary channel at Adobe Creek, enabling a section of this channel to be isolated and controlled for this evaluation and for possible use as a grow-out area for larval razorback suckers in the future. A water control structure also was constructed at Walter Walker allowing 100 cfs of fresh water from the river to enter in an attempt to help lower selenium levels at this site. This appears to have been successful.

Two properties (181 acres) have been acquired along the Colorado River for restoring endangered fish habitat in the floodplain. Approximately 13 properties are currently in various stages of the pre-acquisition process. The priorities along the Colorado River include several gravel pit ponds and partnerships with local private, county, State, and Federal entities. The Recovery Program will continue to support funding and acquisition of interest in bottomlands identified by the Service as needed for recovery of the endangered fish along the Colorado River. Current plans are to acquire interest in up to 3,500 acres of bottomland habitat along the Upper Colorado River in the Grand Valley and along the Gunnison River. Properties will be purchased on a willing seller basis.

A second component of habitat restoration is construction of fish passageways on dams and diversions that have blocked endangered fish access to important historical habitat. These barriers have fragmented habitat and prevented access to spawning, feeding , and winter habitats. Construction of a passageway was completed in January 1998 at the Grand Valley Irrigation Company Diversion Dam. It consists of a notch in the dam and a series of pools and riffles immediately below. This configuration of rocks creates pools and riffles in ascending increments, and allows fish to swim upstream and over the dam during periods of low flow. Two additional fish passages at Price-Stubb and Grand Valley Project Diversion Dams are currently in the planning and evaluation stage. Colorado pikeminnow no longer occur above the Price-Stubb Dam. Passage at the Price-Stubb Diversion Dam is currently scheduled to be completed in September 2000. If the dam removal option is chosen, the schedule could be delayed until April 2002 to accommodate completion of the Plateau Creek Pipeline Project by Ute Water Conservancy District. Restoration of passage at the Government Highline Diversion Dam is tentatively scheduled for completion during 2001.

3. Native Fish Stocking Element

To achieve recovery it is important to maintain the genetic integrity of wild and captive-reared endangered fishes and to prevent irreversible losses of genetic diversity. The genetic management goals of the Recovery Program are to prevent immediate extinction; to conserve genetic diversity

through recovery efforts that will reestablish viable wild stocks by removing or significantly reducing factors that caused population declines; to maintain genetic diversity in captive-reared endangered fish broodstock that is similar to that of the wild stock used as founders; and to produce genetically diverse fish for augmentation efforts.

The razorback sucker is the highest priority for placing in refuge and developing broodstock because of continued population decline and low recruitment. A refuge broodstock of upper Colorado River razorback sucker stock is being developed and augmentation stocking has been implemented in the Gunnison River and in the Colorado River between Rifle and Palisade. The Recovery Program maintains razorback suckers at the Horsethief facility in the Grand Valley as a refugia and for developing broodstock. Bonytail broodstock are currently maintained at the Service's Dexter National Fish Hatchery and Technical Center. One stock of the Colorado pikeminnow is being developed for the augmentation of the upper Colorado River. The hatchery facilities in the Grand Valley consist of buildings for hatching eggs and rearing young, and holding and growout ponds. Expansion of existing facilities to be completed in 1999 included a building to hatch and rear young Colorado pikeminnow. The Recovery Program is in the process of obtaining additional ponds that will be used to grow both razorback suckers and Colorado pikeminnow to a size suitable for stocking.

The Recovery Program has approved a stocking plan for the Colorado River that calls for stocking 102,100 6- to 8-inch and 30,600 12-inch razorback sucker in the spring and fall for 5 years in the Rifle to De Beque Canyon reach and from Palisade to Stateline. The approved plan also calls for stocking 25,600 4-inch and 12,800 8-inch bonytail in the spring and fall for 5 years in the Colorado River from Palisade to Loma. Additionally, in the spring and fall, 800 6-inch and 400 10-inch Colorado pikeminnow are scheduled for stocking for 5 years in the Colorado River from Rifle to De Beque Canyon. Numbers to stock will likely be modified after the first 3 years based on an evaluation of stocking effectiveness. To date, 10,381 bonytail have been stocked in the Colorado River in Professor Valley, Utah, and this stocking will continue for at least 1 more year. Based on approved stocking plans, the Recovery Program intends to stock a total of 7,200 Colorado pikeminnow; 1,030,000 razorback sucker; and 33,400 bonytail into the mainstem Colorado River from Rifle, Colorado, to Lake Powell, Utah. Stocking will proceed in accordance with dates established by the Recovery Program and/or included in the Recovery Action Plan.

4. Nonnative Fish Control

Regulations and agreements

Nonnative fish in the Colorado River system have been identified as a major factor in the decline of the endangered fishes because they compete for food and space and prey on endangered fishes. To prevent further introduction of nonnative fish into the system and to reduce the number of nonnative fish in critical habitat, stocking regulations and bag limits in the State of Colorado have been changed.

In 1996, Procedures for stocking nonnative fish species in the Colorado River were approved by the Recovery Program (USFWS 1996). A Memorandum of Agreement implementing the Procedures was signed September 5, 1996, between the Service and the States. The purpose of the Procedures is to ensure that all future stocking of nonnative fish will be consistent with the recovery of the endangered fishes. This agreement remains in effect through the life of the Recovery Program.

On January 14, 1999, the Colorado Wildlife Commission adopted regulations that limit the stocking of private ponds. The intent and restrictions in these regulations are identical to the Procedures adopted in 1996. Regulations restricting stocking of private ponds will remain in effect for 4 years, at which time the Wildlife Commission will determine if the procedures were effective. If the regulations restricting the stocking of private ponds are rescinded, then other nonnative control/removal efforts will have to be put in place.

Colorado has removed bag limits on all nonnative warmwater sportfishes within the critical habitat reach of the Colorado River. Bag limits had been in place for all warmwater sportfish. The removal of bag limits may increase the numbers of nonnative fish removed from endangered fish habitat. Colorado also has agreed to close river reaches to angling where and when angling mortality is determined to be significant to native fish.

Removal efforts

In order to reduce the number of nonnative fishes in the Colorado River system, several removal programs have been put in place. One effort removes nonnative fish from ponds along the Colorado and Gunnison Rivers where many species of nonnative fishes reproduce and grow. During high water events, these nonnative fishes have access to or get washed into the river where they complete with and prey on native fishes. Off channel ponds along the Colorado River have been identified as the source of many of the nonnative sportfishes that occur in the river and in endangered fish nursery areas. Ponds in critical habitat in the Colorado River are being identified for reclamation. Pond reclamation can include complete removal of nonnative fish, screening ponds to prevent escapement to the river, and/or reshaping ponds so that they no longer support year round habitation by nonnative fish. The most effective and practicable of these alternatives will be implemented on a case by case basis. The Recovery Program is reclaiming up to 25 ponds each year until all public and private ponds that can be reclaimed are completed. The actual number of ponds to be reclaimed each year will be determined through revision of the current Pond Reclamation scope-of-work as part of the Recovery Action Plan. In 1998, the Colorado Division of Wildlife reclaimed 25 surface acres of ponds; negotiated water management for 5 ponds to facilitate seasonal drying; and reduced depth in 1 pond to promote winter kill. This activity will continue as long as deemed appropriate by the Recovery Program.

Backwaters have been identified as important nursery habitat for Colorado pikeminnow and other native fishes. The majority of the fishes found in backwaters are nonnative cyprinids and centrarchids, and biologists believe that these nonnative fishes compete for food and space with

native fishes. Also, some species of nonnative fishes eat the native fishes and this is believed to be a reason for the decline in native fishes. The Recovery Program has implemented nonnative fish removal efforts for small nonnative cyprinids and centrarchids from backwaters and other low velocity habitats. Removal efforts focus on trying to achieve a decrease in numbers of small minnows prior to spawning by Colorado pikeminnow. Some removal may need to occur during razorback spawning. Centrarchids such as green sunfish and largemouth bass are predacious and impact endangered fish populations. These fish will be removed by contractors for the Colorado Division of Wildlife from low velocity habitats during the summer of each year for as long as needed to attain viable endangered fish populations. Other nonnative fish collected while targeting cyprinids and centrarchids also will be removed when encountered. The Colorado Division of Wildlife will prepare and adopt a Colorado River Fisheries Management Plan that will implement a more detailed nonnative fish control effort. The plan will be reviewed and approved by the Recovery Program and Colorado Wildlife Commission. The Plan will be finalized and implemented by the dates specified in the Recovery Action Plan.

5. Research, Monitoring, and Data Management Element

Monitoring the status and trends in fish populations has been an integral component of the Recovery Program. An interagency standardized monitoring program was established in 1988. The ISMP was designed to annually measure the catch per unit of effort of humpback chub and Colorado pikeminnow at different life stages. Young-of-the- year Colorado pikeminnow are sampled by using a seine in backwaters (zero velocity habitat) in four large reaches of the Green and Colorado Rivers during the fall. Subadult and adult Colorado pikeminnow are sampled by electrofishing in 13 reaches of the Yampa, Green, White, and Colorado Rivers during April or May. Humpback chubs are monitored less intensively every 3 years in Black Rocks and Westwater Canyons of the Colorado River. Trammel nets are used in the early fall to sample subadult/adults. More recently, ISMP has been expanded to estimate population sizes. A population estimate of Colorado pikeminnow in the upper Colorado River was around 600 adults in 1991-1994 (Osmundson and Burnham 1996); a preliminary estimate conducted in 1998 yielded over 700 adults (USFWS unpublished data). Preliminary population estimates for humpback chub are 1,500 adults in Black Rocks (Pfeifer et al. 1998) and approximately 7,000 adults in Westwater Canyon. A basin wide razorback sucker monitoring plan has been developed and will include reaches of the Colorado River coincident with augmentation of these populations. Monitoring will continue until the fish are delisted.

The Service anticipates the implementation of the Recovery Actions will provide a positive population response for each species. Information from the ISMP will be used to determine population responses. Population status and trends will be determined by the population indicators outlined in Appendix D. The Recovery Program is currently developing recovery goals for the four endangered fish species. If a population meets or exceeds the recovery goals or the goals described in Appendix D for that species, it will be considered to exhibit a positive

population response. However, until these recovery goals are established, trends in certain population indices (Appendix D) will provide an interim assessment of a species' progress toward recovery.

6. Long-Term Funding

The Recovery Program participants will pursue and support introduction of long-term funding legislation in the Senate and House of Representatives during the 106th Congress. The legislation is to authorize cost shared funding for both the San Juan River and Colorado River Recovery Programs. The purpose of the legislation is to authorize and provide funding for the implementation of all the Recovery Activities of the Recovery Program within the currently established time schedule. This legislation is essential to the implementation of the Recovery Actions described above. The legislation will include authorization for both capital and base funding.

The Recovery Program participants also will continue to pursue and support annual Federal and State appropriations and revenues, as needed, that fund full implementation of the Recovery Actions identified within this opinion. This includes both capital funding and annual base funding.

Capital funding is for planning, design, permitting or other compliance, construction, construction management, replacement of facilities, and the acquisition of interests in land or water, as necessary to carry out the Recovery Program. These capital items include hatchery additions for the genetic conservation and propagation of the endangered fishes, the restoration of floodplain habitat, fish passage, acquisition of water for instream flows (water leases), and the removal or translocation of nonnative fishes. Capital funding of up to $62,000,000 for the Recovery Program is to continue through the year 2005. These activities are substantially cost shared with non-Federal contributions by Upper Basin States and power users.

Base funding is for the operation and maintenance of capital projects, implementation of Recovery Actions other than capital projects, monitoring and research to evaluate the need for or effectiveness of any recovery action, and program management, as necessary to carry out the Recovery Program. Base funding also includes annual funding provided by the Service, Reclamation, Colorado, Utah, and Wyoming under the terms of the 1988 Cooperative Agreement. Base funding for the Recovery Program from power revenues will be up to $4,000,000 per year, adjusted for inflation.

Existing and New Depletions

Existing depletions anticipated to continue into the future, addressed in this biological opinion, consist of Reclamation and non-Federal depletions as described in the Federal action on page 1. Existing project depletions are defined below. Only the amount of water that was depleted as of September 30, 1995, is considered an existing use or depletion of water, except as defined for Green Mountain and Ruedi Reservoirs below. Project depletions above this level are considered

"new" depletions. This would include depletions from new, as yet unbuilt projects, and additional depletion occurring after September 30, 1995, from existing projects. Existing depletions shall remain characterized as "existing depletions" regardless of any subsequent change, exchange, or abandonment of the water rights resulting in such depletions. Also, existing depletions transferred to other facilities remain existing depletions so long as there is no increase in the amount of total depletions attributable to existing depletions.

Existing depletions are defined as follows[2]:

> a) existing depletions anticipated to continue into the future from the Upper Colorado River Basin above the confluence with the Gunnison River are those that actually occurred on or before September 30, 1995 (approximately 1 million acre-feet/year);
>
> b) depletions associated with the total 154,645 acre-feet volume of Green Mountain Reservoir, including the power pool (which includes but is not limited to all of the 20,000 acre-feet contract pool and Historic User's Pool), and the Colorado Big-Thompson Project replacement pool; and
>
> c) depletions associated with Ruedi Reservoir including but not limited to, Round I sales of 7,850 acre-feet, Round II sales of 17,000 acre-feet as discussed in the Service's biological opinion to Reclamation dated May 26, 1995, and as amended on January 6, 1999, and the Fryingpan Arkansas Project replacement pool as governed by the operating principles for Ruedi Reservoir, but excluding 21,650 acre-feet from the marketable yield.

New depletions are defined as average annual depletions from new or existing projects occurring after September 30, 1995, and excludes existing depletions as defined above. New depletions will be calculated as a 10 year moving average as determined by the CWCB and reported to the Service and Recovery Program by January 1 of every odd numbered year (beginning January 1, 2001) as described in Appendix B.

Water users that choose to use the implementation of Recovery Actions under the Recovery Program for Endangered Species Act compliance will be required to sign a Recovery Agreement (Appendix E), except Reclamation will not be required to sign these agreements as discussed later in this opinion. In the Recovery Agreements, individual water users will agree not to take any action which would probably prevent the implementation of the recovery actions of the Recovery Program and to take reasonable actions required to implement the recovery actions. The Service anticipates that water user entities controlling a majority of existing depletions above the Gunnison River will sign Recovery Agreements within 120 days of issuance of this biological opinion, pending review of the opinion and approval of the recovery agreement by their governing

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[2]This definition is for the purpose of defining depletions, a part of the Federal action subject to consultation, and includes as "existing depletions" some water from Reclamation facilities that is not currently being depleted or water that has not actually been depleted.

bodies. Signing of the Recovery Agreement will indicate support for the implementation of recovery actions identified in this opinion, and will provide immediate coverage to those water users for incidental take. If water users choose not to sign a recovery agreement, they could not rely on the Recovery Program for Endangered Species Act compliance. Reasonable and prudent alternatives outside the Recovery Program would have to be developed.

Monetary charges for projects to fund Recovery Actions which choose to rely on the Recovery Program will be assessed consistent with documents establishing the Recovery Program (USFWS 1987). Existing and future Reclamation projects remain exempt from the charge because they contribute annually to the Recovery Program. All other new project proponents undergoing individual section 7 consultations for depletions greater than 100 acre-feet/year are to pay the 1-time charge. New projects pay 10 percent at the time Federal funds or authorizations are obtained and the remainder prior to depletions occurring. Existing projects are to pay the charge for new depletions which have occurred since January 22, 1988. As additional new depletions occur from existing facilities that will have undergone section 7 in accordance with this biological opinion, a depletion charge will be assessed and paid prior to the actual depletion.

The Service will continue to work with proponents of new water projects to minimize project impacts and look for mutually agreeable opportunities to provide conditions that benefit the endangered fishes. The Service intends to coordinate with the lead Federal Agency during the National Environmental Policy Act process and conduct informal section 7 consultation, as appropriate. This will reduce the likelihood of reinitiation of consultation on existing and other new projects that precede the subject project.

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 6 feet in length and weighed nearly 100 pounds (Behnke and Benson 1983). Today, fish rarely exceed 3 feet in length or weigh more than 18 pounds; such fish are estimated to be 45-55 years old (Osmundson et al. 1997). The mouth of this species is large and nearly horizontal with long slender pharyngeal teeth (located in the throat), adapted for grasping and holding prey. The diet of Colorado pikeminnow longer than 3 or 4 inches consists almost entirely of other fishes (Vanicek and Kramer 1969). Males become sexually mature earlier and at a smaller size than do females, though all are mature by about age 7 and 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.

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, 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. No historic records exist that would indicate how far upstream Colorado pikeminnow once occurred in the Colorado River. The only reliable account of the species occurring upstream of the Price Stubb Dam near Palisade, Colorado, is from a Service biologist who reports having captured Colorado pikeminnow 2-3 miles up Plateau Creek while angling there around 1960 (Bob Burdick pers. com.).

Critical habitat was designated in 1994 within the 100-year floodplain of the Colorado pikeminnow's historical range in the following area of the upper Colorado River (59 F.R. 13374).

Colorado, Mesa and Garfield Counties; and Utah, Grand, San Juan, Wayne, and Garfield Counties. The Colorado River and its 100-year floodplain from the Colorado River Bridge at exit 90 north off Interstate 70 in T. 6 S., R. 93 W., section 16 (6th Principal Meridian) to North Wash, including the Dirty Devil arm of Lake Powell up to the full pool elevation, in T. 33 S., R. 14 E., section 29 (Salt Lake Meridian).

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

Colorado pikeminnow were historically distributed throughout warmwater reaches of the Colorado River Basin from Wyoming and Colorado south to the Gulf of California. 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).

Colorado pikeminnow are presently restricted to the Upper Colorado River Basin and inhabit warmwater reaches of the Colorado, Green, and San Juan Rivers and associated tributaries. The

species inhabits about 350 miles of the mainstem Green River from its confluence with the Colorado River upstream to the mouth of the Yampa River. In the Yampa River, its range extends upstream an additional 160 miles. Colorado pikeminnow also occur in the lowermost 104 miles of the White River, another tributary to the Green River. In the mainstem Colorado River, distribution of the species extends 201 miles upstream from the upper end of Lake Powell to Palisade, Colorado (Tyus 1982).

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 life phases.

In the mainstem Colorado River, the magnitude of spring flows has declined by 30-45 percent since the early part of the century (Osmundson and Kaeding 1991, Van Steeter 1996, Pitlick et al. 1999). Such flow reduction negatively affects Colorado pikeminnow 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 impairs essential behavior patterns, such as breeding, feeding, and sheltering.

Osmundson and Burnham (1998) summarized the status and trend of the Colorado River population of Colorado pikeminnow. They found that numbers were low but new individuals were actively recruiting to the adult population, and recruitment largely occurs in pulses from infrequent strong year classes. These investigators concluded that low adult numbers and

infrequent pulsed recruitment make this population vulnerable to extirpation over time from both natural fluctuations in numbers as well as from continued changes in habitat.

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). 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).

Spawning has been confirmed in the Colorado River by the presence of Colorado pikeminnow larvae in all years sampled. Larvae are distributed throughout the river although most have been

found downstream of Grand Junction (McAda and Kaeding 1991, Osmundson and Burnham 1998). Aggregations of ripe adults have been found near Clifton and Grand Junction, Colorado and near the Colorado-Utah state line (Osmundson and Kaeding 1989, McAda and Kaeding 1991, USFWS unpublished data). Suitable spawning habitat (defined below) in the Colorado River near Cataract Canyon, Professor Valley, and upstream from the Dolores River confluence indicate spawning may occur in or near these areas as well (Archer et al. 1985; Valdez 1990).

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 laminar 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).

It is unknown whether tertiary bars similar to those used for Colorado pikeminnow spawning in Yampa Canyon are available in the 15-Mile Reach of the Colorado River. There, significant motion of bed material occurs at near bankfull discharge of 22,000 cfs (Van Steeter 1996). These flows occur on average once in 4 years. Van Steeter (1996) concluded that flows of this magnitude are important because they generally remove fine sediment from the gravel matrix which maintains the invertebrate community and cleans spawning substrate.

Although the location of spawning areas in the Colorado River is not as defined as in the Yampa River, the annual presence of larvae and young-of-the-year downstream of the Walker Wildlife

Area, in the Loma to Black Rocks reach and near the confluence of the Dolores River, demonstrates that spawning occurs every year. Osmundson and Kaeding (1989, 1991) reported that water temperatures in the Grand Junction area were suitable for Colorado pikeminnow spawning. In 1986, a year of high runoff, suitable temperatures for spawning (20° C) occurred in mid-August; in 1989, a year of low runoff, the mean temperature reached 20° C during the last week of June. Tyus (1990) demonstrated that Colorado pikeminnow often migrate considerable distances to spawn in the Green and Yampa Rivers, and similar though more limited movement has been noted in the mainstem Colorado River (McAda and Kaeding 1991).

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).

Larval Colorado pikeminnow have been collected in the Gunnison River up- and downstream of the Redlands Diversion Dam (Anderson 1998; Osmundson and Burnham 1998). Burdick (1997) reports that the capture of larval Colorado pikeminnow in 1995 and 1996 upstream of the Redlands Diversion Dam coupled with aggregations of adult fish during the spawning season confirms that spawning occurs upstream of the dam.

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

Osmundson and Burnham (1998) estimated the population of adult and subadult Colorado

pikeminnow in the Colorado River (from Palisade to the confluence with the Green River) to be 600-650 individuals during 1991-1994. This estimate equates to an average of 4.0-4.2 fish per mile above Westwater Canyon, and 3.1-3.4 fish per mile below Westwater Canyon but the fish are not distributed equally in all parts of the river. Preliminary estimates from a 1998 survey indicate that the population has increased to about 750 subadults and adults in the Colorado River (USFWS unpublished data).

Colorado pikeminnow reproduce each year; however, strong year classes are relatively rare (Osmundson and Burnham 1998). A distinct increase of subadult fish was found below Moab in 1991 and within a few years these fish were distributed throughout the Colorado River. Osmundson and Burnham (1998) concluded that these fish were the result of one or more strong year classes produced during the mid-1980's. McAda and Ryel (1999) have identified another strong year-class that occurred in 1996. In both cases, the common hydrologic conditions that led to successful reproduction and first year survival was a spring and summer of moderately high flows following a year of exceptionally high flood flows (McAda and Ryel 1999).

Analysis of Species/Critical Habitat Likely to be Affected

The Grand Valley area is occupied year round by Colorado pikeminnow. The 15-Mile Reach is the section of the Colorado River extending from the confluence of the Gunnison River upstream to the Grand Valley Irrigation Company Diversion Dam. It has been identified as important habitat for Colorado pikeminnow. Not only are densities of pikeminnow especially high there (Figure 1), but the average size of the fish there is larger than in any other portion of the Colorado River (Figure 2).

Radio-telemetry studies show upstream and downstream movement of adult Colorado pikeminnow in the mainstem Colorado River (McAda and Kaeding 1991). The most dramatic movement was exhibited by a fish implanted with a radio transmitter at Gypsum Canyon in upper Lake Powell on April 5, 1982. The fish was contacted next in the lower Cataract Canyon area on July 9, 1982. The next contact was made above the Black Rocks area of Ruby Canyon, some 160 miles upstream. The movement was accomplished in 41 days and is believed to be related to spawning. At the end of September 1982, this fish was located in the 15-Mile Reach (river mile 178), nearly 200 river miles from its furthest documented downstream location.

Other radio-tagged fish in the Colorado River have not displayed such dramatic migratory behavior. Radio-telemetry studies conducted during 1982-1989, which focused on upstream reaches of the Colorado River in and around the Grand Valley, provide the best indication of use of the 15-Mile Reach above the confluence of the Gunnison River. Movement of these fish during a field season was generally limited to 25-30 miles (Osmundson and Kaeding 1989, McAda and Kaeding 1991).

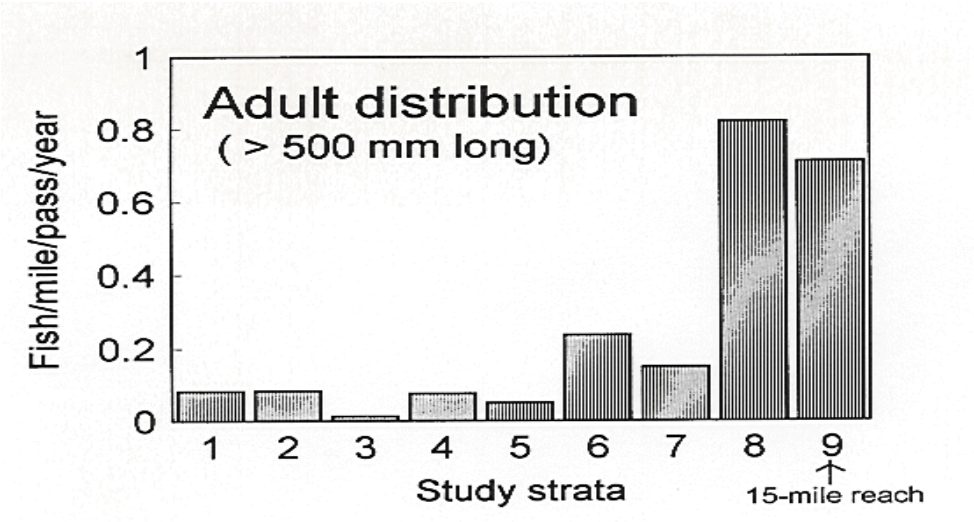

Figure 1. Distribution of adult Colorado pikeminnow (>500 mm long) in the Colorado River. Catch rates (fish per mile) were averaged across sampling (electrofishing and trammel netting) passes in each year and these values from 5 years (1991-1994 and 1998) were averaged. See Osmundson and Burnham (1998) for sampling methodology and Osmundson (1999) for strata locations. The 15-Mile Reach is strata 9.

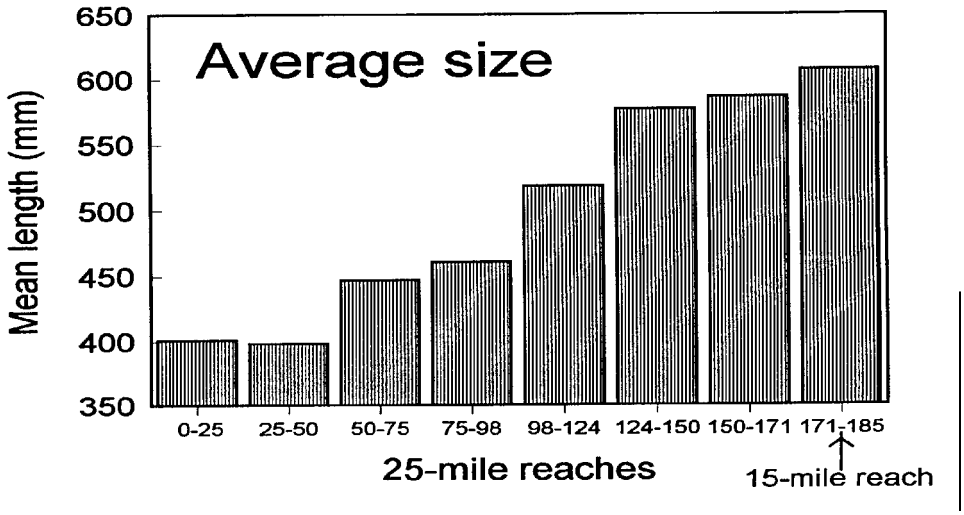

Figure 2. Size distribution of subadult and adult Colorado pikeminnow in the Colorado River based on electrofishing and trammel netting results. Lengths were averaged by 25-Mile Reach within years and reach means were then averaged across years (1991-1994 and 1998). The 15-Mile Reach is miles 171 - 185.

During 1986-1988, 17 adult Colorado pikeminnow were captured in the 15-Mile Reach during April-June and radio-tagged. The fish exhibited a diversity of localized movements throughout the Grand Valley but spent a major part of their time in the 15-Mile Reach. Two remained in the reach throughout the estimated spawning period (Osmundson and Kaeding 1989).

In a study by McAda and Kaeding (1991), a suspected prespawning aggregation of adult Colorado pikeminnow was observed in mid-July of 1982 at river mile 178.3 in the 15-Mile Reach. In the first observation, three radio-tagged fish were tracked to one riverine pool area, and nine adults at or near spawning condition were then captured there after limited net sampling efforts. The aggregation occurred a few days after mean daily water temperature had reached 20° C and during a time when runoff flows were dropping off sharply. A second aggregation was noted at river mile 175.3, 12 days after the initial observation. Drifting trammel nets through an area occupied by two fish equipped with transmitters yielded an additional male Colorado pikeminnow in spawning condition. During this same time period, an adult female was captured near river mile 175 that weighed nearly 1 pound more than when previously captured a month earlier, suggesting the development of spawning (gravid) condition. Two Colorado pikeminnow larvae were subsequently collected within the 15-Mile Reach.

During 4 years (1982-1985) of larval sampling throughout the Grand Valley, 100 larval pikeminnow were collected with fine-mesh hand nets from the two Colorado River reaches immediately upstream and downstream of its confluence with the Gunnison River (McAda and Kaeding 1991). Although the sampling effort was similar in the two river reaches, 98 percent of the larval captures occurred downstream of the Gunnison River confluence. Only two (2 percent) of the larvae were collected from the upstream reach. These observations may indicate that most fish were spawned in the downstream reach or that the larvae were deposited in the upstream reach and drifted downstream to the area where most of the captures were recorded. In 1995, drift nets set in the lower portion of the 15-Mile Reach captured 3 Colorado pikeminnow larvae (Anderson 1998).

No postlarval young-of-year Colorado pikeminnow greater than 25 mm total length were collected from above the Gunnison River confluence in fall collections from 1986-1994; however, one yearling-sized individual was captured there in 1986 (Osmundson and Burnham 1998). A total of 122 Colorado pikeminnow were collected in the 31-Mile Reach downstream of the confluence of the Gunnison River during 1982-1996 (McAda and Ryel 1999). The 1982-1984 catch rate of young-of-year Colorado pikeminnow in the 10-Mile Reach immediately downstream of the confluence of the Gunnison River (river miles 160-170) warranted classification of this reach as a "Young-of-Year Nursery Area" by the Basin Biology Subcommittee (USFWS 1984).

Catch rates of adult (> 500 mm long) Colorado pikeminnow in the 15- and 18-Mile Reaches of the Grand Valley are significantly higher than in any other portion of the Colorado River (Figure 1). In the 15-Mile Reach, adults are most abundant during spring in a 1.3-mile segment between river miles 174.4 and 175.7, particularly in two gravel-pit ponds that were accessible

during high flows. Some of the pikeminnow captured from one pond in 1986 were well tuberculated by June 3, when nearby river temperatures were only 10-13° C (L. Kaeding pers. com.). It has been hypothesized by some investigators that additional thermal units, above those provided in the mainstream, are important in increasing annual growth rates and perhaps in gonadal maturation. If this is true, then access to these sheltered off-channel pools may be very important in increasing rates of survival and successful spawning in the upper reaches of the Colorado River. Historically, bottomlands that routinely flooded during the spring runoff period would have provided these warm productive habitats; in recent years, flooded gravel pits may provide the only comparable habitat.

Although the river downstream of the Grand Valley also supports adult Colorado pikeminnow, the primary importance of these downstream reaches is in providing nursery areas for larvae and rearing areas for juveniles. Concentrations of larvae and young-of-year occur in backwaters in the 65-mile, low-gradient reach between Moab, Utah, and the confluence with the Green River (McAda et al. 1994). These backwaters are especially important during the Colorado pikeminnow's critical first year of life. Juveniles dwell in these downstream reaches until they are 5 or more years old. Then many begin extensive upstream migrations seeking habitats more suited to needs of subadults and adults (Osmundson et al. 1998). The entire river, from the confluence with the Green River upstream to Palisade, Colorado, provides important habitat for sub- and young adults.

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 (6 pounds) in weight and 600 mm (2 feet) in length.

Historically, razorback suckers were found in the mainstem 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 mainstem 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.

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 previously.

> Colorado, Mesa and Garfield Counties. The Colorado River and its 100-year floodplain from Colorado River Bridge at exit 90 north off Interstate 70 in T. 6 S., R. 93 W., section 16 (6th Principal Meridian) to Westwater Canyon in T. 20 S., R. 25 E., section 12 (Salt Lake Meridian) including the Gunnison River and its 100-year floodplain from the Redlands Diversion Dam in T. 1 S., R. 1 W., section 27 (Ute Meridian) to the confluence with the Colorado River in T. 1 S., R. 1 W., section 22 (Ute Meridian).
>
> Colorado, Delta and Mesa Counties. The Gunnison River and its 100-year floodplain from the confluence with the Uncompahgre River in T. 15 S., R. 96 W., section 11 (6th Principal Meridian) to Redlands Diversion Dam in T. 1 S., R. 1 W., section 27 (Ute Meridian).
>
> Utah, Grand, San Juan, Wayne, and Garfield Counties. The Colorado River and its 100-year floodplain from Westwater Canyon in T. 20 S., R. 25 E., section 12 (Salt Lake Meridian) to full pool elevation, upstream of North Wash, and including the Dirty Devil arm of Lake Powell in T. 33 S., R. 14 E., section 29 (Salt Lake Meridian).

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 an estimated population of 25,000 adult razorback suckers in 1995 (Chuck Minckley pers. com.) 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."

The virtual absence of any 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 endorsed by the Recovery Program 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 mainstem river and that razorback suckers

presumably moved to these areas for feeding, resting, sexual maturation, spawning, and other activities associated with their reproductive cycle. Prior to construction of large mainstem 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). Dams changed riverine ecosystems into lakes by impounding water, which eliminated these off-channel habitats in 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) 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 (depending on the specific location).

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.

Populations Dynamics

There are no current population estimates of razorback sucker in the upper Colorado River due to low numbers captured in recent years.

Analysis of Species/Critical Habitat Likely to be Affected

Osmundson and Kaeding (1989) found that 76 percent of the razorback suckers captured in the Colorado River between 1979 and 1985 were captured in the Grand Valley area. Results of surveys conducted during May and June of 1986-1988 indicate that areas within the 15-Mile Reach may be concentration points for the razorback sucker during spring runoff. Male and female razorback suckers in spawning condition have been found in the 15-Mile Reach, although no larvae or juveniles have been found. Although data is limited, radio-telemetry studies led Osmundson and Kaeding (1989) to conclude that razorback suckers may move into the 15-Mile Reach to spawn in the spring, but most spend the remainder of the year in a 18-Mile Reach downstream from the confluence of the Gunnison River.

The current range of the razorback sucker in the Colorado River extends upstream to Rifle, Colorado. Most razorback suckers captured in the Grand Valley area have been located in flooded gravel-pit ponds adjacent to the river. However, Osmundson and Kaeding (1989) documented razorback sucker movement in various river habitats in the Grand Valley area. They documented razorback suckers in the 15-Mile Reach as far upstream as river mile 183.6. Additional surveys since 1988 have documented razorback suckers in riverside ponds as far upstream as river mile 235 near Rifle, Colorado (Burdick 1992).

Humpback Chub

Species/Critical Habitat Description

The humpback chub is a medium-sized freshwater fish (less than 500 mm) of the minnow family. The adults have a pronounced dorsal hump, a narrow flattened head, a fleshy snout with an inferior-subterminal mouth, and small eyes. It has silvery sides with a brown or olive colored back.

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

Until the 1950's, the humpback chub was known only from Grand Canyon. During surveys in the 1950's and 1960's humpback chub were found in the upper Green River including specimens from

Echo Park, Island Park, and Swallow Canyon (Smith 1960, Vanicek et al. 1970). Individuals were also reported from the lower Yampa River (Holden and Stalnaker 1975b), the White River in Utah (Sigler and Miller 1963), Desolation Canyon of the Green River (Holden and Stalnaker 1970) and the Colorado River near Moab (Sigler and Miller 1963).

Critical habitat was designated in 1994 within the humpback chub's historical range in the following sections of the upper Colorado River (59 F.R. 13374). The primary constituent elements are the same as those described for the Colorado pikeminnow.

> Utah, Grand County; and Colorado, Mesa County. The Colorado River from Black Rocks in T. 10 S., R. 104 W., section 25 (6th Principal Meridian) to Fish Ford in T. 21 S., R. 24 E., section 35 (Salt Lake Meridian).
>
> Utah, Garfield and San Juan Counties. The Colorado River from Brown Betty Rapid in T. 30 S., R. 18 E., section 34 (Salt Lake Meridian) to Imperial Canyon in T. 31 S., R. 17 E., section 28 (Salt Lake Meridian).

Status and Distribution

Today the largest populations of this species occur in the Little Colorado and Colorado Rivers in the Grand Canyon, and in Black Rocks and Westwater Canyon in the upper Colorado River. Other populations have been reported in De Beque Canyon of the Colorado River, Desolation and Gray Canyons of the Green River, Yampa and Whirlpool Canyons in Dinosaur National Monument (USFWS 1990b). One individual was recently captured in the Gunnison River (Burdick 1995).

In general, the existing habitat has been modified to the extent that it impairs essential behavior patterns, such as breeding, feeding, and sheltering.

Life History

It is known that these chubs spawn soon after the highest spring flows when water temperatures approach 68° F (Kaeding et al. 1990; Karp and Tyus 1990; USFWS 1990b). The collection of ripe and spent fish indicated that spawning occurred in Black Rocks during June 2-15, 1980, at water temperatures of 11.5° to 16° C; in 1981, spawning occurred May 15-25, at water temperatures of 16° to 16.3° C (Valdez et al. 1982). Humpback chub spawned in Black Rocks on the Colorado River in 1983 when maximum daily water temperatures were 12.6° to 17° C (Archer et al. 1985). In the Grand Canyon, humpback chub spawn in the spring between March and May in the Little Colorado River when water temperatures are between 16° and 22° C. Swimming abilities of young-of-year humpback chub were determined to be significantly reduced when laboratory water temperatures were reduced from 20° to 14° C. Many young-of-year humpback chub are displaced from the Little Colorado River into the mainstem by monsoonal floods from July through September (Valdez and Ryel 1995). Young humpback chub are found

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

Backwaters, eddies, and runs have been reported as common capture locations for young-of-year humpback chub (Valdez and Clemmer 1982). These data indicate that in Black Rocks and Westwater Canyon, young utilize shallow areas. Habitat suitability index curves developed by Valdez et al. (1990) indicate young-of-year prefer average depths of 2.1 feet with a maximum of 5.1 feet. Average velocities were reported at 0.2 feet per second.

Population Dynamics

Based on data collected during the first year of a three year study, Pfeifer et al. (1998) estimated the Black Rocks populations to be about 1,500 adults (95 percent confidence interval 890-2,750). This estimate will undoubtedly be adjusted before the study is completed. Chart and Lentsch (1999) provided annual estimates for Westwater Canyon in 1994-1996 that ranged from 5,186 to 10,148 adults (mean of 6,985).

Analysis of Species/Critical Habitat Likely to be Affected

Valdez et al. (1982) and Wick et al. (1979, 1981) found adult humpback chub in Black Rocks and Westwater Canyons in water averaging 50 feet in depth with a maximum depth of 92 feet. In these localities, humpback chub were associated with large boulders and steep cliffs.

Generally, humpback chub show fidelity for canyon reaches and move very little (Miller et al. 1982; Archer et al. 1985; Burdick and Kaeding 1985; Kaeding et al. 1990). Movements of adult humpback chub in Black Rocks on the Colorado River were usually restricted to 1 mile or less. However, a few fish have moved between Black Rocks and Westwater Canyon, a distance of 14 miles (Valdez and Clemmer 1982, Kaeding et al. 1990, Chart and Lentsch 1999).

Bonytail

Species/Critical Habitat Description

Bonytail are medium-sized (less than 600 mm) fish in the minnow family. Adult bonytail are gray or olive colored on the back with silvery sides and a white belly. The adult bonytail has an elongated body with a long, thin caudal peduncle.

Critical habitat was designated in 1994 within the bonytail's historical range in the following sections of the upper Colorado River (59 F.R. 13374). The primary constituent elements are the same as those described for the Colorado pikeminnow.

Utah, Grand County; and Colorado, Mesa County. The Colorado River from Black Rocks (river mile 137) in T. 10 S., R. 104 W., section 25 (6th Principal Meridian) to Fish Ford in T. 21 S., R. 24 E., section 35 (Salt Lake Meridian).

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

Status and Distribution

The bonytail is the rarest native fish in the Colorado River. It was listed as endangered on April 23, 1980. Formerly reported as widespread and abundant in mainstem rivers (Jordan and Evermann 1896), its populations have been greatly reduced. The fish is presently represented in the wild by a low number of old adult fish in Lake Mohave and perhaps other lower basin reservoirs (USFWS 1990a). The last known riverine area where bonytail were common was the Green River in Dinosaur National Monument, where Vanicek (1967) and Holden and Stalnaker (1970) collected 91 specimens during 1962-1966. From 1977 to 1983, no bonytail were collected from the Colorado or Gunnison Rivers in Colorado or Utah (Wick et al. 1979, 1981; Valdez et al. 1982; Miller et al. 1984). However, in 1984, a single bonytail was collected from Black Rocks on the Colorado River (Kaeding et al. 1986). Several suspected bonytail were captured in Cataract Canyon in 1985-1987 (Valdez 1990).

The existing habitat has been modified to the extent that it impairs essential behavior patterns, such as breeding, feeding, and sheltering.

Life History

The bonytail is considered a species that is adapted to mainstem rivers, where it has been observed in pools and eddies (Vanicek 1967; Minckley 1973). Spawning of bonytail has never been observed in a river, but ripe fish were collected in Dinosaur National Monument during late June and early July suggesting that spawning occurred at water temperatures of about 18° C (Vanicek and Kramer 1969).

Population Dynamics

The number of bonytail in the upper Colorado River are so low that it is not possible to do a population estimate.

Analysis of Species/Critical Habitat Likely to be Affected

Black Rocks and Cataract Canyon are the only areas where bonytail have been found in the Upper Colorado River in the last 20 years. So few fish have been captured that it is difficult to determine species and habitat needs.

IMPORTANCE OF THE 15-MILE REACH

The Service finds that all four species and their critical habitat on the Colorado River are and will be affected by water depletions and recovery actions. However, the 15-Mile Reach is affected more than any of the other reaches by water depletions because it is located downstream of several large diversions and upstream of the Gunnison River confluence. Extremely low water conditions that occur during the late summer and early fall months reduce habitat for Colorado pikeminnow and razorback sucker. Reduced flows during spring runoff reduces the ability for many habitats to be created and maintained. Therefore, many of the recovery actions are targeted for the 15-Mile Reach. Colorado pikeminnow and razorback sucker occur in the 15-Mile Reach, humpback chub and bonytail currently are not known to occur there. The 15-Mile Reach is a particularly important section of river for Colorado pikeminnow and razorback sucker; it is critical to the recovery of each species' Colorado River populations (Osmundson 1999b). The following section summarizes the attributes of this reach and puts in context its importance in relation to the rest of the river.

Colorado pikeminnows require a variety of specific habitat types to fulfill their life history needs. Some of these required habitats are found only in certain areas of the river and are separated from other required habitats by long distances. The 15-Mile Reach provides spawning habitat; spawning by Colorado pikeminnow was documented within the 15-Mile Reach in 1982 and in 1995 by the capture of pikeminnow larvae. The cleaner cobble bars found in upstream reaches, such as the 15-Mile Reach, provide the most suitable sites for spawning. Larvae hatched from eggs deposited in these upstream reaches drift downstream with the current. In downstream reaches, primarily below Moab, Utah, deposits of silt and sand provide many warm backwater sites where young Colorado pikeminnow feed upon the abundant zooplankton and chironomid larvae. When they become piscivorous, young Colorado pikeminnow feed upon the abundant small fishes found in these areas.

Osmundson et al. 1995 reported that backwater area in the 15-Mile Reach is the greatest when the river is flowing around 7,620 cfs. Adult Colorado pikeminnow use backwaters in the 15-Mile Reach all year long, however, backwaters are used most frequently during spring runoff. Backwaters provide warm, off-channel, quiet water when main-channel velocities are high and temperatures are low (Osmundson et al. 1995).

Osmundson et al. (1998) documented the upstream dispersal of subadult and adult Colorado pikeminnow. As the young fish in the downstream nursery areas grow and approach adulthood, they require larger forage fish to maintain growth rates. However, larger forage fish are scarce in these downstream reaches and maturing Colorado pikeminnow begin to move up and down the river seeking better feeding grounds. Eventually, adult Colorado pikeminnow discover the abundant supplies of native fish, primarily bluehead and flannelmouth sucker, in the upper river including the 15-Mile Reach and remain in these upper reaches for the remainder of their lives. Forage fish are generally more abundant in these upper reaches because food for these fishes, algae and aquatic insects, is more abundant (Lamarra 1999). Algae, phytoplankton (free-floating

algae) and periphyton (algae that grows on rock surfaces), is more abundant because the higher water clarity allows deeper light penetration necessary for its growth. Aquatic insects are more abundant because the swifter currents resulting from generally higher gradients flush gravel and cobble substrates providing silt-free crevices required by many aquatic insects. Because of the increasing abundance of forage fish as one moves up river, the average size of Colorado pikeminnow increases upstream with the 15-Mile Reach containing the greatest proportion of large adult Colorado pikeminnow.

The 15-Mile Reach appears to provide the optimum balance between temperature and food abundance for adult Colorado pikeminnow (Osmundson et al. 1998, Osmundson 1999a).

Razorback suckers also are found in the 15-Mile Reach and use the reach as a spawning area (Osmundson and Kaeding 1989, 1991). The complete life cycle of the razorback sucker, in terms of its entire river habitat use pattern, is largely unknown but may be similar to that of Colorado pikeminnow because adults are generally concentrated in upstream reaches of the Colorado and Green Rivers and larvae from spawning sites in the upper Green River have been found to drift long distances down river. Other evidence suggests that bottomlands in both upstream and downstream reaches historically served as nursery areas for larvae when these habitats flooded during the historically higher spring runoff period.

The 15-Mile Reach also is important for the survival and recovery of Colorado pikeminnow and razorback sucker because it provides a refuge for the Colorado River Basin populations should a catastrophic event such as an oil spill or chemical spill affect the Gunnison River or the Colorado River below the Gunnison River confluence.

In summary, the 15-Mile Reach is important for several reasons:

1. The 15-Mile Reach provides valuable spawning habitat for Colorado pikeminnow and razorback sucker.

2. The 15-Mile Reach provides an optimum balance between temperature and food availability for adult Colorado pikeminnow in the Colorado River.

3. The 15-Mile Reach provides an important refuge for endangered fishes should a catastrophic event cause a loss of populations in the Gunnison River or in the Colorado River below the Gunnison River confluence.

FLOW NEEDS FOR ENDANGERED FISHES

The 15-Mile Reach has experienced major water depletions for many years. During late summer and early fall, this reach can be severely dewatered. Although it experiences major water depletions, the 15-Mile Reach is viewed as critical to the recovery of Colorado River populations of Colorado pikeminnow and razorback sucker (humpback chub and bonytail do not currently

occur in the 15-Mile Reach). Providing adequate flows in the 15-Mile Reach, in combination with other recovery actions, has been identified as important to achieving recovery of these species. Flows in the 15-Mile Reach combined with flows from the Gunnison River provide the majority of water downstream to Lake Powell. Flow recommendations for the Gunnison River and the Colorado River downstream of the 15-Mile Reach are currently being developed for the section 7 consultation on the Aspinall Unit. Osmundson and Kaeding (1991) recommended spring peak flows in the reach downstream of the Gunnison River confluence to the Colorado-Utah state line. Mean monthly flows during spring or the rest of the year and recommendations for flows in the nursery areas downstream of Moab, are being developed as part of the Aspinall Unit consultation.

The Service first developed flow recommendations for the 15-Mile Reach in 1989 and 1991. The summer flow recommendations (Kaeding and Osmundson 1989) were developed using the Instream Flow Incremental Methodology. The spring and winter flow recommendations (Osmundson and Kaeding 1991) were based on other methodologies. Stanford (1994) was contracted by the Recovery Program to review these and other flow recommendations in the basin and generally supported the basic recommendations, in addition to recommending further studies. He noted that a high spring peak to base flow ratio is strongly implied by available science and not simply professional judgement. Serious shortcomings of the IFIM approach in developing flow recommendations for endangered fish in the upper Colorado River led the Service to initiate a new study for determining recommended summer and winter flows. Using new information obtained from this study as well as that collected by other researchers, the Service updated and refined its earlier flow recommendations (Osmundson et al. 1995).

The Service's 1989 flow recommendations for summer were developed by modeling microhabitats based on depth, velocity, and substrate measurements at a site thought to be representative of the reach. The Service's 1991 flow recommendations for winter consisted of a tentative recommendation that flows not fall below historic levels; this recommendation was based on the assumption that historic conditions provided adequate winter habitat for adult fish. In refining these flow recommendations for summer and winter, the Service determined which habitat types (pools, riffles, etc.) were preferred by the fish during these seasons and then determined the flow level at which the preferred habitat types are maximized in area. This approach, as with other instream flow methodologies, assumes that increases in the amount of preferred or optimum habitat increases carrying capacity and, barring other potentially limiting factors, results in an increase in population size.

Earlier Service flow recommendations for spring were based on information on how the decrease in magnitude of spring flows could negatively affect endangered fish reproduction and survival. Data were provided which showed that low spring runoff resulted in lower pikeminnow larval production. The explanation for this relationship was that high flows are periodically needed to build cobble bars and flush fine sediment from the gravel/cobble substrates used by pikeminnow for spawning. Data were also provided which showed that razorback sucker spawning coincides with the peak runoff and occurs in warm, off-channel ponds and inundated floodplain habitats.

The explanation for low razorback sucker reproduction was that, currently, flows often do not reach levels high enough to inundate low-lying floodplain features where spawning takes place. The Service also reported that in the absence of high spring flows, important backwater habitats filled with silt and sand, tamarisk colonized sand and cobble bars, and nonnative minnows capable of preying on or competing with larval endangered fishes greatly increased in numbers.

The Service's earlier flow recommendations for spring identified the magnitude and frequency of a range of minimum peak flows and the mean monthly flows capable of producing these peaks and of maintaining the natural shape of the hydrograph. Refinement of these earlier flow recommendations for spring was based on the results of new streambed monitoring studies. The results of one study showed that the spring runoff in 1993, which peaked at 25,900 cfs, was capable of moving coarse bed materials thereby winnowing accumulated fines from the channel substrate. Based on preliminary results from hydrologic modeling (Pitlick and Van Steeter 1994), Osmundson et al. (1995) assumed that the earlier recommended peak of 23,500 cfs would also be capable of moving bed materials. The results of another study (Pitlick et al.1996) showed that a spring runoff with a peak of about 12,900 was capable of flushing accumulated fine sediments from the bottoms of backwaters thereby restoring their depth. Based on this information, the Service refined the earlier recommendations for spring peak day flows as follows:

Target Peak Day Spring Flows in the 15-Mile Reach:

>23,500 cfs (5 in 20 years)
21,750 cfs (10 in 20 years)
16,700 cfs (16 in 20 years)
12,900 cfs (20 in 20 years)

The Service's 1995 year-round flow recommendations are summarized in Table 2 as mean monthly discharges. Spring (April-July) recommendations are further subdivided into 10-day increments and are reported in Table 3 as volumes of water needed for each of twelve 10-day time periods. The mainstem Colorado River above the 15-Mile Reach does not have a large reservoir that controls flows. Therefore, variation in precipitation levels from year to year is taken into account and recommendations are provided for years of high, above-average, below-average, and low snow fall. With the exception of winter, recommendations are for flows considerably lower than historic levels (1902-1942) but somewhat higher than recent levels.

ENVIRONMENTAL BASELINE

Regulations provide that 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. Environmental baselines do not include the effects of the Federal action under review in the consultation.

Applying the above regulations, the environmental baseline for this project includes the past and present effects of Reclamation operations, Federal and non-Federal depletions as well as the past and present actions of funding and implementing the Recovery Plan, but does not include the future effects of the Federal action previously described on page 1. This baseline is used to evaluate the future effects of the Federal action. The environmental baseline for this consultation is not typical, because for the purposes of this analysis, all of the subject existing water depletions including those treated as interrelated, are part of the action. Typically, only impacts from actions with no Federal discretionary authority would be included in the baseline; however, because of the large scope of this programmatic biological opinion, it was not possible to determine the extent of existing or future Federal discretion for all existing and new Federal actions covered by this opinion. Also, it is likely that most water depletion projects have or will have a Federal action associated with them and would rely on the Recovery Program to avoid the likelihood of jeopardy and adverse modification of critical habitat. Because the environmental baseline does not include the project being consulted on, and all water depletions are part of the project being consulted on as described in the Federal action on page 1, the environmental baseline conditions, solely for the purpose of this analysis, represent the river with the impacts of human depletion actions taken out and shall be referred to in this biological opinion as "baseline flow conditions." Other impacts such as nonnative fish, dams, fish barriers, and bank stabilization are assumed to be in place under baseline conditions. The only purpose of using the "baseline flow conditions" is for comparison with existing depletions. This baseline is not appropriate for individual section 7 consultations, nor does it confer any obligation on the Federal action agencies to restore the river to a condition similar to that existing prior to human depletion actions. Baseline flow conditions were modeled as described below.

Table 2. Recommended mean monthly flows for the top of the 15-Mile Reach in cubic feet per second. Rate is the percent of years recommended for identified flows based on winter snowpack levels. For example, in the wettest 25 percent of years, flows in June should average at least 15,660 cfs; stated another way, this recommendation should be met in 5 of every 20 years. During low-water years, June flows should average no less than 6,850 cfs, and such a minimum should occur at a rate of no more than 4 in 20 years (20 percent). Table from Osmundson et al. 1995.

Rate	25 percent	25 percent	30 percent	20 percent
Exceedance	25 percent	50 percent	80 percent	100 percent
JAN	1,630	1,630	1,630	1,240
FEB	1,630	1,630	1,630	1,240
MAR	1,630	1,630	1,630	1,240
APR	3,210	2,440	2,260	1,860
MAY	10,720	9,380	7,710	7,260

JUN	15,660	14,250	11,350	6,850
JUL	7,060	5,370	3,150	1,480
AUG	1,630	1,630	1,240	810
SEP	1,630	1,630	1,240	810
OCT	1,630	1,630	1,240	810
NOV	1,630	1,630	1,630	1,240
DEC	1,630	1,630	1,630	1,240

Table 3. Volumes of water (in hundreds of acre-feet) needed per 10-day period to produce hydro-graphs recommended for the 15-Mile Reach during the spring runoff period (April, May, June and July). AP-1 represents the first 10 days in April; AP-2, the second 10 days, etc. Table from Osmundson et al. 1995.

Rate	25 percent	25 percent	30 percent	20 percent
Exceedance	25 percent	50 percent	80 percent	100 percent
AP-1	317	276	295	245
AP-2	563	450	416	343
AP-3	1,029	726	634	519
MA-1	1,573	1,104	957	892
MA-2	2,073	1,817	1,516	1,488
MA-3	2,944	2,846	2,267	2,085
JN-1	3,197	2,770	2,566	1,778
JN-2	3,209	3,066	2,368	1,404
JN-3	2,914	2,643	1,818	893
JL-1	2,060	1,617	990	470
JL-2	1,328	977	578	246
JL-3	955	707	372	194

The Colorado River Decision Support System includes the State of Colorado's Stream Simulation Model which is a monthly or daily water allocation and accounting model capable of making comparative analyses for the assessment of various historic and future water management policies

in a river basin. While the model is capable of doing daily operations, daily data does not exist in sufficient quantity to operate on a daily basis. It is designed to be applied to any river basin by inputting appropriate data. The State Model's operation, like the stream itself, is governed by its hydrology, water rights, and the associated structures and operating rules. The State Model is capable of simulating stream diversions, instream demands, reservoir operations and river flows on a monthly basis for any stream system using user specified data. One major component of the model is the Base Flow module, which produces a set of stream flows that would have occurred in the basin without a user specified level of human development. When the effects of depletions are removed, the base flow developed would represent baseline flow conditions, as discussed above. The baseline flow conditions for a wet, average and dry year are displayed in Figure 3. Baseline flow conditions provided higher spring peaks and lower base flows. In wet years, average monthly peak in May or June exceeded 26,000 cfs in the 15-Mile Reach. Appendix F describes modeling assumptions used to make the model runs. The results of these runs were used to develop the following figures and tables.

Status of the Species Within the Action Area

It is difficult to determine the status of the species under baseline conditions because baseline conditions assume baseline flow conditions but other factors, such as nonnative fish, dams, fish barriers, dikes, and bank stabilization are assumed to still be in place. These other factors have all been identified as negatively impacting the endangered fishes. There is limited information regarding the four species under more natural flow conditions, but this information would not necessarily include the negative impacts of nonnative fish, dams, fish barriers, dikes, or bank stabilization. Information regarding the four fish species under more natural flow conditions is limited to a few technical papers (Abbott 1861, Baird and Girard 1853, Chamberlain 1904, Cope and Yarrow 1875, Ellis 1914, Everman and Rutter 1895, Girard 1856, Jordan 1891, Jordan and Evermann 1896) and historical photos and accounts of senior citizens interviewed in 1991 (Quartarone 1995). The technical papers generally document the wide spread distribution and report some endangered species common throughout the Colorado River Basin (humpback chub were not even described until 1946 (Miller 1946)). However, this historical information is limited to taxonomic and distributional data. Very little was known about the life history of these species prior to the 1960's (Miller 1964).

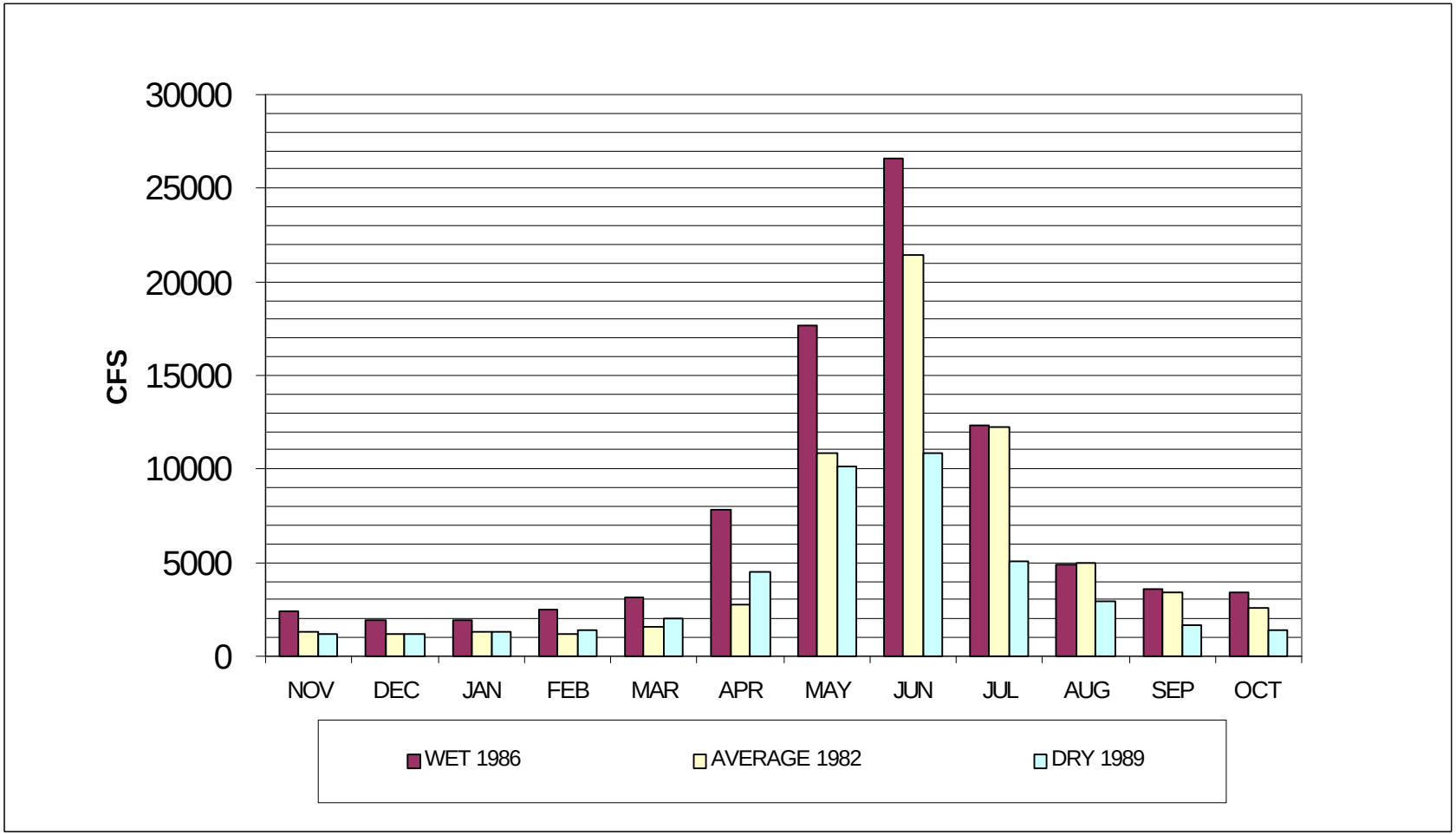

FIGURE 3. Baseline Flow condition in the Colorado River near Palisade below the GVIC Diversion as Modeled by CRDSS.

Factors Affecting Species Environment within the Action Area

The Service assumes that baseline flow conditions would provide improved habitat for the endangered fishes compared to existing flow conditions. However, even with baseline flow conditions, limiting factors for fishes exist under the environmental baseline. Under the modeled baseline flow conditions today, competition and predation from nonnative fishes would be a factor. Also, under the modeled baseline flow conditions today it is likely that many floodplain habitats would be diked off and bank stabilization would be in place. Impacts from dams such as changes in temperatures and sediment loads, and barriers to fish movement would alter habitat conditions for endangered fishes.

EFFECTS OF THE ACTION

The effects of the Federal action described on page 1 are presented in this section.

Factors to be Considered

The Service believes that water depletions are a major factor contributing to the reductions in the populations of the Colorado pikeminnow, humpback chub, bonytail, 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. Implementation of the Recovery Actions outlined in the proposed action are designed to offset depletion impacts to the 15-Mile Reach and the Colorado River downstream to Lake Powell.

Water depletions reduce the ability of the river to create and maintain important habitats and reduce the frequency and duration of availability of these habitats, as described below. Food supply, predation, and competition are important elements of the biological environment. Food supply is a function of nutrient supply and productivity; because high spring flows flood bottomland habitats increasing the nutrient supply and productivity of the river environment, reduction of high spring flows from water storage reservoirs that store water during spring peak flows may reduce food supply. Predation and competition from nonnative fish species have been identified as factors in the decline of the endangered fishes. Water depletions contribute to alterations in flow regimes that favor nonnative fishes, as described below. The Service concludes that water depletions impact all four species of endangered fishes and the primary constituent elements of their critical habitat.

There are a number of benefits associated with implementation of the Recovery Action Plan elements that positively affect the Colorado River from Rifle to Lake Powell, including the 15-Mile Reach. These benefits include: augmentation of late summer/fall base flows; spring peak enhancement; habitat restoration; fish passage; nonnative fish management; and propagation and stocking of endangered fishes.

Analyses for Effects of the Action

Water Quantity

Water depletions have/will cause discrete, identifiable, additive, adverse impacts to the Colorado River endangered fishes. As shown in the following flow analysis, the action subject to consultation has/will cause flow depletions that alter baseline flow regimes. The proposed action is intended to result in the continued existing depletion of water as well as new depletions up to 120,000 acre-feet/year beyond existing levels. Existing depletions are defined under the description of the proposed action.

Quantification of depletion impacts have focused on the 15-Mile Reach for four reasons. First, the Service considers the 15-Mile Reach to be especially important habitat for the Colorado pikeminnow and razorback sucker. Second, the Service has developed flow recommendations for the 15-Mile Reach against which current flows can be compared. Numerous studies of habitat and habitat needs have been conducted in the 15-Mile Reach. Third, the 15-Mile Reach is the most depleted reach on the Colorado River because it is located upstream of the Gunnison River confluence and immediately downstream of the large diversions at and above Palisade; consequently, a reduction in flow will impact the 15-Mile Reach to a greater degree than the other reaches. Fourth, almost any action which offsets depletion impacts to the 15-Mile Reach will necessarily offset depletion impacts to the reaches downstream to the confluence with the Green River because there are no major diversions below the 15-Mile Reach.

To determine the effects of the existing and future levels of depletions on water quantity and alteration of the hydrologic regime, an analysis of flow changes was conducted. This analysis compares existing conditions, future conditions (60,000 acre-feet/year and 120,000 acre-feet/year of additional depletion), the environmental baseline conditions (baseline flow conditions), and 15-Mile Reach flow recommendations.

The State Model was used to model existing conditions and future depletions. Two levels of future demands were added to the model immediately downstream of Cameo: 60,000 and 120,000 acre-feet per year. These demands were imposed in the following distribution:

Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Total[3]
1200	1200	1200	1200	1200	1200	1200	19200	24000	6000	1200	1200	60,000
2400	2400	2400	2400	2400	2400	2400	38400	48000	12000	2400	2400	120,000

These distributions were based primarily on when the water would physically be available. The resulting depletions in the modeling were very close to these demands. The average depletions over the study period were 59,082 and 118,165 acre-feet per year, respectively.

[3]Distribution was developed by Leonard Rice Consulting Water Engineers.

To determine conditions with water depletions and implementation of the recovery actions, the following items were modeled.

Grand Valley Water Management components, which include a reduction in irrigation demand of the Grand Valley Project, and an operational bypass of 9,000 acre-feet/year at the Grand Valley Project headgate.

Grand Valley Project Power demand with a junior priority during summer months.

Orchard Mesa Check operated only to benefit the Grand Valley systems, with surplus Historic Users Pool water delivered to the Grand Valley to benefit endangered fish up to the capacity of the Grand Valley Power Plant canal.

Surplus Historic User Pool water in excess of the Grand Valley Power Plant canal capacity, delivered by agreement for non-consumptive municipal/recreational uses and to indirectly benefit endangered fish.

Wolford Mountain Reservoir releases from the 6,000 acre-feet fish pool to the 15-Mile Reach.

Ruedi Reservoir releases from storage accounts of 21,650 acre-feet[4] (as described above) and 5,000 acre-feet (initial storage release commitment, available every year) and 5,000 acre-feet (available 4 out of 5 years via reservoir operation) to the 15-Mile Reach.

Priority of use of various reservoir storage accounts in deliveries to the 15-Mile Reach were modeled in the following order. This does not represent the priority for release during periods when flows will be augmented.

Ruedi 10,000 acre-feet pool
Ruedi 21,650 acre-feet pool
Wolford Mountain 6,000 acre-feet pool
Green Mountain Historic User Pool Surplus pool

It is important to note that the above priorities are for modeling purposes only. Actual operations will for the most part follow these priorities but do not represent the absolute order in which water will be released from the various facilities due to hydrologic, operational, emergency and other considerations.

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[4]Because the 21,650 could be released from a combination of Ruedi Reservoir and other Division 5 facilities and it is unknown at this time where the total volume would be released from, Ruedi Reservoir was selected for modeling purposes. The benefit to the species and their habitat will be the same regardless of the water source.

Figures 4 - 6 and Tables 4 - 6 compare a range of hydrological conditions in the 15-Mile Reach. In dry years baseline flows are typically lower than existing conditions through the winter months (November, December, January, February, and March). With future water depletions and implementation of the recovery action items, flows are reduced to levels closer to baseline conditions and flow recommendation conditions during those months. During the spring months in dry years (April, May, and June) baseline flow conditions far exceed flow recommendations and existing conditions. During the late summer and fall months baseline flows exceed all flow conditions. However, the implementation of recovery action items, with future depletions will provide flows that meet the flow recommendations during August September and October.

During average years, baseline flows are lower than existing flows during winter months and exceed existing flows the rest of the year. During late summer and fall, conditions with future depletions and implementation of the recovery actions will maintain flows close to the flow recommendation. During the spring months (April, May, and June) baseline flow conditions exceed flow recommendations and existing conditions. However, these figures and tables do not include the flows provided by Coordinated Reservoir Operations or Coordinated Facilities Studies, because the model uses average monthly flows which do not reflect flows provided by these two recovery items designed to augment spring peak flows. Coordinated Reservoir Operations augment the spring peak during below average, average, and above average years, but not during dry or wet years.

During wet years, baseline flows are lower than existing flows in most winter months and exceed existing flows the rest of the year. In wet years, conditions with future depletions and implementation of recovery actions are close to flow recommendations during the runoff months. In wet years, reservoirs fill quickly and the diversions are minor compared to the total volume of flow. During late summer and fall future conditions meet or exceed the flow recommendations.

Augmentation of Late Summer and Fall Base Flows

A number of actions will provide water to the 15-Mile Reach during July, August, and September. It is important to augment flows during these months in the 15-Mile Reach because this is when this reach can be extremely dewatered due to agricultural diversions. The CWCB administers an instream flow right of 581 cfs in the 15-Mile Reach which protects the water released from the Orchard Mesa Power Plant and the Orchard Mesa Irrigation District Pump Station. They also administer an instream flow right for 300 cfs of accretions to the 15-Mile Reach during July, August, and September. These flow rights would ensure protection of some existing flows in the 15-Mile Reach.

Release of 5,000 acre-feet annually plus an additional 5,000 acre-feet 4 out of 5 years from Ruedi Reservoir also would provide water to the 15-Mile Reach during July, August, and September. In addition, the leases for release of 10,825 acre-feet/year of water from Ruedi Reservoir and the permanent dedication of 10,825 acre-feet/year of water from Colorado Water Division Number 5 Facilities will be delivered and protected to the 15-Mile Reach during the late summer period.

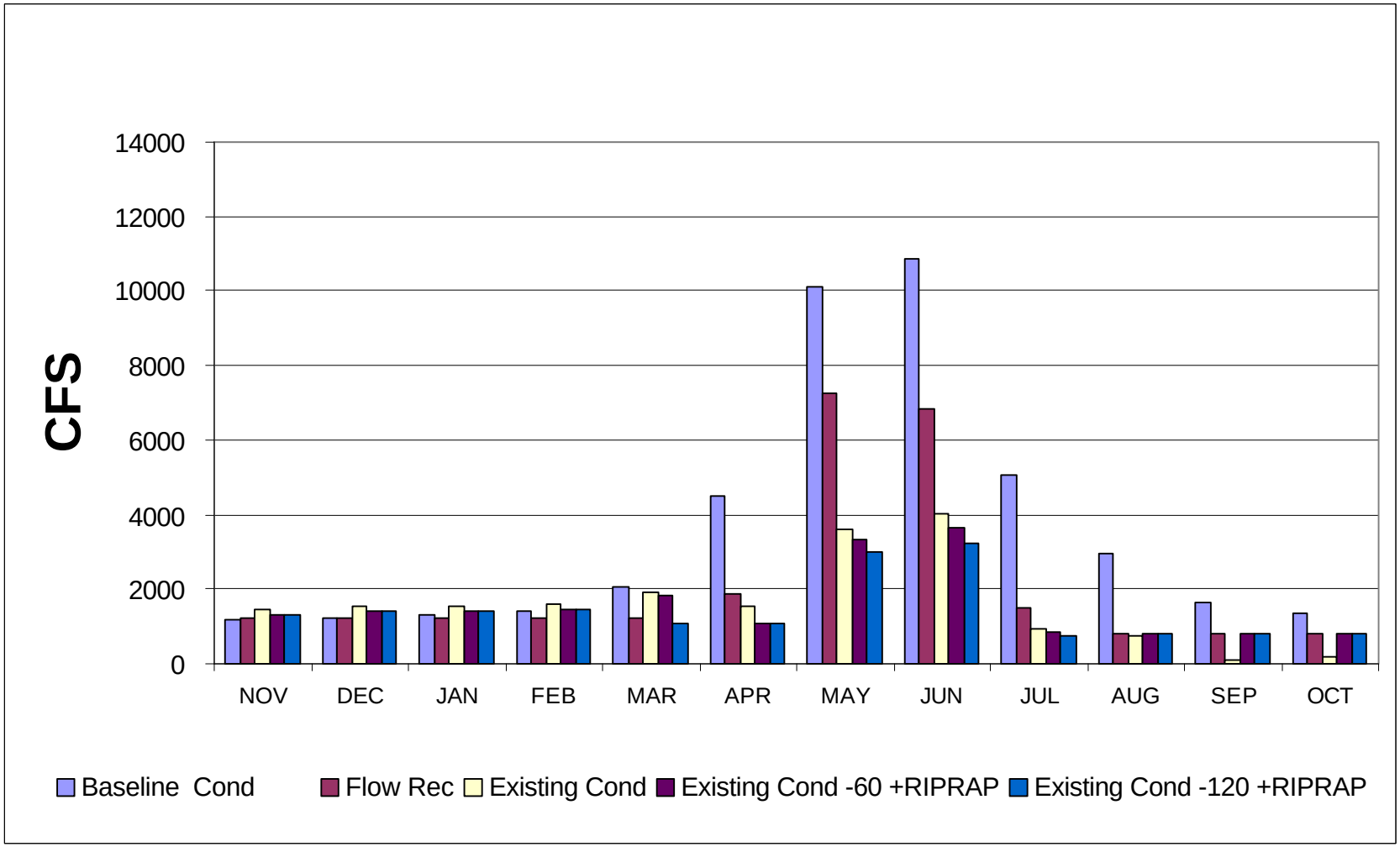

FIGURE 4. Colorado River near Palisade, flow below GVIC Diversion Dam illustrating changes resulting from future depletions and Recovery Actions Items. Dry year (1989) as modeled by CRDSS.

TABLE 4. Changes in Flow Near Palisade in a Dry Year with Future Depletions With and Without Recovery Action Items.

						ACRE-FEET								
	Year	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Total
Existing	1989	87106	95870	93912	88060	118519	90979	222751	240928	58239	46833	6227	11164	1,160,588
	Change	-1154	-1155	-1157	-1158	-1160	-1602	-19198	-23996	-5999	-1200	-58	-57	-57,894
Existing - 60K	1989	85952	94715	92755	86902	117359	89377	203553	216932	52240	45633	6169	11107	1,102,694
														0
	Change	-6691	-7242	-6542	-5224	-5031	-24184	61	-55	8	4173	42030	38699	30,002
Existing - 60 + RIP	1989	79261	87473	86213	81678	112328	65193	203614	216877	52248	49806	48199	49806	1,132,696
	Year	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Total
	Change	-2269	-2274	-2278	-2281	-2287	-3544	-38396	-47665	-11998	-2400	-164	-163	-115,719
Existing - 120	1989	84837	93596	91634	85779	116232	87435	184355	193263	46241	44433	6063	11001	1,044,869
	Change	-6777	-7323	-6621	-5301	-5104	-23442	59	-219	7	5373	42136	38805	31,593
Existing - 120 + RIP	1989	78060	86273	85013	80478	111128	63993	184414	193044	46248	49806	48199	49806	1,076,462
						DRY YEAR (CFS)								
	Year	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	
Existing	1989	1464	1559	1527	1586	1927	1529	3623	4049	947	762	105	182	
	Change	-19	-19	-19	-21	-19	-27	-312	-403	-98	-20	-1	-1	
Existing - 60K	1989	1444	1540	1508	1565	1909	1502	3310	3646	850	742	104	181	
	Change	-112	-118	-106	-94	-82	-406	1	-1	0	68	706	629	
Existing - 60 + RIP	1989	1332	1423	1402	1471	1827	1096	3311	3645	850	810	810	810	
	Year	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	
	Change	-38	-37	-37	-41	-37	-60	-624	-801	-195	-39	-3	-3	
Existing - 120	1989	1426	1522	1490	1545	1890	1469	2998	3248	752	723	102	179	
	Change	-114	-119	-108	-95	-83	-394	1	-4	0	87	708	631	
Existing - 120 + RIP	1989	1312	1403	1383	1449	1807	1075	2999	3244	752	810	810	810	

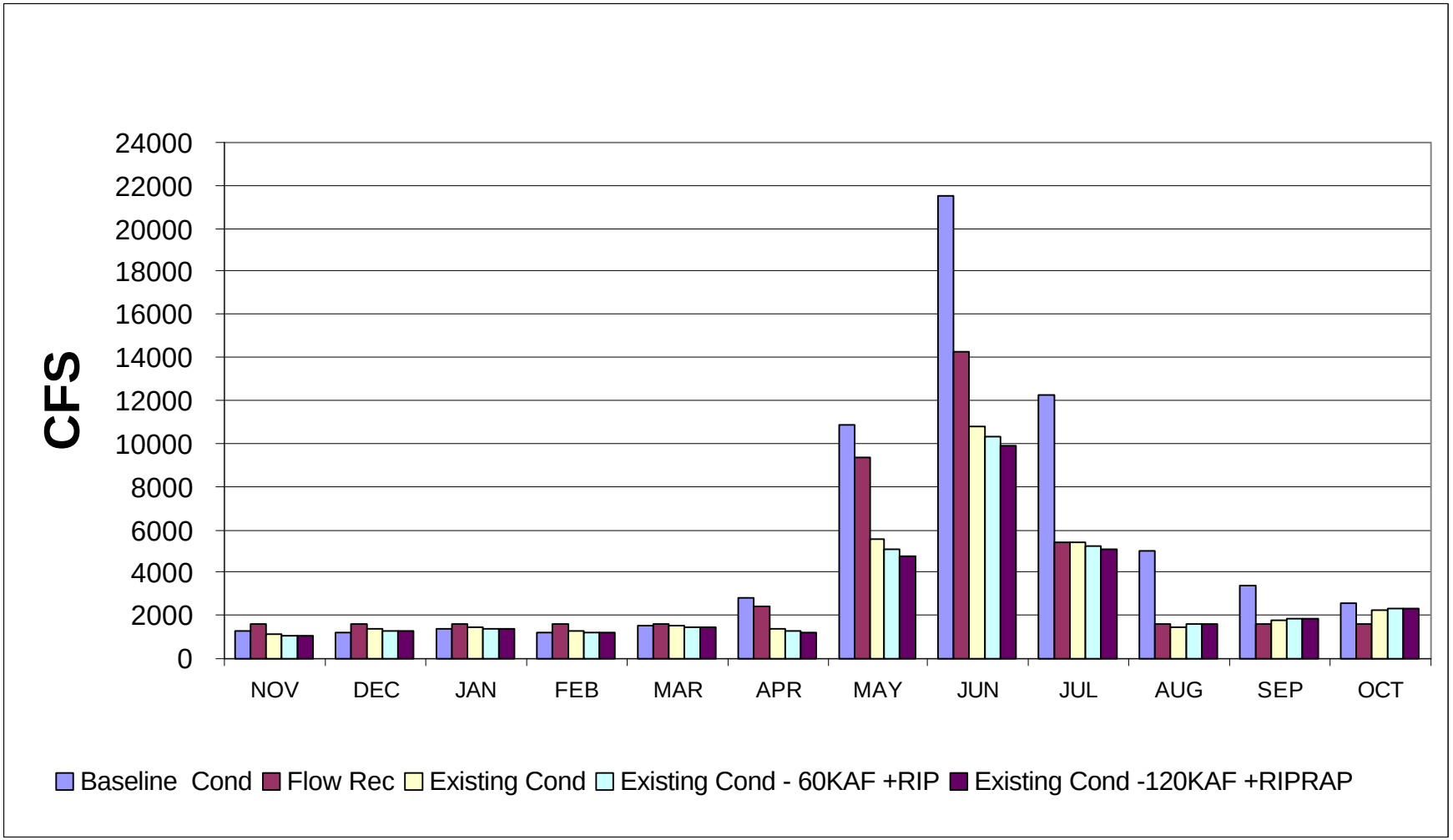

FIGURE 5. Colorado River near Palisade, flow below GVIC Diversion Dam illustrating changes resulting from future depletions and Recovery Actions Items. Average year (1982) as modeled by CRDSS.

TABLE 5. Changes in Flow Near Palisade in a Average Year with Future Depletions With and Without Recovery Action Items.

						ACRE-FEET								
	Year	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Total
Existing	1982	64991	84846	88110	72642	93856	82800	342481	640511	334103	90844	105984	134065	2,135,233
	Change	-1203	-1202	-1201	-1201	-1261	-1203	-21116	-24006	-3910	-3342	-1204	-1200	-62049
Existing - 60K	1982	63788	83644	86909	71441	92595	81597	321365	616505	330193	87502	104780	132865	2,073,184
	Change	-2692	-3776	-3683	-3933	-2433	-6184	-9002	-4116	-10681	12724	7037	10622	-13,425
Existing - 60K + RIP	1982	61096	79868	83226	67508	90162	75413	312363	612389	319512	100226	111817	143487	2,057,067
	Year	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Total
	Change	-2404	-2402	-2401	-2422	-2461	-2403	-42110	-48006	-3910	-5592	-2566	-2484	-119,161
Existing - 120	1982	62587	82444	85709	70220	91395	80397	300371	592505	330193	85252	103418	131581	2,016,072
	Change	-2692	-3777	-3683	-3919	-2433	-6184	-7207	-4118	-16681	14974	7049	10556	-18,115
Existing - 120 + RIP	1982	59895	78667	82026	66301	88962	74213	293164	588387	313512	100226	110467	142137	1,997,957
						AVERAGE YEAR (CFS)								
	Year	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	
Existing	1982	1092	1380	1433	1308	1526	1391	5570	10764	5434	1477	1781	2180	
	Change	-20	-20	-20	-22	-21	-20	-343	-403	-64	-54	-20	-20	
Existing - 60K	1982	1072	1360	1413	1286	1506	1371	5226	10361	5370	1423	1761	2161	
	Change	-45	-61	-60	-71	-40	-104	-146	-69	-174	207	118	173	
Existing - 60 + RIP	1982	1027	1299	1354	1216	1466	1267	5080	10291	5196	1630	1879	2334	
	Year	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	
	Change	-40	-39	-39	-44	-40	-40	-685	-807	-64	-91	-43	-40	
Existing - 120	1982	1052	1341	1394	1264	1486	1351	4885	9957	5370	1386	1738	2140	
	Change	-45	-61	-60	-71	-40	-104	-117	-69	-271	244	118	172	
Existing - 120 + RIP	1982	1007	1279	1334	1194	1447	1247	4768	9888	5099	1630	1856	2312	

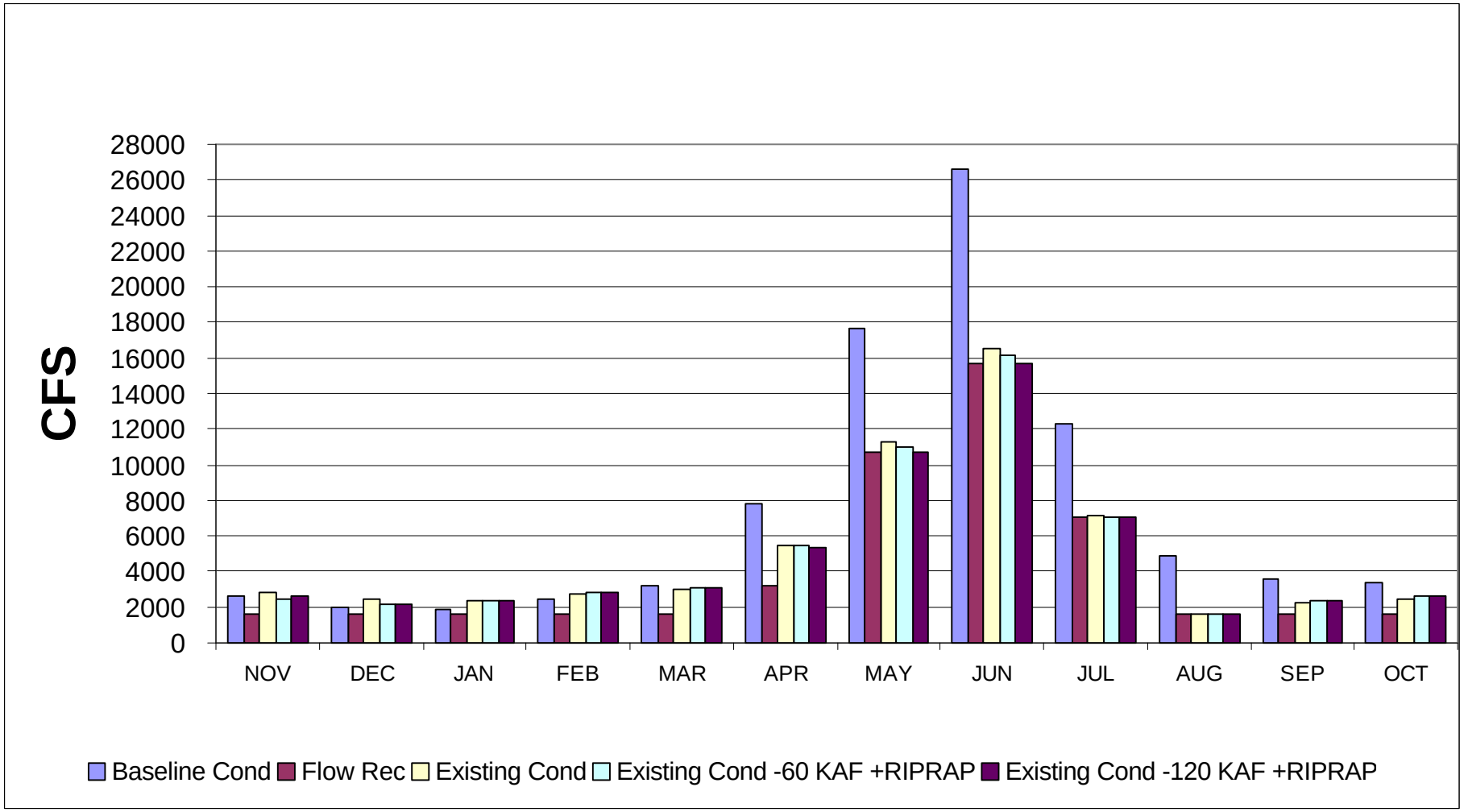

FIGURE 6. Colorado River near Palisade, flow below GVIC Diversion Dam illustrating changes resulting from future depletions and Recovery Actions Items. Wet year (1986) as modeled by CRDSS.

TABLE 6. Changes in Flow Near Palisade in a Wet Year with Future Depletions With and Without Recovery Action Items.

						ACRE-FEET								
	Year	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Total
Existing	1986	166117	148812	143994	153057	187101	323775	694058	986555	436383	100226	132121	149286	3,621,485
	Change	-1200	-1200	-1200	-1200	-1200	-1200	-19200	-24000	-2274	0	-2302	-2180	-57,156
Existing - 60K	1986	164917	147612	142794	151857	185901	322575	674858	962555	434109	100226	129819	147106	3,564,329
	Change	-7775	-16104	3020	6015	5118	-534	-33	367	0	359	11967	17406	19,806
Existing - 60 + RIP	1986	157142	131508	145814	157872	191019	322041	674825	962922	434109	100585	141786	164512	3,584,135
	Year	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Total
	Change	-2400	-2400	-2400	-2400	-2400	-2400	-35722	-50416	-2274	0	-3995	-3930	-110,737
Existing - 120	1986	163717	146412	141594	150657	184701	321375	658336	936139	434109	100226	128126	145356	3,510,748
	Change	-8014	-16343	2781	5776	4879	-534	1	335	0	0	12327	17510	18,718
Existing - 120 + RIP	1986	155703	130069	144375	156433	189580	320841	658337	936474	434109	100226	140453	162866	3,529,466
						WET YEAR (CFS)								
	Year	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	
Existing	1986	2792	2420	2342	2756	3043	5441	11288	16579	7097	1630	2220	2428	
	Change	-20	-20	-20	-22	-20	-20	-312	-403	-37	0	-39	-35	
Existing - 60K	1986	2771	2401	2322	2734	3023	5421	10975	16176	7060	1630	2182	2392	
	Change	-131	-262	49	108	83	-9	-1	6	0	6	201	283	
Existing - 60 + RIP	1986	2641	2139	2371	2843	3107	5412	10975	16182	7060	1636	2383	2675	
	Year	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	
	Change	-40	-39	-39	-43	-39	-40	-581	-847	-37	0	-67	-64	
Existing - 120	1986	2751	2381	2303	2713	3004	5401	10707	15732	7060	1630	2153	2364	
	Change	-135	-266	45	104	79	-9	0	6	0	0	207	285	
Existing - 120 + RIP	1986	2617	2115	2348	2817	3083	5392	10707	15738	7060	1630	2360	2649	

Release and protection of surplus HUP water and flows made available by the Grand Valley Management Project both would augment flows during late summer and early fall. Up to 6,000 acre-feet of water also will be delivered to the 15-Mile Reach from Wolford Mountain Reservoir. All these actions combined provide flows that meet or exceed the 15-Mile Reach flow recommendations under most conditions for August, September, and October (Figures 7,8,9). Because there are no major diversion below the 15-Mile Reach, augmentation of flows in the 15-Mile Reach also would likely benefit all reaches downstream to Lake Powell. The management objective of providing the recommended flows is to provide conditions that promote species recovery by maximizing preferred adult Colorado pikeminnow habitat (Osmundson et al. 1995). When populations are augmented, razorback sucker, and bonytail will benefit from increased base flows inside and outside of the 15-Mile Reach. Increased base flows also would benefit humpback chub populations in Black Rocks and Westwater Canyon.

Water Quality

This biological opinion is limited to addressing water depletions above the confluence of the Gunnison River (water quantity), however, changes in water quantity affect water quality, which is a primary constituent element of critical habitat. Most projects covered by this opinion remove "clean" mountain water before it enters the Colorado River, therefore, depletions could reduce the dilution effect provided by this clean mountain water. This results in an increase in heavy metal, selenium, salts, PAHs, pesticides, and other contaminant concentrations in the Colorado River. An increase in contaminant concentrations in the river would likely result in an increase in the bioaccumulation of these contaminants in the food chain which could adversely affect the endangered fishes, particularly the predatory Colorado pikeminnow. Selenium may be of particular concern due to its effects on fish reproduction and its tendency to concentrate in low velocity areas that are important habitats for Colorado pikeminnow and razorback suckers. The Recovery Program is intended to offset water quality impacts associated with flow reductions (USFWS 1987). These impacts include changes in temperature, salinity and turbidity, as well as the reduced dilution factor associated with depletions. However, the Recovery Program is not intended to offset any point or nonpoint discharges of pollutants, such discharges will have to be offset or avoided by other means. This would include discharges of irrigation water with elevated levels of selenium.

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 for a duration and at a frequency necessary to support all life stages of viable populations of all four endangered fishes. However, the effect of water depletions are most prevalent in the 15-Mile Reach where Colorado pikeminnow and razorback sucker occur. Bonytail and humpback chub do not currently occur in the 15-Mile Reach.

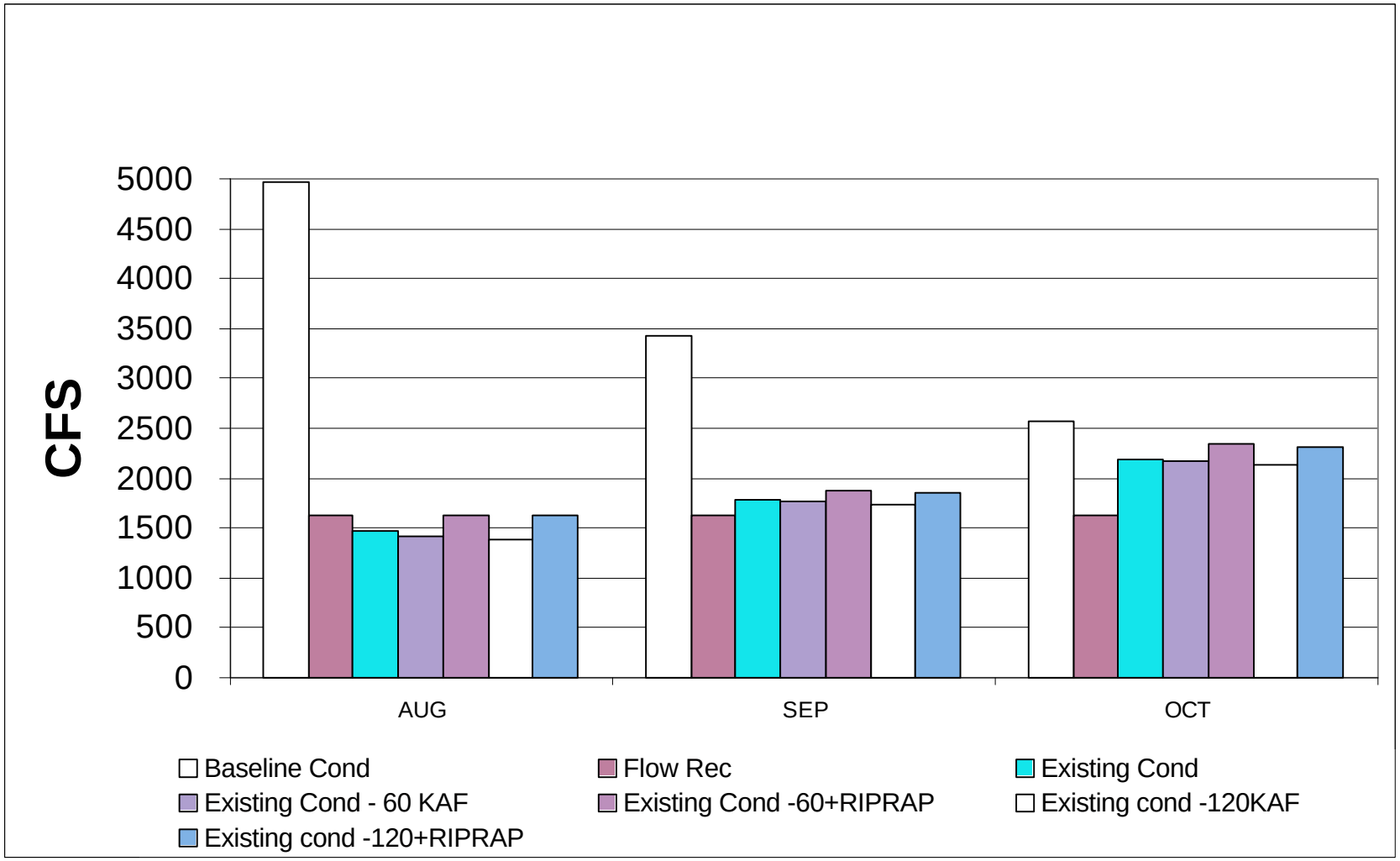

FIGURE 7. Colorado River Near Palisade, flow below GVIC Diversion, August to October for a average year (1982) as modeled by CRDSS.

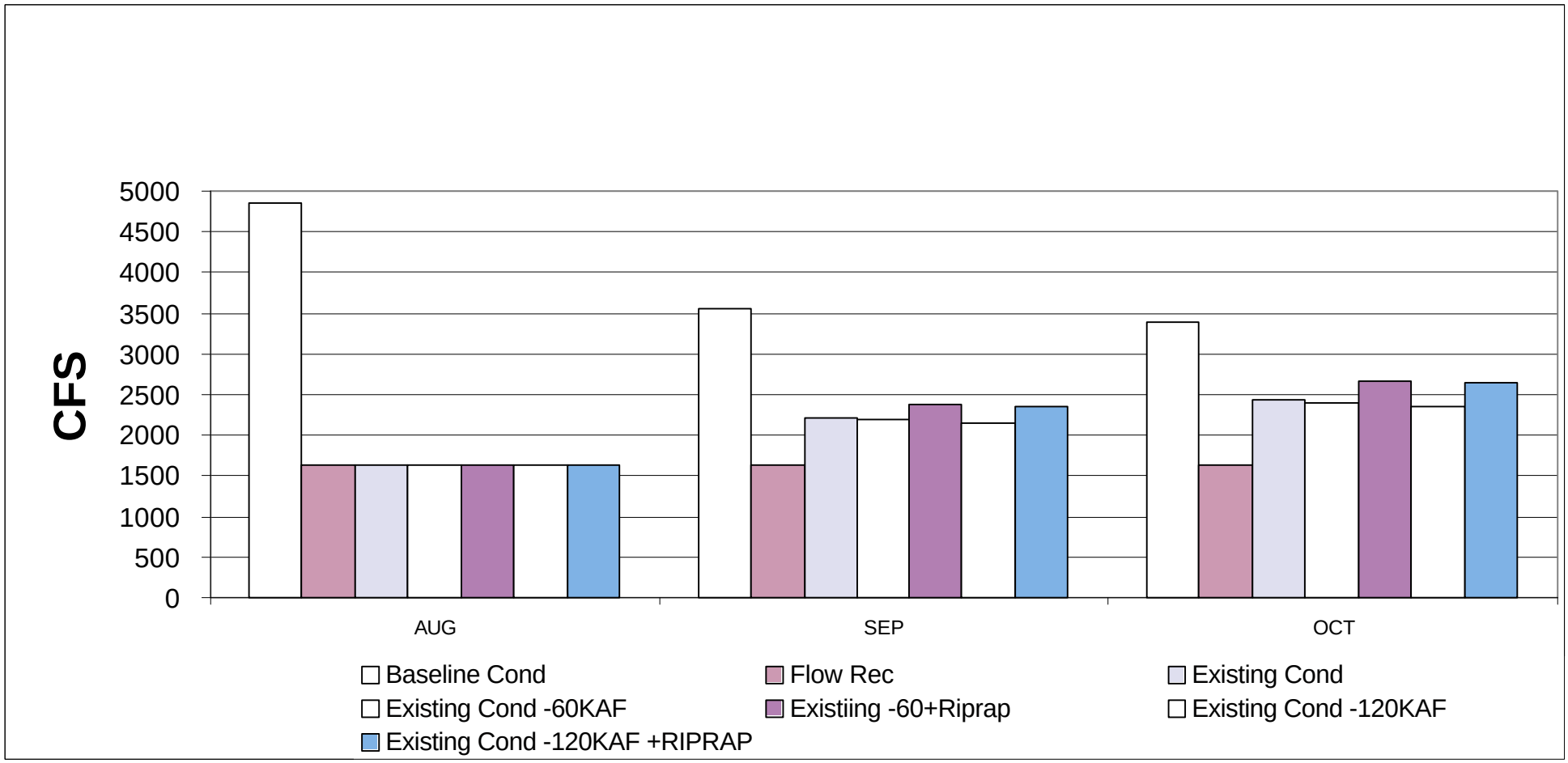

FIGURE 8. Colorado River near Palisade, flow below GVIC Diversion, from August to October for a wet year (1986) as modeled by STATEMOD.

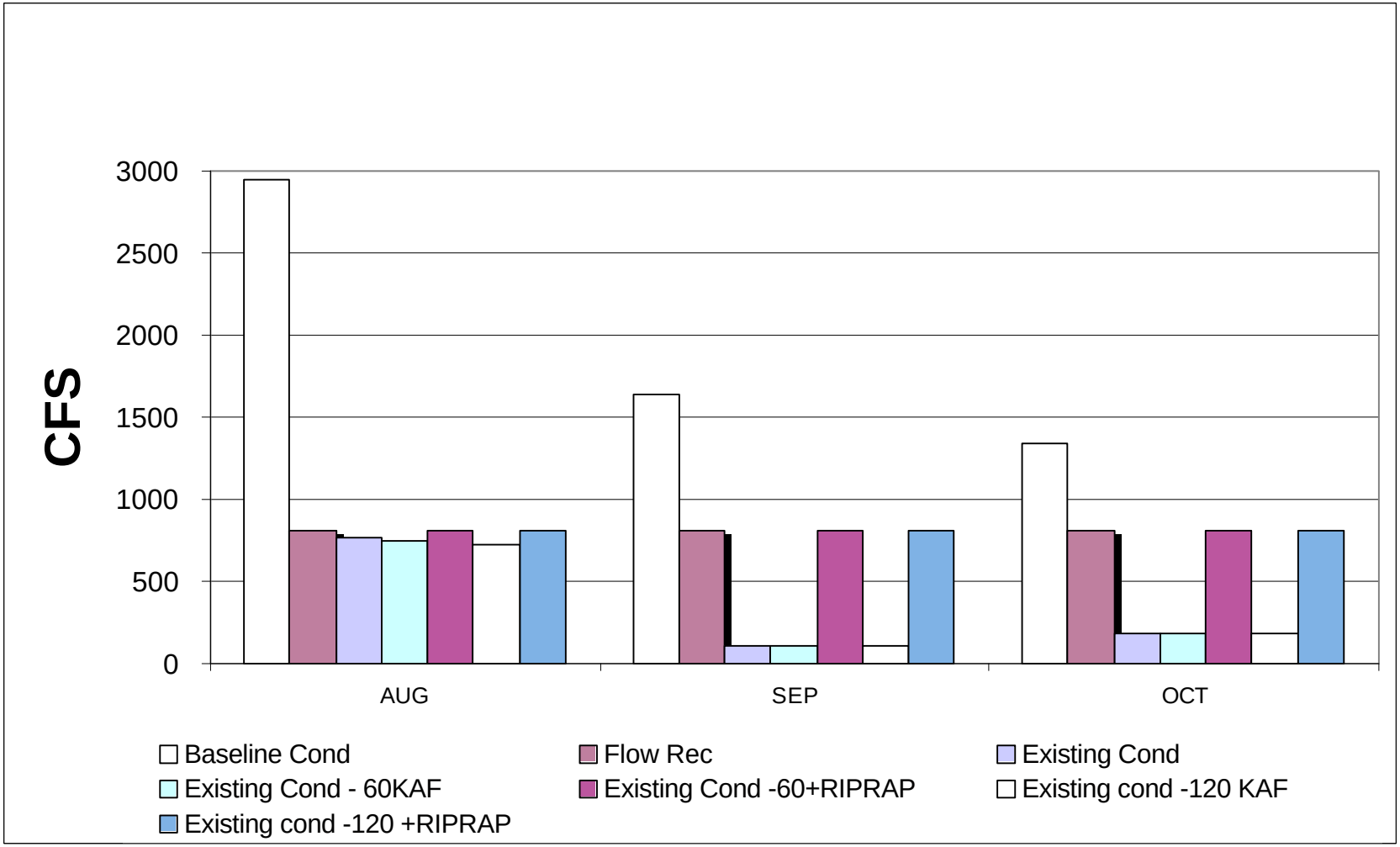

FIGURE 9. Colorado River near Palisade, flow below GVIC Diversion, from August to October for a dry year (1989) as modeled by STATEMOD

The formation of a variety of channel habitats is essential to ensure the availability of the range of habitats required by all endangered fish life stages to fulfill daily requirements (foraging, resting, spawning, avoiding predation, etc.) under various flow conditions. The number and distribution of these channel habitats can be described as channel habitat complexity, diversity, or heterogeneity. Osmundson and Kaeding (1991) found that adult Colorado pikeminnow in the Grand Valley select river segments with a complex morphometry over those that are simple. Floodplain depressions used by razorback sucker are typically formed by abandoned main channels, side-channels, backwaters, and meander cutoffs.

The creation of complex channel habitat and the formation and eventual abandonment of channel features from which floodplain depressions are formed occur primarily during spring runoff when flows are of sufficient magnitude and duration to cause major changes in channel morphology through significant erosion and deposition of bed and bank materials. The reduction in the magnitude, duration, and frequency of high spring flows has slowed the rate at which channel morphology changes (Osmundson and Kaeding 1991). Consequently, the creation of complex channel habitat and floodplain depressions has slowed. In a Geographic Information Systems analyses of aerial photographs, Van Steeter (1996) showed a measurable change in the morphology of the river during the period of water development. Results of the research indicate that there has been a decrease in complexity that appears to be caused by sediment filling in side channels and backwaters during low flow periods. Then vegetation colonizes in these sediments and islands become attached to the floodplain.

The placement of riprap and other bank stabilization measures and the construction of dikes and levees impede changes in channel morphology and contribute to the slowed creation of complex channel habitat. In addition, the construction of dikes and levees reduces existing channel habitat complexity by causing channelization of the river. Dikes and levees also isolate existing floodplain depressions from the channel during high flows. The slowed creation of complex channel habitats and new floodplain depressions, the reduction of existing channel habitat complexity, and the isolation of existing floodplain depressions have acted to reduce the quantity and quality of important habitat for endangered fishes.

Backwaters, identified as important nursery areas for endangered fishes, are altered by the deposition of fine sediments which reduces their depth and consequently their duration and frequency of inundation (Osmundson and Kaeding 1991, Osmundson et al. 1995, Van Steeter 1996). Fine sediments fill the interstitial spaces of gravel and cobble substrates where eggs are deposited by Colorado pikeminnows during spawning. The establishment of vegetation on backwater sediments and on bars further reduces the value of these habitats for endangered fishes because it reduces the ability of the cobble substrate to be flushed clean (Osmundson et al. 1995). Furthermore, higher flows are required to flush sediments from vegetated backwaters than from unvegetated ones. Osmundson and Kaeding (1991) reported observations that, in the 15-Mile Reach during the drought years of 1988 to 1990, backwaters were filling in with silt and spring flows were not sufficient to flush out the fine sediment. Also, they reported that tamarisk colonized sand and cobble bars. The lower frequency of high water years, therefore, decreases

the frequency at which silt and sand is flushed from backwaters, fine sediments are flushed from gravel/cobble substrates, and vegetation is scoured from backwaters and bars. As a result, the frequency at which these habitats are suitable for use by endangered fishes has decreased. Recent studies by Pitlick et al. (1996) indicate that flows in the range of 12,900 and 29,000 cfs mobilize the gravel/cobble substrate.

Also, the quantity and frequency of availability of inundated floodplain depressions used by razorback suckers for spawning is dependent on the magnitude and frequency of spring flows necessary to inundate these areas. The decrease in the magnitude and frequency of spring flows necessary to inundate floodplain depressions is believed to be largely responsible for poor razorback sucker recruitment (Osmundson and Kaeding 1991).

Spring Peak Enhancement to Benefit Physical Habitat

Spring peak flows have been identified as important for habitat formation and maintenance. The Recovery Program has two actions aimed at augmenting spring flows. The benefits of these actions are not reflected in the figures and tables presented in this document, because the hydrology is presented as average monthly flows. In order to show the benefits of the two programs described below, daily flows would need to be modeled. Modeling daily flows was not possible with the model selected, therefore, the benefits are explained below.

The Service and the Recovery Program have been working on a number of initiatives to secure water to augment spring flows to the 15-Mile Reach. The Coordinated Reservoir Operations were implemented to provide a coordinated inter-agency effort to coordinate discretionary bypasses of inflow at major reservoirs in the basin to coincide with the natural spring peak. Augmentation of the peak can occur during below average, average, and above average hydrologic conditions. The Coordinated Reservoir Program was successful in 1997 in providing approximately 2,000 cfs of peak augmentation and in 1998 approximately 2,500 cfs was added to the peak. The Service has identified target flows in the 15-Mile Reach in the range of 12,900 to 29,000 cfs, because flows of this magnitude have been shown to mobilize gravel/cobble substrate (Pitlick et al. 1996).

The second initiative is the Coordinated Management of Colorado Water Division Number 5 Facilities. This initiative is intended to assess water management facilities and operations that can be coordinated to benefit fish habitat in spring and late summer. This analysis will include, but not be limited to examining options similar to what is proposed for operation of Ruedi Reservoir where water is made available to the fish until needed by water interests. The intent of the initiative is for project sponsors to secure a firm water supply for project purposes, and to utilize flexibility that may currently exist to provide water for enhancement of the spring peak. Other options being evaluated include storing or withholding release of available flows in excess of the Service's winter flow recommendations for release during the spring peak, and examining the feasibility and benefits of an off channel storage facility somewhere below the Shoshone Power Plant. The amount of water available, benefits, physical and legal constraints, and recommended

options will be determined through the analysis and presented to the Recovery Program. The intent is to provide additional water up to approximately 20,000 acre-feet/year, without diminishing project yield or causing project sponsors to incur significant costs, for meeting fish flow needs either short-term or under certain hydrologic conditions (above what is currently targeted for coordinated reservoir operations). Following the analysis, agreements and/or operating protocols will be developed, as needed. The analysis should be completed by September 2000 and agreement on implementation reached by March 2001. An example of the benefits of this proposal is that if an additional 20,000 acre-feet is released in a given year, it would augment spring peak flows by approximately 1,000 cfs for 10 days in the 15-Mile Reach.

Reproductive success and natural recruitment are dependent on high spring flows to create and maintain habitat. Augmentation of the spring peak is an essential recovery action upon which the Recovery Program depends to avoid the likelihood of jeopardy and adverse modification of critical habitat. Increased spring peak flows in the 15-Mile Reach, would likely benefit all reaches downstream to Lake Powell.

Habitat Restoration

The habitat restoration element of the Recovery Program will enhance, restore, and protect natural floodplain habitat through easement/acquisition of floodplain property, dike removal, and physical manipulation of habitat. Floodplain habitats inundated and connected to the main channel by high spring flows are typically warmer and substantially more productive than the adjacent river and have abundant vegetative cover. Floodplain habitat has been identified as important for adult Colorado pikeminnow during the pre-spawning period and for all life stages of razorback sucker. Restoration of bottomland habitat is providing pre-spawning staging habitat for Colorado pikeminnow. It will also provide pre-spawning, post-spawning, and nursery habitat for razorback sucker. Bottomland habitats have not been identified as important to humpback chub. Not enough information is available to determine the benefits to bonytail.

The lack of availability of seasonally flooded habitats has been identified as a major factor in the decline of razorback sucker populations. Wydoski and Wick (1998) concluded that zooplankton densities in the main channel of the Green River never reached densities required for larval razorback sucker to survive. However, they consistently found zooplankton densities necessary for survival in floodplain habitats. Because razorback suckers spawn on the ascending limb of the spring runoff hydrograph, when main channel food organism densities are extremely low, Wydoski and Wick (1998) concluded that starvation may be a factor in larval razorback survival. Wydoski and Wick (1998) also concluded that floodplain habitat with vegetative cover provides protection from nonnative predators for larval and juvenile razorbacks. The Service believes that restoring floodplain habitats will increase densities of zooplankton and benthic invertebrates to provide adequate quantity and quality of food organisms for larval razorback sucker survival; and the vegetative cover provided in floodplain habitat will help reduce predation by nonnative fishes.

Fish Passage

Biologists believe dams and water diversion structures in the river are one of the primary reasons for the decline of the Colorado pikeminnow, razorback sucker, humpback chub and bonytail. These barriers have fragmented migration routes of endangered fish, reducing their historic range (to the Gulf of California) by 75 percent. The fish are no longer able to access spawning, feeding, and winter habitats. Upstream of such barriers on the Colorado and Gunnison Rivers, these fish are nearly extinct.

It is believed that Colorado pikeminnow and razorback sucker historically spawned in river reaches above the existing diversion dams within critical habitat. After the dams were built, populations above the dams declined over time. Spawning may have continued to occur, but the newly-hatched larvae would drift downstream over the dams. After rearing downstream, young adults would not have been able to move into upstream areas to replenish the declining spawning populations above the dams. After spawning, adults of these species move back to their home ranges, areas where they can feed, rest, and overwinter. Construction of diversion dams has denied access to some of these habitats. Construction of passage facilities at structures on the Colorado and Gunnison Rivers is expected to restore access to 112 miles of historically-occupied habitats, and assist in recovery of these endangered fishes.

The fish passageway constructed on the Gunnison River at the Redlands Diversion Dam is an example of a successful fish passage project. Since its completion, approximately 28,200 fish have used the fishway, including 42 Colorado pikeminnow. Native fish have comprised about 93 percent of this total. Native fish that had been marked and released above the dam dispersed upstream, some as far as 57 river miles to the base of the Hartland Diversion Dam. Colorado pikeminnow that passed through the fishway have been found upstream. Ongoing studies will determine if fish using the passageway are spawning in the Gunnison River above the Redlands Diversion Dam.

The following recovery actions will eliminate fish passage problems on the upper Colorado River.

> There are three barriers on the Colorado River near Grand Junction, Colorado: Grand Valley Irrigation Company (river mile 185), Price-Stubb (river mile 188), and Grand Valley Project (river mile 194). Restoration of passage at these diversion dams will allow access to 55 miles of habitat, from Palisade (river mile 185) upstream to Rifle (river mile 240), Colorado.
>
> The Grand Valley Irrigation Company diversion dam has been in place since 1883. The low dam (approximately 2-feet high) was a barrier to upstream fish passage at flows less than 1,200 cfs. Construction of a 30 foot wide notch and 5 pools and riffles provides fish passage at flows above 100 cfs, was completed in January 1998. Ten adult Colorado pikeminnow were captured above the dam during recent studies to evaluate the fish passage (Burdick 1999). However, it is unknown whether these fish used the newly constructed notch or passed over the dam during high flows.

Passage at the Price-Stubb Diversion Dam is currently scheduled to be completed in September 2000. However, one fish passage alternative is dam removal and if this option is chosen the schedule could be delayed until April 2002 to accommodate completion of the Plateau Creek Pipeline Project by Ute Water Conservancy District. Restoration of passage at the Government Highline Diversion Dam is tentatively scheduled for completion during 2001.

Biological Environment

Food supply, predation, and competition are important elements of the biological environment. Stocking of nonnative fishes and the modification of flow regimes, water temperatures, sediment levels, and other habitat conditions caused by water depletions has contributed to the establishment of nonnative fishes. Predation and competition from nonnative fishes have been clearly implicated in the population reductions or elimination of native fishes in the Colorado River Basin (Dill 1944, Osmundson and Kaeding 1989, Behnke 1980, Joseph et al. 1977, Lanigan and Berry 1979, Minckley and Deacon 1968, Meffe 1985, Propst and Bestgen 1991, Rinne 1991, and others). Data collected by Osmundson and Kaeding (1991) indicated that during low water years nonnative minnows capable of preying on or competing with larval endangered fishes greatly increased in numbers.

More than 50 nonnative fish species were intentionally introduced in the Colorado River Basin prior to 1980 for sportfishing, forage fish, biological control and ornamental purposes (Minckely 1982, Tyus et al. 1982, Carlson and Muth 1989). Nonnative fishes compete with native fishes in several ways. The capacity of a particular area to support aquatic life is limited by physical habitat conditions. Increasing the number of species in an area usually results in a smaller population of most species. The size of each species population is controlled by the ability of each life stage to compete for space and food resources and to avoid predation. Some nonnative fishes' life stages appear to have a greater ability to compete for space and food and to avoid predation in the existing altered habitat than do some native fishes' life stages. Tyus and Saunders (1996) site numerous examples of both indirect and direct evidence of predation on razorback sucker eggs and larvae by nonnative species.

Nonnative fishes often are stocked in and enter rivers from off-channel impoundments. The periodic introduction of these nonnative fishes into a river allows them to bypass limitations to reproduction, growth, or survival that they might encounter in the river. Consequently, populations of nonnative fishes in the river are enhanced. Endangered and other native species in the river experience greater competition and predation as a result. Tyus and Saunders (1996) concluded that the nonnative fish impacts play a significant role in the decline of the Colorado River endangered fishes.

Nonnative Fish Management

The implementation of the Nonnative Fish Stocking Procedures (USFWS 1996) will help in the effort to reduce competition and predation from nonnative fish. Further reduction of nonnative fishes should come with the State of Colorado's removal of bag limits on all nonnative warmwater sportfishes within critical habitat.

The Recovery Program is in the process of reclaiming floodplain ponds (removal of nonnative fishes from ponds) in critical habitat. Also, small nonnative cyprinids are being removed from backwaters and other low velocity nursery habitats in critical habitat. These efforts are designed to reduce nonnative fish from critical habitat. Centrarchid removal in the Colorado River began in 1997 and continues.

A Fisheries Management Plan is being developed for the reach from Rifle to the Colorado-Utah state line. This plan will incorporate nonnative fish control and management of sportfish. This effort should help reduce nonnative fishes in critical habitat.

Propagation

Recovery Program propagation activities will provide endangered fishes for augmentation of populations and provide refugia to insure various stocks of endangered fishes will not be lost. Propagation facilities are being expanded at the Ouray National Fish Hatchery, Wahweap, and in the Grand Valley.

The Recovery Program is currently managing Colorado River razorback sucker stocks. The Recovery Program has completed a 5 year stocking plan (Nesler 1998) that includes stocking razorback sucker and Colorado pikeminnow in the Colorado River above Palisade. Between 1996 and 1998 over 10,000 bonytail were stocked in the Colorado River in Utah. The 5 year stocking plan calls for stocking bonytail between Palisade and Loma, which includes the 15-Mile Reach. Stocking will proceed in accordance with dates established by the Recovery Program and/or included in the Recovery Action Plan.

Populations of razorback sucker and bonytail are so low in the Upper Colorado River that augmentation of populations is an essential tool for species recovery.

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

The Service believes that the greatest impacts of water depletions addressed in this biological opinion are on endangered fishes and their habitats in the 15-Mile Reach of the Colorado River. Historic water depletions have greatly altered the natural flow regime, and new depletions totaling 120,000 acre-feet/year will have additional impacts. As a result of existing depletions and other factors affecting habitat availability and quality, critical habitat for the endangered fishes has been degraded to varying degrees and population responses to habitat modification varies among

species. Recent population estimates indicate that Colorado pikeminnow populations have increased in the Colorado River (Osmundson and Burnham 1998), but populations are still low compared to historic levels. Nonetheless, the 15-Mile Reach currently supports more adult Colorado pikeminnow per mile than the rest of the mainstem Colorado River except for the adjacent downstream 18-Mile Reach (USFWS, unpublished data). Populations of razorback sucker throughout the Colorado River basin have suffered severe declines, apparently due in part to loss of critical floodplain habitats, and wild fish are almost unknown in recent collections from the upper Colorado River sub-basin. Humpback chubs do not occur in the 15-Mile Reach, and population responses to present river modifications are difficult to determine because populations in the upper Colorado River subbasin were not discovered until the late 1970's. However, results from monitoring suggest that populations in Black Rocks and Westwater Canyon are stable (McAda et al. 1994). Wild populations of bonytail have been extirpated from the upper Colorado River subbasin.

Ongoing or planned Recovery Program actions for the endangered fishes in the Colorado River include augmentation of spring peak flows, providing adequate base flows, implementing control measures for nonnative fishes, restoring access to historically occupied river reaches and habitats, and augmentation of populations through stocking to assist in reestablishing viable populations (particularly bonytail and razorback sucker). The Service has concluded that although the flow-related recovery actions will not be sufficient to fully offset all the adverse effects of historic and new water depletions, it is expected that a combination of flow and nonflow management activities will provide suitable habitat for increasing numbers of the endangered fishes and likely restore critical habitat areas that have been substantially modified or completely lost, to adequately offset such depletions and to avoid take including harm. The life history of the endangered fishes suggests that populations are recruitment-limited (Wydoski and Wick 1998), therefore ensuring adequate levels of recruitment appears to be the key for their recovery. The expected long-term response of the endangered fishes to habitat restoration and population augmentation (where needed) will be a function of the enhancement of populations through increases in abundance, expansion of current distributions, and restoration of viable population structure (i.e., all life stages present and successful recruitment of young to adult stocks).

Management activities to enhance spring (March–July) peak flows include Coordinated Reservoir Operations and implementation of Phase II of Coordinated Facilities. Although the Service recognizes that spring flow recommendations for the endangered fishes will not be met under the proposed action, the expected result of enhancing the spring peak is increased frequency of years in which flows exceed 12,900 cfs, the threshold identified for moving fine sediments (Pitlick et al.1996). Adequate sediment transport is important because cobble and gravel deposits free of silt and sand are preferred spawning sites of the endangered fishes (Tyus 1990; Harvey et al. 1993; Harvey and Mussetter 1994; Wick 1997), and backwaters (the preferred nursery habitat of young Colorado pikeminnow) are maintained by periodic removal of accumulated sediments and rejuvenation of deposits that provide the structure for formation of the habitat after spring flows recede (Rakowski and Schmidt 1999, Osmundson et al. 1995). The Service believes that improving spawning and nursery habitats should result in increased reproductive success and

survival of young fish (i.e., enhanced recruitment) which, over time, should lead to increases in population abundance. While spring flow recommendations have not been achieved in recent years, data indicates that populations of Colorado pikeminnow are increasing (Osmundson and Burnham 1998, USFWS unpublished data). In 1999, the Service released razorback suckers into the Colorado River and anticipates that this and future augmentation efforts will result in self-sustaining populations.

Prior to implementation of recovery actions, recommended summer/fall base-flow targets for the 15-Mile Reach were seldom met. With full implementation of recovery actions, base-flow targets for August–October will be met in most years. The base-flow recommendations are intended to provide the maximum area of habitat preferred adult Colorado pikeminnow (Osmundson et al. 1995) and, therefore, the numbers of adult Colorado pikeminnow in the 15-Mile Reach should increase in response to the additional habitat. Further, the August–October base flows achieved through implementation of the recovery actions should provide adequate depth and stability in nursery backwater and other low-velocity channel-margin habitats, which are the habitat types most sensitive to changes in river stage (Hlohowskyj and Hayse 1995, Osmundson et al. 1995). The Service believes that increases in suitable backwaters should provide additional nursery habitat in the 15-Mile Reach, possibly resulting in increased recruitment of Colorado pikeminnow. The Service concludes that, although information on habitat use by razorback suckers in the 15-Mile Reach is limited, providing nursery backwaters with adequate depth and stability for young fish should increase the likelihood for reestablishment of the species in this reach. All of the 14 early juvenile razorback suckers caught in riverine habitats of the Upper Colorado River Basin since 1962 were from backwaters (Taba et al. 1965; Gutermuth et al. 1994; Muth et al. 1998). The winter base-flow targets will continue to be met with implementation of the proposed action. During winter, adult Colorado pikeminnow mostly use pools and backwaters (Osmundson et al. 1995). Winter flows with the proposed action should provide adequate depth in these habitats for overwinter survival.

Nonnative fishes dominate the ichthyofauna of Colorado River basin rivers and have been identified as contributing to reductions in distribution and abundance of native fishes (Carlson and Muth 1989). Because introduced species vary in body size, environmental tolerances, and habitat preferences and have wide distributions, high abundance, and diets ranging from herbivory to piscivory, they are potential competitors with or predators on nearly all life stages of native fishes, but particularly young fish in nursery habitats. Nonnatives of greatest concern in the Upper Basin are red shiner, common carp, fathead minnow, channel catfish, northern pike, and centrarchids because of known or suspected negative interactions with native fishes (Hawkins and Nesler 1991). Lentsch et al. (1996) and Tyus and Saunders (1996) emphasized the need for nonnative fish control to achieve recovery of the endangered fishes and presented options for controlling nonnative fishes in the upper basin that included more restrictive stocking protocols, more liberalized harvest regulations, mechanical removal, chemical eradication, and management of flows to benefit native fishes and suppress the abundance of nonnative fishes. The purpose of the September 1996 Procedures for Stocking Nonnative Fish Species in the Upper Colorado River Basin is to ensure that all future stocking of nonnative fishes will be consistent with recovery of

the endangered fishes. Ongoing Recovery Program projects to actively control nonnative fishes in the Colorado River include mechanical removal of cyprinids and centrarchids from backwaters, and screening of point-sources and chemical eradication of fishes in ponds adjacent to the river within critical habitat to prevent escapement into the river during high flows. Nonnative fish control activities implemented by the Recovery Program should improve the quality of habitat for all endangered fishes by reducing predation and competition for food and space, resulting in enhanced native fish population abundance. The Service believes that providing backwaters with adequate depth and reduced nonnative predators or competitors will likely increase survival of young Colorado pikeminnow, and, in particular, razorback sucker, thereby potentially resulting in stronger year classes and enhanced levels of recruitment.

Habitat restoration and augmentation of populations through stocking to provide sufficient numbers of fish to take full advantage of restored habitats are key elements for recovery of the endangered fishes. Completion of fish-passage structures on the Colorado River will restore access to 55 miles of habitat historically occupied by endangered fishes between Palisade and Rifle. Runs and pools comprise 49 to 70 percent of the available habitat within this reach; these habitats provide excellent feeding and wintering areas for Colorado pikeminnow and razorback sucker (Anderson 1997). Providing access up to an additional 3,500 acres of floodplain habitat will also improve habitat quality during spring runoff. Floodplain habitats inundated and connected to the main channel by high spring flows are typically warmer and substantially more productive than the adjacent river and have abundant vegetative cover. These habitats apparently are important growth and conditioning areas for all life stages of razorback sucker (also used by adult Colorado pikeminnow), but are critical for survival of early life stages (Wydoski and Wick 1998; Muth et al. 1998). The decline of razorback sucker in the Upper Colorado River Basin has been linked to recruitment failure, and recovery of the species seems unlikely without restoration of floodplain habitats. Enhanced growth of young razorback suckers in warm, food-rich floodplain habitats may increase overall survival by reducing the effects of size-dependent processes on survival, such as shortening the period of vulnerability to predation by nonnative fishes (Muth et al. 1998).

The Service concludes that the effect of implementation of the recovery actions will be an increase in the populations of all four species of endangered fish. The Service believes the above recovery actions must be accomplished on schedule to halt further habitat degradation and promote restoration of important habitats and enhancement of endangered fish populations. The Service recognizes that the 15-Mile Reach flow recommendations will not be met for the spring months, and infrequently not met during the late summer/fall period; however, the Service anticipates that the combination of flow and nonflow recovery actions will increase populations of endangered fishes to the levels described as a “positive response” in Appendix D and restore critical habitat. The Service will use fish population responses to determine if the recovery actions are producing the desired positive results, but, because the endangered fishes are long-lived, detection of responses to recovery actions may take several years. Ultimately, the anticipated long-term species response to the Recovery actions is attainment of recovery goals, which are being developed. If fish population responses do not indicate that the Recovery actions are improving

populations to levels described as a “positive response” in Appendix D, section 7 consultation will have to be reinitiated, according to the conditions for reinitiation listed in the reinitiation notice and Appendix D. It should be noted that Appendix D will be refined as new information becomes available.

The criteria to determine positive or negative fish population responses is presented in the reinitiation notice of this biological opinion and in Appendix D. As described in the reinitiation notice, the status of fish populations will be reviewed prior to new depletions reaching 60,000 acre-feet/year. This review will begin when actual new depletion levels reach 50,000 acre-feet/year or the year 2015, whichever comes first. The method for determining the level of new depletions is described in Appendix B. According to the criteria outlined in Appendix D, a positive response would require the adult Colorado pikeminnow population estimate to increase to and to be maintained at approximately 1,100 individuals in the Colorado River (confluence of the Green River to Rifle). When population estimates for wild adult humpback chub are finalized, they will also be used to determine population response. As outlined in Appendix D, Colorado pikeminnow and humpback chub will serve as surrogates for razorback sucker and bonytail for 10 years. Recovery goals for all four species are expected to be developed in the year 2000. If a population meets or exceeds the numeric recovery goal for that species, it will be considered to exhibit a positive response. However, short of reaching a specific recovery goal, trends in certain populations indices provide an interim assessment of a species’ progress toward recovery.

It is the Service’s best scientific judgment at this time that the combination of flow and nonflow recovery actions will increase population estimates to levels described as a positive response in Appendix D and restore critical habitat. However, if this judgment is determined to be inaccurate during the year 2015 or at the 50,000 acre-feet/year check point, and population estimates for Colorado pikeminnow in the Colorado River do not reach 1,100 adults, this would be considered new information and section 7 consultation will be reinitiated.

CUMULATIVE EFFECTS

Cumulative effects include the effects of future State, 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 Endangered Species Act. The Service is not aware of any future non-Federal actions not included in this action under consultation involving water depletions that are reasonably certain to occur in the action area.

CONCLUSION

After reviewing the current status of the endangered fishes, 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 proposed action is not likely to jeopardize the continued existence of

the Colorado pikeminnow, razorback sucker, bonytail, or humpback chub and is not likely to destroy or adversely modify the designated critical habitat of these species.

INCIDENTAL TAKE

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 this incidental take statement.

The measures described below are nondiscretionary, and must be undertaken so that they become binding conditions of any Federal discretionary activity, for the exemption in section 7(o)(2) to apply. The participating Federal Agencies have a continuing duty to monitor the activity covered by this incidental take statement. If the Recovery Program (1) fails to assume and implement the terms and conditions or (2) fails to retain oversight to ensure compliance with the terms and conditions, the protective coverage of section 7(o)(2) may lapse for the projects covered by this incidental take statement.

Incidental take is considered with full implementation of recovery actions which are part of the Project (Federal Action) which is the subject of this consultation. The Service has determined that no take including harm is anticipated to occur as a result of the depletions contemplated in this opinion because of the implementation of recovery actions. Take that is incidental to activities addressed in this opinion are associated with endangered fish being diverted into irrigation, municipal, and industrial water delivery systems. This incidental take is expected to be in the form of killing because the fish will likely enter canals and be transported by water to agricultural areas or irrigation, municipal, and industrial facilities where they would not survive. Any incidental take associated with recovery actions has been or will be addressed during project specific environmental compliance. The Recovery Program will be responsible for providing any required reasonable and prudent measures to minimize incidental take.

AMOUNT OR EXTENT OF TAKE

The Service considers it likely that adult Colorado pikeminnow and razorback sucker will swim into irrigation canals or be removed from the river through municipal or industrial water delivery systems along the Colorado River above the 15-Mile Reach. There are no major diversions in or downstream of the 15-Mile Reach. In the future, if and when reproducing populations of Colorado pikeminnow and razorback sucker are established upstream of the 15-Mile Reach, the Service anticipates some degree of incidental take of larval and young Colorado pikeminnow and razorback sucker in this area. The take is expected because of lack of larval habitat in canals and killing of larvae in water which will be removed from the river though irrigation, municipal, and industrial water delivery systems. The Service does not anticipate incidental take of bonytail or humpback chub in irrigation, municipal, or industrial water delivery systems because bonytail do not presently occur above the 15-Mile Reach and humpback chub tend to stay in canyon reaches.

The Service finds that the anticipated amount of incidental take associated with irrigation, municipal, and industrial water delivery systems will be difficult to detect for the following reasons: finding a dead or impaired specimen is unlikely; larval fish are extremely small; the river is very turbid and fish of any size are not easily observed. However, the anticipated incidental take for Colorado pikeminnow and razorback suckers >300 mm was estimated as follows.

Adult and Subadult Fish

Existing diversions from Rifle to the 15-Mile Reach include those used for agricultural, municipal, and industrial purposes. Many of these diversions are very small and pose little threat to fish >300 mm, because fish of this size are not likely to enter small canals or pumps. However, two major diversions above the 15-Mile Reach likely take all life stages of fish. These diversions are the Grand Valley Project Diversion Dam (Government Highline Canal) and the Grand Valley Irrigation Company Canal. The reasonable and prudent measure was developed to minimize take above the 15-Mile Reach at these large diversion canals.

The Service anticipates an annual incidental take of 1 percent of the current adult Colorado pikeminnow population above Westwater Canyon. The current population of adult Colorado pikeminnow above Westwater Canyon is estimated to be 253 fish, with a survival rate of 86 percent per year (Osmundson and Burnham 1998). Therefore, the current level of anticipated incidental take is 3 adult Colorado pikeminnow per year. As population estimates change (either up or down), the level of anticipated incidental take would change. A recent management objective of the Recovery Program (Lentsch et al. 1998) is to establish a population of 5,477 adult Colorado pikeminnow in the Colorado River. Assuming this target is met in the future and there is a similar distribution of adult fish as presented by Osmundson and Burnham (1996), there would be approximately 1,683 Colorado pikeminnow above Westwater Canyon. Therefore, the anticipated level of incidental take will increase to 17 adult fish per year or 1 percent of the adult population which ever is greater.

There are no current population estimates for razorback sucker in the Colorado River due to the low numbers of remaining fish. Therefore, the Service estimates the anticipated incidental take to be 2 adult fish per year until augmentation efforts are successful above the diversion structures. The current management objective is to have 5,316 adult razorback suckers in the Colorado River, in Colorado. As the population of razorback suckers increases, the incidental take could increase. The Service estimates future incidental take to be 1 percent of the population. Therefore, the anticipated level of incidental take will increase to 53 adult fish per year or 1 percent of the adult population which ever is greater.

To reduce the level of incidental take of adult and subadult Colorado pikeminnow and razorback sucker, reasonable and prudent measures have been developed.

Young Fish

Currently, there is no anticipated incidental take of larval or young fish, because there is no known reproduction of Colorado pikeminnow or razorback sucker above the 15-Mile Reach. However, in the future when passage is established at Price-Stubb and the Grand Valley Diversions, and reproducing populations are established, and spawning occurs above the 15-Mile Reach, the Service expects young fish might be diverted into canals. When it is detected that endangered fishes are spawning above the 15-Mile Reach, state-of-the-art sampling techniques will be applied to help the Service anticipate incidental take of young razorback sucker and Colorado pikeminnow.

EFFECT OF THE TAKE

In the accompanying biological opinion, the Service determined that this level of anticipated incidental take is not likely to result in jeopardy to the species or destruction or adverse modification of critical habitat with full implementation of recovery actions.

REASONABLE AND PRUDENT MEASURES

The Service believes the following reasonable and prudent measures are necessary and appropriate to minimize take of Colorado pikeminnow and razorback sucker. The two diversions listed below have the greatest potential for access by the endangered fish because of their location and the amount of the river that is diverted at these facilities. It is not anticipated that other existing water delivery systems above the 15-Mile Reach pose much threat to the endangered fish, therefore, individual reasonable and prudent measures above the major diversions are not required at this time .

1. The Recovery Program will design, construct, and maintain fish preclusion devices to prevent or reduce adult and subadult fish (>300 mm total length) from entering the existing major irrigation diversion systems (Grand Valley Irrigation Company Canal and

Grand Valley Project Diversion Dam [Government Highline Canal]). These are Recovery Plan actions II.B.1.b.(3) and II.B.3.b.(3).

TERMS AND CONDITIONS

In order to be exempt from the prohibitions of section 9 of the Act, the following terms and conditions must be complied with, which implement the reasonable and prudent measures described above. These terms and conditions are nondiscretionary.

1. The Recovery Program will develop an appropriate design for fish preclusion devices that are compatible with the operation of the subject facilities.

2. Fish preclusion devices to prevent or reduce adult and subadult fish (>300 mm total length) from entering the canals within the time frame outlined in the Recovery Action Plan will be constructed by the Recovery Program.

3. If another existing water delivery system between Rifle and the 15-Mile Reach is found to result in take that may cause the incidental take limit to be exceeded, then the Recovery Program will design and construct fish preclusion devices to prevent or reduce adult and subadult fish (>300 mm total length) from entering that facility.

4. A plan to monitor the amount of take will be developed by September 30, 2001, by the Recovery Program and added to the Recovery Action Plan.

The reasonable and prudent measures, with their implementing terms and conditions, are designed to minimize incidental take at existing facilities in the action area (Rifle to Lake Powell) from depletions above the confluence with the Gunnison River that might otherwise result from the proposed action. Incidental take statements exempt those actions covered by the incidental take statement from the Act's section 9 prohibitions if the reasonable and prudent measures and the implementing terms and conditions of incidental take statements are complied with. In summary, the anticipated incidental take of Colorado pikeminnow when adults are taken in irrigation canals and municipal intakes is 3 adult fish per year or 1 percent of the latest adult population estimate above Westwater Canyon, whichever is greater. The anticipated level of incidental take of razorback suckers when adults are taken in irrigation canals and municipal intakes is 2 adult fish per year or 1 percent of the adult population, whichever is greater. If, during the course of the action, this minimized level of incidental take is exceeded, such incidental take represents new information requiring reinitiation of consultation to review of the reasonable and prudent measures provided. The Service will consider the causes of the taking and review the need for possible modification of the reasonable and prudent measures.

If consultation is reinitiated because the incidental take limit has been exceeded for existing intakes between Rifle and the 15-Mile Reach, additional reasonable and prudent measures would be developed. The Recovery Program would be responsible for the implementation of any

additional reasonable and prudent measures for such intake structures. As stated in 50 CFR 402.14(I)(2) these "Reasonable and prudent measures along with the terms and conditions that implement them, cannot alter the basic design, location, scope, duration, or timing of the action and may involve only minor changes."

INDIVIDUAL CONSULTATIONS UNDER THE UMBRELLA OF THIS PROGRAMMATIC BIOLOGICAL OPINION

This programmatic consultation is on the Federal action as described on page 1. The Service believes that the Recovery Action Plan items are sufficient to avoid the likelihood of jeopardy and/or adverse modification of critical habitat for depletion impacts for individual existing depletions (estimated average annual 1 million acre-feet/year) as defined in the description of the proposed action, and future depletions (up to 120,000 acre-feet/year). Individual consultation is not required on future specific Federal actions within the scope of this opinion as they relate to Reclamation's existing operations and depletions as defined in the description of the proposed action, or to Reclamation's portion of the 120,000 acre-feet of new depletions from existing projects. Operation of Reclamation facilities to carry out recovery actions as described in this biological opinion will not require further section 7 consultation. However, individual section 7 consultation will still be required on all other future specific Federal actions pursuant to the Endangered Species Act, to determine if they fit under the umbrella of this programmatic biological opinion. Non-Federal projects with existing depletions are not required to consult under section 7 until there is a Federal nexus, at which time it will be determined if the project fits under the umbrella of this programmatic biological opinion. The following criteria must be met at the time of individual project consultation to rely on the Recovery Program and be considered under the umbrella of this programmatic consultation:

1. A Recovery Agreement must be offered and signed prior to conclusion of section 7 consultation.

2. A fee to fund recovery actions will be submitted as described in the proposed action for new depletion projects greater than 100 acre-feet/year. The 2000 fee is $14.36 per acre-foot and is adjusted each year for inflation.

3. Reinitiation stipulations, described below, will be included in all individual consultations under the umbrella of this programmatic.

4. The Service and project proponents will request that discretionary Federal control be retained for all consultations under this programmatic.

Under this opinion, future consultations that meet the criteria would avoid the likelihood of jeopardy and/or adverse modification of critical habitat from depletion impacts. Projects that don't meet the criteria are not part of the proposed action, and therefore will require consultation outside of the Recovery Program.

REINITIATION NOTICE

This concludes formal consultation on the subject action. As provided in 50 CFR sec. 402.16, reinitiation of formal consultation is required for Reclamation projects and where discretionary Federal Agency involvement or control over the action has been retained (or is authorized by law) and under the following conditions:

a. The amount or extent of take specified in the incidental take statement for this opinion is exceeded. The Service has determined that no incidental take, including harm, is anticipated to occur as a result of the depletions contemplated in this opinion because of the implementation of recovery actions. The implementation of the Recovery actions contained in this opinion will further decrease the likelihood of any take caused by depletion impacts.

b. New information reveals effects of the action that may affect listed species or critical habitat in a manner or to an extent not considered in this opinion. In preparing this opinion, the Service describes the positive and negative effects of the action it anticipates and considered in the section of the opinion entitled "Effects of the Action." New information would include, but is not limited to, not achieving a "positive response" or a significant decline in population, as described in Appendix D. Significant decline shall mean a decline in excess of normal variations in population (Appendix D). The current population estimate of adult Colorado pikeminnow in the Colorado River is 600 individuals, with a confidence interval of ± 250. Therefore, with the criteria established in Appendix D, a negative population response would trigger reinitiation if the population declined to 350 adults. The Recovery Program is currently developing recovery goals for the four endangered fishes. If a population meets or exceeds the numeric goal for that species, it will be considered to exhibit a positive response. The Service retains the authority to determine whether a significant decline in population has occurred, but will consult with the Recovery Program's Biology Committee prior to making its determination. In the event of a significant population decline, the Service is to first rely on the Recovery Program to take actions to correct the decline. If nonflow recovery actions have not been implemented, the Service will assess the impacts of not completing these actions prior to reexamining any flow related issues.

New information would also include the lack of a positive population response by the year 2015 or when new depletions reach 50,000 acre-feet/year. According to the criteria outlined in Appendix D, a positive response would require the adult Colorado pikeminnow population estimate to be 1,100 individuals (±250) in the Colorado River (Rifle to the confluence with the Green River). When the population estimate increases above 1,100, a new population baseline is established at the higher population level.

c. The Recovery Action Plan actions listed as part of the Proposed action in this opinion are not implemented within the required time frames. This would be considered a change in the action subject to consultation and the section 7 regulations (50 CFR 402.16 (c)) state that reinitiation of consultation is required if the identified action is subsequently modified in a manner that causes an effect to the listed species or critical habitat that was not considered in the biological opinion.

The Recovery Action Plan is an adaptive management plan because additional information, changing priorities, and the development of the States' entitlement may require modification of the Recovery Action Plan. Therefore, the Recovery Action Plan is reviewed annually and updated and changed when necessary and the required time frames include changes in timing approved by means of the normal procedures of the Recovery Program, as explained in the description of the proposed action. In 2003 and every 2 years thereafter, for the life of the Recovery Program, the Service and Recovery Program will review implementation of the Recovery Action Plan actions to determine timely compliance with applicable schedules.

d. The Service lists new species or designates new or additional critical habitat, where the level or pattern of depletions covered under this opinion may have an adverse impact on the newly listed species or habitat. If the species or habitat may be adversely affected by depletions, the Service will reinitiate consultation on the programmatic biological opinion as required by its section 7 regulations. The Service will first determine whether the Recovery Program can avoid such impact or can be amended to avoid the likelihood of jeopardy and/or adverse modification of critical habitat for such depletion impacts. If the Recovery Program can avoid the likelihood of jeopardy and/or adverse modification of critical habitat no additional recovery actions for individual projects would be required, if the avoidance actions are included in the Recovery Action Plan. If the Recovery Program is not likely to avoid the likelihood of jeopardy and/or adverse modification of critical habitat then the Service will reinitiate consultation and develop reasonable and prudent alternatives.

For purposes of any future reinitiation of consultation, depletions have been divided into two categories.

Category 1:

a) existing depletions, both Federal and non-Federal as described in the project description, from the Upper Colorado River Basin above the confluence with the Gunnison River that had actually occurred on or before September 30, 1995 (average annual of approximately 1 million acre-feet/year);

b) depletions associated with the total 154,645 acre-feet/year volume of Green Mountain Reservoir, including power pool (which includes but is not limited to the all of the 20,000 acre-feet contract pool and historic user's pool), the Colorado Big-Thompson replacement pool, and

c) depletions associated with Ruedi Reservoir including Round I sales of 7,850 acre-feet, Round II sales of 6,135 acre-feet/year as discussed in the Service's biological opinion to Reclamation dated May 26, 1995, and as amended on January 6, 1999, and the Fryingpan Arkansas Project replacement pool as governed by the operating principles for Ruedi Reservoir, but excluding 21,650 acre-feet of the marketable yield.

Category 1 depletions shall remain as Category 1 depletions regardless of any subsequent change, exchange, or abandonment of the water rights resulting in such depletions. Category 1 depletions associated with existing facilities may be transferred to other facilities and remain in Category 1 so long as there is no increase in the amount of total depletions attributable to existing depletions. However, section 7 consultation is still required for Category 1 depletion projects when a new Federal action occurs which may affect endangered species except as provided above under "Individual Consultation Under the Umbrella of this Programmatic Biological Opinion." Reinitiation of this consultation will be required if the water users fail to provide 10,825 acre-feet/year on a permanent basis.

Category 2:

Category 2 is defined as all new depletions up to 120,000 acre-feet/year; this includes all depletions not included in Category 1 that occur after 1995 regardless of whether section 7 consultation has been completed. This category is further divided into two 60,000 acre-feet/year blocks of depletions.

The recovery actions are intended to avoid the likelihood of jeopardy and/or adverse modification of critical habitat and to result in a positive response as described in Appendix D for both 60,000 acre-feet blocks of depletions in Category 2. However, prior to depletions occurring in the second block, the Service will review the Recovery Program's progress and adequacy of the species response to the Recovery Action Plan actions. According to the criteria outlined in Appendix D, a positive response would require the adult Colorado pikeminnow population estimate to be maintained at approximately 1,100 individuals in the Colorado River (Rifle to the confluence with the Green River), unless the criteria in Appendix D is changed because of new information. If the adult Colorado pikeminnow population is maintained at approximately 1,100 adults or whatever is determined to be the recovery goal in the Colorado River, a new population baseline would be established to determine a positive or negative population response.

When population estimates for wild adult humpback chub are finalized, it would also be used to determine population response. As outlined in Appendix D, Colorado pikeminnow and humpback chub population estimates will serve as surrogates for razorback sucker and bonytail to assess the status of their populations for 10 years. Recovery goals for all four species are expected to be developed in the year 2000. If a population meets or exceeds the numeric goal for that species, it will be considered to exhibit a positive response. However, short of reaching a specific recovery goal, trends in certain populations indices provide an interim assessment of a species' progress toward recovery. This review will begin when actual depletion levels from the first depletion block reach 50,000 acre-feet/year or the year 2015, whichever comes first.

Calculation of actual depletions is to be accomplished using Cameo gage records and State Division of Water Resources data (Appendix B). The review will include a determination if all the Recovery actions have been satisfactorily completed, that all ongoing Recovery actions are continuing, and the status of the endangered fish species. If it is determined that the Recovery

actions have all been completed and the status of all four endangered fish species has improved (based on criteria in Appendix D), then the Service intends that this opinion would remain in effect for new depletions up to 120,000 acre-feet/year (total of both 60,000 acre-feet blocks of Category 2 depletions).

Monitoring, as explained in Appendix D, will be ongoing to determine if a population estimate of 1,100 (± one confidence interval) adult Colorado pikeminnow is maintained. If it is not maintained, this would be considered new information and section 7 would have to be reinitiated. Population baselines will be adjusted as population estimates change. If the adult Colorado pikeminnow population estimates increase during the next 15 years, a new population baseline would be established to determine a positive or negative population response. If the population estimate for Colorado pikeminnow in the year 2015 is greater than 1,100 adults, then the higher number would be used to establish a new population baseline. These numeric values may be revised as new information becomes available. Revisions will be made to Appendix D as needed.

If the 50,000 acre-foot or 2015 review indicates that either the recovery actions specified in this opinion have not been completed or that the status of all four fish species has not sufficiently improved, the Service intends to reinitiate consultation on the Recovery Program to specify additional measures to be taken by the Recovery Program to avoid the likelihood of jeopardy and/or adverse modification of critical habitat for depletions associated with the second 60,000 acre-feet/year block. Any additional measures will be evaluated every 5 years. If other measures are determined by the Service or the Recovery Program to be needed for recovery prior to the review, they can be added to the Recovery Action Plan according to standard procedures, outlined in that plan. If the Recovery Program is unable to complete those actions which the Service has determined to be required for the second 60,000 acre-feet/year, consultation on projects with a Federal nexus may be reinitiated in accordance with Endangered Species Act regulations and this opinion's reinitiation requirements. The Service may also reinitiate consultation on the Recovery Program if fish populations do not improve according to the criteria in Appendix D or if any positive response achieved prior to the 50,000 acre-foot or the year 2015 review is not maintained. Failure to maintain a positive response, whenever achieved, will be considered a negative response.

If the Service reinitiates consultation, it will first provide information on the status of the species and recommendations for improving population numbers to the Recovery Program. Only if the Recovery Program does not implement recovery actions to improve the status of the species, will the Service reinitiate consultation with individual projects. The Service will reinitiate consultation first on Category 2 projects and second on Category 1 projects. The Service will only reinitiate consultations on Category 1 depletions if Category 2 depletion impacts are offset to the full extent of the capability of the covered projects as determined by the Service, and the likelihood of jeopardy and/or adverse modification of critical habitat still cannot be avoided. The Service intends to reinitiate consultations simultaneously on all depletions within the applicable category.

All individual consultations conducted under this programmatic opinion will contain language requesting the applicable Federal agency to retain sufficient authority to reinitiate consultation should reinitiation become necessary. The recovery agreements to be signed by non-Federal entities who rely on the Recovery Program to avoid the likelihood of jeopardy and/or adverse modification of critical habitat for depletion impacts related to their projects will provide that such non-Federal entities also must request the Federal agency to retain such authority. Non-Federal entities will agree by means of recovery agreements to participate during reinitiated consultations in finding solutions to the problem which triggered the reinitiation of consultation.

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