United States Department of the Interior

FISH AND WILDLIFE SERVICE
Ecological Services
Colorado Field Office
P.O. Box 25486, DFC (65412)
Denver, Colorado 80235-0486

IN REPLY REFER TO:
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December 4, 2009

Memorandum

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

From: Colorado Field Supervisor, Ecological Services, Lakewood, Colorado

Subject: Final Gunnison River Basin Programmatic Biological Opinion

In accordance with section 7 of the Endangered Species Act (ESA) of 1973, as amended (16 U.S.C. 1531 et seq.), and the Interagency Cooperation Regulations (50 CFR 402), this document transmits the U.S. Fish and Wildlife Service's (Service) Programmatic Biological Opinion (PBO) for the Gunnison River Basin and the operation of the Wayne N. Aspinall Unit and the reconsultation for the Dallas Creek and Dolores Projects and their effects on the endangered Colorado pikeminnow (*Ptychocheilus lucius*), humpback chub (*Gila cypha*), bonytail (*Gila elegans*), and razorback sucker (*Xyrauchen texanus*) and their critical habitats. Consultation for the Gunnison River basin includes operation and depletions associated with existing Bureau of Reclamation (Reclamation) projects, other Federal projects and existing non-federal water depletions.

This biological opinion is in response to your January 15, 2009, correspondence requesting initiation of consultation for the Gunnison River Basin and the operation of the Wayne N. Aspinall Unit. Reclamation proposes to modify operation of the Aspinall Unit to address flow needs for the endangered fish in the Gunnison and Colorado rivers. In addition to reoperation of the Aspinall Unit the proposed action includes addressing all existing water depletions in the Gunnison River basin, new depletions up to 3,500 acre-feet/year (af/yr),, and new depletions associated with the Upper Gunnison Subordination up to 22,200 af/yr. The proposed action includes the continuation of the operation of other Reclamation Projects in the Gunnison Basin and other Federal, private, local, and state water projects and water uses in the Gunnison Basin. Reinitiation of consultation was also requested on the Dallas Project (in the Gunnison Basin) and the Dolores Project (in the Colorado basin downstream of the Gunnison River confluence). The Service concurs that the proposed action may adversely affect the endangered Colorado pikeminnow, humpback chub, bonytail, and razorback sucker and their designated critical habitat on the Gunnison and Colorado Rivers.

This biological opinion is based primarily on our review of the information you provided in your biological assessment. In addition to the four endangered fishes, the biological assessment addressed the following Federally listed threatened, endangered, and candidate species.

Clay-loving wild buckwheat	*Eriogonum pelinophilum*	endangered
Uinta Basin hookless cactus	*Sclerocactus glaucus*	threatened
Jones' cycladenia	*Cycladenia humilis var. jonesii*	threatened
Yellow-billed cuckoo	*Coccyzus americanus*	candidate
Mexican spotted owl	*Strix occidentalis lucida*	threatened
Southwestern willow flycatcher	*Empidonax traillii extimus*	endangered
California condor	*Gymnogyps californianus*	endangered
Black-footed ferret	*Mustela nigripes*	endangered
Canada lynx	*Lynx Canadensis*	threatened
Gunnison's prairie dog	*Cynomys gunnisoni*	candidate
Uncompahgre fritillary butterfly	*Boloria acrocnema*	endangered

Reclamation determined that the proposed action would not affect any of the species listed above, therefore, consultation and concurrence for these species is not necessary.
With respect to critical habitat, this biological opinion does not rely on the regulatory definition of "destruction or adverse modification" of critical habitat at 50 CFR 402.02. Instead, we have relied upon the statutory provisions of the ESA to complete the following analysis.

CONSULTATION HISTORY

Implementation of the Endangered Species Act in the upper Colorado River Basin started with section 7 consultation on Bureau of Reclamation projects in the late 1970's. At that time, the Service determined that the Colorado pikeminnow and humpback chub were in danger of extinction (the bonytail was listed in 1980 and the razorback sucker was listed in 1991). Subsequently, section 2 (c) of the Act was amended as follows: It is further declared to be the policy of Congress that Federal agencies shall cooperate 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 Secretary of the Interior; Governors of Wyoming, Colorado, and Utah; and the Administrator of the Western Area Power Administration (WAPA) cosigned a Cooperative Agreement on January 21-22, 1988, 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, National Park Service, WAPA, Colorado, Utah, Wyoming, Western Resource Advocates, 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. To further define and clarify processes outlined in sections 4.1.5, 4.1.6, and 5.3.4 of the Recovery Program (USFWS 1987), a *Section 7 Consultation, Sufficient Progress, and Historic Projects Agreement* (Section 7 Agreement) and a *Recovery Implementation Program Recovery Action Plan* (RIPRAP) were developed (USFWS 1993, amended 2000). The Section 7 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 Section 7 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 (or serve as conservation measures) and to provide ESA compliance for new and existing projects.

The RIPRAP outlines specific recovery actions, including such measures as acquiring and managing aquatic habitat and water, re-operating existing reservoirs to provide instream flows for fishes, constructing fish passage facilities, controlling nonnative fishes, and propagating and stocking listed fish species. It also stipulates which entity is responsible for taking action, when these actions would be undertaken, and how they would be funded. The RIPRAP was finalized on October 15, 1993, and has been reviewed and updated annually. The primary remaining RIPRAP action for the Gunnison River calls for the re-operation of the Aspinall Unit to provide an appropriate flow regime for endangered fishes.

Section 7 consultations on the operation of initial units of the Colorado River Storage Project (Flaming Gorge, Navajo, and Aspinall) were deferred in the 1980's pending completion of hydrologic, biological, and other studies. Construction of the units occurred prior to passage of the ESA. At the present time, consultations have been completed on the operations of Flaming Gorge Dam and Reservoir and Navajo Dam and Reservoir and operations of these features have been modified to improve habitat conditions of the endangered fish.

The Service issued a jeopardy biological opinion for the Dallas Creek Project on November 16, 1979. The reasonable and prudent alternative was the release of water from the Dallas Creek Project or from other projects that regulate flows in the Gunnison River and the Colorado River in order to replace the depletions caused by the Dallas Creek Project. The biological opinion stated that it may be necessary that an equal volume be released to the Gunnison River from one or more projects, but studies may reveal that flow releases totaling less than 17,200 acre-feet (af) annually may be adequate for the fishes to survive in the areas and in the numbers necessary for recovery. The biological opinion identified the Aspinall Unit as the best source of water for such releases. The Dallas Creek Project will ultimately deplete an annual average of 17,200 af of water in an average year. The full Dallas Creek depletion is included in the baseline because it is addressed in the existing biological opinion; however, 12,200 af of the full depletion has been contracted for but not used at this time. The reasonable and prudent alternative was never implemented and it is now proposed to use the modified operation of the Aspinall Unit to serve as the RPA, therefore, Reclamation requested reinitiation of consultation for the Dallas Creek Project in conjunction with consultation on the Aspinall Unit.

The Service issued a jeopardy biological opinion for the Dolores Project on June 9, 1980. The RPA was the release of water from the Dolores Project, or from other projects that regulate flows in the upper Colorado River basin, to replace the depletions caused by the Dolores Project. It was estimated that the Dolores Project would deplete 131,000 af of water from the upper Colorado River basin in an average year. The RPA did not recommend specific flows to be released pending further study. The BO stated that studies may reveal that flow releases totaling less than 131,000 af annually may be adequate for the fishes to survive in the areas and in the numbers that we believe necessary for recovery. The original depletion estimate for the Dolores Project included downstream releases for the trout fishery. This release is currently a minimum of 31,097 af annually and was incorrectly considered a depletion. Thus the present estimate of depletions for the Dolores Project is no more than 99,200 af/yr. The reasonable and prudent alternative was never implemented and it is now proposed to use the proposed modified operation of the Aspinall Unit and all the Recovery Program actions that contribute to recovery in the Colorado River below the confluence with the Dolores River to offset effects of depletions. Therefore, Reclamation requested reinitiation of consultation for the Dolores Project in conjunction with consultation on the Aspinall Unit.

The Upper Gunnison Subordination Agreement allows junior water users within the natural basin of the upper Gunnison River to develop up to a total of 60,000 af/yr of depletions without interference from the Aspinall Unit. The Service concurred with a "no effect" determination for the Upper Gunnison Subordination Agreement for impacts to the downstream endangered fish based on two conditions: "1) The 60,000 acre-foot depletion will be consulted on during the upcoming Aspinall Unit consultation; and 2) During the interim, all actions that deplete water out of the 60,000 acre-foot block will be considered new projects and consulted on as we have done in the past." (Fish and Wildlife Service 1999).

Sixty nine ESA consultations addressing minor water sales totaling less than 1,000 af/yr from the Aspinall Unit have received biological opinions, citing the Recovery Program as the reasonable and prudent alternative to avoid jeopardy to the endangered fish. These sales are primarily for augmentation of water depletions occurring within the Gunnison basin.

In 2004 the Service issued a biological opinion for the Redlands Canal Fish Screen. The following conservation measures were included in the biological opinion.

> "Reclamation will to the extent allowable under State and Federal law, attempt to release from the Aspinall Unit sufficient water to maintain a minimum flow of 300 cubic feet per second (cfs) during the months of July August, September, and October in the Gunnison River from the Redlands Diversion to the confluence of the Gunnison River with the Colorado River. Said flows include water necessary to maintain fish access to critical habitat in the Gunnison River below Redlands Diversion for authorized fish and wildlife purposes (providing suitable endangered fish habitat). During periods of drought when the 300 cfs below Redlands cannot be met, Reclamation will work with the Service and water users to attempt to maintain flows lower than 300 cfs below Redlands for endangered fish. The operation will remain in place until the Aspinall Operations

Environmental Impact Statement is complete and Reclamation has issued a Record of Decision on Aspinall Operations to address endangered fish flows in the Gunnison and Colorado Rivers. Operations developed through the environmental impact statement and Endangered Species Act Section 7 consultation process will address long term flow requirements below the Redlands Diversion."

The 15-Mile Reach Programmatic Biological Opinion (Fish and Wildlife Service 1999b) addressed the continuation of all existing water depletions, including Reclamation operations and depletions in the Upper Colorado River Basin above the confluence with the Gunnison River; Reclamation's portion of 120,000 af/year of new depletions in the same area; and recovery actions in the Colorado River.

The Service issued a biological opinion for the Paonia Project (Fish and Wildlife Service 2002e) related to a temporary water service contract using temporary capacity in the sediment pool of Paonia Reservoir. The opinion calls for a portion of the water in the surplus capacity to be released during the spring spill period of the reservoir.

BIOLOGICAL OPINION

DESCRIPTION OF THE PROPOSED ACTION

Action Area

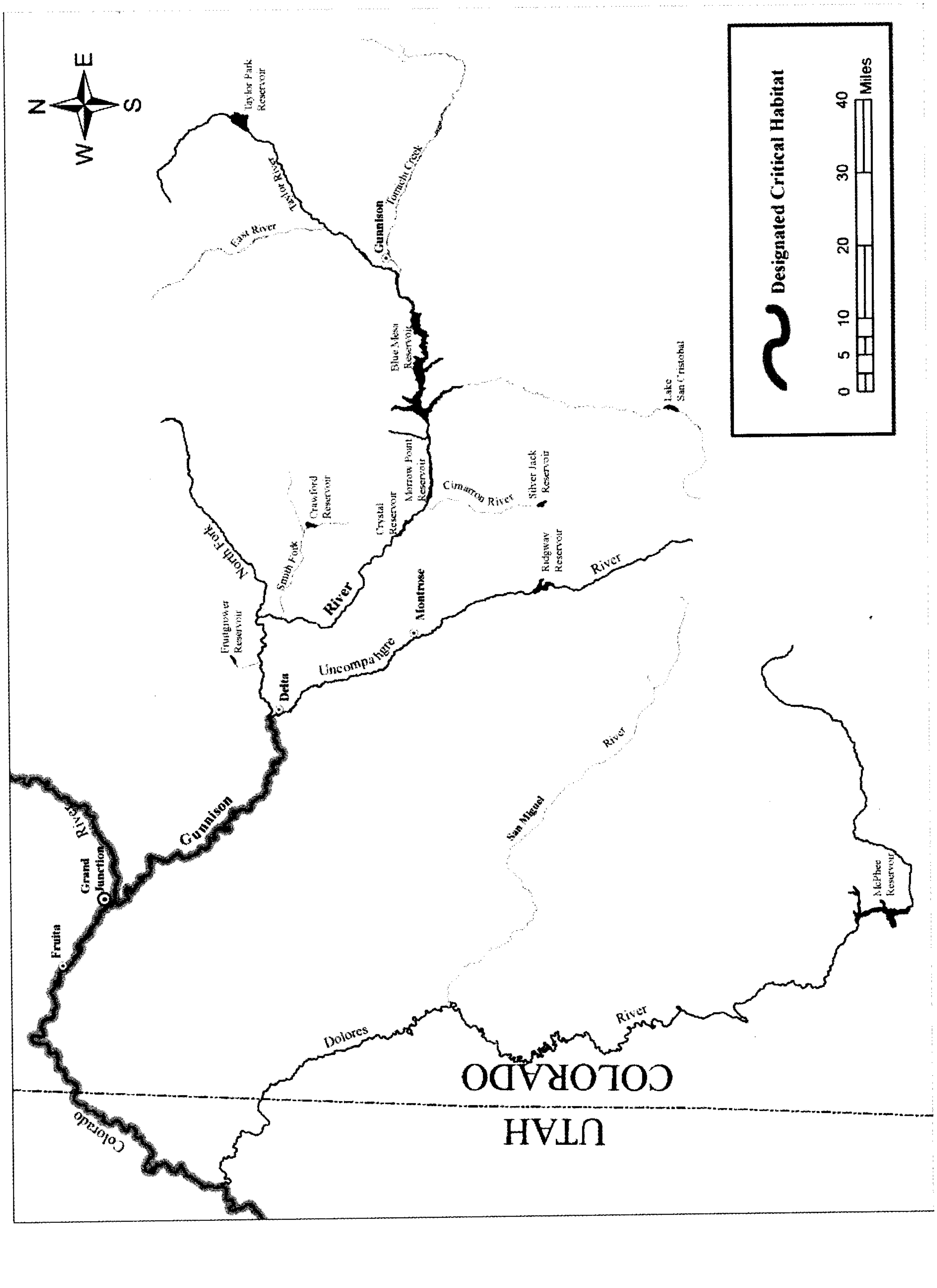
Our regulations define the action area as all areas directly or indirectly affected by the Federal action and not merely the immediate area involved in the action (50 CFR 402.02). Therefore, the action area for this PBO includes the Gunnison River basin from its headwaters continuing downstream to the Colorado River and to the inflow to Lake Powell.

Proposed Action

Aspinall Unit Operations

Reclamation proposes to modify operation of the Aspinall Unit to address flow needs for the endangered fish in the Gunnison and Colorado rivers, while continuing to maintain authorized Unit purposes. The new operation is designed to increase downstream spring peak flows while maintaining moderate base flows. Pursuant to the proposed operating regime, Reclamation will attempt to meet the desired spring peak, minimum duration, and base flow targets at Whitewater and below the Redlands Diversion. The new operation plan has four basic goals:

- Meet or attempt to meet spring peak targets on the Gunnison River and in concert benefit Colorado River mainstem habitat as outlined in the Flow Recommendations (McAda 2003) (Summary Appendix A);
- Meet or attempt to meet minimum duration targets for half bankfull discharge and bankfull discharges pursuant to the Flow Recommendations;


Designated Critical Habitat
0 5 10 20 30 40 Miles
N
E
S
W
Taylor Park Reservoir
Taylor River
Taomichi Creek
Gunnison
East River
Blue Mesa Reservoir
Lake San Cristobal
Morrow Point Reservoir
Crystal Reservoir
Cimarron River
Silver Jack Reservoir
Crawford Reservoir
North Fork
Smith Fork
River
Ridgway Reservoir
River
Montrose
Fruitgrower Reservoir
Uncompahgre
Delta
Gunnison
Grand Junction
River
Fruita
San Miguel
River
McPhee Reservoir
Dolores
River
COLORADO
UTAH
Colorado

- Meet or attempt to meet targets for base flows as outlined in the Flow Recommendations; and
- Meet or attempt to meet fish ladder, fish screen, and migration flows at and below the Redlands Water and Power Diversion Dam (Redlands Diversion).

The new operation plan makes releases that meet or attempt to meet a spring peak target at the Whitewater gage at the time the North Fork of Gunnison River is near its peak (generally May 15 to May 31). Peak targets at Whitewater are based on the May 1 or May 15 "April through July forecast" of Blue Mesa unregulated inflow. The forecast is provided by the National Weather Service through the Colorado Basin River Forecast Center starting in January and is updated twice per month until the end of July. In order to maximize peaks targeted at Whitewater, the proposed action attempts to combine peak Aspinall Unit releases with peak North Fork flows, subject to flood control responsibilities. Therefore, it is not feasible for the proposed operations to specifically attempt to match Gunnison River and Colorado River peaks.

Operations are described on a seasonal basis:

- **January-March:**

Water would be released based upon the most recent April-July inflow forecast and downstream water demands with the goal of achieving a March 31st Blue Mesa Reservoir content target (determined from the January, February, and March 1st forecasted April-July Blue Mesa inflow) and with a goal of higher releases during January for power purposes. The March 31st target is intended to optimize Aspinall Unit operations for storage, flood control, and hydropower production.

The proposed action sets a minimum downstream release for instream flow, generally 300 cfs, which can be higher based on the previous year's operations that consider factors such as the fall brown trout spawn or downstream senior water rights. Maximum releases are limited to the 2,150 cfs Crystal powerplant capacity (approximately 2,150 cfs) in most years. Generally the above release patterns would meet downstream base flow needs for endangered fish; if not, releases will be adjusted accordingly. Crystal releases will reregulate peaking releases from Morrow Point throughout the year to produce stable downstream flows.

- **April-July :**

To make more water available for a spring peak and/or duration flows, Reclamation will not bypass the powerplant at Crystal Dam from April 1 through May 10 (except when Blue Mesa's forecasted inflow indicates that the Year Type is in a "Wet" category, Reclamation may bypass the powerplant to reduce flooding risk). Peak releases will generally be made after May 10th and before June 1st in an attempt to match the peak from the North Fork in order to maximize the potential of meeting the desired peak at Whitewater and to coincide with the releases for the recently decreed Black Canyon of the Gunnison water right. However, this timeframe could be altered to include the late April to late June period if appropriate for endangered species and other resource concerns. Crystal releases, and releases from Morrow Point and Blue Mesa as needed, would begin to be ramped up approximately 5 days prior to the predicted North Fork peak. Releases may be reduced in an attempt to reduce flooding if the Gunnison River at Delta approaches 14,000 cfs.

The magnitude of the desired peak at Whitewater is determined based on the "Year Type" category (Figure 1 and Table 1), as defined in the Flow Recommendations, in conjunction with the most recent forecast information. Releases will be made from the Aspinall Unit using the necessary combination of available powerplants, bypasses and spillways, while attempting to reach the spring peak target. Reclamation's ability to meet a desired peak is limited by the physical constraints/availability of the Aspinall Unit outlet features in some years. For example, Blue Mesa water elevation may not be high enough to use its spillway.

After a peak flow release is made, high releases may continue in an attempt to maintain flows at half bankfull or bankfull levels. Releases for duration of higher flows in conjunction with the desired peak at Whitewater will be made if it is possible to reach 90 percent of the desired peak. The length of duration of flows is dependent on the "Year Type" category in the Flow Recommendations (Table 1).

Reclamation will continue to conduct Aspinall Unit operation meetings three times a year. Prior to spring operations and the spring operations meeting, Reclamation will discuss proposed operations with the Service and any other appropriate agency or organization to collect information for developing an operation plan that will be presented at the operation meetings. It is recognized that proposed operations can change as the forecast changes; therefore, Reclamation will inform the Service each time a deviation from the plan is made.

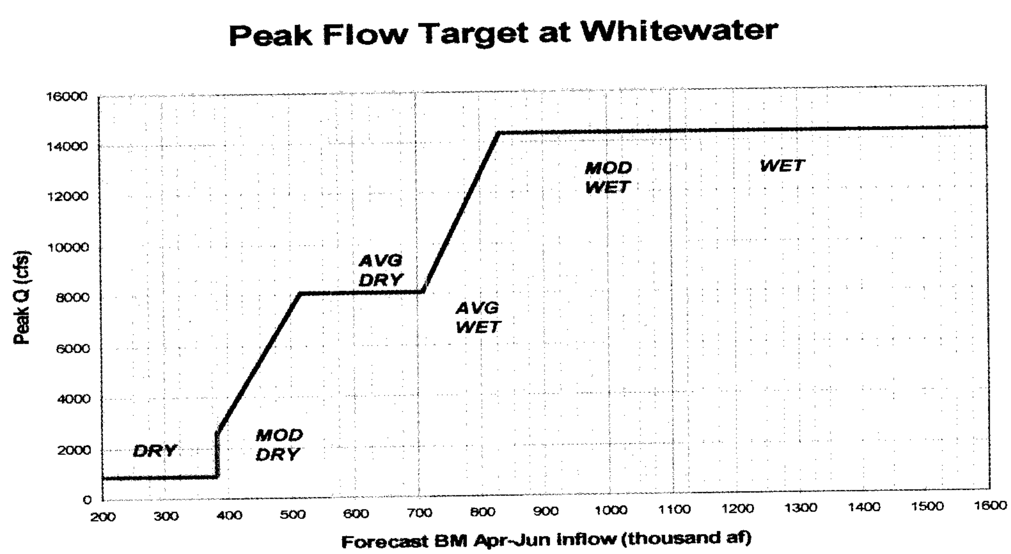


Figure 1. Determination of peak flow target

Table 1. Spring peak and duration targets for range of forecasted inflow.

Blue Mesa Forecasted Inflow	Peak Target @Whitewater	Duration of Half Bank (8,070 cfs)	Duration of Bankfull (14,350 cfs)
Acre-feet	cfs	Days	Days
< 381,000	900	0	0
381,000 to 516,000	2,600 to 8,070	0	0
516,001 to 709,000	8,070	10	0
709,001 to 831,000	8,070 to 14,350	20	2
831,001 to 1,123,000	14,350	40	10
> 1,123,001	14,350	60	15

- **August-December:**

Releases will be set utilizing the most recent forecast of August through December inflow and downstream senior water demands, with the goal of having Blue Mesa Reservoir at or below an elevation of 7,490 feet (580,000 af of live storage) by December 31st to minimize upstream icing. The minimum release criteria of 300 cfs for downstream resources will still apply, as will any releases necessary to meet existing downstream senior water right demands (meaning that Blue Mesa will not store that portion of water needed to satisfy downstream senior water rights).

- **Ramping**

Ramping guidelines for release changes under the proposed action are as follows:

-Daily ramping rates on the ascending limb will be the greater of 500 cfs or 25% of flow in Black Canyon on the previous day. Ramping can be accomplished with more than one change per day.
-Daily ramping rates guidelines for the descending limb will be the greater of 400 cfs or 15% of flow in the Black Canyon on the previous day. Ramping can be accomplished with more than one change per day.
-Ramping up will begin 5 days prior to the estimated peak flow date on the North Fork Gunnison River.

- **Base flows**

Base flows are provided under the proposed action and can vary under different hydrologic conditions (Table 2). The base flow targets are based on the flow recommendations for summer through winter base flows (McAda 2003). Additional releases to maintain minimum base flows at Whitewater will be set each year based on discussions with the Service. In most years, a base flow of 1,050 cfs will be maintained at the Whitewater gage. Such a base flow would normally provide 300 cfs of migration flows downstream from the Redlands Diversion because this diversion is limited by a Federal Energy Regulatory Commission hydropower license to 750 cfs whenever 300 cfs cannot be bypassed. The target of 1050 cfs at Whitewater will be reduced to 750 cfs thereby eliminating the bypass of 300 cfs in dry years except in June and July or moderately dry years except in June, July, and August. When the base flow target at

Whitewater is reduced to 750 cfs additional releases will be made to provide 100 cfs to the Redlands Fish Ladder as needed in April through September and 40 cfs for the Redlands Fish Screen from March through November, using storage water if necessary. Base flows would normally provide adequate migration flows downstream from the Redlands Diversion.

Model results show an increased number of days when base flow targets are not met. However, the model contains a 2 day travel time for releases from the Aspinall Unit to arrive at the lower Gunnison River. This travel time results in modeled periods where base flow targets at Whitewater may not be met and periods where there is less than 140 cfs at the Gunnison River below Redlands. Under actual operations, this travel time can be anticipated and combined with weather and runoff forecasts so meeting the base flow targets will occur more often than shown in the model results.

Table 2. Base flow targets (cfs) at Whitewater Gage under the proposed action.

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Wet	1050	1050	1050	1050	1050	1500	1500	1500	1050	1050	1050	1050
Mod Wet	1050	1050	1050	1050	1050	1500	1500	1500	1050	1050	1050	1050
Avg Wet	1050	1050	1050	1050	1050	1500	1500	1050	1050	1050	1050	1050
Avg Dry	1050	1050	1050	1050	1050	1500	1500	1050	1050	1050	1050	1050
Mod Dry*	750	750	750/790	750/890	750/890	1050	1050	1050	750/890	750/790	750	750
Dry*	750	750	750/790	750/890**	750/890	1050	1050	750/890	750/890	750/790	750/790	750

*During March through November in Moderately Dry and Dry type years, additional releases will be made as necessary to provide flows, above the 750 cfs anticipated to be diverted by the Redlands Water and Power Company, for the fish ladder and fish screen as shown.

** For example, base at Whitewater would be 750 cfs, but 890 would be needed to operate fish passage and fish screen if Redlands was at full diversion

- **Extreme Conditions, Maintenance, and Emergencies**

Flow recommendations address dry years by basing peak flow and duration targets on annual inflow conditions. Therefore, in severe drought years such as 1977 and 2002 no special peak releases are targeted for endangered fish. Dry year peaks are only 900 cfs. Severe droughts, with anticipated shortages to Aspinall Unit water uses, will be responded to through shortage sharing. Operational changes could include temporary modifications of normal operations of the reservoir and potential short-term modifications in the target flows in the proposed operation. In periods of extreme, multi-year droughts, releases from the Aspinall Unit may have to be reduced to match the inflow to the reservoir during part of the year.

The proposed action would include certain specific drought rules:

- In Wet, Moderately Wet, and Average Wet years following a Dry year in which the previous December 31 Blue Mesa content was less than 522,300 af and if March 31 content is less than 400,000 af, half bankfull targets are reduced to the next lower category.

- During Dry and Moderately Dry years, if Blue Mesa content drops below 600,000 af, Whitewater base flow target is reduced from 1,050 cfs to 900 cfs until Blue Mesa content exceeds 600,000 af.
- If a Moderately Dry year follows a Dry or Moderately Dry year, decrease peak target to 5,000 cfs if Blue Mesa content is less than 400,000 af on March 31 or April 30.

Operations at the Aspinall Unit may be modified due to special maintenance or replacement needs which may limit outlet capacities or require special downstream flows for repairs and inspections. Special flows may also be needed at some time in the future for repairs or replacement of the Gunnison Tunnel Diversion Dam, located a short distance downstream from Crystal Dam.

Emergencies are not predictable but may be associated with dam safety, personal safety of individuals or groups associated with recreation or other activities on the river, power system conditions, or releases of oil, hazardous substances, pollutants, or contaminants. Emergencies associated with dam safety could include unforeseen high or low releases or operations to protect dam structures. Emergencies with the safety of individuals may be associated with river rescue or recovery operations. Power emergencies could include insufficient short-term generation capacity, transmission maintenance, and other factors. Emergency operations are typically of short durations as a result of emergencies occurring at the dam or within the transmission network. In the case of emergencies, Reclamation will immediately address the problem and then comply with 50 CFR Section 402.05 emergency procedures, if the emergency requires ESA consultation.

- **General Coordination of Operations**

Reclamation will continue to conduct Aspinall Unit operations meetings 3 times per year. The purpose of operation meetings held in January, April, and August, is to share information between Reclamation and Aspinall stakeholders regarding issues in the Gunnison Basin related to the operation of the Aspinall Unit. Operation of the Aspinall Unit considers projected hydrologic factors, authorized unit purposes, existing senior water rights (including the Black Canyon of the Gunnison water right), target elevations for reservoirs, implementing the proposed action for endangered fish, and other factors.
Reclamation will communicate with appropriate agencies and organizations prior to scheduled operation meetings or as needed to gather information useful in developing proposed operation plans to be presented at operation meetings.

<u>Gunnison Basin Water Depletions</u>

In addition to reoperation of the Aspinall Unit the proposed action includes addressing all existing water depletions in the Gunnison River basin (excluding Redlands Water and Power Diversion because these depletions were addressed in a 2004 BO), new depletions up to 3,500 af/yr, (anticipated to occur primarily in the North Fork basin), and new depletions associated with the Upper Gunnison Subordination up to 22,200 af. The proposed action includes the continuation of the operation of the Dolores Project, other Reclamation Projects in the Gunnison

Basin and other Federal, private, local, and state water projects and water uses in the Gunnison Basin. As with the Aspinall Unit, construction and past operations of facilities for these existing water uses is part of the environmental baseline.

It is estimated that annual depletions from the Gunnison River above the Whitewater gage averaged 503,500 af/yr over the 1975-2005 period (Reclamation 2008). Approximately 93% of these depletions result from irrigation and 7% from domestic and industrial water use and reservoir evaporation. Reclamation projects account for 194,100 af/yr (206,300 af/yr with full Dallas Creek depletion) and private local, state, and other Federal water depletions account for the remainder.

The Dallas Creek Project is within the Gunnison River basin and Reclamation requested reinitiation of consultation because the RPA in the 1979 jeopardy biological opinion was the release of water from the Dallas Creek Project or from other projects that regulate flows in the Gunnison River and the Colorado River in order to replace the depletions caused by the Dallas Creek Project. The biological opinion identified the Aspinall Unit as the best source of water for such releases. The biological opinion recognized that specific flow regimes would not be known until further studies were completed. The Service now has specific flow recommendation for the Gunnison River in critical habitat and the Colorado River from the confluence with the Gunnison River to Lake Powell (McAda 2003). The reasonable and prudent alternative was never implemented and it is now proposed to use the proposed modified operation of the Aspinall Unit, that is designed to meet the flow recommendations, to serve as the RPA. Full build out of the Dallas Creek Project would cause an average annual depletion of 17,200 af/yr; to date the existing depletions from the project are 5,000 af/yr. Because a biological opinion was completed on the Dallas Creek Project, the full 17,200 af is included in the baseline.

Upper Gunnison Subordination

The Upper Gunnison Subordination Agreement allows junior water users within the natural basin of the upper Gunnison River (upstream from Crystal Dam) to develop up to a total of 60,000 af/yr of depletions without interference from the Aspinall Unit water rights. Reclamation has determined that the estimated portion of the 60,000 af/yr subordination being used at this time is up to 8,600 af/yr. Reclamation is requesting consultation for an additional 22,200 af/yr of future depletion under the Upper Gunnison Subordination Agreement because this is the amount they anticipate will be developed in the reasonably foreseeable future.

Dolores Project

The Dolores Project is not in the Gunnison River basin, but it is included in the proposed action as a request for reinitiation of consultation because the reasonable and prudent alternatives in the June 9, 1980 jeopardy biological opinion was the release of water from the Dolores Project, or from other projects that regulate flows in the Colorado River, to replace the depletions caused by the Dolores Project. Reclamation has requested reinitiation of consultation because they are proposing that the action of reoperating the Aspinall Unit to provide flows for endangered fishes satisfies obligations under the RPAs. It was estimated that the Dolores Project would deplete 131,000 af of water in an average year. This original depletion estimate for the Dolores Project erroneously included downstream releases for the trout fishery. Therefore, the correct estimate of depletions from the Dolores Project is no more than 99,200 af/yr.

The Dolores Project biological opinion stated that the primary area of concern in relation to the Dolores Project is the Colorado River from the confluence with the Dolores River to Hite Marina in Lake Powell. It also stated that there was not sufficient data to show that the Dolores River was essential for recovery and that records did not identify the Dolores River as important habitat. The biological opinion stated that water should be released to the Colorado River to offset the depletions from the Dolores Project. Specific flows could not be recommended at the time of the biological opinion, but the opinion stated that Reclamation should maintain seasonal flow patterns in the Colorado River by operation of their facilities. The Service now has specific flow recommendation for the Colorado River from the confluence with the Gunnison River to Lake Powell (McAda 2003). Target flows are measured at the Colorado-Utah state line which is upstream of the confluence with the Dolores River.

Since the Dolores Project biological opinion was issued in 1980, the Recovery Program was established in 1988 (see description under consultation history). One purpose of the Recovery Program is to offset water depletion impacts by implementing the RIPRAP. Procedures outlined in the Section 7 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 (or serve as conservation measures) and to provide ESA compliance for new and existing projects. Since the Recovery Program has been in place, the Service has not required acre-foot for acre-foot replacement of water. Instead, the Service determines what flows are need for endangered fish recovery by developing flow recommendations and Recovery Program determines methods to achieve flow recommendations. The proposed action includes reoperation of the Aspinall Unit on the Gunnison River to assist in meeting recommended flows on the Colorado River to offset water depletion impacts of the Dolores Project.

Providing instream flows is a major Recovery Program recovery element, however, providing flows in the Dolores River for endangered fishes is not listed as a recovery action in the RIPRAP. For the Dolores River the RIPRAP items address nonnative fish escapement from McPhee Reservoir and biological surveys. Both actions are considered complete with the implementation of the McPhee Reservoir Management Plan and the Utah Division of Wildlife survey of the Dolores River (Valdez et al. 1992).

A summary of the water depletions included in the proposed action are presented in Table 3.

Table 3. Estimated average annual depletions in the proposed action.

Project	Estimated average annual depletion (af/yr)	Existing or New Depletion
Aspinall Unit	10,000	Existing
Uncompahgre Project	155,000	Existing
Dallas Creek Project	17,200	5,000 existing, 12,200 new
Paonia Project	10,000	Existing
Smith Fork Project	6,000	Existing

Bostwick Park Project	4,000	Existing
Fruitgrowers Project	4,100	Existing
Other water uses	300,800	Existing
Dolores Project	99,200*	Existing
Upper Gunnison Subordination	30,800 **	8,600 existing, 22,200 new
New Water Depletions	3,500	3,500 new
Total (excludes Redlands)	640,600	Total existing 602,700 Total new 37,900

*The original Dolores Project ESA consultation addressed a 131,000 af/yr depletion. Updated information indicates actual depletions are approximately 99,200 af/yr. For ESA purposes, return flows to the San Juan Basin were considered depletions.
**This is a maximum rather than average annual depletion.

Conservation Measures

Conservation measures are actions that the action agency agrees to implement to further the recovery of the species under review. The beneficial effects of conservation measures were taken into consideration for determining jeopardy, adverse modification of critical habitat and incidental take analyses. Therefore, if the conservation measures are not implemented, a new analysis of jeopardy, adverse modification of critical habitat and incidental take will be required.

Water Depletions

As explained in the Consultation History section, the Recovery Program is intended to implement actions that are needed to recover the endangered fishes and avoid jeopardy and adverse modification of critical habitat. Included in the Recovery Program is a requirement for proponents of projects that cause new water depletions of greater that 100 af/year to make monetary contributions to the Recovery Program. The lead Federal agency in any future individual consultation under this PBO will incorporate any required contribution as a condition of any issued permit or authorization. Existing and future Reclamation projects remain exempt from the charge because Reclamation contributes funds annually to the Recovery Program. All other new project proponents undergoing individual section 7 consultations for depletions greater than 100 af/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 fees collected are used to implement recovery actions as determined appropriate by the Recovery Program.

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 the PBO.

Selenium Management Program

The ongoing operation of irrigation projects and other water uses in the basin will continue to contribute selenium to the Gunnison and Colorado Rivers at levels that adversely affect the endangered fishes and their designated critical habitat and are inhibiting the survival and recovery of the endangered fishes. Reclamation will develop and implement a Selenium Management Program (SMP), in cooperation with the State of Colorado and Gunnison River basin water users to reduce adverse effects of selenium on endangered fish species in the Gunnison and Colorado rivers (see Effects of the Proposed Action section). The SMP will incorporate and accelerate ongoing selenium reduction efforts in the Uncompahgre Valley and other areas of the Gunnison Basin and will add several new elements. The overall long-term goal of the program is to assist in species recovery per the Recovery Goals. The SMP will use the best available scientific information for all elements of the program. Elements of the SMP will include:

- Accelerated implementation of salinity/selenium control projects for irrigated agriculture
- Reduction of other non-point source selenium loading
- Technology development
- Water quality monitoring
- Monitoring of endangered fish populations
- Coordination with lower Gunnison River Basin watershed management plan
- Regulatory support
- Public information and education
- Adaptive management
- Institutional support

Within 18 months of issuance of this programmatic biological opinion Reclamation will provide a draft document detailing the SMP, including goals, timeframes, and a Long Range Plan. Within 24 months, Reclamation will provide a final SMP document. During this period, ongoing projects (lateral piping, on-farm improvements, and other activities) that reduce selenium will continue and implementation of the initial components of the SMP not already underway will begin within 5 years of issuance of this opinion. Reclamation's vision for the program involves a cooperative effort with substantial involvement of stakeholders. The SMP will involve the established Gunnison Basin Selenium Task Force, which is group of private, local, state, and federal interests committed to addressing selenium in locally affected waterways, while maintaining the economic viability, quality of life, and agricultural heritage of the Lower Gunnison River Basin of Western Colorado (www.seleniumtaskforce.org). The Service will appoint a representative to work with Reclamation and the other partners in formulating the SMP.

The SMP Long Range Plan will include implementation schedules, benchmarks, responsible entities, monitoring needs, and coordination with ongoing Recovery Program activities. The SMP will define funding and other resources needed for implementation, including commitments by Reclamation, the State of Colorado, water users, local governments and other parties. The Long Range Plan will be formatted similar to the Recovery Program's Recovery Action Plan and will be updated annually. Progress in implementing the Long Range Plan will serve as the benchmark for evaluating progress in implementing the SMP.

Each element of the SMP is described below. Reclamation will seek supplemental funding (subject to appropriation) to assist in implementing all facets of the SMP as described in items A through J below. The initial goal of the program will be to meet the State water quality standard for selenium in critical habitat in the Gunnison and Colorado Rivers by the timeframe established in the Long Range Plan. The long term goal will be to sufficiently improve water quality conditions by reducing selenium to assist in recovery of the Colorado pikeminnow and razorback sucker. Recovery occurs when natural occurring, reproducing populations are self sustaining, with all life stages present and there is natural recruitment into the adult population. The goal of the SMP with respect to endangered fish in the Gunnison River should be to ensure that selenium levels in the Gunnison River and Colorado River do not impede the achievement of recovery goals and downlisting and delisting of endangered fish.

A. Accelerated Implementation of Salinity and Selenium Control Projects for Irrigated Agriculture

All ongoing salinity and selenium control projects will continue as scheduled. These include piping of laterals, on-farm improvements, and other activities. Three phases of salinity and selenium control projects involving lateral piping have been implemented or are underway in the Uncompahgre Valley. Other projects implemented include on-farm improvements and removal of winter water from canals and laterals. The recently funded Phase 4 ($2.8 million)includes an additional 11.4 miles of lateral lining in high priority selenium reduction areas, bringing the total length of laterals completed or under contract to 51 miles. This phase is presently scheduled to be completed by 2012.

Given sufficient resources, it is estimated that all remaining laterals and small canals in the planned East Side (of Uncompahgre Valley) Laterals Project could be piped in approximately 15 years or by 2024. Construction for lining and piping is often limited to the non-irrigation season, so it is unlikely that this timeframe can be shortened. If the accelerated program was not in place it would take until approximately 2040 to complete the work, assuming sufficient funding was provided.

It is anticipated that the majority of reductions in selenium loading will be accomplished via the Colorado River Basin Salinity Control Program (CRBSCP), NRCS Environmental Quality Incentives Program (EQIP) and grant-funded Task Force activities. Continuing implementation of CRBSCP projects is dependent on a competitive selection process. Uncompahgre Project proposals are expected to remain cost competitive; however, more costly projects (such as canal lining) may require supplemental funding. Reclamation will provide supplemental funding, subject to appropriations, to augment CRBSCP funding for these more costly projects, such as canal lining and pipe replacement of large laterals.

Reclamation will work with water providers, conservation districts and NRCS and the Basin States Salinity Control Program to promote on-farm salinity control projects to reduce seepage losses and deep percolation from irrigation practices in areas with known high selenium loading rates. To the extent possible, Reclamation will work with NRCS to prioritize the funding of EQIP projects in high selenium loading areas of the basin. Such targeted efforts have been documented to result in more cost effective non-point source control proposals by controlling 'two contaminants for the price of one'. Utilizing this approach may further improve the cost effectiveness of proposed Lower Gunnison projects under the CRBSCP.

B. Reduction of Other Non-Point Source Selenium Loading from Developing Areas

To accelerate efforts to reduce selenium loading from urbanizing areas, Federal and State and local entities and basin water users will enhance their level of participation in the Task Force, which plans to identify selenium sources from urban development and propose remediation measures. Reclamation and others will provide additional technical, financial, and administrative assistance so that the Task Force can achieve the following:

- identify and encourage implementation of Best Management Practices to minimize selenium loading to the lower Gunnison River associated with existing and future urban and suburban development activities;
- discourage the construction of unlined ponds and/or water features in pervious selenium rich soils, and address such existing features by lining or eliminating the feature.
- work with developers and local governments, responsible for land use planning, to minimize new selenium loading by avoiding housing and industrial developments which utilize leach fields or outdoor irrigation in areas with high selenium loading potential, such as previously unirrigated lands;
- support local government requirements to convert irrigation delivery systems from open channel to piped systems in urbanizing areas;
- support local government implementation of development codes which encourage or require native landscaping, limit irrigated landscape areas, and/or require efficient landscape irrigation systems on selenium rich lands;
- increase educational programs for better understanding of selenium issues and acceptance of appropriate solutions; and support general water conservation programs for all outdoor water uses (lawns, golf courses, septic systems, etc.), including public education efforts to promote more efficient water use and minimization of deep percolation.

C. Technology Development

Reclamation will utilize its Science and Technology Program to explore new technologies for reducing selenium loading and/or remediating drainage water with elevated selenium concentrations. Some possibilities include flocculating agents, bioreactors, and other technologies to cost effectively treat selenium-rich waters.

D. Water Quality Monitoring

Federal, state and local entities will partner to monitor selenium concentrations in the lower Gunnison River and its tributaries in order to better understand selenium loading mechanisms, quantify selenium loading reductions and establish selenium loading trends over time. The final water quality monitoring program will be included in the SMP.

E. Monitoring of Endangered Fish Populations

The Recovery Program is responsible for monitoring endangered fish populations. The Recovery Program monitors Colorado pikeminnow populations and is developing a basin-wide razorback sucker monitoring program that will include monitoring of multiple life stages. Design of the monitoring program is expected to be completed in fiscal year 2010. Implementation will begin in 2010. It will include multi-life stage monitoring on the lower Gunnison River. Density estimates will be developed for Colorado pikeminnow and razorback sucker in the lower Gunnison River. Monitoring the endangered fish populations will help determine the status of the species before and after the SMP is implemented. During fish community monitoring in the lower Gunnison River, tissue samples will be collected from razorback suckers, as well as a chosen surrogate species, to determine selenium concentrations. These samples will be collected at intervals to assess reduction in selenium contamination from implementation of the SMP.

F. Coordination with Lower Gunnison River Basin Watershed Management Plan

The Selenium Task Force is developing a Watershed Management Plan (WMP) for the lower Gunnison River Basin. The WMP will focus on remediation of selenium with the goal of meeting the 4.6 parts per billion (ppb) Colorado State water quality standard. Any organization addressing remediation planning within the watershed may utilize the WMP for planning purposes. The objective of the WMP is to guide, direct, and prioritize Clean Water Act 319 Grants from EPA to specific projects within the watershed. The WMP will identify causes and sources of water quality impairment, estimate load reductions, describe nonpoint source management measures, identify technical and financial assistance needed to carry out the WMP, provide an implementation schedule, define an education and outreach program, develop milestones for determining progress, set criteria to measure selenium load reductions, and develop a monitoring program to determine effectiveness of implementation efforts. The Task Force will complete the watershed management plan by September 1, 2010.

G. Regulatory Support

Reclamation will take selenium loading into consideration in the review of any proposed new irrigated lands associated with Reclamation projects in the basin. The Bureau of Land Management will be informed of the importance of considering selenium loading during environmental review of any proposed actions on BLM lands or land transfers or exchanges. The Service will conduct section 7 consultation for any proposed Federal actions that could contribute to selenium loading to the Gunnison and Colorado Rivers.

H. Public Information and Education

Reclamation will provide staff support for implementation of a public information and education element as part of the SMP.

I. Adaptive Management and Monitoring

An adaptive-management component will be described in the final SMP. It will include annual review of progress and reporting to the Service, annual updating of the Long Range Plan, a periodic review of the effectiveness of ongoing selenium reduction measures, water quality monitoring data, and status of endangered fish, followed by adjustments in the SMP as needed.

J. Institutional Arrangements

Reclamation is responsible for the development and implementation of the SMP and its associated Long Range Plan. Significant assistance will be required from the Task Force, the State of Colorado, and local water user organizations. Specific roles and responsibilities for each entity will be identified during the development of the Program and Long Range Plan.

Uncertainties

In their Biological Assessment, Reclamation identified uncertainties associated with the proposed action and offered a list of actions to reduce potential adverse effects to the listed species. These uncertainties are summarized below:

- While relationships among initial motion, significant motion and streamflow are well defined, duration of flows necessary to accomplish habitat work is not completely known. Because flow duration recommendations were developed based on a wet period, the recommended durations require a large volume of water that may not always be available.
- Water availability may limit the ability of the Gunnison River to meet the Flow Recommendations under certain conditions.
- Because of timing and other differences in runoff patterns of the Colorado and Gunnison rivers, it is difficult to predict the effect of Gunnison River flow changes on the Colorado River.
- The trade-off facing Colorado pikeminnow between stream bed maintenance and temperature regime in the Gunnison River is an uncertainty that may need to be evaluated by the Recovery Program.
- The Recovery Program may need to evaluate the trade-off between high spring flows and base flows needed during the mid- to late summer to operate Redlands (and, to a lesser extent perhaps, maintain movement of sediment through the system).

Climate Change

The hydrologic model used as the primary basis of Reclamation's effects analysis does not project future flows, but rather relies on the historic record to analyze a range of possible future flows. The historical record includes periods of extreme drought and periods with above average flow, allowing analysis of the proposed Federal action under a wide range of future flow conditions. However, it is possible that future flows may include periods of wet or dry conditions that are outside the range of sequences observed in the historical record, particularly as a result of climate change and increased climate variability.

The Fourth Assessment Report (Summary for Policymakers) of the Intergovernmental Panel on Climate Change (IPCC), published in April of 2007 (IPCC 2007), presented a selection of key findings regarding projected changes in precipitation and other climate variables as a result of a range of unmitigated climate changes projected by IPCC over the next century. Although annual average river runoff and water availability are projected to decrease by 10-30 percent over some dry regions at mid-latitudes, information with regard to potential impacts on specific river basins was not included. Recently published projections of potential reductions in natural flow on the Colorado River Basin by the mid 21st century range from approximately 45 percent by Hoerling and Eischeid (2006), to approximately 6 percent by Christensen and Lettenmaier (2006). A recent analysis of future precipitation minus evaporation (a surrogate for runoff) in the basin suggests an "imminent transition to a more arid climate in southwestern North America" (Seager et al. 2006). While these projections are of great interest, additional research is both needed and warranted to quantify the uncertainty of these estimates (in terms of the actual uncertainty in the climate response as well as the uncertainty due to differences in methodological approaches and model biases) in order to better understand the risks of current and future water resource management decisions.

Although precise estimates of the future impacts of climate change to runoff throughout the Colorado River Basin at appropriate spatial scales are not currently available, these impacts may include decreased mean annual flow and increased variability, including more frequent and more severe droughts. Even without precise knowledge of the effects on runoff, increasing temperatures alone would likely increase evapotranspiration and sublimation, resulting in reduced runoff.

Specific predictions for the Gunnison Basin are highly speculative; however, predictions for the overall Colorado River Basin natural flows have ranged between reductions of 6 to 45 percent over the next 50 years (Reclamation 2007). Recent reports (Ray et al 2008) suggest continued warming in Colorado with less clear trends in annual precipitation, although in general lower and earlier runoff is predicted.

For these reasons, the proposed action calls for using adaptive management to respond to new knowledge and using monitoring to evaluate the physical response of the habitat and biological response of the fish to the flow regimes.

STATUS OF THE SPECIES AND CRITICAL HABITAT

COLORADO PIKEMINNOW

Species Description

The Colorado pikeminnow is the largest cyprinid fish (minnow family) native to North America and 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, Colorado pikeminnow rarely exceed 3 feet in length or weigh more than 18 pounds; such fish are estimated to be 45 to 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 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.

Status and Distribution

Based on early fish collection records, archaeological finds, and other observations, the pikeminnow was once found throughout warm water reaches of the entire Colorado River Basin down to the Gulf of California, including reaches of the upper Colorado River and its major tributaries, the Green River and its major tributaries, the San Juan River and some of its tributaries, and the Gila River system in Arizona (Seethaler 1978, Platania 1990). 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 1850s. By the 1970s 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 approximately 75-80 percent of its former range, the pikeminnow was federally listed as an endangered species in 1967 under the Endangered Species Preservation Act of 1966 (Service 1967, Miller 1961, Moyle 1976, Tyus 1991, Osmundson and Burnham 1998).

The Recovery Plan (Service 2002a, Table 4, Figure 4) provides a summary of habitat occupied by wild Colorado pikeminnow in the Upper Colorado River Basin and limits to its distribution.

Table 4. Locations and limits to distribution of Colorado pikeminnow in the Colorado River System.

River	Occupied Habitat	Limits to Distribution
Green River Subbasin		
1. Green River	Lodore Canyon to Colorado River confluence (580 km)	Cold releases from Flaming Gorge Dam have been warmed and species has naturally expanded upstream into Lodore Canyon; species distributed continuously downstream to Colorado River confluence
1a. Yampa River	Craig, Colorado, to Green River confluence (227 km)	Present distribution similar to historic
1b. Little Snake River	Wyoming to Yampa River confluence (80 km)	Habitat is marginal; flows are reduced; historic distribution unknown
1c. White River	Taylor Draw Dam to Green River confluence (100 km)	Upstream distribution blocked by Taylor Draw Dam
1d. Price River	Lower 143 km above Green River confluence	Streamflow reduced; barriers occur above current distribution
1e. Duchesne River	Lower 10 km above Green River confluence	Streamflow reduced; barriers occur above current distribution
Upper Colorado River Subbasin		

2. Upper Colorado River	Palisade, Colorado, to Lake Powell inflow (298 km)	Passage by Grand Valley Diversion completed in 1998;Grand Valley Project Diversion in 2005; Price-Stubb in 2008; upstream distribution Rifle, Colorado; downstream distribution Lake Powell inflow_[1]
2a. Gunnison River	Lower 54 km above Colorado River confluence	Redlands Fishway allowed passage in 1996; upstream distribution is limited by Hartland Diversion Dam and possibly cold-water releases from the Aspinall Unit
2b. Dolores River	Lower 2 km above Green River confluence	Streamflow altered; no barriers in potential historic habitat
San Juan River Subbasin		
3. San Juan River	Shiprock, New Mexico, to Lake Powell inflow (241 km)	Irrigation diversions block upstream movement; restoration of passage underway; Lake Powell defines downstream distribution

The map below of wild Colorado pikeminnow in the Colorado River basin was reproduced from the Colorado Pikeminnow Recovery Goals (Service 2002a, Figure 1) (Recovery Goals are currently under revision for all four species).

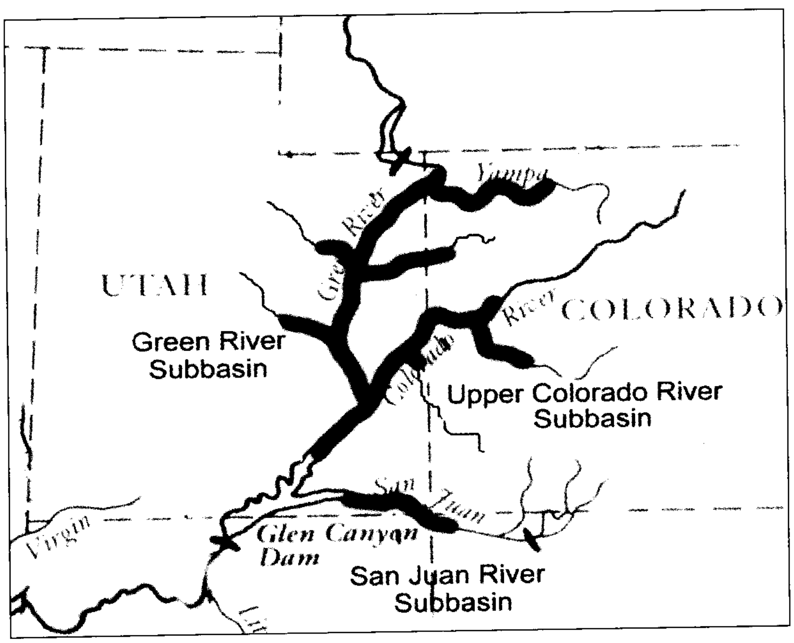


Figure 2. Distribution of Colorado pikeminnow in the Colorado River System.

The Recovery Goals reports estimates of abundance for the three Colorado pikeminnow populations range from about 6,600 to 8,900 wild adults. Estimates of subadults are not currently available for all populations. Estimates of adults for the three subbasins are: Green River, 6,000–8,000; upper Colorado River, 600–900 [includes some subadults]; and San Juan River, 19–50 (Service 2002a).

A more recent report on the status of Colorado pikeminnow in the Green River Basin (Bestgen et al. 2007) presented population estimates for adult (>450 mm total length (TL)) and recruit-sized

[1] Updated since 2002 Recovery Goals

(400 – 449 mm TL) Colorado pikeminnow. The report suggested that numbers of adult pikeminnow declined in the Green River Basin from 3,300 in 2001 to 2,142 in 2003, a reduction of 35%. The 2003 population estimates for Colorado pikeminnow were: Yampa River, 224 adults; White River, 407 adults and zero recruits (approximately 44 recruits were estimated for each year in 2000-2001); mainstem Green River (from the confluence with the Yampa River to the confluence with the Colorado River), 1511 adults and 284 recruits.

Results of recent mark-recapture studies in the upper Colorado River show 2005 river-wide abundance estimates for fish ≥450 mm in length to be 889 individuals (Osmundson and White 2009). These study results indicate that the Colorado River population may have increased substantially since 1991 and that the carrying capacity for the upper Colorado River may be greater than previously assumed. Annual recruitment exceeded the estimated number of annual mortalities (for fish ≥ 450 mm) in six of the nine years of study and there was an estimated net gain of 332 fish over the study period (Osmundson and White 2009).

The species was extirpated from the Lower Colorado River Basin in the 1970's but has been reintroduced into the Gila River subbasin where it exists in small numbers in the Verde River (Service 2002a).

Threats to the Species

Because the pikeminnow was designated as endangered prior to passage of the Endangered Species Act of 1973, a formal listing package identifying threats was not prepared. The pikeminnow recovery goals (Service 2002a) summarize threats to the species as follows: stream regulation, habitat modification, competition with and predation by nonnative fish, and pesticides and pollutants.

Major declines in pikeminnow populations occurred in the lower Colorado River Basin during the dam-building era of the 1930s through the 1960s. Behnke and Benson (1983) summarized the decline of the natural ecosystem, pointing out that dams, impoundments, and water use practices drastically modified the river's natural hydrology and channel characteristics throughout the Colorado River Basin. Dams on the main stem fragmented the river ecosystem into a series of disjunct segments, blocked native fish migrations, reduced water temperatures downstream of dams, created lake habitat, and provided conditions that allow 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.

In the upper Colorado River Basin, declines in pikeminnow populations occurred primarily after the 1960s, when the following dams were constructed: 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. Some native fish populations in the upper basin have managed to persist, while others are nearly extirpated. River reaches where native fish have declined more slowly, more closely resemble pre-dam hydrologic regimes, where adequate habitat for all life phases still exists, and where migration corridors allow connectivity among habitats used during the various life phases.

Stream flow regulation, which includes mainstem dams, cause the following adverse effects to the Colorado pikeminnow and its habitat:

- block migration corridors,
- changes in flow patterns, reduced peak flows and increased base flows,
- release cold water, making temperature regimes less than optimal,
- change river habitat into lake habitat, and
- retain sediment that is important for forming and maintaining backwater habitats

In the Upper Basin, 435 miles of Colorado pikeminnow habitat has been lost by reservoir inundation from Flaming Forge Reservoir on the Green River, Lake Powell on the Colorado River, and Navajo Reservoir on the San Juan River. Cold water releases from these dams have eliminated suitable habitat for native fishes, including Colorado pikeminnow, from river reaches downstream for approximately 50 miles below Flaming Gorge Dam and Navajo Dam. In addition to mainstem dams, many dams (including the Aspinall Unit dams and McPhee Dam) and water diversion structures occur in and upstream from critical habitat that reduce flows and alter flow patterns, which adversely affect critical habitat. Diversion structures in critical habitat divert fish into canals and pipes where the fish are permanently lost to the river system. It is unknown how many endangered fish are lost in irrigation systems, but in some years, in some river reaches, majority of the river flow is diverted into unscreened canals. Installation and operation of fish screens in the major diversions in the Grand Valley have reduced this problem in recent years.

At least 67 species of nonnative fishes have been introduced into the Colorado River Basin during the last 100 years (Tyus et al. 1982, Carlson and Muth 1989, Minckley and Deacon 1991, Tyus and Saunders 1996). Tyus et al. (1982) reported that 42 nonnative fish species have become established in the upper basin, and Minckley (1985) reported that 37 nonnative fish species have become established in the lower basin. Many of these species were intentionally introduced as game or forage fishes, whereas others were unintentionally introduced with game species or passively as bait fish.

Pikeminnow in the upper Colorado River Basin live with about 20 species of warm-water nonnative fishes (Tyus et al. 1982, Lentsch et al. 1996) that are potential predators, competitors, and vectors for parasites and disease. Researchers believe that nonnative fish species limit the success of pikeminnow recruitment (Bestgen 1997, Bestgen et al. 1997, McAda and Ryel 1999). Osmundson (1987) documented predation by black bullhead (*Ameiurus melas*), green sunfish (*Lepomis cyanellus*), largemouth bass (*Micropterus salmoides*), and black crappie (*Pomoxis nigromaculatus*) as a significant mortality factor for YOY and yearling pikeminnow stocked in riverside ponds along the upper Colorado River. Adult red shiners (*Cyprinella lutrensis*) are known predators of larval native fish in backwaters of the upper basin (Ruppert et al. 1993). High spatial overlap in habitat use has been documented among young pikeminnow, red shiner, sand shiner (*Notropis stramineus*), and fathead minnow (*Pimephales promelas*). In laboratory experiments on behavioral interactions, Karp and Tyus (1990) observed that red shiner, fathead minnow, and green sunfish shared activity schedules and space with young pikeminnow and exhibited antagonistic behaviors to smaller pikeminnow. They hypothesized that pikeminnow may be at a competitive disadvantage in an environment that is resource limited. Data collected indicates that during low water years, nonnative minnows capable of preying on or competing with larval endangered fishes greatly increased in numbers (Osmundson and Kaeding 1991, McAda and Ryel 1999).

Channel catfish (*Ictalurus punctatus*) has been identified as a threat to juvenile, subadult, and adult pikeminnow. Channel catfish were first introduced in the upper Colorado River Basin in 1892 (Tyus and Nikirk 1990) and are now considered common to abundant throughout much of the upper basin (Tyus et al. 1982, Nelson et al. 1995). The species is one of the most prolific predators in the upper basin and, among the nonnative fishes, is thought to have the greatest adverse effect on endangered fishes due to predation on juveniles and resource overlap with subadults and adults (Hawkins and Nesler 1991, Lentsch et al. 1996, Tyus and Saunders 1996). Predation upon stocked juvenile Colorado pikeminnow by adult channel catfish has been documented in the San Juan River (Jackson 2005). Juvenile and adult pikeminnow that have preyed on channel catfish have been found choking on the pectoral spines (McAda 1983, Pimental et al. 1985, Ryden and Smith 2002, Lapahie 2003). Although mechanical removal (electrofishing, seining) of channel catfish began in 1995 on the San Juan River, intensive efforts (10 trips/year) did not begin until 2001. Mechanical removal has not yet led to a positive population response in pikeminnow (Davis 2003); however, because the pikeminnow population is so low in the San Juan River, documenting a population response would be extremely difficult.

Threats from pesticides and pollutants include accidental spills of petroleum products and hazardous materials; discharge of pollutants from uranium mill tailings; and high selenium concentration in the water and food chain (Service 2002a). Accidental spills of hazardous material into critical habitat, particularly when considering water of sufficient quality as a primary constituent element, can cause immediate mortality when lethal toxicity levels are exceeded. Pollutants from uranium mill tailings cause high levels of ammonia that exceed water quality standards. Selenium is at levels shown to affect reproduction and recruitment (Stephens et al. 1992; Stephens and Waddell 1998; Osmundson et al. 2000).

Recovery

Objective, measurable criteria for recovery of Colorado pikeminnow in the Colorado River System are presented for the Upper Colorado River Basin (including the Green River, upper Colorado River, and San Juan River subbasins). Recovery of the species is considered necessary only in the upper basin because of the present status of populations and because existing information on Colorado pikeminnow biology support application of the metapopulation concept to extant upper basin populations. The need for self-sustaining populations in the lower basin and associated site-specific management actions and tasks necessary to minimize or remove threats will be reevaluated with the status review of the species, which is conducted at least once every 5 years. The Colorado pikeminnow was listed prior to the 1996 distinct population segment (DPS) policy. If lower basin populations are determined necessary for recovery, the Service may conduct an evaluation to designate DPSs in a future rule-making process. If DPSs are designated, these recovery criteria will need to be reevaluated. These recovery goals are based on the best available scientific information, and are structured to attain a balance between reasonably achievable criteria (which include an acceptable level of uncertainty) and ensuring the viability of the species beyond delisting. Additional data and improved understanding of

Colorado pikeminnow biology may prompt additional revision of these recovery goals.

Downlisting can occur if, over a 5-year period, the upper basin metapopulation is maintained such that: (1) a genetically and demographically viable, self-sustaining population is maintained in the Green River subbasin such that — (a) the trends in separate adult (age 7+; ≥450 mm TL) point estimates for the middle Green River and the lower Green River do not decline significantly, and (b) mean estimated recruitment of age-6 (400–449 mm TL) naturally produced fish equals or exceeds mean annual adult mortality for the Green River subbasin, and (c) each population point estimate for the Green River subbasin exceeds 2,600 adults (2,600 is the estimated minimum viable population [MVP] needed to ensure long-term genetic and demographic viability); and (2) a self-sustaining population of at least 700 adults (number based on inferences about carrying capacity) is maintained in the upper Colorado River subbasin (including the Gunnison River) such that — (a) the trend in adult point estimates does not decline significantly, and (b) mean estimated recruitment of age-6 naturally produced fish equals or exceeds mean annual adult mortality; and (3) a target number of 1,000 age-5+ fish (≥300 mm TL); number based on estimated survival of stocked fish and inferences about carrying capacity) is established through augmentation and/or natural reproduction in the San Juan River subbasin; and (4) when certain site-specific management tasks to minimize or remove threats have been identified, developed, and implemented.

Delisting can occur if, over a 7-year period beyond downlisting, the upper basin metapopulation is maintained such that: (1) a genetically and demographically viable, self-sustaining population is maintained in the Green River subbasin such that — (a) the trends in separate adult point estimates for the middle Green River and the lower Green River do not decline significantly, and (b) mean estimated recruitment of age-6 naturally produced fish equals or exceeds mean annual adult mortality for the Green River subbasin, and (c) each population point estimate for the Green River subbasin exceeds 2,600 adults; and (2) either the upper Colorado River subbasin self-sustaining population exceeds 1,000 adults **OR** the upper Colorado River subbasin self-sustaining population exceeds 700 adults and San Juan River subbasin population is self-sustaining and exceeds 800 adults (numbers based on inferences about carrying capacity) such that for each population — (a) the trend in adult point estimates does not decline significantly, and (b) mean estimated recruitment of age-6 naturally produced fish equals or exceeds mean annual adult mortality; and (3) when certain site-specific management tasks to minimize or remove threats have been finalized and implemented, and necessary levels of protection are attained.

Conservation plans will go into effect at delisting to provide for long-term management and protection of the species, and to provide reasonable assurances that recovered Colorado pikeminnow populations will be maintained without the need for relisting. Elements of those plans could include (but are not limited to) provision of flows for maintenance of habitat conditions required for all life stages, regulation and/or control of nonnative fishes, minimization of the risk of hazardous-materials spills, and monitoring of populations and habitats. Signed agreements among State agencies, Federal agencies, American Indian tribes, and other interested parties must be in place to implement the conservation plans before delisting can occur.

Life History

The life history phases that appear to be most limiting for pikeminnow populations include spawning, egg hatching, development of larvae, and the first year of life. These phases of pikeminnow development are tied closely to specific habitat requirements. Natural spawning of pikeminnow is initiated on the descending limb of the annual hydrograph as water temperatures approach the range of 16 °C (60.8 °F) to 20 °C (68 °F) (Vanicek and Kramer 1969, Hamman 1981, Haynes et al. 1984, Tyus 1990, McAda and Kaeding 1991). Temperature at initiation of spawning varies by river. In the Green River, spawning begins as temperatures exceed 20-23 °C (68-73 °F); in the Yampa River, 16-23 °C (61-68 °F) (Bestgen et al. 1998); in the Colorado River, 18-22 °C (64-72 °F) (McAda and Kaeding 1991); in the San Juan River temperatures were estimated to be 16-22 °C (61-72 °F). Spawning, both in the hatchery and under natural riverine conditions, generally occurs in a 2-month period between late June and late August. However, 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 (68 °F), and lower at 25 °C (77 °F). Mortality was 100 percent at 5, 10, 15, and 30°C (41, 50, 59, and 86 °F). In addition, larval abnormalities were twice as high at 25 °C (77 °F) than at 20 °C (68 °F) (Marsh 1985). Experimental tests of temperature preference of yearling (Black and Bulkley 1985a) and adult (Bulkley et al. 1981) pikeminnow indicated that 25 °C (77 °F) was the most preferred temperature for both life phases. Additional experiments indicated that optimum growth of yearlings also occurs at temperatures near 25 °C (77 °F) (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 preference of 25 °C (77 °F) provides a good indication of optimum growth temperature for all life phases.

Males become sexually mature earlier and at a smaller size than do females, though all are mature by about age 7 and 500 millimeters (20 inches) in length (Vanicek and Kramer 1969, Seethaler 1978, Hamman 1981). Hatchery-reared males became sexually mature at 4 years of age and females at 5 years. After about 10 years of age, female pikeminnow typically grow to larger sizes than males (Osmundson 2002b). Average fecundity of 24, 9-year old females was 77,400 (range, 57,766-113,341) or 55,533 eggs/kg, and average fecundity of 9 ten-year old females was 66,185 (range, 11,977-91,040) or 45,451 eggs/kg (Hamman 1986).

Most information on pikeminnow reproduction has been gathered from spawning sites on the lower 20 miles (12.2 kilometers) of the Yampa River and in Gray Canyon on the Green River (Tyus and McAda 1984, Tyus 1985, Wick et al. 1985, Tyus 1990). Pikeminnow spawn after peak runoff subsides. Spawning is probably triggered by several interacting variables such as day length, temperature, flow level, and perhaps substrate characteristics. 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 non-turbulent 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 site in the upper Colorado River (Service unpublished data) indicate a similar association of habitats. The most unique feature at the sites used for spawning, in comparison with otherwise similar sites nearby, is the lack of embeddedness 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).

Collections of larvae and young-of-year (YOY) downstream of known spawning sites in the Green, Yampa, and San Juan rivers demonstrate that downstream drift of larval pikeminnow occurs following hatching (Haynes et al. 1984, Nesler et al. 1988, Tyus 1990, Tyus and Haines 1991, Platania 1990, Ryden 2003a). Studies on the Green and Colorado rivers found that YOY used backwaters almost exclusively (Holden 2000). During their first year of life, pikeminnow prefer warm, turbid, relatively deep (averaging 0.4 meters [1.3 feet]) backwater areas of zero velocity (Tyus and Haines 1991). After about 1 year, young are rarely found in such habitats, although juveniles and subadults are often located in large deep backwaters during spring runoff (Service, unpublished data; Osmundson and Burnham 1998). Studies indicate that significant recruitment of Colorado pikeminnow may not occur every year, but occurs in episodic intervals of several years (Osmundson and Burnham 1998).

Pikeminnow often migrate considerable distances to spawn in the Green and Yampa rivers (Miller et al. 1982, Archer et al. 1986, Tyus and McAda 1984, Tyus 1985, Tyus 1990), and similar movement has been noted in the mainstem San Juan River. A fish captured and tagged in the San Juan arm of Lake Powell in April 1987, was recaptured in the San Juan River approximately 80 miles upstream in September 1987 (Platania 1990). Ryden and Ahlm (1996) report that a pikeminnow captured at river mile (RM) 74.8 (between Bluff and Mexican Hat) made a 50-60 mile migration during the spawning season in 1994, before returning to within 0.4 river miles of its original capture location. In the Green River system, adult Colorado pikeminnow converge to reproduce at two known spawning areas, Yampa Canyon in the lower Yampa River and Gray Canyon in the Green River (Tyus and McAda 1984; Tyus 1985; Tyus 1990; Tyus 1991; Irving and Modde 2000). Rates of movement for individuals are not precisely known, but 2 individuals made the approximately 400 km migration from the White River below Taylor Draw Dam to the Yampa River spawning area in less than 2 weeks. Bestgen et al. (2007) state that adults migrate up to 745 river km round-trip to spawning areas in Yampa Canyon and in Desolation–Gray Canyon.

In contrast to pikeminnow in the Green and Yampa rivers, the majority of adult Colorado pikeminnow in the San Juan and Colorado Rivers reside closer to the area in which they spawn (McAda and Kaeding 1991, Osmundson et al. 1997, Ryden and Ahlm 1996, Miller and Ptacek 2000). During their study, Ryden and Ahlm (1996) found that pikeminnow in the San Juan River aggregated at the mouth of the Mancos River prior to spawning Information on radio-tagged adult pikeminnow during the fall suggests that pikeminnow seek out deep water areas in the Colorado River (Miller et al. 1982, Osmundson and Kaeding 1989), as do many other riverine species. Pools, runs, and other deep water areas, especially in upstream reaches, are important winter habitats for 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 cover; this allows foraging and resting in areas otherwise exposed to avian or terrestrial predators. Tyus and Haines (1991) found that young 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 exotic, sight-feeding, piscivorous fish. It is unknown whether the river was as turbid historically as it is today. For now, it is assumed that these endemic fishes evolved under 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.

Critical Habitat

Critical habitat for the Colorado pikeminnow 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 FR 13374). Colorado pikeminnow now only occur in the upper Colorado River basin (upstream of Lee Ferry just below the Glen Canyon Dam). Most of Lake Powell is not suitable habitat for Colorado pikeminnow and is not designated critical habitat. The total designated miles is 1,148 and represents 29 percent of the historical habitat for the species:

Moffat County, Colorado. The Yampa River and its 100-year floodplain from the State Highway 394 bridge in T. 6 N., R. 91 W., section 1 (6th Principal Meridian) to the confluence with the Green River in T. 7 N., R. 103 W., section 28 (6th Principal Meridian).

Uintah, Carbon, Grand, Emery, Wayne, and San Juan Counties, Utah; and Moffat County, Colorado. The Green River and its 100-year floodplain from the confluence with the Yampa River in T. 7 N., R. 103 W., section 28 (6th Principal Meridian) to the confluence with the Colorado River in T. 30 S., R. 19 E., section 7 (Salt Lake Meridian).

Rio Blanco County, Colorado; and Uintah County, Utah. The White River and its 100-year floodplain from Rio Blanco Lake Dam in T. 1 N., R. 96 W., section 6 (6th Principal Meridian) to the confluence with the Green River in T. 9 S., R. 20 E., section 4 (Salt Lake Meridian).

Delta and Mesa Counties, Colorado. 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 the confluence with the Colorado River in T. 1 S., R. 1 W., section 22 (Ute Meridian).

Mesa and Garfield Counties, Colorado; and Grand, San Juan, Wayne, and Garfield Counties, Utah. 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).

San Juan County, New Mexico; and San Juan County, Utah. The San Juan River and its 100-year floodplain from the State Route 371 Bridge in T. 29 N., R. 13 W., section 17 (New

Mexico Meridian) to Neskahai Canyon in the San Juan arm of Lake Powell in T. 41 S., R. 11 E., section 26 (Salt Lake Meridian) up to the full pool elevation.

The final critical habitat rule identified water, physical habitat, and the biological environment as the Primary Constituent Elements (PCEs) of critical habitat. The water PCE was further described as including a quantity of water of sufficient quality (i.e., temperature, dissolved oxygen, lack of contaminants, nutrients, turbidity, etc.) that is delivered to a specific location in accordance with a hydrologic regime that is required for the particular life stage for each species. The physical habitat includes areas of the Colorado River system that are inhabited or potentially habitable by fish for use in spawning, nursery, feeding, and rearing, or serve as corridors between these areas. In addition to river channels, these areas also include bottom lands, side channels, secondary channels, oxbows, backwaters, and other areas in the 100-year floodplain, which when inundated provide access to spawning, nursery, feeding, and rearing habitats. The biological environment PCE includes food supply predation, and competition. Food supply is a function of nutrient supply, productivity, and availability to each life stage of the species. Predation and competition, although considered normal components of this environment, are out of balance due to introduced nonnative fish species in many areas.

Species/Critical Habitat Likely to be Affected

The Colorado pikeminnow and its critical habitat in the action area are likely to be adversely affected. The area of critical habitat likely to be affected is 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 the confluence with the Colorado River in T. 1 S., R. 1 W., section 22 (Ute Meridian), continuing down from this point of the Colorado River and its 100-year floodplain to North Wash, and 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).

RAZORBACK SUCKER

Species Description

Like all suckers (family Catastomidae, meaning "down mouth"), the razorback sucker has a ventral mouth with thick lips covered with papillae and no scales on its head. In general, suckers are bottom browsers, sucking up or scraping off small invertebrates, algae, and organic matter with their fleshy, protrusible lips (Moyle 1976). The razorback sucker is the only sucker with an abrupt sharp-edged dorsal keel behind its head. The keel becomes more massive with age. The head and keel are dark, the back is olive-colored, the sides are brownish or reddish, and the abdomen is yellowish white (Sublette et al. 1990). Adults often exceed 3 kilograms (6 pounds) in weight and 600 millimeters (2 feet) in length. Like Colorado pikeminnow, razorback suckers are long-lived, living 40-plus years.

Status and Distribution

On March 14, 1989, the Service was petitioned to conduct a status review of the razorback sucker. Subsequently, the razorback sucker was designated as endangered under a final rule published on October 23, 1991 (56 FR 54957). The final rule stated "Little evidence of natural recruitment has been found in the past 30 years, and numbers of adult fish captured in the last 10 years demonstrate a downward trend relative to historic abundance. Significant changes have occurred in razorback sucker habitat through diversion and depletion of water, introduction of nonnative fishes, and construction and operation of dams" (56 FR 54957). Recruitment of razorback suckers to the population continues to be a problem.

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 that a commercially marketable quantity was caught in Arizona as recently as 1949. In the upper Colorado River Basin, razorback suckers were reported to be very abundant in the Green River near Green River, Utah, in the late 1800s (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 1930s and early 1940s. In the San Juan River drainage, the first documented razorback sucker from the river was captured in 1988 (Platania 1990); however, Platania and Young (1989) relayed historical accounts of alleged razorback suckers ascending the Animas River to Durango, Colorado, around the turn of the century.

The Recovery Goals (Service 2002b, Table 5; Figure 3) provides a summary of habitat occupied by the razorback sucker and limits to its distribution.

Table 5. Locations and limits to distribution of razorback sucker in the Colorado River System.

River	Occupied Habitat	Limits to Distribution
Green River Subbasin		
Green River	Lodore Canyon to Colorado River confluence (580 km); population being augmented	Cold-water releases from Flaming Gorge Dam previously restricted range, but warmed releases may allow for range expansion
Yampa River	Craig, Colorado, to Green River confluence (227 km)	Present in low numbers in historic habitat
White River	Taylor Draw Dam to Green River confluence (100 km)	Found in low numbers; upstream distribution blocked by Taylor Draw Dam
Duchesne River	Lower 2 km above Green River confluence	Found as small aggregations during spring runoff at mouth
Upper Colorado River Subbasin		
Upper Colorado River	Rifle, Colorado, to Lake Powell inflow (29 8 km); population being augmented	Wild population considered extirpated from the river, but fish are being stocked Passage by Grand Valley Diversion completed in 1998;Grand Valley Project Diversion in 2005; Price-Stubb in 2008; upstream distribution Rifle, Colorado; downstream distribution Lake Powell inflow [2]
Gunnison River	Lower 54 km above Colorado River confluence; population being reestablished through stocking.	Wild population considered extirpated from the river, but fish are being stocked in the lower 54 km above the Colorado River confluence to reestablish the population; Redlands Fishway allows passage since 1996; upstream distribution limited by Hartland Diversion Dam and possibly cold-water releases from the Aspinall Unit

[2] Updated since 2002 Recovery Goals

San Juan River Subbasin		
San Juan River	Shiprock, New Mexico, to Lake Powell inflow (241 km); population being reestablished through stocking	Wild population considered extirpated from the river, but fish are being stocked between Shiprock, NM and Lake Powell inflow (241 km) to reestablish the population; diversion structures block upstream movement with remediation underway; Lake Powell defines downstream distribution
Lower Colorado River Subbasin		
Lake Mohave	Potential lake-wide distribution; population being augmented	Found only in reservoir
Lake Mead	Potential lake-wide distribution	Found only in reservoir but may extend upstream into lower Grand Canyon; cold-water releases from Glen Canyon Dam prevent expansion into upper Grand Canyon
Lower Colorado River	Lake Havasu to Davis Dam (96 km)	Stocked fish have not remained in Lake Havasu, but have populated the river between the reservoir and Davis Dam; fish spawned and produced larvae in 2000 and 2001
Gila River Subbasin		
Verde River	Limited distribution of hatchery stocks	
Salt River	Limited distribution of hatchery stocks	

The map below of wild or stocked razorback sucker in the Colorado River basin was reproduced from the Razorback Sucker Recovery Goals (Service 2002b, Figure 1).

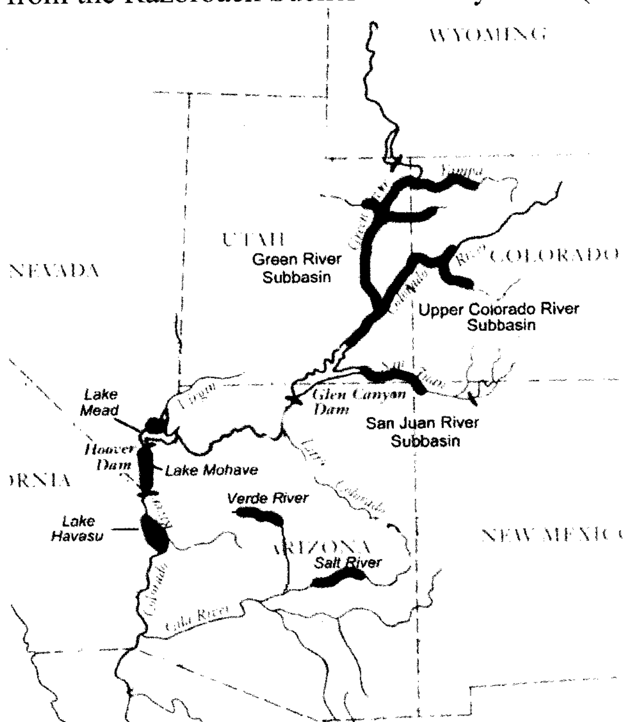


Figure 3. Distribution of wild or stocked razorback sucker in the Colorado River System.

Currently, the largest concentration of razorback sucker remaining in the Colorado River Basin is in Lake Mohave on the border of Arizona and California. Estimates of the wild stock in Lake Mohave have fallen precipitously in recent years from 60,000 as late as 1991, to 25,000 in 1993 (Marsh 1993; Holden 1994), to about 9,000 in 2000 (Service 2002b). Until recently, efforts to introduce young razorback sucker into Lake Mohave have failed because of predation by non-native species (Minckley et al. 1991, Clarkson et al. 1993; Burke 1994). 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 Colorado River Basin, above Glen Canyon Dam, razorback suckers are found in limited numbers in both lentic (lake-like) and riverine environments. Small numbers of razorback suckers have been found in Lake Powell at the mouths of the Dirty Devil, San Juan and Colorado rivers. The largest populations of razorback suckers in the upper basin are found in the upper and middle Green and lower Yampa Rivers (Tyus 1987). Lanigan and Tyus (1989) estimated a population of 948 adults in the upper Green River. Eight years later, the population was estimated at 524 adults and the population was characterized as stable or declining slowly with some evidence of recruitment (Modde et al. 1996). In the Colorado River, most razorback suckers occur in the Grand Valley area near Grand Junction, Colorado; however, they are increasingly rare. More recent accounts are less encouraging on the status of the razorback sucker in the Upper Colorado River Basin, "Less than 100 wild adults are estimated to still occur in the middle Green River of Utah and Colorado, and wild populations are considered gone from the Gunnison, Colorado, and San Juan Rivers" (Upper Colorado River Endangered Fish Recovery Program 2006).

Documented records of wild razorback sucker adults in the San Juan River are limited to two fish captured in a riverside pond near Bluff, Utah in 1976, and one fish captured in the river in 1988, also near Bluff (Platania 1990). Large numbers were anecdotally reported from a drained pond near Bluff in 1976, but no specimens were preserved to verify the species. No wild razorback suckers were found during the 7-year research period (1991-1997) on the San Juan River (Holden 1999). However, hatchery-reared razorback sucker, especially fish greater than 350 millimeters (13.8 inches), introduced into the San Juan River in the 1990s have survived and reproduced, as evidenced by recapture data and collection of larval fish (Ryden 2000b). Until 2003, there was very limited evidence indicating natural recruitment to any population of razorback sucker in the Colorado River system (Bestgen 1990, Platania 1990, Platania et al. 1991, Tyus 1987, McCarthy and Minckley 1987, Osmundson and Kaeding 1989, Modde et al. 1996). In 2003, two juvenile (age-2) razorback sucker (9.8 and 10.6 inches) thought to be wild-produced from stocked fish were collected in the lower San Juan River (Ryden 2004a).

The largest concentration of razorback suckers in the Upper Basin exists in low-gradient flat-water reaches of the middle Green River between and including the lower few miles of the Duchesne River and the Yampa River (Tyus 1987; Tyus and Karp 1990; Muth 1995; Modde and Wick 1997; Muth et al. 2000). This area includes the greatest expanse of floodplain habitat in the Upper Colorado River Basin, between Pariette Draw at River Mile (RM) 238 and the Escalante Ranch at RM 310 (Irving and Burdick 1995).

Lanigan and Tyus (1989) used a demographically closed model with capture-recapture data collected from 1980 to 1988 and estimated that the middle Green River population consisted of about 1,000 adults (mean, 948; 95 percent confidence interval, 758–1,138). Based on a demographically open model and capture-recapture data collected from 1980 to 1992, Modde et al. (1996) estimated the number of adults in the middle Green River population at about 500 fish (mean, 524; 95 percent confidence interval, 351–696). That population had a relatively constant length frequency distribution among years (most frequent modes were in the 505-515 millimeters total length interval) and an estimated annual survival rate of 71 percent. Bestgen et al. (2002) estimated the population of wild razorback sucker in the middle Green River to be much lower than earlier estimates -- about 100 -- based on data collected in 1998 and 1999. There are no current population estimates of razorback sucker in the remainder of the upper Colorado River basin due to low numbers captured in recent years.

Substantial numbers of subadult razorback sucker have been stocked into the upper Colorado River subbasin, including the Gunnison River, since implementing the stocking plan (Nesler et al.2003). An evaluation of stocked razorback sucker concluded survival is low for the first year at large, fish stocked in the summer had lower survival, and larger fish at stocking had better survival (Zelasko et al. 2009). However, large numbers have survived to adulthood. Ripe fish have been collected in spawning aggregations and larvae have been collected in the Green (very large numbers in recent years) Colorado and Gunnison rivers Annual augmentation of subadult and adult razorback sucker occurs in the San Juan River, with an annual goal of 11,400 fish ≥300 mm (Ryden 2003). Reproduction has been documented through the collection of larvae every year since 1998. Juvenile razorback sucker were found in the San Juan River in 2003 and 2004.

<u>Life History</u>

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. 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. Tyus and Karp (1990) and Modde and Wick (1997) suggested that use of warmer, more productive flooded habitats by adult razorback suckers during the breeding season is related to temperature preferences (23–25 degrees C; Bulkley and Pimental 1983) and abundance of appropriate foods (Jonez and Sumner 1954; Vanicek 1967; Marsh 1987; Wolz and Shiozawa 1995; Modde 1997; Wydoski and Wick 1998).

While razorback suckers have never been directly observed spawning in turbid riverine environments within the upper Colorado River Basin, captures of ripe specimens, both males and females, have been recorded in the Yampa, Green, Colorado, and San Juan rivers (Valdez et al. 1982, McAda and Wydoski 1980, Tyus 1987, Osmundson and Kaeding 1989, Tyus and Karp 1989, Tyus and Karp 1990, Osmundson and Kaeding 1991, Platania 1990, Ryden 2000b, Jackson 2003, Ryden 2005). 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. Because of the relatively steep gradient in the San Juan River and lack of a wide flood plain, razorback sucker are likely spawning in low velocity, turbid, main channel habitats. Aggregations of ripe adults have only been documented in a few locations.

Both sexes mature as early as age four (McAda and Wydoski 1980). Fecundity, based on ovarian egg counts, ranges from 75,000-144,000 eggs (Minckley 1983). McAda and Wydoski (1980) reported an average fecundity (N=10) of 46,740 eggs/fish (27,614–76,576). Several males attend each female; no nest is built. The adhesive eggs drift to the bottom and hatch there (Sublette et al. 1990). Marsh (1985) reported that, in laboratory experiments, the percentage of egg hatch was greatest at 20 ˚C (68 ˚F) and all embryos died at incubation temperatures of 5, 10, and 30 ˚C (41, 50, and 86 ˚F).

Because young and juvenile razorback suckers are rarely encountered, their habitat requirements in the wild are not well known, particularly in native riverine environments. However, it is assumed that low-velocity backwaters and side channels are important for young of year (YOY) and juveniles, as it is to the early life stages of most riverine fish. 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 Colorado River Basin (Tyus and Karp 1989, Osmundson and Kaeding 1991). Modde (1996) found that on the Green River, larval razorback suckers entered flooded bottomlands that are connected to the main channel during high flow. However, as mentioned earlier, because of the relatively steep gradient of the San Juan River and the lack of a wide flood plain, flooded bottomlands are probably much less important in this system than are other low velocity habitats such as backwaters and secondary channels (Ryden, 2004a).

Spring migrations by adult razorback suckers were associated with spawning in historic accounts (Jordan 1891; Hubbs and Miller 1953; Sigler and Miller 1963; Vanicek 1967) and a variety of local and long-distance movements and habitat-use patterns have been subsequently documented. Spawning migrations (one-way movements of 30.4–106.0 km) observed by Tyus and Karp (1990) included movements between the Ouray and Jensen areas of the Green River and between the Jensen area and the lower Yampa River. Initial movement of adult razorback suckers to spawning sites was influenced primarily by increases in river discharge and secondarily by increases in water temperature (Tyus and Karp 1990; Modde and Wick 1997; Modde and Irving 1998). Flow and temperature cues may serve to effectively congregate razorback suckers at spawning sites, thus increasing reproductive efficiency and success. Reduction in spring peak flows may hinder the ability of razorback suckers to form spawning aggregations, because spawning cues are reduced (Modde and Irving 1998).

A few domestic-reared razorback suckers released into the wild have exhibited long-distance dispersals. One individual released into the Gunnison River was recaptured 3.5 years later 90 miles up the Green River, having traveled a minimum distance of 228 river miles. Another individual released into the Gunnison River was recaptured 205 river miles downstream in the Colorado River only 6.5 months later (Burdick 2003).

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).

Threats to the Species

A marked decline in populations of razorback suckers can be attributed to construction of dams and reservoirs, introduction of nonnative fishes, alteration of water quality and removal of large quantities of water from the Colorado River system. Dams on the main stem Colorado River and its major tributaries have fragmented populations and blocked migration routes. Dams also have drastically altered flows, water 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 nonnative fishes, many of which have thrived due to man-induced changes to the natural riverine system. Habitat has been significantly degraded to a point where it impairs the essential life history functions of razorback sucker, such as reproduction and recruitment into the adult population. The threats to razorback sucker are essentially the same threats identified for Colorado pikeminnow.

The razorback sucker recovery goals identified streamflow regulation, habitat modification, predation by nonnative fish species, and pesticides and pollutants including selenium as the primary threats to the species (Service 2002b). Within the upper Colorado River Basin, recovery efforts include the capture and removal of razorback suckers from all known locations for genetic analyses and development of brood stocks. In the short term, augmentation (stocking) may be the only means to prevent the extirpation of razorback sucker in the upper Colorado River Basin. However, in the long term it is expected that natural reproduction and recruitment will occur. A genetics management plan and augmentation plan have been written for the razorback sucker (Crist and Ryden 2003, Ryden 2003a, Nesler et al. 2003).

Many species of nonnative fishes occur in occupied habitat of the razorback sucker. These nonnative fishes are predators, competitors, and vectors of parasites and diseases (Tyus et al. 1982, Lentsch et al. 1996, Pacey and Marsh 1999, Marsh et al. 2001). Many researchers believe that nonnative species are a major cause for the lack of recruitment and that nonnative fish are the most important biological threat to the razorback sucker (e.g., McAda and Wydoski 1980, Minckley 1983, Tyus 1987, Service 1998a, Muth et al. 2000). There are reports of predation of razorback sucker eggs and larvae by common carp (*Cyprinus carpio*), channel catfish, smallmouth bass (*Micropterus dolomieui*), largemouth bass, bluegill (*Lepomis macrochirus*), green sunfish, and red-ear sunfish (*Lepomis microlophus*) (Jonez and Sumner 1954, Marsh and Langhorst 1988, Langhorst 1989). Marsh and Langhorst (1988) found higher growth rates in larval razorback sucker in the absence of predators in Lake Mohave, and Marsh and Brooks (1989) reported that channel catfish and flathead catfish were major predators of stocked razorback sucker in the Gila River. Juvenile razorback sucker stocked in isolated coves along the Colorado River in California suffered extensive predation by channel catfish and largemouth bass (Langhorst 1989). Predation upon a recently-stocked razorback sucker by an adult channel catfish was documented in the San Juan River (Jackson 2005). Aggressive behavior between channel catfish and adult razorback sucker has been inferred from the presence of distinct bite marks on the dorsal keels of four razorback suckers that match the bite characteristics of channel catfish (Ryden 2004a).

Lentsch et al. (1996) identified six species of nonnative fishes in the upper Colorado River Basin as threats to razorback sucker: red shiner, common carp, sand shiner, fathead minnow, channel catfish, and green sunfish. Smaller fish, such as adult red shiner, are known predators of larval native fish (Ruppert et al. 1993). Large predators, such as walleye (*Stizostedion vitreum*), northern pike, and striped bass (*Morone saxatilis*), also pose a threat to subadult and adult razorback sucker (Tyus and Beard 1990). Current nonnative fish management in the upper Colorado River Basin has focused on three species: northern pike, smallmouth bass, and channel catfish, which compete with and prey on the endangered and native fish species (see the Threats section under Colorado pikeminnow above). In addition, the Recovery Program is experimenting with the removal of nonnative white sucker (*Catostomus commersoni*), which is know to hybridize with the razorback sucker and the other native suckers.

Critical Habitat

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 FR 13374). The PCEs are the same as critical habitat for Colorado pikeminnow described previously, as is the status of the PCEs. We designated 15 reaches of the Colorado River system as critical habitat for the razorback sucker. These reaches total 1,724 miles as measured along the center line of the river within the subject reaches. The designation represents approximately 49 percent of the historical habitat for the species and includes reaches of the Green, Yampa, Duchesne, Colorado, White, Gunnison, and San Juan Rivers:

Moffat County, Colorado. The Yampa River and its 100-year floodplain from the mouth of Cross Mountain Canyon in T. 6 N., R. 98 W., section 23 (6th Principal Meridian) to the confluence with the Green River in T. 7 N., R. 103 W., section 28 (6th Principal Meridian).

Uintah County, Utah; and Moffat County, Colorado. The Green River and its 100-year floodplain from the confluence with the Yampa River in T. 7 N., R. 103 W., section 28 (6th Principal Meridian) to Sand Wash in T. 11 S., R. 18 E., section 20 (6th Principal Meridian).

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

Uintah County, Utah. The White River and its 100-year floodplain from the boundary of the Uintah and Ouray Indian Reservation at RM 18 in T. 9 S., R. 22 E., section 21 (Salt Lake

Meridian) to the confluence with the Green River in T. 9 S., R 20 E., section 4 (Salt Lake Meridian).

Uintah County, Utah. The Duchesne River and its 100-year floodplain from RM 2.5 in T. 4 S., R. 3 E., section 30 (Salt Lake Meridian) to the confluence with the Green River in T. 5 S., R. 3 E., section 5 (Uintah Meridian).

Delta and Mesa Counties, Colorado. 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).

Mesa and Garfield Counties, Colorado. 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).

Grand, San Juan, Wayne, and Garfield Counties, Utah. 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).

San Juan County; and Utah, San Juan County, New Mexico. The San Juan River and its 100-year floodplain from the Hogback Diversion in T. 29 N., R. 16 W., section 9 (New Mexico Meridian) to the full pool elevation at the mouth of Neskahai Canyon on the San Juan arm of Lake Powell in T. 41 S., R. 11 E., section 26 (Salt Lake Meridian).

Species/Critical Habitat Likely to be Affected

The razor back sucker and portions of its critical habitat, as described below, are likely to be adversely affected by the subject Project:

Mesa and Garfield Counties, Colorado. 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). The action area starts on the Colorado River below the confluence with the Gunnison River.

Delta and Mesa Counties, Colorado. 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). The subject Project occurs within this reach of critical habitat.

Grand, San Juan, Wayne, and Garfield Counties, Utah. 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).

Recovery

Objective, measurable criteria for recovery of razorback sucker in the Colorado River System are presented for each of two recovery units (i.e., the upper basin, including the Green River, upper Colorado River, and San Juan River subbasins; and the lower basin, including the mainstem and its tributaries from Glen Canyon Dam downstream to the southerly International Boundary with Mexico) because of different recovery or conservation programs and to address unique threats and site-specific management actions and tasks necessary to minimize or remove those threats. Recovery of the species is considered necessary in both the upper and lower basins because of the present status of populations and existing information on razorback sucker biology. Self-sustaining populations will need to be established through augmentation. Without viable wild populations, there are many uncertainties associated with recovery of razorback sucker. These recovery goals are based on the best available scientific information, and are structured to attain a balance between the criteria and ensuring the viability of the species beyond delisting. These recovery criteria will need to be reevaluated and revised after self-sustaining populations are established and there is improved understanding of razorback sucker biology.

Downlisting can occur if, over a 5-year period: (1) genetically and demographically viable, self-sustaining populations are maintained in the Green River subbasin and **EITHER** in the upper Colorado River subbasin (including the Gunnison River) or the San Juan River subbasin such that — (a) the trend in adult (age 4+; ≥ 400 mm TL) point estimates for each of the two populations does not decline significantly, and (b) mean estimated recruitment of age-3 (300–399 mm TL) naturally produced fish equals or exceeds mean annual adult mortality for each of the two populations, and (c) each point estimate for each of the two populations exceeds 5,800 adults (5,800 is the estimated minimum viable population [MVP] needed to ensure long-term genetic and demographic viability); and (2) a genetic refuge is maintained in Lake Mohave of the lower basin recovery unit; and (3) two genetically and demographically viable, self-sustaining populations are maintained in the lower basin recovery unit (e.g., mainstem and/or tributaries) such that — (a) the trend in adult point estimates for each population does not decline significantly, and (b) mean estimated recruitment of age-3 naturally produced fish equals or exceeds mean annual adult mortality for each population, and (c) each point estimate for each population exceeds 5,800 adults; and (4) when certain site-specific management tasks to minimize or remove threats have been identified, developed, and implemented.

Delisting can occur if, over a 3-year period beyond downlisting: (1) genetically and demographically viable, self-sustaining populations are maintained in the Green River subbasin and **EITHER** in the upper Colorado River subbasin or the San Juan River subbasin such that — (a) the trend in adult point estimates for each of the two populations does not decline significantly, and (b) mean estimated recruitment of age-3 naturally produced fish equals or exceeds mean annual adult mortality for each of the two populations, and (c) each point estimate for each of the two populations exceeds 5,800 adults; and (2) a genetic refuge is maintained in

Lake Mohave; and (3) two genetically and demographically viable, self-sustaining populations are maintained in the lower basin recovery unit such that — (a) the trend in adult point estimates for each population does not decline significantly, and (b) mean estimated recruitment of age-3 naturally produced fish equals or exceeds mean annual adult mortality for each population, and (c) each point estimate for each population exceeds 5,800 adults; and (4) when certain site-specific management tasks to minimize or remove threats have been finalized and implemented, and necessary levels of protection are attained.

Conservation plans will go into effect at delisting to provide for long-term management and protection of the species, and to provide reasonable assurances that recovered razorback sucker populations will be maintained without the need for relisting. Elements of those plans could include (but are not limited to) provision of flows for maintenance of habitat conditions required for all life stages, regulation and/or control of nonnative fishes, minimization of the risk of hazardous-materials spills, and monitoring of populations and habitats. Signed agreements among State agencies, Federal agencies, American Indian tribes, and other interested parties must be in place to implement the conservation plans before delisting can occur.

Management Actions Needed or Ongoing:

1 Reestablish populations with hatchery-produced fish.
2 Identify and maintain genetic variability of razorback sucker in Lake Mohave.
3 Provide and legally protect habitat (including flow regimes necessary to restore and maintain required environmental conditions) necessary to provide adequate habitat and sufficient range for all life stages to support recovered populations.
4 Provide passage over barriers within occupied habitat to allow unimpeded movement and, potentially, range expansion.
5 Investigate options for providing appropriate water temperatures in the Gunnison River.
6 Minimize entrainment of subadults and adults at diversion/out-take structures.
7 Ensure adequate protection from overutilization.
8 Ensure adequate protection from diseases and parasites.
9 Regulate nonnative fish releases and escapement into the main river, floodplain, and tributaries.
10 Control problematic nonnative fishes as needed.
11 Minimize the risk of hazardous-materials spills in critical habitat.
12 Remediate water-quality problems, such as selenium.
13 Minimize the threat of hybridization with white sucker.
14 Provide for the long-term management and protection of populations and their habitats beyond delisting (i.e., conservation plans).

HUMPBACK CHUB

Species 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 1940s (Miller 1946), presumably because of its restricted distribution in remote white water canyons (USFWS 1990b). Because it was described only after considerable changes in the river system had occurred, the original distribution of this species is not known. The humpback chub was listed as endangered on March 11, 1967.

Status and Distribution

The humpback chub is listed as endangered under the ESA. The species is endemic to the Colorado River System of the southwestern United States. Adults attain a maximum size of about 480 mm total length (TL) and 1.2 kg in weight. Six extant wild populations are known: (1) Black Rocks, Colorado River, Colorado; (2) Westwater Canyon, Colorado River, Utah; (3) Yampa Canyon, Yampa River, Colorado; (4) Desolation/Gray Canyons, Green River, Utah; (5) Cataract Canyon, Colorado River, Utah; and (6) Marble and Grand Canyons, Colorado River, and the Little Colorado River, Arizona. The first five populations are in the Upper Colorado River Basin (i.e., upstream of Glen Canyon Dam, Arizona) and the sixth population is in the Lower Colorado River Basin.

Historic abundance of the humpback chub is unknown, but is surmised from various reports and collections that indicate the species presently occupies about 68% of its historic habitat of about 756 km of river. The species exists primarily in relatively inaccessible canyons of the Colorado River System and was rare in early collections (Tyus 1998). Common use of the name "bonytail" for all six Colorado River species or subspecies of the genus *Gila* confounded an accurate early assessment of distribution and abundance (Holden and Stalnaker 1975a, 1975b; Valdez and Clemmer 1982; Minckley 1996). Of three closely related and sympatric *Gila* species, the roundtail chub (*G. robusta*) and bonytail (*G. elegans*) were described in 1853 by Baird and Girard (Sitgreaves 1853; Girard 1856), but the humpback chub was the last big-river fish species to be described from the Colorado River System in 1946 (Miller 1946). Also, extensive human modifications throughout the system prior to faunal surveys may have depleted or eliminated the species from some river reaches before its occurrence was documented.

Earliest collections of humpback chub are anecdotal and related to early explorations of the Colorado River System that pre-date the species description of 1946. In 1911, Elsworth and Emory Kolb (Kolb and Kolb 1914) reported a large aggregation of *"bony tail"* in the lower Little Colorado River (LCR) in Grand Canyon; photographs show that the fish were humpback chub. A specimen in the fish collection at Grand Canyon National Park, caught in 1932 by angler N.N.

Dodge at Bright Angel Creek, was examined in fall 1942 and used as the holotype for the species description (Miller 1946), along with a second specimen of unknown origin. In the 1940's, five specimens of humpback chub were collected from the Grand Canyon region along with 16 specimens of *G. elegans* and six *G. robusta* (Miller 1944; Bookstein et al. 1985). In 1950, juvenile humpback chub were reported from Spencer Creek in lower Grand Canyon (Wallis 1951; Kubly 1990), but ichthyofaunal surveys in 1958–1959 (McDonald and Dotson 1960) failed to find humpback chub immediately upstream in the gentle meandering reaches of Glen Canyon.

Following completion of Glen Canyon Dam in 1963, humpback chub were consistently reported by Arizona Game and Fish Department creel surveys from Lees Ferry during 1963–1968 (Stone 1964, 1966; Stone and Queenan 1967; Stone and Rathbun 1968). However, Stone and Rathbun (1968) failed to find humpback chub in seven tributaries sampled between Lees Ferry and Lake Mead in 1968, excluding the LCR. Humpback chub were captured in July 1967 and August 1970 (Holden and Stalnaker 1975a), all within *"...a few hundred meters downstream of Glen Canyon Dam"* (personal communication, P. Holden, Bio/West, Inc.). Humpback chub have not been captured in this reach since the dam began releasing cold hypolimnetic waters in about 1970. Humpback chub have consistently been reported in the LCR and Colorado River in Grand Canyon since 1967 as a result of better sampling gear and a better understanding of the life history of the species (Stone and Rathbun 1968; Miller and Smith 1972; Holden and Stalnaker 1975a; Suttkus et al. 1976; Minckley and Blinn 1976; Suttkus and Clemmer 1977; Carothers et al. 1981; Kaeding and Zimmerman 1983; Maddux et al. 1987; Valdez and Ryel 1995; Arizona Game and Fish Department 1996; Douglas and Marsh 1996; Coggins et al. 2006a, 2006b).

Humpback chub were first reported in the Upper Colorado River System in the 1940's from Castle Park, Yampa River, Colorado, in June and July 1948 (Tyus 1998). Pre-impoundment surveys of Flaming Gorge Dam on the Green River in 1958–1959 (Bosley 1960; Gaufin et al. 1960; McDonald and Dotson 1960) treated all *Gila* as *"bonytail"*, which were common downstream of Green River, Wyoming. Humpback chub were reported from Hideout Canyon in the upper Green River (Smith 1960), although a checklist of fish killed by a massive rotenone operation from Hideout Canyon to Brown's Park in September 1962 stated that *"...no humpback chub were collected..."* (Binns 1967). Post-impoundment investigations (Vanicek et al. 1970) reported three humpback chub from the Green River downstream of Flaming Gorge Dam; one each from Echo Park, Island Park, and Swallow Canyon. Specimens were collected in Desolation Canyon on the Green River in 1967 (Holden and Stalnaker 1970), in Yampa Canyon in 1969 (Holden and Stalnaker 1975b), in Cross Mountain Canyon of the Yampa River in the 1970's (personal communication, C. Haynes), and an individual specimen was reported from the White River in Utah in the 1950's (Sigler and Miller 1963). Seven suspected humpback chub were captured in the Little Snake River, a tributary of the Yampa River, in 1988 (Wick et al. 1991). Surveys downstream of Flaming Gorge Dam, including Lodore Canyon, have not yielded humpback chub in that region of the Green River, despite warmer dam releases (Holden and Crist 1981; Bestgen and Crist 2000; Bestgen et al. 2005, 2006a). Eight humpback chub were captured in Whirlpool Canyon, downstream of the Yampa River confluence, from 2002 to 2004 (Bestgen et al. 2006a).

Five specimens were reported from Lake Powell in the late 1960's (Holden and Stalnaker 1970) following completion of Glen Canyon Dam in 1963 and impoundment of the upper Colorado

River through Glen, Narrow, and Cataract canyons. Reproducing populations of humpback chub were first reported from Black Rocks, Colorado in 1977 (Kidd 1977), and from Westwater and Cataract canyons, Utah, in 1979 (Valdez et al. 1982; Valdez and Clemmer 1982).

Six humpback chub populations are currently identified: (1) Black Rocks, Colorado; (2) Westwater Canyon, Utah; (3) LCR and Colorado rivers in Grand Canyon, Arizona; (4) Yampa Canyon, Colorado; (5) Desolation/Gray Canyons, Utah; and (6) Cataract Canyon, Utah (Valdez and Clemmer 1982; U.S. Fish and Wildlife Service 1990a). Each population consists of a discrete group of fish, geographically separated from the other populations, but with some exchange of individuals. River length occupied by each population varies from 3.7 km in Black Rocks to 73.6 km in Yampa Canyon.

The Recovery Goals (Service 2002c; Figure 3) provide a summary of habitat occupied by humpback chub and limits to its distribution.

Population estimates for humpback chub using mark-recapture estimators began in 1998 with the Black Rocks and Westwater Canyon populations (Figure A-1). A frequency pattern of 3 years of annual estimates followed by 2 years with no estimates was recommended at two population estimates workshops to minimize excessive handling of fish (UCRRP 2006). Hence, population estimates in Black Rocks and Westwater Canyon were conducted during 1998-2000 and 2003-2005. These estimates show the Black Rocks population between about 1,000 and 2,000 adults (age 4+) and the Westwater Canyon population between about 1,700 and 5,100 adults (McAda 2002, 2004, 2006; Hudson and Jackson 2003; Jackson 2004). Population estimates for Desolation/Gray Canyon in 2001-2003 show the population between about 1,000 and 2,600 adults (Jackson and Hudson 2005). The Cataract Canyon and Yampa Canyon populations were estimated at about 100 and 400 adults, respectively (Valdez and Badame 2005; Finney 2006).

Population estimates for humpback chub in Grand Canyon are based on an age-structured mark-recapture analysis (ASMR) that uses capture histories from PIT-tagged fish dating to 1989. These estimates are based on constant mortality and variable mortality models for age 4+ fish ($\geq$ 200 mm TL; Coggins et al. 2006a, 2006b; Coggins 2008). Earliest estimates are based on small numbers of marks and recaptures and have wide confidence intervals. These estimates show a decline in the population with the lowest estimate of between 2,400 and 4,400 age 4+ fish in 2001. Recent estimates suggest that the population of adults may be stabilizing and improving after more than a decade of decline (U.S. Geological Survey 2006, 2007). Between 2001 and 2005, the number of adult fish appears to have stabilized at an estimated 5,000 adults. In 2005, scientists also detected more juveniles (age 1 to 4) and young-of-year than previous years indicating good future recruitment. Based on this ASMR analysis and the earliest independent mark-recapture estimates of PIT-tagged humpback chub in Grand Canyon (Valdez and Ryel 1995; Douglas and Marsh 1996), the population associated with the LCR Inflow was probably stabilized at around 6,000 adults (Coggins 2008). A population of 5,000 to 6,000 means this core population far exceeds the MVP of 2,100. Further minimization of threats to the species in Grand Canyon should allow this population to increase.

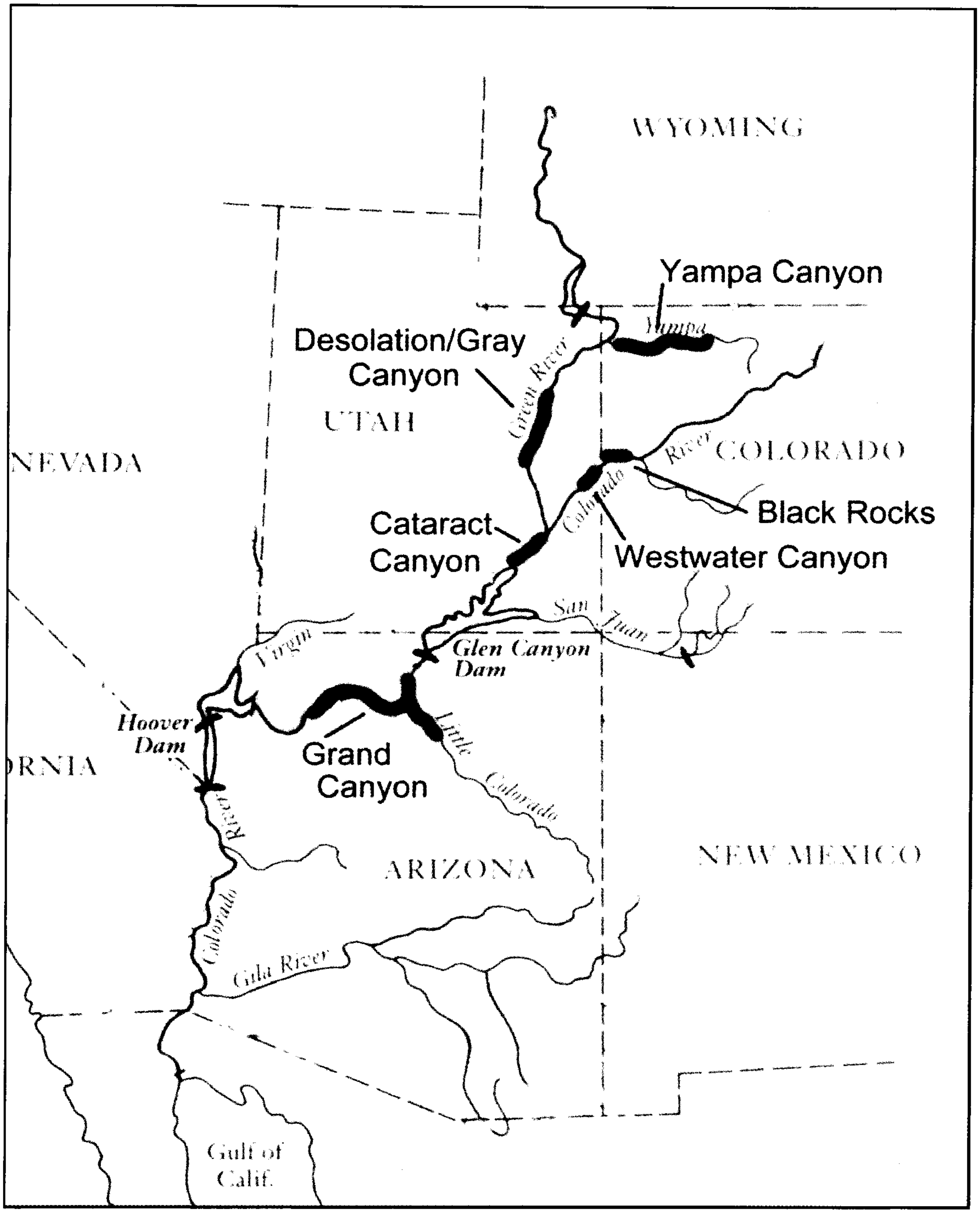


Figure 4. Distribution of humpback chub in the Colorado River System.

Life History

Unlike Colorado pikeminnow and razorback sucker, which are known to make extended migrations of up to several hundred miles to spawning areas in the Green and Yampa rivers, humpback chubs in the Green River do not appear to make extensive migrations (Karp and Tyus

1990). Generally, humpback chub show fidelity for canyon reaches and move very little (Miller et al. 1982; Valdez and Clemmer 1982; Archer et al. 1985; Burdick and Kaeding 1985; Kaeding et al. 1990; Chart and Lentsch 1999a; Chart and Lentsch 1999b). Movements of adult humpback chub in Black Rocks on the Colorado River were essentially restricted to a 1-mile reach. These results were based on the recapture of Carlin-tagged fish and radiotelemetry studies conducted from 1979 to 1981 (Valdez et al. 1982) and 1983 to 1989 (Archer et al. 1985; Kaeding et al. 1990). 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 1999a).

Tyus and Karp (1991) found that in the Yampa and Green rivers in Dinosaur National Monument, humpback chubs spawn during spring and early summer following peak flows at water temperatures of about 20° C. They estimated that the spawning period for humpback chub ranges from May into July, with spawning occurring earlier in low-flow years and later in high-flow years; spawning was thought to occur only during a 4–5 week period (Karp and Tyus 1990). Similar to the Yampa and Green rivers, peak hatch of *Gila* larvae in Westwater Canyon on the Colorado River appears to occur on the descending limb of the hydrograph following spring runoff at maximum daily water temperatures of approximately 20 to 21° C (Chart and Lentsch 1999a). Tyus and Karp (1989) reported that humpback chubs occupy and spawn in and near shoreline eddy habitats and that spring peak flows were important for reproductive success because availability of these habitats is greatest during spring runoff.

High spring flows that simulate the magnitude and timing of the natural hydrograph provide a number of benefits to humpback chubs in the Yampa and Green rivers. Bankfull and overbank flows provide allochthonous energy input to the system in the form of terrestrial organic matter and insects that are utilized as food. High spring flows clean spawning substrates of fine sediments and provide physical cues for spawning. High flows also form large recirculating eddies used by adult fish. High spring flows (50 percent exceedance or greater) have been implicated in limiting the abundance and reproduction of some nonnative fish species under certain conditions (Chart and Lentsch 1999a, 1999b) and have been correlated with increased recruitment of humpback chubs (Chart and Lentsch 1999b).

In the Green River and upper Colorado River, humpback chubs spawned in spring and summer as flows declined shortly after the spring peak (Valdez and Clemmer 1982; Valdez et al. 1982; Kaeding and Zimmerman 1983; Tyus and Karp 1989; Karp and Tyus 1990; Chart and Lentsch 1999a, 1999b). Similar spawning patterns were reported from Grand Canyon (Kaeding and Zimmerman 1983; Valdez and Ryel 1995, 1997). Little is known about spawning habitats and behavior of humpback chub. Although humpback chub are believed to broadcast eggs over mid-channel cobble and gravel bars, spawning in the wild has not been observed for this species. Gorman and Stone (1999) reported that ripe male humpback chubs in the Little Colorado River aggregated in areas of complex habitat structure (i.e., matrix of large boulders and travertine masses combined with chutes, runs, and eddies, 0.5–2.0 m deep) and were associated with deposits of clean gravel.

Muth et al. (2000) summarized flow and temperature needs of humpback chub in the Green River subbasin as:

> "...The habitat requirements of the humpback chub are incompletely understood. It is known that fish spawn on the descending limb of the spring hydrograph at temperatures greater than 17° C. Rather than migrate, adults congregate in near-shore eddies during spring and spawn locally. They are believed to be broadcast spawners over gravel and cobble substrates. Young humpback chubs typically use low-velocity shoreline habitats, including eddies and backwaters, that are more prevalent under base-flow conditions. After reaching approximately 40-50 mm TL, juveniles move into deeper and higher-velocity habitats in the main channel.
>
> Increased recruitment of humpback chubs in Desolation and Gray Canyons was correlated with moderate to high water years from 1982 to 1986 and in 1993 and 1995. Long, warm growing seasons, which stimulate fish growth and a low abundance of competing and predatory nonnative fishes also have been implicated as potential factors that increase the survival of young humpback chubs.
>
> High spring flows increase the availability of the large eddy habitats utilized by adult fish. High spring flows also maintain the complex shoreline habitats that are used as nursery habitat by young fish during subsequent base flows. Low-velocity nursery habitats that are used by young fish are warmer and more productive at low base flows."

Newly hatched larvae average 6.3–7.5 mm TL (Snyder 1981, Behnke and Benson 1983, Muth 1990), and 1-month-old fish are approximately 20 mm long (Hamman 1982). Unlike Colorado pikeminnow and razorback sucker, no evidence exists of long-distance larval drift (Miller and Hubert 1990; Robinson et al. 1998). Upon emergence from spawning gravels, humpback chub larvae remain in the vicinity of bottom surfaces (Marsh 1985) near spawning areas (Chart and Lentsch 1999a).

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. In the Grand Canyon, nearly all fish smaller than 100 mm TL were captured near shore, whereas most fish larger than this were captured in offshore habitats (Valdez and Ryel 1995).

Valdez et al. (1982) and Wick et al. (1981) found adult humpback chub in Black Rocks and Westwater Canyons in water averaging 50 feet in depth with a maximum depth of 92 feet. In these localities, humpback chub were associated with large boulders and steep cliffs. Valdez and Ryel (1997) captured or located adults most often in large recirculating eddies.

<u>Threats to the Species</u>

Although historic data are limited, the presumed range-wide decline in humpback chub is likely due to a combination of factors including alteration of river habitats by reservoir inundation, changes in stream discharge and temperature, competition with and predation by introduced fish species, and other factors such as changes in food resources resulting from stream alterations (Service 1990a).

The primary threats to humpback chub are stream flow regulation, water depletions, and habitat modification (affecting constituent elements: water and physical habitat); competition with and predation by nonnative fishes; parasitism; hybridization with other native *Gila* species; and pesticides and pollutants (Service 2002c) (all affecting constituent element: biological environment). The existing habitat, altered by these threats, has been modified to the extent that it impairs essential behavior patterns, such as breeding, feeding, and sheltering. The threats to humpback chub in relation to flow regulation, water depletions and habitat modification, predation by nonnative fishes, and pesticides and pollutants are essentially the same threats identified for Colorado pikeminnow.

The humpback chub population in the Grand Canyon is threatened by predation from nonnative trout in the Colorado River below Glen Canyon Dam. This population is also threatened by the Asian tapeworm reported in humpback chub in the Little Colorado River (Service 2002c). No Asian tapeworms have been reported in the upper basin populations. In Grand Canyon, brown trout (*Salmo trutta*), channel catfish (*Ictalurus punctatus*), black bullhead (*Ameiurus melas*), and rainbow trout (*Oncorhynchus mykiss*) have been identified as principal predators of juvenile humpback chub, with consumption estimates that suggest loss of complete year classes to predation (Marsh and Douglas 1997; Valdez and Ryel 1997). Valdez and Ryel (1997) also suggested that common carp (*Cyprinus carpio*) could be a significant predator of incubating humpback chub eggs in the lower Colorado River. In the upper basin, Chart and Lentsch (2000) identified channel catfish as the principal predator of humpback chub in Desolation and Gray Canyons. The Upper Colorado River Recovery Plan identified channel catfish as the principal predator of humpback chub in Yampa Canyon and is pursuing development and implementation of a control program (Service 2002c). Current nonnative fish management in the upper Colorado River Basin has focused on three species: northern pike, smallmouth bass, and channel catfish, which compete with and prey on the endangered and native fish species (see the Threats section under Colorado pikeminnow above).

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.

Hybridization with roundtail chub (*Gila robusta*) and bonytail, where they occur with humpback chub, is recognized as a threat to humpback chub. A larger proportion of roundtail chub have been found in Black Rocks and Westwater Canyon during low flow years (Kaeding et al. 1990, Chart and Lentsch 2000), which increase the chances for hybridization.

<u>Critical Habitat</u>
Critical habitat was designated in 1994 within humpback chub historical range in the following sections of the upper Colorado River (59 FR 13374). The PCEs are the same as those described for the Colorado pikeminnow, as is the status of the PCEs. We designated seven reaches of the Colorado River system for a total of 379 miles as measured along the center line of the subject

reaches. The designation represents approximately 28 percent of the suspected historical habitat of the species and includes reaches in the Colorado, Green, and Yampa Rivers in the Upper Basin:

Moffat County, Colorado. The Yampa River from the boundary of Dinosaur National Monument in T. 6 N., R. 99 W., section 27 (6th Principal Meridian) to the confluence with the Green River in T. 7 N., R. 103 W., section 28 (6th Principal Meridian).

Uintah County; and Colorado, Moffat County, Utah. The Green River from the confluence with the Yampa River in T. 7 N., R. 103 W., section 28 (6th Principal Meridian) to the southern boundary of Dinosaur National Monument in T. 6 N., R. 24 E., section 30 (Salt Lake Meridian).

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

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

Garfield and San Juan Counties, Utah. 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).

Species/Critical Habitat Likely to be Affected

The humpback chub and its critical habitat, as described below, are likely to be adversely affected by the subject Project. Although the Project does not occur within the designated critical habitat for the humpback chub, the Project depletion would adversely affect critical habitat by reducing the amount of water flowing into designated critical habitat:

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

Garfield and San Juan Counties, Utah. 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).

Recovery

Objective, measurable criteria for recovery of humpback chub in the Colorado River System are presented for each of two recovery units (i.e., the upper basin, including the Green River and upper Colorado River subbasins; and the lower basin, including the mainstem and its tributaries from Glen Canyon Dam downstream to Lake Mead National Recreation Area). These recovery units have different recovery or conservation programs and need to address unique threats and site-specific management actions and tasks necessary to minimize or remove threats to the species. Recovery of the species is considered necessary in both the upper and lower basins because of the need for multiple, redundant populations. The humpback chub was listed prior to the 1996 distinct population segment (DPS) policy, and the U.S. Fish and Wildlife Service (Service) may conduct an evaluation to designate DPSs in a future rule-making process. If DPSs are designated, criteria for recovery of humpback chub will need to be reevaluated. These recovery goals are based on the best available scientific information, and are structured to attain a balance between reasonably achievable criteria (which include an acceptable level of uncertainty) and ensuring the viability of the species beyond delisting. Additional data and improved understanding of humpback chub biology may prompt additional revision of these recovery goals.

Downlisting can occur if, over a 5-year period: (1) the trend in adult (age 4+; ≥ 200 mm TL) point estimates for each of the six extant populations does not decline significantly; and (2) mean estimated recruitment of age-3 (150–199 mm TL) naturally produced fish equals or exceeds mean annual adult mortality for each of the six extant populations; and (3) two genetically and demographically viable, self-sustaining core populations are maintained, such that each point estimate for each core population exceeds 2,100 adults (2,100 is the estimated minimum viable population [MVP] needed to ensure long-term genetic and demographic viability); and (4) when site-specific management tasks to minimize or remove threats have been identified, developed, and implemented.

Delisting can occur if, over a 3-year period beyond downlisting: (1) the trend in adult point estimates for each of the six extant populations does not decline significantly; and (2) mean estimated recruitment of age-3 naturally produced fish equals or exceeds mean annual adult mortality for each of the six extant populations; and (3) three genetically and demographically viable, self-sustaining core populations are maintained, such that each point estimate for each core population exceeds 2,100 adults; and (4) when certain site-specific management tasks to minimize or remove threats have been finalized and implemented, and necessary levels of protection are attained.

Conservation plans will go into effect at delisting to provide for long-term management and protection of the species, and to provide reasonable assurances that recovered humpback chub populations will be maintained without the need for relisting. Elements of those plans could include (but are not limited to) provision of flows for maintenance of habitat conditions required for all life stages, regulation and/or control of nonnative fishes, minimization of the risk of hazardous-materials spills, and monitoring of populations and habitats. Signed agreements among State agencies, Federal agencies, American Indian tribes, and other interested parties must be in place to implement the conservation plans before delisting can occur.

Management Actions Needed and Ongoing:

1. Provide and legally protect habitat (including flow regimes necessary to restore and maintain required environmental conditions) necessary to provide adequate habitat and sufficient range for all life stages to support recovered populations.
2. Investigate and clarify the role of the mainstem Colorado River in maintaining the

Grand Canyon population.

3. Investigate the anticipated effects of and options for providing warmer water temperatures in the mainstem Colorado River through Grand Canyon.
4. Ensure adequate protection from overutilization.
5. Ensure adequate protection from diseases and parasites.
6. Regulate nonnative fish releases and escapement into the mainstem, floodplain, and tributaries.
7. Control problematic nonnative fishes as needed.
8. Minimize the risk of increased hybridization among *Gila* spp.
9. Minimize the risk of hazardous-materials spills in critical habitat.
10. Provide for the long-term management and protection of populations and their habitats beyond delisting (i.e., conservation plans).

BONYTAIL

Species 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. The head is small and compressed compared to the rest of the body. The mouth is slightly overhung by the snout and there is a smooth low hump behind the head that is not as pronounced as the hump on a humpback chub.

Status and Distribution

The bonytail is listed as endangered under the ESA. The species is endemic to the Colorado River System of the southwestern United States. Adults attain a maximum size of about 550 mm total length (TL) and 1.1 kg in weight. An unknown, but small number of wild adults exist in Lake Mohave on the mainstem Colorado River of the Lower Colorado River Basin (i.e., downstream of Glen Canyon Dam, Arizona), and there are small numbers of wild individuals in the Green River and upper Colorado River subbasins of the Upper Colorado River Basin.

The bonytail is endemic to the Colorado River Basin and was historically common to abundant in warm-water reaches of larger rivers of the basin from Mexico to Wyoming. The species experienced a dramatic, but poorly documented, decline starting in about 1950, following construction of several mainstem dams, introduction of nonnative fishes, poor land-use practices, and degraded water quality (Service 2002d).

The bonytail is the rarest native fish in the Colorado River. Little is known about its specific habitat requirements or cause of decline, because the bonytail was extirpated from most of its historic range prior to extensive fishery surveys. It was listed as endangered on April 23, 1980. Currently, no self-sustaining populations of bonytail are known to exist in the wild, and very few individuals have been caught anywhere within the basin. Since 1977, only 11 wild adults have been reported from the upper basin (Valdez et al. 1994).

Formerly reported as widespread and abundant in mainstem rivers (Jordan and Evermann 1896), its populations have been greatly reduced. Remnant populations presently occur in the wild in low numbers in Lake Mohave and several fish have been captured in Lake Powell and Lake Havasu (Service 2002d). The last known riverine area where bonytail were common was the Green River in Dinosaur National Monument, where Vanicek (1967) and Holden and Stalnaker (1970) collected 91 specimens during 1962-1966. From 1977 to 1983, no bonytail were collected from the Colorado or Gunnison rivers in Colorado or Utah (Wick et al. 1981, Valdez et al. 1982; 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).

Bonytail were extirpated between Flaming Gorge Dam and the Yampa River, primarily because of rotenone poisoning and cold-water releases from the dam (Service 2002c). Surveys from 1964 to 1966 found large numbers of bonytail in the Green River in Dinosaur National Monument downstream of the Yampa River confluence (Vanicek and Kramer 1969). Surveys from 1967 to 1973 found far fewer bonytail (Holden and Stalnaker 1975). Few bonytail have been captured after this period, and the last recorded capture in the Green River was in 1985 (Service 2002d). Bonytail are so rare that it is currently not possible to conduct population estimates.

The map below of the recent distribution of wild bonytail in the Colorado River basin was reproduced from the Bonytail Recovery Goals (Service 2002d, Fig. 4).

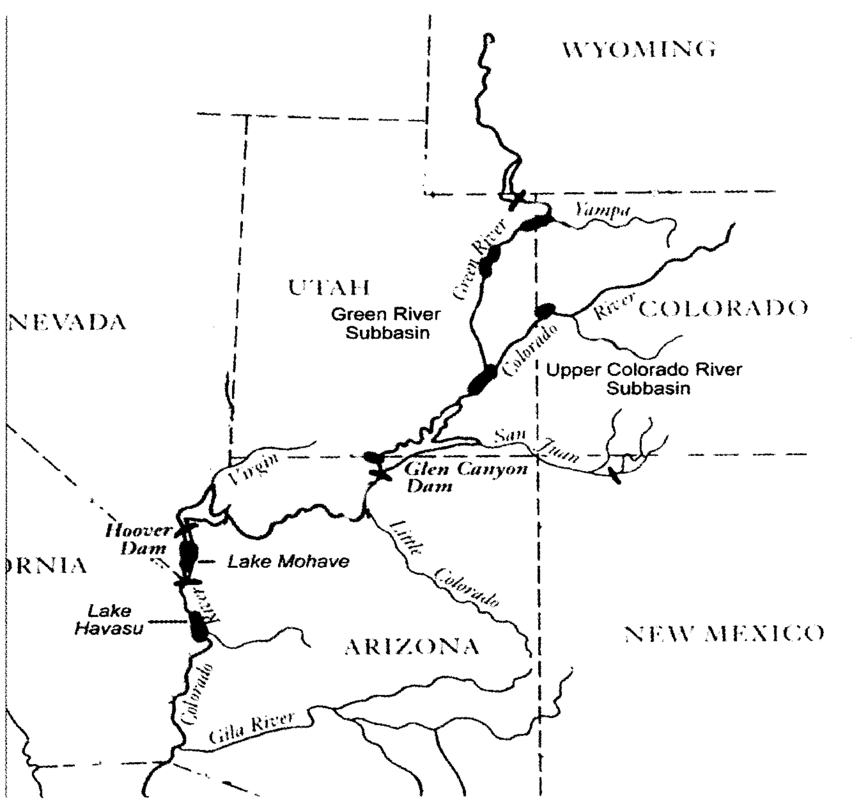


Figure 5. Recent distribution of wild bonytail in the Colorado River System.

Approximately 130,000 hatchery-produced F_1 and F_2 fish were released into Lake Mohave between 1981 and 1987 as part of an effort by the Service to prevent extinction and promote eventual recovery of the species. Younger bonytail of adult size and spawning ability have been collected from the reservoir in the 1990's along with the old adults of the founder population. It is unknown whether these younger adults are from the original stockings or a result of natural reproduction. Releases of hatchery-reared adults into riverine reaches in the upper basin have resulted in low survival (Chart and Cranney 1991), with no evidence of reproduction or recruitment.

The current stocking plan (Nesler et al. 2003) calls for bonytail to be stocked in the middle Green, lower Yampa and Colorado Rivers. The middle Green River and the Yampa River in Dinosaur National Monument have been identified as the highest priority for stocking. The only known bonytail that presently occur in the Yampa River are the individuals recently reintroduced at Echo Park, near the confluence with the Green River.

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). Of five specimens captured most recently in the upper basin, four were captured in deep, swift, rocky canyons (Yampa Canyon, Black Rocks, Cataract Canyon, and Coal Creek Rapid), but the fifth was taken in Lake Powell. Since 1974, all bonytails captured in the lower basin were caught in reservoirs. It has been suggested that the large fins and streamlined body of the bonytail is an adaptation to torrential flows (Miller 1946).

Little is known of the food habits of the bonytail. McDonald and Dotson (1960) reported that *"Colorado chub"* were largely omnivorous with a diet of terrestrial insects, plant matter, and fish. Several chubs were observed feeding on floating masses of debris washed by heavy rainfall. Vanicek (1967) reported that *"Colorado chubs"* fed mainly on terrestrial insects (mostly adult beetles and grasshoppers), plant debris, leaves, stems, and woody fragments.

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). Similar to other closely related *Gila* species, bonytail probably spawn in rivers in spring over rocky substrates; spawning has been observed in reservoirs over rocky shoals and shorelines. It has been recently hypothesized that flooded bottomlands may provide important bonytail nursery habitat.

In the Green River, Vanicek (1967) reported that bonytails were generally found in pools and eddies in the absence of, although occasionally adjacent to, strong current and at varying depths generally over silt and silt-boulder substrates. Adult bonytail captured in Cataract, Desolation, and Gray Canyons were sympatric with humpback chub in shoreline eddies among emergent boulders and cobble, and adjacent to swift current (Valdez 1990). The diet of the bonytail is presumed similar to that of the humpback chub (Service 2002d).

Although sufficient information on physical processes that affect bonytail habitats was not available to recommend specific flow and temperature regimes in the Green River to benefit this species, Muth et al. (2000) concluded that flow and temperature recommendations made for Colorado pikeminnow, razorback sucker, and humpback chub would presumably benefit bonytail and would not limit their future recovery potential. The species is being reintroduced into the Colorado, Green, and Yampa Rivers, and into Lake Havasu and Lake Mojave.

Threats to the Species

The primary threats to bonytail are stream flow regulation and habitat modification (affecting constituent elements: water and physical habitat); competition with and predation by nonnative fishes; hybridization with other native *Gila* species; and pesticides and pollutants (Service 2002d) (affecting constituent element: biological environment). The existing habitat, altered by these threats, has been modified to the extent that it impairs essential behavior patterns, such as breeding, feeding, and sheltering. The threats to bonytail in relation to flow regulation and habitat modification, predation by nonnative fishes, and pesticides and pollutants are essentially the same threats identified for Colorado pikeminnow. Threats to bonytail in relation to hybridization are essentially the same threats identified for humpback chub.

Critical Habitat

Critical habitat was designated in 1994 within the bonytail's historical range in the following sections of the upper Colorado River (59 FR 13374). The PCEs are the same as those described for the Colorado pikeminnow, as is the status of the PCEs. We designated seven reaches of the Colorado River system as critical habitat for the bonytail chub. These reaches total 312 miles as measured along the center line of the subject reaches, representing approximately 14 percent of the historical habitat of the species. Critical habitat includes portions of the Colorado, Green, and Yampa Rivers in the Upper Basin:

Moffat County, Colorado. The Yampa River from the boundary of Dinosaur National Monument in T. 6 N., R. 99 W., section 27 (6th Principal Meridian) to the confluence with the Green River in T. 7 N., R. 103 W., section 28 (6th Principal Meridian).

Uintah County; and Colorado, Moffat County, Utah. The Green River from the confluence with the Yampa River in T. 7 N., R. 103 W., section 28 (6th Principal Meridian) to the boundary of Dinosaur National Monument in T. 6 N., R. 24 E., section 30 (Salt Lake Meridian).

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

Grand County, Utah; and Mesa County, Colorado. The Colorado River from Black Rocks (RM 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).

Garfield and San Juan Counties, Utah. 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).

Species/Critical Habitat Likely to be Affected

The bonytail and its critical habitat, as described below, are likely to be adversely affected by the subject Project. Although the Project does not occur within the designated critical habitat for the bonytail, the Project depletion would adversely affect critical habitat by reducing the amount of water flowing into designated critical habitat.

Grand County, Utah; and Mesa County, Colorado. The Colorado River from Black Rocks (RM 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).

Garfield and San Juan Counties, Utah. 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).

Recovery

Objective, measurable criteria for recovery of bonytail in the Colorado River System are presented for each of two recovery units (i.e., the upper basin, including the Green River and upper Colorado River subbasins; and the lower basin, including the mainstem and its tributaries from Lake Mead downstream to the southerly International Boundary with Mexico) because of different recovery or conservation programs and to address unique threats and site-specific management actions and tasks necessary to minimize or remove those threats. Recovery of the species is considered necessary in both the upper and lower basins because of the present status of populations and existing information on bonytail biology. Self-sustaining populations will need to be established through augmentation. Without viable wild populations, there are many uncertainties associated with recovery of bonytail. The bonytail was listed prior to the 1996 distinct population segment (DPS) policy, and the U.S. Fish and Wildlife Service (Service) may conduct an evaluation to designate DPSs in a future rule-making process. These recovery goals are based on the best available scientific information, and are structured to attain a balance between reasonably achievable criteria and ensuring the viability of the species beyond delisting. These recovery criteria will need to be reevaluated and revised after self-sustaining populations are established and there is improved understanding of bonytail biology.

Downlisting can occur if, over a 5-year period: (1) genetically and demographically viable, self-sustaining populations are maintained in the Green River subbasin and upper Colorado River subbasin such that — (a) the trend in adult (age 4+; ≥ 250 mm total length) point estimates for each of the two populations does not decline significantly, and (b) mean estimated recruitment of age-3 (150–249 mm TL) naturally produced fish equals or exceeds mean annual adult mortality for each of the two populations, and (c) each point estimate for each of the two populations exceeds 4,400 adults (4,400 is the estimated minimum viable population [MVP] needed to ensure long-term genetic and demographic viability); and (2) a genetic refuge is maintained in a suitable location (e.g., Lake Mohave, Lake Havasu) in the lower basin recovery unit; and (3) two genetically and demographically viable, self-sustaining populations are maintained in the lower basin recovery unit (e.g., mainstem and/or tributaries) such that — (a) the trend in adult point estimates for each population does not decline significantly, and (b) mean estimated recruitment of age-3 naturally produced fish equals or exceeds mean annual adult mortality for each population, and (c) each point estimate for each population exceeds 4,400 adults; and (4) when certain site-specific management tasks to minimize or remove threats have been identified, developed, and implemented.

Delisting can occur if, over a 3-year period beyond downlisting: (1) genetically and demographically viable, self-sustaining populations are maintained in the Green River subbasin and upper Colorado River subbasin such that — (a) the trend in adult point estimates for each of the two populations does not decline significantly, and (b) mean estimated recruitment of age-3 naturally produced fish equals or exceeds mean annual adult mortality for each of the two populations, and (c) each point estimate for each of the two populations exceeds 4,400 adults; and (2) a genetic refuge is maintained in the lower basin recovery unit; and (3) two genetically and demographically viable, self-sustaining populations are maintained in the lower basin recovery unit such that — (a) the trend in adult point estimates for each population does not decline significantly, and (b) mean estimated recruitment of age-3 naturally produced fish equals or exceeds mean annual adult mortality for each population, and (c) each point estimate for each population exceeds 4,400 adults; and (4) when certain site-specific management tasks to minimize or remove threats have been finalized and implemented, and necessary levels of protection are attained.

Conservation plans will go into effect at delisting to provide for long-term management and protection of the species, and to provide reasonable assurances that recovered bonytail populations will be maintained without the need for relisting. Elements of those plans could include (but are not limited to) provision of flows for maintenance of habitat conditions required for all life stages, regulation and/or control of nonnative fishes, minimization of the risk of hazardous-materials spills, and monitoring of populations and habitats. Signed agreements among State agencies, Federal agencies, American Indian tribes, and other interested parties must be in place to implement the conservation plans before delisting can occur.

Management Actions Needed and Ongoing:

1. Reestablish populations with hatchery-produced fish.
2. Identify genetic variability of bonytail and maintain a genetic refuge in a suitable location in the lower basin.
3. Provide and legally protect habitat (including flow regimes necessary to restore and maintain required environmental conditions) necessary to provide adequate habitat and sufficient range for all life stages to support recovered populations.
4. Provide passage over barriers within occupied habitat to allow unimpeded movement and, potentially, range expansion.
5. Investigate options for providing appropriate water temperatures in the Gunnison River.
6. Minimize entrainment of subadults and adults at diversion/out-take structures.
7. Investigate habitat requirements for all life stages and provide those habitats.
8. Ensure adequate protection from overutilization.

9. Ensure adequate protection from diseases and parasites.
10. Regulate nonnative fish releases and escapement into the main river, floodplain, and tributaries.
11. Control problematic nonnative fishes as needed.
12. Minimize the risk of increased hybridization among *Gila* spp.
13. Minimize the risk of hazardous-materials spills in critical habitat.
14. Remediate water-quality problems.
15. Provide for the long-term management and protection of populations and their habitats beyond delisting (i.e., conservation plans).

ENVIRONMENTAL BASELINE

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

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

<u>Status of the Species in the Action Area</u>
The action area includes critical habitat for Colorado pikeminnow and razorback sucker on the Gunnison River from the confluence of the Uncompahgre River to the confluence of the Colorado River and downstream from the confluence on the Colorado River to the inflow to Lake Powell. Colorado pikeminnow also have been found in the Gunnison River upstream from the confluence with the Uncompahgre River as far as the Hartland Diversion Dam (approximately 4 miles). Several segments of the Colorado River in Ruby Canyon (Black Rocks) and Westwater Canyon are critical habitat for humpback chub and bonytail. Estimates of wild adult Colorado pikeminnow in the upper Colorado River (from Palisade, Colorado to Lake Powell, including the lower 3.5 miles of the Gunnison River below the Redlands Diversion Dam) were approximately 889 (fish $\geq$ 450 mm) in 2005 (Osmundson and White 2009). This population estimate includes the 15-mile reach of the Colorado River above the confluence with the Gunnison River, whereas the action area does not include the 15-mile reach. However, fish can freely swim into this reach from either the Gunnison River or the Colorado River below the confluence, so the upper Colorado River (including the Gunnison River) is considered one population. There are no specific population estimates for Colorado pikeminnow in the Gunnison River, however, adult fish occur there, and spawning has been documented. A total of 102 Colorado pikeminnow have used the Redlands fish ladder since it was built in 1996. Few wild razorback suckers occur in the action area; however, the population is being augmented by stocking both in the Colorado and Gunnison Rivers. Stocked fish have survived to adulthood in both rivers and larval razorback suckers have been captured in both rivers. A total of 25 razorback suckers have used the Redlands fish ladder. Humpback chub occur in Black Rocks, Westwater Canyon, and Cataract Canyon, but generally not in other river reaches in the action

area. However, one humpback chub was captured in the Gunnison River in 1993 (Burdick 1995). Wild bonytail are extremely rare in the action area, but an active stocking program is augmenting the population, including stocking in a gravel pit connected to the river near Whitewater. One bonytail has ascended the Redlands fish ladder.

FACTORS AFFECTING THE SPECIES ENVIRONMENT WITHIN THE ACTION AREA

Critical Habitat - Gunnison River

Critical habitat on the Gunnison River historically experienced high spring turbid flows and low flows throughout the rest of the year. High spring flows create and maintain the braided channels that provide a variety of important habitats (Osmundson and Kaeding 1989; Osmundson and Kaeding 1991). Water depletions began in the Gunnison River basin with private irrigation in the 1880s (McAda 2003). The Redlands Diversion Dam was built on the lower Gunnison River 3 miles upstream of the Colorado River in 1918 and blocked upstream fish movement until a fish ladder was constructed in 1996. The dam can divert up to 750 cubic feet per second and can dry up the Gunnison River below the dam during extremely low-flow periods. Major water projects upstream of critical habitat include the Gunnison Tunnel, Taylor Park Reservoir, Ridgway Reservoir, Crawford Reservoir, Paonia Reservoir, Fruitgrowers Reservoir, and the Aspinall Unit (Blue Mesa Reservoir, Morrow Point Reservoir, and Crystal Reservoir). Releases from Crystal Reservoir control approximately one-half of the flows on the Gunnison River through critical habitat.

The Gunnison River in critical habitat flows mostly through sedimentary canyons. Floodplains occur in approximately 25 percent of the critical habitat reach (Maddux et al. 1993). The most extensive floodplains occur near the City of Delta downstream to Roubideau Creek. This reach has the greatest number of complex channel habitats. Numerous braided channels with several large vegetated islands and riffles, runs and backwaters occur in this reach. In the canyon reaches floodplains are limited and several historical floodplains are now fruit orchards and gravel pits.

<u>Primary Constituent Element – Water Quantity</u>

The quantity of water in the Gunnison River has been reduced by water development projects. By 1900, most of the readily available direct flow sources of irrigation water had been developed by private individuals and small irrigation companies (Colorado Water Conservation Board 1962). By 1960, agricultural water depletions in the basin were estimated at 312,000 af (Colorado Water Conservation Board 1962) with additional depletions from domestic uses and reservoir evaporation. In the 1960-1990 period, several moderately sized reservoirs were constructed in the basin including Ridgway (Dallas Creek Project), Paonia, Crawford, and Silver Jack.

The Aspinall Unit was constructed in the 1960-1980 period. Flows regimes have been altered significantly by the Aspinall Unit which stores water during high spring flows and releases water during low flow periods (Figure 6). The Aspinall Unit has not significantly changed the annual volume of water flowing downstream but has changed the flow pattern. Spring flows have been reduced and low flows increased the remainder of the year. Spring through fall water temperatures have been reduced from historic temperatures by a maximum of 4 °F in critical habitat, which may affect maturation of adult fish or spawning success (McAda and Kaeding 1991).

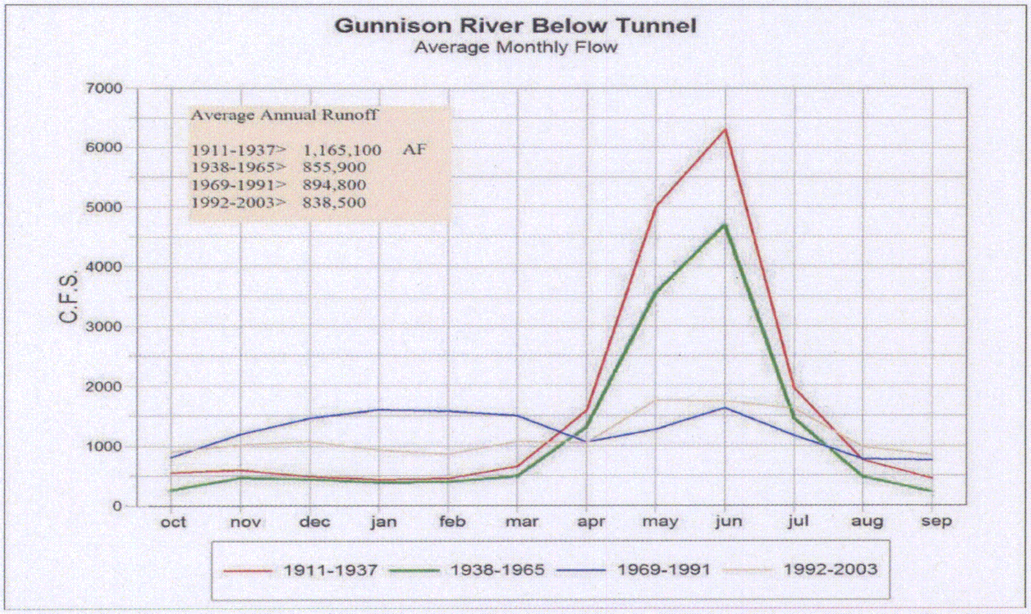


Figure 6. Average Monthly Flow in the Gunnison River below the Aspinall Unit

Pitlick et al. (1999) reported that since 1950, annual peaks of the Colorado River near Cameo have decreased by 29 % and annual peaks of the Gunnison near Grand Junction decreased by 38 %. Due to the Aspinall Unit, extreme low flows in the Gunnison no longer occur. .Mean annual flows of the Gunnison have not changed significantly since 1950, for example mean annual flows from 1902 to 1949 were 2,578 cfs and from 1950 to 1995 were 2,507 cfs (Pitlick et al. 1999. Annual flows of the Colorado River have decreased significantly due to transmountain diversions.

The baseline and the proposed operations for the Aspinall Unit were modeled using RiverWare, a software modeling tool for river systems. The analysis used hydrologic data from 1975-2005 and the results of the modeling estimate conditions as if the baseline or proposed action were in place during the 1975-2005 period. Therefore, the model is used as a comparison and planning tool where results are a general prediction of future conditions under the baseline or proposed action. Actual future hydrology conditions will depend largely on future weather conditions. Appendix B, Table 1, provides the baseline river flows for the Gunnison River at Whitewater, for the period of record.

Primary Constituent Element – Water Quality

The lower Gunnison and Grand Valleys in Western Colorado exist in an area that is rich in Mancos Shale soils (Butler et al. 1991, 1994, 1996). The sediments that comprise Mancos shale are typically high in selenium. Selenium is mobilized in the Gunnison and Colorado Rivers as a direct result of irrigation, and the associated deep percolation and seepage are involved in the solution and transportation of selenium from the soil to the rivers. Selenium levels, while still of concern, have been declining since initial spikes in concentrations when irrigation was initiated in the western Colorado valleys, but still are at levels which inhibit survival and recovery of the listed fishes.

Although selenium is an essential micronutrient, the margin of safety between selenium deficiencies (too little) and selenium toxicity (too much) is very narrow and may only be 10-fold (Maier et al. 1987). Excessive selenium concentrations in fish tissues can cause a variety of toxic effects at the biochemical, cellular, organ and tissue levels (Sorensen 1991, Lemly 1998). Dietary selenium toxicity is an important cause of reproductive failure in fish, and can occur at the same time that adult fish appear to be healthy (Lemly 1998).

In 1997, the Colorado Water Quality Control Commission (CWQCC) adopted a 5 ppb aquatic life protection standard for total selenium (4.6 ppb dissolved) in the Gunnison River Basin. Several stream segments, including about 57 miles of mainstem Gunnison River between Delta and the Colorado River confluence do not meet this standard, and appeared on the 1998 Clean Water Act (CWA) 303(d) list of impaired water bodies for the state of Colorado. These 57 miles including the 100 year floodplain are also designated critical habitat for the Colorado pikeminnow and the razorback sucker. Exceedances in the mainstem Gunnison River range from 6-9 ppb. It has been estimated that approximately 60 % of the selenium load measured at the Gunnison River near Whitewater gage came from loading sources in the Uncompahgre River Basin, primarily from irrigated areas on the east side of the Uncompahgre Valley (Butler et al. 1996). The Gunnison Selenium Task Force, consisting of a group of private, local, state and federal interests, was formed to address these problems and resolve them at the local level.

In 2002, the CWQCC adopted a 5 ppb aquatic life protection standard for selenium in the Colorado River. A 38 mile segment of the mainstem Colorado River below the Gunnison River confluence downstream to the Colorado-Utah stateline was placed on the Clean Water Act (CWA) 303(d) list of impaired water bodies for the state of Colorado. These 38 miles, including the 100 year floodplain, are also designated critical habitat for the Colorado pikeminnow and the razorback sucker. The Grand Valley Selenium Task Force was created to address water quality exceedances in the Colorado River in the Grand Valley.

Selenium concentrations in water, sediment, invertebrates, fish and bird tissue samples in the Gunnison River both downstream and upstream from the Uncompahgre River confluence and in the upper Colorado River downstream from the Gunnison River confluence in Grand Junction, Colorado exceed those concentrations shown to adversely impact fish and wildlife elsewhere (Butler et al 1991, 1994, 1996; Butler and Osmundson 2000, Hamilton 2004, Hinck et al. 2007; Lemly 1996a, Maier and Knight 1994, Ohlendorf 2003, Skorupa 1998). A toxicity threshold for selenium in whole fish (4 ug/g dry weight (DW)) has been recommended for the protection of freshwater fish (USDOI 1998, Lemly 1996a, Lemly 1996b, Skorupa 1998; Hamilton 2002b). The mean selenium concentration of 7.1 ug/g DW was calculated for fish samples collected during 1992 from the Gunnison River Basin. Selenium concentrations in about 71% of the fish samples from the Gunnison and North Fork of the Gunnison Rivers, 64 % of the fish from the Uncompahgre River, and about 55% of the fish samples from the Colorado River exceeded the 4 ug/g DW whole body fish selenium toxicity guideline. Specific toxicity thresholds for pikeminnow and razorback have not been determined.

Researchers have recognized the challenge associated with evaluating risks from elevated selenium to aquatic communities (Lemly and Skorupa 2007, McDonald and Chapman 2007, Ohlendorf et al. 2008). A tiered assessment is often recommended, starting with exposure monitoring and comparison to screening benchmarks. Lemly and Skorupa (2007) recommended proceeding to a selenium management plan that reduces selenium loads if selenium tissue benchmarks are exceeded. This approach may provide a considerable savings in cost and time associated with further extensive studies. McDonald and Chapman (2007) recommended building a weight of evidence case, and proceeding ahead with reproductive toxicity testing and population assessment studies if tissue benchmarks are exceeded. McDonald and Chapman (2007) did however recognize that remediation actions may be warranted when tissue residue guidelines are exceeded, in cases where costs for further investigation clearly exceed the costs to implement remediation and risk management. At a recent workshop of the Society of Environmental Toxicology and Chemistry (SETAC) 46 individuals from business, academia, government, and nongovernmental organizations came together to develop consensus on a path for the assessment of selenium in the aquatic environment (Chapman et al. 2009). The Service summarizes some of their pertinent findings below to acknowledge where the scientific community may be headed in the future:

- Selenium is a growing problem of global concern.
- Diet is the primary pathway of selenium bioaccumulation for both invertebrates and vertebrates.
- Traditional methods for predicting toxicity on the basis of exposure to dissolved water concentrations do not work for selenium because of the bioaccumulative nature of selenium.
- Selenium toxicity is primarily manifested as reproductive impairment due to maternal transfer, resulting in embryotoxicity and teratogenicity in egglaying vertebrates.
- A key aspect of selenium toxicity is the narrow range between dietary essentiality and toxicity.
- Protection of top predators may not guarantee protection of all biota situated lower in the food web.
- Population-level effects from selenium in natural ecosystems are difficult to detect. This difficulty reflects differences in species sensitivity as well as food web complexities and demographics where population-level effects are suspected.
- There is consensus that fish and bird eggs are the critical media in terms of assessing or predicting selenium toxicity at a given location, and measured concentrations in these tissues are most strongly linked to adverse effects.
- The vulnerability of a species is the product of its sensitivity to selenium in its eggs, its propensity to transfer selenium from its body into its eggs, and its propensity to accumulate selenium from its environment, as affected by its diet choices and intake rates, and by site-specific factors controlling the transfer of selenium into and within the food web.
- For reliable prediction of effect thresholds across a range of sites, numeric benchmarks for egg concentrations provide the greatest certainty.
- For site-specific assessment of selenium risks to fish, the field collection of ripe females or newly laid embryos for laboratory examination of larval effects is an

important indicator of selenium risks when the effect measure is related to the egg selenium concentration.
- Embryo mortality and severe development abnormalities can result in impaired recruitment of individuals into populations.

A growing body of literature indicates that selenium contamination, regardless of source or form, is locally impacting razorback suckers in critical habitat in the Gunnison and Colorado Rivers. A toxicity guideline of 8 ug/g DW has been recommended in fish muscle tissue for the protection of reproductive health in freshwater fish (Lemly 1996b, USDOI 1998). Muscle plug samples taken from endangered Colorado pikeminnow in the Colorado River within the Grand Valley had selenium concentrations that ranged from 3-30 ug/g DW. Sixteen Colorado pikeminnow muscle plugs taken from fish collected at Walter Walker State Wildlife Area in Grand Junction downstream of the Gunnison River confluence contained a mean selenium concentration of 17 ug/g DW, more than twice the toxicity threshold of 8 ug/g DW (Osmundson et al. 2000).

Hatchery raised razorback suckers that had been stocked in the Colorado and Gunnison Rivers at least eight months prior to sampling had muscle plug biopsies taken for selenium analysis. The selenium concentrations for muscle plugs taken from 34 razorback suckers sampled during 2005 ranged from 3.5 ug/g DW to 27.1 ug/g DW, with a mean selenium concentration of 7.9 ug/g DW (Osmundson et al. 2009). Of these 34 muscle plugs, almost one-third (11) had selenium concentrations greater than the 8 ug/g DW toxicity guideline for fish muscle tissue. Selenium concentrations in muscle plugs taken from 19 razorback suckers and corresponding egg samples collected by Hamilton et al. (2001) were used to develop a prediction model to estimate egg concentrations in the recaptured razorback suckers sampled in the Colorado and Gunnison Rivers. Estimated egg selenium concentrations using this prediction model for 5 fish were in the high hazard category (Lemly 1995), and for 9 fish were in the moderate hazard category (Osmundson 2009). An important consideration regarding selenium impacts to endangered Colorado River fish is the fact that "Species with long life cycles and low reproductive rates are often more vulnerable to increases in mortality than species with short life cycles and high reproductive rates" (Lemly and Skorupa 2007). Colorado River endangered fish are long-lived fish with delayed maturation, and relatively low reproductive rates (USFWS 2002a & b). There is a high probability that the reproductive capability of Colorado pikeminnow and introduced razorback suckers is being compromised. Osmundson et al. (2009) discovered that razorback suckers accumulate significantly higher selenium concentrations than flannelmouth and bluehead suckers in the same river segments, which puts them at higher risk for adverse effects from elevated selenium concentrations. Hamilton et al. (2005b) found that razorback sucker dietary items collected from wetlands adjacent to the Colorado River with $\geq$ 4.6 ug/g DW caused rapid mortality of razorback sucker larvae. Most invertebrate samples collected from the Colorado and Gunnison rivers exceed this selenium concentration (Barb Osmundson, per.com.2009), as well as the 3 ug/g DW dietary toxicity threshold in fish and wildlife (Lemly 1996b, USDOI 1998). Hamilton (1998, 2002a, 2005a, 2005b) evaluated selenium toxicity to razorback suckers, and concluded that remediation of high selenium sites may be essential to the recovery of endangered fish in the Colorado River basin. Beyers and Sodergren (1999, 2002) also evaluated selenium exposure to larval razorback suckers, and did not detect adverse effects. However, Beyers and Sodergren (1999, 2002) did not include maternal deposition of selenium into eggs, and thus lacked a key component of selenium exposure for larval fish (Ohlendorf 2003, Kroll and

Doroshov 1991, Lemly 1993, Maier and Knight 1994, deBruyn et al. 2008, Chapman 2009). An important data gap is the sensitivity of juvenile fish feeding on high selenium food items in the environment after the fish were previously exposed to selenium via maternal transfer (deBruyn et al. 2008). "Exposure to selenium as a developing embryo may influence the toxicokinetics and toxicodynamics of selenium in young developing fish relative to those not previously exposed to selenium via maternal transfer"(deBruyn et al. 2008). This phenomenon may have also played a role in the differences of selenium toxicity to razorback suckers found by Hamilton et al. (2005b) and Beyers and Sodergren (1999, 2002).

Cool releases from the Aspinall Unit cause Gunnison River summer temperatures in critical habitat to be about 3 degrees °C cooler than river reaches in other parts of the Colorado River Basin that have relatively large populations of Colorado pikeminnow. Studies examined the potential for extending the range of Colorado pikeminnow in the Gunnison River, and determined that distribution of Colorado pikeminnow was temperature-limited and extended only to about 33 miles upstream of the Colorado River confluence (Osmundson 1999). Cooler water upstream does not preclude fish from using upper reaches but the cooler temperatures can interfere with reproduction and can lower growth rates. Good prey and habitat conditions were reported upstream, but there was only sporadic use by Colorado pikeminnow (Osmundson 1999).

Primary Constituent Element - Physical Habitat

The Gunnison River is an alluvial, gravel-bed river in reaches where the endangered fishes occur. In general, changes in the river such as reduced peak flows, bank protection, and other factors which occurred in the 19th and 20th centuries reduced floodplain connectivity and simplified main-channel habitats. Pitlick et al. (1999) concluded that the key factor in maintaining river habitats was to assure that sediment entering critical habitat continues to be carried downstream so it does not accumulate and reduce channel complexity.

The Gunnison River provides a variety of habitats (floodplains, side channels, secondary channels, and backwaters) important for Colorado pikeminnow and razorback sucker spawning, nursery habitat, feeding, and rearing (McAda 2003). Current flow regimes are not adequate to maintain or restore these habitats.

Primary Constituent Element - Biological Environment

The large-bodied fish community in the Gunnison River is comprised predominantly of native fishes compared to the Colorado River fish community, which is dominated by nonnative fishes (Burdick 1995). The Redlands Diversion Dam has blocked migration of nonnative fishes from the Colorado River into the Gunnison River. In 2 years of extensive sampling, only one channel catfish was captured in the Gunnison River (Burdick 1995). Northern pike are known to occur in two upstream reservoirs (Paonia and Crawford) and were occasionally captured on the Gunnison River (Burdick 1995), but the population has been reduced in the Gunnison River with mechanical removal (McAda 1997). The small-bodied fish community in the Gunnison River is comprised predominantly of nonnative fishes (e.g., red shiners, sand shiners, fathead minnows) (Burdick 1995).

CRITICAL HABITAT - COLORADO RIVER FROM GUNNISON RIVER CONFLUENCE TO LAKE POWELL

Historically, the Colorado River produced high spring turbid flows that maintained critical habitat by inundating floodplains, maintaining side channels, and creating backwaters. The Colorado River below the confluence with the Gunnison River flows approximately 18 miles through the Grand Valley. In the Grand Valley reach, numerous gravel pit ponds occupy the floodplain and many of the river banks have been armored with riprap. The river channel is braided around vegetated gravel islands and the habitat consists of runs, riffles, eddies, backwaters, and side channels.

The Colorado River downstream of the Grand Valley flows through 29 miles of Horsethief and Ruby Canyons with limited floodplain areas and shear sandstone walls. Black Rocks is a mile-long reach of river that flows through a geologic upthrust of metamorphic gneiss that confines the river creating a deep channel with strong eddies and turbulent currents. Five miles downstream, the river flows through Westwater Canyon for 14 miles. Westwater Canyon also is formed by an upthrust of black rock that creates unique habitat conditions similar to Black Rocks but with significant whitewater rapids. This reach encompasses critical habitat for humpback chub and bonytail from upstream of Black Rocks to below Westwater Canyon. Below Westwater Canyon the river flows through shallow canyons and open valleys and then through steep sandstone canyons above and below Moab.

Habitats are comprised of deep runs and pools with several rapids formed by side canyons. Many backwaters with sand/silt substrate occur between Moab and the confluence with the Green River during low flow periods (Valdez et al. 1982b). Between the confluence with the Green River and Lake Powell the Colorado River flows through Cataract Canyon where the river has deep swift runs, major rapids, large eddies, and pools. Lake Powell now inundates the lower end of Cataract Canyon where there is a transition zone between riverine and lacustrine habitat.

Primary Constituent Element - Water

Like the Gunnison River, the quantity of water in the Colorado River has been reduced by water development projects. Any water depletions in the Gunnison River will adversely affect the Colorado River critical habitat below the confluence. Flows regimes have been altered significantly in the Colorado River: in addition to the alteration caused by the Aspinall Unit, flow in the Colorado River has been altered by numerous upstream reservoirs and water projects, many of which transport large volumes of water out of the Colorado River basin. The Dolores Project causes water depletions to critical habitat in the Colorado River downstream of the Dolores River confluence to Lake Powell.

Coordinated Reservoir Operations (CROS) on the upper Colorado River is an ongoing program implemented by the Recovery Program to coordinate bypasses of reservoir inflows, which would otherwise be spilled or bypassed at another time, from various reservoirs resulting in enhancement of spring peak flows to improve habitat in the 15-Mile Reach of the Colorado River. While the target is the Cameo gage, upstream of the 15-mile reach, the enhanced spring peak benefits endangered fish habitat downstream to Lake Powell. The intent of the program is to coordinate spring releases of the reservoirs to enhance the downstream peak for a period up to 14 days. In 5 years (during the 1997-2008 period) releases ranged from 7,000 to 40,000 af. An extended drought prevented reservoir operators from conducting Coordinated Reservoir Operations for six consecutive years (2000 – 2005). However, during the 2006 water year, the coordinated bypass of inflows was implemented by various participating reservoirs for 7 to 12 days. A total of 28,717 acre-feet was released from the CROS reservoirs. These releases increased the peak flow at Cameo from 14,387 cfs to 16,400 cfs. As another example, in 2008 normal reservoir releases were increased over 1,000 cfs under this program for a 3 to 5 day period.

Releases of water from upstream reservoirs enhance late summer and fall base flows in the Colorado River, averaging 56,000 af per year since 2000. In 2008, releases were 114,255 af (UCRRP 2009). Efficiency programs have been implemented on the Grand Valley Project, upstream from the Gunnison confluence, to reduce diversions and/or return administrative spills above the 15-Mile Reach by an average of 43,929 af/year over the 2002 through 2008 period of operation. This "saved" water remains in the river and contributes to the development of a surplus storage condition in Green Mountain Reservoir (UCRRP 2009). Over the 2002 through 2008 period, Green Mountain surplus storage releases have averaged 27,960 af/ year. Efficiency programs continue to be developed for other irrigation systems. Most recently Reclamation, in cooperation with the Orchard Mesa Irrigation District and California Polytechnic University, has developed plans for the Orchard Mesa Canal Automation Project which would reduce river diversions by an estimated 17,000 af/year and again contribute to larger magnitude Green Mountain Reservoir surplus storage. The Recovery Program has adopted this Project and committed to fund construction subject to the development of cost sharing agreement(s) to fund associated O&M costs. Negotiations are moving forward on the cost sharing agreement(s) and construction could begin in 2012.

The cumulative effects of Recovery Program actions such as CROS, Aspinall reoperations, and other water management programs in the Colorado River benefit habitat in the river from the 15-mile reach to Lake Powell. In addition, Recovery Program activities on the Green River supplement these efforts in the river reach from the Green-Colorado River confluence to Lake Powell.

Elevated selenium concentrations associated with irrigation drainwater were found in the Colorado River during National Irrigation Water Quality Program investigations (Butler et al. 1994, 1996; Butler and Osmundson 2000). These elevated selenium concentrations still occur in water, sediment, and biota, and continue to pose a risk to this PCE. The Colorado River below the confluence with the Gunnison to the State line and associated tributaries (approximately 38 miles of critical habitat) appear on the State of Colorado's 303(d) list of impaired waters because of selenium. Selenium concentrations in water and fish tissue are inversely related to flows; i.e. the lower the flows the higher the selenium concentrations (Osmundson et al. 2000).

<u>Primary Constituent Element - Physical Habitat</u>

Westwater and Cataract Canyons provide movement and migration corridors between the other relatively flat water habitats. Floodplain habitats between the canyons provide warm water, low velocity, feeding and nursery habitats. Many backwaters between Westwater Canyon and Lake Powell provide nursery habitat. The Service has developed flow recommendations for the Colorado River below the confluence with the Gunnison River (McAda 2003) designed to maintain spawning and backwater habitat. Under current conditions these recommended flows are achieved only in naturally wet years.

Primary Constituent Element - Biological Environment
This PCE is impaired by the presence of nonnative fishes common in this reach of the Colorado River. Nonnative fishes occupy the same backwaters that are very important for young Colorado pikeminnow and razorback sucker. Largemouth bass (*Micropterus salmoides*) and green sunfish (*Lepomis cyanellus*) are the most common large-bodied fishes that occupy backwater habitats year-round (Osmundson 2003). The three most common small-bodies fishes found in backwaters are fathead minnow, sand shiner, and red shiner, comprising 80 to 100 percent of the fish found in Colorado River backwaters (McAda 2003).

The critical habitat units within the action area (the Gunnison River from the Uncompaghre River confluence to the confluence with the Colorado River and the Colorado River below the Gunnison River confluence to the inflow to Lake Powell) have been identified in the recovery goals for each of the four endangered fish species (USFWS 2002a, b, c, d) as essential for the conservation of the species. Critical habitat in the action area represents approximately 25 percent of the total critical habitat for Colorado pikeminnow. Colorado pikeminnow is a wide ranging species sometimes migrating extensive distances to carry out life history functions. The action area also encompasses a large area of razorback sucker critical habitat. Natural reproduction of razorback sucker is very rare, but it has been documented within critical habitat on the Gunnison River by collection of larvae. Critical habitat for humpback chub and bonytail are limited to shorter reaches of the Colorado River within critical habitat for Colorado pikeminnow and razorback sucker. These shorter reaches include unique habitats required for humpback chub and bonytail that are found in only a few other places in the entire Colorado River basin.

Climate Change

A factor which may be affecting the timing and magnitude of flows in the Gunnison and Colorado Rivers is climate change. In the Colorado River basin, records document an annual mean air surface temperature increase of approximately 1.4°C (2.5°F) over the past century with temperatures today at least 0.8°C (1.5°F)warmer than during the 1950 drought (NRC 2007, Lenart 2007). Udall and Bates (2007) found that multiple independent data sets confirm widespread warming in the West. Both in terms of absolute degrees and in terms of annual standard deviation, the Colorado River Basin has warmed more than any region of the United States (NRC 2007).

In the western United States warming has resulted in a shift of the timing of spring-snowmelt driven streamflow. Stewart et al. (2005) show that timing of spring snowmelt and runoff in the western United States during the last five decades has shifted so that the major peak runoff now arrives 1 to 4 weeks earlier, resulting in less flow in the spring and summer. While it is reasonable to expect that runoff in the Gunnison and Colorado Rivers is occurring earlier because of warmer air temperatures, analysis of the timing of spring runoff has not been done.

EFFECTS OF THE ACTION

EFFECTS TO ENDANGERED SPECIES

ASPINALL OPERATIONS

The intent of the proposed action is to improve the habitat conditions for the endangered fishes by reoperation of the Aspinall Unit. Reoperation will provide a flow regime that provides a more natural hydrograph than under the current operating conditions. Improved habitat conditions are anticipated from the increased frequency, magnitude, and duration of spring peak flows and protection of base flows on the Gunnison and Colorado Rivers. The extent of flow improvements on the Colorado River below the confluence with the Gunnison River has not been modeled. The flow changes will assist in improving and maintaining habitat conditions for spawning and recruitment and for maintenance of adult Colorado pikeminnow and razorback sucker habitat. Figure 7 illustrates the results of modeling the proposed action compared to actual measured flows and the modeled Environmental Baseline. Generally the proposed action provides higher springs peaks that provide improved conditions for habitat maintenance. Annual peak flows at Whitewater for the modeled 31 years for baseline and proposed action is illustrated in Figure 1, Appendix B.

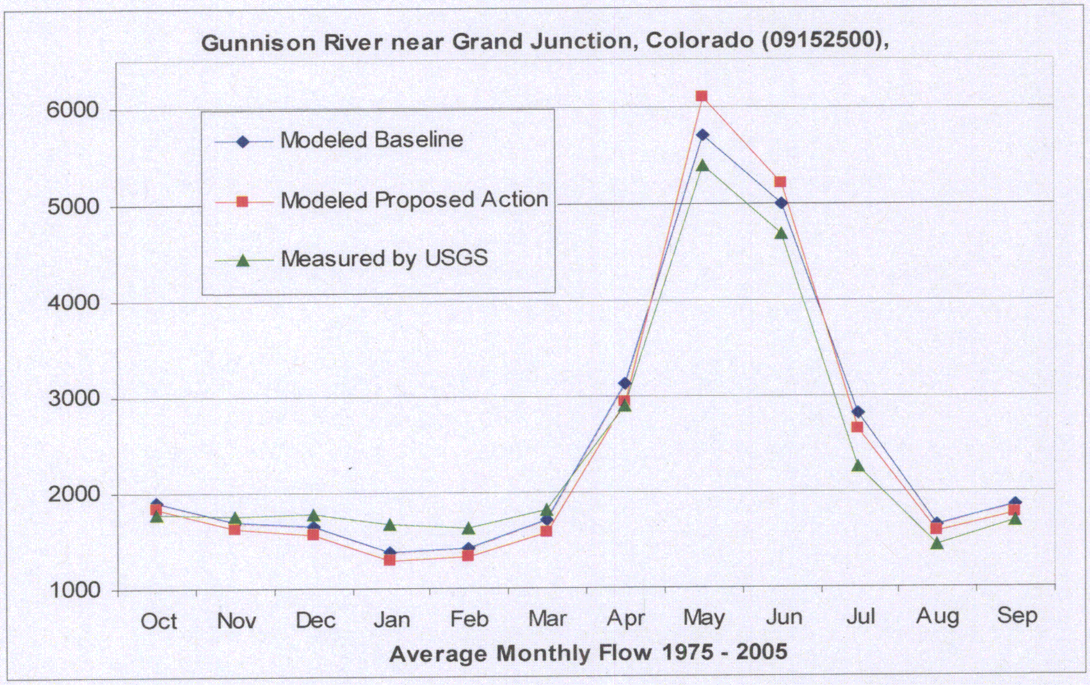


Figure 7. Average Monthly Flow in the Gunnison River near Grand Junction, Colorado

In order to evaluate the proposed action Reclamation modeled the proposed operations as explained in the Baseline Section. The model results show that the peak flows at Whitewater would increase in most years as shown in Table 6.

Table 6 Summary of peaks (cfs) under baseline and proposed action, Whitewater gage.

Year	Baseline Peak	Proposed Action Peak	Year	Baseline Peak	Proposed Action Peak
1975	8927	12296	1991	8412	8593
1976	5130	8386	1992	6063	8583
1977	1581	1636	1993	20492	21040
1978	10678	11364	1994	4919	7755
1979	15164	16261	1995	19346	19125
1980	13884	16326	1996	7860	12412
1981	3773	3771	1997	11996	14530
1982	9140	11023	1998	9877	9158
1983	20640	20350	1999	6793	7783
1984	20782	20941	2000	4817	7840
1985	15186	15503	2001	3487	7439
1986	10357	13727	2002	1153	1170
1987	9365	10191	2003	5312	7033
1988	3436	5814	2004	3413	5207
1989	2465	5243	2005	13574	11372
1990	2574	2566			

Flows adequate to move sediment through the Gunnison River system are crucial to maintaining and improving critical habitat for the listed fishes. Flows that are half bankfull (8,070 cfs) or bankfull (14,350 cfs) are considered target flows for sediment movement (McAda 2003). Half of the river cross sections (27) surveyed by Pitlick et al. (1999) reach half bankfull (initial motion) at 8,070 cfs and half of the river cross sections reach bankfull (significant motion) at 14,350 cfs. Initial motion refers to the onset of streambed particle movement, and significant motion refers to continuous movement of most all particles in the streambed. McAda (2003) recommends providing sufficient flows to mobilize the river bed on a regular basis to make sure fine sediments continue to be transported downstream and fish habitat is maintained.

Because the target flows are averages, areas in the river reach initial motion and significant motion at flows above and below the target flows. Therefore, flows above and below the target also provide habitat benefit. Table 7 shows the percentage of transects that reach initial and significant motion under different flow conditions (Pitlick et al. 1999). Flows in the range of 4,400 to 5,300 cfs also have the capacity to mobilize sand and finer sediments, which should function to keep spawning substrates relatively clean (Pitlick et al. 2007).

Table 7. Percentage of transect reaching critical levels at different flows.

	Transects		Duration of flow		
Flow (cfs)	% at half bankfull	% at bankfull	Days, under baseline	Days, under proposed action	% Difference
6,000	19	0	28.0	29.6	+6
7,000	33	0	21.6	24.2	+12
8,000	46	2	16.5	17.6	+7
10,000	81	6	8.8	10.9	+24
14,000	100	46	3.1	3.5	+13

The model results show that under the proposed action there is a 24% increase in average number of days at or above 10,000 cfs, at which time 80% of the transects are at half bankfull flow elevations. Average number of days of flows at 6,000 and 7,000 also increases by 6% and 12%, at which level 20 to 35% of all transects are at half bankfull flows, indicating that finer bed materials are mobilized in many areas and gravel embededness (gravel buried in sediment) is reduced. Model results show an additional six years that flows would exceed 5000 cfs and an additional 7 years that flows would exceed 7,000 cfs. Also, flow would exceed 8,000 cfs and 10,000 cfs in an additional three years (Table 2, Appendix B).

Model results show peak flows equal to or greater than initial motion threshold flows (8,070 cfs) occur during three (19%) more years under the proposed action than under the baseline, and flows equal to or greater than significant motion threshold flows (14,350 cfs) occur during two (33%) more years than under baseline condition (Table 3, Appendix B).

The increase in frequency and duration of initial and significant motion (half- and bankfull flows) under the proposed action would help maintain the interstitial spaces in gravel and cobble bars that provide spawning habitat for adults, habitat for larval fish immediately after hatching, and for macroinvertebrates which are important for the food web of the endangered fish. Increases in significant motion conditions shift cobble and gravel bars, scour vegetation, and help maintain side channels which overall help maintain or improve channel complexity of benefit to the fish.

Flow regimes under the proposed action would result in increased interannual variability on the Gunnison River. In particular, during moderately dry years, spring releases would be made in proportion to inflow at Blue Mesa (381,000 to 516,000 af), which adds more certainty that the Gunnison River at Whitewater would vary between 2,600 to 8,070 cfs from one year to the next. Similar proportionality would be seen during average wet years. In contrast, under baseline flows, such proportionality would be maintained only if excess water was available. Increased variability should support in-channel processes that help maintain habitat for the endangered fish, particularly during moderately dry years when half bankfull conditions could be attained at a greater percentage of river reaches than under baseline flows.

Floodplain and backwater habitat on the Gunnison River would be improved under the proposed action. Inundation of floodplains tends to increase significantly between 5,000 cfs and 14,000 cfs. Frequency and duration of spring peak flows in this range are greater under the proposed action than under baseline flow conditions. At 5,000-6,000 cfs small floodplain wetlands begin to be inundated in the area immediately downstream of Delta (Johnson Slough, others), and the Craig gravel pit pond near Whitewater connects to the main channel Gunnison River (Reclamation 2006). Flooded acreage at the Escalante State Wildlife Area increases with Gunnison River flows such that 80, 140 and 200 acres become inundated at 8,000, 10,000 and 14,000 cfs, respectively (Valdez and Nelson 2006; Irving and Burdick 1995). Wetlands near Confluence Park at Delta flood at about 9,000 to 10,000 cfs. The percentage of years these floodplains get inundated increases under the proposed action as shown in Table 8.

Table 8. Floodplain flows-Baseline and Proposed Action for period of study.

	Days >5,000 cfs (Craig, Johnson' Slough)		Days > 8,000 cfs (Escalante 80 acs)		Days >10,000 cfs (Escalante 100 acs, Confluence Park)		Days > 14,000 cfs (Escalante 200 acs)	
	Baseline	Action	Baseline	Action	Baseline	Action	Baseline	Action
Avg. days/yr	35.4	36.3	16.5	17.6	8.8	10.9	3.1	3.5
% of yrs	68	87	52	61	35	48	19	26

In the Colorado River spring peak flows below the confluence with the Gunnison River would increase with implementation of the proposed action. The greatest increase would be seen in moderately wet and moderately dry years, during which 1,500-2,000 cfs would be added to the flow of the Colorado River. About 2,000 cfs and 1,000 cfs would be added in average dry and average wet years respectively. Dry and wet year additions would generally be negligible. Benefits to the Colorado River due to increased flows from the Gunnison River would be maximized during years when coordinated reservoir operations in the upper Colorado River basin are implemented. Since 2000, releases from upstream Colorado River reservoirs, coordinated reservoir operations, and irrigation efficiency improvements averaged 48,000 af per year (Recovery Program 2008).

Flows in the Colorado River downstream from the Gunnison confluence were examined, but not modeled (Table 9). Because the proposed operation attempts to match the spring peak with the North Fork, matching the peak on the Colorado River would only occur when the Colorado was peaking at the same time as the North Fork. Reclamation determined that specifically modeling the flows on the Colorado River below the confluence with the Gunnison River would not contribute to alternative selection, which was the primary purpose of the modeling. More information on the predicted peak flows in the Colorado River with the proposed operation in place is presented in Appendix B, Table 4. Peak flow recommendations for the Colorado River at the Colorado/Utah state line are presented in Table 10.

Table 9. Approximate average contribution of Gunnison River (cfs) to Colorado River during May spring peak during study period.

	Baseline Conditions	Proposed Action
Dry Year	2,072	2,120
Moderately Dry Year	4,229	6,864
Average Dry Year	7,807	10,445
Average Wet Year	11,048	13,028
Moderately Wet Year	12,354	15,070
Wet Year	19,052	19,053

Table 10. Colorado River Spring Peak Flow Recommendation at Colorado-Utah Stateline

Hydrologic Category	Peak Target at Colorado-Utah Stateline - cfs	Duration of Half Bankfull Days (18,500 cfs)	Duration of Bankfull Days (35,000 cfs)
Dry	5,000–12,100	0	0
Moderately Dry	9,970–27,300	0-10	0
Average Dry	18,500–26,600	20-30	0
Average Wet	≥35,000	30-40	6-10
Moderately Wet	35,000–37,500	50-65	15-18
Wet	39,300–69,800	80-100	30-35

The proposed operation of Aspinall combined with the ongoing and future flow enhancement programs on the Colorado River above the confluence with the Gunnison will improve habitat conditions on the Colorado River below the confluence with the Dolores River. In most years (moderately wet, moderately dry, average dry and average wet) Aspinall Operations would in general contribute an additional 2,000 cfs to the peak in the Colorado River. CROS would contribute another 1,000 cfs to peak flows in the Colorado River, for an additional 3,000 cfs. Base flow enhancement programs in the Colorado River increase base flows on an average of 56,000 af/yr, with an additional 17,000 af/yr anticipated with the Orchard Mesa project.

Water Depletions

Historic on-going and future depletions adversely affect Colorado pikeminnow, razorback sucker, bonytail, and humpback chub by reducing the amount of water in the river system upon which they depend. The consultation includes continuation of existing water depletions of 602,700 af/yr which are included in the environmental baseline and will continue to adversely affect the endangered fishes. The proposed new depletions of 37,900 af/yr and the existing depletions total 640,600 af/year. The effects to all four species primarily result from the effects of the action upon their habitats. In general, the on-going historic water uses included in the proposed action would adversely affect the four listed fish by reducing the amount of water available to them, increasing the likelihood of water quality issues, increasing their vulnerability to predation, and reducing their breeding opportunities by shrinking the amount of breeding habitat within their range. For example, the Dolores Project decreases the spring run-off flow contribution to the Colorado River.

The continued depletion of 602,700 af/year and the new depletion of 37,900 af/yr from the Gunnison, Dolores, and Colorado Rivers changes the natural hydrological regime that creates and maintains important fish habitats, such as spawning habitats, and reduces the frequency and duration of availability of these habitats for the four endangered fish. The reduction of available habitats will directly affects individuals of all four species by decreasing reproductive potential and foraging and sheltering opportunities. Many of the habitats required for breeding become severely diminished when flows are reduced. As a result, individual fish within the action area may not be able to find a place to breed, or will deposit eggs in less than optimal habitats more prone to failure or predation. In addition, reduction in flow rates lessens the ability of the river to inundate bottomland, a source of nutrient supply for fish productivity and food supply. Water depletions also exacerbate competition and predation by nonnative fishes by altering flow and temperature regimes toward conditions that favor nonnatives.

The continued and proposed depletions affect the water quality in the action area by increasing concentrations of heavy metals, selenium, salts, pesticides, and other contaminants. Increases in water depletions will cause associated reductions in assimilative capacity and dilution potential for any contaminants that enter the Gunnison and Colorado Rivers. Operation of the Aspinall Unit has historically increased flows in months outside of the spring runoff and has provided dilution of contaminants. Increasing spring peaks as described in the proposed action will slightly reduce this dilution effect outside of the spring peak. The facilities' depletions and change in operations would cause a proportionate decrease in dilution, which in turn would cause a proportionate increase in heavy metal, selenium, salts, pesticides, and other contaminant concentrations in the Gunnison River, as well as the Colorado River to Lake Powell. 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 is 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 (Hamilton 1998, Osmundson et al. 2000, Lemly 2002, Butler et al. 1996). Selenium is efficiently transferred in eggs from parents to offspring, where it can cause edema, hemorrhaging, spinal deformities, and death (Lemly 1996b). Also, Hamilton et al. (2005b) found that exposure of dietary items $\geq$ 4.6 ug/g selenium DW in razorback sucker larvae (that had survived previous exposure from maternal deposition of selenium into the eggs) caused rapid mortality of these larvae. Ohlendorf (2002) and Lemly (1998) noted that excess selenium in the diet of fish can cause a variety of toxic effects at the subcellular, cellular, organ, and system levels. These effects are exhibited through effects on reproduction and reduced survival of young fish, as well as effects on health, physiology, and survival of older fish. The mortality of larvae/fry that is associated with excess selenium can have important effects on populations resulting in lack of recruitment.

The subject action would adversely affect the four listed fish by resulting in continued reduction of water and associated effects to habitat. This ongoing reduction would contribute to the cumulative reduction in high spring flows, which are essential for creating and maintaining complex channel geomorphology and suitable spawning substrates, creating and providing access to off-channel habitats, and possibly stimulating Colorado pikeminnow spawning migrations. 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 endangered fishes. To the extent that the subject action will continue to reduce flows, the ability of the river to provide these functions will be reduced. This reduction of water affects habitat availability and habitat quality.

To the extent that it would reduce flows and contribute to further habitat alteration, the subject action would contribute to an increase in nonnative fish populations. 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. Endangered fishes within the action area would experience increased competition and predation as a result.

EFFECTS TO CRITICAL HABITAT

All four of the listed Colorado River fish require the same PCEs essential for their survival. Therefore, we are combining our analysis of all four species into one section. Because the amount of designated critical habitat varies for each of the four species, the amount of habitat affected will vary; however, the effects would be the same for all critical habitat within the action area.

Water, physical habitat, and the biological environment are the PCEs 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.

This analysis of the effects of the proposed action to critical habitat is dependent on the implementation of the proposed action and the mandatory conservation measures. If the conservation measures are not implemented within the proposed timeframes, the effects to critical habitat will likely result in adverse modification to critical habitat that appreciably diminishes the value of critical habitat for both survival and recovery.

Primary Constituent Element – Water

The subject action includes the continued existing water depletions of 602,700 af/yr and new depletions of 37,900 af/yr that would deplete up to 574,048 af/year from the Colorado River Basin. Removing water from the river system changes the natural hydrological regime that creates and maintains important fish habitats, such as spawning habitats, and reduces the frequency and duration of availability of these habitats of the four endangered fish. In addition, reduction in flow rates lessens the ability of the river to inundate bottomland, a source of nutrient supply for fish productivity and important nursery habitat for razorback sucker. Water depletions move flow and temperature regimes toward conditions that favor nonnative fish, thus adding to pressures of competition and predation by these nonnative fishes as discussed above.

The action under consultation includes all Reclamation projects in the Gunnison River basin, including the Uncompahgre Project. Data collected during 1991-1992 showed that irrigation drainage from the Uncompahgre Project contributes about two-thirds of the selenium load in the Gunnison River at Whitewater and 30 percent of the selenium load in the Colorado River near the Colorado-Utah State line (Butler et al. 1996). Since that time, some water quality improvement projects have been implemented in the Uncompahgre Project. Elevated selenium concentrations associated with the Uncompahgre Project and other basin water uses continue to occur in water, sediment, and biota in the Gunnison River and Colorado River below the confluence with the Gunnison River, and continue to pose a risk to endangered fish. Selenium is of particular concern due to its effects on fish reproduction and its tendency to be at high levels in low velocity areas that are important habitats for Colorado pikeminnow and razorback suckers (Hamilton 1998, Osmundson et al. 2000, Lemly 2002, Butler et al. 1996). Once selenium is in the water in aquatic systems, it is readily taken up from solution by food-chain organisms and can quickly reach toxic concentrations in consumer fish and wildlife species (Lemly 1996b). Field studies have documented selenium bioaccumulation factors of 500 to 35,000 in contaminated aquatic ecosystems where water concentrations of waterborne selenium were in the 2-to16-ug/l range (Lemly 1996b).

Changes in water quantity would affect water quality, which is a PCE of critical habitat. Contaminants enter the Gunnison River from various point and non-point sources, resulting in increased concentrations of heavy metals, selenium, salts, pesticides, and other contaminants. Increases in water depletions (37,9000 af/yr) will cause associated reductions in assimilative capacity and dilution potential for any contaminants that enter critical habitat in the Gunnison and Colorado Rivers. The subject depletions and proposed new operations that reduce average flows in non-peak flow periods would cause a proportionate decrease in dilution, which in turn would cause a proportionate increase in heavy metal, selenium, salts, pesticides, and other contaminant concentrations in the Gunnison River, as well as the Colorado River to Lake Powell. Increased contaminant concentrations increase the risk of reaching or exceeding toxicity thresholds, with the associated increased risk of toxic effects. Toxic effects thresholds for tissue concentrations that affect the health and reproductive success of freshwater and anadromous fish are as follows: whole body, 4 ug/g DW; skeletal muscle (skinless fillets), 8 ug/g DW; liver, 12 ug/g DW; ovaries and eggs, 10 ug/g DW (Lemly 1996a, Ohlendorf 2002, USDOI 1998). 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 razorback suckers and also the predatory Colorado pikeminnow.

Implementation of the Selenium Management Program is expected to provide gradual improvements in water quality in the action area and reduce the selenium concentrations in the Gunnison and Colorado rivers to the point that elevated selenium concentrations are no longer inhibiting the survival and recovery of the endangered fishes.

Primary Constituent Element - Physical Habitat

The subject action would affect the physical condition of habitat for the four listed fish by positively changing the flow pattern in the river to a more natural flow regime. Higher and more frequent spring flows are essential for creating and maintaining complex channel geomorphology and suitable spawning substrates. They also create and provide access to off-channel habitats, and provide spawning cues for the endangered fishes. 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 endangered fishes

Primary Constituent Element - Biological Environment

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.

However, the proposed reoperation of the Aspinall Unit would provide higher spring flows that could be detrimental to nonnative fishes. Therefore, it is unknown if the proposed action will increase or decrease nonnative fishes in the Gunnison River.

Species Response to the Proposed Action

Colorado Pikeminnow

Spring runoff provides environmental cues for spawning activity and the proposed increased releases from the Aspinall Unit will enhance spring peak flows under certain hydrologic conditions. Increased magnitude and duration of spring peak flows in the Gunnison River will maintain and improve spawning substrate by flushing fine sediment from the interstices of gravel and cobble substrates, which will improve survival of eggs and larvae. During moderately dry years increased frequency of peak flows between 2,600 and 8,070 cfs will improve spawning habitat. Flows in the range of 4,400 to 5,300 cfs are beneficial because they have the capacity to mobilize sand and finer sediments, which should function to keep spawning substrates relatively clean (Pitlick et al. 2007). Higher flows provided during wetter years, will provide a more widespread cleansing of gravel and cobble bars and will maximize Colorado pikeminnow reproductive success. Higher and more frequent spring flows will provide more off-channel and floodplain habitat for feeding and resting of adult Colorado pikeminnow. A similar response is expected on the Colorado River below the confluence with the Gunnison River.

The purpose of implementing the Selenium Management Program is to reduce selenium levels in the Gunnison and Colorado Rivers. This should reduce reproductive and recruitment effects of selenium on Colorado pikeminnow to the extent that it is no longer inhibiting survival and recovery of the endangered fishes.

Razorback sucker

The effects to spawning activity for the razorback sucker should be similar to Colorado pikeminnow. The increased magnitude and frequency of flows in moderate years will provide spawning cues and maintain spawning habitat.

Connection to important floodplain rearing habitats in the Gunnison River (Craig, Escalante, Confluence Park, and Johnson Slough) during the spring peak will be more frequent under the proposed action. The increase in duration of connection within a year is important because a wider window of opportunity is open to drifting larvae for entrainment into productive rearing habitats. Even short periods of inundation can provide the warm, food-rich habitat required for high survival of larvae (McAda 2003).

The purpose of implementing the Selenium Management Program is to reduce selenium levels in the Gunnison and Colorado Rivers. This should reduce reproductive and recruitment effects of selenium on razorback sucker to the extent that it is no longer inhibiting survival and recovery of the endangered fishes.

Humpback chub and bonytail

Humpback chub bonytail generally do not occur in the Gunnison River, but the effects of the proposed action downstream in the Colorado River will be similar to the effects to Colorado pikeminnow and razorback sucker including: spawning cues due to spring peak flows, maintenance of habitat complexity over a range of flows, maintenance of spawning gravel, creation and maintenance of backwaters, reduction of non-native fish due to higher flows.

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 ESA. Reclamation did not identify and the Service is not aware of any future non-Federal actions not included in this action under consultation that are reasonably certain to occur in the action area.

CONCLUSION

After reviewing the current status of the Colorado pikeminnow, humpback chub, bonytail, and razorback sucker, the environmental baseline for the action area, the effects of the proposed action (including the proposed operation of the Aspinall Unit, the new and historic water depletions and the mandatory conservation measures), and the cumulative effects, it is the Service's biological opinion that the proposed action as described in this biological opinion, is not likely to jeopardize the continued existence of endangered fish and is not likely to destroy or adversely modify designated critical habitat.

The implementation of the proposed action is expected to result in overall beneficial effects to the species and critical habitat in the Gunnison and Colorado Rivers downstream from the Aspinall Unit and induce a positive species response due to a more natural hydrologic regime and an improvement in water quality through the Selenium Management Program. The basis for the determination of no jeopardy and no adverse modification of critical habitat is summarized below. If the conservation measures are not implemented within the proposed timeframes, the effects to critical habitat will likely result in adverse modification to critical habitat that appreciably diminishes the value of critical habitat for both survival and recovery.

Colorado Pikeminnow

The Service concludes that although some aspects of the proposed action will continue to adversely affect Colorado pikeminnow and critical habitat, such as continued water depletions and water quality concerns, the proposed action will result in long-term positive benefits for the Colorado pikeminnow and critical habitat. Positive effects of the proposed action include: increased frequency and duration of peak flows to maintain habitats for adult fish including spawning bars; maintenance backwater habitats for young fish; spring peak flows to provide spawning cues; base flows that would provide fish passage; increased inundation and access to floodplains which would provide warm, food rich environments for adult and subadult Colorado pikeminnow; and improved water quality as a result of the Selenium Management Program.

Razorback Sucker

The Service concludes that although some aspects of the proposed action will continue to adversely affect razorback sucker and critical habitat, such a continued water depletions and water quality concerns, the proposed action will result in long-term positive benefits for the razorback sucker and critical habitat. Positive effects of the proposed action include: increased frequency and duration of peak flows to maintain habitats for adult fish including spawning bars; maintenance backwater habitats for young fish; spring peak flows to provide spawning cues; base flows that would provide fish passage; increased inundation and access to floodplains which would provide warm, food rich environments for all life stages of razorback sucker; and improved water quality as a result of the Selenium Management Program.

Humpback Chub

The Service concludes that although some aspects of the proposed action will continue to adversely affect humpback chub and critical habitat, such a continued water depletions and water quality concerns, the proposed action will result in long-term positive benefits for the humpback chub and critical habitat. While humpback chub do not occur in the Gunnison River, the additional spring peak flows contributed to the Colorado River by the proposed action should benefit humpback chub downstream in Black Rocks and Westwater Canyon.

Bonytail

The Service concludes that although some aspects of the proposed action will continue to adversely affect bonytail and critical habitat, such a continued water depletions and water quality concerns, the proposed action will result in long-term positive benefits for the humpback chub and critical habitat. Although there is uncertainty about some aspects of bonytail life history the proposed action should improve habitat conditions for survival and recruitment.

INCIDENTAL TAKE STATEMENT

Section 9 of the ESA and Federal regulation pursuant to section 4(d) of the ESA prohibit the take of endangered and threatened species, respectively, without 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 of listed species by significantly impairing essential behavioral patterns, including breeding, feeding, or sheltering. Harass is defined by the USFWS 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, 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 ESA provided that such taking is in compliance with the terms and conditions of this Incidental Take Statement.

Amount or Extent of Take

Water depletion
Colorado pikeminnow, humpback chub, bonytail, and razorback sucker are harmed from the reduction of water in their habitats resulting from the subject action in the following manner-- 1) individuals using habitats diminished by the ongoing and proposed water depletions could be more susceptible to predation and competition from non-native fish; 2) habitat conditions may be rendered unsuitable for breeding because ongoing and future reduced flows would impact habitat formation and maintenance as described in the biological opinion.

Estimating the number of individuals of these species that would be taken as a result of new and historic water depletions is difficult to quantify for the following reasons--(1) determining whether an individual forwent breeding as a result of water depletions versus natural causes would be extremely difficult; (2) finding a dead or injured listed fish would be difficult, due to the large size of the action area, the small number of individuals of the listed species, and because carcasses are subject to scavenging; (3) natural fluctuations in river flows and species abundance may mask depletion effects, and (4) effects that reduce fecundity are difficult to quantify. However, we believe the level of take of these species can be monitored by tracking the level of water reduction and adherence to the Recovery Program. Specifically, if the Recovery Program and relevant RIPRAP measures (those listed under Colorado River Action Plan: Gunnison River) are not implemented, or if the current anticipated level of water depletion is exceeded, we fully expect the level of incidental take to increase as well. Therefore, we exempt all take in the form of harm that would occur from the removal of an average of 640,600 af of water per year. Water depletions above the amount addressed in this biological opinion would exceed the anticipated level of incidental take and are not exempt from the prohibitions of section 9 of the Act.

The implementation of the Recovery Program is intended to minimize impacts of water depletions, therefore, support of Recovery Program activities by the Reclamation and others as described in the proposed action exempts Reclamation and water users in the basin from the prohibitions of section 9 of the Act. Reclamation is responsible for reporting to the Service if the amount of average annual depletion is exceeded.

Water Quality
Colorado pikeminnow, humpback chub, bonytail, and razorback sucker are being harmed from the continuation of discharge of selenium related to the Uncompahgre Project and other water uses in the Gunnison Basin. Approximately 60% of the selenium load measured in the Gunnison River near Whitewater comes from loading sources in the Uncompahgre River Basin (Reclamation 2006). The continued operation of the Uncompahgre Project and other water uses is associated with continued loads of salt and selenium in irrigation drain-water being carried to

the Gunnison River by adjacent tributaries. Selenium concentrations in designated critical habitat in the Gunnison River between Delta, Colorado and the Colorado River confluence, as well as the Colorado River downstream of the Gunnison River confluence, exceed the state water quality selenium standard for the protection of aquatic life. Selenium concentrations exceed toxic effect threshold concentrations and are indicative of reproductive impairment occurring in endangered Colorado River fish and migratory birds. Selenium from the female's diet is incorporated into eggs, and high concentrations may result in reduced production of viable eggs, and/or post-hatch mortality due to metabolism of egg selenium by developing larval fish (deformities and altered physiology) (Lemley 2002, Sorensen 1991). Implementation of the Selenium Management Program is intended to reduce adverse effects of selenium on endangered fish by reducing selenium loads, concentrations, and exposure to selenium.

Estimating the number of individuals of these species that would be harmed as a result of increased contaminant concentrations associated with water depletions and reoperation is difficult to quantify for the following reasons--(1) determining whether an individual did not successfully reproduce as a result of increased selenium concentrations due to water depletions would be extremely difficult; (2) finding deformed larval fish or winter mortality of juvenile fish resulting from exposure to high selenium concentrations would be difficult, due to the large size of the action area, the small number of individuals of the listed species, and because carcasses are subject to scavenging; and (3) determining sublethal effects resulting from increased selenium concentrations. However, we believe the level of take of these species can be monitored by tracking the level of water reductions and associated selenium concentrations.

Selenium concentrations will be monitored as part of the Selenium Management Program by comparing future conditions with existing conditions. The best available scientific techniques will be used to monitor selenium. Currently, the US Geological Survey (USGS) has developed trends in flow-adjusted dissolved selenium loads and concentrations in the Gunnison River basin (at the Whitewater gage) from 1986 through 2008 (Mayo and Leib, 2009, in prep). This data shows selenium concentrations decreasing over time and can be characterized with a downward trend. Therefore, we anticipate that with the implementation of the Selenium Management Program, selenium levels will decrease in the Gunnison River. At the end of any 5-year period, if the data shows that selenium concentrations are increasing based on a statistical analysis of field data, the anticipated level of take would be exceeded. The Service will coordinate with USGS and Reclamation to determine appropriate data analysis.

Additional information on the monitoring and analysis will be developed during preparation of the Selenium Management Plan. Implementation of the Selenium Management Program is intended to reduce adverse effects of selenium on endangered fish species. Therefore, it is essential that the Selenium Management Program be fully implemented by Reclamation and others in order for Reclamation and water users in the basin to be exempt from the section 9 prohibitions.

Diversion Structures

It is anticipated that existing water diversions in Gunnison River in critical and occupied habitat have the potential to take endangered fishes. This incidental take is expected to be in the form of mortality because any fish that enter canals or other water diversion facilities may not survive if they are stranded when water is no longer diverted or there is no possibility for fish to return to the river. In 2004 a biological opinion (ES/GJ-6-CO-04-F-003) was issued that addressed take associated with the Redlands Diversion, the only major diversion in critical habitat in the action area. The other diversions in critical habitat are pumps or instream diversions for individual farms/orchards or small groups of users. These small diversions should pose little threat to adult and subadult fish because they would not be diverted because of their size. As fish recover and spawning increases in the Gunnison River, some loss of larval fish would be expected at these small diversions; however because diversions generally divert well less than one percent of the river flow, large numbers of larvae should not be diverted.

EFFECT OF TAKE

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

REASONABLE AND PRUDENT MEASURES

The implementation of the Recovery Program and the proposed operations of the Aspinall Unit are intended to recover the listed species and minimize impacts of water depletions, therefore, the proposed operations and other recovery action items will also serve as reasonable and prudent measures for minimizing the take that results from the water depletions addressed in the biological opinion. Development and implementation of the Selenium Management Program is intended to minimize the take of endangered fishes related to water quality issues. In order to be effective the Selenium Management Program must be implemented in a timely manner. To reduce the level of incidental take associated with water depletions and water quality, the following reasonable and prudent measures have been developed to minimize take:

1. Implementation of the proposed action will include an adaptive management process. Reclamation will work through the Recovery Program to implement appropriate monitoring and research studies to test the result of implementing the proposed action. The purpose of adaptive management is to improve the condition of critical habitat for endangered fish and thereby contribute to their recovery. The Service considers the Recovery Program the appropriate science body to develop and implement monitoring and research studies that would address uncertainties associated with the proposed action. In accordance with the Section 7 agreement, Reclamation and the Service will work with the Recovery Program to revise the RIPRAP as necessary to incorporate the approved studies deemed necessary to evaluate the proposed action.
2. Reclamation will produce a summary report each year to document annual operations and the information used to develop those operations.
3. Reclamation will implement a mechanism (Memorandum of Agreement or similar process) between all appropriate parties to facilitate the development of the Selenium Management Program. This agreement would commit the parties to actively participate in implementation of the program.
4. Reclamation will keep the Service apprised of the progress of the Selenium Management Program.

5. Water quality in the Gunnison and Colorado Rivers will be monitored under various programs and Reclamation will compile data and report to the Service.
6. Biological monitoring developed in coordination with the Recovery Program will be conducted to determine effects to aquatic resources in the Gunnison River and Colorado Rivers.
7. Reclamation shall ensure that proposed conservation measures (outlined in the project description), as further refined by these terms and conditions, are formally adopted and implemented.

TERMS AND CONDITIONS

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

1. Reclamation will work through the Recovery Program technical committees to develop a Study Plan to evaluate the effects of the proposed operations of the Aspinall Unit and how it improves habitat and thereby contributes to recovery. The Study Plan should be completed within one year of the finalization of this biological opinion and should focus on previously identified uncertainties related to geomorphic processes, floodplain inundation, and temperatures (see Uncertainties section). The Study Plan should also include an evaluation of the effects of reoperation on critical habitat in the Colorado River from the Gunnison River confluence to Lake Powell.
2. Reclamation will provide to the Service and Recovery Program a concise annual operations report by December 31 of each year. The primary purpose of the annual report is to provide an assessment of how well operations of the Aspinall Unit contributed to meeting target flows in the Gunnison and Colorado Rivers. The report should include information on the planned operations based on the forecast and the actual operations; flows provided at Whitewater and below the Redlands; the Colorado River at the Colorado/Utah state line and at the Cisco gage; and any operational issues (spillway inspections, etc.).
3. Eight months after the final PBO is issued Reclamation will complete a MOA or similar mechanism, with appropriate parties, to develop the Selenium Management Program.
4. Six months after the final PBO is issued, and every 6 months thereafter, Reclamation will provide an update to the Service on the status of the development of Selenium Management Program.
5. Eighteen months after the final PBO is issued, Reclamation will provide the draft Selenium Management Program document, and a final document with associated agreements with key cooperators to the Service within 24 months.
6. Implementation of the initial components of the SMP not already underway will begin within 5 years of issuance of this opinion.
7. Reclamation will provide annual water quality summary reports to the Service by December 31 of each year.

8. Reclamation will provide a report on biological monitoring (including fish monitoring in the Gunnison and Colorado Rivers) to the Service by December 31 in years when monitoring is conducted.

CONSERVATION RECOMMENDATIONS

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

Dolores River

Colorado pikeminnow occur in the lower few kilometers of the Dolores River. Three native species of concern, the roundtail chub (*Gila robusta*), bluehead sucker (*Catostomus discobolus*) and flannelmouth sucker (*Catostomus latipinnis*) occur in the warm water reaches of the Dolores River. A range-wide conservation agreement and strategy for these species was developed by the States of Utah, Colorado, Wyoming, Arizona, New Mexico, and Nevada (UDWR 2006). The object of the strategy is to identify and significantly reduce or eliminate threats to the persistence of the three species throughout their ranges. Reclamation and the Service are signatory to the agreement and strategy.

In the early 1990's a Biology Committee was established for the Dolores Project. The committee includes Reclamation, the Service, Colorado Division of Wildlife, Bureau of Land Management, and Trout Unlimited. The purpose of the committee is to provide recommendations to Reclamation on administration of the pool of water reserved for downstream use (fish pool). The fish pool is managed for the trout fishery below McPhee Dam. The pool does have additional benefits of providing base flows to the middle and lower Dolores River. Now in addition to the trout fishery, the committee provides recommendations for the downstream native fishery.

The Dolores River Dialogue is a collaborative group of conservation, water management, land management, recreational and governmental representatives working to explore opportunities to manage McPhee Reservoir to improve downstream ecological conditions while honoring water rights, protecting agricultural and municipal water supplies, and protecting the continued enjoyment of rafting and fishing.

Improving the habitat for the three species of concern in the Dolores River will also improve habitat conditions for Colorado pikeminnow and potentially other endangered fish, because the Dolores River was historic habitat. Range expansion of endangered fish into the Dolores River, while not specified in the Recovery Goals, would provide conservation benefits to the species. As such we propose that following conservation recommendations:

1. We recommend that Reclamation continue support efforts of the three species conservation strategy on a range-wide basis, including conservation efforts on the Dolores River.

2. We recommend that Reclamation continue to work with the Biology Committee to consider spill and flow management options to benefit the native fishery in the middle and lower Dolores River while continuing to honor commitments related to downstream rafting.

3. We recommend that Reclamation continue to take an active role in the Dolores River Dialogue, in particular activities related to native fish.

Selenium

1. We recommend that the Recovery Program initiate investigations to determine appropriate levels of selenium to insure recovery of Colorado pikeminnow and razorback sucker. We recognize any new studies would follow established Recovery Program protocol for priority and funding.

In order for the Service to be kept informed of actions minimizing or avoiding adverse effects or benefitting listed species or their habitats, the Service request notification of the implementation of any conservation recommendations. The Service requests that Reclamation report annually on activities related to these conservation recommendations, including a report to the Service each year on flow management on the Dolores River. After 3 years, Reclamation will assess and report the extent to which such flow management may contribute to endangered fish recovery.

INDIVIDUAL CONSULTATIONS UNDER THE UMBRELLA OF THIS PROGRAMMATIC BIOLOGICAL OPINION

This programmatic consultation is on the reoperation of the Aspinall Unit and current and some future water depletions in the Gunnison River basin. The Service determined that the proposed reoperation of the Aspinall Unit, the proposed Selenium Management Program, and the remaining Recovery Action Plan items are sufficient to avoid the likelihood of jeopardy and/or adverse modification of critical habitat for depletion impacts for existing depletions (estimated average annual 602,700 af/year) and future depletions (37,900 af/year), as defined in the proposed action. This PBO does not address non-depletion or non-selenium related effects to the species or critical habitat, it only addresses the actions outlined in the description of the proposed action. New projects proposed in critical habitat that directly impact endangered fish and critical habitat will require separate section 7 consultation outside this PBO. Individual section 7 consultation is required on all future specific Federal actions pursuant to the ESA, to determine if they fit under the umbrella of this programmatic biological opinion. Non-Federal projects with existing depletions (as of the date of this biological opinion) 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 for individual projects depleting more than 100 af/yr, prior to conclusion of section 7 consultation. An example of a Recovery Agreement is provided in Appendix C.

2. For projects involving water depletions less than 100 af/year, the Federal agency must document the project location, the amount of the water depletion, identify if the depletion is new or historic, and provide the information to the Service when consultation is initiated.

3. A fee to fund recovery actions will be submitted as described in the proposed action for new depletion projects greater than100 af/year. The current fee for fiscal year 2009 is $18.29/af and is adjusted each year for inflation. The fees fund Recovery Program activities.

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

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

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. The proposed action includes adaptive management 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. Every 2 years, for the life of the Recovery Program, the Service and Recovery Program will review implementation of the Recovery Action Plan actions that are included in this biological opinion to determine timely compliance with applicable schedules. As provided in 50 CFR sec. 402.16, reinitiation of formal consultation is required for new projects where discretionary Federal Agency involvement or control over the action has been retained (or is authorized by law) and under the following conditions:

1. **The amount or extent of take specified in the incidental take statement for this opinion is exceeded**. The terms and conditions outlined in the incidental take statement are not implemented. The implementation of the proposed reoperation of Aspinall and the Selenium Management Program will further decrease the likelihood of take caused by water depletion impacts.

2. **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**, such as impacts due to climate change. 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."

3. **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.** It would be considered a change in the action subject to consultation if the reoperation of Aspinall and the Selenium Management Program described in this opinion are not implemented within the required timeframes. If a draft Selenium Management Program document is not completed within 18 months of the final Programmatic Biological Opinion and a final document within 24 months, reinitiation of consultation will be required. Reinitiating consultation could consist of an exchange of memoranda examining the progress made on the plan and evaluating the consequences of extending the timeframe. Also, at any time, if funding is not available to implement the Selenium Management Program reinitiation of consultation will be required.

   The analysis for this biological opinion assumed implementation of the Colorado River Mainstem Action Plan of the RIPRAP because the Colorado pikeminnow and razorback sucker that occur in the Gunnison River use the Colorado River and are considered one population. The essential elements of the Colorado River Plan are as follows: 1) provide and protect instream flows; 2) restore floodplain habitat; 3) reduce impacts of nonnative fishes; 4) augment or restore populations; and 5) monitor populations and conduct research to support recovery actions. The analysis for the non-jeopardy determination of the proposed action that includes about 37,900 af/year of new water depletions from the Gunnison River Basin relies on the Recovery Program to provide and protect flows on the Gunnison and Colorado Rivers.

4. **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 can't avoid the likelihood of jeopardy and/or adverse modification of critical habitat then the Service will reinitiate consultation and develop reasonable and prudent alternatives.

If the annual assessment from Reclamation's reports indicates that the operation of the Aspinall Unit to meet flow targets or that the Selenium Management Program, as specified in this opinion has not been implemented as proposed, Reclamation will be required to reinitiate consultation to specify additional measures to be taken by Reclamation or the Recovery Program to avoid the likelihood of jeopardy and/or adverse modification of critical habitat for depletions and water quality. Also, if the status of all four fish species has not sufficiently improved, as determined by the Service in a formal sufficient progress finding under provisions of the Recovery Program, Reclamation will be required to reinitiate consultation. 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. If the Recovery Program is unable to complete those actions which the Service has determined to be required, Reclamation will be required to reinitiate consultation in accordance with ESA regulations and this opinion's reinitiation requirements.

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.

Thank you for your interest in conserving endangered species and for the time and effort that Reclamation staff contributed to this PBO.

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APPENDIX A

SUMMARY OF FLOW RECOMMENDATIONS

Summary of Flow Recommendations to Benefit Endangered Fishes in the Colorado and Gunnison Rivers

The Service provided flow recommendation for the Gunnison and Colorado Rivers to benefit endangered fishes in 2003 (McAda 2003). The Flow Recommendations generally call for higher spring peak flows and lower base flows to produce a more natural river hydrograph. Flow Recommendations are designed to meet the physical and biological needs of the endangered fishes. A summary of the Flow Recommendations is provided below. To review the entire report, go to http://www.usbr.gov/uc/wcao/rm/aspeis/pdfs/GunnCoFlowRec.pdf

RECOMMENDATION GOALS

→ Provide habitats and conditions that provide for spawning and reproduction;

→ Provide in-channel habitat for all life stages for endangered fish;

→ Provide backwater habitat and conditions necessary for overall fish health; and

→ Provide base flows that promote growth and survival of young fish during summer, autumn, and winter.

HYDROLOGIC CATEGORIES (Runoff varies year to year, dependent on snowpack)

→ **Wet (0--10% exceedance).**—A year during which the forecasted April—June runoff volume has been equal or exceeded in 10% or less of the years since 1937. This hydrologic condition has a 10% probability of occurrence.

→ **Moderate Wet (10--30% exceedance).**—A year during which the forecasted April—July runoff volume has been equaled or exceeded in 10-30% of the years since 1937. This hydrologic condition has a 20% probability of occurrence.

→ **Average Wet (30—50% exceedance).**—A year during which the forecasted April—July runoff volume has been equaled or exceeded in 30—50% of the years since 1937. This hydrologic condition has a 20% probability of occurrence.

→ **Average Dry (50—70% exceedance).**—A year during which the forecasted April—July runoff volume has been equaled or exceeded in 50—70% of the years since 1937. This hydrologic category has a 20% probability of occurrence.

→ **Moderate Dry (70—90% exceedance).**—A year during which the forecasted April—July runoff volume has been equaled or exceeded in 70—90% of the years since 1937. This hydrologic condition has a 20% probability of occurrence.

→ **Dry (90—100% exceedance).**—A year during which the forecasted April—July runoff volume has been equaled or exceeded in 90% or more of the years since 1937. This hydrologic condition has a 10% probability of occurrence.

INFLOWS TO BLUE MESA UNDER HYDROLOGIC CATEGORIES

→ **Wet**— Over 1,123,000 af (≥ 161% of average).

→ **Moderately Wet**— Between 871,000 af and 1,123,000 af (125—161% of average).

→ **Average Wet**— Between 709,000 and 871,000 af (102—125% of average).

→ **Average Dry.**— Between 561,000 and 709,000 af (80—102% of average).

→ **Moderately Dry.**— Between 381,000 and 561,000 (55—80% of average).

→ **Dry.**— Less than 381,000 af (< 55% of average).

SUMMER THROUGH WINTER BASE FLOW RECOMMENDATION FOR THE GUNNISON AND COLORADO RIVERS

Hydrologic Category	Gunnison River at Whitewater	Colorado River at Stateline
Wet; 0—10% Exceedance	1,500—2,500 cfs[3]	3,000—6,000 cfs
Moderately Wet; 10—30% Exceedance	1,050—2,500 cfs	3,000—4,800 cfs
Average Wet; 50—70% Exceedance	≥1,050—2,000 cfs	3,000—4,800 cfs
Average Dry; 50—70% Exceedance	≥1,050— ≥2,000 cfs	2,500—4,000 cfs
Moderately Dry; 70—90% Exceedance	≥750— ≥1,050 cfs	2,500—4,000 cfs
Dry; 90—100% Exceedance	≥750— ≥1,050 cfs	≥1,800 cfs

[3] cfs = cubic feet per second

SPRING PEAK-FLOW RECOMMENDATIONS FOR THE GUNNISON RIVER NEAR GRAND JUNCTION[4]

Hydrologic Category	Expected Occurrence	Flow Target and Duration[5]		Instantaneous Peak Flow (cfs)
		½ Fullbank Discharge Days/Year ≥ 8,070 cfs	Fullbank Discharge Days/Year ≥ 14,350 cfs	
Wet	10%	60—**100**	15—**25**	15,000—23,000[6]
Moderately Wet	20%	40—**60**	10—**20**	14,350-16,000[C]
Average Wet	20%	20—**25**	2—**3**	≥ 14,350[7]
Average Dry	20%	10—**15**	0—**0**	≥ 8,070[d]
Moderately Dry	20%	0—**10**	0—**0**	≥ 2,600[8]
Dry	10%	0—**0**	0—**0**	~ 900—4,000[9]
Long-term Weighted Average[10]		20—**32**	4—7	

For example, in a moderately wet year, flows of 14,350 cfs are recommended for 10-20 days.

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[4] This table represents one possible way of achieving the long-term weighted average for sediment transport.
[5] Lower value in each range is for maintenance, higher (bold) value in each range is for improvement.
[6] Instantaneous peak flows within this range have occurred in these hydrologic categories since Blue Mesa Reservoir was closed. The observed instantaneous peaks are desired in the future in conjunction with meeting the flow targets. No specific peak flow with this range is recommended to ensure continued variability among years.
[7] Expected minimum peak flow when recommendations are met; actual peak may exceed the value, ensuring continued variability among years.
[8] Instantaneous peak flow that has occurred since Blue Mesa was closed. Peak flows are expected to equal or exceed this level in years when 8,070 cfs is not reached.
[9] Range of peak flows within this category that have occurred since Blue Mesa Reservoir was closed. Lowest number reflects base flow. Peak flows are expected to continue to occur within this range; no specific flow within this range is recommended, ensuring variability among years.
[10] Weighted values equals days/year x expected occurrence (the sum of all weighted average values equals the long-term weighted average in days/year.

SPRING PEAK-FLOW RECOMMENDATIONS FOR THE COLORADO RIVER NEAR THE COLORADO—UTAH STATE LINE[11]

Hydrologic Category	Expected Occurrence	Flow Target and Duration[12]		Instantaneous Peak Flow (cfs)
		½ Fullbank Discharge Days/Year ≥ 18,500 cfs	Fullbank Discharge Days/Year ≥ 35,000 cfs	
Wet	10%	80—**100**	30—**35**	39,300—69,800[13]
Moderately Wet	20%	50—**65**	15—**18**	35,000—37,500[14]
Average Wet	20%	30—**40**	6—**10**	≥ 35,000[15]
Average Dry	20%	20—**30**	**0**	18,500—26,600[d]
Moderately Dry	20%	0—**10**	**0**	9,970—27,300[16]
Dry	10%	**0**	**0**	5,000—12,100[f]
Long-term Weighted Average[17]		28—**39**	7.2—**9.1**	

[11] This table represents one possible way of achieving the long-term weighted average for sediment transport.
[12] Lower value in each range is for maintenance, higher (bold) value in each range is for improvement.
[13] Instantaneous peak flows within this range have occurred in these hydrologic categories since Blue Mesa Reservoir was closed. These observed instantaneous peaks are desired in the future in conjunction with meeting the flow targets. No specific peak flow is recommended to ensure continued variability among years.
[14] Lower number reflects the expected minimum peak flow when recommendations are met and the upper number reflects peak flows that have occurred since Blue Mesa Reservoir was closed. Peak flow is expected to occur within this range, but no specific value is provided to ensure variability among years.
[15] Expected peak flow when flow recommendations are met. Actual peak may exceed this level ensuring variability among years.
[16] Range of peak flows that have occurred since Blue Mesa Reservoir was closed. Peak flows are expected to continue to fall within this range when 18,500 cfs is not reached. No specific recommendation within this range is made to ensure variability among years.
[17] Weighted values equals days/year x expected occurrence (the sum of all weighted averages equals the long-term weighted average in days/year).

APPENDIX B

HYDROLOGY

Table 1. Baseline river flows (average monthly cfs), Gunnison River at Whitewater, for period of record used in Biological Assessment analysis assuming Aspinall Unit and other water projects and uses in place and operating.

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Peak daily mean for Year
1975	766	751	1326	3`93	6385	5467	3589	1937	2082	1993	1683	1650	8927
1976	1226	1286	1121	1678	3429	2484	1721	1120	1524	1628	1122	858	5130
1977	880	771	812	768	846	761	795	750	774	883	868	753	1581
1978	745	676	841	3581	6361	5805	2426	1319	1370	844	972	1149	10678
1979	1767	2711	2746	4571	9213	6919	2879	1680	1739	1635	1511	1412	15164
1980	1214	2580	1955	4225	9887	7174	2330	1305	1291	1007	1337	1518	13884
1981	1064	600	887	1337	1542	1393	1021	923	1181	1455	1083	823	3773
1982	1279	1388	1310	3463	6959	4748	2475	2077	2787	2731	2502	2443	9140
1983	1436	1360	1865	2839	8631	13662	7850	3138	2207	2477	2284	2582	20640
1984	2848	2630	2703	4968	13738	13722	6757	2894	2525	2998	2955	3180	20782
1985	2835	2360	2021	6747	10494	10121	3312	1567	2319	2723	2557	2655	15186
1986	2519	1744	3803	5796	8378	6447	5018	1995	2747	3378	3236	3305	10357
1987	2073	1885	2035	5198	6706	5877	2023	2088	2369	1851	1575	1569	9241
1988	1145	1301	1168	2309	2206	1901	1509	963	1351	1148	937	867	3436
1989	1027	1278	1790	2566	1805	1594	1442	1110	1258	1148	970	892	2465
1990	778	725	792	1007	1643	1662	1363	908	1156	1353	1163	1194	2574
1991	988	919	1042	1854	4985	4124	1937	1680	2073	1942	1702	1813	8412
1992	1135	956	1175	3314	3712	2731	2088	1702	1784	1961	1716	1396	6063
1993	1083	1325	2857	4991	12960	9242	3771	2220	2374	2650	2244	1969	20492
1994	1344	1230	1505	2167	3534	2830	1568	1251	1562	1771	1579	1518	4919
1995	1143	1056	2700	3797	8893	13680	12698	3043	2695	2780	2832	2762	19346
1996	1674	2286	2858	4046	5822	3341	1903	1541	2065	1956	1982	2079	7860
1997	2706	2739	2972	4431	8647	8757	3408	2517	3232	3188	2824	2730	11996
1998	1582	1469	2141	3646	7196	3200	2295	1545	1890	2049	1841	1732	9877
1999	1178	1159	1461	1383	3276	4499	2851	2882	2751	2468	2229	2188	6793
2000	1456	1464	1609	2764	2729	1831	1661	1141	1440	1623	1246	1133	4817
2001	1073	924	1176	1520	2939	2184	1817	1545	1841	1689	1403	1358	3487
2002	1069	911	904	1095	918	731	708	835	1097	1154	883	749	1153
2003	705	699	787	1169	2998	1809	629	767	1233	1020	859	753	5312
2004	754	730	1117	2039	2409	1543	1385	936	1325	1306	981	887	3413
2005	1206	1734	1578	4324	8022	4545	2184	1478	1686	1949	1528	1221	13574
Avg	1377	1408	1711	3122	5718	4993	2820	1641	1862	1895	1697	1650	

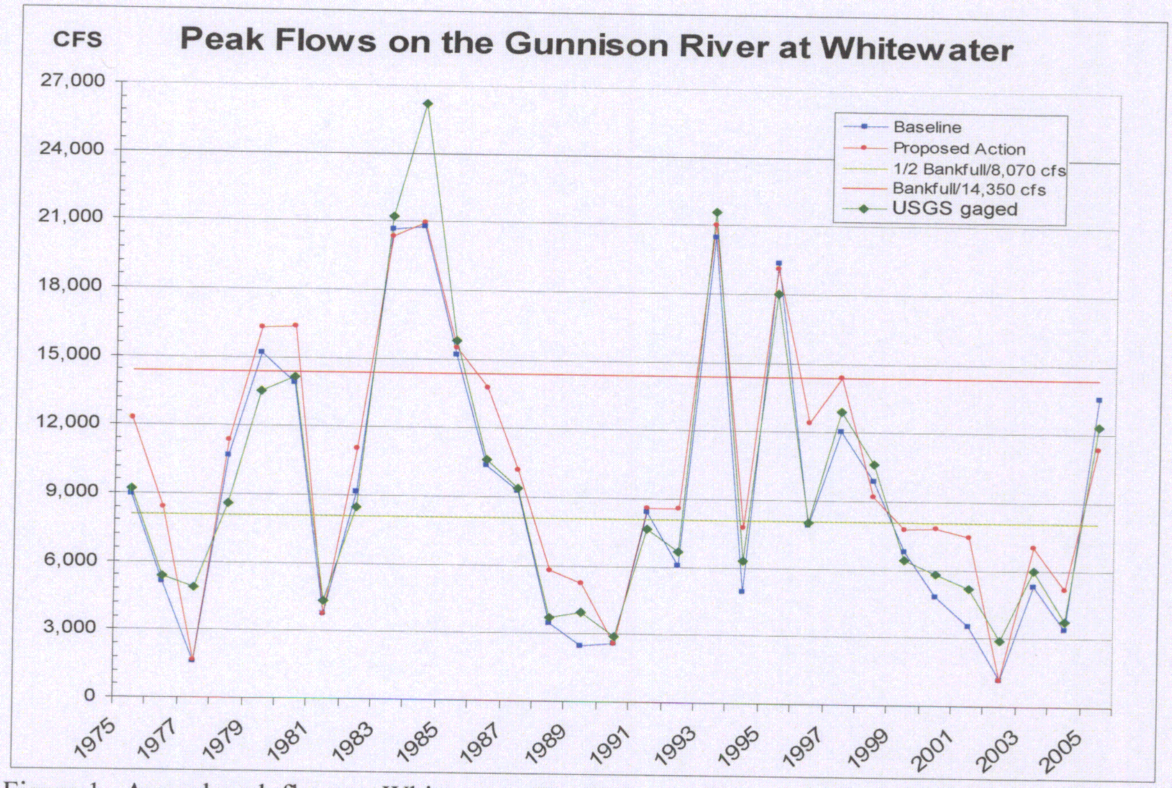

Figure 1. Annual peak flows at Whitewater, Baseline, and Proposed Action depicting 31 years from 1/1/1975 to 12/31/2005.

Table 2. Number of days target flows are met each year.

Gunnison River @ Whitewater Days > 8070 cfs			Gunnison River @ Whitewater Days > 14,350 cfs		
Year	Baseline	Proposed Action	Year	Baseline	Proposed Action
1975	7	23	1975	0	0
1976	0	2	1976	0	0
1977	0	0	1977	0	0
1978	10	22	1978	0	0
1979	27	33	1979	4	4
1980	41	36	1980	0	3
1981	0	0	1981	0	0
1982	8	14	1982	0	0
1983	53	54	1983	13	16
1984	66	67	1984	27	25
1985	61	56	1985	3	5
1986	25	27	1986	0	0
1987	16	16	1987	0	0
1988	0	0	1988	0	0
1989	0	0	1989	0	0
1990	0	0	1990	0	0
1991	1	1	1991	0	0
1992	0	1	1992	0	0
1993	48	49	1993	17	17
1994	0	0	1994	0	0
1995	72	72	1995	23	22
1996	0	9	1996	0	0
1997	47	37	1997	0	1
1998	6	5	1998	0	0
1999	0	0	1999	0	0
2000	0	0	2000	0	0
2001	0	0	2001	0	0
2002	0	0	2002	0	0
2003	0	0	2003	0	0
2004	0	0	2004	0	0
2005	12	8	2005	0	0
Average	16.1	17.2	Average	2.8	3.0

Table 3. Comparison of Baseline/ Proposed Action, number of days above given flow,

Year	Water category	**Base >5000 cfs**	**Action >5000 cfs**	Base >7000 cfs	Action >7000 cfs	**Base >8000 cfs**	**Action >8000 cfs**	Base >10000 cfs	Action >10000 cfs	**Base >14000 cfs**	**Action >14000 cfs**
1977	Dry	**0**	**0**	0	0	**0**	**0**	0	0	**0**	**0**
1981	Dry	**0**	**0**	0	0	**0**	**0**	0	0	**0**	**0**
2002	Dry	**0**	**0**	0	0	**0**	**0**	0	0	**0**	**0**
1990	Dry	**0**	**0**	0	0	**0**	**0**	0	0	**0**	**0**
1988	ModDry	**0**	**3**	0	0	**0**	**0**	0	0	**0**	**0**
1989	ModDry	**0**	**2**	0	0	**0**	**0**	0	0	**0**	**0**
1992	ModDry	**2**	**8**	0	3	**0**	**1**	0	0	**0**	**0**
1994	ModDry	**0**	**11**	0	4	**0**	**0**	0	0	**0**	**0**
2000	ModDry	**0**	**10**	0	3	**0**	**0**	0	0	**0**	**0**
2001	ModDry	**0**	**10**	0	3	**0**	**0**	0	0	**0**	**0**
2003	ModDry	**2**	**9**	0	1	**0**	**0**	0	0	**0**	**0**
2004	ModDry	**0**	**1**	0	0	**0**	**0**	0	0	**0**	**0**
1976	AvgDry	**2**	**13**	0	8	**0**	**2**	0	0	**0**	**0**
1987	AvgDry	**60**	**59**	34	34	**18**	**17**	0	1	**0**	**0**
1991	AvgDry	**26**	**24**	4	9	**1**	**2**	0	0	**0**	**0**
1998	AvgDry	**40**	**40**	18	14	**7**	**6**	0	0	**0**	**0**
1999	AvgDry	**12**	**17**	0	11	**0**	**0**	0	0	**0**	**0**
1982	AvgWet	**38**	**43**	16	23	**9**	**15**	0	6	**0**	**0**
1983	AvgWet	**92**	**91**	59	67	**53**	**54**	44	44	**13**	**17**
1996	AvgWet	**28**	**27**	7	20	**0**	**9**	0	4	**0**	**0**
2005	AvgWet	**48**	**41**	19	17	**12**	**10**	7	5	**0**	**0**
1975	ModWet	**41**	**39**	26	33	**8**	**24**	0	6	**0**	**0**
1978	ModWet	**44**	**44**	15	36	**11**	**25**	2	9	**0**	**0**
1979	ModWet	**65**	**75**	35	44	**27**	**34**	16	22	**4**	**5**
1980	ModWet	**67**	**67**	50	45	**42**	**36**	13	17	**0**	**3**
1985	ModWet	**84**	**82**	75	73	**62**	**57**	29	31	**4**	**6**
1986	ModWet	**101**	**77**	40	44	**25**	**28**	5	17	**0**	**0**
1993	ModWet	**80**	**73**	66	58	**49**	**50**	27	35	**17**	**18**
1995	ModWet	**94**	**88**	76	74	**73**	**72**	61	69	**28**	**29**
1997	ModWet	**76**	**75**	53	50	**47**	**37**	12	15	**0**	**2**
1984	Wet	**94**	**95**	78	77	**67**	**67**	57	56	**31**	**30**
Avg.		**35.4**	**36.3**	21.6	24.2	**16.5**	**17.6**	8.8	10.9	**3.1**	**3.5**
Additional	Years		**6**		**7**		**3**		**3**		**2**
Additional	Days		**28**		**80**		**35**		**64**		**13**

Table 4. Predicted and potential changes in flow as result of proposed action, Colorado River, Colorado-Utah stateline.

Year	Historic peak (cfs) (instantaneous peak)	Potential change in peak (cfs)	Historic avg. monthly flow in May	Predicted change in avg. monthly flow in May	Historic avg. monthly flow in June	Predicted change in avg. monthly flow in June
1975	26,300	+3369	13,150	+201	18,710	+861
1976	14,400	+3256	8,843	+1754	8,881	-191
1977	5,080	+55	2,283	0	2,688	+118
1978	27,800	+686	11,540	+639	19,690	+1376
1979	36,000	+1097	18,650	-237	22,760	+2143
1980	32,100	+2442	20,300	+357	22,290	+259
1981	12,100	-2	4,600	-3	6,516	+30
1982	19,300	+1883	12,340	+500	16,370	+409
1983	62,100	-290	17,540	-34	41,400	+383
1984	69,800	+159	37,960	-3	43,120	-23
1985	39,300	+317	28,570	+494	25,280	-135
1986	33,800	+3370	22,370	+246	24,070	+1585
1987	22,500	826	15,520	+276	11,080	-167
1988	15,400	+2378	8,551	+461	9,108	-52
1989	9,970	+2778	6,651	+703	6,234	-59
1990	12,600	-8	4,078	-3	7,131	-78
1991	19,800	+181	10,610	+293	14,320	-27
1992	16,500	+2520	10,170	+418	7,415	+15
1993	44,300	+548	27,350	-573	25,390	+1293
1994	13,600	+2836	9,912	+969	7,857	-601
1995	49,300	+990	15,040	+493	33,590	+28
1996	29,100	+4552	18,460	+1275	17,620	+166
1997	37,500	+2534	22,500	+566	29,980	+125
1998	26,100	-719	18,470	-178	12,450	-71
1999	17,900	+3644	9,775	+1178	15,190	-118
2000	17,900	+3023	10,940	+1108	8,640	+359
2001	13,200	+3952	9,017	+1353	6,310	-473
2002	5,520	+17	2,640	-1	2.431	+145
2003	26,100	+1721	9,043	+459	10,100	+16
2004	9,450	+1794	6,615	+459	5,309	-230
2005	31,000	-2202	16,110	-909	15,750	-42

APPENDIX C

RECOVERY AGREEMENT EXAMPLE

RECOVERY AGREEMENT

This RECOVERY AGREEMENT is entered into this ___ day of ____________, ________, by and between the United States Fish and Wildlife Service (Service) and name of Water User (Water User).

WHEREAS, in 1988, the Secretary of Interior, the Governors of Wyoming, Colorado and Utah, and the Administrator of the Western Area Power Administration signed a Cooperative Agreement to implement the Recovery Implementation Program for Endangered Fish Species in the Upper Colorado River Basin (Recovery Program); and

WHEREAS, the Recovery Program is intended to recover the endangered fish while providing for water development in the Upper Basin to proceed in compliance with state law, interstate compacts and the Endangered Species Act; and

WHEREAS, the Colorado Water Congress has passed a resolution supporting the Recovery Program; and

WHEREAS, on _________, 2009, the Service issued a programmatic biological opinion (2009 Opinion) for the Gunnison River Basin and the operation of the Wayne N. Aspinall Unit concluding that implementation of specific operation of the Aspinall Unit, implementation of a Selenium Management Plan and specified elements of the Recovery Action Plan (Recovery Elements), along with existing and a specified amount of new depletions, are not likely to jeopardize the continued existence of the endangered fish or adversely modify their critical habitat in the Gunnison River subbasin and Colorado River subbasin downstream of the Gunnison River confluence; and

WHEREAS, Water User is the choose one: owner/operator/contractor of name of water project or projects (Water Project), which causes or will cause depletions to the Gunnison River subbasin; and

WHEREAS, Water User desires certainty that its depletions can occur consistent with section 7 and section 9 of the Endangered Species Act (ESA); and

WHEREAS, the Service desires a commitment from Water User to the Recovery Program so that the Program can actually be implemented to recover the endangered fish and to carry out the Recovery Elements.

NOW THEREFORE, Water User and the Service agree as follows[18]:

1. The Service agrees that implementation of the Recovery Elements specified in the 2009 Opinion will avoid the likelihood of jeopardy and adverse modification under section 7 of the ESA, for depletion impacts caused by Water User's Water Project. Any consultations under section 7 regarding Water Project's depletions are to be governed by the provisions of the 2009 Opinion. The Service agrees that, except as provided in the 2009 Opinion, no other measure or action shall be required or imposed on Water Project to comply with section 7 or section 9 of the ESA with regard to Water Project's depletion impacts or other impacts covered by the 2009 Opinion. Water User is entitled to rely on this Agreement in making the commitment described in paragraph 2.

2. Water User agrees not to take any action which would probably prevent the implementation of the Recovery Elements. To the extent implementing the Recovery Elements requires active cooperation by Water User, Water User agrees to take reasonable actions required to implement those Recovery Elements. Water User will not be required to take any action that would violate its decrees or the statutory authorization for Water Project, or any applicable limits on Water User's legal authority. Water User will not be precluded from undertaking good faith negotiations over terms and conditions applicable to implementation of the Recovery Elements.

3. If the Service believes that Water User has violated paragraph 2 of this Recovery Agreement, the Service shall notify both Water User and the Management Committee of the Recovery Program. Water User and the Management Committee shall have a reasonable opportunity to comment to the Service regarding the existence of a violation and to recommend remedies, if appropriate. The Service will consider the comments of Water User and the comments and recommendations of the Management Committee, but retains the authority to determine the existence of a violation. If the Service reasonably determines that a violation has occurred and will not be remedied by Water User despite an opportunity to do so, the Service may request reinitiation of consultation on Water Project without reinitiating other consultations as would otherwise be required by the "Reinitiation Notice" section of the 2009 Opinion. In that event, the Water Project's depletions would be excluded from the depletions covered by 2009 Opinion and the protection provided by the Incidental Take Statement.

4. Nothing in this Recovery Agreement shall be deemed to affect the authorized purposes of Water User's Water Project or The Service' statutory authority.

6. This Recovery Agreement shall be in effect until one of the following occurs.

a. The Service removes the listed species in the Upper Colorado River Basin from the endangered or threatened species list and determines that the Recovery Elements are no longer needed to prevent the species from being relisted under the ESA; or

[18]Individual Recovery Agreement may be changed to fit specific circumstances.

b. The Service determines that the Recovery Elements are no longer needed to recover or offset the likelihood of jeopardy to the listed species in the Upper Colorado River Basin; or

c. The Service declares that the endangered fish in the Upper Colorado River Basin are extinct; or

d. Federal legislation is passed or federal regulatory action is taken that negates the need for [or eliminates] the Recovery Program.

7. Water User may withdraw from this Recovery Agreement upon written notice to the Service. If Water User withdraws, the Service may request reinitiation of consultation on Water Project without reinitiating other consultations as would otherwise be required by the "Reinitiation Notice" section of the 2009 Opinion.

______________________________ __________

Water User Representative

Date

______________________________ __________

Western Colorado Supervisor
U.S. Fish and Wildlife Service

Date

(ES/GJ-6-CO-09-F-0001- GU___/___)