

Long-Range Plan

San Juan River Basin Recovery Implementation Program

The logo for the San Juan River Basin Recovery Implementation Program is located on the left side of the bottom section. It features a central illustration of a fish, likely a trout, swimming in a river. The fish is surrounded by a circular border with multiple concentric rings in various colors (red, yellow, green, blue). The text "San Juan River Basin" is arched above the fish, and "Recovery Implementation Program" is arched below it. To the right of the logo is a rectangular photograph of a wide river valley with a winding river, surrounded by green hills and mountains in the distance.

San Juan River Basin
Recovery Implementation Program

April 2009

Recommended Citation:

San Juan River Basin Recovery Implementation Program. 2009. Long-range plan. San Juan River Basin Recovery Implementation Program, U.S. Fish and Wildlife Service, Albuquerque, New Mexico.

LONG-RANGE PLAN

San Juan River Basin Recovery Implementation Program

April 2009

ACKNOWLEDGEMENTS

This Long-Range Plan (LRP) was compiled by SWCA, Inc. with the assistance of the Program Coordinator's Office, Biology Committee, Hydrology Committee, and Coordination Committee of the San Juan River Basin Recovery Implementation Program (Program). The primary authors of the LRP were members of the Program's Biology Committee and Richard Valdez of SWCA, Inc. David Campbell, U.S. Fish and Wildlife Service Program Coordinator, and Sharon Whitmore, Assistant Program Coordinator, provided ongoing guidance and review of the document. Mark McKinstry, Bureau of Reclamation, served as Contract Officer Technical Representative and provided assistance with the organizational framework of the LRP. Members of the Biology Committee that helped craft the document included Paul Holden, Ron Bliesner, and Jim Brooks (also of the Coordination Committee), as well as Ron Ryel of the Peer Review Panel. Further technical review was provided by the Biology Committee, Hydrology Committee, and Peer Review Panel. The Coordination Committee provided guidance and oversight for development of the LRP.

TABLE OF CONTENTS

	Page
INTRODUCTION.....	1
Background.....	1
Purpose.....	2
Authority.....	3
DEMOGRAPHIC AND RECOVERY FACTOR CRITERIA	4
Colorado Pikeminnow.....	5
Demographic Criteria.....	4
Recovery Factor Criteria	6
Razorback Sucker.....	7
Demographic Criteria.....	7
Recovery Factor Criteria	8
RECOVERY ELEMENTS AND ACTIONS.....	9
How This Long-Range Plan Addresses Recovery Goals.....	9
Element 1. Development, Integration, and Evaluation of Information for Recovery	12
Goal 1.1—Describe Biotic and Abiotic Baseline Conditions	12
Goal 1.2—Develop New Information as Necessary	14
Goal 1.3—Synthesize and Integrate Information to Evaluate Progress Toward Recovery	14
Element 2. Management and Augmentation of Populations and Protection of Genetic Integrity.....	15
Goal 2.1—Establish a Genetically and Demographically Viable, Self-Sustaining Colorado Pikeminnow Population.....	16
Goal 2.2—Establish a Genetically and Demographically Viable, Self-Sustaining Razorback Sucker Population	17
Element 3. Protection, Management, and Augmentation of Habitat.....	18
Goal 3.1—Provide Suitable Flows to Support Recovery of Colorado Pikeminnow and Razorback Sucker Populations	22
Goal 3.2—Provide Suitable Habitat to Support Recovery of Colorado Pikeminnow and Razorback Sucker Populations	19
Goal 3.3—Provide Increased Range to Support Recovery of Colorado Pikeminnow and Razorback Sucker Populations	23
Goal 3.4—Provide Suitable Water Quality to Support Recovery of Colorado Pikeminnow and Razorback Sucker Populations.....	24
Element 4. Interactions between Native and Nonnative Fish Species.....	24
Goal 4.1—Control Problematic Nonnative Fishes as Needed	25
Goal 4.2—Manage Sport Fish in a Manner Compatible with Endangered Fish Recovery.....	26
Element 5. Monitor Fish and Habitat	27
Goal 5.1—Monitor Fish Populations of the San Juan River	27
Goal 5.2—Monitor Habitat Use and Availability	29
Goal 5.3—Integrate and Synthesize Monitoring Data and Information to Evaluate Fish Community and Ecosystem Responses to Recovery Actions	29

TABLE OF CONTENTS (continued)

	Page
Element 6. Information and Education.....	30
Goal 6.1—Increase Public Awareness and Support for the Endangered Fishes and the Recovery Program	31
Element 7. Program Coordination.....	31
Goal 7.1—Facilitate Program Planning and Management.....	32
Goal 7.2—Ensure Information Integration and Program Review.....	32
Goal 7.3—Facilitate Contract and Funding Management.....	33
LITERATURE CITED.....	34
Appendix A. Tasks, priorities, responsibilities, dates, and descriptions for elements of the Long-Range Plan	
Appendix B. Timeframes for elements of the Long-Range Plan	

LIST OF TABLES

Table	Page
1. Tasks in this Long-Range Plan that address recovery goals criteria for each species.....	10
2. Ongoing reports to be produced through this Long-Range Plan	11

LIST OF FIGURES

Figure	Page
1. Components and relationships of the San Juan River Basin Recovery Implementation Program including the Long-Range Plan.....	3

INTRODUCTION

Background

The San Juan River Basin Recovery Implementation Program (Program) was initiated in October 1992 to protect and recover populations of two federally-listed endangered fish species in the San Juan River Basin (Basin) while water development proceeds in compliance with all applicable federal, state, and tribal laws. The two listed fish species are the Colorado pikeminnow (*Ptychocheilus lucius*; formerly known as Colorado squawfish) and razorback sucker (*Xyrauchen texanus*). Activities and actions within the Program serve as the "reasonable and prudent alternative" for projects in the San Juan River Basin and help to ensure that those projects will not jeopardize the continued existence of the endangered species. It is anticipated that actions taken under the Program will benefit other native fishes in the Basin and prevent them from becoming endangered.

The goals of the Program are:

1. To conserve populations of Colorado pikeminnow and razorback sucker in the Basin consistent with the recovery goals established under the Endangered Species Act of 1973, as amended, 16 U.S.C. §§ 1531 *et seq.* (ESA).
2. To proceed with water development in the Basin in compliance with federal and state laws, interstate compacts, U.S. Supreme Court decisions, and federal trust responsibilities to the Southern Ute Tribe, Ute Mountain Ute Tribe, Jicarilla Apache Nation, and Navajo Nation.

The Program was initiated in 1992 after the rediscovery and documentation of successful spawning by Colorado pikeminnow and the continued presence of razorback sucker in the San Juan River. Adult and young-of-year Colorado pikeminnow and adult razorback sucker were collected during 1987-1989 by biologists gathering detailed fish community data for use in potential razorback sucker reintroduction efforts (Platania et al. 1991). This discovery resulted in the reinitiation of Section 7 consultation through the Bureau of Reclamation (Reclamation) for the Animas-La Plata Project, and subsequently, the Navajo Indian Irrigation Project underwent Section 7 consultation through the Bureau of Indian Affairs.

A 7-year research program, conducted during 1991-1997, provided a baseline of information that identified and characterized factors limiting the two endangered species. The research program was incorporated into the Recovery Program when it was formed in 1992. Culmination of the research program in 1997 marked the end of the research phase and the beginning of the implementation and management phase for the Program. In 1991, a Program Document (Document) was developed to provide the framework for the Program. This Document was adopted by the Coordination Committee in 1992 (SJRRIP 1992) and updated in 2006 (SJRRIP 2006). The Document outlines the Program's purposes, authorities, structure, and operating procedures including funding and budgeting. The Document details the purposes of the Program's committees and defines their composition, authorities, and duties. The Document also includes a description of the process for conducting Section 7 consultations and for reviewing sufficient progress. The Section 7 procedures specifically reference implementation of a Long Range Plan as the principal means for determination

of ESA compliance for water projects in the Basin. The Program operates through a committee processes that identifies the actions needed to attain the Program goals. The committees include representatives of the signatories to a cooperative agreement (SJRRIP 1992), including state and federal agencies and Native American Tribes. Water development and conservation interests are also Program participants.

Purpose

The purpose of this Long-Range Plan (LRP) is to identify specific actions to be implemented in the Basin that will contribute to recovery of the Colorado pikeminnow and razorback sucker in accordance with species recovery goals (U.S. Fish and Wildlife Service [Service] 2002a, 2002b). Recovery of both protected species will be accomplished within context of conservation and management of the entire native fish assemblage and in a manner that does not compromise, impair, or diminish persistence of unprotected native fishes. The LRP uses research information from past San Juan River studies, as well as that from other regions and Program evaluation reports to identify multi-year research, monitoring, and recovery actions necessary to achieve the Program goals.

The need for a long-range plan was identified in the original Program Document (SJRRIP 1992). The first LRP was developed in 1995 by the Biology Committee and was intended primarily to guide the Program through the completion of a 7-year research program to identify and characterize factors limiting the two endangered species. The research program was completed in 1997 and it became necessary to revise and update the LRP to provide guidance on the implementation and management phase of the Program. This revised LRP was a culmination of drafts that updated the 1995 plan and identified new recovery actions based on evaluation and review of the Program's progress (Holden 2000; Miller 2006; SJRRIP 2006) and on species recovery goals. The LRP will be reviewed annually and updated as needed. The relationship of the LRP to the various Program components is shown in Figure 1.

This LRP identifies actions and tasks to be accomplished and the time frame for carrying these out these tasks and activities consistent with species recovery and appropriate for evaluating Program progress. This LRP identifies and describes the progression and priority of implementing identified recovery actions that are expected to result in recovery and delisting of the Colorado pikeminnow and razorback sucker. Because actions identified in this LRP are linked to recovery goals and plans adopted by the Service (USFWS 2002a, 2002b), accomplishing the actions and tasks described in this LRP constitutes the milestones toward achieving recovery of the endangered fish species. As long as these actions and tasks are satisfactorily met and demonstrably contribute to recovery of the listed fishes, it is the mutual expectation of the participants that the Program serves as the foundation for a reasonable and prudent alternative for Section 7 consultations, but shall not preclude the development of reasonable and prudent alternatives independent of the Program.

In order to define and describe specific program activities and projects for upcoming years, the Program develops Annual Work Plan. Annual Work Plans identify and describe activities to be conducted by the program in a given year for conservation of the endangered species. The LRP guides the Program in the development of Annual Work Plans and helps link Program activities for continuity and consistency. Approval of Annual Work Plans and budgets by the Coordination Committee is based, in part, on consistency and compliance with the LRP and available funds.

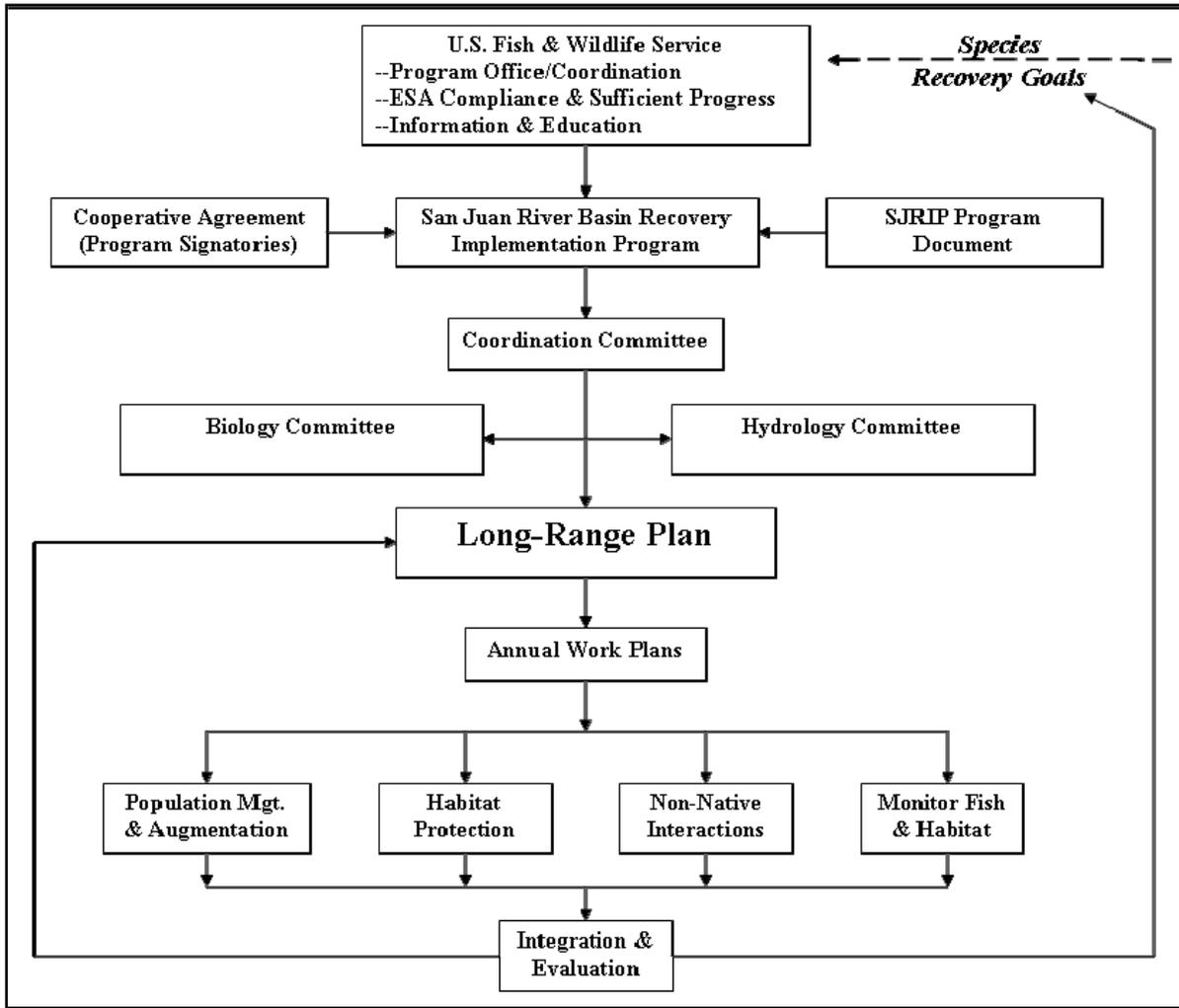


Figure 1. Components and relationships of the San Juan River Basin Recovery Implementation Program including the Long-Range Plan.

Authority

The Program became operational in October 1992 upon execution of a Cooperative Agreement signed by representatives of the Department of the Interior; the States of Colorado and New Mexico, and the Ute Mountain Ute and Southern Ute tribes; and the Jicarilla Apache Nation. The Bureau of Land Management became a participant in the Program in October 1993 as a condition of a Biological Opinion regarding oil and gas development in the Basin, and the Navajo Nation joined the Program in November 1996.

Annual funding reliability is critical to the success of the Program. The Program must be conducted on a continuous basis, and recovery actions need to be funded in a timely manner. Prior to

2001, Program funding was provided by the Reclamation, the Bureau of Indian Affairs, and the Service. On January 24, 2000, Congress enacted Public Law 106-392 that authorized and directed Reclamation to fund the San Juan River Basin Recovery Implementation Program and the Upper Colorado River Endangered Fish Recovery Program (UCRRP). Public Law 106-392 authorized the Secretary of the Interior to use Colorado River Storage Project (CRSP) power revenues to fund annual base costs of both recovery programs, and authorized cost-sharing of capital costs for implementing recovery projects for both recovery programs through the use of federal appropriations, CRSP power revenues, and state and local funding contributions. If the availability of power revenues proves insufficient to meet the annual base funding and capital project needs exceed revenues, Western Area Power Administration and Reclamation may request federal appropriations to meet these needs.

DEMOGRAPHIC AND RECOVERY FACTOR CRITERIA

Recovery goals for Colorado pikeminnow and razorback sucker identify demographic and recovery factor criteria needed to achieve recovery of the species in the Colorado River System (Service 2002a, 2002b). Five-year status reviews for both species are currently being conducted by the Service, and revised recovery goals are expected in 2009. The UCRRP implements and coordinates these management actions in the Upper Colorado River Basin in Colorado, Utah, and Wyoming, exclusive of the San Juan River Basin. The San Juan River Basin Recovery Implementation Program implements and coordinates these management actions in the San Juan River and its tributaries in Colorado, New Mexico, and Utah. The recovery goals provide site-specific management actions; objective, measurable criteria; and estimates of time and costs as guidance for each of the recovery programs.

Demographic criteria and recovery factor criteria for the San Juan River Basin identified in the recovery goals are summarized below. The demographic criteria identify the number of populations, numbers of individuals in each population, and the recruitment rates necessary for downlisting and delisting each species. The recovery factor criteria identify actions that should be taken to minimize or remove threats to each of the endangered fish species as identified for each of the five listing factors in Section 4(a)(1) of the ESA. As described in the species recovery goals, implementation of actions and achievement of criteria for downlisting and delisting of the Colorado pikeminnow and razorback sucker are the responsibility of each of the conservation programs in charge of management of these species for their region of the Colorado River System. Hence, achievement of demographic and listing factor criteria in the San Juan River Basin is the responsibility of the San Juan River Basin Recovery Implementation Program. The demographic criteria and recovery factor criteria for each of the two endangered fish species are provided in this LRP to help identify specific actions and tasks that are considered necessary for downlisting and delisting these species.

Colorado Pikeminnow

Demographic Criteria

Recovery of the Colorado pikeminnow is considered necessary only in the Upper Colorado River Basin. Recovery is dependent on the maintenance of a wild population of at least 2,600 adults in the Green River subbasin and at least 700 adults in the upper Colorado River subbasin, as well as a target of 1,000 subadults in the San Juan River subbasin (note that recovery goals consider the San Juan drainage as a subbasin of the Upper Colorado River Basin). Once each described population is established, the downlist monitoring period is 5 years and the delist period is an additional 8 years.

Downlist criteria

The downlist criteria for the Colorado pikeminnow are based on the establishment and maintenance, for a 5-year period, of two self-sustaining populations of at least 2,600 adults each, including one in the upper Colorado River subbasin and one in the Green River subbasin. Downlisting will also depend on the establishment of a 1,000 subadults in the San Juan River subbasin through augmentation and/or natural reproduction. The following are the criteria quoted from the recovery goals for the Colorado pikeminnow (Service 2002a):

Upper Colorado River Subbasin

1. A self-sustaining population of at least 700 adults (number based on inferences about carrying capacity) is maintained over a 5-year period, starting with the first point estimate acceptable to the Service, such that:
 - a. the trend in adult (age 7+; ≥ 450 mm TL) point estimates does 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.

San Juan River Subbasin

1. A target 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.

Delist criteria

The delist criteria for the Colorado pikeminnow are based on maintenance of a self-sustaining population of at least 2,600 adults (MVP, minimum viable population size) in the Green River for an additional 8 years beyond downlisting. Also, either the upper Colorado River subbasin population exceeds 1,000 adults, or populations of 700 and 800 adults are established and maintained in the upper Colorado River subbasin and the San Juan River subbasin, respectively, for the 8-year delist

period. In order for the species to be delisted, all threats must be sufficiently minimized or removed. The following are criteria quoted from recovery goals for the Colorado pikeminnow (Service 2002a):

Upper Colorado River and San Juan River Subbasins

1. One of the following must be met over an 8-year period beyond downlisting, starting with the first point estimate acceptable to the Service:

A self-sustaining population that exceeds 1,000 adults (age 7+; ≥ 450 mm TL) is maintained in the upper Colorado River subbasin **OR** a self-sustaining population that exceeds 700 adults is maintained in the upper Colorado River subbasin and a self-sustaining population that exceeds 800 adults is maintained in the San Juan River subbasin, such that for each population (numbers of adults based on inferences about carrying capacity):

- a. the trend in adult point estimates does 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.

Recovery Factor Criteria

Recovery factor criteria in the recovery goals describe site-specific management actions necessary to minimize or remove threats to the species and support wild self-sustaining populations. This LRP incorporates these actions to ensure that the Program is carrying out activities consistent with species recovery. Action 3 does not apply to the San Juan River subbasin, but is included to show the full scale of actions necessary to address threats to the Colorado pikeminnow. The following actions are quoted from the recovery goals for the Colorado pikeminnow (Service 2002a):

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. Provide passage over barriers within occupied habitat to allow adequate movement and, potentially, range expansion.
3. Investigate options for providing appropriate water temperatures in the Gunnison River.
4. Minimize entrainment of subadults and adults in diversion canals.
5. Ensure adequate protection from overutilization.
6. Ensure adequate protection from diseases and parasites.
7. Regulate nonnative fish releases and escapement into the main river, floodplain, and tributaries.
8. Control problematic nonnative fishes as needed.
9. Minimize the risk of hazardous-materials spills in critical habitat.
10. Remediate water-quality problems.
11. Provide for the long-term management and protection of populations and their habitats beyond delisting (i.e., conservation plans).

Razorback Sucker

Demographic Criteria

Recovery of the razorback sucker in all regions of the Colorado River System is dependent on the establishment of wild populations from stocking of hatchery-produced fish. In order for the species to be considered for downlisting, each population must consist of fish that are spawned and hatched in the wild; hatchery fish cannot be included in recovery demographic criteria. Once each self-sustaining population is established, the downlist monitoring period is 5 years and the delist period is an additional 3 years.

Downlist criteria

The downlist criteria for the razorback sucker are based on establishment and maintenance, for a 5-year period, of four self-sustaining populations of 5,800 adults each, including two populations in the Upper Colorado River Basin and two in the lower basin. For the upper basin, one population will be established and maintained in the Green River subbasin, and the second in either the upper Colorado River subbasin or in the San Juan River subbasin according to the following criteria quoted from the razorback sucker recovery goals (Service 2002b):

Upper Colorado River and San Juan River Subbasins

1. A self-sustaining population is maintained in **EITHER** the upper Colorado River subbasin or the San Juan River subbasin over a 5-year period, starting with the first point estimate acceptable to the Service, such that for either population:
 - a. the trend in adult (age 4+; 400 mm TL) point estimates 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, and
 - c. each point estimate exceeds 5,800 adults (MVP).

The minimum viable population (MVP) of 5,800 wild adults is defined as the number of adults necessary to maintain a genetically and demographically viable, self-sustaining population for about 200 years.

Delist criteria

The delist criteria for the razorback sucker are based on maintenance of four self-sustaining populations of at least 5,800 adults for an additional 3 years beyond downlisting. Also, in order for the species to be delisted, all threats to the species must be sufficiently minimized or removed. For the upper basin, one population will be maintained in the Green River subbasin, and the second in either the upper Colorado River subbasin or in the San Juan River subbasin

according to the following criteria quoted from the razorback sucker recovery goals (Service 2002b):

Upper Colorado River and San Juan River Subbasins

1. A self-sustaining population is maintained in **EITHER** the upper Colorado River subbasin or the San Juan River subbasin over a 3-year period, starting with the first point estimate acceptable to the Service, such that for either population:
 - a. the trend in adult (age 4+, 400 mm TL) point estimates 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, and
 - c. each point estimate exceeds 5,800 adults (MVP).

Recovery Factor Criteria

Recovery factor criteria in the recovery goals describe site-specific management actions necessary to minimize or remove threats to the species and support wild self-sustaining populations. This LRP incorporates these actions to ensure that this Program is carrying out activities consistent with species recovery. Actions 2 and 5 do not apply to the San Juan River, but are included to show the full scale of actions necessary to address threats to the razorback sucker. The following actions are quoted from the razorback sucker recovery goals (Service 2002b):

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.
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).

RECOVERY ELEMENTS AND ACTIONS

This LRP consists of the following seven Program elements:

1. Development, Integration, and Evaluation of Information for Recovery.
2. Management and Augmentation of Populations and Protection of Genetic Integrity.
3. Protection, Management, and Augmentation of Habitat.
4. Interactions between Native and Nonnative Fish Species.
5. Monitoring Fish and Habitat.
6. Information and Education.
7. Program Coordination.

Elements 2 through 5 were identified in the 1995 and 2006 Program Documents. Element 1 was added to identify the need and process for integration and evaluation of existing information and development of new research as needed. Elements 6 and 7 were added to provide actions and tasks for information and education, as well as Program coordination.

For each Program element, the goals, actions, and tasks necessary to achieve the overall Program purpose are identified and described in the following sections. The goals under each element describe major targets that need to be achieved in order to fulfill the specified element. Actions identified under each goal describe the principle actions, and the tasks describe the specific activities or projects. A status box is provided next to each task that identifies the overall status of the task as completed, ongoing, or years in which the activity is planned.

This LRP identifies activities believed necessary to recover the Colorado pikeminnow and razorback sucker in the San Juan River Basin. The LRP describes what actions will be implemented, who will implement them, when they will be implemented, and why. Details of how actions and tasks will be carried out are left to supporting documents and plans, such as genetics management plans, augmentation plans, monitoring plans, and annual work plans. This LRP functions under the principles of adaptive management where annual updates and periodic revisions are necessary to ensure use of the best available scientific information in modifying or eliminating existing activities and formulating future Program activities.

This LRP identifies actions and tasks that began in 1992, at the initiation of the Recovery Program. Incorporating past Program activities into the LRP provides documentation and accounting of activities, time schedules, and successes and failures of each. This LRP can serve as an accounting of the institutional knowledge of the Program and will enable interested parties to assess overall Program progress over time. The LRP is also intended to facilitate evaluation of the Program's progress toward species recovery and development of sufficient progress reports for ESA Section 7 compliance. Furthermore, this LRP is designed to facilitate tracking of projects and associated budgets to assist the Program Coordinator and Reclamation's budget office. Detailed descriptions of each task with priorities, primary responsibilities, and start and end times are provided in Appendix A of this LRP. Priorities assigned to tasks in Appendix A reflect necessary actions identified in recovery goals.

Although one of the main goals of this Program is to conserve populations of Colorado pikeminnow and razorback sucker in the Basin consistent with species recovery goals, it is also important to ensure restoration and maintenance of the native fish community. Environmental conditions that support the endangered species also provide suitable conditions for the native fish community and vice versa. Native fishes provide an important food source for the predaceous Colorado pikeminnow, are important in maintaining ecological balance and food web dynamics, and serve as indicator species for a healthy ecosystem. The San Juan River Basin supports seven fish species native to the warm reaches of the drainage, including roundtail chub (*Gila robusta*), Colorado pikeminnow, speckled dace (*Rhinichthys osculus*), bluehead sucker (*Catostomus discobolus*), flannelmouth sucker (*Catostomus latipinnis*), razorback sucker, and mottled sculpin (*Cottus bairdi*) (Holden 1999).

Tasks That Address Recovery Goals

This LRP addresses the species recovery goals through specific tasks that detail actions necessary to quantify demographic criteria and remove or minimize species threats (Table 1). The LRP identifies tasks that reestablish populations with hatchery fish a systematic manner for monitoring population abundance. Numerous tasks help to provide and legally protect habitat, especially flows, and also provide for fish passage, as well as minimize entrainment. A series of ongoing tasks continue to be evaluated, including protection from overutilization and diseases and parasites, as well as water-quality remediation and minimizing the risk of hazardous materials spills. Control of problematic nonnative fish, regulating their escapement, and minimizing the threat of hybridization for razorback sucker are also important activities of this Program and the subject of several tasks.

Table 1. Tasks in this Long-Range Plan that address recovery goals criteria for each species.

Recovery Goals Criteria	Colorado Pikeminnow	Razorback Sucker
Demographic criteria	1.2.1.1, 5.1.1.1-5.1.1.2, 5.1.3.1	1.2.1.1, 5.1.1.1-5.1.1.2, 5.1.3.1
Reestablish populations with hatchery-produced fish	2.1.1.1, 2.1.1.2, 2.1.2.1-2.1.2.4	2.2.1.1, 2.2.1.2, 2.2.2.1-2.2.2.4
Provide and legally protect habitat	1.2.2.1, 3.1.1.1-3.1.1.3, 3.1.4.1, 3.2.2.1-3.2.2.2, 5.3.3.7	1.2.2.1, 3.1.1.1-3.1.1.3, 3.1.4.1, 3.2.2.1-3.2.2.2, 5.3.3.7
Provide passage over barriers	3.3.1.1-3.3.1.6	3.3.1.1-3.3.1.6
Minimize entrainment at diversion structures.	3.3.3.1-3.3.3.7	3.3.3.1-3.3.3.7
Ensure adequate protection from overutilization	4.2.2.1-4.2.2.2	4.2.2.1-4.2.2.2
Ensure adequate protection from diseases and parasites	1.1.4.5	1.1.4.5
Regulate nonnative fish releases and escapement	4.2.1.1-4.2.1.2	4.2.1.1-4.2.1.2
Control problematic nonnative fishes	1.1.4.3, 4.1.1.1-4.1.1.7, 4.1.3.1	1.1.4.3, 4.1.1.1-4.1.1.7, 4.1.3.1
Minimize risk of hazardous-materials spills	3.4.3.1	3.4.3.1
Remediate water-quality problems	1.1.4.1, 3.4.1.1, 5.3.4.1	1.1.4.1, 3.4.1.1, 5.3.4.1
Minimize threat of hybridization	Not Applicable	2.2.5.1-2.2.5.2

Ongoing Reports

A series of ongoing reports or workshops are identified in this LRP. The reports are designed to provide cohesive and periodic updates on specific issues and are distinct from project reports that describe the findings of a particular study. These reports are provided to the Coordination Committee, the Program Coordinator, Reclamation, and the Technical Committees and are listed in Table 2. The LRP also identifies several workshops that should be held as necessary to help coordinate Program activities and to provide technical assistance to biologists on population estimators and monitoring. These workshops are also listed in Table 2.

Table 2. Ongoing reports to be produced through this Long-Range Plan.

Identified Task	Report or Workshop	Report Schedule/Interval
1.3.1.1	Synthesis and Integration Report; evaluates progress toward minimizing limiting factors, details ongoing Program activities, and assesses current status of native and endangered fish populations.	Every 5 years but may vary in timing due to competing fiscal resources, project scheduling, or significant new information.
1.3.2.1	Flow Recommendations Update Report; evaluates and updates flow recommendations and response of native and endangered fishes to flow recommendations.	As necessary.
2.1.3.2 2.2.3.2	Standardized Database; for all stocked and recaptured Colorado pikeminnow and razorback sucker in order to determine the fate of stocked fish	Annual entry of data with appropriate documentation.
5.1.1.1	Standardized Fish Monitoring Plan; to assess the presence, status, and trends of Colorado pikeminnow and razorback sucker.	Current version completed in 2006 (Propst et al. 2006).
5.1.1.2	Annual Fish Monitoring Report; to ensure that the best sampling design and strategies are employed.	Annual reports by Biology Committee.
5.1.1.3	Monitoring Plan Workshop; to coordinate sampling design, data collection, and desired precision and detection levels for detecting responses.	As necessary.
5.1.3.2	Population Estimation Workshop; to evaluate population estimators used in other systems to identify the most reliable and suitable estimator(s) for Colorado pikeminnow and razorback sucker.	As necessary.
5.2.1.1	Standardized Habitat Monitoring Plan; to assess habitat and flow relationships.	To be written in 2009-2010.
5.2.1.2	Habitat Monitoring and Mapping Workshop; to refine and improve habitat evaluation methods.	As necessary.

Description of Program Elements

The elements and tasks listed below are designed to guide the Program for federal fiscal years 2008 through 2023, with annual updates as new information is obtained. This schedule is consistent with the razorback sucker recovery goals that estimate recovery by the year 2023. Authorization for construction costs under P.L. 106-392 (as amended by P.L. 107-375) also extends to the year 2023.

Element 1. Development, Integration, and Evaluation of Information for Recovery

Ongoing development, integration, and evaluation of information are essential for assessing progress toward species recovery as well as for guiding future Program direction. An important first step of the SJRRIP was implementation of a research phase to document distribution and abundance resident fishes, characterize species life histories, and identify limiting factors. A 7-year research program was conducted during 1991 through 1997 that provided a baseline of information and identified and characterized factors limiting the Colorado pikeminnow and razorback sucker (Holden 2000). The research program was incorporated into the Recovery Program when it was formed in 1992. An array of potential limiting factors have been investigated, including water quality, spawning habitat, nursery habitat, recruitment, hybridization, truncated range, capture-related stress, nonnative fishes, habitat quantity and diversity, flow regime, food, population size, disease, movement barriers, thermal regime, and entrainment in diversion structures. Although activities have been implemented by the Program to address these factors, much remains to be learned about the life history of the endangered fishes, their relationships with other native and nonnative fishes, their habitat associations, and components of their environment that directly and indirectly influence their welfare. Once a potential limiting factor is identified and characterized through research, efforts are made to implement activities that will eliminate or mitigate its impacts. These activities may not always successfully eliminate threats and mitigation alternatives may be developed.

Many of the actions and tasks identified in the initial 7-year research phase of the Program have been completed and the work has contributed understanding the San Juan River Basin. However, because contemporary Colorado pikeminnow and razorback sucker populations in the San Juan River were extremely small, there is still the need to identify and characterize limitations to establishment and maintenance of self-sustaining populations. The knowledge gained from the initial and future research coupled with other Program activities is valuable in evaluating progress toward species recovery and guiding future Program direction through periodic revision of the LRP. Periodic synthesis of this information is vital to interpreting results of research and management so that informed decisions might be made on future management actions and strategies.

Goal 1.1—Describe Biotic and Abiotic Baseline Conditions.

Action 1.1.1 Determine the relative abundance and distribution of endangered fishes, as well as other native and nonnative fishes in the San Juan River Basin.

Completed

Task 1.1.1.1 Conduct ichthyofaunal surveys of mainstem, tributary streams, and secondary channels to determine fish species associated with these habitats.

Completed

Task 1.1.1.2 Conduct radio telemetry investigations to help define species distributions, movements, spawning sites, and habitat use.

Completed

Task 1.1.1.3 Monitor the distribution and abundance of wild fish populations in the San Juan River to document status and trends.

Action 1.1.2 Describe life history parameters of wild Colorado pikeminnow and razorback sucker.

<input type="checkbox"/> Ongoing	Task 1.1.2.1 Document and quantify reproduction, survival, and recruitment.
<input type="checkbox"/> Completed	Task 1.1.2.2 Locate and describe areas of reproductive activity and nursery habitats to better understand species spawning needs.
<input checked="" type="checkbox"/> Completed	Task 1.1.2.3 Describe and quantify, to the extent possible, habitats selected by various life stages of Colorado pikeminnow and razorback sucker.
Action 1.1.3 Describe and evaluate flow, habitat, and other abiotic relationships.	
<input checked="" type="checkbox"/> Completed	Task 1.1.3.1 Describe, model, and evaluate different flow regimes.
<input checked="" type="checkbox"/> Completed	Task 1.1.3.2 Determine response, to the extent possible, of geomorphology and habitat to flow with the use of habitat mapping, river geomorphology, etc.
<input type="checkbox"/> Ongoing	Task 1.1.3.3 Evaluate water quality as potential limiting factors.
Action 1.1.4 Identify and evaluate limiting factors and determine necessary research to identify actions that will minimize or remove these limiting factors.	
<input type="checkbox"/> Ongoing	Task 1.1.4.1 Compile, evaluate, and synthesize historical water quality information on the San Juan River, combined with existing or new research on the effects of contaminants on aquatic species, to identify water quality parameters that may be detrimental to native and endangered fish species (e.g., mercury, selenium, polycyclic aromatic hydrocarbons [PAHs]).
<input checked="" type="checkbox"/> Completed	Task 1.1.4.2 Determine and quantify mesohabitat types and channel forms used by native and endangered fish.
<input checked="" type="checkbox"/> Completed	Task 1.1.4.3 Evaluate effects of nonnative fishes on native and endangered species and identify the most problematic nonnative species.
<input checked="" type="checkbox"/> Completed	Task 1.1.4.4 Estimate numbers of wild Colorado pikeminnow and razorback sucker in the San Juan River Basin and evaluate prospects for reestablishment of populations with and without hatchery augmentation.
<input checked="" type="checkbox"/> Completed	Task 1.1.4.5 Survey health of fish in the San Juan River to ensure adequate protection from diseases and parasites.
Action 1.1.5 Synthesize and integrate information to describe baseline conditions and to guide future actions.	
<input checked="" type="checkbox"/> Completed	Task 1.1.5.1 Synthesize, integrate, and evaluate the 7-year research program.

Goal 1.2—Develop New Information as Necessary.

Action 1.2.1 Assemble information from population management and augmentation.

2009-2015

Task 1.2.1.1 Use data and information gathered from fish surveys, hatchery augmentation, and survival studies to describe best strategies for establishing wild populations of endangered fish and restoring the native fish community.

2009-2015

Task 1.2.1.2 Assimilate the genetics information on Colorado pikeminnow and razorback sucker to describe best strategies for establishing and maintaining genetically viable wild populations of endangered fish.

Ongoing

Task 1.2.1.3 Monitor genetics of Colorado pikeminnow and razorback sucker in the San Juan River to determine if and to what extent wild produced individuals depart from genetic structure of parental stock (hatchery derived).

Action 1.2.2 Assemble information from habitat evaluation and management.

Ongoing

Task 1.2.2.1 Use data and information gathered from habitat assessments to describe best strategies for providing suitable habitat for native and endangered fish.

Action 1.2.3 Assemble information from nonnative fish capture information.

Completed

Task 1.2.3.1 Use data and information gathered from nonnative fish efforts to describe best strategies for minimizing negative impacts to native and endangered fish species.

Action 1.2.4 Collect and assemble information on native fishes (exclusive of Colorado pikeminnow and razorback sucker).

Ongoing

Task 1.2.4.1 Use previous and current data collected during ongoing investigations to characterize dynamics of native fishes and their response to management activities intended to improve status of listed species.

Action 1.2.5 Characterize relationships of unprotected native species assemblage health or well-being and recovery of protected species.

Ongoing

Task 1.2.5.1 Use collected data to better define the interdependencies of protected and unprotected native species.

Goal 1.3—Synthesize and Integrate Information to Evaluate Progress Toward Recovery.

Action 1.3.1 Synthesize and integrate information from all studies for Program evaluation and to evaluate progress toward recovery.

Ongoing

Task 1.3.1.1 Produce report that evaluates progress toward minimizing limiting factors, ongoing Program activities, and assesses current status of native and endangered fish populations. This report should be produced at 5-year intervals, but completion may vary due to fiscal constraints, project scheduling, or new information.

Action 1.3.2 Evaluate and update flow recommendations.

Ongoing

Task 1.3.2.1 Provide Flow Recommendations Update Report as necessary that evaluates and updates flow recommendations and response of native and endangered fishes to flow recommendations (see Task 3.1.1.2).

Element 2. Management and Augmentation of Populations and Protection of Genetic Integrity

This element ensures that the Program's augmentation protocols maintain genetically diverse fish species while producing and rearing Colorado pikeminnow and razorback sucker to stock in the river system. Wild self-sustaining populations of Colorado pikeminnow and razorback sucker do not currently exist in the San Juan River Basin. Recovery goals for both species identify the need to establish self-sustaining populations through augmentation with hatchery-produced fish. The Program has adopted a genetics management plan (Crist and Ryden 2003) that identifies appropriate genetic lineages for use in hatchery programs and stocking efforts for the San Juan River. Augmentation plans (Ryden 2003a, 2003b) for each of the two endangered species were also developed. Production, rearing, and stocking of these fish need to continue to establish wild populations. Stocking protocols and fate of stocked fish should be monitored and evaluated to determine the best strategies for enhancing survival and recruitment. Survival models should be used to estimate and adjust stocking goals of augmentation plans and to ensure that sufficient numbers of genetically viable fish are being stocked.

Surveys in the late 1980s reported few wild Colorado pikeminnow or razorback sucker in the San Juan River (Platania 1990; Platania et al. 1991). Prior to initiation of the Program, the Service proposed stocking razorback sucker into the San Juan River in 1986 to restore the species to the San Juan River. The effort was not undertaken, but Colorado pikeminnow and razorback sucker persistence in the river were documented. An experimental stocking program for razorback sucker was begun in 1994, under Program auspices, and experimental stocking of Colorado pikeminnow was begun in 1996. Brood stocks of razorback sucker are held at Dexter National Fish Hatchery and Technology Center (NFH), where fish are spawned, hatched, and reared. Dexter NFH and the Colorado Division of Wildlife J.W. Mumma Native Species Hatchery also hold brood stocks of Colorado pikeminnow and it is spawned, hatched, and reared at each facility. Because of the need to stock razorback sucker >300 mm total length (to enhance survival), two facilities are used to rear fish; Uvalde National Fish Hatchery and Navajo Indian Irrigation Project (NIIP) ponds. In addition excess fish from other facilities that raise Colorado pikeminnow and razorback sucker may be stocked into the San Juan River.

Since its inception, the Program continues to identify and develop strategies for producing and rearing both Colorado pikeminnow and razorback sucker, including hatchery production and grow-out facilities. Brood stocks of razorback sucker are held at Dexter National Fish Hatchery (NFH) and Technology Center where the fish are spawned, hatched, and reared. Dexter NFH also holds brood stocks of Colorado pikeminnow, where the fish are spawned, hatched, and reared. Two grow-out facilities are also being used because of the need to stock

large razorback sucker to enhance survival. These facilities include Uvalde National Fish Hatchery and Program Ponds located on the Navajo Indian Irrigation Project (NIIP) and are managed in cooperation with the Navajo Agricultural Products Industry (NAPI). The numbers of fish that need to be produced by these facilities are identified in the species augmentation plans. In addition to the fish produced by these facilities, excess fish may be stocked into the San Juan River from other facilities that raise Colorado pikeminnow and razorback sucker.

Goal 2.1—Establish a Genetically and Demographically Viable, Self-Sustaining Colorado Pikeminnow Population.

Action 2.1.1 Develop plans for rearing and stocking Colorado pikeminnow.

- | | |
|-----------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------|
| <input checked="" type="checkbox"/> Completed | Task 2.1.1.1 Develop a genetics management plan to guide artificial propagation and ensure genetic diversity and viability of Colorado pikeminnow. |
| <input checked="" type="checkbox"/> Completed | Task 2.1.1.2 Develop an augmentation plan for Colorado pikeminnow to provide a strategy for producing, rearing, and stocking fish. |
| <input type="checkbox"/> 2008-2009 | Task 2.1.1.3 Evaluate and adjust stocking goals of augmentation plan. |
| <input type="checkbox"/> Ongoing | Task 2.1.1.4 Review and update Colorado pikeminnow augmentation plan as needed. |

Action 2.1.2 Produce, rear, and stock sufficient numbers of Colorado pikeminnow to meet stocking goals of augmentation plan.

- | | |
|------------------------------------|--------------------------------------------------------------------------------------------------------------------------------|
| <input type="checkbox"/> 2003-2009 | Task 2.1.2.1 Annually produce and rear at least 300,000 age-0 (50–55 mm TL) and 3,000 age-1 Colorado pikeminnow at Dexter NFH. |
| <input type="checkbox"/> 2003-2009 | Task 2.1.2.2 Annually stock >300,000 age-0 Colorado pikeminnow. |
| <input type="checkbox"/> 2003-2009 | Task 2.1.2.3 Annually stock 3,000 age-1 Colorado pikeminnow. |
| <input type="checkbox"/> Ongoing | Task 2.1.2.4 Opportunistically stock available Colorado pikeminnow in excess of those described above. |

Action 2.1.3 Monitor status and success of stocked Colorado pikeminnow.

- | | |
|------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <input type="checkbox"/> Ongoing | Task 2.1.3.1 Determine survival and recruitment of stocked Colorado pikeminnow to determine when to implement mark-recapture population estimates. |
| <input type="checkbox"/> 2008-2009 | Task 2.1.3.2 Develop a Standardized Database for all stocked and recaptured Colorado pikeminnow in order to determine the fate of stocked fish (integrate into Program database—Tasks 2.2.3.2 and 7.2.1.4). |

Action 2.1.4 Evaluate factors limiting Colorado pikeminnow population recovery.

- | | |
|------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------|
| <input type="checkbox"/> 2003-2011 | Task 2.1.4.1 Identify, describe, and implement strategies for improving survival and retention of stocked Colorado pikeminnow, including |
|------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------|

acclimation prior to stocking, size of fish stocked, time and location of stocking, physiological conditioning, and predator avoidance.

2003-2015

Task 2.1.4.2 Identify, describe, and implement strategies for improving long-term survival and recruitment of Colorado pikeminnow, including nonnative fish removal, enhancing habitat and food resources, enhancing genetic diversity and viability, and mitigating barriers to range fragmentation.

Goal 2.2—Establish a Genetically and Demographically Viable, Self-Sustaining Razorback Sucker Population.

Action 2.2.1 Develop plans for rearing and stocking razorback sucker.

Completed

Task 2.2.1.1 Develop a genetics management plan to guide artificial propagation and ensure genetic diversity and viability of razorback sucker.

Completed

Task 2.2.1.2 Develop an augmentation plan for razorback sucker to provide a strategy for producing, rearing, and stocking fish.

2003-2009

Task 2.2.1.3 Evaluate and adjust stocking goals of augmentation plan.

Ongoing

Task 2.2.1.4 Review and update razorback sucker augmentation plan as needed.

Action 2.2.2 Produce, rear, and stock sufficient numbers of razorback sucker to meet stocking goals of augmentation plan.

2004-2011

Task 2.2.2.1 Produce and rear razorback sucker at Dexter NFH for stocking to grow-out facilities.

2004-2011

Task 2.2.2.2 Annually stock three NAPI grow-out ponds with 3,000-3,500 fish (> 200 mm TL) hatchery-reared razorback sucker per pond.

2004-2011

Task 2.2.2.3 Produce 12,000 razorback sucker per year (>300 mm TL) at Uvalde NFH.

2004-2011

Task 2.2.2.4 Stock at least 91,200 razorback sucker (> 300 mm TL) during 2004-2011 or 11,400 per year.

2004-2011

Task 2.2.2.5 Support operation and maintenance of hatchery facilities (Dexter and Uvalde NFH) for razorback sucker production.

2004-2011

Task 2.2.2.6 Operate and maintain NAPI grow-out ponds.

2004-2011

Task 2.2.2.7 Opportunistically stock available razorback sucker in excess of the 11,400 described above.

Action 2.2.3 Monitor status and success of stocked razorback sucker.

□ 2004-2011

Task 2.2.3.1 Determine survival and recruitment of stocked razorback sucker to assess stocking success and make necessary adjustments to stocking program.

□ 2008-2009

Task 2.2.3.2 Develop a Standardized Database for all stocked and recaptured razorback sucker in order to determine the fate of stocked fish (integrate into Program database—Tasks 2.1.3.2 and 7.2.1.4).

Action 2.2.4 Evaluate factors limiting razorback sucker population recovery.

□ 2004-2011

Task 2.2.4.1 Identify, describe, and implement strategies for improving survival and retention of stocked razorback sucker, including acclimation prior to stocking, size of fish stocked, time and location of stocking, physiological conditioning, and predator avoidance.

□ 2004-2015

Task 2.2.4.2 Identify, describe, and implement strategies for improving long-term survival and recruitment of razorback sucker, including nonnative fish removal, enhancing habitat and food resources, enhancing genetic diversity and viability, and mitigating barriers to range fragmentation.

Action 2.2.5 Evaluate the risk of hybridization among sucker species.

□ 2004-2011

Task 2.2.5.1 Quantify the extent of hybridization among native suckers to determine if releasing large numbers of hatchery razorback suckers into the San Juan River will reduce genetic diversity and viability of razorback sucker and/or flannelmouth sucker.

□ Ongoing

Task 2.2.5.2 Quantify the extent of hybridization between native suckers with nonnative white suckers to determine if hybridization is reducing genetic diversity and viability of native suckers (i.e., razorback sucker, flannelmouth sucker, bluehead sucker).

□ 2011

Task 2.2.5.3 Identify and implement necessary actions to minimize hybridization among native suckers and nonnative suckers.

Element 3. Protection, Management, and Augmentation of Habitat

This element identifies actions and tasks that address protect, manage, and augment suitable flows, habitat, range, and water quality to support recovery of Colorado pikeminnow and razorback sucker populations. Flow recommendations were developed for the San Juan River (Holden 1999) and are being evaluated. The foundation for these flow recommendations is mimicry of the natural flow regime of the San Juan River. Scientists recognize that ecological communities and species have adapted and evolved to temporal flow variations specific to different riverine systems (Poff et al. 1997). Providing flows that reflect a more natural regime is necessary to provide the ecological conditions for restoring and maintaining natural biological variability and health (Stanford et al. 1996). For the San Juan River, the intent was to use linkages between hydrology, geomorphology, habitat and biology to define mimicry in terms of flow magnitude, duration, and frequency for runoff and base flow periods. These flow

characteristics were to be compared with statistics of the pre-Navajo Dam river hydrology to refine the flow recommendations.

Flow recommendations for the San Juan River were developed in part to aid in the creation and maintenance of habitats important to various life stages of native and endangered fish species. Monitoring habitat availability, use, and change in availability in response to flow conditions is important to the evaluation and refinement of the flow recommendations and to the recovery of the San Juan River populations of Colorado pikeminnow and razorback sucker. The data integration analyses of 2006 indicated that complex channel reaches (those with high habitat diversity, islands, multiple channels and complex channel margins) correlate positively to native fish abundance. Backwater and low-velocity habitats are more likely to occur in these reaches, and capture locations of YOY endangered fishes also tends to be correlated with channel complexity. Hence, flow management is most effective for providing suitable habitats when the processes that create and maintain complex channel reaches, or result in the loss or creation of backwaters and other habitats important to the endangered fishes are understood and monitored. In addition to providing suitable flows, it is imperative that fish have full access to important river reaches. Range fragmentation in the San Juan River impedes movement of fish and access to spawning areas and feeding grounds. Additional range for Colorado pikeminnow and razorback sucker is being provided through modification of water diversions that allow fish to move upstream and downstream. This LRP identifies actions that provide fish passage at diversions that will enable fish to move freely for over 180 miles from the Lake Powell inflow upstream past the confluence of the Animas River. Some of the fish passage facilities selectively pass fish and help to diminish movement by problematic nonnative fish to key habitats of native and endangered fishes. There are eight major diversion structures on the mainstem San Juan River in New Mexico, ranging from soil and boulder dikes to concrete and metal weirs over which the entire river flows. The most upstream of these structures are dikes and levees at the heads of the Citizens Ditch and the Hammond Canal, which are upstream of the Animas River confluence and outside of designated critical habitat for either species. These cooler reaches of river are not likely to currently be occupied by Colorado pikeminnow and razorback sucker. Five structures, located downstream of Farmington, were identified as impediments or partial impediments to fish movement. Fish access was restored at three sites by removing Cudei Diversion Dam at River Mile (RM) ~142, and constructing fish passages at Hogback Diversion Dam at RM 159 in 2001 and Public Service Company of New Mexico (PNM) Weir at RM 166.6 in 2003. Evaluations of Arizona Public Service Company Weir at RM 163.3 and Fruitland Diversion Dam at RM 178.5 are underway to determine the degree of impediment to fish movement and the feasibility of modifying the structures. Construction will begin in 2009 on a weir wall at Hogback Diversion Dam to prevent entrainment of fish in the irrigation canal.

A natural waterfall formed in the San Juan River at the Lake Powell inflow when the water elevation of that reservoir was lowered in the 1990's. This waterfall is a potential impediment to upstream movement of native and endangered fish, but may also impede nonnative fish from moving upstream from the reservoir. The Biology Committee discussed the need for an artificial barrier at the lower end of the San Juan River to exclude predators from recolonizing the river when water level in Lake Powell rises to a level that the waterfall is inundated. Reclamation assessed the risk of this occurring and concluded that there is a 60 to 75% chance that the waterfall will be inundated for a total of 30 months (not necessarily continuously) between 2008 and 2030. Probabilities for longer inundation are available. The Coordination Committee directed the Program Office to work with the Biology Committee to develop a study plan for a comprehensive report on this issue. The report will include a risk assessment of the impacts of waterfall inundation including non-native fish invasion on the native fish community, fish emigration, habitat fragmentation, and recovery of the listed species. It will consider

management options (e.g., barrier, passive non-native fish removal, temporary weirs) and provide recommendations.

Another potential impediment to recovery is entrainment of all life stages of native and endangered fishes in diversion structures. In 2005, the Program funded the design of fish screens or deflection weirs for the Hogback diversion to reduce entrainment of endangered fishes into the Hogback Canal. Construction of a deflection weir at the Hogback Canal is scheduled to be completed by April 2010, given current budget limitations and the status of preconstruction activities. Principles for minimizing entrainment that are learned from the Hogback Canal design will be used to construct these features on other diversions and canals. Arizona Public Service weir and Fruitland Diversion Dam, the last two potential impediments for fish passage, are being evaluated for possible modification.

An important goal of this element is to provide suitable habitat to support recovered populations of Colorado pikeminnow and razorback sucker. Suitable habitat is intrinsically linked to river flows and the Program is evaluating and identifying flows that provide suitable habitat for various life stages of each of the endangered species. Backwaters are important habitats for young and adult Colorado pikeminnow and razorback sucker but are in low abundance in the San Juan River. Initial results of studies in the San Juan River suggest that stocking and holding young Colorado pikeminnow in low-velocity habitats may increase their retention and survival in the river compared to stocking them in high-velocity habitats. The ability to construct experimental backwaters to aid in the retention of stocked Colorado pikeminnow was evaluated and recommended (Bliesner and Lamarra 2000, 2002, 2007) but existing low velocity retention areas were found that negated the need for mechanically creating backwaters for stocking purposes. The Program's habitat and geomorphology studies have recently shown that nonnative vegetation encroachment (primarily Russian olive and tamarisk) has contributed to long-term narrowing and simplification of the river channel and may affect the ability of the river to provide important habitats for young endangered fishes (Bliesner 2004, Bliesner and Lamarra 2007). Mechanical removal of these invasive riparian species at selected locations and timed to match high flows, may be necessary and feasible to restore channel complexity. Research on mechanical augmentation of habitat is being conducted under this LRP and when determined feasible, the Biology Committee will recommend implementation of habitat construction.

Cold releases from Navajo Dam were identified as a factor potentially limiting reproduction and upstream distribution of the endangered fishes in the San Juan River (Bliesner and Lamarra 2000). Modeling of reservoir and release temperatures (Cutler 2006), together with an assessment of longitudinal warming and fish temperature requirements (Lamarra 2007) revealed that cold releases did not impede endangered fish reproduction or limit endangered fish populations downstream of the Animas River. Consequently, the Biology Committee in 2007 recommended that installation of a temperature control device at the Navajo Dam outlet works was not warranted.

Based on data collection and evaluation over the last 15 years, the Biology Committee has concluded that water quality in the San Juan River is not a limiting factor to recovery of the endangered fishes or to restoration and maintenance of the native fish community. Years of monitoring and research have not clearly linked water contaminants and pollutants with adverse effects to the Colorado pikeminnow and razorback sucker (Abell 1994). Nevertheless, the Biology Committee has concluded that water quality should continue to be monitored to evaluate trends and patterns of various water quality components. Under this element, water quality of the

San Juan River Basin will continue to be evaluated in coordination with other agencies, and potential problems identified to native and endangered fishes.

Goal 3.1—Provide Suitable Flows to Support Recovery of Colorado Pikeminnow and Razorback Sucker Populations.

<p>Action 3.1.1</p> <div style="border: 1px solid black; padding: 2px; width: fit-content; margin-bottom: 10px;"><input checked="" type="checkbox"/> Completed</div> <div style="border: 1px solid black; padding: 2px; width: fit-content;"><input type="checkbox"/> 2010-2011</div>	<p>Develop flow regimes to provide adequate base flow and function to maintain habitat for Colorado pikeminnow and razorback sucker.</p> <p>Task 3.1.1.1 Identify and implement flow recommendations for the San Juan River.</p> <p>Task 3.1.1.2 Develop and implement a process for revising flow recommendations (see Task 1.3.2.1).</p>
<p>Action 3.1.2</p> <div style="border: 1px solid black; padding: 2px; width: fit-content; margin-bottom: 10px;"><input type="checkbox"/> 2005-2011</div> <div style="border: 1px solid black; padding: 2px; width: fit-content; margin-bottom: 10px;"><input type="checkbox"/> 2009</div> <div style="border: 1px solid black; padding: 2px; width: fit-content; margin-bottom: 10px;"><input type="checkbox"/> As Requested</div> <div style="border: 1px solid black; padding: 2px; width: fit-content;"><input type="checkbox"/> Annually</div>	<p>Develop and maintain a hydrology model to evaluate flow recommendations in the context of water supply and demand in the Basin.</p> <p>Task 3.1.2.1 Develop, evaluate, and maintain a San Juan Basin River hydrology model that provides a scientifically sound representation of the San Juan River.</p> <p>Task 3.1.2.2 Conduct peer review of the hydrology model by qualified specialists not affiliated with the Program.</p> <p>Task 3.1.2.3 Provide analysis using the hydrology model for the evaluation of flow recommendations.</p> <p>Task 3.1.2.4 Support operation and maintenance of stream gauges for San Juan River as needed.</p>
<p>Action 3.1.3</p> <div style="border: 1px solid black; padding: 2px; width: fit-content; margin-bottom: 10px;"><input type="checkbox"/> Ongoing</div>	<p>Coordinate with Bureau of Reclamation on Navajo Dam operations.</p> <p>Task 3.1.3.1 Provide input and recommendations to U.S. Fish and Wildlife Service and Bureau of Reclamation on alternate dam operations when extreme hydrologic conditions prevent flow recommendations from being met.</p>
<p>Action 3.1.4</p> <div style="border: 1px solid black; padding: 2px; width: fit-content; margin-bottom: 10px;"><input type="checkbox"/> 2009-2023</div>	<p>Provide and protect flows in the San Juan River consistent with flow recommendations.</p> <p>Task 3.1.4.1 Develop and implement mechanisms for protecting water required to meet flow recommendations.</p>
<p>Action 3.1.5</p> <div style="border: 1px solid black; padding: 2px; width: fit-content; margin-bottom: 10px;"><input type="checkbox"/> 2009-2011</div> <div style="border: 1px solid black; padding: 2px; width: fit-content;"><input type="checkbox"/> 2009-2011</div>	<p>Review and evaluate San Juan River stream flow in light of hydrologic variability.</p> <p>Task 3.1.5.1 Conduct a comprehensive analysis of hydrologic variability in the San Juan River.</p> <p>Task 3.1.5.2 Evaluate the possible and most probable impacts of hydrologic variability on future water availability.</p>

2009-2011

Task 3.1.5.3 Evaluate the ability of the river to meet the functions provided by the flow recommendations given ranges of hydrologic variability and develop contingency strategies.

 2011-2013

Task 3.1.5.4 Evaluate non-flow alternatives that would work in conjunction with flows to meet the functions provided by flow recommendations during extended periods of droughts.

Goal 3.2—Provide Suitable Habitat to Support Recovery of Colorado Pikeminnow and Razorback Sucker Populations.

Action 3.2.1 Identify, characterize, and quantify suitable habitat.

 2005-2009

Task 3.2.1.1 Assess data collected to identify and describe flow-habitat relationships.

 2009-2013

Task 3.2.1.2 Identify habitats and areas of essential habitat to native and endangered fishes at different volumes of water released (including timing and duration) from Navajo Dam.

 2005-2015

Task 3.2.1.3 Assess whether and to what extent, the seasonal and longitudinal distributions of endangered fishes, other native and nonnative fish species can be determined in response to various flow releases from Navajo Dam. Quantify seasonal and longitudinal distributions of endangered fishes, as well as other native and nonnative fish species.

 2005-2015

Task 3.2.1.4 Characterize channel morphology and river channel dynamics to better understand flow-habitat relationships.

Action 3.2.2 Provide suitable habitat.

 2005-2015

Task 3.2.2.1 Implement flows that provide suitable habitat for endangered fishes and other native fishes in the San Juan River.

 2005-2015

Task 3.2.2.2 Use information gathered under Tasks 3.2.1.1 to 3.2.1.4 as the foundation for identifying and evaluating the need to implement other recovery actions, including but not limited to, habitat modification (flow or mechanically induced) and population augmentation.

Action 3.2.3 Evaluate and implement habitat restoration strategies to augment the function of river flow to create and maintain suitable habitat.

 2009-2010

Task 3.2.3.1 Evaluate construction of backwater habitats to serve as low-velocity nursery habitat.

 2009-2011

Task 3.2.3.2 Evaluate selective nonnative vegetation removal in conjunction with high flow conditions for habitat creation and maintenance.

 As necessary

Task 3.2.3.3 Evaluate large-scale nonnative vegetation control, as feasible and necessary.

2011-2012

Task 3.2.3.4 Develop a plan for feasible habitat restoration strategies, and implement such plan as funding becomes available.

Goal 3.3—Provide Increased Range to Support Recovery of Colorado Pikeminnow and Razorback Sucker Populations.

Action 3.3.1 Provide and maintain fish passage at diversion structures.

 Completed

Task 3.3.1.1 Identify and evaluate fish barriers in the San Juan River.

 Completed

Task 3.3.1.2 Remove Cudei Diversion to provide fish passage.

 Completed

Task 3.3.1.3 Provide and maintain fish passage at the Hogback Diversion.

 Completed

Task 3.3.1.4 Provide and maintain selective fish passage at the Public Service Company of New Mexico (PNM) Weir.

 Ongoing

Task 3.3.1.5 Provide and maintain fish passage at the Arizona Public Service Company (APS) Weir.

 Ongoing

Task 3.3.1.6 Evaluate need for fish passage at the Fruitland Diversion.

Action 3.3.2 Evaluate fish passage for native and endangered fish species to and from Lake Powell in light of a natural waterfall at low reservoir elevations.

 2009-2010

Task 3.3.2.1 Identify extent of problem from natural waterfall on passage of native and endangered fishes from Lake Powell into the San Juan River.

 2009-2011

Task 3.3.2.2 Evaluate strategies for providing passage of native and endangered fishes from Lake Powell into the San Juan River, as feasible and needed.

Action 3.3.3 Minimize fish entrainment at diversion structures.

 2004-2011

Task 3.3.3.1 Identify and evaluate diversions with potential fish entrainment in the San Juan River.

 2009-2010

Task 3.3.3.2 Design and construct a fish deflection weir at the Hogback Diversion.

 2009-2011

Task 3.3.3.3 Evaluate the need for and construct, if appropriate, a fish screen or deflection weir at the Arizona Public Service Company (APS) Weir.

 2009-2011

Task 3.3.3.4 Evaluate the need for and construct, if appropriate, a fish screen or deflection weir at the Jewett Valley Ditch.

2009-2011

Task 3.3.3.5 Evaluate the need for and construct, if appropriate, a fish screen or deflection weir at the Fruitland Canal.

 2009-2011

Task 3.3.3.6 Evaluate the need for and construct, if appropriate, a fish screen or deflection weir at the San Juan Generating Station.

 2009-2011

Task 3.3.3.7 Evaluate the need for and construct, if appropriate, a fish screen or deflection weir at the Farmer's Mutual Canal.

Goal 3.4—Provide Suitable Water Quality to Support Recovery of Colorado Pikeminnow and Razorback Sucker Populations.

Action 3.4.1 Describe water quality and identify potential problems to native and endangered fishes.

 Ongoing

Task 3.4.1.1 Continue to evaluate water quality of the San Juan River Basin, in coordination with other agencies, and identify potential problems to native and endangered fishes (see Task 1.1.4.1).

Action 3.4.2 Evaluate effects of river temperature on native and endangered fishes.

 Completed

Task 3.4.2.1 Determine if cold water releases from Navajo Dam into the San Juan River impede endangered fish reproduction or limit endangered fish populations downstream of the Animas River.

Action 3.4.3 Minimize the risk of hazardous-materials spills in critical habitat.

 2009-2010

Task 3.4.3.1 Identify and remediate potential sources of hazardous materials to areas of designated critical habitat (e.g., oil pipelines, riverside retention ponds), as funding becomes available.

Element 4. Interactions between Native and Nonnative Fish Species

This element identifies actions to reduce negative interactions between the endangered fish species and problematic nonnative fish species. Over twenty species of nonnative fish have been documented from the San Juan River Basin, compared to nine native species. Nonnative fishes can numerically dominate riverine habitats and communities, negatively interact with native and endangered fish species, and contribute to their decline (Mueller 2005). The 2002 recovery goals for Colorado pikeminnow and razorback sucker (Service 2002a, 2002b) identified predation and competition by nonnative fish species as a primary threat to these endangered species. The recovery goals state that management actions to address threats posed by nonnative fishes should be implemented in two steps: (1) develop management programs to identify the levels of management needed to minimize or remove the threat for selected species in selected river reaches (requirement for downlisting), and (2) implement the identified levels of nonnative fish management (requirement for delisting). Nonnative fish management actions conducted by the Program are consistent with these actions.

The suite of nonnative fishes in the San Juan River includes warm-water sport fishes and non-sport fishes (Brandenburg and Gido 1999; Brooks et al. 2000). Rainbow trout and brown

trout comprise the tailwater trout fishery below Navajo Dam (Ahlm 1993; Larson and Ahlm 1994) and do not occupy the same river reaches as the endangered fishes, which are found further downstream in warmer water. The non-sport fish include several species of minnows and suckers with little or no commercial or sport value. There is no known strategy will eliminate these unwanted species from the Basin and so, their populations will need to be reduced to a level that minimizes or removes the threat of predation and competition to native species.

Although nonnative fish are problematic in the San Juan River, fish numbers in most reaches are dominated by native species. Mechanical removal of nonnative fish in the San Juan River began in 1997 and is ongoing. Additionally, opportunistic removal of nonnative fish during research and monitoring activities augments this effort. Intensive removal efforts began in 1999 in the river near Farmington and in 2002 in the canyon section between Mexican Hat and Clay Hills, Utah. Other measures such as selective fish passage structures have been implemented and will continue to be operated. Measurable objectives and quantitative methods for assessing and maintaining effectiveness of nonnative fish control will be developed and implemented through this LRP. Nonnative fish stocking and baitfish policies of affected states have been evaluated and nonnative fish are not being stocked in critical habitat of the endangered fishes in the San Juan River.

Sport fish are important to recreational and commercial interests throughout the southwestern United States. Management of these species sometimes conflicts with conservation of native fish species (Clarkson et al. 2005). The San Juan River does not receive a great deal of fishing pressure other than the blue ribbon trout fishery in the tailwaters of Navajo Dam. Nevertheless, appropriate sport fish management is necessary and important to minimize conflicts and ensure conservation of native and endangered fish species. The States of Utah and New Mexico currently have open bag limits on channel catfish and striped bass in the San Juan River. The State of Colorado allows daily bag limits of 10 fish of each species. Although recreational fishing pressure on the San Juan River is limited, maintenance of these regulations will aid the Program in the goal of limiting nonnative fish distribution and abundance. Navajo Nation sport fishing regulations are also included in meeting this goal.

Goal 4.1—Control Problematic Nonnative Fishes as Needed.

Action 4.1.1 Develop, implement, and evaluate the most effective strategies for reducing problematic nonnative fishes.

<input checked="" type="checkbox"/> Completed	Task 4.1.1.1 Identify and prioritize the most problematic nonnative fish species.
<input checked="" type="checkbox"/> Completed	Task 4.1.1.2 Design and implement a pilot program to evaluate nonnative fish control strategies and gears.
<input type="checkbox"/> 2009-2010	Task 4.1.1.3 Develop a long-term nonnative fish control strategy and specific objectives for nonnative fish control.
<input type="checkbox"/> Ongoing	Task 4.1.1.4 Mechanically remove nonnative fish to achieve objectives.
<input type="checkbox"/> Annually	Task 4.1.1.5 Conduct annual review of nonnative fish control strategy.
<input type="checkbox"/> Ongoing	Task 4.1.1.6 Evaluate and implement effective alternative nonnative fish reduction methods.

- Ongoing Task 4.1.1.7 Remove nonnative fishes at selected fish passage structures.
- Ongoing Task 4.1.1.8 Evaluate effects of nonnative fish control on distribution, abundance, and demographics (e.g., fish size, age, sexual maturity) of nonnative fish populations.
- Ongoing Task 4.1.1.9 Evaluate effects of nonnative fish control on distribution, abundance, and demographics (e.g., fish size, age, sexual maturity) of the endangered fish populations and native fish community.

Action 4.1.2 Establish and evaluate strategies for handling removed nonnative fish in collaboration with state and tribal agencies.

- 2005-2009 Task 4.1.2.1 Evaluate and revise, as necessary, translocation strategy for channel catfish removed from the San Juan River Basin.
- 2005-2009 Task 4.1.2.2 Implement standardized fish health analysis for translocated channel catfish to avoid transfer of harmful pathogens.
- Ongoing Task 4.1.2.3 Develop, evaluate, and implement standard procedures for disposal of fish that cannot be translocated.

Action 4.1.3 Identify and regulate nonnative fish releases and escapement into the main river, floodplain, and tributaries.

- 2009-2010 Task 4.1.3.1 Consolidate all information for a comprehensive report and risk assessment of waterfall inundation and associated immigration of nonnative fish from Lake Powell including options and recommendations for potential management actions.
- 2010-2011 Task 4.1.3.2 Implement measures to reduce the risk of immigration of nonnative fish from Lake Powell, as feasible and necessary.
- 2010-2011 Task 4.1.3.3 Identify major sources of nonnative fish from tributaries and off-channel features to minimize reinvasion of riverine habitats by problematic species.
- As necessary Task 4.1.3.4 Implement measures to reduce escapement of nonnative fish from tributaries and off-channel features, as necessary.

Action 4.1.4 Establish criteria for reduction of target nonnative fish populations.

- 2008-2009 Task 4.1.4.1 Establish target criteria for reduction of problematic nonnative fish species to estimate time, effort, and cost for controlling nonnative fishes.

Goal 4.2—Manage Sport Fish in a Manner Compatible with Endangered Fish Recovery.

Action 4.2.1 Develop policies and agreements among affected stakeholders for nonnative game fish management.

- | | |
|-------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------|
| <input type="checkbox"/> 2008-2009 | Task 4.2.1.1 Develop and implement a sport fish stocking policy among the states and tribes. |
| <input type="checkbox"/> 2009 | Task 4.2.1.2 Execute agreements among the states and tribes. |
| Action 4.2.2 Ensure that fishing regulations and enforcement are consistent with endangered fish recovery. | |
| <input type="checkbox"/> 2008-2009 | Task 4.2.2.1 Review and revise fishing regulations, as necessary, to ensure consistency with endangered fish recovery. |
| <input type="checkbox"/> Ongoing | Task 4.2.2.2 Collaborate with state and tribal agencies to enforce fishing regulations. |

Element 5. Monitor Fish and Habitat

Monitoring the San Juan River fish populations and their habitat is necessary to evaluate management actions and to document the Program's progress toward achieving species recovery. The Program has developed a standardized fish monitoring plan and protocol that describes the sampling design and strategies to be used in monitoring Colorado pikeminnow and razorback sucker as part of fish community monitoring (Propst et al. 2000). This monitoring plan should be revised as necessary to provide ongoing information to guide researchers in planning and conducting fish community monitoring.

Monitoring the endangered fish provides information necessary to assess the status and trends of the Colorado pikeminnow and razorback sucker populations in order to gauge progress toward recovery. Ongoing monitoring of stocked and wild fish will help to evaluate the success of stocking strategies and the need for additional hatchery augmentation. Once populations are established, reliable and precise population estimates will help to determine if downlist and delist criteria of recovery goals are being achieved, as is currently being done for Colorado pikeminnow and humpback chub in the upper Colorado and Green rivers. Recovery goals for the Colorado pikeminnow and razorback sucker are closely linked between this Program and the UCRRP, and annual monitoring of fish populations in the San Juan River should continue in order to determine survival of stocked fish, reproduction, and recruitment. Because recovery goals require wild populations, criteria are needed to supplement catch rate estimators with mark-recapture population estimates of wild-produced adults and juveniles. Relationships between catch rate estimators and mark-recapture population estimates of fish in the upper basin may be helpful in developing these criteria. Implementation of mark-recapture estimators will require a comprehensive assessment of logistics, personnel, equipment, and funds.

Other native and nonnative fish populations will also be monitored to better understand the status and trends of these species and their inter-relationships with the endangered fish species. To the extent possible, habitat monitoring should be closely coordinated and integrated with fish community monitoring to allow assessment of changing habitat availability and fish use in response to management actions and population recovery. A standardized habitat monitoring program for the San Juan River was included in the 2000 monitoring plan and is under evaluation. The plan should be designed to monitor and evaluate habitat changes with time and management actions. The data and information from habitat monitoring should be integrated with different monitoring activities to assess the effectiveness of management actions, such as flow management, fish population estimates, and nonnative fish population abundances.

Goal 5.1—Monitor Fish Populations of the San Juan River.

Action 5.1.1 Develop a standardized monitoring program for fish.

Completed

Task 5.1.1.1 Develop, implement, and refine a Standardized Fish Monitoring Plan to assess the presence, status, and trends of Colorado pikeminnow and razorback sucker.

Annually

Task 5.1.1.2 Analyze and evaluate monitoring data and produce Annual Fish Monitoring Reports to ensure that the best sampling design and strategies are employed.

As Necessary

Task 5.1.1.3 Organize and conduct Monitoring Plan Workshops, as necessary, to coordinate sampling design, data collection, and desired precision and detection levels for detecting responses.

Action 5.1.2 Implement the Standardized Fish Monitoring Plan to track the presence, status and trends of endangered fish populations.

2003-2015

Task 5.1.2.1 Conduct larval fish studies to determine if reproduction is occurring, locate spawning and nursery areas, and to gauge the extent of annual reproduction.

2003-2015

Task 5.1.2.2 Conduct juvenile fish studies to determine if young fish are surviving and recruiting and the areas and habitat used for rearing.

2003-2015

Task 5.1.2.3 Conduct adult fish studies to estimate densities of fish (CPUE) and estimates of population size (mark-recapture estimates).

2003-2015

Task 5.1.2.4 Continue to collect catch rate statistics to estimate relative abundance of endangered fish populations.

2003-2015

Task 5.1.2.5 Use mark-recapture population estimators, when feasible and in conjunction with catch rate estimators, to evaluate stocking success for Colorado pikeminnow and razorback sucker.

Action 5.1.3 Obtain reliable population estimates of Colorado pikeminnow and razorback sucker.

2012-2014

Task 5.1.3.1 Develop target criteria to implement mark-recapture population estimates consistent with recovery goals requirements.

As Necessary

Task 5.1.3.2 Conduct Population Estimation Workshops and evaluate population estimators used in other systems to identify the most reliable and suitable estimator(s) for Colorado pikeminnow and razorback sucker.

2015-2023

Task 5.1.3.3 Use mark-recapture population estimators, when feasible and in conjunction with catch rate estimators, to provide reliable estimates of adults, subadults, survival, and recruitment consistent with recovery goals criteria to gauge recovery of Colorado pikeminnow and razorback sucker.

Ongoing

Task 5.1.3.4 Procure adequate numbers of PIT tags for marking native and endangered fish.

Action 5.1.4 Monitor other native and nonnative fish populations.

 2012-2014

Task 5.1.4.1 Monitor other native and nonnative fish populations.

Goal 5.2—Monitor Habitat Use and Availability.

Action 5.2.1 Develop a standardized monitoring program for habitat.

 2009-2010

Task 5.2.1.1 Modify the existing Standardized Habitat Monitoring Plan to incorporate findings from the 2005-2009 detailed reach study, if appropriate.

 2009-2010

Task 5.2.1.2 Organize and conduct Habitat Monitoring and Mapping Workshops, as necessary, to refine and improve habitat evaluation methods.

Action 5.2.2 Implement a standardized monitoring program for habitat.

 2008-2012

Task 5.2.2.1 Quantify attributes of habitats important to each life stage of endangered fish.

 2008-2012

Task 5.2.2.2 Map habitat at different flows as described in the revised Standardized Habitat Monitoring Plan.

 2008-2012

Task 5.2.2.3 Monitor long-term habitat response of the river channel to flow recommendations.

 Ongoing

Task 5.2.2.4 Monitor water quality in the San Juan River (see Task 3.4.1.1).

Action 5.2.3 Identify and refine habitat/fish relationships.

 2007-2009

Task 5.2.3.1 Determine if a habitat/fish relationship can be defined, the probability of success, the level of data needed to accomplish this, and the cost of collecting the data.

 2007-2009

Task 5.2.3.2 Identify principal river reaches and habitats used by various life-stages of endangered fishes.

 2007-2009

Task 5.2.3.3 Relate geo-referenced fish capture data to habitat data.

 2007-2009

Task 5.2.3.4 Collect geo-referenced habitat and fish use data in at least two selected reaches with complex morphology to determine habitat selection.

 2007-2009

Task 5.2.3.5 Map at high resolution and monitor changes in habitat in at least two selected reaches with complex morphology at different flows.

 2007-2009

Task 5.2.3.6 Refine and standardize habitat classification for consistent use with fish sampling and habitat mapping.

Goal 5.3—Integrate And Synthesize Monitoring Data And Information To Evaluate Fish Community And Ecosystem Responses To Recovery Actions.

Action 5.3.1 Develop fish community and ecosystem response strategies.

2008-2009

Task 5.3.1.1 Continue to develop a centralized database that incorporates all data from standardized monitoring and integrate into the Program database (see also Task 7.2.1.4).

Completed

Task 5.3.1.2 Develop an ecosystem model specific to the San Juan River and present it for approval by the Biology Committee (completed in 2000-2005).

Completed

Task 5.3.1.3 Hold workshop on ecosystem model specific to the San Juan River to evaluate model and determine future direction of this effort (Workshop held in 2007).

As necessary

Task 5.3.1.4 Evaluate and review available fisheries data for use in the model to evaluate recovery actions.

As necessary

Task 5.3.1.5 Refine ecosystem model specific to the San Juan River and use with other existing data to evaluate fish community response to recovery actions.

Action 5.3.2 Recommend and implement appropriate monitoring strategies to evaluate ecosystem response.

2009-2010

Task 5.3.2.1 Develop an integrated fish and habitat monitoring plan that includes an annual process for assessing and modifying monitoring activities so that current status of native and endangered fish populations and habitat can be assessed and progress toward recovery can be determined.

Element 6. Information and Education

The Upper Colorado River Endangered Fish Recovery Program and the San Juan River Basin Recovery Implementation Program each have a multi-stakeholder structure in which federal and state agencies work with public and private entities to recover endangered fish species in a manner that is consistent with federal, state, and tribal water laws. Although their structure and goals are similar, these recovery programs operate independently, working with their own program partners and governing committees to fulfill requirements detailed in their respective cooperative agreements. Nevertheless, the similarities in these programs provide for effective communication and public outreach under a coordinated effort.

Using a shared approach, the two recovery programs coordinate their outreach efforts to ensure that common audiences receive accurate and consistent information about the endangered fish species and efforts to recover them. These audiences include the general public, elected officials, Indian Tribes, landowners, anglers, river rafters and guides, environmental organizations, water and power developers, teachers, students, and Program participants. Although the geographic coverage of these recovery programs differs, the majority of affected parties are interested in the recovery efforts taking place for both programs.

Goal 6.1—Increase Public Awareness and Support for the Endangered Fishes and the Recovery Program.

Action 6.1.1 Provide information to the public on the Recovery Program.

Ongoing

Task 6.1.1.1 Provide public information through news articles, press releases, radio and television ads, and other media to inform the public of Program activities in collaboration with the UCRRP I&E Coordinator. Provide press releases routinely on the SJRIP for distribution to the media in Farmington, Durango, Albuquerque, and others in the basin.

Action 6.1.2 Coordinate public outreach with Upper Basin Recovery Program.

Ongoing

Task 6.1.2.1 Develop and maintain a formal outreach support agreement between the San Juan River Basin Recovery Implementation Program and the Upper Colorado River Endangered Fish Recovery Program.

Ongoing

Task 6.1.2.2 Develop and exchange information and materials to incorporate into PowerPoint presentations, newsletters, Program highlights and Program displays.

Ongoing

Task 6.1.2.3 Participate in selected outreach efforts at local, state, and regional water development conferences.

Element 7. Program Coordination

The U.S. Fish and Wildlife Service is responsible for coordinating the San Juan River Basin Recovery Implementation Program. To fulfill this responsibility, the Service has appointed a Program Coordinator who is responsible for overall Program planning and management, information integration and review, and facilitation of contracting funding and management. The Program Coordinator and the Program's Technical Committees have developed this LRP to facilitate achievement of recovery of the endangered fish species of the San Juan River Basin. The Program Coordinator annually compiles Program reports for transmittal to the involved agencies and to the Coordination Committee.

The Program Coordinator also works with the Program's Technical Committees to identify and expedite individual projects that are needed to accomplish the LRP for each of the recovery elements. The Program Coordinator, together with the Program's Technical Committees, drafts Annual Work Plans consisting of high priority individual projects, and forwards these to the Coordination Committee for review and approval. The Program Coordinator is responsible for maintaining records showing distribution and expenditures of all annual and capital funds expended under the Annual Work Plan by each funding source. The Program Coordinator is responsible for insuring that the Program operates according to the Program Document; including the preparation of this LRP, the Annual Work Plans, budgets, and annual progress reports. In all these tasks, the Program Coordinator is assisted by the Technical Committees to ensure that appropriate work products are reviewed and approved by the Technical Committees and all work products are approved by the Coordination Committee.

Goal 7.1—Facilitate Program Planning and Management.

Action 7.1.1 Develop and coordinate a Program plan.

 Completed

Task 7.1.1.1 Develop and implement a Long-Range Plan as a framework for ongoing and future Program activities.

 Annually

Task 7.1.1.2 Annually review and update the Long-Range Plan to reflect new projects and Program progress.

 Annually

Task 7.1.1.3 Revise the Long-Range Plan as new information becomes available on changes to future Program activities.

Action 7.1.2 Provide ongoing Program management.

 Annually

Task 7.1.2.1 Convene annual Program coordination meetings to review the preceding year's monitoring, recovery and research data; assess progress toward recovery; and provide recommendations to modify the Long-Range Plan.

 Annually

Task 7.1.2.2 Develop list of prioritized actions and projects for the Annual Work Plan that most benefit recovery of the endangered fish populations.

 Annually

Task 7.1.2.3 Develop and issue Requests for Proposals (RFPs) for projects that most benefit recovery of the endangered fish populations.

 Annually

Task 7.1.2.4 Assemble and review annual scopes of work to identify most suitable projects for funding and implementation.

 Annually

Task 7.1.2.5 Develop Annual Work Plan with scopes of work and budgets.

 Annually

Task 7.1.2.6 Coordinate and schedule meetings of the Coordination Committee and the Technical Committees, as necessary.

Goal 7.2—Ensure Information Integration and Program Review.

Action 7.2.1 Coordinate and evaluate Program monitoring, research, and reporting activities.

 Annually

Task 7.2.1.1 Conduct annual review of Program progress and integrate all monitoring, recovery, and research activities, data and results.

 Annually

Task 7.2.1.2 Participate in annual researcher's meetings in conjunction with the Upper Basin Researcher's Meeting to present results and interpretations of ongoing projects.

 Annually

Task 7.2.1.3 Prepare annual report with assistance of the Technical Committees as an assessment of progress towards recovery (i.e., Sufficient Progress Report), and formal recommendations for changes in

direction, termination of projects, new projects, and other important Program issues.

Annually

Task 7.2.1.4 Establish and maintain a Program database of information collected under the various Program projects (see also Tasks 2.1.3.2, 2.2.3.2, and 5.3.1.1).

Annually

Task 7.2.1.5 Maintain a standardized process for peer review by qualified specialists in appropriate technical disciplines for significant Program science projects and reports.

Annually

Task 7.2.1.6 Establish and maintain a Program database of all rare fish collections including cross-referencing capabilities with stocking dates and localities.

Goal 7.3—Facilitate Contract and Funding Management.

Action 7.3.1 Ensure appropriate and legal contract and funding practices.

Annually

Task 7.3.1.1 Work jointly with the Bureau of Reclamation to maintain and distribute annual base and capital funds allocated under the Annual Work Plan by each funding source.

Annually

Task 7.3.1.2 Administer Program contracts and provide an accounting of Program funds expended at the end of each federal fiscal year.

Annually

Task 7.3.1.3 Manage the Capital Improvement Program to maintain records showing the distribution and expenditures of capital funds under the Annual Work Plan by each funding source, and provide an accounting of funds expended at the end of each federal fiscal year.

LITERATURE CITED

(Includes literature cited in Appendices)

- Abell, R. 1994. San Juan River Basin water quality and contaminants review. Volumes I and II. Museum of Southwestern Biology, Department of Biology, University of New Mexico.
- Ahlm, L. A., 1993. San Juan River tailwater trout fishery investigations - 1992 Annual Report. New Mexico Department of Game and Fish, Navajo Dam, New Mexico.
- Archer, E. 2000. Appendix B: effects of food availability and competition on age-0 Colorado pikeminnow growth and lipid accrual in the San Juan River. Pages B-1 to B-42 in Archer, E., T.A. Crowl, and M. Trammell, editors. Age-0 native species abundances and nursery habitat quality and availability in the San Juan River, New Mexico, Colorado, and Utah. Utah Division of Wildlife Resources, Salt Lake City, Utah.
- Archer, E., and T. A. Crowl. 2000a. Chapter 2: age-0 native fish year class abundances and size in relation to flow and temperature patterns in the San Juan River 1991-1997. Pages 2-1 to 2-19 in Archer, E., T.A. Crowl, and M. Trammell, editors. Age-0 native species abundances and nursery habitat quality and availability in the San Juan River, New Mexico, Colorado, and Utah. Utah Division of Wildlife Resources, Salt Lake City, Utah.
- Archer, E., and T. A. Crowl. 2000b. Chapter 3: nursery habitat survey of the San Juan River, New Mexico and Utah, 1994-1997. Pages 3-1 to 3-36 in Archer, E., T.A. Crowl, and M. Trammell, editors. Age-0 native species abundances and nursery habitat quality and availability in the San Juan River, New Mexico, Colorado, and Utah. Utah Division of Wildlife Resources, Salt Lake City, Utah.
- Archer, E., T. A. Crowl, and M. Trammell. 2000. Age-0 native species abundances and nursery habitat quality and availability in the San Juan River, New Mexico, Colorado, and Utah. Utah Division of Wildlife Resources, Salt Lake City, Utah.
- Bliesner, R., and V. Lamarra. 2000. Hydrology, geomorphology, and habitat studies. Final Draft Report of Keller-Bliesner Engineering and Ecosystem Research Institute to San Juan River Basin Recovery Implementation Program, U.S. Fish and Wildlife Service, Albuquerque, NM.
- Bliesner, R., and V. Lamarra. 2002. Hydrology, geomorphology, and habitat studies; final report. San Juan River Basin Recovery Implementation Program, U.S. Fish and Wildlife Service, Albuquerque, New Mexico.
- Bliesner, R. 2004. San Juan River Basin Recovery Implementation Program Habitat Response Analysis 1992-2002. Keller-Bliesner Engineering, Logan, Utah.
- Bliesner, R., and V. Lamarra. 2007. San Juan River habitat studies; evaluation of constructed experimental backwaters to aid in the retention of stocked Colorado Pikeminnow. Annual Research Report of Keller-Bliesner Engineering and Ecosystems Research Institute to San Juan River Basin Recovery Implementation Program, U.S. Fish and Wildlife Service, Albuquerque, NM.
- Brandenburg, W. H. and K. B. Gido. 1999. Predation by Nonnative Fish on Native Fishes in the San Juan River, New Mexico and Utah. *Southwest Naturalist* 44(3):392-394.

- Brandenburg, W. H., M. A. Farrington, and S. J. Gottlieb. 2003. Razorback sucker larval fish survey in the San Juan River during 2002. University of New Mexico, Albuquerque, New Mexico.
- Brandenburg, W. H., M. A. Farrington, and S. J. Gottlieb. 2004a. Razorback sucker larval fish survey in the San Juan River during 1999-2002 three-year summary. University of New Mexico, Albuquerque, New Mexico.
- Brandenburg, W. H., M. A. Farrington, and S. J. Gottlieb. 2004b. Razorback sucker larval fish survey in the San Juan River during 2003. University of New Mexico, Albuquerque, New Mexico.
- Brooks, J. E., M. J. Buntjer, and J. R. Smith. 2000. Non-native species interactions: management implications to aid in recovery of the Colorado pikeminnow *Ptychocheilus lucius* and razorback sucker *Xyrauchen texanus* in the San Juan River, Colorado, New Mexico, Utah. San Juan River Basin Recovery Implementation Program, U.S. Fish and Wildlife Service, Albuquerque, New Mexico.
- Buhl, K. J. and S. J. Hamilton. 2000. The chronic toxicity of dietary and waterborne selenium to adult Colorado pikeminnow (*Ptychocheilus lucius*) in a water quality simulating that in the San Juan River. U.S. Geological Survey, Yankton, South Dakota.
- Buntjer, M., T. Chart, and L. Lentsch. 1993. Early life history fisheries survey of the San Juan River, New Mexico and Utah, 1992. Utah Division of Wildlife Resources for San Juan River Basin Recovery Implementation Program, U.S. Fish and Wildlife Service, Albuquerque, New Mexico.
- Buntjer, M., T. Chart, and L. Lentsch. 1994. Early life history fisheries survey of the San Juan River, New Mexico and Utah, 1993. Utah Division of Wildlife Resources for San Juan River Basin Recovery Implementation Program, U.S. Fish and Wildlife Service, Annual Research Report, Fiscal Year 1993, Albuquerque, New Mexico.
- Clarkson, R.W., P.C. Marsh, S.E. Stefferud, and J.A. Stefferud. 2005. Conflicts between native fish and nonnative sport fish management in the southwestern United States. *Fisheries* 30(9):20-27.
- Crist, L.W. and D.W. Ryden. 2003. Genetics management plan for the endangered fishes of the San Juan River. Report of Bureau of Reclamation and U.S. Fish and Wildlife Service, San Juan River Basin Recovery Implementation Program, U.S. Fish and Wildlife Service, Albuquerque, NM.
- Cutler, A. 2006. Navajo Reservoir and San Juan River temperature study. Final Report. U.S. Department of the Interior, Bureau of Reclamation, Upper Colorado Regional Office, Salt Lake City, UT.
- Dowling, T. E., and W. L. Minckley. 1993. Genetic diversity of razorback sucker as determined by restriction endonuclease analysis of mitochondrial DNA. Report of Arizona State University, Department of Zoology for U.S. Bureau of Reclamation, Final Report, Arizona.

- Farrington, M. A., W. H. Brandenburg, and S. J. Gottlieb. 2003. Colorado pikeminnow larval fish survey in the San Juan River during 2002. University of New Mexico, Albuquerque, New Mexico.
- Farrington, M. A., W. H. Brandenburg, and S. J. Gottlieb. 2004. Colorado pikeminnow larval fish survey in the San Juan River during 2003. University of New Mexico, Albuquerque, New Mexico.
- Gido, K. B., and D. L. Propst. 1994. San Juan River secondary channel community studies, permanent study sites, 1993 Annual Report. U.S. Fish and Wildlife Service for San Juan River Basin Recovery Implementation Program, Annual Research Report, Fiscal Year 1993, U.S. Fish and Wildlife Service, Albuquerque, New Mexico.
- Gido, K. B., and D. L. Propst. 1995. San Juan River secondary channel community studies, permanent study sites, 1994 Draft Annual Report. Museum of Southwestern Biology, Department of Biology, University of New Mexico and New Mexico Department of Game and Fish, Albuquerque.
- Gido, K. B., and D. L. Propst. 1999. Habitat use and association of native and nonnative fishes in the San Juan River, New Mexico and Utah. *Copeia* 1999(2):321-332.
- Goettlicher, W. P., and M. J. Pucherelli. 1994. Mapping instream habitat on the San Juan River using airborne videography, 1993. For Bureau of Reclamation, Annual Progress Report, Denver, Colorado.
- Golden, M. E., and P. B. Holden. 2003. Summary of monitoring activities and other studies conducted by the San Juan River Basin Recovery Implementation Program, 1999-2002. Bio-West, Inc., Logan, Utah.
- Hamilton, S. J., and K. J. Buhl. 1997a. Hazard assessment of inorganics, individually and in mixtures, to two endangered fish in the San Juan River, New Mexico. *Environmental Toxicology and Water Quality* 12:195-209.
- Hamilton, S. J., and K. J. Buhl. 1997b. Hazard evaluation of inorganics, singly and in mixtures, to flannelmouth sucker *Catostomus latipinnis* in the San Juan River, New Mexico. *Ecotoxicology and Environmental Safety* 1997 (38):296-308.
- Holden, P.B. (Ed.) 1999. Flow recommendations for the San Juan River. San Juan River Basin Recovery Implementation Program, Biology Committee. U.S. Fish and Wildlife Service, Albuquerque, NM.
- Holden, P.B. (Ed.) 2000. Program evaluation report for the 7-year research period (1991-1997). San Juan River Basin Recovery Implementation Program, U.S. Fish and Wildlife Service, Albuquerque, NM.
- Lamarra, V. 2004. Statistical analysis of habitat availability and fish abundance in the San Juan River. Ecosystems Research Institute, Logan, Utah.
- Landye, J., B. McCasland, C. Hart, K. Hayden, and J. C. Thoesen. 2000. San Juan River fish health surveys, 1992-1999. U.S. Fish and Wildlife Service, Pinetop Fish Health Center, Pinetop, Arizona.

- Larson, R. D., and L. A. Ahlm. 1994. San Juan River tailwater trout fishery investigations, 1993 Annual Report. New Mexico Department of Game and Fish, Navajo Dam, New Mexico.
- Lashmett, K. 1993. Fishery survey of the lower San Juan River and the upper arm of Lake Powell (RMI 4.0 - 11.0), 1991/92 Annual Report. Report of U.S. Bureau of Reclamation for San Juan River Basin Recovery Implementation Program, U.S. Fish and Wildlife Service, Albuquerque, New Mexico.
- Lashmett, K. 1994. Fishery survey of the lower San Juan River and the upper arm of Lake Powell (RMI 4.0 - 0.8), 1993 Annual Report. U.S. Bureau of Reclamation for San Juan River Basin Recovery Implementation Program, U.S. Fish and Wildlife Service, Annual Research Report, Fiscal Year 1993, Albuquerque, New Mexico.
- Lashmett, K. 1995. Fishery survey of the lower San Juan River and the upper arm of Lake Powell (RMI 4.0 - 1.9), 1994 Annual Report. Report of U.S. Bureau of Reclamation for San Juan River Basin Recovery Implementation Program, U.S. Fish and Wildlife Service, Annual Research Report, Fiscal Year 1994, Albuquerque, New Mexico.
- Masslich, W., and P.B. Holden. 1996. Expanding distribution of Colorado squawfish in the San Juan River: a discussion paper. Report of Bio/West, Inc. for the San Juan River Basin Recovery Implementation Program, U.S. Fish and Wildlife Service, Albuquerque, NM.
- Miller, W. J. 2006. Standardized monitoring program five-year data integration report. San Juan River Basin Recovery Implementation Program, U.S. Fish and Wildlife Service, Albuquerque, NM.
- Miller, W. J., A. L. Hobbes, and D. L. Propst. 1993. Ichthyofaunal surveys of the Animas, La Plata, Florida, Los Pinos, and San Juan rivers, New Mexico and Colorado, August and September, 1992 Annual Report. Report of W.J. Miller and Associates and Endangered Species Program, New Mexico Department of Fish and Game for San Juan River Basin Recovery Implementation Program, U.S. Fish and Wildlife Service, Albuquerque, New Mexico.
- Miller, W. J., and J. Ptacek. 2000. Colorado pikeminnow habitat use in the San Juan River, New Mexico and Utah. Miller Ecological Consultants, Inc., for San Juan River Basin Recovery Implementation Program, U.S. Fish and Wildlife Service, Albuquerque, New Mexico.
- Miller, W. J., and D. E. Rees. 2000. Ichthyofaunal surveys of tributaries of the San Juan River, New Mexico. Report of Miller Ecological Consultants, Inc., for San Juan River Basin Recovery Implementation Program, U.S. Fish and Wildlife Service, Albuquerque, New Mexico.
- Mueller, G.A. 2005. Predatory fish removal and native fish recovery in the Colorado River mainstem: what have we learned? *Fisheries* 30(9):10-19.
- Odell, S. 1995. Polynuclear aromatic hydrocarbon study: 1994 annual report of data collection activities concerning suspected contributions of polynuclear aromatic hydrocarbons by oil and gas leasing on public lands in the San Juan Basin, New Mexico. Bureau of Land Management for San Juan River Basin Recovery Implementation Program, U.S. Fish and Wildlife Service, Annual Research Report, Fiscal Year 1994, Albuquerque, New Mexico.

- Odell, S. 1997. Polynuclear aromatic hydrocarbon study: 1996 annual report of data collection activities concerning suspected contributions of polynuclear aromatic hydrocarbons by oil and gas leasing on public land in the San Juan Basin, New Mexico. U.S. Bureau of Land Management for San Juan River Basin Recovery Implementation Program, U.S. Fish and Wildlife Service, 1996 Annual Report, Albuquerque, New Mexico.
- Platania, S. P. 1990. Biological summary: San Juan River ichthyofaunal study, New Mexico-Utah, 1987 to 1989. Museum of Southwestern Biology, Department of Biology, University of New Mexico for U.S. Bureau of Reclamation, Salt Lake City, Utah.
- Platania, S.P., K.R. Bestgen, M.A. Moretti, D.L. Propst and J.E. Brooks. 1991. Status of Colorado squawfish and razorback sucker in the San Juan River, Colorado, New Mexico, and Utah. *Southwestern Naturalist* 36 (1):147-150.
- Platania, S. P., R. K. Dudley, and S. L. Maruca. 2000. Drift of fishes in the San Juan River 1991-1997, Final Report. Division of Fishes, Museum of Southwestern Biology, Department of Biology, University of New Mexico, Albuquerque, New Mexico.
- Poff, N.L., J.D. Allan, M.B. Bain, J.R. Karr, K.L. Prestegard, B.D. Richter, R.E. Sparks, and J.C. Stromberg. 1997. The natural flow regime: a paradigm for river conservation and restoration. *BioScience* 47:769-784.
- Propst, D. L., A. Hobbes, and K. Lawrence. 1999. Chapter 4: physical and biological response to test flows, red shiner section. Pages 4-1 to 4-88 in P.B. Holden, editor. *Flow recommendations for the San Juan River*. San Juan River Basin Recovery Implementation Program, USFWS, Albuquerque, New Mexico.
- Propst, D. L., and A. L. Hobbes. 2000. Seasonal abundance, distribution, and population size-structure of fishes in San Juan River secondary channels 1991-1997. Conservation Services Division, New Mexico Department of Game and Fish, Santa Fe, New Mexico.
- Propst, D.L., S. P. Platania, D. W. Ryden, and R. L. Bliesner. 2000. San Juan River monitoring plan and protocols. San Juan River Basin Recovery Implementation Program, U.S. Fish and Wildlife Service, Albuquerque, New Mexico.
- Propst, D. L., A. H. Kingsburg, and R. D. Larson. 2004. Small-bodied fish monitoring San Juan River, 1998-2002. U.S. Fish and Wildlife Service, Albuquerque, New Mexico.
- Pucherelli, M. J., and R. C. Clark. 1990. San Juan River habitat mapping using remote sensing techniques. U.S. Bureau of Reclamation, AP-90-4-2, Denver, Colorado.
- Pucherelli, M. J., and W. P. Goettlicher. 1992. Mapping instream habitat on the San Juan River using airborne videography. U.S. Bureau of Reclamation Technical Report, R-92-16, Denver, Colorado.
- Ryden, D. W. 1997. Five-year augmentation plan for razorback sucker in the San Juan River. U.S. Fish and Wildlife Service, Grand Junction, CO.
- Ryden, D.W. 2000a. Adult fish community monitoring on the San Juan River, 1991-1997. U.S. Fish and Wildlife Service, Grand Junction, CO.

- Ryden, D.W. 2000b. Monitoring of experimentally stocked razorback sucker in the San Juan River: March 1994 through October 1997. Final Report, U.S. Fish and Wildlife Service, Grand Junction, CO.
- Ryden, D. W. 2003a. An augmentation plan for Colorado pikeminnow in the San Juan River. U.S. Fish and Wildlife Service, Grand Junction, CO.
- Ryden, D. W. 2003b. An augmentation plan for razorback sucker in the San Juan River; an addendum to the five-year augmentation plan for razorback sucker in the San Juan River (Ryden 1997). U.S. Fish and Wildlife Service, Grand Junction, CO.
- Ryden, D. W. 2003c. Long term monitoring of sub-adult and adult large-bodied fishes in the San Juan River: 1999-2001 integration report. U.S. Fish and Wildlife Service, Grand Junction, Colorado.
- Ryden, D. W. 2003d. Long term monitoring of sub-adult and adult large-bodied fishes in the San Juan River: 2002, interim progress report. U.S. Fish and Wildlife Service, Grand Junction, Colorado.
- Ryden, D. W. 2004a. Long term monitoring of sub-adult and adult large-bodied fishes in the San Juan River: 2003, interim progress report. U.S. Fish and Wildlife Service, Grand Junction, Colorado.
- Ryden, D. W. 2004b. Sub-adult and adult large bodied fish community monitoring trip, fall 2003. U.S. Fish and Wildlife Service, Grand Junction, CO.
- Ryden, D. W. 2005. Sub-adult and adult large bodied fish community monitoring trip, fall 2004. U.S. Fish and Wildlife Service, Grand Junction, CO. San Juan River Basin Recovery Implementation Program. 1995. I. Program Document, II. Cooperative Agreement, III. Long-Range Plans, IV. Rip Side By Side Analysis. San Juan River Basin Recovery Implementation Program, U.S. Fish and Wildlife Service, Albuquerque, N.M.
- Ryden, D. W., and L. A. Alm. 1996. Observations on the distribution and movements of Colorado squawfish, *Ptychocheilus lucius*, in the San Juan River, New Mexico, Colorado, and Utah. *Southwestern Naturalist* 41(2):161-168.
- San Juan River Basin Recovery Implementation Program (SJRIP). 1995. I. Program Document, II. Cooperative Agreement, III. Long-Range Plans, IV. Rip Side By Side Analysis. San Juan River Basin Recovery Implementation Program, U.S. Fish and Wildlife Service, Albuquerque, N.M.
- San Juan River Basin Recovery Implementation Program (SJRIP). 2006. Final Program Document. San Juan River Basin Recovery Implementation Program, U.S. Fish and Wildlife Service, Albuquerque, N.M.
- Simpson, Z. R., and J. D. Lusk. 1999. Environmental contaminants in aquatic plants, invertebrates, and fishes of the San Juan River mainstem, 1990-1996. U.S. Fish and Wildlife Service, Albuquerque, New Mexico.
- Stanford, J.A., J.V. Ward, W.J. Liss, C.A. Frizzell, R.N. Williams, J.A. Lichatowich, and C.C. Coutant. 1996. A general protocol for restoration of regulated rivers. *Regulated Rivers: Research and Management* 12:391-413.

- Trammell, M. A., and E. Archer. 2000. Chapter 4: evaluation of reintroduction of young of year Colorado pikeminnow in the San Juan River 1996-1998. Pages 4-1 to 4-33 in Archer, E., T.A. Crowl, and M. Trammell, editors. Age-0 native species abundances and nursery habitat quality and availability in the San Juan River, New Mexico, Colorado, and Utah. Utah Division of Wildlife Resources, Salt Lake City, Utah.
- Turner, T. F., M. V. McPhee, D. Alò, W. H. Brandenburg, and S. P. Platania. 2002. Determination of occurrence of hybridization of San Juan River razorback sucker through genetic screening of larval fishes. Draft Report submitted to SJRIP.
- Turner, T. F., T. E. Dowling, M. J. Osborne, M. V. McPhee, R. E. Broughton, and J. R. Gold. 2008. Microsatellite markers for the endangered razorback sucker, *Xyrauchen texanus*, are widely applicable to genetic studies of other catostomine fishes. Conservation Genetics, In press (available online at Springer).
- U.S. Fish and Wildlife Service (Service). 2002a. Colorado pikeminnow (*Ptychocheilus lucius*) Recovery Goals: amendment and supplement to the Colorado Squawfish Recovery Plan. U.S. Fish and Wildlife Service, Mountain-Prairie Region (6), Denver, Colorado. Available in pdf format at <http://www/r6.fws.gov/crrip/rg.htm>.
- U.S. Fish and Wildlife Service (Service). 2002b. Razorback sucker (*Xyrauchen texanus*) Recovery Goals: amendment and supplement to the Razorback Sucker Recovery Plan. U.S. Fish and Wildlife Service, Mountain-Prairie Region (6), Denver, Colorado. Available in pdf format at <http://www/r6.fws.gov/crrip/rg.htm>.
- Wilson, R.M., J.D. Lusk, S. Bristol, B. Waddell, and C. Wiens. 1995. Environmental contaminants in biota from the San Juan River and selected tributaries in Colorado, New Mexico, and Utah. Regions 2 and 6, U.S. Fish and Wildlife Service for San Juan River Basin Recovery Implementation Program, Annual Research Report, Fiscal Year 1994, U.S. Fish and Wildlife Service, Albuquerque, New Mexico.
- Wirth, D. 1999. Annual report on data collection activities for 1997 and 1998 concerning suspected contributions of polynuclear aromatic hydrocarbon by oil and gas leasing on public lands in the San Juan Basin, New Mexico. Bureau of Land Management, Farmington, New Mexico.

Appendix A. Tasks, priorities, responsibilities, dates, and descriptions for elements of the Long-Range Plan.

The following are criteria used as guidance for “Recovery Goals Priority” used in column 2 of the following tables:

Low	The task is not linked to site-specific management actions of recovery goals and is not necessary for species recovery.
Medium	The task is indirectly linked to site-specific management actions and may be supportive of species recovery.
High	The task is linked or related to a site-specific management action cited in recovery goals and may be necessary to achieve species recovery goals.
Highest	The task reflects a site-specific management action cited in recovery goals and is necessary to achieve species recovery.

The following are abbreviations used in the following Tables:

BC	Biology Committee
BIA	Bureau of Indian Affairs
BOR	Bureau of Reclamation
CC	Coordination Committee
CPM	Colorado pikeminnow
DNFH	Dexter National Fish Hatchery and Technology Center
FWS	U.S. Fish and Wildlife Service
GJ	Grand Junction
HC	Hydrology Committee
NMGF	New Mexico Game and Fish Department
NN	Navajo Nation
PO	Program Office
RBS	Razorback sucker
UNFH	Uvalde National Fish Hatchery

Table A1. Tasks, priorities, responsibilities, dates, and descriptions for Element 1.—Development, Integration, and Evaluation of Information for Recovery.

Tasks	Recovery Goals Priority	Primary Responsibility	Start Date	Completion Date	Description and Comments
Goal 1.1—Describe Biotic and Abiotic Baseline Conditions.					
Action 1.1.1 Determine the relative abundance and distribution of endangered fishes, as well as other native and nonnative fishes in the San Juan River Basin.					
Task 1.1.1.1 Conduct ichthyofaunal surveys of mainstem, tributary streams, and secondary channels to determine fish species associated with these habitats.	Medium (Completed)	FWS, NMGF, BC	1987	1997	Ichthyofaunal surveys were during 1987-1989 (Platania 1990) to determine the size of the remaining CPM population and to characterize the fish population of the San Juan River. Additional surveys were done during the 7-Year Research Program.
Task 1.1.1.2 Conduct radio telemetry investigations to help define species distributions, movements, spawning sites, and habitat use.	Medium (Completed)	FWS	1991	2000	Although this task was completed (Ryden 2000; Miller and Ptacek 2000), more radiotelemetry work may be necessary to better understand habitat use and movement of newly established populations of CPM and RBS.
Task 1.1.1.3 Monitor the distribution and abundance of wild fish populations in the San Juan River to document status and trends.	High (Completed)	BC	1991	1997	Results of the 7-Year Research Program were assimilated (Holden 2000) and strategies for research and monitoring were developed.
Action 1.1.2 Describe life history parameters of wild CPM and RBS.					

Tasks	Recovery Goals Priority	Primary Responsibility	Start Date	Completion Date	Description and Comments
Task 1.1.2.1 Document and quantify reproduction, survival, and recruitment.	High	FWS, NMGF	1991	Ongoing	Survival will be estimated by age group for RBS and CPM. Survival can be estimated from periodic comparison of abundance estimates and from mark-recapture analyses. Recruitment will be estimated from periodic abundance estimates of subadults and adults. Estimates of recruitment are demographic criteria of recovery goals. Results of the 7-Year Research Program were assimilated (Holden 2000) and strategies for research and monitoring were developed.
Task 1.1.2.2 Locate and describe areas of reproductive activity and nursery habitats to better understand species spawning needs.	High	FWS, BC, NMGF	1991	1997	Reproduction should be documented from capture of ripe and gravid fish, drifting larvae, and age-0 fish. Wild adult CPM were radio-tracked during 1991-1997 (Ryden 2000) and in 1993-1994 to assess habitat use (Miller and Ptacek 2000). Results of the 7-Year Research Program were assimilated (Holden 2000) and strategies for research and monitoring were developed
Task 1.1.2.3 Describe and quantify habitats selected by various life stages of CPM and RBS.	High (Completed)	FWS, NMGF	1991	1997	Capture locations of RBS and CPM should be described and quantified and river flows documented. Results of the 7-Year Research Program were assimilated (Holden 2000) and strategies for research and monitoring were developed
Action 1.1.3 Describe and evaluate flow, habitat, and other abiotic relationships.					
Task 1.1.3.1 Describe, model and evaluate different flow regimes.	High (Completed)	FWS, BOR	1995	1997	Requested releases have been evaluated for response of habitat (Pucherelli and Clark 1990; Pucherelli and Goettlicher 1992; Goettlicher and Pucherelli 1994; Bliesner and Lamarra 2002) and fish (Propst et al. 1999).

Tasks	Recovery Goals Priority	Primary Responsibility	Start Date	Completion Date	Description and Comments
Task 1.1.3.2 Determine response of geomorphology and habitat to flow with the use of habitat mapping, river geomorphology, etc.	High (Completed)	FWS, NMGF	1995	1997	Relationships have been developed between channel geomorphology, mesohabitats, and river flow to identify flows that maximize habitat of various life stages of RBS and CPM (Archer and Crowl 2000b; Archer et al. 2000; Bliesner and Lamarra 2000, 2007; Gido and Propst 1999; Lamarra 2004; Miller and Ptacek 2000). River reaches with simple, moderate, and complex channels have been mapped for geomorphic features and mesohabitats.
Task 1.1.3.3 Evaluate water quality as potential limiting factors.	High	FWS	1995	Ongoing	Various studies have been completed that assessed various aspects of water quality (e.g., Abell 1994; Buhl and Hamilton 2000; Hamilton and Buhl 1997a, 1997b; Odell 1995, 1997; Wilson et al. 1995). Results of the 7-Year Research Program were assimilated (Holden 2000) and strategies for research and monitoring were developed
Action 1.1.4 Identify and evaluate limiting factors and determine necessary research to identify actions that will minimize or remove these limiting factors.					
Task 1.1.4.1 Compile, evaluate, and synthesize historic water quality information on the San Juan River to identify water quality parameters that may be detrimental to native and endangered fish species (e.g., mercury, selenium, polycyclic aromatic hydrocarbons [PAHs]).	Highest	BC, BOR	1991	Ongoing	Historic water quality information for the San Juan River has been compiled and evaluated to identify water quality parameters that may be potentially detrimental to native and endangered fish species (Abell 1994). Results of the 7-Year Research Program were assimilated (Holden 2000) and strategies for research and monitoring were developed
Task 1.1.4.2 Determine and quantify mesohabitat types and channel forms used by native and endangered fish.	High (Completed)	FWS, NMGF	1991	1997	Primary habitats used by wild fish have been documented (Archer and Crowl 2000b; Archer et al. 2000; Bliesner and Lamarra 2000, 2007; Gido and Propst 1999; Lamarra 2004; Miller and Ptacek 2000).

Tasks	Recovery Goals Priority	Primary Responsibility	Start Date	Completion Date	Description and Comments
Task 1.1.4.3 Evaluate effects of nonnative fish on native and endangered species and identify the most problematic nonnative species.	Highest (Completed)	FWS, NMGF	1996	1999	Initial evaluation of nonnative fish in the San Juan River has been completed (Brooks et al. 2000; Propst and Hobbes 2000).
Task 1.1.4.4 Estimate numbers of wild CPM and RBS in the San Juan River Basin and evaluate prospects for reestablishment of populations with and without hatchery augmentation.	High (Completed)	FWS, NMGF, BC	1991	1997	Numbers of wild CPM and RBS were found to be low in the San Juan River (Holden 2000).
Task 1.1.4.5 Survey health of fish in the San Juan River to ensure adequate protection from diseases and parasites.	Highest (Completed)	FWS	1998	2000	Fish health surveys were conducted on the San Juan River during 1992-1997 (Landye et al. 2000).
Action 1.1.5 Synthesize and integrate information to describe baseline conditions and to guide future actions.					
Task 1.1.5.1 Synthesize, integrate, and evaluate the 7-year research program.	High (Completed)	FWS, NMGF		2000	A 7-Year Research Program was conducted 1991-1997 (Holden 2000). This effort helped to provide baseline information for the ichthyofauna of the San Juan River. During this program effort, methods were sometimes modified to meet the exigencies of the San Juan River, to incorporate new information and technologies, and to improve efficiency and quality of data collected.
Goal 1.2—Develop New Information as Necessary.					
Action 1.2.1 Assemble information from population management and augmentation.					
Task 1.2.1.1 Use data and information gathered from fish surveys, hatchery augmentation, and survival studies to describe best strategies for establishing wild populations of endangered fish and restoring the native fish community.	High	FWS, NMGF	2009	2015	Information will be assimilated to continually evaluate stocking success and establishment of wild populations of CPM and RBS.

Tasks	Recovery Goals Priority	Primary Responsibility	Start Date	Completion Date	Description and Comments
Task 1.2.1.2 Assimilate the genetics information on CPM and RBS to describe best strategies for establishing and maintaining genetically viable wild populations of endangered fish.	High	FWS, NMGF	2009	2015	Although a genetics management plan has been developed, ongoing genetic monitoring of fish stocks is necessary to ensure genetic integrity of CPM and RBS.
Task 1.2.1.3 Monitor genetics of Colorado pikeminnow and razorback sucker in the San Juan River to determine if and to what extent wild produced individuals depart from genetic structure of parental stock (hatchery derived).	Medium	FWS		Ongoing	
Action 1.2.2 Assemble information from habitat evaluation and management.					
Task 1.2.2.1 Use data and information gathered from habitat assessments to describe best strategies for providing suitable habitat for native and endangered fish.	High			Ongoing	A great deal of data and information has been collected, and continues to be collected, on the San Juan River fishes. This information needs to be continually assimilated, synthesized, and interpreted.
Action 1.2.3 Assemble information from nonnative fish capture information.					
Task 1.2.3.1 Use data and information gathered from nonnative fish efforts to describe best strategies for minimizing negative impacts to native and endangered fish species.	Highest (Initial phase completed)	FWS, NMGF	2000	2005	A pilot study and ongoing investigations have been conducted to implement and evaluate the best strategies for controlling nonnative fish. Ongoing evaluation is needed, including assessment of new technologies for controlling nonnative fishes.
Action 1.2.4 Collect and assemble information on native fishes (exclusive of Colorado pikeminnow and razorback sucker).					
Task 1.2.4.1 Use previous and current data collected during ongoing investigations to characterize dynamics of native fishes and their response to management activities intended to improve status of listed species.				Ongoing	

Tasks	Recovery Goals Priority	Primary Responsibility	Start Date	Completion Date	Description and Comments
Action 1.2.5 Characterize relationships of unprotected native species assemblage health or well-being and recovery of protected species.					
Task 1.2.5.1 Use collected data to better define the interdependencies of protected and unprotected native species.				Ongoing	
Goal 1.3—Synthesize and Integrate Information to Evaluate Progress Toward Recovery.					
Action 1.3.1 Synthesize and integrate information from all studies for Program evaluation and to evaluate progress toward recovery.					
Task 1.3.1.1 Produce report that evaluates progress toward minimizing limiting factors, ongoing Program activities, and assesses current status of native and endangered fish populations. This report should be produced at 5 year intervals, but completion may vary due to fiscal constraints, project scheduling, or new information.	Highest	FWS, PO	2003	Ongoing	The Program Office will coordinate the assimilation of a synthesis report as needed that assesses current knowledge, new strategies, and progress toward species recovery. This report may occur every 5 years but may vary in timing due to competing fiscal resources or project scheduling or significant new information.
Action 1.3.2 Evaluate and update flow recommendations.					
Task 1.3.2.1 Provide Flow Recommendations Update Report as necessary that evaluates and updates flow recommendations and response of native and endangered fishes to flow recommendations.	Highest	BC, HC, CC		Ongoing	The Biology Committee will assemble a report that evaluates and updates the flow recommendations. This report is provided to the Coordination Committee for approval.

Table A2. Tasks, priorities, responsibilities, dates, and descriptions for Element 2.—Management and Augmentation of Populations and Protection of Genetic Integrity.

Tasks	Recovery Goals Priority	Primary Responsibility	Start Date	Completion Date	Description
Goal 2.1—Establish a Genetically and Demographically Viable, Self-Sustaining CPM Population.					
Action 2.1.1 Develop plans for rearing and stocking CPM.					
Task 2.1.1.1 Develop a genetics management plan to guide artificial propagation and ensure genetic diversity and viability of CPM.	Highest (Completed)	FWS, DNFH		2003	A Genetics Management Plan for RBS and CPM was developed in 2003 (Crist and Ryden 2003).
Task 2.1.1.2 Develop an augmentation plan for CPM to provide a strategy for producing, rearing, and stocking fish.	Highest (Completed)	FWS		2003	An Augmentation Plan for CPM was developed in 2003 (Ryden 2003).
Task 2.1.1.3 Evaluate and adjust stocking goals of augmentation plan.	High	BC, PO	2008	2009	Bioenergetics models and/or population recruitment models may be used to estimate and evaluate stocking goals of the augmentation plan. These models help to determine the numbers of stocked fish necessary to achieve species recovery goals considering observed survival and recruitment rates. This information will help to adjust stocking rates accordingly.
Task 2.1.1.4 Review and update CPM augmentation plan as needed.	High	FWS, PO		Ongoing	An annual review of the CPM augmentation plan will evaluate whether the stocking goals are being met and if the plan is adequate to achieve goals. The augmentation plan will be updated as needed.

Tasks	Recovery Goals Priority	Primary Responsibility	Start Date	Completion Date	Description
Action 2.1.2 Produce, rear, and stock sufficient numbers of CPM to meet stocking goals of augmentation plan.					
Task 2.1.2.1 Annually produce and rear at least 300,000 age-0 (50–55 mm TL) and 3,000 age-1 CPM at Dexter NFH.	Highest	FWS, DNFH	2003	2009	At least 300,000 age-0 (50–55 mm TL) CPM will be produced and reared annually at the Dexter NFH for a 7-year period, 2003–2009.
Task 2.1.2.2 Annually stock >300,000 age-0 CPM.	Highest	FWS, DNFH	2003	2009	At least 300,000 age-0 (50–55 mm TL) CPM will be released annually from the Dexter NFH, into the San Juan River for a 7- year period, 2003–2009.
Task 2.1.2.3 Annually stock 3,000 age-1 CPM.	Highest	FWS, DNFH	2003	2009	A total of 3,000 age-1 CPM will be stocked and PIT tagged annually in the San Juan River for a 7- year period, 2003–2009.
Task 2.1.2.4 Opportunistically stock available CPM in excess of those described above.	Highest	FWS, PO		Ongoing	Excess CPM may be available from the upper basin or other sources. These should be procured and stocked opportunistically in excess of the numbers described above.
Action 2.1.3 Monitor status and success of stocked CPM.					

Tasks	Recovery Goals Priority	Primary Responsibility	Start Date	Completion Date	Description
Task 2.1.3.1 Determine survival and recruitment of stocked CPM to assess stocking success and to determine when to implement mark-recapture population estimates.	High	FWS, BC	1996	Ongoing	Every CPM captured will be examined for marks (e.g., coded wire tag, PIT tag, etc.) and information will be assimilated on these marked fish to estimate survival and recruitment. Experimental stocking of YOY CPM began in 1996 (Trammell and Archer 2000). The numbers of stocked CPM surviving in the wild will be estimated from the monitoring program (see Goal 5.1 Monitor Fish Populations). These surviving fish will help to contribute toward reproduction in the wild and eventual species recovery.
Task 2.1.3.2 Develop a standardized database for all stocked and recaptured CPM in order to determine the fate of stocked fish (integrate into Program database—Tasks 2.2.3.2 7.2.1.4).	High	PO	2008	2009	All CPM released into the San Juan River will be tabulated and tracked to understand survival of fish and success of the augmentation program. Fish of sufficient size will be PIT-tagged and a standardized database will be established and updated annually for access by researchers. This database shall be part of the overall Program database—see Tasks 2.2.2.3 and 7.2.1.4.
Action 2.1.4 Evaluate factors limiting CPM population recovery.					

Tasks	Recovery Goals Priority	Primary Responsibility	Start Date	Completion Date	Description
Task 2.1.4.1 Identify, describe, and implement strategies for improving survival and retention of stocked Colorado pikeminnow, including acclimation prior to stocking, size of fish stocked, time and location of stocking, physiological conditioning, and predator avoidance.	High	FWS, BC	2003	2011	Factors that limit or impede survival of stocked CPM will be identified and strategies will be developed to eliminate or ameliorate these factors.
Task 2.1.4.2 Identify, describe, and implement strategies for improving long-term survival and recruitment of Colorado pikeminnow, including nonnative fish removal, enhancing habitat and food resources, enhancing genetic diversity and viability, and mitigating barriers to range fragmentation.	High	BC, FWS	2003	2015	Scientific evidence shows that acclimation by fish before release may reduce dispersal and increase survival. Experiments should be conducted to evaluate dispersal and survival of fish released directly into the wild vs. fish held at on-site acclimation pens.
Goal 2.2—Establish a Genetically and Demographically Viable, Self-Sustaining RBS Population.					
Action 2.2.1 Develop plans for rearing and stocking RBS.					
Task 2.2.1.1 Develop a genetics management plan to guide artificial propagation and ensure genetic diversity and viability of RBS.	Highest (Completed)	FWS, BC		2003	A Genetics Management Plan for RBS and CPM was developed in 2003 (Crist and Ryden 2003).

Tasks	Recovery Goals Priority	Primary Responsibility	Start Date	Completion Date	Description
Task 2.2.1.2 Develop an augmentation plan for RBS to provide a strategy for producing, rearing, and stocking fish.	Highest (Completed)	FWS, BC		2003	An experimental stocking program for RBS was conducted 1994-1997. An Augmentation Plan for RBS was developed in 1997 (Ryden 1997) for a 5-year period, 1997-2001, and recommended stocking 73,482 RBS; only 5,890 were stocked for a lack of hatchery and grow-out facilities. An addendum to the plan was developed in 2003 (Ryden 2003) to extend the program for 8 years, 2004-2011, and recommended stocking 91,200 age-2 RBS (> 300 mm TL) or 11,400 annually.
Task 2.2.1.3 Estimate and adjust stocking goals of augmentation plan.	High	FWS, BC	2003	2009	Bioenergetics models and/or population recruitment models may be used to estimate and evaluate stocking goals of the augmentation plan. These models help to determine the numbers of stocked fish necessary to achieve species recovery goals considering observed survival and recruitment rates. This information will help to adjust stocking rates accordingly.
Task 2.2.1.4 Review RBS augmentation plan as needed.	High	BC, FWS		Ongoing	An annual review of the RBS augmentation plan will evaluate whether the stocking goals are being met and if the plan is adequate to achieve species recovery goals. The augmentation plan will be updated as needed

Tasks	Recovery Goals Priority	Primary Responsibility	Start Date	Completion Date	Description
Action 2.2.2 Produce, rear, and stock sufficient numbers of RBS to meet stocking goals of augmentation plan.					
Task 2.2.2.1 Produce and rear RBS at Dexter NFH for stocking to grow-out facilities.	Highest	DNFH	2004	2011	RBS will be produced and reared annually at Dexter NFH in accordance with the genetics management plan and stocked into grow-out facilities; currently NAPI ponds and Uvalde NFH. Fish of sufficient size should be marked with PIT tags.
Task 2.2.2.2 Annually stock three NAPI grow-out ponds with 3,000-3,500 fish per pond (> 200 mm TL) hatchery-reared RBS.	Highest	DNFH, NN	2004	2011	RBS will be stocked annually into three NAPI grow-out ponds with 3,000-3,500 (> 200 mm TL) hatchery-reared RBS produced at Dexter NFH (expectation to harvest 40-60%) using a single cohort strategy; pit tag and stock 300 mm fish in 12 months
Task 2.2.2.3 Produce 12,000 RBS per year (>300 mm TL) at Uvalde NFH.	Highest	UNFH	2004	2011	A total of 12,000 RBS per year (>300 mm TL) will be produced annually at Uvalde NFH.
Task 2.2.2.4 Stock at least 91,200 RBS (> 300 mm TL) during 2004-2011 or 11,400 per year.	Highest	FWS	2004	2011	At least 91,200 RBS (> 300 mm TL) will be harvested annually from grow-out ponds and/or supplemental hatchery facilities and stocked into the San Juan River over an 8-year period, 2004-2011, or 11,400 per year.
Task 2.2.2.5 Support operation and maintenance of hatchery facilities (Dexter and Uvalde NFH) for RBS production.	High	PO, FWS	2004	2011	The operation and maintenance of hatchery facilities at Dexter and Uvalde NFH will be supported for RBS production.

Tasks	Recovery Goals Priority	Primary Responsibility	Start Date	Completion Date	Description
Task 2.2.2.6 Operate and maintain NAPI grow-out ponds.	Medium	NN	2004	2011	The operation and maintenance of Navajo Agricultural Products Industry (NAPI) grow-out ponds will be supported for RBS production.
Task 2.2.2.7 Opportunistically stock available RBS in excess of the 11,400 described above.	High	PO, FWS	2004	2011	Excess RBS may be available from the upper basin or other sources. These should be procured and stocked opportunistically in excess of the 12,000 described above.
Action 2.2.3 Monitor status and success of stocked RBS.					
Task 2.2.3.1 Determine survival and recruitment of stocked RBS to assess stocking success and to determine when to implement mark-recapture population estimates.	High	FWS, BC	2004	2011	Every RBS captured will be examined for marks (e.g., coded wire tag, PIT tag, etc.) and information will be assimilated on these marked fish to estimate survival and recruitment. The numbers of stocked RBS surviving in the wild will be estimated from the monitoring program (see Goal 5.1 Monitor Fish Populations). These surviving fish will help to contribute toward reproduction in the wild and eventual species recovery.

Tasks	Recovery Goals Priority	Primary Responsibility	Start Date	Completion Date	Description
Task 2.2.3.2 Develop a standardized database for all stocked and recaptured RBS in order to determine the fate of stocked fish (integrate into Program database—Tasks 2.1.2.3 and 7.2.1.4).	High	PO	2008	2009	All RBS released into the San Juan River will be tabulated and tracked to understand survival of fish and success of the augmentation program. Fish of sufficient size will be PIT-tagged and a standardized database will be established and updated annually for access by researchers. This database shall be part of the overall Program database—see Tasks 2.1.3.2 and 7.2.1.4.
Action 2.2.4 Evaluate factors limiting RBS population recovery.					
Task 2.2.4.1 Identify, describe, and implement strategies for improving survival and retention of stocked razorback sucker, including acclimation prior to stocking, size of fish stocked, time and location of stocking, physiological conditioning, and predator avoidance	High	FWS	2004	2011	Factors that limit or impede survival of stocked RBS will be identified and strategies will be developed to eliminate or ameliorate these factors.
Task 2.2.4.2 Identify, describe, and implement strategies for improving long-term survival and recruitment of razorback sucker, including nonnative fish removal, enhancing habitat and food resources, enhancing genetic diversity and viability, and mitigating barriers to range fragmentation.	High	BC	2004	2015	Scientific evidence shows that acclimation by fish before release may reduce dispersal and increase survival. Experiments should be conducted to evaluate dispersal and survival of fish released directly into the wild vs. fish held at on-site acclimation pens.
Action 2.2.5 Evaluate the risk of hybridization among sucker species.					

Tasks	Recovery Goals Priority	Primary Responsibility	Start Date	Completion Date	Description
Task 2.2.5.1 Quantify the extent of hybridization among native suckers to determine if releasing large numbers of hatchery razorback suckers into the San Juan River will reduce genetic diversity and viability of razorback sucker and/or flannelmouth sucker.	Medium	BC	2004	2011	There is some information on the extent of hybridization between native suckers (i.e., razorback, flannelmouth, bluehead) and nonnative white suckers in the San Juan River (Turner et al. 2002, 2008).
Task 2.2.5.2 Quantify the extent of hybridization between native suckers with nonnative white suckers to determine if hybridization is reducing genetic diversity and viability of native suckers (i.e., razorback sucker, flannelmouth sucker, bluehead sucker).	Medium	BC		Ongoing	Hybridization may be reducing genetic viability of native suckers and may require actions to reduce white suckers, such as mechanical removal.
Task 2.2.5.3 Identify and implement necessary actions to minimize hybridization among native suckers and nonnative suckers.	Medium	BC	2011	2011	

Table A3. Tasks, priorities, responsibilities, dates, and descriptions for Element 3.—Protection, Management, and Augmentation of Habitat.

Tasks	Recovery Goals Priority	Primary Responsibility	Start Date	Completion Date	Description
Goal 3.1—Provide Suitable Flows to Support Recovery of CPM and RBS Populations.					
Action 3.1.1 Develop flow regimes to provide adequate base flow and function to maintain habitat for CPM and RBS.					
Task 3.1.1.1 Identify and develop flow recommendations for the San Juan River.	Highest (Completed)	BC		1999	Flow Recommendations for the San Juan River were developed and implemented in 1999 (Holden 1999).
Task 3.1.1.2 Develop and implement a process for revising flow recommendations (see Task 1.3.2.1).	Highest	BOR, FWS	2010	2011	The process for revising flow recommendations uses information from habitat to flow relationships and the hydrology model. The flow recommendations will continue to be evaluated and revised until a long-term flow regime is established for the San Juan River and the RBS and CPM are recovered.
Action 3.1.2 Develop and maintain a hydrology model to evaluate flow recommendations in the context of water supply and demand in the Basin.					

Tasks	Recovery Goals Priority	Primary Responsibility	Start Date	Completion Date	Description
Task 3.1.2.1 Develop, evaluate, and refine a San Juan Basin hydrology model that provides a scientifically sound and biologically relevant representation of the San Juan River.	High	FWS, BOR, BC, HC	2005	2011	A San Juan Basin Hydrology Model was developed to provide a tool to analyze ways to manage flows in the San Juan River Basin for the benefit of endangered fish while allowing water development to proceed. The purpose of the model is to: a) provide input to the development and periodic evaluation and analysis of flow recommendations, and b) assess the impact of project development on basin depletions and recommended flows for endangered fish. Model development has undergone three generations (Generations I, II, and III). The utility and effectiveness of the hydrology model is evaluated periodically by the Hydrology Committee.
Task 3.1.2.2 Conduct peer review of the hydrology model by qualified specialists not affiliated with the Program...	High	PO	2009	2011	An independent peer review will be conducted of the hydrology model to determine if the model properly represents San Juan River hydrology and to ensure that the model can be used to evaluate flow recommendations.
Task 3.1.2.3 Provide model analysis for the evaluation of flow recommendations.	High	HC		As requested	The Hydrology Committee will, at the request of the Coordination Committee, provide model analyses for the evaluation of flow recommendations and project impacts.

Tasks	Recovery Goals Priority	Primary Responsibility	Start Date	Completion Date	Description
Task 3.1.2.4 Support operation and maintenance of stream gauges for San Juan River as needed	Highest	BOR, PO		Annually	Stream gauges necessary for monitoring flow of the San Juan River will be maintained by the Program.
Action 3.1.3 Coordinate with BOR on Navajo Dam operations.					
Task 3.1.3.1 Provide input and recommendations to U.S. Fish and Wildlife Service and Bureau of Reclamation on alternate dam operations when extreme hydrologic conditions prevent flow recommendations from being met.	Medium	BC, HC		Ongoing	BOR will organize semi-annual meetings with stakeholders on operations of Navajo Dam. BOR will coordinate these meetings and solicit input from stakeholders.
Action 3.1.4 Provide and protect flows in the San Juan River consistent with flow recommendations.					
Task 3.1.4.1 Develop and implement mechanisms for protecting water required to meet flow recommendations.	Highest	BOR	2009	2023	BOR will coordinate with the States of New Mexico and Colorado to ensure protection of water released from Navajo Reservoir intended to fulfill flow recommendations.
Action 3.1.5 Review and evaluate San Juan River stream flow in light of hydrology variability.					
Task 3.1.5.1 Conduct a comprehensive analysis of hydrologic variability in the San Juan River.	High	FWS	2009	2011	
Task 3.1.5.2 Evaluate the possible and most probable impacts of hydrologic variability on future water availability.	Medium	FWS, BC	2009	2011	The long-term consequences of climate change are unknown. Possible impacts on stream flow and other environmental variables need to be evaluated in order to identify possible contingencies and alternative management actions.

Tasks	Recovery Goals Priority	Primary Responsibility	Start Date	Completion Date	Description
Task 3.1.5.3 Evaluate ability of the river to meet the functions provided by the flow recommendations during extended periods of drought and develop contingency strategies.	Medium	FWS, BC	2009	2023	An evaluation of the river’s ability to meet flow recommendations under periods of extended drought should be evaluated.
Task 3.1.5.4 Evaluate non-flow alternatives that would work in conjunction with flows to meet the functions provided by flow recommendations during extended periods of droughts.	High	FWS, BOR, BC	2011	2013	Non-flow alternatives should be evaluated to help offset possible effects of climate variability and to augment the beneficial effects of flow recommendations.
Goal 3.2—Provide Suitable Habitat to Support Recovery of CPM and RBS Populations.					
Action 3.2.1 Identify, characterize, and quantify suitable habitat.					
Task 3.2.1.1 Assess data collected to identify and describe flow-habitat relationships.	High	FWS, BC	2005	2009	Use available data collected to date to accomplish task.
Task 3.2.1.2 Identify habitats and areas of essential habitat to native and endangered fishes at different volumes of water released (including timing and duration) from Navajo Dam.	Medium	FWS, BC	2009	2013	Fish may change distributional patterns with different flow regimes. These changes may be seasonal or caused by changes in habitat.
Task 3.2.1.3 Assess whether and to what extent, the seasonal and longitudinal distributions of endangered fishes, other native and nonnative fish species can be determined in response to various flow releases from Navajo Dam. Quantify seasonal and longitudinal distributions of endangered fishes, as well as other native and nonnative fish species.	Medium	BC FWS	2005	2015	Flow recommendations were designed to maintain channel complexity and provide necessary habitats for native and endangered fishes. This task will link information gathered under Tasks 1.3.1.1 and 1.3.1.2 with the hydrology of flow recommendations.

Tasks	Recovery Goals Priority	Primary Responsibility	Start Date	Completion Date	Description
Task 3.2.1.4 Characterize channel geomorphology and river channel dynamics to better understand flow-habitat relationships.	Medium	BC	2005	2015	A study was done as part of the 7-Year Research Program to characterize channel geomorphology and river channel dynamics (Bliesner and Lamarra 2000).
Action 3.2.2 Provide suitable habitat.					
Task 3.2.2.1 Implement flows that provide suitable habitat for endangered fishes and other native fishes in the San Juan River.	Highest	FWS, BC	2005	2015	Understanding habitat response to flow is central to this Program.
Task 3.2.2.2 Use information gathered under Tasks 3.2.1.1 to 3.2.1.4 as the foundation for identifying and evaluating the need to implement other recovery actions, including but not limited to, habitat modification (flow or mechanically induced) and population augmentation.	Highest	FWS, BC	2005	2015	Flow recommendations continue to be implemented and evaluated.
Action 3.2.3 Evaluate and implement habitat restoration strategies to augment the function of river flow to create and maintain suitable habitat.					
Task 3.2.3.1 Evaluate construction of backwater habitats to serve as low-velocity nursery habitat if lack of backwater habitat is found to be limiting recovery...	High	BOR, BC, PO NN	2009	2010	Backwaters serve as low-velocity nursery habitats for native and endangered fish. Backwaters will be mechanically created.
Task 3.2.3.2 Evaluate selective nonnative vegetation removal in conjunction with high flow conditions for habitat creation and maintenance.	High	BOR, BC, FWS, NN	2009	2011	Tamarisk and Russian olive have encroached into riparian areas, stabilized the channel, and reduced channel complexity that is selected by native and endangered fishes.
Task 3.2.3.3 Evaluate large-scale nonnative vegetation control, as feasible and necessary.	Medium	BOR, BC, FWS, NN	As needed		Tamarisk and Russian olive have encroached into riparian areas, stabilized the channel, and reduced channel complexity that is selected by native and endangered fishes.

Tasks	Recovery Goals Priority	Primary Responsibility	Start Date	Completion Date	Description
Task 3.2.3.4 Develop and implement a plan for feasible habitat restoration strategies, and implement such plan as funding becomes available.	High	BOR, BC, FWS, NN	2011	2012	Other habitat creation and restoration strategies will be developed and implemented (2010–2012), as identified by Program review processes.
Goal 3.3—Provide Increased Range to Support Recovery of CPM and RBS Populations.					
Action 3.3.1 Provide and maintain fish passage at diversion structures.					
Task 3.3.1.1 Identify and evaluate fish barriers in the San Juan River.	Highest (Completed)	BC		1996	Fish barriers were identified and evaluated in 1996 by Masslich and Holden (1996).
Task 3.3.1.2 Remove Cudei Diversion to provide fish passage.	Highest (Completed)	BIA, NN		2001	The Cudei Diversion was removed in 2001. The Cudei Diversion is owned by the Navajo Nation.
Task 3.3.1.3 Provide and maintain fish passage at the Hogback Diversion.	Highest (Completed)	BIA, NN		2002	Fish passage at Hogback Diversion was completed in 2002. The Hogback Diversion is owned by the Navajo Nation.
Task 3.3.1.4 Provide and maintain selective fish passage at the Public Service Company of New Mexico (PNM) Weir.	Highest (Completed)	FWS, NN		2003	Fish passage at Public Service Company of New Mexico (PNM) Weir was completed in 2003.
Task 3.3.1.5 Provide and maintain fish passage at the Arizona Public Service Company (APS) Weir.	Highest	BOR		Ongoing	Design for fish passage at the Arizona Public Service Company (APS) Weir was completed in 2008.
Task 3.3.1.6 Evaluate fish passage at the Fruitland Diversion.	Highest	BOR, NN		Ongoing	A feasibility study was completed in 2008 for a simple but effective approach to improving fish passage at the Fruitland Diversion. The Fruitland Diversion is owned by the Navajo Nation.

Tasks	Recovery Goals Priority	Primary Responsibility	Start Date	Completion Date	Description
Action 3.3.2 Evaluate fish passage for native and endangered fish species to and from Lake Powell in light of a natural waterfall at low reservoir elevations.					
Task 3.3.2.1 Identify extent of problem from natural waterfall on passage of native and nonnative fish from Lake Powell into the San Juan River.	High (Completed)	FWS, BOR, BC	2009	2010	The extent that the natural waterfall in the lower San Juan River impedes fish migration should be determined. BOR assessed the risk for predators recolonizing the river when water level in Lake Powell rises to a level that the waterfall is inundated. They concluded that there is a 60 to 75% chance the waterfall will be inundated for a total of 30 months (not necessarily continuously) between 2008 and 2030. Probabilities for longer inundation are available (6-26-07 CC Meeting).
Task 3.3.2.2 Evaluate strategies for providing passage of native and endangered fish from Lake Powell into the San Juan River, if needed.	High	FWS, BOR, BC	2009	2011	If necessary, strategies for providing fish passage at this natural barrier should be developed. If a barrier is determined to be necessary, the BC believes it should provide selective upstream passage for native species and should be built in a location where it can be operated, possibly at Mexican Hat.
Action 3.3.3 Minimize fish entrainment at diversion structures.					

Tasks	Recovery Goals Priority	Primary Responsibility	Start Date	Completion Date	Description
Task 3.3.3.1 Identify and evaluate diversions with potential fish entrainment in the San Juan River.	High	BC	2004	2011	Diversions and canals will be evaluated for potential entrainment of fish. This may lead to design and construction of fish screens or deflection weirs to address significant entrainment issues.
Task 3.3.3.2 Design and construct a fish deflection weir at the Hogback Diversion.	Highest	BOR, BC, PO, FWS, NN	2009	2011	A fish deflection wier has been designed for the Hogback Diversion. BOR is working on securing a long-term contract for O&M and on NEPA compliance. Anticipates a contract being awarded for that project in late FY2009, construction occurring in winter 2009 and 2010, and the project being completed in spring of 2010.
Task 3.3.3.3 Evaluate the need for and construct, if appropriate, a fish screen or deflection weir at the Arizona Public Service Company (APS) Weir.	Highest	BOR, BC, POFWS	2009	2011	Need for a fish screen or deflection weir will be evaluated at the Arizona Public Service Company (APS) Weir. Update needed.
Task 3.3.3.4 Evaluate the need for and contract, if appropriate, a fish screen or deflection weir at the Jewett Valley Ditch.	Highest	BOR, FWS	2009	2011	Need for a fish screen or deflection weir will be evaluated at the Jewett Valley Ditch.
Task 3.3.3.5 Evaluate the need for and contract, if appropriate, a fish screen or deflection weir at the Fruitland Canal.	Highest	BOR, BC, PO, FWS	2009	2011	Need for a fish screen or deflection weir will be evaluated at the Fruitland Canal.
Task 3.3.3.6 Evaluate the need for and construct, if appropriate, a fish screen or deflection weir at the San Juan Generating Station.	Highest	BOR, BC, PO, FWS	2009	2011	Need for a fish screen or deflection weir will be evaluated at the San Juan Generating Station.
Task 3.3.3.7 Evaluate the need for and construct, if appropriate, a fish screen or deflection weir at the Farmer's Mutual Canal.	Highest	BOR, BC, PO, FWS	2009	2010	Need for a fish screen or deflection weir will be evaluated at the Farmer's Mutual Canal.

Tasks	Recovery Goals Priority	Primary Responsibility	Start Date	Completion Date	Description
Goal 3.4—Provide Suitable Water Quality to Support Recovery of CPM and RBS Populations.					
Action 3.4.1 Describe water quality and identify potential problems to native and endangered fish.					
Task 3.4.1.1 Continue to evaluate water quality of the San Juan River Basin, in coordination with other agencies, and identify potential problems to native and endangered fish (see Task 1.1.4.1).	Highest	FWS, BOR, BC		Ongoing	Initial investigations revealed a suite of water quality issues on the San Juan River, but none could be independently or synergistically linked to failure of the CPM or RBS populations.
Action 3.4.2 Evaluate effects of river temperature on native and endangered fish.					
Task 3.4.2.1 Determine if cold water releases from Navajo Dam into the San Juan River impede endangered fish reproduction or limit endangered fish populations downstream of the Animas River.	High (Completed)	BC		2006	Cold releases from Navajo Dam into the San Juan River were found to not impede endangered fish reproduction or limit endangered fish populations downstream of the Animas River (Bliesner and Lamarra 2000).
Action 3.4.3 Minimize the risk of hazardous-materials spills in critical habitat.					
Task 3.4.3.1 Identify and remediate potential sources of hazardous materials to areas of designated critical habitat (e.g., oil pipelines, riverside retention ponds).	Highest	FWS	2009	2011	The Program will identify and remediate any potential sources of hazardous materials, such as gas lines, oil product pipelines, riverside retention ponds, etc.

Table A4. Tasks, priorities, responsibilities, dates, and descriptions for Element 4.—Interactions between Native and Nonnative Fish Species.

Tasks	Recovery Goals Priority	Primary Responsibility	Start Date	End Date	Description
Goal 4.1—Control Problematic Nonnative Fishes as Needed.					
Action 4.1.1 Develop, implement, and evaluate the most effective strategies for reducing problematic nonnative fish.					
Task 4.1.1.1 Identify and prioritize the most problematic nonnative fish species.	Highest (Completed)	BC	2000	2003	This determination may be made through a risk assessment or as a consensus of biologists. Davis (2003) identified channel catfish and common carp as the most problematic species.
Task 4.1.1.2 Design and implement a pilot program to evaluate nonnative fish control strategies and gears.	Highest (Completed)	FWS	2000	2003	The Nonnative Fish Monitoring And Control Plan (Davis 2003) served as a pilot program and identified removal reaches and evaluated sampling gears and strategies.
Task 4.1.1.3 Develop a long-term nonnative fish control strategy and specific objectives for nonnative fish control...	Highest	FWS	2009	2010	A nonnative fish control strategy will be developed and implemented for the San Juan River. This strategy will identify removal tactics, gear types, personnel, and costs necessary to meet removal criteria established in Task 5.1.1.2.
Task 4.1.1.4 Mechanically remove nonnative fish to achieve objectives.	Highest		Ongoing		Full implementation of the nonnative fish control strategy began in 2008.

Tasks	Recovery Goals Priority	Primary Responsibility	Start Date	End Date	Description
Task 4.1.1.5 Conduct annual review of nonnative fish control strategy.	Highest	BC	Annually		The nonnative fish reduction strategy will be evaluated annually to determine if current efforts are meeting criteria as established in Task 1.3.2.2. If criteria are not being met, increases or reallocation of effort may be necessary or Task 5.1.2.4 may be implemented to identify alternative strategies.
Task 4.1.1.6 Evaluate and implement effective alternative nonnative fish reduction methods.	Highest	FWS	2000	Ongoing	The effectiveness of mechanical removal will be evaluated by analyzing trends in catch rates, length distributions, population size of nonnative fishes, and determining if removal criteria are being met. If mechanical removal is determined to be ineffective, alternative methods will be developed, evaluated, and implemented. These may include use of chemicals (e.g., rotenone, cyanide), species-specific viruses (e.g., carp viremia), and genetic manipulation (e.g., Trojan gene).
Task 4.1.1.7 Remove nonnative fish at selected fish passage structures.	Highest	NN, FWS, BOR		Ongoing	Nonnative fish will be removed at fish passage structures designed for selective passage (see Action 3.2.1).
Task 4.1.1.8 Evaluate effects of nonnative fish control on distribution, abundance, and demographics (e.g., fish size, age, sexual maturity) of nonnative fish populations.	Highest	FWS, BOR		Ongoing	Full implementation of the nonnative fish control strategy began in 2008.

Tasks	Recovery Goals Priority	Primary Responsibility	Start Date	End Date	Description
Task 4.1.1.9 Evaluate effects of nonnative fish control on distribution, abundance, and demographics (e.g., fish size, age, sexual maturity) of the endangered fish populations and native fish community.	Highest	NN, FWS, BOR		Ongoing	Fish population respond in various ways to severe reduction from mechanical removal. These responses need to be evaluated to determine if removal will require different strategies.
Action 4.1.2 Establish and evaluate strategies for handling removed nonnative fish in collaboration with state and tribal agencies.					
Task 4.1.2.1 Evaluate and revise, as necessary, translocation strategy for channel catfish removed from the San Juan River.	Medium	FWS	2005	2009	Channel catfish removed from the San Juan River are translocated to closed impoundments within the San Juan River Basin. These translocations will be evaluated and revised, as necessary, to ensure compliance with all state, federal and tribal regulations.
Task 4.1.2.2 Implement standardized fish health analysis for translocated channel catfish to avoid transfer of harmful pathogens.	Medium	FWS	2005	2009	Standardized fish health analysis will be implemented on channel catfish every 2 years to identify and prevent the unintentional spread of harmful pathogens to local impoundments. If potential fish health problems are detected, the translocation strategy will be appropriately revised.
Task 4.1.2.3 Develop, evaluate, and implement standard procedures for disposal of fish that cannot be translocated.	High	FWS	Ongoing		Procedures for disposal of fish are important to maintain good relationships with affected stakeholders and the public.
Action 4.1.3 Identify and regulate nonnative fish releases and escapement into the main river, floodplain, and tributaries.					

Tasks	Recovery Goals Priority	Primary Responsibility	Start Date	End Date	Description
Task 4.1.3.1 Consolidate all information for a comprehensive report and risk assessment of waterfall inundation and associated immigration of nonnative fish from Lake Powell including options and recommendations for potential management actions.	Low	PO, BC	2009	2010	The risk of immigration of nonnative fishes from Lake Powell into the San Juan River will be assessed and measures will be identified to reduce the risk, if necessary. At present, a natural water falls exists at the outflow of the San Juan River that prevents access by most fish from Lake Powell. PO and BC will develop workplan for comprehensive report.
Task 4.1.3.2 Implement measures to reduce the risk of immigration of nonnative fish from Lake Powell, as feasible and necessary.	Low	BC	2010	2011	Measures identified necessary in Task 4.1.3.1 will be implemented to reduce the risk of immigration of nonnative fish from Lake Powell.
Task 4.1.3.3 Identify major sources of nonnative fish from tributaries and off-channel features to minimize reinvasion of riverine habitats by problematic species.	High	BC	2010	2011	Major sources of nonnative fish from tributaries and off-channel features will be identified, including inflowing streams, riverside ponds, canals, or other features. Isotopes may be used to locate sources of nonnative fish with established signatures of source waters. Measures to reduce escapement of nonnative fish from these sources will be identified.
Task 4.1.3.4 Implement measures to reduce escapement of nonnative fish from tributaries and off-channel features, as necessary.	High	PO, BOR, FWS	As needed		Measures identified necessary in Task 5.1.3.3 will be implemented to reduce escapement of nonnative fish from tributaries and off-channel features.
Action 4.1.4 Establish criteria for reduction of target nonnative fish populations.					

Tasks	Recovery Goals Priority	Primary Responsibility	Start Date	End Date	Description
Task 4.1.4.1 Establish target criteria for reduction of problematic nonnative fish species to estimate time, effort, and cost for controlling nonnative fishes.	Highest	BC, FWS	2008	2009	Target criteria will be established for reduction of the most problematic nonnative fish species. These criteria will describe annual and long-term target removal levels. These criteria may be expressed as percentage reduction of the total population, as generated by Ricker stock-recruitment models; or as exploitation rate, such as the Kwak and Peterson model. These models estimate the proportion of population reduction necessary to cause recruitment failure; i.e., mortality exceeds survival ($\lambda < 1.0$). Bioenergetics models may also apply.
Goal 4.2—Manage Sport Fish in a Manner Compatible with Endangered Fish Recovery.					
Action 4.2.1 Develop policies and agreements among affected stakeholders on nonnative game fish management.					
Task 4.2.1.1 Develop and implement a sport fish stocking policy among the states and tribes.	Highest	PO	2008	2009	A sport fish stocking policy will be developed and implemented among the States and Tribes for the San Juan River Basin. The Upper Basin Recovery Program has developed and implemented such a document.

Tasks	Recovery Goals Priority	Primary Responsibility	Start Date	End Date	Description
Task 4.2.1.2 Execute agreements among the states and tribes.	Highest	CC		2009	One or more agreements will be executed among the States of New Mexico, Utah, and Colorado and the Navajo Nation on a nonnative sport fish stocking policy.
Action 4.2.2 Ensure that fishing regulations and enforcement are consistent with endangered fish recovery.					
Task 4.2.2.1 Review fishing regulations and revise, as necessary, to ensure consistency with endangered fish recovery.	Medium	NMGF, NN	2008	2009	State and tribal fishing regulations will be reviewed. Recommendations may be made for new regulations or revision of existing regulations that are consistent with endangered fish recovery. An example is to increase or removal bag limits for problematic nonnative species.
Task 4.2.2.2 Collaborate with state and tribal agencies to enforce fishing regulations.	Medium	NMGF, NN		Ongoing	Illicit translocation of nonnative fish can introduce new problematic species and expands their range. The Recovery Program will collaborate with state and Navajo Nation law enforcement agencies to reduce illicit translocations, including baitfish and live-well releases.

Table A5. Tasks, priorities, responsibilities, dates, and descriptions for Element 5.—Monitor Fish and Habitat.

Tasks	Recovery Goals Priority	Primary Responsibility	Start Date	End Date	Description
Goal 5.1—Monitor Fish Populations of the San Juan River.					
Action 5.1.1 Develop a standardized monitoring program for fish.					
Task 5.1.1.1 Develop, implement, and refine a Standardized Fish Monitoring Plan to assess the presence, status, and trends of Colorado pikeminnow and razorback sucker.	Highest (Most recent version completed in 2006)	BC, NMGF, FWS	2009	2010	A Monitoring Plan And Protocols was developed for the San Juan River Basin in 2000 and updated in 2006 (Propst et al. 2006) to identify changes in the endangered and other native fish populations, status, distributions, and habitat conditions. The goals of the plan are to: 1) track the status and trends of endangered and other fish populations in the San Juan River, 2) track changes in abiotic parameters, including water quality, channel morphology, and habitat, important to the fish community, and 3) utilize data collected under Goals 1 and 2 to help assess progress towards recovery of endangered fish species. This monitoring plan describes protocols for monitoring larval drift, YOY and small-bodied fish, subadults and adults; and channel geomorphology, cobble bars, backwaters, habitat mapping; as well as water temperature, and water quality. BC to hold workshops in 2009 to update plan.

Tasks	Recovery Goals Priority	Primary Responsibility	Start Date	End Date	Description
Task 5.1.1.2 Analyze and evaluate monitoring data and produce Annual Fish Monitoring Reports to ensure that the best sampling design and strategies are employed.	Highest	BC	2006	Annually	As a goal of the monitoring plan, this task will a) determine relative annual reproductive success of CPM and RBS; and b) determine population trends, including size-structure of adult and juvenile fishes.
Task 5.1.1.3 Organize and conduct Monitoring Plan Workshops, as necessary, to coordinate sampling design, data collection, and desired precision and detection levels for detecting responses.	High	PO, BC	As needed		A monitoring workshop will be organized for 2009 to coordinate sampling design, data collection, and desired precision and detection levels for detecting responses. Additional workshops may be held as needed.
Action 5.1.2 Implement a Standardized Monitoring Plan to track the presence, status and trends of endangered fish populations.					
Task 5.1.2.1 Conduct larval fish studies to determine if reproduction is occurring, locate spawning and nursery areas, and to gauge the extent of annual reproduction.	Highest		2003	2015	Long-term CPM and RBS sucker larval fish surveys have been conducted since 2003. Principal Investigators: Brandenburg, Farrington, and Propst
Task 5.1.2.2 Conduct juvenile fish studies to determine if young fish are surviving and recruiting and the areas and habitat used for rearing.	Highest		2003	2015	Long-term small-bodied fish monitoring has been in place since 2003. Principal Investigators: Paroz and Propst
Task 5.1.2.3 Conduct adult fish studies to estimate densities of fish (CPUE) and estimates of population size (mark-recapture estimates).	Highest		2003	2015	Long term monitoring of sub-adult and adult large-bodied fishes has been in place since 2003. Principal Investigator: Ryden.
Task 5.1.2.4 Continue to collect catch rate statistics to estimate relative abundance of endangered fish populations.	Highest		2003	2015	Implemented via long-term monitoring, non-native fish removal, and stocking programs.

Tasks	Recovery Goals Priority	Primary Responsibility	Start Date	End Date	Description
Task 5.1.2.5 Use mark-recapture population estimators, when feasible and in conjunction with catch rate estimators, to evaluate stocking success for CPM and RBS.	Highest		2003	2015	Implemented via long-term monitoring, non-native fish removal, and stocking programs.
Action 5.1.3 Obtain reliable population estimates of RBS and CPM.					
Task 5.1.3.1 Develop target criteria to implement mark-recapture population estimates consistent with recovery goals requirements.	High	BC	2012	2014	Reliable and precise mark-recapture population estimates are required for recovery goals. Criteria will be developed to transition from catch rate indices to mark-recapture population estimators for subadult and adult RBS and CPM. These criteria may be numbers of fish per kilometer or a similar metric that signals when population sizes are sufficiently large to implement mark-recapture sampling.
Task 5.1.3.2 Conduct Population Estimation Workshops and evaluate population estimators used in other systems to identify the most reliable and suitable estimator(s) for Colorado pikeminnow and razorback sucker.	High	PO, BC	As needed		One or more workshops will be held starting in 2009 to evaluate population estimators to be used for RBS and CPM in the San Juan River. Estimation techniques used in other systems will be evaluated to identify the most reliable and suitable estimators.
Task 5.1.3.3 Use mark-recapture population estimators, when feasible and in conjunction with catch rate estimators, to provide reliable estimates of adults, subadults, survival, and recruitment consistent with recovery goals criteria to gauge recovery of CPM and RBS.	High	FWS	2015	2023	Implement and refine mark-recapture population estimates for RBS and CPM that provide reliable and precise estimates of subadult and adults, as well as estimates of survival.
Task 5.1.3.4 Procure adequate numbers of PIT tags for marking native and endangered fish.	High	BOR		Ongoing	PIT tags are the standard marking tool for the endangered fishes.

Tasks	Recovery Goals Priority	Primary Responsibility	Start Date	End Date	Description
Goal 5.2—Monitor Habitat Use and Availability.					
Action 5.2.1 Develop a standardized monitoring program for habitat.					
Task 5.2.1.1 Modify the existing Standardized Habitat Monitoring Plan to incorporate findings from the 2005-2009 detailed reach study, if appropriate.	Medium	BC	2009	2010	BC workshops will be conducted in 2009 to evaluate current fish and habitat monitoring and develop a comprehensive plan for fish and habitat monitoring.
Task 5.2.1.2 Organize and conduct Habitat Monitoring and Mapping Workshops, as necessary, to refine and improve habitat evaluation methods.	Highest	PO, BC	2009	2010	As a goal of the monitoring plan, this task will determine population trends, including size-structure of adult and juvenile fishes. BC workshops will be conducted in 2009 to evaluate current fish and habitat monitoring and develop a comprehensive plan for fish and habitat monitoring.
Action 5.2.2 Implement a standardized monitoring program for habitat.					
Task 5.2.2.1 Quantify attributes of habitats important to each life stage of endangered fish.	High	FWS, BC	2008	2012	Habitats used by various life stages of CPM and RBS should be monitored and related to flow and river location.
Task 5.2.2.2 Map habitat at different flows as described in the revised Standardized Habitat Monitoring Plan			2008	2012	
Task 5.2.2.3 Monitor long-term habitat response of the river channel to flow recommendations.	High	BC	2008	2012	Long-term river-wide response of the river channel (i.e., aggradation or degradation) will be monitored and related to the flow recommendations to assess gross overall channel change (as needed).

Tasks	Recovery Goals Priority	Primary Responsibility	Start Date	End Date	Description
Task 5.2.2.4 Monitor water quality in the San Juan River (see Task 3.4.1.1).	Highest	FWS, BOR	Ongoing		No critical water quality parameters have been identified in the San Juan River that are causing failure of CPM or RBS populations. These need to be monitored to ensure that water quality does not become problematic.
Action 5.2.3 Identify and refine habitat/fish relationships.					
Task 5.2.3.1 Determine if a habitat/fish relationship can be defined, the probability of success, the level of data needed to accomplish this, and the cost of collecting the data.	High	FWS, BC	2007	2009	Data Integration and Habitat and Fish Monitoring Workshops will be initiated in 2009. Results will be used to evaluate, and modify, current monitoring and data collection methodologies.
Task 5.2.3.2 Identify principal river reaches and habitats used by various life-stages of endangered fish.	High	FWS, BC	2007	2009	An understanding of river reaches and habitats used by CPM and RBS is important in understanding how flows benefit these habitats.
Task 5.2.3.3 Relate geo-referenced fish capture data to habitat data.			2007	2009	
Task 5.2.3.4 Collect geo-referenced habitat and fish use habitat data in at least two selected reaches with complex morphology to determine habitat selection.	High	BC	2007	2009	Geo-referenced habitat association data will be collected with fish capture data, as feasible, to provide habitat use data for RBS and CPM of all life stages.
Task 5.2.3.5 Map at high resolution and monitor changes in habitat in at least two selected reaches with complex morphology at different flows.	High	BC	2007	2009	This task will use bankfull channel area, island counts, and bed-form topographic data to monitor response of at least two selected reaches with complex morphology and habitat to flow recommendations (2005-2009).

Tasks	Recovery Goals Priority	Primary Responsibility	Start Date	End Date	Description
Task 5.2.3.6 Refine and standardize habitat classification for consistent use with fish sampling and habitat mapping.	High	BC	2007	2009	A standard habitat classification system is needed that can be used for fisheries, hydrology, geomorphology, etc.
Goal 5.3— Integrate And Synthesize Monitoring Data And Information To Evaluate Fish Community And Ecosystem Responses To Recovery Actions.					
Action 5.3.1 Develop fish community and ecosystem response strategies					
Task 5.3.1.1 Develop a centralized database that incorporates all data from standardized monitoring and integrate into the Program database (see also Task 7.2.1.4).	High	PO	2008	2009	The San Juan River Basin Recovery Implementation Program will develop and maintain a centralized database of all monitoring activities. This database shall be part of the overall Program database—see Task 7.2.1.4.
Task 5.3.1.2 Develop an ecosystem model specific to the San Juan River and present it for approval by the Biology Committee.	Medium (Completed)	BC, FWS	2000	2005	Completed in 2000-2005. The Program may choose to further develop an ecosystem model specific to the San Juan River to assist in evaluating possible responses by fish species to management actions.
Task 5.3.1.3 Hold workshop on ecosystem model specific to the San Juan River to evaluate model and determine future direction of this effort	Medium (Completed)	FWC, BC	2007	2007	Workshop held in 2007.

Tasks	Recovery Goals Priority	Primary Responsibility	Start Date	End Date	Description
Task 5.3.1.4 Evaluate and review available fisheries data for use in the model to evaluate recovery actions.	Medium		As needed		A great deal of information has been gathered on the fish community of the San Juan River. This information should be assimilated. Data Integration and Habitat and Fish Monitoring Workshops will be initiated in 2009.
Task 5.3.1.5 Refine ecosystem model specific to the San Juan River and use with other existing data to evaluate fish community response to recovery actions.	Medium	BC, FWS	As needed		The Program may evaluate existing ecosystem models (e.g., Ecopath, Ecosim, RAMAS, Vortex) to assist in evaluating possible responses by fish species to management actions.
Action 5.3.2 Recommend and implement appropriate monitoring strategies to evaluate ecosystem response					
Task 5.3.2.1 Develop an integrated fish and habitat monitoring plan that includes an annual process for assessing and modifying monitoring activities so that current status of native and endangered fish populations and habitat can be assessed and progress toward recovery can be determined.	High	PO, BC	2009	2010	BC will be conducting monitoring workshops in 2009 to evaluate current fish and habitat monitoring. A stated purpose of the workshops is to develop an integrated fish and habitat monitoring plan that includes annual evaluation and data integration, and an adaptive management component.

Table A6. Tasks, priorities, responsibilities, dates, and descriptions for Element 6.—Information and Education.

Tasks	Recovery Goals Priority	Primary Responsibility	Start Date	End Date	Description
Goal 6.1—Increase Public Awareness and Support for the Endangered Fishes and the Recovery Program.					
Action 6.1.1 Provide information to the public on the Recovery Program.					
Task 6.1.1.1 Provide public information through news articles, press releases, radio and television ads, and other media to inform the public of Program activities in collaboration with the UCRRP I&E Coordinator. Provide press releases routinely on the SJRIP for distribution to the media in Farmington, Durango, Albuquerque, and others in the basin.	High	PO	1992	Ongoing	Public information will be provided through news articles, press releases, radio and television ads, and other media to inform the public of Program activities.
Action 6.1.2 Coordinate public outreach with Upper Basin Recovery Program.					
Task 6.1.2.1 Develop and maintain a formal outreach support agreement between the San Juan River Basin Recovery Implementation Program and the Upper Colorado River Endangered Fish Recovery Program.	High	PO	1992	Ongoing	A formal outreach support agreement will be executed and maintained between the San Juan River Basin Recovery Implementation Program and the Upper Colorado River Endangered Fish Recovery Program.
Task 6.1.2.2 Develop and exchange information and materials to incorporate into PowerPoint presentations, newsletters, Program highlights and Program displays.	High	PO	1992	Ongoing	The I&E coordinator will develop and exchange information and materials to incorporate into PowerPoint presentations, newsletters, Program highlights and Program displays.
Task 6.1.2.3 Participate in selected outreach efforts at local, state, and regional water development conferences.	High	PO	1992	Ongoing	The I&E program will participate in selected outreach efforts at local, state, and regional water development conferences.

Table A7. Tasks, priorities, responsibilities, dates, and descriptions for Element 7.—Program Coordination.

Tasks	Recovery Goals Priority	Primary Responsibility	Start Date	End Date	Description
Goal 7.1—Facilitate Program Planning and Management.					
Action 7.1.1 Develop and coordinate a Program plan.					
Task 7.1.1.1 Develop and implement a Long-Range Plan as a framework for ongoing and future Program activities.	Highest (Completed)	PO	1995	1995	A Long-Range Plan was developed in 1995 (San Juan River Basin Recovery Implementation Program 1995).
Task 7.1.1.2 Annually review and update the Long-Range Plan to reflect new projects and Program progress.	High	PO, BC, HC, CC	Annually		The Program Office will update the Long-Range Plan following the annual meeting. The Coordination Committee, Technical Committees and the Service will provide recommendations to the Program Coordinator for updating the Long-Range Plan. The update will reflect accomplishments during the past year, new projects needed to achieve goals, changes in timing of projects.
Task 7.1.1.3 Revise the Long-Range Plan as new information becomes available on changes to future Program activities.	High	PO, BC, HC, CC	Annually		The Long-Range Plan was revised in 2008 with this document.
Action 7.1.2 Provide ongoing Program management.					

Tasks	Recovery Goals Priority	Primary Responsibility	Start Date	End Date	Description
Task 7.1.2.1 Convene annual Program coordination meetings to review the preceding year’s monitoring, recovery and research data; assess progress toward recovery; and provide recommendations to modify the Long-Range Plan.	High	PO	Annually		The Program Coordinator will chair an annual meeting of the Coordination, Biology, and Hydrology committees and the Service to review the preceding year’s monitoring, recovery and research data, assess progress toward recovery, and provide recommendations to modify monitoring, recovery and research actions, as appropriate.
Task 7.1.2.2 Develop list of prioritized actions and projects for the Annual Work Plan that most benefit recovery of the endangered fish populations.	High	BC, PO	Annually		Based on the Long-Range Plan, the Program Office will work with the Technical Committees to develop a list of prioritized projects for the next Annual Work Plan. The prioritized list will be consistent with the Long Rang Plan and approved by the Technical Committees and Coordination Committee.

Tasks	Recovery Goals Priority	Primary Responsibility	Start Date	End Date	Description
Task 7.1.2.3 Develop and issue Requests for Proposals (RFPs) for projects that most benefit recovery of the endangered fish populations.	Highest	PO	Annually		Scopes of work will be prepared for the list of prioritized projects and requests for proposals will be solicited. Upon receipt of the scopes of work, and responses to requests for proposals, the prioritized projects will have associated budgets. These will be compared to the availability of funds. Projects that are low on the priority list will not be included in the Work Plan if funding is not available to fund all projects in that fiscal year. This effort will be conducted by the Program Coordinator. Unfunded, low priority, projects may be considered in the next Annual Work Plan.

Tasks	Recovery Goals Priority	Primary Responsibility	Start Date	End Date	Description
Task 7.1.2.4 Assemble and review annual scopes of work to identify most suitable projects for funding and implementation.	Highest	PO	Annually		If the Program Office, in consultation with the Service and the Program’s Coordination Committee and Technical Committees, identifies an action that may facilitate the recovery of the endangered fish populations in the San Juan River and the action is not included in the Long-Range Plan, the Program Coordinator will forward to the Coordination Committee a recommendation for the inclusion of the action in the LRP, along with information on the identified action that the Coordination Committee needs to complete its review and approval of the recommendation. Approval will be based on whether the LRP accurately reflects the best scientific information available, the efficient implementation of recovery goals, and the management actions of the Program.

Tasks	Recovery Goals Priority	Primary Responsibility	Start Date	End Date	Description
Task 7.1.2.5 Develop Annual Work Plan with scopes of work and budgets.	High	PO	Annually		Scopes of work will be developed by researchers in response to priority management actions and research needs identified in Task 7.1.2.2. These scopes of work will be incorporated into an Annual Work Plan and reviewed by the Biology Committee and recommendations forwarded to the Coordination Committee for approval.
Task 7.1.2.6 Coordinate and schedule meetings of the Coordination Committee and the Technical Committees, as necessary.	High	PO	Annually		The Program Office will coordinate and schedule meetings for the Coordination Committee and the Technical Committees.
Goal 7.2—Ensure Information Integration and Program Review.					
Action 7.2.1 Coordinate and evaluate Program monitoring, research, and reporting activities.					

Tasks	Recovery Goals Priority	Primary Responsibility	Start Date	End Date	Description
Task 7.2.1.1 Conduct annual review of Program progress and integrate all monitoring, recovery, and research activities, data and results.	High	PO	Annually		The Program Office will annually review the Program’s progress towards recovering the endangered species. The Program Coordinator will be assisted by his staff and the Biology Committee and will include review and evaluation of progress, annual, and final reports; as well as all monitoring, recovery and research activities, data and results. The Program Office will also ensure, through the Biology and Hydrology committee, that all required Program documents are completed on schedule and as needed to accomplish the Program purpose and goals.
Task 7.2.1.2 Participate in annual researcher’s meetings in conjunction with the Upper Basin Researcher’s Meeting to present results and interpretations of ongoing projects.	High	PO	Annually		Researchers will be encouraged to make presentations at the annual Upper Basin Researcher’s Meeting to review the preceding year’s monitoring, recovery and research data; assess progress toward recovery; and provide recommendations to modify research, monitoring, and recovery activities.
Task 7.2.1.3 Prepare annual report with assistance of the Technical Committees as an assessment of progress towards recovery (i.e., Sufficient Progress Report), and formal recommendations for changes in direction, termination of projects, new projects, and other important Program issues.	Highest	PO	Annually		The Program Office will prepare an annual Sufficient Progress Report and will assist the Upper Basin Recovery Program in preparation of the Annual Report to Congress. These reports will describe and assess the Program’s progress toward species recovery.

Tasks	Recovery Goals Priority	Primary Responsibility	Start Date	End Date	Description
Task 7.2.1.4 Establish and maintain a Program database of information collected under the various Program projects (see also Tasks 2.1.3.2, 2.2.3.2, and 5.3.1.1).	Highest	PO	Annually		A comprehensive database will be developed to centralize data for all Program activities, including monitoring, stocked fish, nonnative fish control, etc.
Task 7.2.1.5 Maintain a standardized process for peer review by qualified specialists in appropriate technical disciplines for significant Program science projects and reports.	High	PO, BOR	Annually		The Program Office will ensure that a standardized process for peer review is maintained. This review will be done by qualified specialists in appropriate technical disciplines for significant Program science projects and reports.
Task 7.2.1.6 Establish and maintain a Program database of all rare fish collections including cross-referencing capabilities with stocking dates and localities.	High	PO	Annually		Program Office will compile and maintain all rare fish collection information in a relational database for use by Program participants.
Goal 7.3—Facilitate Contract and Funding Management.					
Action 7.3.1 Ensure appropriate and legal contract and funding practices.					

Tasks	Recovery Goals Priority	Primary Responsibility	Start Date	End Date	Description
Task 7.3.1.1 Work jointly with the Bureau of Reclamation to maintain and distribute annual base and capital funds allocated under the Annual Work Plan by each funding source.	Highest	BOR, PO	Annually		The Program Office will work with the Bureau of Reclamation to maintain and distribute all annual base and capital funds allocated under the Work Plan by each funding source. Reclamation will administer the Program contracts funded with power revenues or state/local cost-shares. This task includes development of scopes of work, advertising of requests for proposals, managing the contractor selection process, contracting with the selected contractor, monitoring and reporting of performance to the Program, ensuring contractor compliance with the contract, and closeout of the contract.
Task 7.3.1.2 Administer Program contracts and provide an accounting of Program funds expended at the end of each federal fiscal year.	Highest	BOR, PO	Annually		Reclamation will provide an accounting of Program funds and any matching funds from other sources within 60 days of the end of each federal fiscal year. An accounting of funds expended during the preceding year will be provided to the Program after the end of each federal fiscal year.

Tasks	Recovery Goals Priority	Primary Responsibility	Start Date	End Date	Description
Task 7.3.1.3 Manage Capital Improvement Program to maintain records showing the distribution and expenditures of capital funds under the Annual Work Plan by each funding source, and provide an accounting of funds expended at the end of each federal fiscal year.	Highest	BOR, PO	Annually		Reclamation will manage the Capital Improvement Program and work with the Program Office to maintain records showing the distribution and expenditures of capital funds expended under the Work Plan by each funding source. An accounting of funds expended during the preceding year will be provided at the end of each federal fiscal year.

Appendix B. Timeframes for elements of the Long-Range Plan

Update/Revision in Progress