

Evolution of A Cooperative Recovery Program
for Endangered Fishes in the Upper Colorado River Basin

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Abstract

Settlement of the arid west, that began over 100 years ago, pivoted around the concept of "mastery over nature" to develop and control water. Drought conditions in the late 1800s and prolonged flooding in the early 1900s stimulated the construction of major main-stem dams to control water in the lower basin, beginning in the late 1930s. These dams altered the natural flow and water temperature regimes and converted large reaches of stream habitat into reservoirs. Concurrently, various fish species were accidentally or intentionally introduced that are predators on, or competitors with, endemic fishes. These changes were correlated to the decline of several endemic large river fishes -- Colorado squawfish, Ptychocheilus lucius; humpback chub, Gila

cypha; bonytail, gila elegans; and razorback sucker, Xyrauchen texanus. The Colorado squawfish was extirpated and populations of bonytail, humpback chub, and razorback sucker were drastically reduced in the lower basin before biological studies were made. Recent recovery activity in the lower basin has included reintroductions of the fishes into historic waters. In the upper basin, construction of major dams began later -- in the 1960s. Federal legislation, such as the Endangered Species Act of 1973, provided protection for endangered and threatened species. In 1969, enactment of the National Environmental Policy Act required federal agencies to consider all reasonable alternatives when the environment is affected by federally sponsored or regulated development activities. These two federal laws, along with the Fish and Wildlife Coordination Act, provide the major mandates for expanding the work on the rare fishes in the Upper Colorado River Basin. The earliest aquatic studies in the upper basin were made to answer various environmental questions. In the late 1960s and early 1970s, studies were conducted on relative abundance and distribution of the upper basin fishes. During the mid-1970s, several studies were conducted on the life history and ecological requirements of the endangered Colorado River fishes. A major study began in June 1979, when the U.S. Fish and Wildlife Service and the Bureau of Reclamation signed a Memorandum of Understanding to obtain essential information for the recovery of the rare fishes. This action resulted in the formation of the Colorado River Fishery Project and the later implementation of the most intensive studies on endangered fishes in the upper basin to date. Other studies by the Colorado Division of Wildlife, Utah Division of Wildlife, Colorado Cooperative Fish and Wildlife Research Unit, Utah Cooperative Fishery Research Unit, and Colorado State University also contributed significantly to

knowledge of the rare fishes. Because of conflicts between water development and the protection of endangered fishes, the U.S. Fish and wildlife Service established an Upper Colorado River Coordinating Committee in 1984, composed of representatives from federal and state conservation agencies, conservation groups, and water users. Four years of intense negotiations resulted in the development of a "Recovery Implementation Program for Endangered Fish Species in the Upper Colorado River Basin" in 1987 that was acceptable to all groups. This recovery program is a milestone that coordinates federal, state, and private actions to conserve the rare fishes in a manner compatible with State's water rights allocation systems and the various interstate compacts that guide water allocation, development, and management in the upper basin.

Introduction

The Colorado River originates as clear, cold, headwater streams in the Rocky, Uinta, and Wind River mountains. It flows through high deserts where spectacular canyons have been carved by erosion of ^{western} ~~the~~ soft sandstones. ^{States} Historically the river and its larger tributaries were warm and turbid in summer ~~and were~~ characterized by large changes in volume and velocity. Several unique large-river fishes evolved in the Colorado River system in response to ~~the~~ geology and climate of the ^{region} ~~Great Basin~~, and the resulting riverine environment. The native fish fauna of the Colorado River Basin is unique in having an endemism of 74% (Miller 1958) that resulted from a long period of isolation. Three of the endemic fishes -- the Colorado squawfish (Ptychoceilus lucius), humpback chub (Gila cypha), and bonytail (Gila elegans) -- are federally listed as endangered. A fourth, the razorback sucker

(Xyrauchen texanus), is extremely rare and is a candidate for federal listing; ^{in all Colorado River basin states in which accounted,} it is considered endangered in Colorado and is protected in Utah. These four ^{species} species are referred to here collectively as the endangered Colorado River fishes.

An understanding of ~~the~~ recovery effort for the endangered Colorado River fishes requires an appreciation of the importance of the Colorado River as a source of water for municipal, industrial, and agricultural purposes. Settlement of the arid West began over 100 years ago and emphasized a "mastery over nature." The Colorado River ^{has} been altered to develop and control its water to the extent that it has been described as the most heavily used, controlled, and fought-over river in the world (Crawford and Petersen 1974). Although the Colorado receives less water per square ~~mile~~ ^{of} drainage than any other major river in the United States, it provides 15 million people with water for municipal, agriculture, mining, industrial, and recreational purposes (Utah Water Research Laboratory 1975). Further alteration of this already over-allocated resource is considered by some ~~people~~ as necessary to supply water for the expanding population ~~of the~~ Southwest and to develop some of the largest fuel deposits (coal, oil, oil shale, and uranium) in the United States (Bishop et al. 1975).

Legal control of water in the Colorado River drainage began with the Colorado River Compact of 1922. The compact divided the water between the seven states composing the upper and lower basin, anticipated demands for water in Mexico that were eventually agreed upon, and imposed certain restrictions on quantities and scheduling of flows (Harris et al. 1982). The

1948 Upper Colorado River Compact provided annual consumptive rights for Arizona and apportioned the remaining water to the upper basin states of Colorado, New Mexico, Utah, and Wyoming. The division of water among the upper and lower basin states cleared the way for the development of upper basin water projects. In 1956, the Colorado River Storage Project Act authorized the construction of large main/stem dams on the upper Colorado River and its tributaries. Six reservoirs (Lake Powell, Flaming Gorge, Blue Mesa, Morrow Point, Crystal, and Navajo) were formed as part of the storage units. The construction of mainstem dams was completed in 1980 when Lake Powell was filled.

In the early 1960s, the endangered Colorado River fishes were considered undesirable as game fish by conservation agencies. As a result, the largest rotenone treatment conducted in the United States was made in the reach of the Green River that is now impounded by Flaming Gorge Dam (Binns 1965). This 1962 treatment eliminated the Colorado squawfish and possibly the bonytail and humpback chub from the reservoir basin. Because the rotenone was not completely detoxified by potassium permanganate, the chemical continued downstream into Dinosaur National Monument. The reduction in native fishes was greatest in the uppermost part of the Monument at the Gates of Lodore and diminished as the chemical moved downstream. Although the chemical treatment adversely affected the native fishes and invertebrates, the ecological changes to the riverine environment caused by construction of Flaming Gorge Dam are believed to be more important in reducing native fish populations (Binns 1965).

The Colorado River Storage Project dams and reservoirs, along with private and local water developments, have altered natural flow regimes, water temperatures, and turbidity in the Upper Colorado River Basin. These projects also resulted in direct losses of stream habitat through inundation by reservoirs and blockage of migration routes. The characteristic high spring and low winter flows have been changed to much more stabilized seasonal flows that have rapid daily fluctuations in some areas (Vanicek et al. 1970). Concurrent with these environmental changes, various fish species were accidentally or intentionally introduced into the upper basin. In 1976, the Colorado River Wildlife Council listed 20 species (40%) as native to the river system and 30 species (60%) as introduced (Richardson 1976). At the same time, Holden and Stalnaker (1975) reported 10 native fishes (34.5%) and 19 introduced species (65.5%) in the upper basin. By 1982, the number of introduced species increased to 76% of the total of 55 fishes in the upper basin (Tyus et al. 1982a). The principal causes of the decline of the endangered Colorado River fishes in the upper basin are believed to be blockage of migration routes, alteration of streamflows and water temperatures, as well as competition and predation by introduced fish.

Competition for water in the Colorado River

Drought conditions in the late 1800s, followed by prolonged flooding in the early 1900s, stimulated the demand for water control in the lower Colorado River (Fradkin 1981). The construction of Hoover Dam in 1935, and other dams later in the lower basin changed much of a free-flowing river to a lacustrine environment⁵ with greatly altered streamflows and temperature regimes.

Associated with these habitat changes, the endangered Colorado River fishes declined markedly in the lower basin. The Colorado squawfish was extirpated and bonytail, humpback chub, and razorback sucker were drastically reduced in numbers. Only large, old adults of bonytail and razorback sucker were still found in several reservoirs in the lower basin in the late 1980s. A viable population of the humpback chub remained in the Little Colorado River near its confluence with the Colorado River. Few ^{early} studies on the biology or ecological requirements of the fish were made in the lower basin, but their decline was documented by Miller (1961), Minckley and Deacon (1968), and others.

The ^{se} endangered Colorado River fishes were still found in the relatively unaltered upper basin (Figure 1) during the early 1900s. However, pre-impoundment studies ~~of the upper basin~~ in the early 1960s suggested that ~~th~~ numbers of some ~~of these~~ species were low, indicating that ~~se~~ fishes may ~~have never been~~ abundant, or that the fish were never adequately sampled. Competition for water resources of the upper basin intensified during the 1960s. Various reports summarized the supply and demand of water and evaluated alternative uses of water from the Colorado River (e.g., National Research Council 1968). The U.S. Water Resources Council (1968) completed a comprehensive study that provided appraisals of natural resources and their geographic distribution, made projections of future requirements, defined problems and needs, and presented a program with alternatives for resource development and conservation to the year 2020. The Council concluded that ample resources were available to meet fishing needs in the upper basin if minimum **streamflows** and adequate conservation pools in reservoirs were

provided for game fish. However, the report did not include conservation of ~~the~~ endangered ~~Colorado River~~ fishes because their endangered status was not widely recognized or appreciated.

Other comprehensive reports developed in the mid-1970s included the Western U.S. Water Plan (known as the Westwide Study). This plan, conceived under authority of the Colorado River Basin Project Act of 1968, was designed to develop adequate information on which to base future decisions on water and related resources in the 11 western states (U.S. Bureau of Reclamation 1975). This ~~plan~~, and other reports, focused primarily on the quantity and quality of water. In 1976 the U.S. Fish and Wildlife Service funded a symposium through Resources for the Future to summarize problems of water, fish and wildlife, and potential energy developments and their impacts in the Upper Colorado River (Spofford et al. 1980).

Future demands and allocations of Colorado River water were concisely summarized by Weatherford and Jacoby (1975), who stated, "In broad terms, the problem of managing the Colorado River is the problem of allocating a flow resource in such a way as to satisfy legally preferred current demands without foreclosing the satisfaction of a different set of configuration of demands in the future. When so viewed, it is clear that there will be no single or final solution to the problems of allocation and management in the Colorado River Basin. The time for seriously addressing emerging generation of problems, however, is now."

Key Federal Environmental Legislation

The American public's concern about environmental issues was marked by surges and declines during the past century. Two world wars and a depression interrupted the public's concern for the environment that did not revive until the mid-1950s (McEvoy 1973). The Fish and Wildlife Coordination Act requires consideration of fish and wildlife resources in development projects. However, it was not until the late 1960s that an "environmental movement" began in the United States. The federal government acknowledged a national responsibility to save endangered native species of fish and wildlife through the Endangered Species Preservation Act of 1966. The 1966 Act was amended and broadened the responsibilities of the federal government as the Endangered Species Conservation Act of 1969. During 1969, the National Environmental Policy Act also became law and regulations to implement this Act were published by the Council on Environmental Quality; this law required that the environmental impacts be described, alternative actions be considered, and public input be sought for all Federal development projects.

The Endangered Species Act of 1973, however, was the most significant federal legislation that provided protection for endangered fauna and flora. Section 7 of this act was particularly significant because it stated that all federal agencies shall "insure that actions authorized, funded, or carried out by them do not jeopardize the continued existence of such endangered species and threatened species or result in the destruction or modification of habitat of such species" Section 4 provided for the listing and recovery of threatened or endangered species and directed the Secretary, Department of the

Interior, to develop and implement recovery plans. Section 6 encouraged cooperation of the federal government with the States in the conservation of any threatened or endangered species and provided funds to the States to conduct studies on such species. Section 9 prohibited the taking (including activities from harassment to capture) of listed species without proper Federal and State collector's permits. The 1973 Act and the later amendments of 1978 and 1982 provided the foundation for the recovery effort that is now under way for the endangered Colorado River fishes in the upper basin. This Act, in concert with the National Environmental Policy Act and the Fish and Wildlife Coordination Act, provides the major legal mandate for expanding recovery efforts on the endangered fishes in the Upper Colorado River Basin.

Early Section 7 Consultation Procedures

Section 7 of the 1973 Endangered Species Act requires that federal agencies must determine if their proposed action may affect a threatened or endangered species. If so, then formal consultation with the U.S. Fish and Wildlife Service (Service) is required. In 1981 the Service developed an approach to Section 7 consultation to protect the endangered fishes in the Upper Colorado River Basin while allowing certain types of water development to proceed. The first consultation completed under this approach involved the Windy Gap Project in the headwaters of the Colorado River, hence the approach became known as the "Windy Gap Process." It was based on the premise that, even though the effects of water depletions related to a specific project could not be quantified, the cumulative effects of water depletions (i.e., removal and consumptive use of water) in the upper basin were likely to

jeopardize the continued existence of the listed fishes unless intensive measures were taken to protect and manage these fishes and their habitat. The intent was to include, through agreement, the participation of Federal and State agencies and project sponsors in the conservation of the fishes and their habitat.

Under the Windy Gap Process, a sponsor of a private water development project^{1/} was required to compensate monetarily for actions that would result in jeopardy to threatened or endangered species. The process involved a one-time monetary contribution based on a formula that considered the quantity of water that would be depleted, the volume of water remaining after interstate compact flows to the lower basin were delivered, and the estimated cost (\$25 million) of implementing a comprehensive fishery conservation effort. Consultation under the Windy Gap Process resulted in nearly \$1.3 million being provided to the Service between 1981 and 1987 for conservation of the endangered fishes. The funds are used for studies of ecological requirements of the endangered fish, propagation and stocking, habitat improvements, and other recovery efforts.

In response to Congressional testimony by several major environmental organizations, the Windy Gap Process was not used by the Service on large water depletion projects after 1985. The environmental organizations alleged

1/ The Windy Gap Process did not apply to Bureau of Reclamation projects. Instead, the Bureau agreed to set aside water in its reservoirs for later release to habitat occupied by the endangered fishes.

that the process entailed "excessive and unnecessary risks of extinction for these species" (Environmental Defense Fund et al. 1985). Instead, interim consultation procedures on large-water depletion projects were used by the Service until the Interagency Coordination Committee developed a Section 7 consultation process that was acceptable to all committee members (see later discussion). Under the interim procedures, biological opinions were issued with conservation measures^{2/} that included withholding water in reservoirs to be released as needed to provide instream habitat for the endangered Colorado River fishes, to purchase of instream water rights, and to fund critical studies of the habitat requirements of these species.

Early Studies of the Upper Colorado River

The early detailed investigations of the biota of the Upper Colorado River Basin were directed toward pre- and post-impoundment studies to answer various questions about water quality (Sigler et al. 1966; Tsivoglov et al. 1959) or the effects of alterations in water quality and streamflow on game fish (Coon 1965; Powell 1958; Weber 1959).

In March 1963, the Secretary of the Department of the Interior requested that the Utah Cooperative Fishery Research Unit conduct investigations in Dinosaur National Monument, Colorado-Utah on changes in habitat and fish

^{2/} Conservation measures are defined as reasonable and prudent alternatives to which a project proponent agrees to before to the Service issues a final biological opinion.

populations in the Green River that resulted from the closure of Flaming Gorge Dam. The 1963-1966 studies concluded that some of the large native fishes disappeared from the 105-km reach of the Green River below Flaming Gorge Dam because of cold water releases (Vanicek 1967; Vanicek et al. 1970). However, the Green River below the Yampa River confluence still contained the endangered Colorado River fishes -- a presumed consequence of the Yampa's ameliorating effect on water temperature.

Work by the Utah Cooperative Fishery Research Unit during 1963-1966 focused on the basic life history of the Colorado squawfish and bonytail (Vanicek 1969; Vanicek and Kramer 1969; Vanicek et al. 1970) and macroinvertebrates (Pearson 1967; Pearson et al. 1968). These studies suggested that year classes of the Colorado squawfish were strong in 1959, 1961, 1963, 1964 and possibly 1966 (Vanicek 1967), but weak in 1962 and 1965. The formation of strong year classes during years when streamflows and water temperatures are more suitable for survival of recruits could be an evolutionary life history strategy of the Colorado squawfish (Tyus 1986). Vanicek (1967) also reported the difficulty in separating the various species of Gila, especially during early life. This led to the study of Gila taxonomy by Holden (1968), but the taxonomic problem was not fully resolved. In 1988 the U.S. Fish and Wildlife Service contracted with the Smithsonian Institute to review and develop a program to resolve the problem.

Holden (1973) studied the relative abundance and distribution of native fishes in the Upper Colorado River Basin and documented problems with recruitment of Colorado squawfish in Echo Park of Dinosaur National Monument

where juvenile squawfish were abundant in 1968, scarce in 1969, and non-existent in 1970. However, he reported young-of-the-year squawfish in Desolation Canyon in 1971 and in the Green River at Canyonlands National Park in 1970 and 1971. During 1974-1976, studies focused on obtaining further life history information on the endangered Colorado River fishes (McAda 1977; Seethaler 1978). McAda (1977) provided new biological information and synthesized all known life history information on the razorback sucker. Seethaler (1978) provided a comprehensive summary of the life history of the Colorado squawfish, including the first information on reproduction, fecundity, maturity, and early-life development. An annotated bibliography assembled in 1976 and updated in 1980 listed all biological studies of the native fishes and macroinvertebrates, and provided selected references that discussed the economical, political, and sociological factors confounding management of the Colorado River system (Wydoski et al. 1980). Other studies were also conducted in upper basin rivers by Colorado State University personnel in the late 1970s -- e.g., work on invertebrates by Carlson et al. (1979).

Colorado River Fishery Project

The requirements of Section 7 of the Endangered Species Act had potentially serious ramifications for new water projects that were being proposed by the Bureau of Reclamation (Bureau) and the operation of several existing Reclamation facilities (e.g., Flaming Gorge and Blue Mesa reservoirs). However, the lack of data on the instream flow and habitat requirements of the endangered Colorado River fishes was recognized by the

Bureau and the Service as a serious impediment to developing reasonable and prudent alternatives for existing and proposed Reclamation projects. As a result, the Bureau agreed to provide funding to the Service to gather essential information on the ecological requirements of the rare fishes in the upper basin.

In June 1979, the Service and the Bureau signed a Memorandum of Understanding whereby the Bureau agreed to fund a comprehensive investigation of the endangered Colorado River fishes in the upper basin. The Service agreed to obtain essential information needed to provide biological opinions on the impact of existing and proposed water development projects on the endangered Colorado River fishes. The primary objective of the Service effort, which was named the Colorado River Fishery Project, was to acquire information needed to recover the endangered fish while allowing Reclamation to operate existing water development projects, and to plan and construct proposed projects. This Service project is the largest single fishery project established to study endangered fishes in the United States.

The initial scope of the Colorado River Fishery Project was broad and included 965 km of the Colorado and Green rivers and their tributaries in Colorado and Utah. Studies focused on the identification of spawning requirements; habitat requirements of the young and adults; migratory behavior; interspecific competition; predation and food habits; effects of temperature, salinity and chemicals; development of culture techniques, disease and parasite diagnostics; and taxonomic classification (Miller et al. 1982a). Field investigations from 1979 to 1981 focused on sampling the Upper

Colorado River from Lake Powell to Rifle, Colorado (Valdez et al. 1982a), and the Green River from its confluence with the Colorado River upstream to Split Mountain Gorge (Tyus et al. 1982b) to determine the distribution, relative abundance, movements, and habitats of various life stages for of the four rare fishes.

The 1979 Memorandum of Understanding was amended in 1981 to include an investigation of the humpback chub in the Little Colorado River, Arizona (Kaeding and Zimmerman 1983), and to expand the field investigations to include the Dolores and Gunnison rivers in Colorado and Utah (Valdez et al. 1982b). Additional funds were provided by the Bureau of Land Management to include the White River, Colorado-Utah, in the field investigations (Miller et al. 1982b) and Congress and the U.S. National Park Service provided funds for a field study of the Yampa River and Green River in Dinosaur National Monument (Miller et al. 1982c). Funding provided through the Windy Gap Process was used for 3-year habitat use and radiotelemetry studies of the Colorado squawfish and humpback chub on the upper Colorado River and to investigate the use of "nonflow" alternatives (habitat development, fish passage, and stocking) as a means of maintaining and ensuring the recovery of the endangered Colorado River fishes (Archer et al. 1985).

Laboratory investigations outlined in the Memorandum of Understanding for the Colorado squawfish included studies of swimming stamina, temperature tolerance and preferences, total dissolved solids tolerance and preference, and bioassays of potentially toxic trace elements. In addition, various contracted studies were completed on the physicochemical habitat conditions on

the Green and Colorado rivers, culture of the rare fishes, disease survey, movements of Colorado squawfish in the inlet to Lake Powell, and fish stomach content analysis (Miller et al. 1982a, Part 3).

Knowledge of the endangered Colorado River fishes was summarized in a 1981 symposium that emphasized studies done after 1975 (Miller et al. 1982d). Although the work of the Colorado River Fishery Project continued after 1982; it emphasized the filling of gaps in the knowledge of the ecological requirements of the four rare fishes. Primary emphasis was on delineating ecological requirements such as necessary streamflows, describing movements (especially associated with spawning), and identifying factors that limited recruitment (Archer et al. 1984; Kaeding et al. 1986; Tyus et al. 1987).

Other Studies of Colorado River Fishes

Studies on the ecological requirements of the rare fishes were also conducted by biologists with the Colorado Division of Wildlife and Utah Division of Wildlife Resources from the early 1980s to the present (e.g., Haynes and Muth 1982; Radant 1982; Radant 1986; Wick et al. 1986). These studies, funded through Section 6 of the Endangered Species Act and by the states, have provided much of the basic information used to make decisions on efforts made in behalf of the rare fishes. Studies by the Colorado Division of Wildlife documented the importance of the Yampa River to the Colorado squawfish. The importance of the Green River to the squawfish and humpback chub was verified by the Utah Division of Wildlife Resources. Distribution of endangered Colorado River fishes in Cataract Canyon were made by private

consultants under contract with the Bureau of Reclamation (e.g., Valdez 1986). Developments at Willow Beach (Arizona) National Fish Hatchery and Dexter (New Mexico) National Fish Hatchery provided knowledge on the culture and propagation of rare Colorado River fishes (Hammon 1982a, 1982b). A description of the larval stages of the endangered Colorado River fishes was completed at Colorado State University by Muth (1988).

Coordination and Cooperation Between Agencies

Colorado River Fishes Recovery Team. The Endangered Species Act directed the Secretary of the Interior to develop and implement recovery plans for threatened and endangered species with the aid of appropriate public and private agencies, institutions, and other qualified individuals. By this authority, the U.S. Fish and Wildlife Service invited various agencies interested in management of the Colorado River to participate on the Colorado River Fishes Recovery Team. Formed in December 1975, as the Colorado Squawfish Recovery Team, the effort was expanded in 1976 to include all endangered Colorado River fishes (Miller 1982). Representation on the recovery team included the States of Arizona, California, Colorado, Nevada, New Mexico, and Utah, the Bureau of Reclamation, the National Park Service, and the Fish and Wildlife Service. The team members have written recovery plans for the bonytail, humpback chub, and Colorado squawfish. The latest versions of these plans have been broadly reviewed by various agencies with an interest in the Colorado River, and the final versions are expected to be approved by the Regional Director, U.S. Fish and Wildlife Service Region 6, Denver, Colorado, during 1989.

Colorado River Endangered Fishes Researchers Meetings. Since 1983, fishery biologists and other researchers from state and federal agencies, universities, and private consulting firms in the Upper Colorado River Basin have held an annual Endangered Fishes Researchers Meeting sponsored by the states of Colorado and Utah. The open communication and coordination provided by the annual meeting has improved cooperation between biologists so that efforts are more effectively directed and integrated. Communication between biologists from the upper and lower basins has been enhanced through the annual meeting of the Desert Fishes Council and through meetings of the Colorado River Fishes Recovery Team.

American Fisheries Society. Members of the Endangered Species Committee, Bonneville Chapter of the American Fisheries Society wrote a position paper in 1974 that strongly supported the protection of natural habitats and species that are threatened, endangered, or of special concern in Utah, including the status of the endangered Colorado River fishes (Holden et al. 1978). Members of the Threatened and Endangered Species Committee of the American Fisheries Society developed systematic guidelines and policies for introductions of threatened and endangered fishes to supplement an existing population or to establish a new population (Williams et al. 1988). These guidelines focus on planning introductions, implementation, and evaluation of the introduction that is intended to increase the probability of success in recovery of rare fishes. Further communication about the endangered Colorado River fishes occurs at meetings of the Western Division of the American Fisheries Society (Miller et al. 1982b) and at meetings of the Bonneville and

Colorado-Wyoming Chapters.

Interagency Coordinating Committee. The 1982 amendments to the Endangered Species Act declared that "the policy of Congress is that Federal agencies shall coordinate with State and local agencies to resolve water resource issues in concert with the conservation of endangered species." This amendment was added to the Endangered Species Act to address specific conflicts that had developed concerning water development and conservation of the endangered species in the Upper Colorado and Platte River basins.

By 1984, the Service had issued nearly 100 biological opinions, concluding that the site-specific cumulative effect of water development and depletions were likely to jeopardize the continued existence of the endangered Colorado River fishes. Also in 1984, the Service issued a draft Conservation Plan that specified minimum **streamflows** needed by the endangered fishes for all the major rivers in the upper basin. This plan drew harsh reaction from the upper basin states because it based its recommendations on historic conditions rather than on biologically documented needs of the endangered fishes (Zallen 1986). The plan was interpreted as a threat to future water development in the upper basin.

In response to this controversy and the failure to weaken the Endangered Species Act (Tarlock 1984), water development interests became much more actively involved in trying to resolve the growing controversy over the endangered fishes and water development in the upper basin. For example, the directors of the Colorado Water Congress established a "Special Project on

Threatened and Endangered Species" in December 1983 (Pitts 1988). The goal of this Special Project was to find an administrative solution, acceptable to water development interests, the Federal government, the States, and environmental organizations, that would allow water development to continue while avoiding conflicts with the Endangered Species Act in the Upper Colorado River Basin and the Platte River Basin.

Also in response to the growing controversy, the Service began discussions between representatives of the Bureau of Reclamation and the states of Colorado, Utah, and Wyoming, private water-development interests and environmental groups. These discussions led to the formation of the Upper Colorado River Coordinating Committee (Coordinating Committee) in March, 1984. The primary goal of the Committee was to develop a recovery program for the endangered fishes within the framework of existing states' water rights and terms of the Colorado River compacts.

One of the first Coordinating Committee activities was the formation of the Biology and Hydrology Subcommittees to review and synthesize technical information on the endangered fishes and their streamflow requirements. Biological and hydrological data, summarized by the respective Subcommittees, were used as a basis for drafting the Recovery Implementation Program for the endangered fish species in the upper Colorado River. After nearly four years of intense discussions, data analyses, and negotiations, the Recovery Program was finalized in September 1987 (U.S. Fish and Wildlife Service 1987a). After completion of an environmental assessment of the Recovery Implementation Program (U.S. Fish and Wildlife Service 1987b), the Secretary of the Interior

joined the Governors of Colorado, Utah, and Wyoming and the Administrator for the Western Area Power Administration in executing a cooperative agreement to formally implement the program. The agreement created a 10-member Upper Colorado River Implementation Committee^{3/} to oversee the Service's Recovery Program (Rose and Hamill 1988). Creation of the Implementation Committee resulted in the disbanding of the Upper Colorado River Coordinating Committee as well as the Biology and Hydrology Subcommittees. In turn, a Technical working Group and a Management working Group were created to oversee on-going activities. The signing of this agreement and implementation of the Recovery Program was made possible, in part, by legislation in Colorado that recognizes instream flows for fish as a beneficial use of water.

The Recovery Implementation Program outlines a multimillion dollar recovery effort consisting of five recovery elements:

1. Provision of Instream Flows. The Service will quantify instream flows needed for recovery of the four rare fishes in the upper Colorado and Green river subbasins. The Upper Colorado River Implementation Committee, in cooperation with the state agencies, will identify and recommend alternatives to the Secretary of the Interior for implementing the Service's flow recommendations.

^{3/} Voting members include the Fish and wildlife Service; the Bureau of Reclamation; the Western Area Power Authority; the states of Colorado, Utah, and Wyoming; a representative of environmental organizations (e.g., Audubon Society); and private water development interests in the three states.

It is anticipated that the instream flow needs of the rare fishes in the major reaches of the Colorado and Green rivers can be provided through program refinement and protection of releases from Federal reservoirs, such as Flaming Gorge and Blue Mesa. In addition, the Recovery Program provides for water rights acquisition in relatively unregulated systems such as the Yampa and White rivers, conversion of these rights into instream flows for the fish, and administration of those rights pursuant to State water laws. In 1988, Congress appropriated \$1 million to initiate the acquisition of water for instream flows.

2. Habitat Development and Maintenance. The Service and the states will perform research to determine if and how development and maintenance of habitat (creation of backwaters, construction of jetties, fish ladders, etc.) will contribute to recovery.
3. Native Fish Stocking. If practical, a hatchery, rearing, and stocking program will be implemented as a means to produce fish for research and to augment endangered fish populations. Consideration will be given to supplementing existing populations of the endangered fishes where studies conclude that it would help promote self-sustaining populations.
4. Management of Non-native Species and Sportfishing. Some introduced fish species are known to prey on or compete with the

endangered fishes and may be limiting recruitment. In addition, mortality of the Colorado squawfish and humpback chub may increase by their vulnerability to anglers. These potential recovery problems will be closely monitored by Colorado River Fishery Project personnel, the Colorado Division of wildlife, and the Utah Division of wildlife Resources. Where necessary and feasible, control efforts will be made through a cooperative effort between state conservation agencies and the Service.

5. Research, Monitoring, and Data Management. The Upper Colorado River Implementation Committee meets periodically to review research progress and data management on the life history, ecology, and habitat requirements of the endangered Colorado River fishes, as well as the effectiveness of management and recovery activities. By consensus, the Committee members will guide future research projects, as well as management and recovery activities.

The ultimate goal of the Recovery Implementation Program is to recover, delist, and manage the three endangered fishes and to free the razorback sucker of the need for protection under the Endangered Species Act. The initial timeframe for achieving this goal has been established at fifteen years from the Recovery Implementation Program acceptance in 1987.

The funding for the Recovery Implementation Program is a cooperative responsibility. The projected annual budget for the Recovery Program is \$2.3 million, adjusted annually for inflation. Sources of funding include federal

and state governments, power and water users, and private donations. Two capital funds will be requested from Congress. A minimum of \$10 million will be requested for the purchase of water rights to protect instream flows required by the fish. In addition, a \$5 million fund will be needed to begin capital construction for facilities needed for recovery, such as fish passageways and rearing facilities.

Several aspects of the Recovery Implementation Program have been controversial, particularly the recovery elements related to habitat improvement, management of predators or competitors, and the operation of federal reservoirs to meet the habitat needs of the fish. However, the most controversial aspect of the Program centers on the process for conducting Section 7 consultations. The Program does not identify a process for consultation on direct impacts (e.g., obstruction of migration routes, alteration of physical habitat, inundation of riverine habitat, and temperature modification from reservoirs releases). Direct project impacts will be addressed by the Service on a case-by-case basis through the Section 7 consultation process. Under the Recovery Implementation Program, the Service has determined that project water depletions, which the Service has consistently maintained are likely to jeopardize the listed fishes, can be offset by (1) program activities partly funded by water project proponents through a one-time contribution to the Recovery Program in the amount of \$10 per acre-foot (adjusted annually for inflation) of the project's average annual depletion, and (2) appropriate legal protection of instream flows pursuant to state laws. The Service has taken the position that protection of the instream flow needs of the fishes must proceed concurrently, and not lag

behind, water depletions in the Upper Colorado River Basin. Consequently the \$10 per acre-foot depletion contributions for water depletions is being implemented only on a case-by-case basis, depending on whether progress has been sufficient in obtaining instream flow protection.

Epilogue

The recovery program for the rare fishes in the Upper Colorado River Basin has been the largest and most comprehensive recovery effort for endangered fishes in the United States. The program resulted partly because of two major pieces of federal legislation -- the Endangered Species Act of 1973 and amendments and the National Environmental Policy Act -- and has been influenced by the conflict for water needed for the endangered fishes and for municipal, industrial, and agricultural purposes. The Service's Colorado River Fishery Project, Bureau of Reclamation, and the States of Colorado and Utah have conducted/sponsored intensive biological studies on endangered fishes. The technical assistance provided through these studies by state and federal biologists has been used by the Upper Colorado River Coordinating Committee to develop a Recovery Program that was acceptable to water users, federal and state governments, and conservation groups (U.S. Fish and Wildlife Service 1987a). Intense negotiations by the Committee over a four-year period resulted in a program in 1987 that allowed certain water development to occur while directing a large-scale effort to recover the endangered Colorado River fishes in the upper basin over 15 years.

The Recovery Implementation Program is a milestone that coordinates

federal, state, and private actions to conserve the endangered Colorado River fishes in a manner compatible with state's water rights allocation systems and the various interstate compacts that guide water allocation, development, and management in the upper basin. For the first time, there is a long-term commitment for funding of a multi-faceted recovery effort -- a commitment to acquire and legally protect the instream flow needs of the endangered fishes -- and the affected parties are working together in a cooperative manner. This commitment provides a unique and unprecedented opportunity to make significant gains in the conservation of endangered Colorado River fishes. The Recovery Implementation Program provides a workable framework for moving forward -- the challenge will be to ensure that water can be managed and allocated to meet existing and new municipal, industrial, and agricultural uses while providing adequate instream flows for the endangered Colorado River fishes. Recovery and Section 7 actions must be based upon sound biological principles so that the primary objective of the Endangered Species Act is achieved (i.e., to preserve the ecosystem upon which the endangered Colorado River fishes depend). The success of the Recovery Implementation Program also requires a strong commitment by the participants on the Upper Colorado River Implementation Committee, to balance (to the maximum extent possible) the needs of all the parties (water developers, power-users, environmentalists, anglers, etc.) who have a concern and interest in water resources of the Upper Colorado River. This effort demonstrates that realistic management of endangered species is possible but that the constraints of knowledge, time, politics, and available funds require creative thinking for effective management of natural resources.

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W Y O M I N G

Flaming Gorge

R 0 0 0 0 0 0 0 0

VERNAL

Ashley Creek

CRAIG

Duchesne R.

Green

White

Yampa

Little Snake R.

RANGELY

MEEKER

U T A H

C O L O R A D O

211

Desolation Canyon

RIFLE

Gray Canyon

157

241

GREEN RIVER

Black Rocks

GRAND JUNCTION

131

Westwater Canyon

154

Professor Valley

111

181

Labyrinth Canyon

MOAB

71

Potash

47

Cataract Canyon

81

82

-3

HITE

Gypsum Canyon

4

Lake Powell

20 20 40 60

SCALE OF KILOMETERS

20 0 20 40 60

SCALE OF MILES

Figure 1. The Upper Colorado River Basin showing the location of major cities, rivers, and canyons. (The numbers refer to river miles with 0 at the confluence of the Colorado and Green rivers.)