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United States Department of the Interior

FISH AND WILDLIFE SERVICE

UTAH FIELD OFFICE
LINCOLN PLAZA
145 EAST 1300 SOUTH, SUITE 404
SALT LAKE CITY, UTAH 84115

In Reply Refer To
(ES)

November 7, 1994

RECEIVED
NOV 14 1994
DIV OF OIL, GAS & MINING

Utah Coal Regulatory Program
Division of Oil, Gas and Mining
355 West North Temple
3 Triad Center, Suite 350
Salt Lake City, UT 84180-1203

Attention: Pamela Grubaugh-Littig

Re: Updated Information - Conversion from Significant Revision to Notice of Intent to Conduct Minor Exploration, PacifiCorp, Trail Mountain Mine, ACT/015/009-93A, Folder #2, Emery County, Utah #2

Dear Ms. Grubaugh-Littig:

This is in response to your letter of September 27, 1994 concerning the Trail Mountain Mine Notice of Intent to Drill. The Service issued a Biological Opinion for this project to the Manti-La Sal National Forest on June 30, 1994. The opinion addressed impacts to the Colorado River fishes from depletions of water. A depletion charge was assessed to the company. A copy of the opinion is enclosed for your information.

The Fish and Wildlife Service has reviewed the material provided and believes no other significant impacts to wildlife resources would be expected. We are returning the materials you provided as we do not maintain the mine plan for this project.

Sincerely,

Robert D. Williams
Assistant Field Supervisor

Enclosures (2)

United States Department of the Interior

FISH AND WILDLIFE SERVICE
Mountain-Prairie Region

IN REPLY REFER TO:
ES/6-UT-94-F-012
Mail Stop 60120

MAILING ADDRESS:
Post Office Box 25486
Denver Federal Center
Denver, Colorado 80225

STREET LOCATION:
134 Union Blvd.
Lakewood, Colorado 80228

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NOV 14 1994
DIV OF OIL, GAS & MINING

JUN 30 1994

Mr. Ira W. Hatch
Ferron Ranger District
Manti-La Sal National Forest
P.O. Box 310
Ferron, Utah 84523

Dear Mr. Hatch:

In accordance with section 7 of the Endangered Species Act of 1973, as amended (16 U.S.C. 1531 et seq.), and the Interagency Cooperation regulations (50 CFR 402), this transmits the Fish and Wildlife Service's (Service) final biological opinion for impacts to federally listed endangered species for the PacifiCorp application for coal exploration drilling in the Trail Mountain Permit Area. This opinion is provided to you as the lead Federal Agency regarding section 7 consultation on projects covered under this consultation. Copies of this opinion should be provided to the applicant because the Service has incorporated reasonable and prudent alternatives that should be included as conditions of any permits issued by the Forest Service for this project.

Reference is made to your May 2, 1994, correspondence requesting initiation of formal section 7 consultation for the subject project. The Service concurs that the average annual depletion of water from the Upper Colorado River Basin (Upper Basin) "may affect" the endangered Colorado squawfish (Ptychocheilus lucius), humpback chub (Gila cypha), bonytail (Gila elegans), and razorback sucker (Xyrauchen texanus) and "may affect" their critical habitat. The Service concurs with your determination that the proposed project would not affect the bald eagle (Haliaeetus leucocephalus).

BIOLOGICAL OPINION

Based upon the best scientific and commercial information that is currently available, it is the Service's biological opinion that the proposed project as described below, is likely to jeopardize the continued existence of the Colorado squawfish, humpback chub, bonytail, and razorback sucker and result in the destruction or adverse modification of their critical habitat. The Service has developed reasonable and prudent alternatives to avoid the likelihood of jeopardy to the endangered fishes and to avoid destruction or adverse modification of their critical habitat.

PROJECT DESCRIPTION

PacifiCorp has submitted a drilling application amendment to the Utah Department of Natural Resources, Division of Oil, Gas, and Mining, to build new access roads, reconstruct previously used access roads, and drill 13 exploration holes in the Trail Mountain Permit Area over the next 2 years. The proposed exploration area is located on the eastern side of the Wasatch Plateau approximately 9 miles northwest of Orangeville, Utah, within T. 17 S., R. 6 E., sections 27 and 34 and T. 18 S., R. 5 E., section 2. The holes will start in the North Horn Formation and penetrate the Price River Formation, Castlegate Sandstone, Blackhawk Formation, and the upper portion of the Star Point Sandstone. Surface elevation varies from approximately 8,200 to 8,800 feet. A maximum of approximately 10 acres would be disturbed for drill pads and access roads. The purpose of the proposed project is to evaluate coal quality and quantity ahead of mining.

The Division of Oil, Gas, and Mining is the responsible agency for approval of on-lease exploration and mining activities. The Forest Service, as the surface management agency, has authority to consent or not consent to the proposed exploration drilling and to impose such stipulations as necessary with respect to the use and protection of nonmineral interests.

On the upper bench in the northern portion of the project area, above approximately 9,000 feet, dominant plant communities are sagebrush and a grass seeding mingled among quaking aspen stands. Below about 9,000 feet, the southern portion of the proposed project area has mixed plant communities of grasslands (Salina wild rye), sagebrush (mountain big sagebrush/Sandberg bluegrass), mountain brush (true mountain mahogany/serviceberry/curl leaf mahogany/mountain big sagebrush/Sandberg bluegrass), and pinyon-juniper stands. Small riparian communities are present near springs and seeps. The plant communities are considered to be in midseral status. Recently completed contour furrowing and wildlife browse enhancement projects have created some early seral plant communities in small areas.

The drilling activity will take place on sites of approximately 1 acre each. Topsoil would be removed and stockpiled for reclamation. The only other earthwork at the site is the construction of a mud pit approximately 20 feet by 40 feet and 10 feet deep. If conditions require, the pit may be enlarged or another pit dug on the pad, during drilling. Drilling is done with air or foam mist--no toxic materials are used. Single land access roads are constructed, with the topsoil also stockpiled for reclamation. Pads are reclaimed as soon as the mud pit is dry, and the roads are reclaimed as soon as they are no longer needed. Topsoil is replaced, and the area is immediately seeded with a mix specified by the Forest Service. Previous drilling activity in the area has shown that total reclamation can be expected in 3 to 5 years, even during periods of drought. The proposed activities would begin on or about July 5 and continue through November.

About 1.37 acre-feet (445,714 gallons) of water will be used in the drilling process and road maintenance (dust suppression). The proposed water sources are a pond located in NE¼ NE¼ section 28, T. 17 S., R.6 E., identified as 28-1P and a spring located in NE¼ NW¼ section 2, T. 18 S., R.6 E., identified

as 18-2-1. The Forest Service estimates that the cumulative impact of the proposed project will result in an average annual net depletion of approximately 1.37 acre-feet from the Green River subbasin of the Upper Basin.

BASIS FOR BIOLOGICAL OPINION

This biological opinion addresses the average annual net depletion of no more than 1.37 acre-feet over a 3-year period from the Upper Basin. The endangered Colorado squawfish, humpback chub, bonytail, and razorback sucker inhabit the Colorado River and the Green River from the confluence with the Colorado River upstream to near the Willow Creek confluence (Swallow Canyon). The main stem Green River and its tributary, the Yampa, contain the largest known riverine populations of Colorado squawfish and razorback sucker. Humpback chub have a limited, discontinuous distribution in canyon-bound habitats and persist in small numbers in Desolation and Whirlpool Canyons. The bonytail is extremely rare throughout the Upper Basin.

Water depletions in the Upper Basin have been recognized as a major source of impact to endangered fish species. Continued water withdrawal has restricted the ability of the Colorado River system to produce flow conditions required by various life stages of the fishes. Impoundments and diversions have reduced peak discharges by 48 percent since 1942, while increasing base flows by 21 percent in some reaches. These depletions along with a number of other factors have resulted in such drastic reductions in the populations of the Colorado squawfish, humpback chub, bonytail, and razorback sucker that the Service has listed these species as endangered and has implemented programs to prevent them from becoming extinct.

The importance of the Green River to rare and endangered fish was established by the "Recovery Implementation Program for Endangered Fish Species in the Upper Colorado River Basin" (Recovery Program) and recognized by many biologists as noted in the recovery plans for each of the species. The Green River and its tributaries were listed as the highest priority for recovery of the Colorado squawfish in the Colorado River Basin in the recently revised Colorado Squawfish Recovery Plan (U.S. Fish and Wildlife Service 1991). The Green River in Desolation and Gray Canyons and in Dinosaur National Monument (Dinosaur) is considered extremely important in the recovery of the humpback chub in the Humpback Chub Recovery Plan (U.S. Fish and Wildlife Service 1990a). The Bonytail Chub Recovery Plan (U.S. Fish and Wildlife Service 1990b) indicates that one of the last known riverine concentrations of bonytail was in the Green River within Dinosaur. In addition, the Green River supports the largest known population of razorback sucker in their natural riverine habitat (Lanigan and Tyus 1989).

The Recovery Program placed a high priority on habitat management in the Colorado, Green, and Yampa Rivers through protection of instream flows. Because of the importance of providing legal protection for instream flows, the Service considers, within the section 7 process, the legal protection of flows essential to offsetting project impacts.

Critical habitat has been designated for the Colorado squawfish, humpback chub, bonytail, and razorback sucker within the 100-year floodplain in portions of their historic range (59 F.R. 13374). Destruction or adverse modification of critical habitat is defined in 50 CFR 402.02 as a direct or indirect alteration that appreciably diminishes the value of critical habitat for both the survival and recovery of a listed species. In considering the biological basis for proposing critical habitat, the Service focused on the primary physical and biological elements that are essential to the conservation of the species without consideration of land or water ownership or management. The Service has identified water, physical habitat, and biological environment as the primary constituent elements. This includes a quantity of water of sufficient quality that is delivered to a specific location in accordance with a hydrologic regime that is required for the particular life stage for each species.

Water depletions reduce the ability of the river system to provide the required water quantity and hydrologic regime necessary for recovery of the fishes. The physical habitat includes areas of the Colorado River system that are inhabited or potentially habitable for use in spawning and feeding, as a nursery, or serve as corridors between these areas. In addition, oxbows, backwaters, and other areas in the 100-year floodplain, when inundated, provide access to spawning, nursery, feeding, and rearing habitats.

Water depletions in the Upper Basin reduce the ability of the river to create and maintain these important habitats. Food supply, predation, and competition are important elements of the biological environment. Food supply is a function of nutrient supply and productivity, which could be limited by reduction of high spring flows brought about by water depletions. Predation and competition from nonnative fish species has been identified as a factor in the decline of the endangered fishes. Water depletions contribute to alterations in flow regimes that favor nonnative fishes. The Service concludes that water depletions impact the primary constituent elements; however, reasonable and prudent alternatives have been developed by the Service that would avoid destruction or adverse modification to designated critical habitat.

BIOLOGICAL BACKGROUND

Colorado Squawfish

General Status

Historically, Colorado squawfish occurred in mainstream habitats of the Colorado River system. The species was found in the Colorado River from the Utah-Arizona border to the Sea of Cortez in Mexico, and the Salt and Gila Rivers of the Lower Colorado River Basin (Lower Basin). However, all Lower Basin populations are considered extirpated (Minckley 1973). In the Upper Basin, Colorado squawfish occurred in the Colorado, Green, Yampa, White, Dolores, Gunnison, San Juan, Uncompahgre, and Animas Rivers and in many smaller tributaries. Although still occurring in much of its former Upper Basin range, most areas contain only remnants of their former number, and few reproducing populations exist.

All life history phases of the Colorado squawfish are considered in this biological opinion and include migration, spawning, and larval recruitment to the adult life stage. These phases are closely related with specific flow events and habitat requirements. The recovery goals for Colorado squawfish established through the Recovery Program are to "maintain and protect self-sustaining populations and natural habitat."

Adults

Adult Colorado squawfish are widely distributed in the Yampa and Green Rivers, and the fish is considered more abundant in the Green River than any other location (Holden and Stalnaker 1975; Tyus et al. 1982a and 1982b; Behnke and Benson 1983; Tyus 1991a). In the mainstream Green River, adults are most prevalent in upper (i.e., near Ouray, Utah) and lower (i.e., near Labyrinth Canyon) sections (Tyus et al. 1987).

During the winter months, adult Colorado squawfish occupy a variety of low velocity habitats including slow runs, slackwaters, eddies, and backwaters (ephemeral along-shore embayments) (Valdez and Masslich 1989; Wick and Hawkins 1989). Colorado squawfish select certain river reaches in the Green and upper Yampa Rivers and generally remain active in these areas all winter (Valdez and Masslich 1989; Wick and Hawkins 1989). The fish presumably use ice as cover and some local movements are probably made to avoid floating ice jams (Valdez and Masslich 1989).

Flow fluctuations in the winter may affect fish use of preferred winter habitats. Movement patterns of radio-tagged fish suggested that such fluctuations result in greater movement of Colorado squawfish than in more stable conditions (Valdez and Masslich 1989; Wick and Hawkins 1989). Valdez and Masslich (1989) believed that a rapid change in river stage altered locations of squawfish preferred microhabitats resulting in greater fish movement. Increased movement was hypothesized as resulting in increased energy expenditure and decreased body condition. Decreases in body condition during winter may affect ova development, number, and size.

In spring and early summer, adult Colorado squawfish are most often located in seasonally inundated shoreline habitats, including backwaters or bottomlands (Tyus 1990). Radio-tracking data indicated use of shoreline backwater habitat in the 1981 low-flow year and use of flooded bottomlands during the 1983 high-flow year (Tyus and Karp 1989). During the 2 high-flow years, 1983 and 1984, adult Colorado squawfish also used flooded shorelines (Tyus et al. 1987). From late April to May in 1985 and 1987, at flows of 8,000-10,000 cfs, they used the inundated portions of Old Charley Wash. Wick et al. (1983) noted during 1982 (an average-flow year) that adult Colorado squawfish used backwater and eddy habitats as runoff flows increased from early May through mid-June. In May, backwater habitat use occurred in backed-up tributary mouths and diked-off side channels. Adult squawfish moved to main channel habitats as the river level dropped.

Adult Colorado squawfish occupy a variety of habitats in mid-to-late summer but are most common in eddies, pools, runs, and shoreline backwaters over sand and silt substrates (Tyus et al. 1984 and 1987). Visual observations of fish in shallow water suggests that adults use sheltered microhabitats behind boulders, flooded vegetation, or other cover. During the summer, radio-tagged fish were most often located in deeper shoreline habitats where movements suggested heavy use of the eddy-run interface (Tyus et al. 1987).

Capture of introduced northern pike (Esox lucius) and channel catfish (Ictalurus punctatus) in habitats shared by adult Colorado squawfish (Wick et al. 1985; Tyus and Beard 1990) suggests a potential for competition and/or predation during times of resource limitation. Although Pimentel et al. (1985) found that Colorado squawfish did not prefer channel catfish as prey, observations of channel catfish lodged in throats of adult Colorado squawfish (McAda 1983; Pimentel et al. 1985; Wick et al. 1985) indicate that these introduced fish are eaten by Colorado squawfish, and some may cause mortality. However, little is known concerning conditions that either favor or impede nonnative fish. McAda and Kaeding (1989) found that during years of low annual runoff, numbers of nonnative fish increased; yet in years of moderately high runoff, their relative abundance decreased. Predacious fish of concern include channel catfish, northern pike, and walleye (Stizostedion vitreum).

Migration

The initiation of spawning migration is an important component of the reproductive cycle of the Colorado squawfish. Based on radio-tracking data (Wick et al. 1983; Tyus and McAda 1984; Tyus 1990), fish in the Green and Yampa Rivers initiated spawning migrations around the summer solstice; Green River fish initiated migrations about June 21 (range: May 23-July 22), and Yampa River fish migrated about June 15 (range: May 26-July 13). These movements included downstream migrations in the Yampa and White Rivers and upstream and downstream migrations in the Green River (Tyus et al. 1987; Tyus 1990).

Flows and water temperatures were highly variable during Colorado squawfish spawning migrations, and migrations were initiated earlier in low-water years (e.g., 1981) and later in higher water years (e.g., 1983). The earlier the spring peak flow occurred, the longer the interval before migration began (Tyus 1990). Initiation of spring migration occurred about 28 days after peak flow in the Yampa and Green Rivers (Tyus and Karp 1989). Migration was associated with water temperatures of at least 9 °C (average 14 °C).

Homing behavior in Colorado squawfish is suggested by long-distance movement patterns and repeated recaptures of the same fish on spawning grounds in subsequent years (Wick et al. 1983; Tyus 1985 and 1990). Fish use of more than one spawning area was not detected (Tyus 1990), supporting the idea of spawning fidelity in Colorado squawfish. Colorado squawfish spawning areas thus should be protected as unique habitats that are essential to the conservation of the species.

The migrations and homing behavior of Colorado squawfish mandate protection of known migration routes. Migrations of Colorado squawfish are vulnerable to stream blockage (Tyus 1984), as evidenced by the recent loss of 50 miles of occupied habitat in the White River due to blockage (Martinez 1986) at Kenny Reservoir. Lack of access to spawning grounds was implicated in the decline of Colorado squawfish (Joseph et al. 1977; Tyus 1984).

Spawning

Males generally mature at age 5 or 6 and females at age 6 or 7 (Hamman 1981; Vanicek and Kramer 1969; Seethaler et al. 1979). Most mature fish in the Green and Yampa Rivers migrate in spring to two locations identified as spawning areas. These include riffle and pool habitats in Yampa Canyon on the lower Yampa River and Gray Canyon on the Green River (Tyus and Karp 1989; Tyus 1990).

The annual spawning period (as indicated by the presence of migrating radio-tagged fish on spawning grounds, collections of ripe fish, or calculated dates of larval emergence in spawning reaches) lasts about 4 to 5 weeks. An optimum spawning period also was calculated by averaging the dates in which radio-tagged fish and ripe fish were present in the spawning reach and back-calculated dates of egg deposition. The length of the estimated optimal spawning period (about 26 days) was similar in both spawning areas for all years. Spawning generally occurred earlier in low-water years (1981, 1987, and 1988) and later in high-flow years (1983 and 1984). Discharge was variable between years during the optimum spawning period, but average temperatures ranged from about 22-25 °C (Tyus 1990). Others reported a peak in spawning after temperatures reach 20 °C (Haynes et al. 1984; Hamman 1982a; Holden and Stalnaker 1975; Tyus and McAda 1984). Spawning, both in the hatchery and in the wild, generally occurs from July-August but may extend into early August depending on flows and temperature.

Vanicek and Kramer (1969) first suggested that discharge and temperature influenced spawning in Colorado squawfish. Data from 1981 to 1988 indicated that spawning occurred during the period of declining flows following spring peak runoff and increasing temperatures (Tyus 1990). This generally occurred about 26 days (range: 17-33 days) following migration. Peak discharge preceding spawn and mean minimum temperatures during spawn were highly correlated with the spawning period, ostensibly because discharge, temperature, and the spawning period are correlated. Spawning of Colorado squawfish is considered a result of complex environmental and biological influences and is not triggered by a single flow or temperature event (Tyus 1990). As an example, flow spikes from rainstorms during spring runoff also may influence ovulation and spawning in Colorado squawfish, as recently hypothesized by Nesler et al. (1988). Radio-tracking data suggest that all adult Colorado squawfish do not spawn each year, and male and female fish may require different stimuli for gonadal maturation (Tyus 1990), some of which appear to be flow related.

Breeding adults were most often concentrated in river reaches containing deep pools, eddies, and submerged cobble/boulder bars. Radio-tagged fish moved from pools or eddies to presumably spawn on bars and then returned to the former habitat (Tyus et al. 1987), behavior similar to that of spawning northern squawfish (Beamesderfer and Congleton 1981). Turbid riverine conditions precluded direct observations of egg deposition; yet, cobbles removed from the substrate during this time of year are clean of sediment and algae (Archer and Tyus 1984; U.S. Fish and Wildlife Service, unpublished data). There is substantial field and laboratory data showing that Colorado squawfish and other squawfish species require cleaned cobble surfaces for successful egg adhesion (Burns 1966; Patten and Rodman 1969; Hamman 1981). Hamman (1981) also noted hatching of Colorado squawfish larvae from cobble surfaces. The need for cleaned cobble and boulder substrates is supported by spawning of Colorado squawfish following peak flows and peak sediment transport (Tyus and Karp 1989). Spring scouring, a gradual decrease in summer flow, and a concomitant decrease in sediment load aid in preventing siltation of cobble bars. Thus, magnitude, timing, and duration of spring flows are considered potential limiting factors for successful reproduction by Colorado squawfish.

Temperature also affects egg development and hatching. In the laboratory, egg mortality was 100 percent in a controlled test at 13 °C. At 16-18 °C, development of the egg is slightly retarded, but hatching success and survival of larvae were higher. At 20-26 °C, development and survival through the larval stage were up to 59 percent (Hamman 1981).

Larvae and Postlarvae

Colorado squawfish eggs hatch in 4-5 days at 20-21 °C. Sac-fry emerge from cobble bars and drift downstream with declining flows (Tyus et al. 1982b and 1987; Haynes et al. 1985; Tyus 1987; Tyus and Haines 1991) to concentrate in shallow backwater habitats in the Green River. Newly emerged Colorado squawfish fry drift to the mouth of the Yampa River from the midpoint of the spawning grounds, river mile 16.5-18.2, in about 6 days after hatching (Tyus and Haines 1991). Nesler et al. (1988) also noted rapid downstream transport of larvae (3-15 days) following hatching. From 1979 to 1988, peaks in abundance of young Colorado squawfish occurred in the Green River about 100 miles downstream of the Yampa River spawning reach (Tyus et al. 1982b and 1987; Tyus and Haines 1991). Young fish presumably use river transport for dispersal from upstream spawning grounds to downstream nursery habitats (Tyus and McAda 1984; Tyus 1986; Nesler et al. 1988; Tyus and Haines 1991; Paulin et al. 1990). Gradually decreasing flows following spring runoff create productive nursery habitats which persist with summer-winter base flow conditions. Availability (quality and quantity) of these habitats in the Green River is considered essential for successful recruitment of the species.

Flow, river temperature, availability of backwater habitat, and predator abundance contribute to mortality of drifting larvae. Berry (1988) noted that larval Colorado squawfish acclimated to about 22 °C are adversely affected by cold water of 10 °C and 15 °C. Young Colorado squawfish are routinely collected in isolated pools in the Green River system (U.S. Fish and Wildlife

Service, unpublished data). These pools form when decreasing flows strand bodies of water from the main channel. Natural fluctuations in river level are usually slow enough to make this a gradual process and thereby allow entrapped fish to escape. Abrupt fluctuations in river level, as is characteristic of the Green River and other regulated systems, could increase mortality of small fish by cutting off escape routes and thereby increasing potential for competitive interactions and exposure to terrestrial predation. Herons (Ardeidae), raccoons (Procyon lotor), garter snakes (Thamnophis spp.), and other animals were observed feeding on fish trapped in isolated pools (Erman and Leidy 1975; U.S. Fish and Wildlife Service, unpublished data).

Age-0 Colorado squawfish are most abundant in shoreline backwaters when water temperatures are the same or greater than the main river channel. Mark-recapture studies indicated a diel movement of postlarval (age-0 and age-1) fish between backwaters and the mainstream river in April, October, and November (Tyus 1991b).

Postlarval squawfish appear adaptable to changing conditions. During the winters of 1985-1986, 1987-1988, and 1988-1989, a significant overwintering mortality of age-0 Colorado squawfish was not detected (Tyus and Haines 1991). In addition, low flows in 1988 did not reduce standing crops (7.7 fish/100 m^2 seined) or growth of young Colorado squawfish. Total length of the fish in October 1988 (41.3 and 45.0 mm, upper and lower Green River, respectively) was similar to other years of best growth (Tyus and Haines 1991). Additionally, high spring catches of age-0 fish (6.5-28.9 fish/100 m^2 seined) showed good overwinter survival in some years. Laboratory studies (Thompson 1989) found that all age-0 Colorado squawfish survived simulated winter conditions when fed, and only smaller individuals with low lipid content died when starved 210 days at 3-4 °C. Thompson found that age-0 fish actively foraged in laboratory and field conditions, and it is assumed that healthy young survived the winters under 1985-1989 flow conditions (Tyus and Haines 1991).

Late summer and autumn are critical periods for growth and survival of young Colorado squawfish, and historical flows in the Green River system at this time are predictably low. Juvenile temperature tests showed that preferred temperatures ranged from 21.9-27.6 °C. The most preferred temperature for juveniles and adults was estimated at 24.6 °C. Temperatures near 24 °C also are best for optimal development and growth of young (Miller et al. 1982b). Tyus et al. (1987) noted that abundance and growth of young Colorado squawfish in the Green River were negatively correlated with high, cooler late summer and autumn flows. During the late summer and autumn, catch and growth were highest in average flow years of 1979 and 1980 and lowest in abnormally high flow years of 1983 and 1984 (Tyus et al. 1987). In 1983 and 1984, unusually high releases from Flaming Gorge Dam in the late summer and autumn inundated backwater nursery areas, and survivorship of young Colorado squawfish was low. These relationships suggest that flows promoting growth and survival of small Colorado squawfish vary with time of year and that both reproduction and survival are highest in years when hydrographs more closely approximated natural flow conditions. This presumably relates to the availability of nursery backwater habitat in autumn (Tyus and Haines 1991).

A summer flow range of about 1,100-1,800 cfs maximized the number of backwaters in the upper Green River basin on aerial photography and videography (Pucherelli and Clark 1989). These authors also noted that flows above 1,800 cfs reduced numbers of backwaters at Island Park and Jensen during their study. High spring flows may be needed to maximize backwater formation, and gradually decreasing flows may be required to produce good nursery habitats (Pucherelli and Clark 1989).

Effects of competition and predation by introduced fish on growth and survival of young Colorado squawfish have yet to be adequately assessed, but the common use of backwater habitats and foods by young Colorado squawfish and small introduced fish species (e.g., channel catfish, green sunfish (Lepomis cyanellus), and red shiner (Notropis lutrensis) (Jacobi and Jacobi 1982; McAda and Tyus 1984; Muth, pers. comm.)) suggests a potential for negative interactions. Karp and Tyus (1990b) suggested that growth and survival of young Colorado squawfish may be adversely affected by the aggressive behavior of introduced green sunfish, red shiner, and fathead minnow (Pimephales promelas). This may be most acute when increases or decreases in river level reduces the availability of quality backwater habitat.

There is some indication that abundance of nonnative fish may be adversely affected by periods of high flow (Haynes et al. 1985; Minckley and Meffe 1987; T. Nesler, written communication). Still, the hypothesis that native Colorado River fish exhibit greater tolerance to extreme flooding was not adequately tested. In the Green River, abundance of Colorado squawfish and red shiner in backwaters was lowest in years of high summer flows (Haines and Tyus 1990).

Backwater nursery habitats were influenced by inundation and resuspension of organic material from shorelines during increased flows and ultimately influenced backwater nursery habitats. This energy source was important for standing crops of fish food organisms (Grabowski and Hiebert 1989). Backwaters in the Ouray area, where young Colorado squawfish were most abundant, were richer in food than upstream areas studied. Reduced water-level fluctuations in that area resulted in more stable backwater habitats and possibly reduced the export of nutrients and food (Grabowski and Hiebert 1989).

Juveniles

Colorado squawfish reach about 74 mm total length by age-2; their greatest growth occurs during their third and fourth years just prior to attaining maturity. Little is known about the habitat requirements of juveniles, but they were captured in a variety of shoreline habitats including backwaters and flooded bottomlands. Juvenile Colorado squawfish may be more numerous in the lower Green River (Tyus et al. 1987) because of the downstream drift of larvae. If so, a long-distance upstream movement by juveniles is needed to repopulate upstream areas. Because only large-sized fish are found in the upper Yampa River and the highest concentration of juveniles occur in the lower Green River, upstream movements probably occur during the late juvenile or early adult stages (Tyus 1986 and 1990; Tyus et al. 1987). These movements require unrestricted access, which is considered essential to the species.

Critical Habitat

Critical habitat has been designated within the 100-year floodplain of the Colorado squawfish's historical range in the following sections of the Upper Basin (59 F.R. 13374).

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

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

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

Colorado, Delta and Mesa Counties. The Gunnison River and its 100-year floodplain from the confluence with the Uncompahgre River in T. 15 S., R. 96 W., section 11 (6th Principal Meridian) to the confluence with the Colorado River in T. 1 S., R. 1 W., section 22 (Ute Meridian).

Colorado, Mesa and Garfield Counties; and Utah, Grand, San Juan, Wayne, and Garfield Counties. The Colorado River and its 100-year floodplain from the Colorado River Bridge at exit 90 north off Interstate 70 (river mile 238) in T. 6 S., R. 93 W., section 16 (6th Principal Meridian) to North Wash, including the Dirty Devil arm of Lake Powell up to the full pool elevation, in T. 33 S., R. 14 E., section 29 (Salt Lake Meridian).

New Mexico, San Juan County; and Utah, San Juan County. The San Juan River and its 100-year floodplain from the State Route 371 Bridge in T. 29 N., R. 13 W., section 17 (New Mexico Meridian) to Neskahai Canyon in the San Juan arm of Lake Powell in T. 41 S., R. 11 E., section 26 (Salt Lake Meridian) up to the full pool elevation.

HUMPBACK CHUB

General Status

Humpback chub originally inhabited the main stem Colorado River from what is now Lake Mead to the canyon areas of the Green and Yampa River basins. They were considered less common than other endemic fish of the region but occur in fairly large numbers where reproducing populations exist. The greatest concentrations of humpback chub occur in the Grand Canyon portion of the Colorado and Little Colorado Rivers and Westwater/Blackrocks region of the Colorado River. Smaller populations and incidental catches are reported from

the Yampa River; Desolation, Gray, and Whirlpool Canyons of the Green River; and Cataract Canyon of the Colorado River. The recovery goals for humpback chub established through the Recovery Program are to "maintain or establish and protect five self-sustaining populations, natural habitat, and two refugia."

Adults

Humpback chub occur in several canyon-bound sections of the Green River basin, including the lower portion of the Little Snake and Yampa Rivers and Whirlpool, Desolation, and Gray Canyons of the Green River (Holden 1978; Tyus et al. 1982a, 1982b, and 1987; Karp and Tyus 1990a; M. Moretti and E. Wick, pers. comm.). Surveys conducted prior to and after closure of Flaming Gorge Dam indicated that all three forms of Colorado River chubs were locally common in the Green River. This includes bonytail and roundtail chubs in the upper Green River above Ouray, Utah. Humpback chubs occurred in Desolation and Gray Canyons and in the Flaming Gorge basin of the upper Green River (Smith 1960; Holden 1978; Vanicek 1967; Seethaler et al. 1979). Although intensive netting and electrofishing efforts in the Green River mainstream by Service and Utah Division of Wildlife Resources biologists yielded over 500 chubs (Miller et al. 1982c; Tyus et al. 1987; M. Moretti, pers. comm.), status of humpback chub in that system is not well understood, due in part to confusion with specific identification of some fish (Tyus et al. 1987; Rosenfeld and Wilkinson 1989; M. Moretti, pers. comm.).

More intensive studies are needed to further evaluate the systematics of Colorado River chubs and to determine their habitat needs in the Green River basin. The morphological variation that occurs in some areas of sympatry may be induced by recent habitat change (Valdez and Clemmer 1982). If preferred spawning conditions and/or habitats are unavailable for one or more species, spawning might occur during other times and/or places that promote hybridization. Thus, the presence of intermediate forms in altered systems (e.g., Green River and Colorado River) and the paucity of such forms in some unaltered rivers (e.g., Yampa River and Little Colorado River) suggest that natural riverine environments are important for recovery of the humpback chub. The following paragraphs summarize information on habitat use of humpback chub in Dinosaur, particularly Yampa Canyon (Tyus and Minckley 1988; Tyus and Karp 1989; Karp and Tyus 1990a) because little of this information is available for the mainstream Green River basin.

During spring and early summer, humpback chub in the Green River basin are most prevalent in high-gradient, whitewater reaches dominated by rocky runs, riffles, and rapids. Adult fish are most often collected in seasonally flooded shoreline eddies that are downstream of large boulders and upstream of rapids. Juveniles appear more common in smaller eddies in rocky shoreline runs. Humpback chub remain rare in Dinosaur, and only 133 juvenile and adult fish were captured during spring sampling efforts from 1986-1989 (Karp and Tyus 1990a). Feeding habits of humpback chub are relatively unknown in the Green River basin, but stomachs of a few fish contained hymenopterans and plant debris. Humpback chub also feed on Mormon crickets and presumably other foods at various levels within the water column (Karp and Tyus 1990a).

Although fall and winter habitat requirements of humpback chub are not well known, some observations in Dinosaur suggest that the fish remain in pools and eddies of impounded water and rapids in low flow conditions (Karp and Tyus 1990a). Minimum flows are thus required to maintain such habitats from midsummer through late winter, but specific flow levels for the Green River are not determined.

Spawning

Humpback chub generally spawn between temperatures of 16-20 °C but may also spawn in temperatures as low as 11.5 °C (Valdez and Clemmer 1982) and as high as 20.5 °C (Kaeding and Zimmerman 1983). Eggs are adhesive, but little is known about preferred substrate for egg deposition. Hatchery success diminishes as temperatures vary from their optimum of 20 °C (Hamman 1982a; Marsh 1985). The eggs generally hatch in 5-7 days at 19-20 °C (Hamman 1982a).

In Dinosaur, humpback chub spawn in spring and early summer following highest spring flows at river temperatures about 20 °C (Karp and Tyus 1990a). This included May and June in low (e.g., 1987 and 1989) and average (e.g., 1988) flow years but extended into July during the 1986 high-flow year. Ripe fish are predominantly captured in shoreline eddy habitats in the upper 30 miles of the Yampa Canyon, and there is some indication that these fish remain in or near specific eddies for extended periods and return to the same eddy during the spawning season in different years (Karp and Tyus 1990a). It is unknown where humpback chubs deposit eggs, but the use of shoreline eddies that are associated with boulder/sand substrates is considered important to the breeding requirements of humpback chub in Dinosaur. Availability of shoreline eddy habitat is greatest with spring flooding and decreases thereafter with decreasing summer flows; these habitats are formed and maintained by spring runoff. Loss or reduction of spring runoff could reduce availability of spawning habitat and consequently adversely affect humpback chub reproduction. Habitat alternation also may promote hybridization with other species (Valdez and Clemmer 1982). Flow reductions (absence of spring peak) and decreased temperatures were implicated as factors curtailing successful spawn and increasing competition in the Colorado River (Kaeding and Zimmerman 1983).

Larval and Juvenile

Larval and young-of-year humpback chub are generally found in low velocity microhabitats associated with backwaters and eddies. Fish grow from 7.5-10.5 cm during their first year of life, and by age-2 many are 200 mm (8 inches). Males begin reaching sexual maturity at age-2 and females at age-3. Once humpback chubs reach sexual maturity, growth slows considerably.

Critical Habitat

Critical habitat has been designated within the humpback chub's historical range in the following sections of the Upper Basin (59 F.R. 13374).

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

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

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

Utah, Grand County; and Colorado, Mesa County. The Colorado River from Black Rocks in T. 10 S., R. 104 W., section 25 (6th Principal Meridian) to Fish Ford (river mile 106) in T. 21 S., R. 24 E., section 35 (Salt Lake Meridian).

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

BONYTAIL

Status and Distribution

Historically, the bonytail occurred throughout the Colorado River main stem and its major tributaries, including the Gila and Salt Rivers in the Lower Basin and the Green, Yampa, White, Gunnison, and San Juan Rivers in the Upper Basin. Recent collections indicate the fish is extremely rare and is extirpated from much of its former range, although individual fish are still occasionally collected from the Upper and Lower Basins. Supplemental stocking from hatchery fish and maintaining stocks in hatcheries may be necessary to preclude this species from becoming extinct. The recovery goal for bonytail (U.S. Fish and Wildlife Service 1990b) is to "prevent immediate extinction."

Adults

Habitat requirements of the bonytail in the Green River basin are little known. Fish collections in Echo Park (Dinosaur) before and after closure of Flaming Gorge Dam indicated that the species was present in moderate numbers at the confluence of Yampa and Green Rivers (Vanicek 1967). But, more recent investigations in that area yielded few captures. Holden and Stalnaker (1975) reported the capture of 36 bonytails in the Yampa (lower 10 miles) and upper Green Rivers from 1968 to 1970. Holden and Crist (1981) collected one bonytail in the lower Yampa River in 1979, and Service biologists captured one suspected juvenile in 1987. Preliminary results of a radio-tracking study of adult bonytail introduced into the upper Green River in 1988 and 1989 indicate

that the fish exhibit crepuscular movements and are somewhat quiescent during the day and night (S. Cranney, Utah Division of Wildlife Resources, pers. comm.).

Spawning

Bonytail spawning locations are unknown. Vanicek and Kramer (1969) believed spawning occurred in the Green River between mid-June and early July when water temperatures were near 18 °C. Similar to humpback chub, the optimum temperature for hatching success was reported at 20-21 °C (Hamman 1982b and 1985). Hatching success decreased considerably when temperatures varied ±10 °C. When temperatures are near optimum (20-21 °C) hatching occurs in 4-7 days (Hamman 1982b).

Larval and Juvenile

Little data exist on larval and juvenile bonytail in the wild because of their extreme rarity. Vanicek and Kramer (1969) reported mean total lengths of 55, 100, and 158 mm for age-1 through age-3 bonytail from the Green River. Still, like most larval fish, it is presumed that their survival and growth are dependent on low velocity habitats.

Bonytail drastically declined in the Echo Park area, presumably due to flow and temperature changes resulting from closure of Flaming Gorge Dam. A similar pattern was noted in the Colorado River downstream from Glen Canyon Dam (Utah State Department of Fish and Game 1964 and 1969). Although the preimpoundment poisoning of riverine habitat in the upper Green River in 1962 contributed to the decline of the bonytail in that system, fish collections in Dinosaur before and after the poisoning (Binns et al. 1963; Vanicek and Kramer 1969; Vanicek et al. 1970) suggested that the downstream extent of the poison was not the only factor in the dramatic decline of the species from the Echo Park area. Decreased temperatures and changing flow patterns caused by the construction and operation of Flaming Gorge Dam permanently altered the physical environment, and bonytail habitats may have been lost. Thus, Flaming Gorge Dam operations also could affect the future of bonytail reintroductions and recovery efforts in the Green River system.

Critical Habitat

Critical habitat has been designated within the bonytail's historical range in the following sections of the Upper Basin (59 F.R. 13374).

> Colorado, Moffat County. The Yampa River from the boundary of Dinosaur National Monument in T. 6 N., R. 99 W., section 27 (6th Principal Meridian) to the confluence with the Green River in T. 7 N., R. 103 W., section 28 (6th Principal Meridian).
>
> Utah, Uintah County; and Colorado, Moffat County. The Green River from the confluence with the Yampa River in T. 7 N., R. 103 W., section 28 (6th Principal Meridian) to the boundary of Dinosaur National Monument in T. 6 N., R. 24 E., section 30 (Salt Lake Meridian).

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

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

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

RAZORBACK SUCKER

General Status

Historically, razorback suckers were abundant throughout the Colorado River Basin, primarily in the main stem and the major tributaries from Wyoming to Mexico. At present, the largest concentrations occur in the Green River in the Upper Basin and Lake Mohave in the Lower Basin. Fish in reproductive condition also were captured in the Yampa, Colorado, and San Juan Rivers, which suggests the importance of these river systems. Although reproduction in the wild was documented, larvae were seldom captured and may not survive past 20 mm in size. The lack of recruitment places this species in a precarious situation. Because of its recent listing, there is no formal recovery goal for the razorback sucker. However, the immediate goal is to prevent their extinction in the wild.

Adults

In the Upper Basin, adult razorback suckers were captured predominantly from the upper Green River (mile 176-345) and in the lower 13 miles of the Yampa River (Azevedo 1962; Vanicek et al. 1970; Holden and Stalnaker 1975; Seethaler et al. 1979; McAda and Wydoski 1980; Miller et al. 1982a; Tyus et al. 1982b; Tyus 1987; Tyus and Karp 1990). Catch-effort estimates suggest that adult razorback suckers are rarer than other native suckers and the endangered Colorado squawfish.

Radio-tagged razorback suckers overwintered in the Jensen, Island Park, and Echo Park reaches of the Green River (McAda and Wydoski 1980; Valdez and Masslich 1989). In winter, razorback suckers used slow runs, slackwaters, eddies, and backwaters in the Green River, where local movements increased with flow fluctuation (Valdez and Masslich 1989).

Razorback suckers in breeding condition were captured primarily on several cobble/gravel/sand bars in the lower Yampa and upper Green Rivers (including Echo Park and the reach from Ashley Creek to near the lower boundary of Dinosaur) but also were collected in flooded shorelines, bottomlands, and tributary mouths (including Old Charley Wash, lower Ashley Creek and Duchesne River, and Stewart Lake Drain (Tyus and Karp 1990)). From 1987 to 1989 (low and moderate water years), most ripe fish (98 percent) were collected in

riffle areas, but during the high water of 1986, 30 percent of all ripe or tuberculate razorback suckers were captured in flooded river bottoms of Old Charley Wash and Stewart Lake Drain. Twelve ripe adults were observed in Old Charley Wash in late May-early June 1986 at flows of about 19,000-20,000 cfs (Tyus and Karp 1990).

Migration

Razorback suckers exhibited both local and long-distance spring and summer movements (Tyus 1987; Tyus and Karp 1990). Two spawning migrations were detected with fish movement between lower Yampa and upper Green Rivers and movement between upper Green River and Ouray area (Old Charley Wash and lower Duchesne River (Tyus and Karp 1990)).

Spawning

Spawning of razorback suckers occurred during ascending and highest spring peak flows, as indicated by capture of ripe fish (Tyus and Karp 1989 and 1990). Ripe fish were captured in main channel habitats at water temperatures of about 14-15 °C (Tyus 1987; Tyus and Karp 1990). However, temperatures averaged 19.6 °C (range 17.5-21 °C) in flooded areas (Old Charley Wash and Stewart Lake Drain) in spring 1986 when ripe razorback suckers were present. Main channel temperatures were colder (mean 15.6 °C, range 15-16.5 °C) at this time, which suggests that razorback suckers may seek warmer habitats in the spring. Bulkley and Pimentel (1983) reported that razorback suckers preferred temperatures of about 22-25 °C and avoided temperatures of 8-15 °C. Razorback sucker eggs taken in the Green River experienced poor hatching at 11 °C due to fungus, but hatching was successful (80 percent or more) when incubated at 20 °C (U.S. Fish and Wildlife Service, unpublished data). Marsh (1985) noted optimal hatch in razorback sucker larvae incubated at 20 °C, but historic water temperatures in the upper Green River at Jensen did not average 20 °C until June-July (Smith and Green 1991). Thus, required spawning and incubation temperatures of razorback sucker are not well understood and continue to be studied.

Larval and Juvenile

The capture and artificial spawning of ripe razorback suckers in the lower Yampa and upper Green Rivers (Severson et al. 1990) and the tentative identification of larvae in upper Green River seine collections (R.T. Muth and D. Snyder, pers. comm.) suggest that razorback suckers reproduce successfully, but there is little recruitment there or elsewhere in the Colorado River Basin (Holden 1978; McAda and Wydoski 1980; Minckley 1983; Tyus 1987; Marsh and Minckley 1989; Tyus and Karp 1990). The existing standing crops of razorback sucker in the Green River are presumably old fish (Tyus, pers. comm.) that were spawned in the mid-1960's.

The apparent lack of widespread recruitment in the razorback sucker was attributed to habitat alteration, such as lower water temperatures (Marsh 1985) and predation by introduced common carp (*Cyprinus carpio*), green sunfish, channel catfish, flathead catfish (*Pylodictus olivaris*), and other

nonnative fish (Minckley 1983; Brooks et al. 1985; Tyus 1987; Marsh and Langhorst 1988; Marsh and Minckley 1989). Predation by nonnative fish is believed to be a serious threat to the survival and recovery efforts of the razorback sucker. The absence of young fish in the Green River basin population also may be linked with the reduced availability of inundated shorelines due to curtailment of spring flooding. Naturally inundated lowlands, such as Old Charley Wash and the Stewart Lake area, that were readily accessible to razorback suckers in the spring are now less accessible due to blockage and low water levels following closure of Flaming Gorge Dam.

Habitat requirements of this species in riverine environments are not well known because of the scarcity of extant populations (Minckley 1983; Lanigan and Tyus 1989) and the absence of younger life history stages (McCarthy and Minckley 1987; Tyus 1987). Adult razorback suckers in the Green River basin are old individuals (Tyus 1987), and the low number of reproducing razorback suckers is considered limiting (Lanigan and Tyus 1989; Tyus and Karp 1990). Nonnative fish, high spring flows, warming river temperatures, and inundated shorelines and bottomlands all appear as factors that influence successful reproduction and recruitment in the razorback sucker.

Critical Habitat

Critical habitat has been designated within the 100-year floodplain of the razorback sucker's historical range in the following sections of the Upper Basin (59 F.R. 13374).

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

Utah, Uintah County; and Colorado, Moffat County. The Green River and its 100-year floodplain from the confluence with the Yampa River in T. 7 N., R. 103 W., section 28 (6th Principal Meridian) to Sand Wash at river mile 96 in T. 11 S., R. 18 E., section 20 (6th Principal Meridian).

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

Utah, Uintah County. The White River and its 100-year floodplain from the boundary of the Uintah and Ouray Indian Reservation at river mile 18 in T. 9 S., R. 22 E., section 21 (Salt Lake Meridian) to the confluence with the Green River in T. 9 S., R 20 E., section 4 (Salt Lake Meridian).

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

Colorado, Delta and Mesa Counties. The Gunnison River and its 100-year floodplain from the confluence with the Uncompahgre River in T. 15 S., R. 96 W., section 11 (6th Principal Meridian) to Redlands Diversion Dam in T. 1 S., R. 1 W., section 27 (Ute Meridian).

Colorado, Mesa and Garfield Counties. The Colorado River and its 100-year floodplain from Colorado River Bridge at exit 90 north off Interstate 70 in T. 6 S., R. 93 W., section 16 (6th Principal Meridian) to Westwater Canyon in T. 20 S., R. 25 E., section 12 (Salt Lake Meridian) including the Gunnison River and its 100-year floodplain from the Redlands Diversion Dam in T. 1 S., R. 1 W., section 27 (Ute Meridian) to the confluence with the Colorado River in T. 1 S., R. 1 W., section 22 (Ute Meridian).

Utah, Grand, San Juan, Wayne, and Garfield Counties. The Colorado River and its 100-year floodplain from Westwater Canyon in T. 20 S., R. 25 E., section 12 (Salt Lake Meridian) to full pool elevation, upstream of North Wash, and including the Dirty Devil arm of Lake Powell in T. 33 S., R. 14 E., section 29 (Salt Lake Meridian).

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

REASONABLE AND PRUDENT ALTERNATIVES

On January 21-22, 1988, the Secretary of the Interior; the Governors of Wyoming, Colorado, and Utah; and the Administrator of the Western Area Power Administration were cosigners of a Cooperative Agreement to implement the Recovery Program (U.S. Fish and Wildlife Service 1987). An objective of the Recovery Program was to identify reasonable and prudent alternatives that would ensure the survival and recovery of the listed species while providing for new water development in the Upper Basin.

The following excerpts are pertinent to the consultation because they summarize portions of the Recovery Program that address depletion impacts, section 7 consultation, and project proponent responsibilities:

> "All future Section 7 consultations completed after approval and implementation of this program (establishment of the Implementation Committee, provision of congressional funding, and initiation of the elements) will result in a one-time contribution to be paid to the Service by water project proponents

> in the amount of $10.00 per acre-foot based on the average annual depletion of the project . . . . This figure will be adjusted annually for inflation [the current figure is $12.34 per acre-foot] . . . . Concurrently with the completion of the Federal action which initiated the consultation, e.g., . . . issuance of a 404 permit, 10 percent of the total contribution will be provided. The balance . . . will be . . . due at the time the construction commences . . . ."

It is important to note that these provisions of the Recovery Program were based on appropriate legal protection of the instream flow needs of the endangered Colorado River fishes. The Recovery Program further states:

> ". . . it is necessary to protect and manage sufficient habitat to support self-sustaining populations of these species. One way to accomplish this is to provide long term protection of the habitat by acquiring or appropriating water rights to ensure instream flows . . . . Since this program sets in place a mechanism and a commitment to assure that the instream flows are protected under State law, <u>the Service will consider these elements under Section 7 consultation as offsetting project depletion impacts</u>."

Thus, the Service has determined that project depletion impacts, which the Service has consistently maintained are likely to jeopardize the listed fishes, can be offset by (a) the water project proponent's one-time contribution to the Recovery Program in the amount of $12.34 per acre-foot of the project's average annual depletion, (b) appropriate legal protection of instream flows pursuant to State law, and (c) accomplishment of activities necessary to recover the endangered fishes as specified under the Recovery Implementation Program Recovery Action Plan (Plan). The Service believes it is essential that protection of instream flows proceed expeditiously, before significant additional water depletions occur.

With respect to (a) above (i.e., depletion charge), the applicant will make a one-time payment which has been calculated by multiplying the project's average annual depletion (<u>to be determined</u>) by the depletion charge in effect at the time payment is made. For Fiscal Year 1994 (October 1, 1993, to September 30, 1994), the depletion charge is $12.34 per acre-foot for the average annual depletion which equals a total payment of (<u>to be determined</u>) for this project. This amount will be adjusted annually for inflation on October 1 of each year based on the previous year's Composite Consumer Price Index. The Service will notify the applicant of any change in the depletion charge by September 1 of each year. Ten percent of the total contribution (<u>to be determined</u>), or total payment, will be provided to the Service's designated agent, the <u>National Fish and Wildlife Foundation</u> (Foundation) at the time of issuance of the Federal approvals from the Forest Service. The balance will be due at the time the construction commences. The payment will be included by the Forest Service as a permit stipulation. The amount payable will be adjusted annually for inflation on October 1 of each year based on the

Composite Consumer Price Index. Fifty percent of the funds will be used for acquisition of water rights to meet the instream flow needs of the endangered fishes (unless otherwise recommended by the Implementation Committee); the balance will be used to support other recovery activities for the Colorado River endangered fishes. All payments should be made to the Foundation.

National Fish and Wildlife Foundation
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Each payment is to be accompanied by a cover letter that identifies the project and biological opinion that requires the payment, the amount of payment enclosed, check number, and any special conditions identified in the biological opinion relative to disbursement or use of the funds (there are none in this instance). The cover letter also shall identify the name and address of the payor, the name and address of the Federal Agency responsible for authorizing the project, and the address of the Service office issuing the biological opinion. This information will be used by the Foundation to notify the payor, the lead Federal Agency, and the Service that payment has been received. The Foundation is to send notices of receipt to these entities within 5 working days of its receipt of payment. The Forest Service will track the yearly amount of water depletions made during each fiscal year covered by this consultation and will provide an annual report to the Service by December 31 of each year.

In order to further define and clarify processes outlined in sections 4.1.5, 4.1.6, and 5.3.4 of the Recovery Program, an additional section 7 agreement and Plan addressing section 7 consultation on depletion impacts was developed (U.S. Fish and Wildlife Service 1993). The section 7 agreement establishes a framework for conducting all future section 7 consultations on depletion impacts related to new projects and those associated with historic projects in the Upper Basin. Procedures outlined in the section 7 agreement will be used in conjunction with the Plan to determine if sufficient progress is being accomplished in the recovery of the endangered fishes to enable the Recovery Program to serve as a reasonable and prudent alternative to avoid jeopardy. The Plan was finalized on October 15, 1993, and will be reviewed annually.

In accordance with the agreement, the Service has agreed to assess impacts of projects that require section 7 consultation and determine if progress toward recovery has been sufficient for the Recovery Program to serve as a reasonable and prudent alternative. If sufficient progress is being achieved, biological opinions will be written to identify activities and accomplishments of the Recovery Program that support it as a reasonable and prudent alternative. If sufficient progress in the recovery of the endangered fishes has not been achieved by the Recovery Program, actions from the Plan will be identified which must be completed to avoid jeopardy to the endangered fishes. For historic projects, these actions will serve as the reasonable and prudent alternative as long as they are completed according to the schedule identified in the Plan. For new projects, these actions will serve as the reasonable and prudent alternative so long as they are completed before the impact of the project occurs. It is anticipated that the projects permitted under this consultation will be new.

The evaluation by the Service to determine if sufficient progress has been achieved considered (a) actions which result in a measurable population response, a measurable improvement in habitat for the fishes, legal protection of flows needed for recovery, or a reduction in the threat of immediate extinction; (b) status of fish populations; (c) adequacy of flows; and (d) magnitude of the project impact. In addition, the Service considered support activities (funding, research, information and education, etc.) of the Recovery Program if they help achieve a measurable population response, a measurable improvement in habitat for the fishes, legal protection of flows needed for recovery, or a reduction in the threat of immediate extinction. The Service evaluated progress separately for the Colorado River and Green River subbasins; however, it gave due consideration to progress throughout the Upper Basin in evaluating progress toward recovery.

Based on current Recovery Program accomplishments (Appendix A) and the expectation that the Plan will be fully implemented in a timely manner, the Service determined that sufficient progress has been achieved under the Recovery Program so that it could serve as the reasonable and prudent alternative to avoid jeopardy to the endangered fishes by the impacts caused by these projects. For historic projects, the responsibility for implementation of all elements of the reasonable and prudent alternative rests with the Recovery Program participants, not the individual project proponent. For new projects, the responsibility for implementation of elements of the reasonable and prudent alternative is shared by the Recovery Program and the applicant. Recovery Program participants are responsible for carrying out activities outlined in the Plan.

The Forest Service should condition the permits to retain jurisdiction in the event that the Recovery Program is unable to implement the Plan in a timely manner. In that case, as long as the lead Federal Agency has discretionary authority over the project, reinitiation of section 7 consultation may be required so that a new reasonable and prudent alternative can be developed by the Service.

INCIDENTAL TAKE

Section 9 of the Endangered Species Act, as amended, prohibits any taking (harass, harm, pursue, hunt, shoot, wound, kill, trap, capture or collect, or attempt to engage in any such conduct) of listed species without a special exemption. Under the terms of section 7(b)(4) and section 7(0)(2), taking that is incidental to and not intended as part of the agency action is not considered taking within the bounds of the Endangered Species Act, provided that such taking is in compliance with the incidental take statement.

CONCLUSION

This concludes the Service's biological opinion on the impacts of the proposed projects. This opinion was based upon the information described herein. If new information becomes available, new species listed, or should there be any changes in the total annual amount of water depleted by this project (1.37 acre-feet) over a 2-year period, or any other change which alters the operation of the projects from that which is described in your

correspondence and which may affect any endangered or threatened species in a manner or to an extent not considered in this biological opinion (see 50 CFR 402.16), formal section 7 consultation should be reinitiated.

Thank you for your cooperation in the formulation of this biological opinion and your interest in conserving endangered species.

Sincerely,

ROBERT D. JACOBSEN
ACTING Regional Director

REFERENCES

Archer, D.L., and H.M. Tyus. 1984. Colorado squawfish spawning study, Yampa River. U.S. Fish and Wildlife Service, Salt Lake City, Utah. 32 pp.

Azevedo, R.L. 1962. Dinosaur National Monument-Green River fish collections. Fishery management report. U.S. Fish and Wildlife Service, Albuquerque, New Mexico. 41 pp.

Beamesderfer, R.C., and J.L. Congleton. 1981. Spawning behavior, habitat selection and early life history of northern squawfish with inferences to Colorado squawfish. Pages 47-127 in Colorado River Fishery Project, Part 3, Final Report. U.S. Fish and Wildlife Service and Bureau of Reclamation, Salt Lake City, Utah.

Behnke, R.J., and D.E. Benson. 1983. Endangered and threatened fishes of the upper Colorado River basin. Cooperative Extension Service, Colorado State University, Fort Collins. Bulletin 503A. 38 pp.

Berry, C.R., Jr. 1988. Effects of cold shock on Colorado squawfish larvae. Southwestern Naturalist 33:193-197.

Binns, N.A., F. Eiserman, F.W. Jackson, A.F. Regenthal, and R. Stone. 1963. The planning, operation, and analysis of the Green River rehabilitation project. Utah State Department of Fish and Game and Wyoming Game Fish Department, Salt Lake City and Cheyenne. 83 pp.

Brooks, J.E., P.C. Marsh, and W.L. Minckley. 1985. Reintroduction and monitoring of razorback sucker in the lower Colorado River basin. Proceedings Western Division, American Fisheries Society 65:203.

Bulkley, R.V., and R. Pimentel. 1983. Temperature preference and avoidance by adult razorback suckers. Transactions of the American Fisheries Society 112:601-607.

Burns, J.W. 1966. Sacramento squawfish. Pages 525-527 in A. Calhoun, ed. Inland Fisheries Management. State of California, Department of Fish and Game.

Erman, D.C., and G.R. Leidy. 1975. Downstream movements of rainbow trout fry in a tributary of Sagehen Creek, under permanent and intermittent flow. Transactions of the American Fisheries Society 104:467-473.

Grabowski, S.J., and S.D. Hiebert. 1989. Some aspects of trophic interactions in selected backwaters and the main channel of the Green River, Utah. 1987-1988. Final Report. Bureau of Reclamation, Denver, Colorado.

Haines, G.B., and H.M. Tyus. 1990. Fish associations and environmental variables in age-0 Colorado squawfish habitats, Green River, Utah. Journal of Freshwater Ecology 5:427-436.

Hamman, R.L. 1981. Spawning and culture of Colorado squawfish in raceways. Progressive Fish Culturist 43:173-177.

Hamman, R.L. 1982a. Culture of endangered Colorado River Fishes, sections I-V. In W. Miller et al., eds. Colorado River Fishery Project, Part 3, Final Report. U.S. Bureau of Reclamation, Salt Lake City, Utah.

Hamman, R.L. 1982b. Report number 3, Culture of endangered Colorado River fishes: Section V; Induced spawning and culture of bonytail chub. U.S. Fish and Wildlife Service, Willow Beach National Fish Hatchery, Boulder City, Nevada. 8 pp.

Hamman, R.L. 1985. Induced spawning and culture of hatchery reared bonytail. Progressive Fish Culturist 47:239-241.

Haynes, C.M., T.A. Lytle, E.J. Wick, and R.T. Muth. 1984. Larval Colorado squawfish (Ptychocheilus lucius Girard) in the upper Colorado River basin, Colorado, 1979-1981. Southwestern Naturalist 29:21-33.

Haynes, C.M., R.T. Muth, and T.P. Nesler. 1985. Identification of habitat requirements and limiting factors for Colorado squawfish and humpback chub. Final Report, Federal Aid in Fish and Wildlife Restoration, Project SE-3-4. Colorado Division of Wildlife, Denver. 62 pp.

Holden, P.B. 1978. A study of the habitat use and movement of the rare fishes in the Green River, Utah. Transactions of the Bonneville Chapter, American Fisheries Society 1978:64-90.

Holden, P.B., and C.B. Stalnaker. 1975. Distribution of fishes in the Dolores and Yampa River systems of the Upper Colorado Basin. Southwestern Naturalist 19:403-412.

Holden, P.B., and L. Crist. 1981. Documentation of changes in the macroinvertebrate and fish populations in the Green River due to inlet modification of Flaming Gorge Dam. Contract No. 0-07-40-S1357, Water and Power Resources Service, U.S. Fish and Wildlife Service, Salt Lake City, Utah.

Jacobi, G., and M. Jacobi. 1982. Fish stomach content analysis. Pages 285-324 in Colorado River Fishery Project, Part 3, Final Report. U.S. Fish and Wildlife Service and Bureau of Reclamation, Salt Lake City, Utah.

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

Kaeding, L.R., and M.A. Zimmerman. 1983. Life history of the humpback chub in the Little Colorado and Colorado rivers of the Grand Canyon. Transactions of the American Fisheries Society 112:577-594.

Karp, C.A., and H.M. Tyus. 1990a. Humpback chub (Gila cypha) in the Yampa and Green Rivers, Dinosaur National Monument, with observations on roundtail chub (G. robusta) and other sympatric fishes. Great Basin Naturalist 50:257-264.

Karp, C.A., and H.M. Tyus. 1990b. Behavioral interactions between young Colorado squawfish and six fish species. Copeia 1990:25-34.

Lanigan, S.H., and H.M. Tyus. 1989. Population size and status of razorback sucker in the Green River basin, Utah and Colorado. North American Journal of Fisheries Management 9:68-73.

Marsh, P.C. 1985. Effect of incubation temperature on survival of embryos of native Colorado River fishes. Southwestern Naturalist 30:129-140.

Marsh, P.C., and D.R. Langhorst. 1988. Feeding and fate of wild larval razorback sucker. Environmental Biology of Fishes 21:59-67.

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

Martinez, P.J. 1986. White River Taylor Draw Project. Pre- and Post-impoundment Fish Community Investigations. Final Report. Colorado Division of Wildlife. 121 pp.

McAda, C.W. 1983. Colorado squawfish, Ptychocheilus lucius (Cyprinidae), with a channel catfish, Ictalurus punctatus (Ictaluridae), lodged in its throat. Southwestern Naturalist 28:119-120.

McAda, C.W., and H.M. Tyus. 1984. Resource overlap of Age-0 Colorado squawfish with other fish species in the Green River, 1980. Proceedings of the Bonneville Chapter, American Fisheries Society 1984:44-54.

McAda, C.W., and R.S. Wydoski. 1980. The razorback sucker, Xyrauchen texanus, in the Upper Colorado River Basin, 1974-76. U.S. Fish and Wildlife Service Technical Paper 99. 15 pp.

McCarthy, M.S., and W.L. Minckley. 1987. Age estimation for razorback sucker from Lake Mohave, Arizona, and Nevada. Journal of Arizona-Nevada Academy Sciences 21:87-97.

Miller, W.H., D.L. Archer, H.M. Tyus, and R.M. McNatt. 1982a. Yampa River fishes study, Final Report. U.S. Fish Wildlife Service and National Park Service Cooperative Agreement 14-16-0006-81-931 (1A), Salt Lake City, Utah. 107 pp.

Miller, W.H., D.L. Archer, H.M. Tyus, and K.C. Harper. 1982b. White River fishes study, Final Report. U.S. Fish and Wildlife Service, Salt Lake City, Utah. 58 pp.

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

Minckley, W.L. 1973. Fishes of Arizona. Arizona Game and Fish Department. Phoenix. 293 pp.

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

Minckley, W.L., and G.K. Meffe. 1987. Differential selection by flooding in stream fish communities of the arid American southwest. Pages 93-104 in W.J. Matthews and D.C. Heins, eds. Community and Evolutionary Ecology of North American Stream Fishes. University of Oklahoma Press, Norman.

Nesler, T.P., R.T. Muth, and A.F. Wasowicz. 1988. Evidence for baseline flow spikes as spawning cues for Colorado squawfish in the Yampa River, Colorado. American Fisheries Society Symposium 5:68-79.

Patten, B.G., and D.T. Rodman. 1969. Reproductive behavior of northern squawfish (Ptychocheilus oregonensis). Transactions of the American Fisheries Society 98:108-111.

Paulin, K.M., H.M. Tyus, and C.M. Williams. 1990. Response of young Colorado squawfish and razorback suckers to water flow and light intensity. Unpublished report. U.S. Fish and Wildlife Service, Vernal, UT.

Pimentel, R., R.V. Bulkley, and H.M. Tyus. 1985. Choking of Colorado squawfish, Ptychocheilus lucius (Cyprinidae), on channel catfish, Ictalurus punctatus (Ictaluridae), as a cause of mortality. Southwestern Naturalist 30:154-158.

Pucherelli, M.J., and R.C. Clark. 1989. Comprehensive Report (1986-1988) on the Effects of Green River Flows on Backwater Habitat Availability as Determined by Remote Sensing Techniques. U.S Bureau of Reclamation, Engineering and Research Center, Denver, Colorado.

Rosenfeld, M.J., and J.A. Wilkinson. 1989. Biochemical genetics of the Colorado River Gila complex (Pisces: Cyprinidae). Southwestern Naturalist 34:232-244.

Seethaler, K.H., C.W. McAda, and R.S. Wydoski. 1979. Endangered and threatened fish in the Yampa and Green rivers of Dinosaur National Monument. Proceedings of the first conference on scientific research in the national parks. Vol. 1. National Park Service Transactions and Proceeding Series (5):605-612.

Severson, S.H., C.A. Karp, H.M. Tyus, and G.B. Haines. 1990. Rearing of razorback suckers at Ouray, Utah. Proceedings of the Bonneville Chapter, American Fisheries Society. In press.

Smith, G.R. 1960. Annotated list of fishes of the Flaming Gorge Reservoir Basin, 1959. Pages 163-168 in A.M. Woodbury, ed. Ecological studies of the flora and fauna of Flaming Gorge Reservoir basin, Utah and Wyoming. Anthropological Papers 48, University of Utah Press, Salt Lake City.

Smith, G.R., and R.G. Green. 1991. Flaming Gorge consolidated hydrology report. U.S. Fish and Wildlife Service, Division of Water Resources, Denver, Colorado.

Thompson, J.M. 1989. The role of size, condition, and lipid content in the overwinter survival of age-0 Colorado squawfish. M.S. Thesis, Colorado State University, Fort Collins. 82 pp.

Tyus, H.M. 1984. Loss of stream passage as a factor in the decline of the endangered Colorado squawfish. Pages 138-144 in Issues and technology in the management of impacted Western Wildlife. Proceedings of a National Symposium. Thorne Ecological Institute Technical Publication 14. Boulder, Colorado.

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

Tyus, H.M. 1986. Life strategies in the evolution of the Colorado squawfish (Ptychocheilus lucius). Great Basin Naturalist 46:656-661.

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

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

Tyus, H.M. 1991a. Ecology and management of Colorado squawfish. Pages 329-402 (Chapter 19) in Minckley, W.L., and J.E. Deacon, eds. Battle against extinction: native fish management in the American West. University of Arizona Press, Tucson.

Tyus, H.M. 1991b. Movements and habitat use of young Colorado squawfish in the Green River, Utah. Journal of Freshwater Ecology 6:43-51.

Tyus, H.M., and J. Beard. 1990. Esox lucius (Esocidae) and Stizostedion vitreum (percidae) in the Green River basin, Colorado and Utah. Great Basin Naturalist 50:33-39.

Tyus, H.M., and G.B. Haines. 1991. Distribution, habitat use, and growth of age-0 Colorado squawfish in the Green River basin, Colorado and Utah. Transactions of the America Fisheries Society 120:79-89.

Tyus, H.M., and C.A. Karp. 1989. Habitat use and streamflow needs of rare and endangered fishes, Yampa River, Colorado. U.S. Fish and Wildlife Service, Biological Report 89(14). 27 pp.

Tyus, H.M., and C.A. Karp. 1990. Spawning and movements of razorback sucker, Xyrauchen texanus, in the Green River basin of Colorado and Utah. Southwestern Naturalist 35:427-433.

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

Tyus, H.M., and W.L. Minckley. 1988. Migrating Mormon crickets, Anabrus simplex (Orthoptera: Tettigoniidae), as food for stream fishes. Great Basin Naturalist 48:25-30.

Tyus, H.M., B.D. Burdick, R.A. Valdez, C.M. Haynes, T.A. Lytle, and C.R. Berry. 1982a. Fishes of the Upper Colorado River Basin: Distribution, abundance and status. Pages 12-70 in W.H. Miller, H.M. Tyus, and C.A. Carlson, eds. Fishes of the Upper Colorado River System: Present and future. American Fisheries Society, Bethesda, Maryland. 131 pp.

Tyus, H.M., C.W. McAda, and B.D. Burdick. 1982b. Green River Fishery Investigations: 1979-1981. Pages 1-99 in Colorado River Fishery Project, Part 2, Final Report. U.S. Fish and Wildlife Service and Bureau of Reclamation, Salt Lake City, Utah.

Tyus, H M., B.D. Burdick, and C.W. McAda. 1984. Use of radiotelemetry for obtaining habitat preference data on Colorado squawfish. North American Journal of Fisheries Management 4:177-180.

Tyus, H.M., R.L. Jones, and L.M. Trinca. 1987. Green River rare and endangered fish studies, 1982-1985. Final Report. Colorado River Fishes Monitoring Project, U.S. Fish and Wildlife Service, Vernal, Utah. 117 pp.

U.S. Fish and Wildlife Service. 1987. Recovery Implementation Program for Endangered Fish Species in the Upper Colorado River Basin. U.S. Fish and Wildlife Service, Denver, Colorado. 82 pp.

U.S. Fish and Wildlife Service. 1990a. Humpback Chub Recovery Plan. U.S. Fish and Wildlife Service, Denver, Colorado. 43 pp.

U.S. Fish and Wildlife Service. 1990b. Bonytail Chub Recovery Plan. U.S. Fish and Wildlife Service, Denver, Colorado. 35 pp.

U.S. Fish and Wildlife Service. 1991. Colorado Squawfish Recovery Plan. U.S. Fish and Wildlife Service, Denver, Colorado. 56 pp.

U.S. Fish and Wildlife Service. 1993. Section 7 Consultation, Sufficient Progress, and Historic Projects Agreement and Recovery Action Plan, Recovery Implementation Program for Endangered Fish Species in the Upper Colorado River Basin. U.S. Fish and Wildlife Service, Denver, Colorado. 50 pp.

Utah State Department of Fish and Game. 1964. Reservoir fisheries investigation: Glen Canyon unit, Upper Colorado River Storage Project. Annual Progress Report 1. Utah State Department of Fish and Game, Salt Lake City. 30 pp.

Utah State Department of Fish and Game. 1969. Glen Canyon reservoir postimpoundment investigation. Annual Progress Report 6. Utah State Department of Fish and Game, Salt Lake City. 16 pp.

Valdez, R.A., and G.H. Clemmer. 1982. Life history and prospects for recovery of the humpback chub and bonytail chub. Pages 109-119 in W.H. Miller, H.M. Tyus, and C.A. Carlson, eds. Fishes of the Upper Colorado River system: Present and Future. American Fisheries Society, Bethesda, Maryland.

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

Vanicek, C.D. 1967. Ecological studies of native Green River fishes below Flaming Gorge Dam, 1964-1966. Ph.D. Thesis, Utah State University, Logan. 125 pp.

Vanicek, C.D., and R.H. Kramer. 1969. Life history of the Colorado squawfish, Ptychocheilus lucius, and the Colorado chub, Gila robusta, in the Green River in Dinosaur National Monument 1964-1966. Transactions of the American Fisheries Society 98:193-208.

Vanicek, C.D., R.H. Kramer, and D.R. Franklin. 1970. Distribution of Green River fishes in Utah and Colorado following closure of Flaming Gorge Dam. Southwestern Naturalist 14:297-315.

Wick, E.J., and J.A. Hawkins. 1989. Colorado squawfish winter habitat study, Yampa River, Colorado, 1986-1988. Contribution 43, Larval Fish Laboratory, Colorado State University, Fort Collins. 96 pp.

Wick, E.J., D.L. Stoneburner, and J.A. Hawkins. 1983. Observations on the ecology of the Colorado squawfish (Ptychocheilus lucius) in the Yampa River. Report Number 83-7, Colorado Water Resources Field Support Laboratory. National Park Service, Fort Collins. 55 pp.

Wick, E.J., J.A. Hawkins, and C.A. Carlson. 1985. Colorado squawfish and humpback chub population and habitat monitoring, 1983-1984. Colorado Division of Wildlife, Denver. 48 pp.

APPENDIX A

ACTIVITIES AND ACCOMPLISHMENTS OF THE RECOVERY IMPLEMENTATION PROGRAM RELATED TO SECTION 7 CONSULTATIONS UPPER COLORADO RIVER BASIN MAY 1994

Background

The Fish and Wildlife Service (Service) will determine whether progress by the Recovery Implementation Program (Program) provides a reasonable and prudent alternative based on the following factors:

a. Actions which result in a measurable population response, a measurable improvement in habitat for the fishes, legal protection of flows needed for recovery, or a reduction in the threat of immediate extinction.

b. Status of fish populations.

c. Adequacy of flows.

d. Magnitude of the impact of projects.

The Service will assess the impacts of projects that require Section 7 consultations and determine if accomplishments under the Program are sufficient for it to serve as a reasonable and prudent alternative. Generally, sufficient progress will be evaluated separately for the Colorado and Green River Subbasins, although due consideration will be given to progress throughout the Upper Colorado River Basin.

Colorado River Subbasin Accomplishments

A. Accomplishments which result in a measurable population response, a measurable improvement of habitat, legal protection of flows, or a reduction in the threat of immediate extinction:

1. Execution of an agreement by the Bureau of Reclamation (Reclamation), Service, and Colorado Water Conservation Board to provide a permanent commitment of 10,000 acre-feet of Ruedi Reservoir releases to and through the 15-mile reach.

2. Establishment of refugia for the Colorado squawfish and razorback sucker from the Colorado River.

3. Agreement by Reclamation and the Colorado Water Conservation Board to provide an additional 10,000 acre-feet of water from Ruedi Reservoir on a year-to-year basis. The additional water has been/will be provided in 1991, 1992, 1993, and 1994. A longer term arrangement of water from the Ruedi Reservoir is being developed.

4. Reoperation of the Aspinall Unit to provide test flows and enhance endangered fish habitat conditions in the Gunnison and Colorado Rivers.

B. Status of fish populations:

	Colorado River	Gunnison River
Colorado squawfish	small; stable	small; declining
Humpback chub	healthy	N/A
Bonytail	extirpated	extirpated
Razorback sucker	small; declining	extirpated

C. Adequacy of flows:

1. Winter--adequate; legal protection yet to be provided.

2. Spring--duration and magnitude of peak spring flows is less than adequate; legal protection yet to be provided.

3. Summer-Fall--generally adequate with shortages in the 15-mile reach; legal protection partially provided.

Green River Subbasin Accomplishments

1. Actions which result in a measurable population response, a measurable improvement of habitat, legal protection of flows, or a reduction in the threat of immediate extinction:

   a. Reoperation of Flaming Gorge Project to enhance endangered fish habitat in the Green River pursuant to the biological opinion on the reoperation of the Flaming Gorge Project.

   b. Partial establishment of refugia for razorback sucker from the Green and Yampa Rivers.

2. Status of fish populations:

	Green	Yampa/Little Snake	White
Colorado squawfish	stable; possible increase	stable	stable
Humpback chub	small/stable ?	small/stable ?	N/A
Bonytail	extirpated	extirpated	N/A
Razorback sucker	small/declining	small/declining	very rare/ declining

3. Adequacy of flows:

   a. Service flow recommendations being implemented pursuant to Flaming Gorge biological opinion; legal protection yet to be provided.

   b. Yampa River/Little Snake River--current flows adequate with some localized shortages in late summer and early fall; legal protection yet to be provided.

   c. White River--current flows adequate; legal protection yet to be provided.

   d. Duschesne--flow requirement unknown.

Major Recovery Program Support Activities (Basinwide):

Support activities (funding, research, I and E, etc.) in the Program that contribute to sufficient progress to the extent they help achieve a measurable population response, a measurable improvement in habitat for the fishes, legal protection of flows needed for recovery, or a reduction in the threat of immediate extinction.

1. Signing of a cooperative agreement to implement the Recovery Program.

2. Resolutions supporting the Recovery Program made by water user groups in Utah, Colorado, Wyoming, and several major environmental groups.

3. Active participation by all cooperators in implementing the Recovery Program, including meeting all funding commitments and seeking funds from Congress necessary to implement the program.

4. The expenditure of $21.8 million from FY 89 to FY 94 to implement the Recovery Program work plans. These work plans have provided funding for numerous high priority recovery activities and studies related to the endangered Colorado River fishes.

5. Commitment by members of the Recovery Program to develop and implement in a timely manner the Recovery Implementation Program Recovery Action Plan, which will give priority consideration to implementing recovery actions which will result in significant protection and improvement of the endangered fish populations in their habitat.

6. Development of an enforcement agreement between the Service and the State of Colorado to protect instream flows acquired under the Recovery Program for the endangered fishes.

7. Finalization of a policy by the Colorado Water Conservation Board for protection of instream flow until uncertainty concerning habitat needs and compact development are resolved.