Southwestern Fishes and the Enigma of "Endangered Species"

Man's invasion of deserts creates problems for native animals, especially for freshwater fishes.

W. L. Minckley and James E. Deacon

Increasing public interest in man's pressure on the world's biota is evident from the number of agencies now actively involved in attempts to conserve what remains. These range from small, private conservation clubs to large established groups such as The Nature Conservancy and the International Union for the Conservation of Nature and Natural Resources. Activities of some organizations have been complemented by action on the part of some state and federal departments. For example, in January 1967 the Nevada Game and Fish Commission accepted responsibility for preserving the unique, endemic fishes of that state, and acted to protect habitats of a number of forms, and in December 1967 California initiated similar action (*1*). The U.S. Bureau of Sport Fisheries and Wildlife has defined rare and endangered species, and has begun to catalog them (*2*). A laboratory for studying and preserving such organisms is established at the Bureau's Patuxent Wildlife Center in Maryland.

Concern for natural environments has therefore spread from individuals through state, local, and federal governments, to become international in scope; with such a diversity of interest, it is not surprising that there are some problems. Emotion and lack of understanding often obscure the picture, and these factors, coupled with gross lack of basic biological information on many species, promote confusion and conflict. In this article we outline some of our ideas on the problem of "endangered species," discussing certain freshwater fishes of the Southwest as examples. We do not aspire to solve problems or smooth conflicts—perhaps we shall confuse the issues for some. If so, we hope the confusion leads to constructive inquiry.

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Kinds of Species

In considering "endangered species" one is immediately confronted with a need to understand, and to be able to explain, diverse abundances and degrees of dispersion. Except for domesticated animals, not considered here, the only objective definition of "endangered" must be one given in terms of an organism's ability to maintain its populations in nature. If the organism is to accomplish this, suitable habitat must be continuously available.

Recognizing some subjectivity and overlap, we divide organisms into four broad categories with respect to habitat needs:

1) Species having habitats produced by or changed by man, which have responded to man's influence by extending their range and abundance.

2) Organisms which have not responded to man's influence and which inhabit large geographic areas and are at present common.

3) Animals which require large, special habitats.

4) Species living in small, unique habitats as relicts or isolated endemics.

Category 1 is irrelevent to our discussion, except where introduced or invading forms are detrimental to indigenous species.

Category 2 likewise needs little discussion. This category includes animals, tolerant of environmental extremes, which occupy broad spectra of available habitats in their native ranges. Influences of man on animals of category 2 are fairly direct, and decreases in gross abundance (as opposed to decreases in number per unit area of suitable habitat) must already have occurred in most species. However, because of the wide ecological tolerances of these species, modifications of habitat must be extensive to extirpate them. Even if local decimation occurs, their broad, general distributions insure against extinction. There may in the future be cause for concern for animals of this category, but at present those of other categories bear far greater pressure.

Animals of category 3 are intimately dependent on some major feature or features of their environment. This dependence automatically places them in an untenable position if the feature they need is also needed by, or modified by, man. A familiar example is the American bison, which man actively eliminated in the natural state, converting its grasslands for agriculture and for grazing herds of domestic meat-producing animals. Bison now are essentially domesticated and are common, but for a few years they were certainly endangered. A number of other spectacular species are known, even by laymen, to be endangered. Large amounts of money and hundreds of hours of time are spent in perpetuating these forms, especially if they are of commercial, sporting, or esthetic importance.

Many fishes are included in category 3. In fresh waters, those kinds that depend on, or move through, large, strongly flowing rivers are especially noteworthy. No species of Pacific salmon (genus *Oncorhynchus*) is immediately endangered, yet certain runs of these fishes have declined or disappeared because of man-made obstruction of rivers or modifications of spawning grounds; such phenomena are well documented. Similar effects are known, but less well substantiated, in a number of "big-river" fishes of North America. More subtle, but perhaps even more important, are changes in the quality of water, induced by impoundment. Siltation behind dams, concomitant reductions in silt loads of rivers, increased penetration of light, changes in temperature relations—all contribute to form a new habitat, which elicits faunal change. The channelization of rivers often has opposite effects and modifies riparian habitats drastically (*3*). In the American Southwest, complete drying of streams or of riparian habitats may destroy whole faunas (*4*). In all instances, faunal shifts that occur must, definition, involve relative changes in abundance. Some species may be eliminated, others may be reduced in numbers, and some may be benefited.

Animals in category 4 are the easiest to define, simply because of the generally small, unique habitats in which they live. Such habitats often lack biological diversity. Minor changes may therefore effect major fluctuations in species abundance. Because of its isolation, an island is an especially likely site for such a catastrophe; indigenous organisms are few, and the system is ecologically unsaturated. Aggressive exotic species that travel with man have, when successfully established, a profound and usually detrimental influence. This was exemplified by the rapid destruction of a major part of the isolated avifauna on the Hawaiian Archipelago in the late 1800's and early 1900's (*5*). In most respects, desert springs are similarly isolated, insofar as many aquatic animals are concerned—often even more so than oceanic islands (*6*). Series of springs in desert regions form aquatic archipelagos that differ from their oceanic analogs in that they often contain organisms that are relicts of past ages, rather than organisms resulting from chance invasion and subsequent differentiation. The restricted and ecologically simplified nature of these habitats leaves them especially susceptible to faunal destruction, especially when the springs are located in areas of rapid population growth, where the demand for water exceeds the supply.

Status of Selected Fishes

Faunal depletion in aquatic habitats of the American Southwest is the simple rule. Much surface water is directly removed for use by man. Most of the remaining natural waters are highly modified, physicochemically or biologically. Because of these factors, big-river fishes (category 3) present a special, pressing problem in the region. Table 1 illustrates the gross changes that have occurred in the fish fauna of a major stream in Arizona, the Salt River, near its downstream end at Tempe (Fig. 1). Extirpation of a major part of the fauna between 1890 and 1926 is evident, corresponding to early modifications of the stream by Caucasian man and impoundment of Roosevelt Lake on the river in 1910. A chain of impoundments was then progressively created on the Salt River between Tempe and Roosevelt. The Verde River, a major confluent of the Salt, maintained some water in the channel at Tempe for a while. Bartlett Reservoir on the Verde was closed in 1939, however, and this, in combination with construction of another dam, resulted in almost total desiccation of the channel of the Salt River by the late 1950's (*7*). Only subsurface percolation of water, mostly from underflow of municipal waste waters, maintained isolated fish habitats along the nearly dry stream. Such habitats persist today. Introduced fishes became increasingly established after 1926, and extirpation of additional native fishes quickly followed.

All the species that occupied the Salt River at Tempe in 1890 exist today somewhere in the Colorado River basin. The variation in their success in maintaining populations is, however, great; some species remain abundant, others are reduced in number, and a few are on the verge of extinction. This variation illustrates some of the problems involved in the study and definition of "endangered species."

Two large species especially relevant

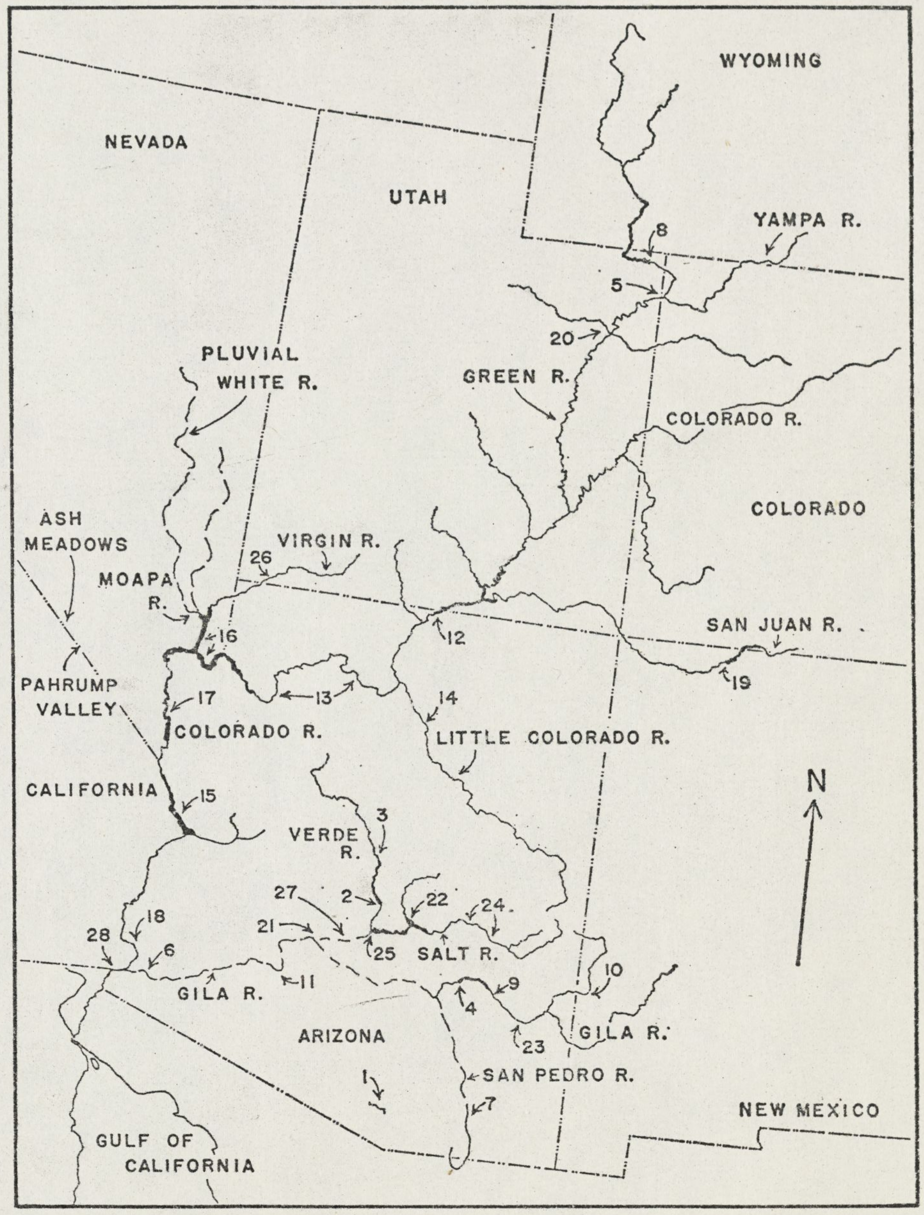

Fig. 1. Sketch map of the Colorado River basin, southwestern United States, showing rivers and localities mentioned in the text. (1) Arivaca Creek; (2) Bartlett Dam; (3) Camp Verde, Arizona; (4) Coolidge Dam; (5) Dinosaur National Monument; (6) Dome, Arizona; (7) Fairbank and Tombstone, Arizona; (8) Flaming Gorge Dam; (9) Ft. Thomas, Arizona; (10) Frisco Hot Spring; (11) Gila City (= Gila Bend), Arizona; (12) Glen Canyon Dam and Lee's Ferry, Arizona; (13) Grand Canyon; (14) Grand Falls; (15) Lake Havasu; (16) Lake Mead; (17) Lake Mojave; (18) Martinez Lake; (19) Navajo Dam; (20) Ouray, Utah; (21) Phoenix, Arizona; (22) Roosevelt Lake and Roosevelt, Arizona; (23) Safford, Arizona; (24) Salt River Canyon; (25) Saguaro Lake; (26) St. George, Utah; (27) Tempe, Arizona; (28) Yuma, Arizona.

to this discussion are the Colorado River squawfish, *Ptychocheilus lucius*, and the humpback sucker, *Xyrauchen texanus*. The status of these fishes above Grand Canyon, particularly in the Green River, has been outlined by Vanicek (*8*). Both species were effectively eliminated from about 250 miles (400 kilometers) of the mainstream and 250 miles of tributaries of the Green River above the Flaming Gorge Dam site by fish-control operations in 1962, some kill being observed downstream as far as Dinosaur National Monument (*9*). Neither species is now found above the dam, or in the 65-mile stretch of cold tail-waters between Flaming Gorge Dam and the mouth of the Yampa River in Dinosaur National Monument. Both squawfish and humpback sucker, however, are common in the Green River between Echo Park (Yampa River) and Ouray, Utah. Koster (*10*) reported adult squawfish (and possibly humpback suckers) from the San Juan River, in New Mexico, in 1959. He pointed out, however, that the segment of river from which the fish were obtained was soon to be flooded by the construction of Navajo Dam. Squawfish ran to the base of Grand Falls on the Little Colorado River in years past (*11*), but that area is now essentially dry. We have seen, or heard of, two adult or subadult squawfish taken from the Colorado River between Glen Canyon Dam and Lee's Ferry in the period 1962–66. No humpback suckers have been seen in that segment of the river, but one hybrid, *Xyrauchen texanus* × *Catostomus latipinnis*, was taken below Glen Canyon in 1966 [such hybrids have previously been reported by Hubbs and Miller (*12*)]. On the basis of these data and of a general account by Sigler and Miller (*13*), it appears that both squawfish and humpback suckers are persisting above, and in, Grand Canyon. We leave further documentation of their status in that area to others.

For the region below Grand Canyon our data are specific. Colorado River squawfish were abundant at Yuma in the early 1900's, and in the lower Gila River near Dome in 1920 (*4*). They persisted in the lower Colorado mainstream until the 1940's (*14*), but since 1950 they have become increasingly uncommon. We have heard of only two specimens from the lower Colorado in the period 1962–67.

In historic times, squawfish lived in the Gila River mainstream as far east as Ft. Thomas, in the San Pedro River at least to Fairbank (*15*), and in the Verde River to Camp Verde (*16*), and presumably they were present throughout the Salt River Canyon and above it (*4*, *17*). We have collected intensively in the Gila River basin since 1963 and can attest to the virtual, and perhaps actual, extinction of both squawfish and humpback sucker there. The headwaters of the Gila River were blocked by Coolidge Dam in 1929 (*7*); the river is now a dry wash throughout most of its lower course. The formerly large San Pedro River rarely flows in its lower part, and is a small creek near its headwaters. The Verde and Salt rivers are effectively impounded, and the upper Verde has diminished flow and is entrenched in its floodplain (*16*). Only the Salt River, in its central canyon, seems a suitable habitat for either squawfish or humpback sucker. No adult squawfish has been taken from the Roosevelt area on the Salt River since 1937 (*4*). Dammann (see *17*) saw two adults taken in the Salt River Canyon in 1948, however, and Miller (*4*) caught two young squawfish near the same locality in 1950. Branson *et al.* (*18*) reported seven juvenile specimens seined in the canyon in 1959. We and other workers known to us have failed to obtain any squawfish or humpback suckers since 1963, during intensive studies of that area, and John K. Andersen (*19*) of the U.S. Bureau of Sport Fisheries and Wildlife, who has worked in the canyon for the past few years, has not taken either of these fishes in his sampling program, or seen either in fishermen's creels.

The habitats of humpback suckers and squawfish are similar, though the suckers are more likely to frequent marshes, lakes, and quieter parts of rivers. Humpback suckers have been less commonly reported than squawfish, perhaps because humpback are less easily taken by conventional fishing methods. The recent status of the species in part of the upper Colorado is given by Vanicek (*8*). Below Grand Canyon it appears to be maintaining a fairly constant abundance. Norman Wood (*20*) of the Nevada Game and Fish Commission has found no changes in the numbers of humpback observed in lakes Mead and Mojave over the last 15 years. However, his conclusion is based on casual observations made during fish-population census, and no actual data are available. Spawning aggregations of this species were observed several times in the lakes (*21*), most recently in March 1967 in a shallow cove of Lake Mojave (*20*). The sucker also persists farther downstream, in Lake Havasu and below, perhaps as far as Martinez Lake (where, according to local testimony, one was seen in 1966), but it is becoming increasingly rare.

The upstream limit of range of humpback suckers in the Gila River basin was probably similar to that of squawfish. The suckers were abundant enough to be marketed in Tombstone, as "buffalo fish," prior to the 1880's (*4*, *15*); presumably these specimens were caught in the adjacent San Pedro River. We know of no records of humpback suckers from the Gila River mainstream above Phoenix, or from the Verde River, but large populations formerly were present in the Salt River. According to Hubbs and Miller (*12*), the fish was common near Roosevelt, Arizona, prior to the closure of Roosevelt Dam. In 1926, many suckers were seined in Roosevelt Lake and in Tonto Creek upstream from the lake, but none is now found in either area (*22*). The large populations persisted until the 1950's in lakes downstream from Roosevelt; commercial fishermen took 6 tons of humpback from Saguaro Lake in 1949, but none was found when the lake was drained in 1966 (*22*).

We point out again that both these fishes appear to be maintaining populations in some areas of the Colorado River basin, yet the relatively well-documented decline of both in the Gila River basin is instructive, and may foreshadow their extinction elsewhere. Large fishes like squawfish and humpback sucker have long life expectancies, and the presence of large adults may not indicate a "healthy" population. The large average size of humpback suckers in the Salt River impoundments in 1949 [some weighed more than 14 pounds (6 kilograms) and were more than 30 inches (75 centimeters) long (*12*)] may have foreshadowed their imminent decline through lack of reproductive success. Despite observations of the spawning of humpback in the lower Colorado River lakes, no specimen shorter than about 15 inches has been caught in recent years (*20*–*22*).

One can hardly say that such fishes are "maintaining their populations," and only long-range trends are available as a basis for estimating their status. There are few basic data available on the physiological, ecological, or behavioral requirements for their continued reproductive success. It is easy to say that such big-river fishes disappear as a result of impoundment, the implication being that the presence of a dam is directly responsible. Yet these fishes are becoming extirpated in areas, like the Salt River Canyon, where such modifications are yet to be made. Our lack of information on species requirements for reproductive success and on such matters as the effects of introduced fishes on native species is discouraging.

Another kind of big-river fish—the small, streamlined woundfin, *Plagopterus argentissimus,* adapted to life in sandy, swift, turbid, downstream parts of the lower Colorado basin—occurred in the Salt River at Tempe (Table 1) and in the Gila River at Yuma, Dome, and Gila City, in the period 1890–95 (*4, 23*). Elsewhere in the system this species was not recorded by early (or later) collectors. The last reproducing population of the monotypic genus *Plagopterus* now lives in the lower Virgin River of southwest Utah, northwest Arizona, and southeast Nevada. A few stragglers have been caught in the lower Moapa River (Nevada) in recent years (*24*).

Plans by the U.S. Bureau of Reclamation to construct a dam on the lower Virgin River 8 miles above St. George, Utah, would affect about 80 of the approximately 90 miles of river habitat suitable for this species. Planning calls for flow in the Virgin River downstream to be maintained only by return irrigation flow and springs in and below "the narrows," about 12 miles below St. George (*25*). The Bureau estimates that, downstream from the proposed dam, turbidity will decrease, salinity will increase, and flow in the river will be equalized. Equalization of flow means that, on the average, flow will be decreased in every month, but the decrease will be less in the summer than in the winter. Assuming that the Virgin River Dam is funded and constructed and that predictions of the downstream effects are borne out, we are still unable to confidently predict what will happen to *Plagopterus.* We do know, however, that *Plagopterus* disappeared from the Gila River early in this century, presumably because of the first man-induced changes; that despite its ability to invade the somewhat smaller Moapa River it has not become established there; and that it is fulfilling its life cycle only in the lower Virgin River. These facts suggest that any change in river condition is likely to be detrimental. Such change should be avoided until some attempt has been made to define habitat requirements for the species.

The Gila spinedace, *Meda fulgida,* is endemic in the Gila River basin, requires another kind of habitat, and demonstrates yet another type of sensitivity to man's activities. The spinedace frequents moderately swift currents flowing over gravel bottoms at or near the lower ends of riffles, and is midwater in habit (*23, 26*). In this respect it resembles any number of small cyprinids of more eastern drainages. At one time it occurred throughout the upper Gila River basin (Fig. 2B). Many streams in which it formerly lived still flow strongly, and the habitats seem totally suitable for its continued life, yet in recent years it has not been taken anywhere in the Verde River drainage, where it was abundant in the past. The aggressive, introduced red shiner,

Table 1. Fishes recorded from the Salt River, Maricopa County, Arizona, in the city of Tempe, in the period 1890–1967. Dashed lines span the period during which a species probably inhabited this segment of the stream; (O) occurrences documented by specimens in museums or recorded in the literature; (X) probable occurrence of a species at a given time, on the basis of collections made before that time or in other parts of the drainage, both upstream and downstream from Tempe.

Species	Year of collection or probable occurrence				
		1900	1920	1940	1960	
Native species						
Gila elegans	O----					
Meda fulgida	O----					
Plagopterus argentissimus	O----					
Ptychocheilus lucius	X----					
Rhinichthys osculus	O----					
Catostomus latipinnis	O----					
Xyrauchen texanus	O----					
Agosia chrysogaster	X----	----------	O----			
Gila intermedia	X----	----------	O----			
Gila robusta	X----	----------	O----			
Poeciliopsis occidentalis	O----	----------	O----			
Cyprinodon macularius	O----	----------	O----	X----	O----	
Catostomus insignis	O----	----------	X----	X----	O----	O--
Pantosteus clarki	O----	----------	X----	X----	O----	O--
Introduced species						
Gambusia affinis			----O----	O----	O----	O--
Lepomis cyanellus			----O----	X----	O----	O--
Cyprinus carpio				----O----	X----	O--
Ictalurus melas				----O----	O----	O--
Lepomis macrochirus				----O----	X----	O--
Pomoxis nigromaculatus				----O----	X----	X--
Poecilia latipinna					----O----	O--
Micropterus salmoides					----O----	O--
Dorosoma petenensis						----O--
Carassius auratus						----O--
Notemigonus crysoleucus *						----O--
Notropis lutrensis						----O--
Pimephales promelas *						----O--
Ictalurus natalis						----O--
Ictalurus punctatus						----O--
Lebistes reticulatus *						----O--
Poecilia mexicana *						----O--
Xiphophorus variatus *						----O--
Lepomis microlophus						----O--
Tilapia mossambica *						----O--

*These species were taken prior to severe flooding in the Salt River channel at Tempe in the winter of 1965–66, but not subsequently

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ENDANGERED AND THREATENED FISH IN THE YAMPA AND GREEN RIVERS OF DINOSAUR NATIONAL MONUMENT

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ABSTRACT

This paper summarizes our knowledge of four threatened or endangered fish (Colorado squawfish, *Ptychocheilus lucius*; humpback chub, *Gila cypha*; bonytail chub, *Gila elegans*; and humpback sucker, *Xyrauchen texanus*) of the Green and Yampa Rivers in Dinosaur National Monument. The survival of these endemic fish may largely depend upon the preservation of a natural river environment such as that found in the Monument.

Adult humpback suckers are found in the lower Yampa in the spring and fall; adult Colorado squawfish move into the Yampa in early summer. Young humpback suckers have not been found anywhere in the river system. Juvenile squawfish have not been found in the Monument since 1969, but small numbers have been collected in the Green River, a few miles downstream. Humpback chubs, that were never abundant, are rare in the Monument. The bonytail chub, which was abundant in the early 1960's before the closing of Flaming Gorge Dam, has not been found in the Monument in recent years.

The temperature, flow, turbidity, and other characteristics of the Green River above the confluence with the Yampa River in Echo Park has been so altered by Flaming Gorge Dam, 105 kms upstream, that these endemic fish are no longer found there. The Yampa River modifies the effect of the dam such that pre-impoundment conditions are partially restored below the confluence with the Green River. The endangered fish still exist in the Yampa and in the Green below the confluence. Alteration of the flow regime and water temperature below the dam and competition from exotic fish are believed to be the major factors in the decline of these four unique species. Other possible factors in their decline are listed.

INTRODUCTION

The Colorado River system of the western United States has been greatly modified during the past 100 years, primarily by the construction of dams. The resulting alterations of the flow regimes and water temperatures below these impoundments, and competition with introduced fish, are believed to be the major factors in the decline of four endemic Colorado River fish: the Colorado squawfish (*Ptychocheilus lucius*), humpback chub (*Gila cypha*), bonytail chub (*Gila elegans*), and humpback sucker (*Xyrauchen texanus*) (Vanicek, Kramer and Franklin 1970, Minckley 1973, Holden and Stalnaker 1975b). The first two species are officially designated as "endangered" by the U.S. Department of the Interior (1973); the latter two were recommended for listing as "endangered" and "threatened" respectively, by the Desert Fishes Council in 1975.

Other water development projects are in progress or in the planning stages for the upper Colorado River basin. Crawford and Peterson (1974) noted that the Colorado River, the key to development of the arid southwestern United States, is probably the most utilized, controlled, and fought over river in the world. This river annually derives less water per square mile of drainage than any other major river in the United States, yet it serves 15 million people with water for cities, irrigated agriculture, recreation, mining, and industry (Utah Water Research Laboratory 1975). This region contains some of the largest fuel deposits (coal, oil, oil shale, uranium) in the United States, and water will be a principal factor in the development of these energy resources (Bishop, Chambers, Mace, and Mills 1975). Consequently, there is manifest pressure to proceed with further alteration of this already over-allocated water resource. More development will impose additional stress upon the endemic fish fauna of this unique ecosystem.

This paper summarizes the status of threatened and endangered fish inhabiting Dinosaur National Monument based upon a literature review and current research by the Utah Cooperative Fishery Research Unit.

DESCRIPTION OF THE AREA

The upper Green and Yampa Rivers originate as cold, clear, headwater streams in the Rocky and Uinta Mountains. These streams supply the main tributaries that flow through deserts where spectacular canyons have been carved by erosion of the soft sandstones. Historically, the main stems were warm and turbid, being subject to sudden changes in volume and velocity. Flaming Gorge Dam, that was completed in 1963 near the Utah-Wyoming border, has changed the upper Green River. Characteristic high spring and low winter flows were converted to relatively stabilized annual flows that may display rapid daily fluctuations (Vanicek, Kramer, and Franklin 1970).

Dinosaur National Monument is located in northwestern Colorado and northeastern Utah (Figure 1). The Yampa River empties into the Green River at Echo Park approximately 105 kms below Flaming Gorge Dam, modifying and paritally restoring the Green to preimpoundment conditions. For the next 42 kms, the Green River passes alternately through canyons, and meandering flats until it opens upon the Wonsits Valley in the Uinta Basin at the Monument's southwest boundary. At this point the river has largely recovered from the impact of Flaming Gorge Dam with respect to temperature and perhaps several other parameters as well.

We note, therefore, three distinct habitat types within the study area, plus one section in which there is a gradation between these types.

<u>The Green River above Echo Park</u> - A cold water environment under the artificial control of Flaming Gorge Dam.

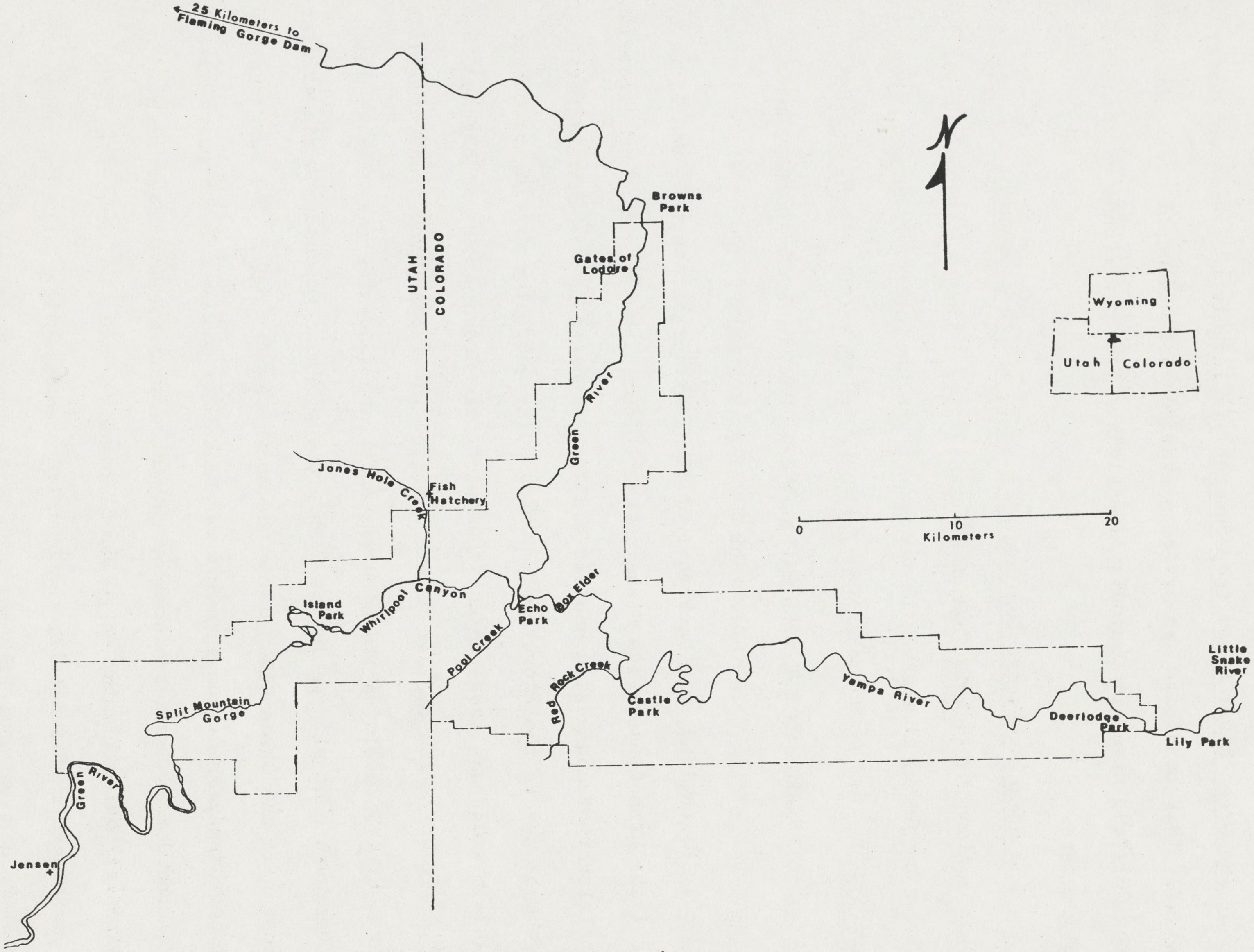

Figure 1. Dinosaur National Monument study area.

The Yampa River - Still a relatively free-flowing, warmwater river.

The Green River below the Monument - A largely recovered warmwater river. This condition appears to prevail downstream until the Green joins the Colorado River in Canyonlands National Park, a distance of about 550 kilometers.

The Green River between Echo Park and the lower Monument boundary - This region of gradation extends about 42 km from the confluence of the Yampa and Green Rivers to the southwest boundary of the Monument where conditions that were historically found in this stream are maintained.

RESEARCH ON THE FISH FAUNA IN THE WATERS OF AND ADJACENT TO DINOSAUR NATIONAL MONUMENT

In March 1963, the Secretary of the Interior, Stewart L. Udall, requested that the Utah Cooperative Fishery Unit conduct investigations to determine the extent of changes in habitat and fish populations in Dinosaur National Monument due to the closure of Flaming Gorge Dam. The conclusion of the 1963-66 study was that the environment of the Green River was changed significantly from the dam to the mouth of the Yampa River (Vanicek 1967). The Yampa River, retaining its natural character, moderates the altered Green River such that all species of fish present before impoundment are still present in the Green River below the mouth of the Yampa. The large native fishes disappeared from this 105 km reach due to the cold water released from the dam and were replaced by the introduced rainbow trout (*Salmo gairdneri*) below Flaming Gorge Dam (Vanicek, Kramer, and Franklin 1970).

Between 1968 and 1972, the Utah Unit assessed the distribution and relative abundance of fish throughout the upper Colorado and Green Rivers, including major tributaries (Holden 1973). Since 1974, the Unit has been investigating the movement, habitat, and possible spawning areas for the

Colorado squawfish and humpback sucker in the lower Yampa and upper Green Rivers. The studies by the Unit since 1968 have indicated that these four indigenous fish species are declining in abundance. In most areas, only large adult specimens have been captured, indicating a lack of reproductive success.

FISH FAUNA

The native fish fauna of the Colorado River basin is unique, with 74 percent of the native species being endemic to this river system (Miller 1959). This high degree of endemism is linked to a long period of isolation reflected in the geologic history of the basin. The Colorado River Wildlife Council has listed 20 species (40 percent) as native to the river and 30 species (60 percent) as introduced into the river system (Richardson 1976). Holden and Stalnaker (1975a) record 10 native fish species (34.5 percent) and 19 introduced species (65.5 percent) in the main stems of the upper Colorado River system. In our present study we have updated the list of fishes to reflect conditions as we now perceive them in the vicinity of Dinosaur National Monument.

Holden (1973) found all 10 of the native species and all but 4 (15 of the 19) of his introduced species in the lower Yampa. Our recent observations are similar to Holden's. However, we did not find largemouth bass (Micropterus salmoides), bluegill (Lepomis macrochirus), green sunfish (Lepomis cyanellus), or walleye (Stizostedion vitreum). Holden considered these fish to be occasional or rare. More significantly, we have failed to collect any specimens of the native bonytail chub. We have collected three introduced species from the Yampa River that were not documented previously. One plains killifish (Fundulus kansae) was captured near Red Rock Creek in July 1975, and one Utah chub (Gila atraria) was collected at Box Elder in April

1976 (See locations on Figure 1). The sand shiner (*Notropis stramineus*) has been collected by seines in Lily Park and in the Little Snake River just above the Monument boundary. Researchers from Colorado State University are also collecting this species from Lily Park and further upstream in the Yampa River.

In the Green River we found one smallmouth bass (*Micropterus dolomieui*) at Horseshoe Bend (about 40 kilometers below the Monument) in October, 1975, and one northern pike (*Esox lucius*) was captured below Horseshoe Bend in May, 1976 by the Colorado Squawfish Recovery Team. Indeed, the Green River below the Monument appears to differ from the Yampa in species composition in several notable respects. The centrarchids and walleye, only occasionally found in the Yampa River, are common in this portion of the Green. The red shiner (*Notropis lutrensis*) is very rare in the Yampa, but is abundant in the lower reaches of the Green River in the Monument and downstream. We collected two juvenile squawfish in the Green River at Jensen, Utah in October, 1975, and the Squawfish Recovery Team captured several below Jensen in May 1976. Thus, downstream from the Monument conditions appear suitable for at least limited reproductive success but not upstream. The species composition appears to reflect the differences in the habitats that were described above.

CURRENT STATUS OF ENDANGERED AND THREATENED ENDEMIC FISH OF THE UPPER COLORADO RIVER SYSTEM

The decline of the endemic fish fauna of the upper Colorado River may be attributable to various factors. The following outline lists some of the possible causes contributing to the decline of these species:

I. Stream Alteration

   A. Dams

      1. Physical obstructions to movement and migration.

2. Flow Patterns - more stable on an annual basis, less stable on a daily basis.
    a. Loss of the scouring effect from peak flows.
    b. Loss of flows that may illicit spawning migration or behavior.
    c. Effect on other habitat characteristics such as changes in substrate, river morphology, and riparian vegetation.
3. Temperatures - cooler in summer, warmer in winter.
4. Turbidity - reduced downstream.
5. Reservoirs
    a. Not suitable for successful reproduction of large-river fish.
    b. Favor other species.

B. Irrigation
1. Increased leaching of the soil resulting in increased salinity through return flows.
2. Changes in water quality due to the addition of fertilizers, pesticides, and other materials.

C. Dewatering (transmountain diversion, reservoir evaporation, irrigation, industry, culinary, etc.)
1. Reduces flow (volume and velocity)
2. Concentrates dissolved solids, increasing salinity.

D. Channelization
1. Eliminates slow-moving backwaters and eddies.
2. Alters species composition.
3. Substrate becomes unstable affecting invertebrates that may serve as a food supply.

E. Unstable Banks (livestock grazing, roads, and other structures and activities of man) - alters river morphology.

II. Pollution and Eutrophication

A. Industrial, agricultural, and municipal wastes that may be toxic may increase.

B. Water quality may be changed, particularly salinity and sedimentation.

III. Parasites - may be introduced by exotic fish species.

IV. Competition and Predation - increased by introduction of non-native fish species.

V. Food Organisms - species composition and abundance may change with changes in stream habitat.

VI. Fishing Pressure - large, adult Colorado squawfish and the bonytail and humpback chubs are very vulnerable to sport fishing.

Colorado squawfish - Whereas this species was once abundant throughout the Colorado River system with a range extending from Wyoming to the Gulf of California, it is now restricted to small numbers within parts of the upper basin (Figure 2). Remnant populations may exist below Lake Powell, but the existence of viable populations is doubtful. The occurrence of this species in the San Juan River is also uncertain. They are no longer found in the now clear, cooler waters of the Green River above the confluence with the Yampa River, but adults have been collected from 1968-71 and 1974-76 (Holden 1973, McAda and Seethaler 1975) in the lower Yampa during July and August, after water temperatures have reached 20-21 C. Most captured squawfish have been males; no ripe females have been collected. However, several suspected spent females were collected in the Yampa between Cross Mountain and the confluence of the Little Snake River, and a fisherman

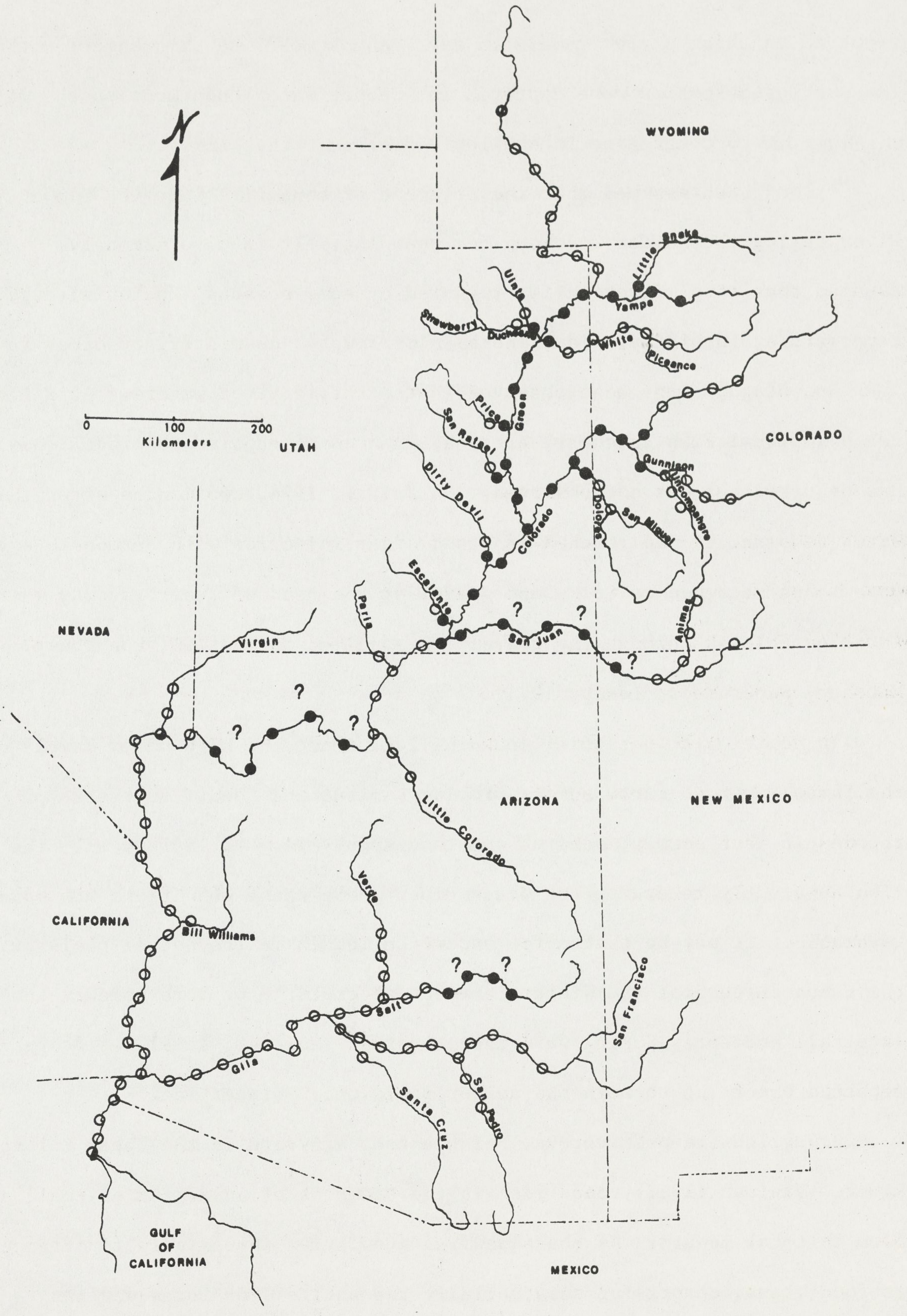

Figure 2. Historical (open and solid circles) and present (solid circles only) distribution of the Colorado squawfish in the Colorado River basin. (The question marks indicate uncertainty in fish distribution.)

reported catching a ripe female in early August 1975 at this same location. The suspected females were captured in deeper water than most of the males which tended to congregate in shallow eddies near the bank.

It has been assumed that the movement of squawfish into the Yampa River during the summer has been for spawning. It is also commonly assumed that this migration is triggered by some seasonal factor(s) e.g., temperature, turbidity, flow, photoperiod, water chemistry, or other factors.

Spawning has not been observed in the turbid river waters. At Willow Beach National Fish Hatchery, Arizona, spawning of captive Colorado Squawfish has occurred but was not observed. On July 1, 1974, two months after the water temperature had reached 18 C and after injection with hormones, eggs were found attached to rocks and gravel at the head of their raceway where water percolated through the gravel (Personal communication, Don Toney, Hatchery Supervisor; Toney, 1974).

In addition to potential spawning locations, the high water levels of the Yampa River in early summer provide habitat and food. As the Yampa recedes in late summer, habitat and food supply is greatly reduced. The fish apparently return to the Green River where these conditions are more favorable. It may be that a few squawfish remain in the deeper pools of the Yampa throughout the winter, but our attempts to capture some in the late Fall and early Spring were unsuccessful. However, local residents reported observing them in the deeper pools under winter ice.

Squawfish are piscivorous, being a top carnivore in the Upper Colorado River. Vanicek (1967) found fish in the stomachs of squawfish as small as 50mm in total length. As the squawfish grow, fish increase in importance as food items, comprising substantially the entire diet for squawfish larger than 200 mm. They are opportunists, however, and will eat other food items such as frogs and mice.

Squawfish reproduction has declined steadily since the 1960's. Vanicek (1967) determined that in 1959, 1961, 1963, 1964, and possibly 1966 strong year classes were present, while in 1962 and 1965 they were weak. He collected 275 young of the year in 1964, 42 in 1965, and 560 in 1966. Holden (1973) found young of the year squawfish in Desolation Canyon in 1971 and in the Green River at Canyonlands National Park in 1970 and 1971. He considered juvenile squawfish to be abundant at Echo Park in 1968, but he found very few in 1969 and none in 1970. As previously noted, we have found evidence of recent reproduction of squawfish in the Green River at Jensen, Utah where conditions appear to still be suitable. The decline in successful reproduction can be correlated with the impoundment at Flaming Gorge and concurrent changes in composition of the fish fauna. Conditions within the river which may favor exotic species may be detrimental to the native species.

We have determined that sexual maturity for squawfish occurs when the fish reach a minimum total length of 420 mm at approximately seven years of age. Historically squawfish have attained much greater size than they do today. It is not known whether this size was due to increased longevity or whether conditions favored faster growth in the past. These factors may have implications for the reproductive potential of the squawfish that is not yet fully understood.

Humpback sucker - The range of this unique fish has been drastically reduced in the Colorado River system (Figure 3). The humpback sucker has been completely extirpated from the Gila River system of the lower Colorado River basin where it was once quite abundant (Minckley 1973). In 1949, a commercial fisherman working in Sahuaro Lake (Arizona) had a spawning season catch of more than six tons of this species (Hubbs and Miller 1953). However,

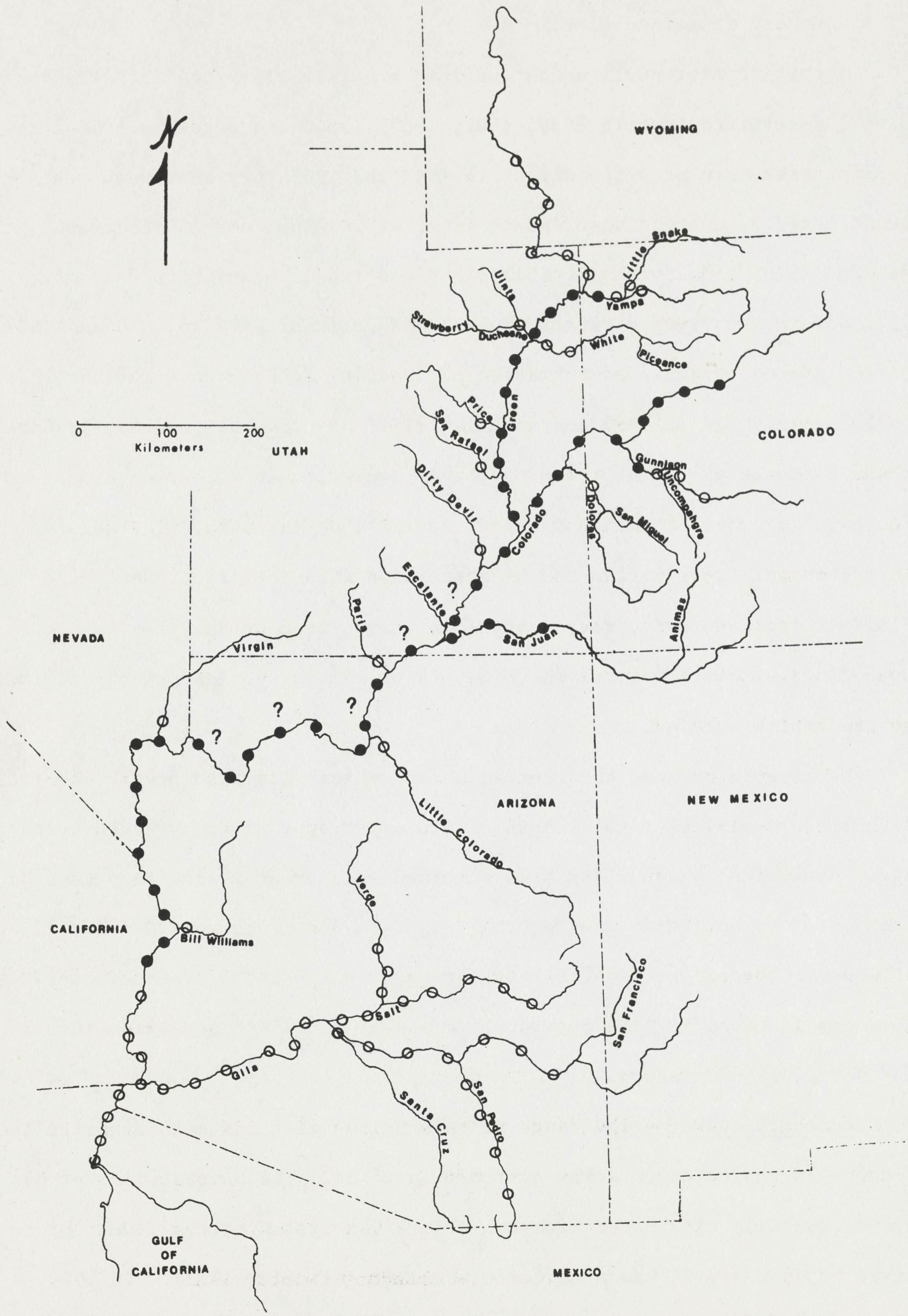

Figure 3. Historical (open and solid circles) and present (solid circles only) distribution of the humpback sucker in the Colorado River basin. (The question marks indicate uncertainty in fish distribution.)

this abundant fish had vanished from Sahuaro Lake when it was drained in 1966 (Minckley and Deacon 1968). Humpback suckers were also relatively common in the Colorado River reservoirs during the 1940-50's (Dill 1944; Wallis 1950; Douglas 1952; Jonez and Sumner 1954). This species is still found in Lakes Mojave and Mead, but it is declining in numbers and appears to be approaching extinction below Lake Mojave (Minckley 1973).

Although the humpback sucker is more widespread in the upper Colorado River basin, it has been considered to be rare by all investigators (Vanicek, Kramer and Franklin 1970; Miller 1972; Holden and Stalnaker 1975a, 1975b). During the present study (1974-76), humpback suckers were considered to be relatively common but not numerous at two locations in the upper basin: at the mouth of the Yampa River during the early spring and late fall, and in a flooded gravel pit (Walter Walker Wildlife Area) that is connected to the Colorado River near Grand Junction, Colorado during all seasons of the year. Humpback suckers are primarily captured in quiet water areas except during the spring when they congregate in swift water over gravel bars for spawning.

Evidence of successful reproduction has been absent in recent years (Vanicek, Kramer and Franklin 1970; Minckley 1973; Holden and Stalnaker 1975a, 1975b). In the spring of 1975, ripe male and female humpback suckers were collected over a gravel bar in the Yampa River about 400 meters upstream from its mouth. One of these females (tagged at Island Park) had traveled 21 kms upstream in three weeks. Another spawning bar was located about 2.5 kms upstream on the Yampa River. This is the farthest penetration up the Yampa River by this species that was documented during this study, although humpback suckers were reported eighteen miles upstream during a previous investigation (Holden, unpublished field notes).

Humpback suckers were also attempting to spawn along the shoreline of the gravel pit and on gravel bars in the Colorado River near Grand Junction, Colorado. Neither young of the year or juvenile humpback suckers were captured at any location, even after many attempts.

During the spawning period, water temperatures in the Yampa River increased from 6 to 10 C and turbidities increased from 600 to 1000 Jackson Turbidity Units (JTU). The temperature of the Colorado River averaged 12 C during this time with turbidities of greater than 1000 JTUs. Temperatures in the gravel pit were approximately 17 C and turbidities were slightly more than 100 JTUs. The spawning bars consisted of large cobble-sized rocks at depths of one-half to one meter, with water velocities that averaged one meter per second. The shoreline of Walter Walker Wildlife Area is composed of similar sized rocks and was often agitated by wave action. Douglas (1952) described the spawning activities of humpback suckers in Lake Havasu on the lower Colorado River which were undoubtedly representative of the activities in the gravel pit. However, actual spawning was not observed during this investigation due to the extreme turbidity at most spawning locations.

Hybridization between the flannelmouth (*Catostomus latipinnis*) and the humpback suckers has been reported in other studies (Hubbs and Miller 1953; Vanicek, Kramer and Franklin 1970; Holden and Stalnaker 1975a) and was observed during this investigation. The incidence of hybridization appears to be on the increase (Holden and Stalnaker 1975a) as would be expected in an altered system where one fish is considerably more abundant than another, but both have similar reproductive requirements. During the course of our research, eight *X. texanus* x *C. latipinnis* crosses were collected. Humpback suckers also appear to be hybridizing with the introduced Utah sucker (*C. ardens*) in the lower basin (Gustafson 1975) and these hybrids may appear in the Upper Colorado River Basin in the near future.

Humpback chub - Previously found in the Flaming Gorge basin of the upper Green River, only a few (26) were captured in Dinosaur National Monument in 1968-71, usually from eddies adjacent to fast currents (Holden 1973). Only recently discovered (Miller 1946), they have never been known to be abundant. In 1973, the Colorado Division of Wildlife found a population of this species in the Colorado River in deep glides near the border between Colorado and Utah (G. Kidd, personal communication). We collected 12 specimens of this species including possible hybrids with other Gila from an eddy about two miles upstream from Castle Park in 1975, 5 on the Yampa near the cut-off channel to the Green at Echo Park in 1975, and 1 at Lily Park in 1976. While our nets were set in eddies and were near or at the surface, they were adjacent to or in deep water (about 4-5 meters deep). We postulate that humpback chubs may be found in association with deeper pools in the Upper Colorado River system.

Bonytail chub - Although formerly abundant, the numbers of this species have been drastically reduced since the closure of Flaming Gorge Dam. Vanicek (1967) found that bonytail chubs were more numerous than roundtail chubs (Gila robusta) for the 1959, 1960 and 1961 year-classes, while the roundtail chubs remain quite common and in no apparent danger of extinction. Only a few bonytail chubs have been found recently (1968-71) in the lower Yampa and Green Rivers in Dinosaur National Monument and a few in Desolation Canyon and Canyonlands National Park (Holden 1973). No bonytail chubs were collected during 1974-76 in Dinosaur National Monument. An occasional bonytail chub is collected in the lower Colorado River basin (Lake Mohave, Arizona) (D. Toney, personal communication). Indeed, this species appears close to extinction.

PROBLEMS ASSOCIATED WITH DEFINING "CRITICAL HABITAT"

In December of 1975, the Colorado Squawfish Recovery Team, composed of members from various federal and state agencies, held its first meeting in Las Vegas, Nevada. Several meetings have been held by the Team since then and a draft "recovery plan" for preservation of the Colorado Squawfish has been prepared. One of the problems that confronted the Team was defining "critical habitat" for this species.

The Endangered Species Act of 1973 - P.L. 93-205 (U.S. 93rd Congress, 1973) with amendments in the Federal Register requires that the "critical habitat" for endangered species be defined so that the potential effects of future alterations to ecosystems can be identified and alternatives sought that would minimize the impacts on fish and wildlife.

The defining of "critical habitat" for aquatic organisms is not as simple as for terrestrial organisms. Water quality, and quantity, in addition to the physical environment, is important for aquatic organisms. Alterations (e.g. water temperature, dissolved oxygen) that are made upstream could affect the aquatic organisms far downstream. In addition, the streamflow requirements for the endemic fish in the Colorado River are not known. Ohmart, Deason and Freeland (1975) have shown that the backwater marsh habitat of the lower Colorado River was never very extensive but extremely important for various species of wildlife. Vanicek and Kramer (1969) reported that young squawfish and chubs were commonly captured in backwater habitats in the upper basin. The natural flushing action of the spring runoff may be necessary to keep these habitats from becoming filled with silt and organic material. The historic annual peak flows in the upper Colorado River have been reduced by reservoirs and may result in a reduction of the critical nursery areas that are used by young endemic fish.

IMPORTANCE OF THE WATERS IN DINOSAUR NATIONAL MONUMENT FOR THE CONTINUED EXISTENCE OF ENDEMIC FISH

The Yampa River may provide a refuge for some, if not all, of the large-river endemic fish that are now threatened or endangered. However, we believe its major contribution to the continued survival of threatened and endangered fish is its amelioration of the Green River below their confluence. Our concern is that any alteration of the Yampa River or its tributaries could have a serious negative impact upon this ameliorating effect. Although some comprehensive plans (e.g. Water Resources Council 1971) have been made for the management of the upper Colorado River, fish and wildlife have not been considered adequately in these plans. Information needed for such planning has been widely scattered in the literature but is now being compiled for reference in future management (Wydoski, Gilbert, Seethaler, and McAda 1976).

The rationale and moral obligation that man has to protect threatened and endangered species has been summarized in various papers (e.g. U.S. Fish and Wildlife Service 1969, Pister 1976). Decisions regarding alterations to the environment must be based upon sound ecological principles if water development is to be compatible with the ecosystem. Often our native flora and fauna serve as "environmental barometers" to maintain the quality of land and water. When these species begin to disappear, it is a warning that something has changed in the ecosystem that may also affect man. In addition, the Fish and Wildlife Service (1969) has taken the position that the true value of any wildlife species grows greater as its numbers decline, for in a few individuals are concentrated all the worth of one small but valuable part of our environment.

Natural areas that are within federal refuges, monuments, or parks can provide suitable habitat for threatened or endangered species if the habitat can be protected. Geologic interpretive programs have been implemented by the National Park Service at Dinosaur National Monument. While these programs help to interpret the geological evolution that has occurred in these areas, other interpretive programs could be developed to describe the dynamic evolution that is occurring in the Monument today as in the case of the endemic fish species.

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Ann Rappoport

Preliminary Summary

Response to Questionnaire —

"Evaluation of Past Wildlife Mitigations"

— Feb. 3, 1978.

Marine Advisory Service
University of Rhode Island
Narragansett, RI 02882

We are sorry to inform you that our limited supply of Marine Technical Report 67 Synopsis of Biological Data on the Striped Bass, Morone saxatilis (Walbaum) has been exhausted. The data in this report, however, is included as part of a final report to the USEPA on the culture of this species. This final report will be released in the EPA Ecological Research Series later this year.

We do have a loan copy of the publication which we can share with you. Just write to:

Coastal Information
University of Rhode Island
Narragansett Bay Campus
Narragansett, RI 02882
(401) 792-6211

Please request call number F/94.52.

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Striped bass rept.

Mr. Robert Behnke
Dept. of Fishery and Wildlife
Biology
Colorado State University
Fort Collins, CO 80523

Horowitz, R. S.
Temporal variability
patterns and the
distribution patterns
of stream fishes.
Ecol. Monog. - 1978 -

PHONE CALL

Date ____________

M. ____________

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By M. ____________

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The message was ____________

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HJR 1055

LDO NO. 79 1759/1

First Regular Session
Fifty-second General Assembly

STATE OF COLORADO

BY REPRESENTATIVES Theos, DeFilippo, Boley, and Hinman; also SENATORS Soash and Anderson.

HOUSE JOINT RESOLUTION NO.

WHEREAS, The United States fish and wildlife service in conjunction with the Colorado division of wildlife are breeding and nurturing the growth in population of several varieties of fish, including the Colorado River squawfish, the humpback chub, and the humpback sucker; and

WHEREAS, Such activity is being conducted at the state fish hatchery in Rifle, Colorado, and at the federal fish hatchery in Willow Bank, Arizona, for stocking Colorado's Yampa River and possibly other rivers in this state; and

WHEREAS, The intent and purpose of such activity is based upon the assumption that the demise of such fish has been caused by construction of large reservoirs and other similar water projects, and such assumption has been proven to be erroneous and without merit by a number of studies, including an extensive study conducted by an agency of the United States fish and wildlife service; and

WHEREAS, Because such fish are classified as endangered or threatened and therefore afforded special treatment and consideration, stocking Colorado waters with such fish will preclude the development of dams and other types of water projects and will possibly have a negative effect on agriculture, livestock grazing, forest and timber activities, tourism, and recreational opportunities; and

WHEREAS, The divisions of wildlife in Arizona and New Mexico have clashed with the United States fish and wildlife service over proposed activities of a similar nature, and one of these states has refused to cooperate in similar activities and has stopped similar breeding efforts pending assessment of the ramifications thereof; and

WHEREAS, It is proper and fitting that Colorado likewise cease to allow such activities until such time as the widespread effects of such activities can be assessed and evaluated; now, therefore,

Capital letters indicate new material to be added to existing statute.
Dashes through the words indicate deletions from existing statute.

Be It Resolved by the House of Representatives of the Fifty-second General Assembly of the State of Colorado, the Senate concurring herein:

That the division of wildlife of the department of natural resources of the state of Colorado is hereby urged to cease the expenditure of state funds for the purpose of breeding, hatching, and stocking endangered or threatened species of fish in the waters of Colorado and to terminate its cooperation with the United States fish and wildlife service with regard to such matters and that the governor of the state of Colorado is hereby urged to prohibit such activities and such cooperation.

Be It Further Resolved, That copies of this resolution be sent to the governor of the state of Colorado, the executive director of the department of natural resources, and the director of the division of wildlife of the department of natural resources.

Mike Prewitt: Nov. 6

Greatly expanded sites for flow modeling study. In Yampa, Deer Lodge, Box Elder; Echo Park in Green, below Flaming Gorge, Jensen (old site); - New USGS sediment transport study planned for Little Snake - Yampa to predict bedload changes from J-CM. - What will future channel morphology, bed form of river be ??.

← flat shelf area important for squawfish reproduction - fluctuating flows, dry out or too high velocity - Ken Bovee writing paper on fluctuating flows (few weeks I get copy to review).

- 6 sites for Upper Basin study (IFB)

Colo. - Bl. Rcks., Moab, Potash

Green - Ouray, Desolation, Labyrinth canyons areas where end. sp. reprod. successfully.

Nevada problem: Develop desert or save fish

By John Rice

RENO (AP) — When Nevada officials wanted to build a new state prison in arid desert country near tiny Indian Springs, a major worry was a possible lack of water. Another, ironically, was the presence of fish.

Nevada, the nation's driest state, seems to teem with unique fish species inhabiting meager springs and streams. Their presence — and vulnerability — has put roadblocks in front of Nevadans' attempts to develop their deserts.

At least eight Nevada fish species are included on the U.S. Fish and Wildlife Service's endangered or threatened lists. Eight more should be on the lists, according to Gale Kobetich, field supervisor for the service's endangered species office in Sacramento.

"Most of them, if we didn't mess with the habitat, they would not be endangered," Kobetich said. "But because of the pressures on the habitat, most of them are threatened at least, some of them truly endangered."

Because water is so precious in Nevada, continued conflicts between efforts to develop the desert and to save the fish are almost certain, according to state Water Engineer Bill Newman.

The conflicts could involve the state's only two sizable population centers — Las Vegas and Reno — as well as a Pentagon proposal to dot the desert with the massive MX nuclear missile system.

Nevada officials were relieved to learn recently their proposed Indian Springs prison would not affect on the Desert pupfish or Pahrump killifish, according to a Fish and Wildlife Service study.

The two tiny species are both on the federal endangered list, arousing fears the prison — like Tennessee's Tellico Dam — could be stalled or delayed by federal environmental protection laws, sending construction costs soaring due to inflation.

Ranchers in the Ash Meadows area of the searing Amargosa Desert weren't as lucky. A federal court order prohibits water pumping, which would pull the groundwater level below a point at which the inchlong Devil's Hole pupfish can survive in the warm limestone pothole, which is its only home.

Biologist James Deacon of UNLV recently proposed raising the minimum ground water level higher,— a level which might infringe upon existing water rights, according to state Water Engineer Bill Newman.

More importantly, "the site around Devil's Hole was an alternative water supply for Las Vegas," Newman said. "This would pretty much preclude that."

To protect another small fish — the two-to three-inch-long Moapa Dace — the Fish and Wildlife Service recently purchased a hot springs resort north of Las Vegas. Its proposal to purchase a neighboring — more heavily used — part of Warm Springs oasis ignited an outcry from Las Vegans fearful the resort would be shut down.

The service backed off from that plan, but it is still considering buying parts of the resort or finding another way to protect it, worried further tampering with the spring would wipe out the fish.

The biggest controversy swirls around two of the state's biggest fish, the endangered cui ui sucker, which can reach 2 feet in length; and the threatened Lahontan cutthroat trout, which has been caught at 68 pounds. Both inhabit the Truckee River and Pryamid Lake.

Reno and Sparks draw most of their water from the Truckee. But Reno, in the midst of a casino building boom, has run out of water available for growth, forcing state officials to halt approvals of new subdivisions.

Angry local developers and politicians place part of the blame on federal refusal to let them use water from Stampede Reservoir upstream. Sen. Paul Laxalt, R-Nev., also has complained loudly about use of water for the fish.

Federal officials are releasing water from that reservoir to cool the Truckee during lowwater periods so the cui ui can migrate upstream and spawn. Downstream, the Pyramid Lake Indians, who historically have fed upon the fish and now depend upon tourist income from fishermen,— have strongly backed the federal position.

Most of the rare fish are relics of the prehistoric era when Nevada's valleys were immersed under lakes, Kobetich said.

"As these lakes dried, the fish were isolated," he said. And so, for thousands of years, the fish evolved along their own paths, many forming entirely unique species.

"Many of the springs ... are no bigger than this table," said state fisheries expert Jack Dieringer, tapping on a 10-foot-long table he leaned against. "You drop the water table two feet and the habitat's gone."

Isolation also has made the fish vulnerable. Kobetich said many of the species have developed in habitats where there were few, if any, natural enemies. The introduction of exotic fish has contributed to the disappearance of some native species and mortal threats to others, Kobetich said.

At least one fish, the relic dace in the Steptoe Valley near Ely, is so different from any others biologists aren't sure where it came from. "Its antecedents are lost in time," Kobetich said.

Rare fish are spread throughout the state, as is the Air Force's proposed site for the MX missile. The military has offered a $33 billion plan to build 200 loops, each with 23 hardened missile silos, in Nevada and western Utah valleys.

It isn't yet sure where it would find the water to build what Air Force officials call the largest project in man's history.

Dieringer said Air Force officials are now drilling test wells to see how much water they can pump without affecting springs. If it seemed a missile site would kill a fish species, Dieringer said the state would request it be relocated.

"If they didn't relocate, I'd imagine you'd find someone who'd take them to court," he said.

Developers tend to see the issue in economic terms. The existence of the small fish can cause millions of dollars in delays, or the loss of proposed farms or homes.

In defense of the fish, "a lot of people argue economics and scientific agruments and possible benefits to man," Kobetich said. "But as far as I'm concerned, there is only one argument. We do not have the right to destroy another species."

Temp-Flow relation
[1979?]

JUNIPER-CROSS MOUNTAIN PROJECT IMPACTS
ON ENDANGERED SPECIES IN THE GREEN RIVER

Robert Behnke, December 30, 1979

To assess possible favorable impacts to endangered species and to explore possible areas for mitigation from the operation of the Juniper-Cross Mountain Project, I have evaluated several sources of data particularly those dealing with squawfish abundance and reproduction, derived mainly from the studies of David Varnicek and Paul Holden from a period of 1963 through 1978.

In reference to the physical aspects of the Green River hydrology and water development projects my conclusions are that temperature is of more significance than flow for successful squawfish reproduction and that diurnal fluctuations in river level are probably of greater significance than average flow volume when the daily fluctuations approach or exceed 1 foot in the Green River in the Jensen-Ouray, Utah, area.

The implications are that if normal Yampa River temperatures, with July maxima of 72° to 78° F, can be maintained with the project, then the project will have a beneficial impact on squawfish reproduction in the Green River because of the greater than average July and August flows, which, in turn, increases the "meliorating" warming effect of the Yampa on the colder Green River. If, as predicted in the environmental assessment, Cross Mountain Dam would release water with a maximum temperature of 57° F (if Juniper Dam has no surface discharge), then the Yampa would probably enter the Green River in Echo Park with water temperatures similar to the Green River with summer maxima of about 60° to 68° F and the project would have a negative temperature effect on squawfish reproduction in the Green River, downstream to about Ouray, Utah.

The diurnal fluctuations in flow from Cross Mountain Dam, would be beneficial if they acted to dampen the diurnal fluctuations from Flaming Gorge Dam. However, this would not likely occur unless the operations of power production was precisely coordinated between the two dams to achieve a leveling effect at their confluence in Echo Park. A modified operational regime at Cross Mountain Dam suggests a possibility for mitigation (or more correctly, enhancement). Unless the Bureau of Reclamation would be willing to coordinate the releases from Flaming Gorge Dam to achieve an antagonistic (leveling) effect of the two diurnal flow fluctuations, it would be fruitless to pursue the matter. Without coordination between the releases from Flaming Gorge and Cross Mountain dams, the variable releases probably would, by chance, act to dampen overall fluctuations, but, if on just one or two days, during July and August, the Green River and Yampa River fluctuations coincided to increase the combined amplitude of fluctuation, then a considerable amount of potential squawfish nursery area (the quiet backwaters of 1 to 2 foot depths) would be lost.

Background

A post impoundment study of Green River fishes was conducted by David Vanicek from 1963 to 1966 and the results incorporated into his Ph.D. thesis. Paul Holden continued the studies of upper Colorado River basin fishes for M.S. (1968) and Ph.D. (1973) degrees. Holden then continued studies on Green and Yampa river fishes as a consultant to federal agencies from 1977 to the present.

In relation to physical and biological changes in the Green River from the construction and operation of Flaming Gorge Dam, four periods characterized by different flows, temperatures, and species composition, can be defined.

The first period, to 1962, is the preimpoundment period, before Flaming Gorge Dam was closed (and the upper Green River poisoned). Squawfish were relatively common in the Green River up to about the Flaming Gorge Dam site. They were reproducing well. Vanicek's collections of fishes showed a normal distribution of age classes. His data indicates that 1962 was a weak year-class for squawfish. In 1962, flows were high -- the highest flows in the upper Colorado River basin during the last 20 year period (Fig. 1.2, Joseph , et al. 1977).

Humpback chub were rare in preimpoundment surveys. A few were recorded from the Green River at Hideout Flats (now under Flaming Gorge Reservoir) and from Echo Park at the Green and Yampa confluence.

The second period, from 1963 to 1966, was characterized by the filling of Flaming Gorge Dam and sharply reduced flows in the Green River. The discharges from Flaming Gorge Dam were from deep, cold (hypolimnion) strata. At Greendale, Utah, just below Flaming Gorge Dam, the average monthly temperatures for the Green River in the 1957-59 period were 70° for July and 68° for August. The average water temperature at Greendale in 1963 was 43° in July and 44° in August. The average monthly flows at Greendale from 1951 to 1962 were 3,375 (range from 909 to 6,995) cubic feet per second for July and 1,635 cfs (range from 700 to 3,711) for August. The July, 1963, flows averaged 104 cfs and the August, 1963, flows averaged 102 cfs at Greendale -- all time record lows. Yet, below the confluence of the Yampa River, Vanicek found the 1963 year-class of squawfish to be the most abundant year-class in his study.

This inverse relationship between flows and squawfish spawning success can best be explained by the increased water temperatures in July and August, 1963, below the confluence with the Yampa. Although the flows from

Flaming Gorge Dam were cold in 1963, the very low volume of discharge was warmed by ambient air temperatures much more effectively than would have been a larger volume, moving downstream at a greater velocity. 1963 was a low flow year in the upper basin. The average Yampa River flow was 288 cfs in July, 1963 (average Yampa July flow from 1950 to 1960 was 1,487 cfs with a range from 298 to 6,919 cfs). The average Yampa flow in August, 1963, was 291 c.f.s. Thus, although the July and August 1963 flows of the Yampa were very low, they were almost three times the volume of the Flaming Gorge Dam releases and they exerted an overwhelming "meliorating" or warming impact on the Green River.

At Jensen, Utah, 45 miles downstream from the confluence of the Green and Yampa rivers (the confluence of the Green and Yampa is 65 miles below Flaming Gorge Dam), the July, 1963, flows averaged 498 c.f.s. (compared to a 1951 to 1962 July average of 5,189 c.f.s. with a range from 1,531 to 14,740 c.f.s.) and the August flow averaged 453 c.f.s. The July, 1963 temperature of the Green River at Jensen averaged 72°, which was the same as the preimpoundment July temperature at this site. The August, 1963, temperature of the Green River also averaged 72° which was warmer than the preimpoundment August average of 70°. Thus, despite July and August flows that were less than 10% of the preimpoundment flows below the confluence with the Yampa River, water temperatures were as warm or warmer than preimpoundment years and the squawfish produced the most abundant year-class found in Vanicek's study.

It is not clear from Vanicek's data, precisely where squawfish were found. He found squawfish from 1963 to 1966 only below the Yampa confluence, but this area from Echo Park to Ouray, Utah included several sampling sites. The Green River from Jensen to Ouray is a low gradient, sluggish river. I would envision that during the extremely low 1963 flows, the river channel formed several side channels and backwater habitats which provided good nursery areas for newly hatched squawfish. It should be emphasized that the 1963 to 1966 operation of Flaming Gorge Dam was characterized by slight peaking flows, of much less magnitude than characteristic of the period after 1966. Pearson (1967) reported a daily fluctuation of 4 inches in the Green River at Island Park (32 miles above Jensen) in 1965. Holden reported a daily fluctuation of 16 inches at Jensen in 1978. I suspect that the 1963 squawfish year-class would not have been so abundant if they were subjected to daily fluctuations of the magnitude characteristic of recent years -- much of the quiet, backwater habitat would be flooded and desiccated every day.

Vanicek's collections showed poor reproductive success for squawfish in the Green River in 1965. The 1965 summer flows in the Green River at Jensen were several fold greater than the 1963 flows (average 3,900 c.f.s. July, and 1,700 c.f.s. August). 1965 temperatures were lower at Jensen than in 1963 (average 67° July, 66° August), but were not much different from 1964 and 1966 average temperatures when squawfish reproduction was more successful than in 1965. However, the rate and timing of warming was different in 1965. During preimpoundment years, the Green River at Jensen averaged 115 days when the mean temperature exceeded 60°. There were only 83 days of temperatures exceeding a mean of 60° in 1965 at Jensen as compared to 147 days of 60°+ temperatures in the excellent reproductive year of 1963 and 103 days of 60°+ water in 1964, a year characterized by moderate reproductive success.

The third period of changes in the Green River from about 1967 through 1977 after Flaming Gorge Reservoir filled and peaking power production expanded was characterized by still lower temperatures in the discharge

(40°-42° July, August), increase in the volume of discharge, and great increases in the amplitude of daily fluctuation. During this period, the meliorating influence of the Yampa River was relatively reduced and squawfish became rare and with little evidence of reproductive success in the Green River downstream to below Ouray, Utah, about 270 miles downstream from Flaming Gorge Dam.

It was during this period that the red shiner began rapidly spreading up the Green River from the Colorado River. By 1977, the red shiner had replaced the redside shiner in the Green River up to Jensen.

Evidently, the higher, colder flows of the 1967-1977 period, combined with sharp diurnal fluctuations, and perhaps influenced by increasing dominance of redside shiners, greatly suppressed successful squawfish reproduction in the Green River from the Yampa confluence to Ouray -- the area where Vanicek collected 1469 squawfish from 1963 to 1966. Vanicek collected 4079 redside shiners in this area (of a total of 23,735 fish), which demonstrates that squawfish can maintain viable, self-reproducing populations with redside shiners (at least until the redside shiner attains a critical dominance, as it probably did in the Yampa River) as long as summer temperatures are sufficiently warm and quiet backwater habitat is available.

This period also resulted in large numbers of mature squawfish entering the Yampa River from the Green, evidently influenced by warmer temperatures necessary for spawning. From 1968 through 1971 Holden captures 261 squawfish from the lower Yampa River. However, successful reproduction did not occur and this run essentially faded away by the late 1970's.

The fourth period, beginning in 1978, is characterized by a change in the outlet discharge from Flaming Gorge Dam to release warmer water. Although primarily installed to improve the tailwater trout fishery, it is hoped that the warmer discharge will benefit endangered species in the Green River. Holden sampled the Green River in 1978 to detect changes in the fauna from the warmer discharge. In July and August, 1978, the Flaming Gorge discharge averaged about 55°-56° (compared to previous 40°-42° July, August temperatures) with an average discharge of 2030 cfs in July and 1713 cfs in August. 1978 was a wet year and Yampa River discharges were above average. This resulted in an average Green River flow at Jensen, Utah of 6003 cfs in July (average preimpoundment July flow at Jensen was 5189 cfs) and August flow averaging 2459 cfs. The summer of 1978 was cooler than average and this resulted in average temperatures of only 68° in July and 67° in August for the Green River at Jensen. These temperatures were similar to the 1963-66 averages at Jensen and about 2 to 3 degrees warmer than the 1967-77 period. Holden found 16 young-of-the-year squawfish at Jensen in 1978 and 8 yearlings (born in 1977). He also found 3 yearlings at Island Park, upstream from Jensen. His samples also indicated that the red shiner was the overwhelmingly dominant fish in the Green River and that the redside shiner was virtually gone. The FWS sponsored sutidies in 1979 found abundant young squawfish in the Green River up to Jensen, demonstrating that reproduction was highly successful in 1978 (and probably 1977). 1977 was a very dry year with flows well below normal but with warm summer temperatures.

It is probably that successful reproduction by squawfish above Jensen was somewhat inhibited in 1978 by the cooler temperatures, due to the cool summer weather, and partly by the daily fluctuations in flow. However, a critical evaluation of potential squawfish nursery areas would be necessary to evaluate the impacts of fluctuation in river level. Holden (1977, Fig. 12) illustrates a backwater habitat in Desolation Canyon where young-of-the-year squawfish were found (an area with only 3 to 4 inches of daily fluctuation). It would take a decline in water level of two feet to reduce the size of this particular backwater by 50%. Holden found all young-of-the-year squawfish in backwater habitat, typically living in depths of 1 to 2 feet. Juvenile squawfish (1 and 2 years old) were found in similar types of habitat, but were more variable in relation to preference for current and depth. Young-of-the-year humpback chub were found in a much wider range of habitats than were the young squawfish.

According to the hydrology section of the Juniper-Cross Mountain Project, the operational regime would increase the average Yampa River flows below the Little Snake River, from a present July mean of 1,688 cfs to between 2,147 to 2,256 cfs. The August flow would increase from a mean of 415 c.f.s. to between 1,045 to 2,100 c.f.s. Thus, the meliorating effect of the Yampa on the Green would be increased an average from 27 to 34% in July and from 152 to 406% in August (if temperatures remain in present range). This can be a significant benefit to squawfish. Holden has pointed out that typically, flows in the Yampa fall sharply by mid July, with a great lessening of the warming influence on the Green. If the Yampa River can maintain the present summer temperature regime, the increased July and August flows would benefit endangered species because of the increased warming influence. If Cross Mountain and Flaming Gorge releases could be coordinated to dampen the combined fluctuations at Echo Park, I believe squawfish would increase their abundance to or above the 1963-66 period in the Green River from Ouray to Echo Park.

In the consultation process, the District should demand that FWS be as aggressive with Bureau of Reclamation projects as it is with private developers in requesting operational regimes producing favorable conditions for endangered species. The trade-offs for endangered species mitigation should be clearly spelled out. If Juniper Reservoir uses surface discharge, the warmer, more productive waters are flushed out. The sport fishery potential is greatly lessened. Warmer surface flows from Cross Mountain Reservoir will exclude a potentially fine trout fishery in 50 miles of the Yampa River below the dam. Colorado will suffer a great loss in angler use of the reservoirs and of the Yampa River if the project is operated to favor endangered species in the Green River. Should not FWS expect Wyoming and Utah to suffer comparable losses in the sport fishery of Flaming Gorge Reservoir and its tailwaters (and loss of electrical generation power) for the good of endangered species?

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[Ca mid 1980s]

Mitigation and Section 7 on the Upper Colorado River

Ron Lambertson's presentation

INTRODUCTION

As a result of man's actions in his efforts to provide food, energy, and other societal needs, dramatic changes have occurred in the natural environment upon which species depend. This has often led to major conflicts between natural values and economic development. The demands on the Colorado River System and its inclusive ecosystem, brought by the need for energy development and production for expanding local and national growth, will further degrade a unique habitat that some scientists presently believe may no longer be supportive of native fish populations. In an effort to reconcile fish habitat needs with project development, new approaches are necessary. However, the traditional concept of mitigation cannot be applied to the problems facing us with endangered species. The very fact that they are listed as endangered indicates that the habitat is so deteriorated and the species so restricted in abundance and distribution, that further habitat loss will have only a greater impact on a precarious situation. The listing of these species was intended as an indication to the public of the importance of applying conservation measures towards a recovery effort in protecting and restoring the species and their natural habitat. Compensation, the basic concept behind the accepted definition of mitigation, does not offer this opportunity of protection.

Attempts to provide protection through Section 7 of the Endangered Species Act (ESA) of 1973, as amended, will be discussed in this paper. The discussion will be divided into two sections, the first to cover the concept of mitigation as it applies to the ESA, and the second a discussion of Colorado River problems and the past and present attempts to resolve these problems.

Section I: Mitigation and the Endangered Species Act

The Endangered Species Act mandates the consideration of impacts upon endangered, threatened, and proposed species and/or critical habitat resulting from any Federal activity or program. Specifically, the Act proclaims a goal of protecting the ecosystems upon which federally listed species depend, while providing a program for their conservation. This can be accomplished directly through land acquisition and preservation or indirectly through Section 7 of the Act, which states:

> "Each Federal agency shall, in consultation with, and with the assistance of the Secretary, insure that any action authorized, funded, or carried out by such agency is not likely to jeopardize the continued existence of any endangered or threatened species or result in the destruction or adverse modification of habitat of such species which is determined by the Secretary, after consultation as appropriate with affected States, to be critical..."
> (87 Stat. 884; 16 U.S.C 1531 et. seq.)

This Section 7 consideration involves four discrete duties for Federal agencies:

1. To review and utilize existing programs to further the purposes of the Act;
2. To utilize authorities to further such purposes by carrying out conservation programs;

3. To insure that Federal activities are not likely to jeopardize the continued existence of endangered or threatened species; and
4. To insure that Federal activities do not destroy or adversely modify habitat determined to be critical to listed species.

This latter point has been interpreted as prohibiting only those modifications to the habitat which have a significant adverse impact on listed species. Federal agencies, in applying the traditional concept of mitigation, have interpreted this to mean that mitigative measures may be reasonably utilized in resolving conflicts between Federal projects and any fish and wildlife resource, a definition consistent with that found in the Fish and Wildlife Coordination Act (FWCA), as well as other Federal acts.

Mitigation is a viable concept long used by Federal agencies. In biological terms the issue becomes whether project modifications may ameliorate or reduce, but not eliminate, adverse impacts to the habitat and to the species, with the result being a net loss to the species and habitat. In regards to this the goal of the FWCA is one of conservation and enhancement, by preventing the loss of or damage to wildlife resources in connection with Federal projects. To Federal agencies, that means that projects should be modified to incorporate recommendations for conservation, acquisition of lands to compensate for destruction of habitat, or other measures replacing loss, as necessary.

However, Section 7 of the ESA guarantees a higher level of protection. Therefore, Federal agencies must respond in such a way that the traditional concept of mitigation may not be adequate. Mitigative measures, and the term itself, are conspicuously absent from the Act. The ESA cannot be satisfied by project modifications which only reduce the extent of the adverse impacts if such reductions do not meet the specific legal standards in the Act.

As noted in a recent Supreme Court decision (TVA vs. Hill, 1977), "...one would be hard pressed to find a statutory provision whose terms were any plainer than those in Section 7." Under Section 7, two burdens are imposed on Federal agencies:

1. affirmative - Section 7(a)(1) directs Federal agencies "...to utilize their authorities to carry out conservation programs for listed species;" and,

2. prohibitive - Section 7(a)(2) requires every Federal agency "... to insure that its actions are not likely to jeopardize the continued existence of any listed species or result in the destruction or adverse modification of critical habitat."

It was Congress' intent that an agency cannot be excused from the jeopardy prohibition without approval granted in the exemption process. Therefore, it is in an agency's interest to undertake a conservation program as a positive step towards recovery. Such programs have included research, habitat acquisition and maintenance, and species propagation, among others.

If a potential conflict occurs between a listed species and any Federal program or activity, an agency has two avenues of compliance with the ESA. At the early stages of project planning it can consult informally with the hope of identifying modifications of the action which would eliminate the "may affect" situation and satisfy the Section 7 requirements. The FWS will provide guidance in the form of recommendations with the intent of conserving the species. An agency can also consult formally resulting in the issuance of a biological opinion by the FWS.

In the biological opinion, the Secretary can provide recommendations for conservation and if warranted, "reasonable and prudent" project alternatives which, if adopted, could avoid violation of Section 7 by eliminating jeopardy. This consultation process is an attempt to find ways that would allow planning, construction, and the operation of a proposed project to be compatible with the Act. An agency should be aware that no irreversible or irretrievable commitment of resources should be made until their Section 7 obligations have been concluded. For reference two terms need to be defined here:

> Reasonable and prudent alternatives - "...actions that can be implemented in a manner consistant with the purpose of the action and...which avoid the likelihood of jeopardy or result in the destruction or adverse modification of critical habitat."

> Conservation - "...use of all methods and procedures that are necessary to bring a listed species to the point at which it may be removed from the list. Methods and procedures include...resources management, such as research, acquisition, propagation..."

Conservation ~~Compensation~~ cannot be achieved through mitigative measures. Section 7 is applied to prevent jeopardy, not mitigate jeopardy; mitigation only decreases negative impacts. As species are listed because of man's past and present actions, any further adverse impact could have far reaching consequences inconsistent with the primary goal of the ESA. However, there are actions that we can take that could be considered mitigation, but which do not result in a net loss to the species or habitat. It is the goal of the ESA (16 U.S.C. part 446) to "...bring any endangered or threatened species to the point at which the measures provided pursuant to this Act are no longer necessary."

Section II: Mitigation and the Colorado River Basin

Historically, the FWS has looked at each Federal project or program on a case-by-case basis when applying Section 7 of the Act. The burden for compliance is by law on the action agency to insure that its actions are not likely to jeopardize listed species. However, the initiative to develop a plan of action now lies with the FWS in areas of major concern such as the Colorado River System, where negative impacts can have far reaching results. To take into consideration the biological needs of the fish and the future economic and developmental needs of the region and the Nation, the FWS has determined that a comprehensive plan relative to the listed fish is now required.

Since each project will have a biological impact, additive on the system as a whole, those impacts should be minimized to the point that there can be beneficial effects to the fish and their associated habitats. This will require

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cooperation between all interested parties to allow the development of a plan of action by the FWS consistent with the intent of Congress and the ESA.

With the increased emphasis on water resource development during the past several years, a number of water projects have been proposed for the upper Colorado River Basin. Of the main rivers involved (Colorado, Green, White, and Yampa) only isolated and specific reaches presently contain populations of the three endangered fish, the Colorado River squawfish, the humpback chub, and the bonytail chub. Habitat modifications occasioned by several large projects constructed in the past are believed to have contributed to the decline of these fish. As additional projects were proposed for construction, the Bureau of Reclamation, in 1979, proposed that a fisheries study be conducted to determine the causes for the rapid decline in Upper Basin species and to devise a strategy for their preservation.

The need for these studies relative to water development projects exists because there has been a lack of specific biological and technical data for the rivers involved. The rapid decline in the populations of the listed fish is of critical importance as it provides an indication of accelerated habitat deterioration. Data now indicates that protection of existing habitat conditions will not necessarily insure the continued survival of the fish. However, it is difficult to assess impacts on these species and the related ecosystem without further study. This cannot be accomplished on a project-by-project basis, since any further project development could increase the likelihood of jeopardy. Factors such as changes in water quality, temperature, seasonal and diurnal flow, and habitat alteration are known to have contributed to the present status of these fish. Completion of ongoing research will allow collection of the data necessary to fully analyze project impacts and should be used in conjunction with other data to develop a basin-wide policy towards these listed fish and their habitat. Because of the relationship between flows in the tributaries and in the mainstem Colorado, completion of all studies is important in providing a basis for compilation and analysis of alternatives relative to future projects. Insufficient funds and a rigid time table further complicates the issue. These studies, and those currently being conducted on the Platte River System can serve as a model in providing a thorough review of these types of endangered species problems.

In the past the FWS has dealt with other major Western water projects where energy development and/or water rights threaten the listed fish and habitat. The 1978 Amendments to the Act provided an exemption possibility for the first major Western water project controversy, the Grayrocks Dam and Reservoir Project on the North Platte River; the whooping crane and its critical habitat were the primary concern.

Consultation on Grayrocks was conducted in 1978 with a jeopardy opinion issued on December 8, 1978. However, as with the Tellico Dam controversy, Congress included as part of the Amendments, a provision for an exemption if no formal resolution could be attained. Congress also instructed that, if so determined, the Federal agencies involved shall require such modifications in the operation or design of the project as they may determine are required to insure that the project is not likely to jeopardize the continued existence of endangered species. An amount of money ($7,000,000) was placed into an irrevocable trust for the maintenance and improvement of whooping crane habitat on the Platte

River to offset the impact on the critical habitat of all water removed. The expenditure of these funds for a conservation plan on the Platte River is consistent with the intent of the ESA.

In the past, specific projects in the Colorado River Basin have been dealt with on a case-by-case basis with both jeopardy and non-jeopardy opinions rendered. Recommendations, such as maintenance of minimum stream flow, reduction of water diversion during critical periods, replacement of diverted water, buying of replacement water, conducting studies to determine the presence of listed fish, and the development of a management plan for listed fish in the project area have been made and accepted by project sponsors.

Presently, there are over 20 major water projects in the Upper Basin awaiting Federal approval. Without data on relationships between specific flows and other habitat parameters on the biological requirements of the listed fish, it is felt by FWS personnel that final determinations and issuance of biological opinions cannot be completed at this time. A delay has been requested for most biological opinions until early 1982, following completion of the fisheries studies ongoing on the Colorado, Green, Yampa, and White Rivers, and other tributaries. With the completion of these studies, we expect to be able to draw more reliable conclusions about the impacts of proposed projects upon the three endangered fish and then be able to develop more reasonable alternatives for project sponsors to evaluate. Most project sponsors have agreed to await completion of these studies.

However, with the increasing need and demand for energy development and production another year's delay cannot be tolerated for some projects. Some are under construction and await Federal response for completion. Therefore, requests for prompt action have resulted in the development of a conceptual management plan by the FWS Regional Office in Denver as an interim measure until such time as a comprehensive plan is developed.

A preliminary step was taken in February of this year in an attempt to resolve a conflict on the upper Colorado River. This proposed project, the Windy Gap Project, is designed to divert from one watershed up to 93,000 acre-feet per year into the Colorado Big Thompson project for eventual municipal and industrial use. The Regional Office was concerned that further project development would jeopardize these fish species.

With the rapidly approaching deadlines for determinations on Windy Gap and several other projects, the FWS Regional Office developed this management plan which will protect certain populations of these species while allowing the water resource projects to proceed. The central thesis behind this plan is that the cumulative impacts of further reductions and modifications to stream flows by projects in the Upper Colorado River system will result in the eventual extinction of these species. The proposed management plan would allow the projects to be constructed, while providing, if so determined by studies conclusions, for (1) the maintenance of current populations of these species in areas where no water projects are planned, such as the Black Rocks area of Ruby Canyon and Westwater Canyon on the mainstem Colorado and Desolation Canyon on the Green; (2) artificial propagation, and (3) habitat development and improvement, such as creation of backwater areas for spawning and rearing.

In resolution of the Windy Gap Project, the Northern Colorado Water Conservancy District agreed that it would fund certain measures for the conservation of the endangered fish. Project plans were modified to include (1) the establishment of backwater areas and other habitat manipulation as necessary, (2) fund a field research team over a 3-year period to evaluate habitat improvement and to continue to collect physical data needed to assess the impacts of water depletions, sedimentation, and water quality changes on the life cycles of the listed fish, (3) water releases to maintain minimum flows, and (4) a fish culture and stocking program. The FWS will work with the District in developing these options. As a result of these commitments, a non-jeopardy opinion was reached and the project is proceeding. In rendering this opinion, the Regional Office had to evaluate the expected project impacts on the present survival of the species separate from its future recovery. Obviously, an approach of this nature may not be applicable to other types of projects which directly impact listed fish and habitat.

It is proposed that construction of the pending projects be authorized in conjunction with the implementation of the management plan. Several project sponsors have agreed to finance a portion of the management plan if it would help to maintain the species (Windy Gap, Moon Lake, and Cheyenne Water Supply Project). Costs are allocated in direct proportion to the amount of water withdrawn. This is based on a formula worked out by Regional personnel and would involve less than one percent of project costs. As an interim approach, this plan will be subject to modification until a thorough analyses of fisheries data can be made.

A further refinement of this conceptual approach was detailed in an April 17, 1981, letter from Under Secretary Donald Paul Hodel to the Cheyenne Board of Public Utilities on the proposed Stage II of the Cheyenne Water Supply Project. The proposal, acccepted by the Utility Board, "would allow construction to proceed in conjunction with implementation of a management plan." The three points of this proposal include: (1) the FWS will continue with the Yampa River Study with a determination at the completion as to the likelihood of jeopardy; (2) the FWS to issue a non-jeopardy opinion contingent on point three; and (3) the City of Cheyenne to agree, contingent upon the final study determination, to fund a fish management plan not to exceed $180,000. It was determined by FWS personnel that because of the nature of Stage II of the project (small water depletion) that the survival of the species would not be jeopardized. However, the effect on the eventual recovery of these fish again could not be determined without further data. A non-jeopardy opinion was issued, allowing the project to proceed.

It became apparent a few years ago that dramatic changes were occurring in the natural ecosystem of the Colorado River Basin that were having and would have profound effects, not only on listed species, but all species and associated habitats in the Colorado Basin. A lack of data made it difficult to assess the extent of the impacts or the extent of the predicament in which we now find the fish as well as ourselves. The rapid increase in population, coupled with the demand, worldwide, for vast amounts of inexpensive energy along with the need for water has occurred faster than we or the ecosystem were prepared for. Therefore, the FWS has instructed its Regional representatives in the Colorado River Basin to begin development of a comprehensive management plan for the listed fish and associated habitat. However, we realize that a plan covering only the listed fish is wholly inadequate relative to the demands on the system and the needs of all species and habitats, while satisfying human needs as well. Therefore, we are requesting the help and input from all agencies, States, and interested parties in formulating this regional plan for endangered fish in the Colorado River System in an effort to realize all eventualities.

In this regard, the FWS Regional Office in Denver has recently appointed a coordinator for development of the Colorado River Conservation Plan for endangered fish. At the Regions' suggestion, representatives of all agencies involved will be meeting to discuss and develop a comprehensive plan, compatible with all local and regional needs. Aspects of the plan to be considered are identification of those areas of the Colorado Basin that are critical to the recovery of the listed fish, identification of the major problems facing the listed species and strategies for solving the problems, completion of existing studies and the recovery plans for all species, use of the plan in application to upcoming biological opinions, analysis of existing and expected data, sport fishing, management potential and problems, fish culturing and stocking, and estimates of annual expected costs.

<u>Summary</u>

Up to this time the approach has been piece-meal and often inadequate. Without a general plan for the conservation of the listed fish, some of the previous actions may be for naught. However, until such time as a comprehensive plan is developed and found acceptible, the project-by-project approach must suffice. A comprehensive plan will require the cooperation of myriad and diverse interest groups. The goal will be to assure beneficial impacts from project development that can be applied to the survival and eventual recovery of the listed fish. The ultimate goal is to protect the listed fish and, therefore, the natural ecosystem to the greatest extent possible, while promoting responsible area economic growth and development.

1980 UPDATE ON ENDANGERED SPECIES

Robert J. Behnke

November 4, 1980

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In late August, 1980, the Division of Wildlife's endangered species monitoring team sampled newly hatched larval fishes from the Yampa River in Dinosaur National Monument. In the lower Yampa River, in a section from the confluence with the Green River to a point 6.7 miles upstream, larvae of endangered species were found. To date, the entire collection has not been examined, but 25 squawfish and 1 humpback chub have been identified.

According to what I have said and written in the past concerning the influence of red shiners and redside shiners on squawfish reproduction, the finding of young squawfish in the lower Yampa was not unexpected -- in fact it was predictable (if I am correct in my assessment of the interaction of red and redside shiners with the squawfish). In the 1970's the red shiner moved up the Green River, virtually replacing the redside shiner. Where red shiners were the dominant species, squawfish and humpback chub reproduced successfully. Where redside shiners are dominant, no young squawfish or humpback chub are found. In 1977, the red shiner was first recorded from the lower Yampa. I found the red shiner to be relatively common in the Yampa at Lily Park (two miles below Cross Mountain) in October, 1979. Evidently, the red shiner is in the process of replacing the redside shiner as a dominant species in the lower Yampa River. If this is true, then more widespread evidence of successful reproduction of squawfish and of humpback chub will likely be found in 1981 if the Yampa in Dinosaur Monument is sampled again.

Thus, the significant new information relevant to Juniper-Cross Mountain impact on endangered species is that the lower Yampa River will now be considered as an important area for endangered species reproduction. In regards to proposed Project flows, the major problem I foresee concerns the diurnal flow fluctuations from peaking power production at Cross Mountain Dam (estimated to be 2.5 feet at Lily Park and 1 foot at confluence with the Green).

An adult humpback chub was collected in 1980 from Cross Mountain Canyon (about 1 mile from upstream entrance). This find extends the known range of the humpback chub to above the Cross Mountain Dam site. The occurrence of humpback chub in Cross Mountain Canyon also was not unexpected. I had a reliable report from a former student that he caught a humpback chub in the lower end of Cross Mountain Canyon while fishing for catfish in 1978. In October, 1978, I surveyed and sampled the Yampa River in Cross Mountain Canyon with the DOW crew. We collected 100's of roundtail chub but no humpback chub. The canyon area does provide some deep-water pools (10 to 20 feet in depth). These pools are not large with good habitat diversity in comparison to the "prime" humpback chub habitat in Ruby Canyon of the Colorado River. Thus, Cross Mountain Canyon can be considered as marginal humpback chub habitat -- they are there in low numbers, but maintenance of the present environment in Cross Mountain Canyon is not critical for the preservation or recovery of the species.

Numerous adult squawfish were taken in the Yampa in 1980, particularly at Lily Park and in Juniper Canyon. An 18 inch squawfish was captured at the lower end of Cross Mountain Canyon. This particular fish had been tagged in 1979 in the Green River. There is no doubt that adult squawfish may migrate for considerable distances. The squawfish found in the Yampa River above Cross Mountain at Maybell and in Juniper Canyon may have migrated from the lower Yampa or Green. After finding an area of good habitat, such as Juniper Canyon, they remain as permanent residents. The lack of any evidence of successful reproduction of squawfish above Cross Mountain Canyon, supports my contention that the Project area is not a significant part of the range of the squawfish and not part of "critical" habitat -- it is not "critical" for the preservation or recovery of the species.

IMPLICATIONS

The documented occurrence of endangered species reproduction in the lower Yampa River, will most probably result in requests by FWS and DOW that no diurnal fluctuation from peaking power production at Cross Mountain Dam be permitted. The rationale of such a request would be based on the fact that young squawfish are most frequently found in relatively shallow water (1 to 2 foot depths) and fluctuations of 1-2 feet each day would alternately innundate and desiccate the prime larval habitat.

I examined photographs of the sites where squawfish larvae were found to estimate the impact from daily fluctuations. In some sites, I could argue an improved condition would result (some young squawfish were isolated in pools that would desiccate before next year's high flow). In other sites, a daily fluctuation would most likely be harmful. The instream flow methodology currently used by FWS to quantify desirable flows for various life history stages of squawfish could be applied but I doubt that the results would be conclusive. Each site with similar habitat characteristics would have to be cross-sectioned with detailed data taken for computer modeling to predict changes from changing flows. The results would most likely support my observations of the photographs -- successful reproduction might continue in some areas with a one foot or more diurnal fluctuation and not in others.

In last year's report I alluded to the impact of diurnal fluctuation in river flow on the success of squawfish reproduction. During the early years of the operation of Flaming Gorge Dam (1963-1966), abundant squawfish reproduction occurred in the Green River from the Yampa confluence to

Ouray, Utah. In recent years, squawfish reproduction has been good in the Green River below Ouray, but not above. The main difference between the two time periods is that during the early years of operation, the amplitudes of peak releases from Flaming Gorge were much less than in recent years. In 1966, the diurnal fluctuation in the Green River at Island Park (32 miles above Jensen) was 4 inches. In 1978, the daily fluctuation at Jensen was 16 inches. Below Ouray, in Desolation Canyon, where squawfish continue to have good reproductive success, the daily fluctuation is 3 to 4 inches. This circumstantial evidence suggests that a daily fluctuation of 4 inches or less may not inhibit squawfish reproduction, but a fluctuation of 12 inches or more is probably harmful.

In view of the difficulties involved in defending a no negative impact position for the proposed flow regime below Cross Mountain Dam, it may be judicious to plan to consider the demand that no (or a greatly reduced) fluctuation be permitted below Cross Mountain. I cannot envision that spending any amount of money for further studies would produce evidence that the proposed fluctuating flows below Cross Mountain would not be deleterious to squawfish. A budget of 1.5 million dollars has been proposed for fish and wildlife mitigation with $300,000 of this earmarked for a "modeling" stream flow study. I doubt that much value would be received from a $300,000 "modeling" study. Could this money be used for mitigation to eliminate or greatly dampen the flow fluctuations below Cross Mountain Dam?

In any event, if the FWS is truly concerned about endangered fish species and not merely looking for opportunities to block the Juniper-Cross Mountain Project, they should vigorously pursue the matter of flow fluctuations by demanding that future operation of Flaming Gorge Dam be similarly modified to eliminate the flow and temperature regime that has suppressed endangered species reproduction for more than 10 years in 150 miles of the Green River. Concerning "jeopardy" to endangered species, the impact of the proposed fluctuations from Cross Mountain Dam on the lower Yampa River is insignificant in comparison to the impact of Flaming Gorge Dam on the Green River downstream to about Ouray, Utah.

RIVER FLOWS

The contention made in last year's report that the proposed flow regime (volume of flow; not considering fluctuations) from the Project would have a beneficial impact on squawfish downstream was supported by a study by Prewitt and Carlson (1980). Four different methods of predicting flows necessary to maintain squawfish habitat were compared. Basically, the prediction of minimum, adequate, and optimum flows depends on quantifying certain habitat characteristics such as depth and velocity in areas where squawfish are known to exist. Then the data are programmed into a computer model which reveals how much useable squawfish habitat is gained or lost with increasing and decreasing flows.

In the Yampa River, the site north of Maybell and the site at Lily Park were modeled to predict flows necessary to maintain squawfish. The conclusion was that 200 cfs would be a good flow to maintain squawfish habitat. At Lily Park, where catfish are abundant, the computer output predicted that increasing the flow to 1200 cfs would favor the squawfish over the catfish (because of the higher velocity). If the fishes respond as predicted, the increased flows of July and August due to the Project (below confluence with the Little Snake where July flows would average 2,120 cfs [26% increase] and August flows would average 1,326 cfs [320% increase]) will favor the squawfish over the catfish and increase squawfish abundance.

In most rivers, with most fish species, the critical flows, in relation to maintaining good habitat, are the low base flows of late summer, autumn, and winter. Higher base flows result in more optimum habitat and increased fish abundance. By storing the peak flow of May and June and distributing this flow throughout the rest of the year, the Juniper-Cross Mountain Project will elevate the base flow in the lower Yampa and Green rivers. Habitat conditions for fishes will be improved over natural flow conditions.

I don't believe FWS can successfully challenge this conclusion. The problem left to be resolved concerns the peaking power fluctuation of flow.

Figure 1 illustrates the change in the Yampa River hydrograph below the confluence with the Little Snake that would result from the Juniper-Cross Mountain Project. The base flow will be greatly increased, particularly during the critical period of spawning and rearing for endangered species. The base flow will often approximate the average annual daily flow -- the most optimum condition for fishes.

LITERATURE CITED

Prewitt, C. G. and C. A. Carlson. 1980. Evaluation of four instream flow methodologies used on the Yampa and White rivers, Colorado. U.S. Bur. Land Mgt., Biol. Sci. Ser. 2:65p.

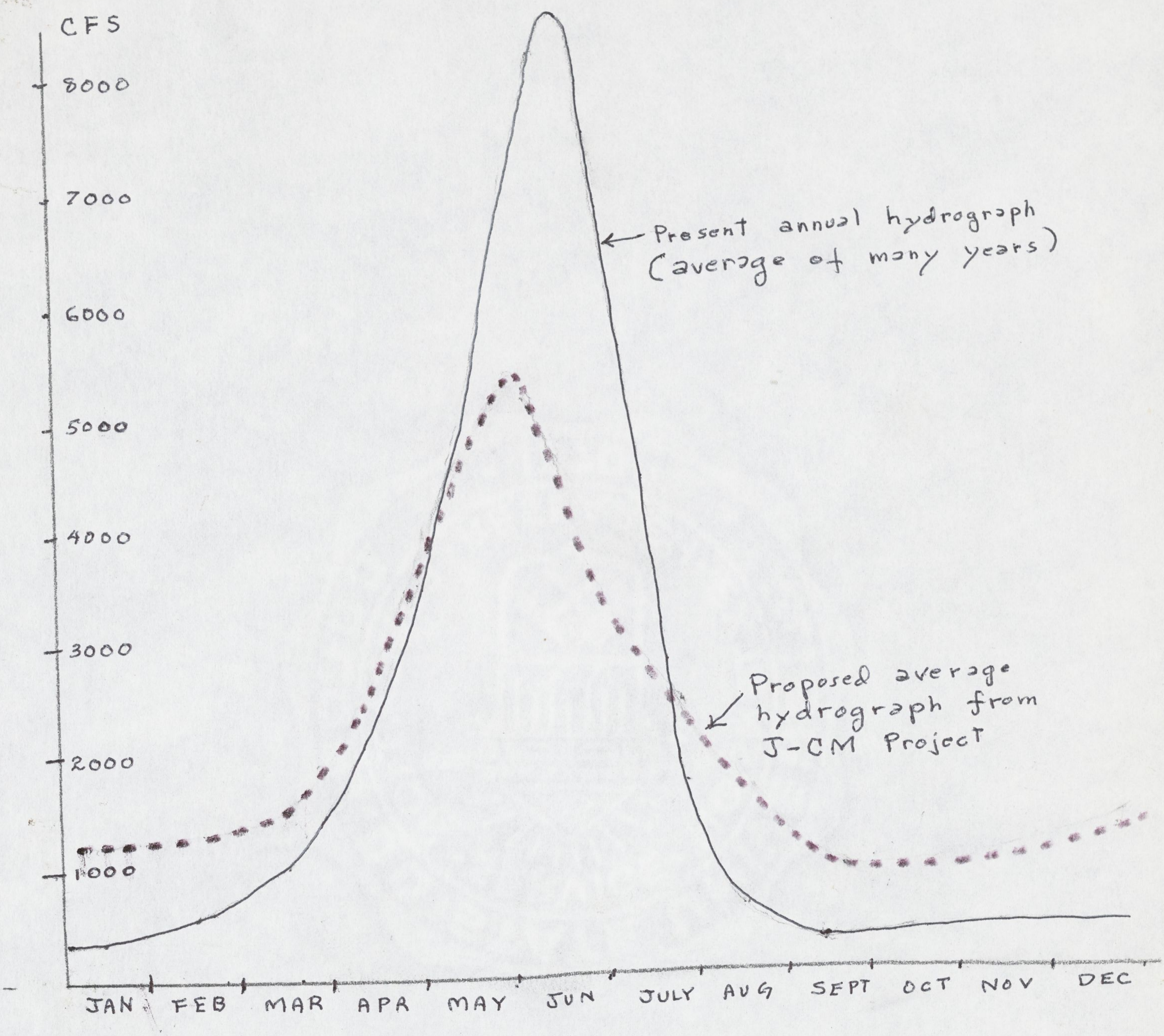

Figure 1. Average annual hydrograph of the Yampa River below confluence with the Little Snake and average hydrograph resulting from Project. The storage of peak flows and their gradual release increases the base flows particularly during critical periods of reproduction and rearing of endangered species. The higher base flows create more useable habitat for endangered species and should increase their abundance. The higher velocity of the base flow should favor native fishes over non-native fishes. This increase of base flows will be extended into the Green River but it will be of a lesser relative magnitude.

UPDATE ON ENDANGERED SPECIES

1980 ~~Update~~ on ~~Endangered Species~~

~~and Implications~~ Robert J. Behnke

November 4, 1980

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Prewitt study why flow fixed [uncertain reading]

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(9)

Gorge Dam on the Green River downstream to about Ouray, Utah.

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[ca 1980-82]

MATTERS SUGGESTED FOR DISCUSSION AT
WATER DISTRICT, COLORADO-UTE MEETING

For the meeting tentatively scheduled August 25, in Grand Junction, some ~~the~~ strategies and direction should be evolved on the matters discussed below.

During the past year successful reproduction of squawfish was documented in the lower Yampa River and adult squawfish movement was traced from the Green River-lower Yampa upstream to Juniper canyon and back downstream to the lower Yampa for spawning. Also, one humpback chub was recorded from Cross Mountain Canyon. Although these events were not really unexpected, they do change the conclusions made in the original biological assessment of the Juniper-Cross Mountain Project regarding no negative impacts on endangered species.

We must face the realities that 1. Squawfish from the Green River and lower Yampa River do migrate into the reservoir site area and feedand grow there. That is, the reservoir site areas contribute to the total mumbers and biomass of squawfish and, 2. Some of these squawfish in the reservoir site area migrate back downstream to spawn in the lower Yampa in areas where young squawfish were collected last year. That is, they make a contribution to the continued existence of the species.

Although additional information and data will be gathered this year, the basic realities 1 and 2 will not change and the District must be ready to deal with this matter when we are confronted with it at some future time (perhaps for inclusion in the EIS).

At the upper echelon of FWS, they are eager to resolve the Juniper-Cross Mountain conflict with endangered species. At the lower level of the Colorado River Fishes Study Team, they are adamantly opposed to the Project. I don't believe we can hope for a strictly political decision whereby negative input is ignored by FWS in order to make a nonjeopardy opinion favorable to the District because the negative information would be available to the National Wildlife Federation for a legal challenge. Thus, we will have to come up with some ideas that are biologically sound and workable--ideas that if successfully implemented would avoid negative impacts and promote favorable impacts on endangered species.

We can refine and modify plans to suit new information and any input we receive from FWS, but presently, I envision mitigation-enhancement measures along the following lines. The amount of squawfish (and humpback chub) that would be lost by blocking access to the upper Yampa River can be roughly quantified (as was done in a recent report sent to Mr. McCarty for inclusion in his latest (July 29) response to FERC). This lost fecundity can be compensated for by artificial propagation. The District would probably be requested to contribute to a fund for hatchery propagation of Colorado River endangered species.

The potential for enhancement consists of chances to improve downstream habitat conditions, especially nursery habitat, from a new flow regime and any artificial structural devices that may create new or improved habitat. In this regard, I need to know more about the range of flow regimes that the

Project can release from Cross Mountain Dam. The environmental assessment report mentions three possible ranges of flows for each month of the year. In figure 1 of my June 19th report I plotted the range of the three proposed Project flow regimes, superimposing them on the average annual Yampa River hydrograph to illustrate that the post-project flows would be much superior to "normal" flows in regards to fish habitat. However, I would need to know the extent that flows from Cross Mountain Dam can be manipulated to meet any requests from FWS for a specific flow regime during a certain period and to dampen or eliminate downstream impacts of daily fluctuation from dam operation. These will be critical matters in future negotiations for a nonjeopardy opinion that can be defended.

Opponents to the Juniper-Cross Mountain Project are not likely to publicly declare that the Project should not be built but rather their strategy will be to attempt to place the District in the role of an uncompromising exploiter. This could be done by proposing flow regimes from Cross Mountain Dam for endangered species that Colorado-Ute would consider as infeasible to meet. Opponents then could propagandize the fact that "environmentally sound" flows had been proposed but rejected by the District. For future negotiations and discussions I will have to have a better understanding of just how flexible proposed flow regimes can be from Cross Mountain Dam within the limits of the production of electricity.

Along the lines of influencing public and political opinion, how can capitalize on the fact that, in regards to the well-being of endangered species, the Green River and the operation of Flaming Gorge Dam is much more significant then is the Yampa River and the Juniper-Cross Morntain Project. Without changes in the operation of Flaming Gorge Dam, there can not be an increase in squawfish abundance. The District has already proposed an operational regime designed to favor endangered species and is willing to discuss how the operational regime can be further improved. What is the official position of the Dept. of Interior regarding the operation of their dams and projects to favor endangered species? Private enterprise can not do this job alone without government cooperation to improve habitat conditions in the Green River from modifying the operation of Flaming Gorge Dam. If DOI is really serious about saving endangered species and demands severe limitations on the operation of Cross Mountain Dam, then they must also apply these same criteria to their own projects.

Also regarding flows, I hope to soon have a review and critique of Paul Holden's work: "The relationship between flows in the Yampa River and success of rare fish populations in the Green River system," funded by the National Park Service. The District (must be in a position to refute the statements) contained in this work to the effect that ("normal" flows in Yampa) are necessary to the rare fishes in the Green River. If Holden is correct, then any interference with "normal" flows would jeopardize the continued existence of the endangered species.

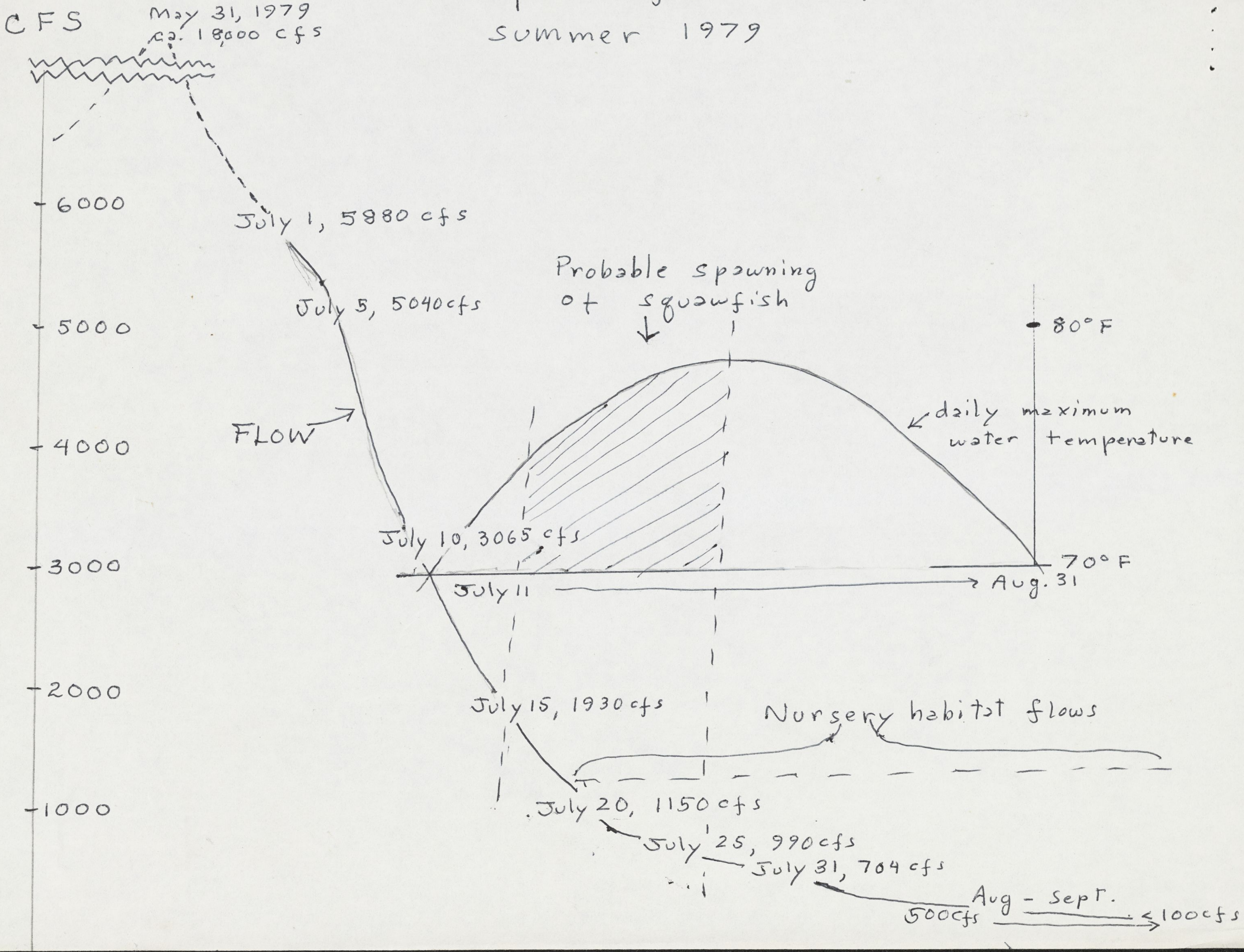
We should also discuss "downstream habitat changes" as a result of the Project. This concerns the changes in channel morphology and river characteristics as a result of changing the flow regime and the sediment transport capacity of the Yampa River. In previous reports I pointed out a need for the District to have some expertise in the area of hydrology-fluvial geomorphology to articulate and lend credibility to any conclusions made.

In 1980 FWS invited 20 world authorities on river mechanics to a workshop in Fort Collins. The participants were given background data on the Yampa River and then asked to predict the downstream changes that would occur from the operation of the Juniper-Cross Mountain Project. The participants each wrote a chapter for the Proceedings of this workshop. The Proceedings have not been published but I have a copy that I will bring to the meeting. There is a wealth of information contained. Although each participant mentioned that additional field work was necessary to better quantify their predictions, the general consensus was there would be no significant changes below the confluence with the Little Snake River because the post-project flows would be more than adequate to transport all of the sediment deposited by the Little Snake River as is currently being done. Thus, we now have considerable support for the statement I made in my "scenario" report that no significant habitat changes will occur downstream from Cross Mountain Dam.

Concerning other downstream environmental changes, I recently read USGS Professional Paper 1132 (1980) on vegetational changes along the Colorado River below Glen Canyon Dam as a result of the new flow regime. There has been a great increase in riparian vegetation and associated birds, mammals, reptiles, etc. for hundreds of miles downstream from the dam, despite daily fluctuations of six feet or more at Lee's Ferry, 20 miles below the dam. This response came about because the historical peak flood flows have been eliminated.

The enclosed figure is based on USGS Yampa River flow data for the 1979 water year. From temperature data I estimated squawfish spawning time. The point I emphasize is that "normal" flows drop so quickly in the lower Yampa, the squawfish nursery habitat--the side channels and backwaters--that the newly hatched fish would enter in late July, are essentially gone in late August-September. Most of the critical habitat would be high and dry as flows drop from more than 1000cfs at hatching to less than 100cfs in September (less than 5% of the average annual daily flow). Regulated flows can certainly be an improvement over these natural conditions.

Yampa R. flows & temperatures summer 1979



COLORADO RIVER WATER
CONSERVATION DISTRICT

March 31, 1981

Dr. Robert Behnke
Colorado State University
3429 E. Prospect
Fort Collins, Colorado 80525

Juniper-Cross Mountain Project, FERC #2757
McCarty's letter of March 24, 1981

Dear Bob:

Would you please let me have a cost estimate for the work you suggest on pages 11 and 12 of your March 1981 preliminary draft: Operation of Cross Mountain Reservoir and Possible Constraints on its Flow Regime in Relation to Endangered Species.

Very truly yours,

Rolly

ROLAND C. FISCHER
Secretary-Engineer

RCF/ems
c: Doug Wagoner, Colorado-Ute

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303/945-8522 / P.O. BOX 1120 / GLENWOOD SPRINGS, COLORADO 81601

COLORADO RIVER WATER CONSERVATION DISTRICT

March 31, 1981

Mr. Doug Wagoner
Colorado-Ute Electric Association
P.O. Box 1149
Montrose, Colorado 81401

Juniper-Cross Mountain Project, FERC #2757
Colorado River Squawfish - McCarty's letter of March 24, 1981

Dear Doug:

As you can tell from the enclosed copy of my letter to Bob Behnke I have asked him to prepare a cost estimate for the work he proposes be done in his March 1981 document "Preliminary Draft: Operation of Cross Mountain Reservoir and Possible Constraints on its Flow Regime in Relation to Endangered Species.

I would assume you agree that the work should be carried out and as soon as I hear back from Bob Behnke we will discuss this matter further.

Very truly yours,

ROLAND C. FISCHER
Secretary-Engineer

RCF/ems
enclosure
c: Bob Behnke

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303/945-8522 / P.O. BOX 1120 / GLENWOOD SPRINGS, COLORADO 81601

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Robert L. McCarty
Charles M. Noone
Christopher D. Williams
Dennis P. Donnelly
Michael N. McCarty

Telephone
554-2955
Area Code 202

March 24, 1981

Mr. Roland C. Fischer
Colorado River Water
Conservation District
P.O. Box 1120
Glenwood Springs, CO 81601

RE: Juniper - Squawfish (0375 C.03)

Dear Rolly:

Bob Behnke sent me a note dated March 9 covering a 12 page preliminary draft entitled "Operation of Cross Mountain Reservoir and Possible Constraints on its Flow Regime in Relation to Endangered Species", March 1981, which he indicated had been sent to Doug Wagoner. I assume that both you and Kenneth have also received copies.

I agree with the Behnke conclusion that even if Interior directed FWS to make a no jeopardy opinion NWF would very probably challenge the result. Whether or not they would be successful it seems to me would depend in large part on who knew more about the facts. Bob Behnke seems to be suggesting that we should make our own study, I assume this summer, by putting a graduate student on the ground (and in the water) (Behnke report p. 11) whereunder that person would almost literally follow every move made by young squawfish on a day by day basis. This work would apparently involve monitoring the red shiner - redside shiner situation.

Bob does not put a cost figure on the work but I would urge that you try to find out from him what the cost would be and arrange promptly with Doug to make sure that we can get this work done. The arrangement should assure that the work is done under Bob's general direction and supervision. If a helper for the field work is needed I hope that is arranged.

While we have many issues we still have to defuse the squawfish item is undoubtly the hinge. With the Interior study presently going forward that agency will be in the position of knowing more than anyone else unless we have Bob supervising the apparently most critical element for us, namely, what fluctuation below Cross Mountain can the squawfish live with (and we hope prosper), and how short can we make the low-fluctuation flow period? This same study, of course, should examine the possibility of maintaining nursery areas at about the peak flow levels, possibly making artificial channels, which might obviate any significant flow reductions entirely.

Our own expert tells us (at p. 10): "There is no way a substantial case can be made for a no effect or a beneficial effect on squawfish reproduction" under the current proposed flow regime from Cross Mountain.

In these circumstances we should get into the necessary studies so that Bob will have a real basis for altering that view.

With best regards,

Sincerely,

McCARTY, NOONE & WILLIAMS

Robert L. McCarty

RLM:dp

cc: Messrs. Balcomb, Wagoner, Behnke

Department of Fishery and Wildlife Biology

Colorado State University
Fort Collins, Colorado
80523

Mar. 9, 81

Dear Bob:

Enclosed is report sent to Doug Wagner, Colo-Ute explaining some problems we face with the proposed flow regime. You might come up with some new ideas on how to best handle this matter.

I received a copy of your response to FERC (Feb. 23 comments to Mr. Lindsay). They seem to cover the subject quite well, but I might suggest you could bring out the extra costs involved (ca. 1 million $ +) for variable surface releases from both reservoirs that are specifically built into Project plans to warm flows for endangered species.

Sincerely,

Bob

CSU
Department of Fishery and Wildlife Biology
Colorado State University
Fort Collins, Colorado
80523

Mar. 10, 81

Dear Ken:

Enclosed is a copy of my summary regarding the major problem I see in regards to Cross Mtn. Dam flows and the End. Sp. Act. I don't see any quick and simple solution at this time.

FWS plans to capture squawfish in the Yampa and Green R. next month and put radio tags on them to follow them around and try to find out when and where they spawn.

FWS people want to put off the consultation on Juniper-Cross as long as possible. They have a real dilemma. If they make a jeopardy opinion their in trouble with Sec. Watt. If they don't they'll be sued by Nat. Wildlife Fed., so expect every delaying tactic they can think of.

Sincerely,

Bob

[1981]

SUPPLEMENT TO AQUATIC ENVIRONMENT SCENARIO

Robert J. Behnke

June 2, 1981

I have had the "scenario" reviewed for possible errors, flaws, and weaknesses. Besides a few misspellings and typos, everything I wrote can be used as is--there are no basic errors in my interpretations regarding water quality, aquatic environmental change, etc. I note that Bob McCarty has excerpted sections of the scenario to respond to FERC questions. Mr. McCarty rightly excised my personal comments interspersed throughout the paper. These were put in to call attention to the general lack of knowledge and expertise evidenced by the requests. The FERC request demonstrates a problem concerning the content of environmental assessments that must be overcome if great delays in the EIS process are to be avoided. The problem concerns separating the relevant from the irrelevant and getting to the crucial issues. The crucial issues of environmental impact assessment for the Juniper-Cross Mountain Project is simply: what would the Project do to squawfish and humpback chub? And this, in turn, is mainly a matter of analyzing the proposed Project flow regime and attempt to decide on a flow regime most favorable for the successful reproduction of the endangered species.

During the early years of environmental impact statement preparation, the EIS was characterized by species lists, page after page of tables of data, etc. They were often several volumes in size but essentially worthless in respect to providing meaningful information to evaluate changes in the ecosystem. This problem was soon recognized and federal agencies (typically USFWS as lead agency) sponsored many meetings and symposia on the matter of improved biological assessment. For example, "Classification, inventory, and analysis of fish and wildlife habitat". Proceedings of a national symposium, Phoenix, Ariz., Jan. 1977; FWS/OBS-78/76:604p, and, "Biological evaluation of environmental impacts"(proceedings of symposium at 1976 annual meeting of the Ecological Society of America and the Am. Inst. Biol. Sci., cosponsored by FWS and CEQ) FWS/OBS-80/26:237p. The latter publication contains a quote from Russell Peterson, former chairman, CEQ:...

"The purpose of the EIS is to clarify, not obscure, issues and to forecast and analyze significant impacts of a proposal and its reasonable alternatives. Efforts must be made early in the EIS process to weed out unnecessary information. Then, by focusing attention on meaningful analysis, the legal adequacy of an EIS will also be supported and enhanced."

This same publication contains many attacks on the notion that compiling species lists and more and more irrelevant data has any validity.

Thus, I was somewhat dumbfounded to receive the FERC request in 1981, for more species lists, more irrelevant data compilation, etc., six months after the "scoping" meeting on the Juniper-Cross Mountain Project.

I would also point out that in May, 1981, the FWS released a list of the 100 top priority national fish and wildlife issues. Colordao River endangered fishes ranked 13 on this list. With such emphasis then, by FWS regarding improved biological assessment and on the Colorado River endangered fishes, the request list from FERC seems completely inappropriate. At this rate, the EIS will take years to complete and will still not resolve the problem of endangered species conflicts. An interesting question concerns why, despite the emphasis given Colorado River endangered fishes by FWS, and the FWS development of expertise for biological assessments, this agency has refused to allow this expertise to be applied to Colorado River endangered fish problems? The Office of Biological Services (OBS) of FWS is the agency responsible for developing assessment expertise and resolving conflicts between fish and wildlife and development. Yet the employees of the Western Energy and Land Use Team (WELUT of OBS) in Fort Collins have been ordered not to get involved with endangered species. I can find no adequate answer as to why FWS, after building up an area of expertise especially to resolve conflicts between energy development and fish and wildlife, now forbids this expertise to be applied in situations where it is desperately needed.

I would suggest that the District try to guide and speed-up the resolution of potential endangered species conflicts by arranging a meeting with FWS (plus Colo. DOW, BLM, FERC, Battelle, and any interested parties).

I believe a problem is that FWS wants to delay formal endangered species consultation on Juniper-Cross Mountain because they would then have only 90 days to make a jeopardy or nonjeopardy opinion. If our meeting is merely an informal discussion and not the initiation of formal endangered species consultation, this problem can be avoided. Our goal in such a meeting should be to get general agreement on the points I brought out in my "scenario"--that the critical issue to be resolved to avoid jeopardy to endangered species concerns the proposed Project flows. What should these flows be? Is more research needed; if so, what should be done? What should be the District's role in future research?

One of my former graduate students, Mr. Terry Hickman, is currently the FWS endangered species consultant for the Juniper-Cross Mountain Project. I will contact Mr. Hickman regarding "informal" discussions and request that he contact the District to set up a meeting. A problem here is that Mr. Hickman isn't entirely familiar with all of the details, especially flow considerations, necessary to make significant progress toward problem resolution. I would request that Mr. Mike Prewitt, who has been in charge of the flow studies of the Colorado River endangered species research (and currently Assistant Director of this research project), be present. I talked with Mr. Prewitt last week. He now tells me that he believes a flow of 1500 cfs would be best for squawfish reproduction in the lower Yampa.

During the raft trip, the person from Western Engineers told me that if Cross Mountain Dam released two peaking power surges each day, they would essentially cancel each other out downstream. At Harding's Hole (16.5 miles from mouth of Yampa) such a flow regime (without any spillover at dam or any input from Little Snake River) would vary from 1700 cfs to 1900 cfs each day during July. This type of flow regime would appear to be very favorable to endangered species and, if agreeable with Colorado-Ute, I believe we can use this option of "double peaking" as a powerful mitigation measure and essentially avoid the problem of daily fluctuation I have brought up in several previous reports. During the raft trip I did not observe any likely endangered species nursery habitat (side channels and backwaters) until the Harding's Hole area on the river (however, I must admit that the habitat at 300 cfs when young squawfish were found last August would be different than at the 3000 cfs flows during our raft trip).

Currently, the FWS (Washington office) is urging the Colorado River endangered species research team to resolve the problems of the Juniper-Cross Mountain Project this year. However, Bill Miller, the Director of this research, maintains they need "more data," "more research," etc., and if they err they must err on the side of endangered species. FWS has come up with a gimmick that might forever perpetuate its "research." Based on a formula on virgin flows and percent depletions of virgin flows, three recent projects were given nonjeopardy opinions after they agreed to pay "mitigation" money to FWS. On this basis, this District might be requested to pay about $750,000 to deplete flows of about 40,000 acre feet annually by reservoir evaporation. The National Wildlife Federation is giving close scrutiny to this idea of endangered species "bribe" money to resolve potential jeopardy situations, and I doubt that NWF would let FWS get away with such a deal on Juniper-Cross Mountain even if the District was willing to pay.

If a meeting can be arranged, we should get together the previous day to plan strategy. I would like to examine the aerial photos of the lower Yampa taken by Western Engineers last August and correlate them with a quantification of the habitat where the young squawfish were found about that same time.

ADDENDA TO SCENARIO

The Raft Trip

The raft trip of May 14-17 provided some valuable first hand observations of potential endangered species habitat. The canyon areas of the Yampa River provide good adult habitat (deep pools and runs) but little nursery habitat for successful reproduction. Islands, side channels and backwaters were not observed until Harding's Hole (16.5 miles from mouth) and then, intermittently, the river would have channel configurations providing potential nursery habitat every few miles to the confluence with the Green. It is the Green River, however, especially in its brood expanses at Island Park and below Split Mountain (near Jensen) that provides an abundance of potential habitat for the young of endangered species. This observation reinforces the point I have emphasized many times--the Juniper-Cross Mountain Project can not do the job of enhancing the endangered species environment alone. The most significant factor will be the future operation of Flaming Gorge Dam--and this point should be agreed upon by FWS representatives at any meeting we might have. It is basic to any meaningful resolution of "jeopardy."

Other Items

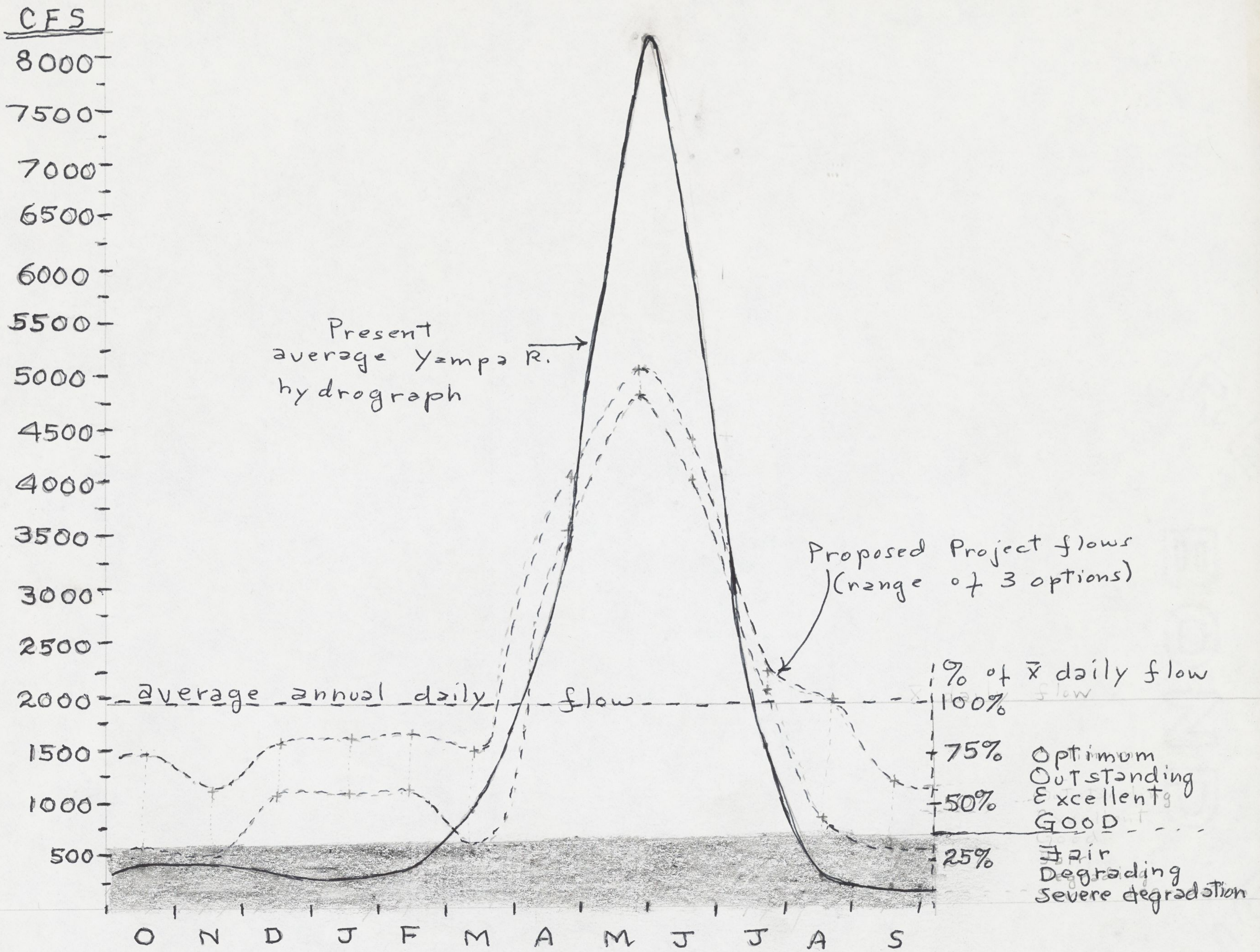
Since writing the "scenario" I have received additional literature pertinent to points discussed. Considerable research on the impacts of peaking power flow fluctuations has been done at the University of Idaho. A former C.S.U. student is currently a graduate student there and he kindly sent the following reports: "A study of fish and aquatic macroinvertebrate fauna in the South Fork Boise River below Anderson Ranch Dam with emphasis on effects of fluctuating flows;" "Effects of water fluctuations on benthic insects;" "The effects of regulated flow on benthic insects in the Clearwater River;" "Interacting effects of minimum flow and fluctuating shorelines on benthic stream insects;" and, "The effects of river fluctuations resulting from hydroelectric peaking on selected aquatic invertebrates."

I also obtained a nine page bibliography and a package of the most pertinent reprints from the Canadian Department of Fisheries and Oceans concerning their research on experimental lakes--limnology, nutrients, toxicology, heavy metal contamination, primary production, invertebrates, fishes, etc. This new information essentially supports and adds depth to the various points brought out in my "scenario."

Regarding fisheries management of Juniper and Cross Mountain reservoirs, I neglected to point out that the history of fisheries management by the states in other upper basin reservoirs is well documented by the states involved--Navajo Reservoir (New Mexico), Lake Powell (Utah and Arizona) and Flaming Gorge (Utah and Wyoming). Each state conducted reservoir fisheries investigations. The Bur. Rec. has nothing to do with formulating fisheries management plans. For example, Utah Div. Wildlife Resources publication 78-9 "Background of Flaming Gorge Fisheries Investigations," discusses the work on Flaming Gorge by Wyoming and Utah and lists many of the publications based on these studies (a most recent Utah publication concerns an evaluation of forage and game fishes for potential introduction into Flaming Gorge).

Although these publications contain useful information applicable for fisheries management of Juniper and Cross Mountain reservoirs, I can not understand why the District receives requests for fisheries management plans. The agency that builds and operates the reservoirs is not involved in fisheries management. We should try to find out who is asking these questions and why they want the information. Someone at the upper echelon of FERC should start to play a decisive role in seeing to it that the Juniper-Cross Mountain EIS process moves right along on schedule by making it clear that an aggressive policy must be initiated to sort out relevant from irrelevant issues. The District should no longer be plagued with requests for species lists and answers to dumb questions on bacteria, zinc, moss on the rocks, and piles of driftwood--these are simply diversionary to the important issue of avoiding jeopardy to endangered species.

I have also redrawn the figure to graphically demonstrate why postimpoundment flows would be beneficial to aquatic life.


CFS
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Present average Yampa R. hydrograph
Proposed Project flows (range of 3 options)
average annual daily flow
% of x̄ daily flow
100%
75% Optimum
Outstanding
50% Excellent
GOOD
25% Fair
Degrading
Severe degradation
O N D J F M A M J J A S

Figure 1. Preimpoundment and postimpoundment proposed flows based on three possible release schedules (from table 3.2-1 Exhibit W), correlated with Tennant's (1976) classification of flows favorable to fishery values andaquatic life based on percentage of average daily flow. Note the present Yampa River hydrograph (below confluence with Little Snake River) is characterized by fair to degrading flows (10% to 30% of average daily flow) for most of the year, particularly in late July and August, the time of spawning and early life history of squawfish. The proposed Project flows would increase these fishery values from fair-degrading into the good, excellent, outstanding, and optimum range for most of the year.

Also the present annual flow regime of the Yampa River is extremely variable. For example, the average daily flow in July, based on 28 years of USGS records is 1688 cfs. However, the "average" flow is illusionary--it doesn't occur. Over 28 years the average daily July flow has ranged from 156 cfs to 6919 cfs, a 44 fold difference.

Only once during this 28 year period has the average daily July flow been within ± 10% of the long-term average. One standard deviation around this mean value gives a range of flows from 211 cfs to 3165 cfs, which would be expected to occur 68% of the time. Thus, what is the "best" flow favoring squawfish reproductive success? The major advantage of regulated flow is that, after peak runoff, the flows can be stabilized. Once a "best" endangered species flow is determined for critical life history periods, this flow can be repeated year after year with considerable regularity and predictability.

[Ca 1981]

Summary of Endangered Species Concerns

Prior to receiving the Juniper-Cross Draft EIS, it may be useful to detail some points discussed at the meeting in Glenwood Springs, December 3.

An obvious problem is that those people directly involved in endnagered species studies for the USFWS and the CDOW, and whose information and opinions are forwarded to the FERC for the EIS process, are emotionally committed against the Project.

A useful strategy would be to get official statements at high levels in DOI and CDOW delineating the basic premise of endangered species research in relation to avoiding and resolving potential conflicts between the ESA and energy development, and then make the case that not only has such research not been carried out in such a manner to attain these goals - but, indeed, has actually been conducted as if intended for an adversary position.

We do have an official statement made by Mr. Shreiner, then Associate Director FWS in charge of endangered species, to the 1977 annual meeting of western state fish and game commissioners:

> We must stop our traditional adversary role in water development, agricultural expansion, energy production, etc., and start trying to help the developers locate the site, design the structure and develop the operational regime that will do the least harm to wild plant and animal species and their habitats. It is likely that we can enhance the habitat and ultimately the species if we accept the fact that development must and will continue. So I repeat, realistic endangered species administration means all of us helping developers to locate, design

and operate their projects in a manner that is least harmful to species and their habitats.

It can be abundantly demonstrated that this policy has not been a guiding principal in the history of the FWS input to the proposed J-CM Project assessment. The point is, research has been conducted on the endangered Colorado River fishes since 1964. Eighteen years of study and data should be sufficient to come up with some conclusions that can be applied to making recommendations on operational regimes favorable to endangered species. After the Green River fish eradication of 1962, FWS funded endangered species research studies at Utah State University (David Vanicek 1964-1966). From 1967 to 1975 Paul Holden continued such studies at Utah State. In 1975 further funding at Utah State supported the work of Carl Seethaeler on squawfish and the BLM initiated a baseline study of the Yampa and White rivers through Colorado State University, later continued to the present by CDOW monitoring program (and expanded to include the Colorado River). Each of these research contracts contain preamble type of statements justifying the need for such work as a basis for preserving the rare species in a changing environment. From 1979 through 1981, the FWS upper Colorado endangered fishes study with funding by the Bureau of Reclamation and BLM, has been conducted. The implication was that this would be the study to end all studies--all the necessary information would be compiled, synthesized, and analyzed to come up with an environmental management plan for the upper basin that would recommend operational regimes for completed projects, allow the completion of ongoing projects, and the licensing of proposed projects.

The final report from FWS to Bur. Rec. on this research is due in January 1982. On the basis of the data in the final report, FWS will prepare a "conservation plan" (due July, 1982) that has been touted as a plan designed to resolve conflicts. For example, standard statements are found in the biological opinions included in assessments or EIS' (Dallas Creek, West Divide, Windy Gap) that little is known on these species (squawfish and humpback chub) but, . . .

> Information obtained during the study via field, laboratory, and hatchery work will make it possible to provide recommendations to maintain and develop more favorable habitat for the listed fishes. Results of the study will be available for use in 1982.

Basically, it comes down to maintaining suitable flow and temperature regimes in critical sections of the upper basin where endangered fishes are known to live and reproduce. Thus, the most significant facet of the FWS endangered species research is the quantification of squawfish and hump-back chub habitat for various life history stages and then predict positive and negative impacts on the habitat from changing flows. The FWS instream flow methodology has been used for this purpose (PHABSIM--physical habitat simulation model), but now a curious situation has developed whereby the FWS study team is playing down the significance of the flow study and casting doubt on its usefulness. One reason for this attitude is due to the realization that the information would not be useful (in fact detrimental) for making a case against the J-CM Project. This is due to the fact that Project flows raise the late summer base flows and increase the quality and quantity of endangered species habitat in the lower Yampa and Green rivers according to the model.

This, in turn, has changed the FWS priorities toward the significance of maintaining free passage and "natural" flows. This sentiment is clearly echoed in the letters written to the FERC by CDOW employees. I will not here take the time to critique these letters but I found them to reflect a poor understanding (sometimes simply wrong) of evolutionary biology and of the facts they discuss and of the application of "science" to fishery problems. The CDOW input to FERC contain no hint of seeking a resolution to the endangered fish problem. They are entirely negative in tone and suggest or imply that "more research" is necessary (which of course, goes on indefinitely).

Concerning Coordination Act Report

If necessary, I can provide more in-depth analysis of the reservoir fisheries recommendation, that requests a new fish hatchery to stock 1.1 million rainbow trout per year. For example, Mr. Burkhart would probably agree with me that the reservoir environments would be more conducive to kokanee salmon production rather than rainbow trout and kokanee can be stocked for about one cent per fish compared to 18 cents each for trout. However, of more immediate concern is the terrestrial mitigation requests. Here the major species is mule deer. The GIS model used for the mitigation request is open to real question. A C.S.U. thesis: Pattern recognition for wildlife habitat evaluation in southeast Idaho, by J. A. Jengo, 1981, contains a more sophisticated and accurate technique to assess wildlife habitat (for ex. in the area of the proposed reservoirs). CDOW has a computer model for mule deer based on this technique (each square mile section, based on detailed maps, is evaluated according to certain criteria to predict the amount of mule deer habitat present--thereby predicting how many deer would be lost if that section of land is lost).

In consideration for minimizing additional costs, if Dr. Armstrong declines further involvement, I could inquire about the services of a C.S.U. wildlife graduate student with the necessary expertise to critique the GIS model and perhaps perform a more sophisticated anlaysis. A potential problem I see here is that the GIS model is "shakey" and although a more in-depth analysis would provide better data on which to make predictions and recommendations, I can't predict if the "better" model would lighten the burden of mitigation demands.

Summary

As a guiding principal for compromise and resolution of problems that will be apparent from FWS and CDOW input into the EIS process, policy statements from FWS and CDOW regarding the purpose of endangered species studies in relation to resolving conflicts would be helpful. The "research" to date, has been based on a false premise of the objectives of "research" and impact predictions involving natural resources. A basic fault may lie with universities and the teaching of the "scientific method." It is quite impossible to obtain the quantitativeness and predictive accuracy with data from natural systems as is possible with chemistry and physics--there are too many uncontrollable variables involved. With the current mentality, the present "research" would go on forever because positive predictions can never be made and therefore "more research" will always be necessary.

There will be some discussion of flow recommendations in the FWS 'Conservation plan,' but FWS does not presently plan to complete a report on its instream flow studies (PHABSIM) correlating endangered species habitat with the Bureau of Reclamation's Colorado River simulation model. I believe it would be useful if FWS were to be influenced to provide this documentation to the Bur. Rec.

Regarding the mitigation requests, it would be enlightening to obtain a policy statement from CDOW on their attitude regarding the creation of new waters for angling. The coordination act report indicates the new reservoirs would be an adverse fishery impact because they would call for more trout to be stocked. If this were true, why does CDOW actively build reservoirs or lease water in them (ex. Peal Lake, Steamboat Lake, and others in Yampa Drainage)? Did CDOW demand the Denver Water Board build a hatchery to stock Dillon and Green Mountain reservoirs when they were open to the public for fishing?

The terrestrial mitigation requests are the major problem. Perhaps costs can be minimized here if the analysis was done first on a small scale. For example, a few square mile tracts of the Juniper and Cross Mountain areas were analyzed in detail to compare results with the GIS model. If the preliminary results look promising, the entire area could be completed, if not, another strategy would be developed.

I will be learning more about terrestrial impact assessment and mitigation during the next few months, but presently, I do not have an in-depth knowledge and understanding of the subject. The key would be to have the CDOW 1975 wildlife maps, used as the basis for the GIS analysis for mitigation requests, critically analyzed for errors to get an estimate of how much erroneous data and degree of uncertainty are involved.

Responses to Issues Raised in Zallen

to Lindsay Letter of Aug. 25

Robert Behnke

Q. 22, 23: Salinity. The revised evaporation predictions for Juniper-Cross Mtn. reservoirs has been considerably reduced. This lower evaporation figure proportionately reduces predicted increases in salinity due to evaporation. The points raised ignore the evidence brought out in my scenario report that nutrient trapping in the reservoir hypolimnion can be expected to lower TDS values of the inflowing water. Also the presently irrigated agricultural land that would be innundated by the reservoirs increases TDS in return irrigation flow. This source of TDS will be eliminated by the reservoirs.

Q. 25. Largemouth bass and walleye in L. Powell have mercury levels exceeding safe levels for human consumption. Has a public health warning been issued in this case? If not, why not? Tell Margo to send us the data on this so the people of Colorado and Utah can be properly warned of the danger of eating fish from L. Powell. Within a comparative framework, what evidence is there in the Juniper-Cross Mtn. basins that heavy metals could be a human health hazzard, even by biomagnification, from eating fish?

Q. 27. This is one of their 'merry-go-round' questions that we've gone over several times. I pointed out in previous responses that Juniper and Cross Mtn. reservoirs would have surface releases, thus the water temperature would be essentially similar to historical temperatures below Cross Mtn. Dam except that radiant heating of reservoir surface would warm water earlier than normal (beneficial impact) and a hypolimnion release in winter wouldprovide warmer than normal flows (approx. 40° vs. 32°)--also beneficial. FWS then brought up the point that hydro dams must have intakes at least 30 feet below surface (colder water). Bob Christenson (IECO) gave us a definitive statement that Juniper-Cross Mtn. intakes would be 6 ft. below surface (essentially surface temperature). This information was clearly and unequivocally imparted to FWS (Jacobson, Hickman, and Miller) by Eric Kuhn and I at ~~June~~ Aug. meeting in Salt Lake City. Have Bob Christenson write a discussion on how releases will be made, if necessary.

This is an example of what FWS is doing wrong. In the spirit of the Fish and Wildlife Coordination Act and the Endangered Species Act, they should be emphasizing the potentially positive aspects dams and reservoirs can have on flows, temperatures, and water quality, and come to us and advise what operational regime would be best for the fishes, how can we make them better? There has been a complete absence of any hint of positive cooperation in all imputs to FERC from FWS.

Q. 30. Little Snake River Projects. Any projects on Little Snake (Cheyenne diversions, Savory Pot Hook) will reduce sediment input to Yampa. This would be beneficial, but FWS can claim that reduced sediment from Little Snake will increase river degradation (actually beneficial impact on aquatic life) from sediment free flows from Cross Mountain Dam. The National Park Service will fund a $250,000 sediment transport study on the Yampa River (you might contact DNM or Park Service headquarters in Denver to get specifics) which should cover this matter.

Re. channel and riparian changes due to new flow regime. The following references--Turner, R.M. and M.M. Karpiscak. 1980. Recent vegetation changes along the Colorado River between Glen Canyon Dam and Lake Mead, Arizona. U.S.G.S. Prof. Pap. 1132:125p.

Graf, W.L. 1980. The effects of dam closure on downstream rapids. Water resources Research 16(1):129-136.

Dolan, et al. 1974. Man's impact on the Colorado River in the Grand Canyon. Am. Sci. 62:392-406.

Dolan. 1978. Structural control of rapids and pools of the Colorado River in the Grand Canyon. Science 202:629-631.

Laursen, E. M., et al. 1976. On sediment transport through the Grand Canyon. Proc. third interagency sedimentation conf., Water Resources Council, Denver: 4-87.

Pemberton, E. L. 1976. Channel changes in the Colorado River below Glen Canyon Dam. Ibid. 5-73.

--essentiall predict that sediment free flows, higher than normal for most months of year, but without peak flood flows, will degrade (deepen channels), result in more severe rapids (larger rock not "flushed" downstream due to lack of flood flows), tend to erode wide sandy beach areas, and greatly increase the riparian vegetation (and associated animals) due to a more stable water level on an annual basis.

As discussed in more detail in FWS' "Proceedings of downstream river channel changes from diversions or reservoir construction" (Has FWS supplied the District with a copy as promised by Bob Jacobson?), the impacts will vary in the Yampa River according to the structural features of the river. In rock walled canyon areas, no change will occur from a new flow regime. In wide, gently sloping valley areas, such as the Mantle Ranch (a rare environment on lower Yampa) the sandy beach areas will erode to more narrow, steeper banks if the sediment transport capacity of flows from Cross Mountain Dam greatly exceed the amount of sediment brought in by the Little Snake. Is this really an issue of great import as made out by FWS? Who cares? Keith Counts and his crew might have to take an extra minute or two to beach their rafts, beyond this I see no problems. The Black Rocks area of Ruby Canyon, with its abundance of humpback chub and squawfish is just such an area where nature has caused a scour effect of the Colorado River to produce steep sided sand and rock banks. The endangered species love it.

It is then mentioned that although trout benefit from new environments below dams, squawfish have disappeared in the tailwaters below all dams on the Colorado River. That is strictly due to cold water released from the hypolimnion of Bur. Rec. dams and has nothing to do with habitat changes induced by new flows. The Juniper and Cross Mtn. dams are the first dams with proposed surface releases specifically designed to benefit endangered species. Why not recognize this fact and try to work with us on doing the best job possible to design a flow and temperature regime most beneficial to endangered species?

As of 1981, during 1979, 1980, and 1981, FWS will have spent 2 million dollars on upper Colorado basin endangered fishes study. Has any of this effort been expended on attempting to associate hydrological features favoring endangered species in such a way that future flows might be manipulated to create new areas of favorable habitat? (No).

Q. 34. Riparian vegetation changes. Request that Park Service "experts" put their "experience" in writing. The citations given, esp. USGS Prof. Pap. 1132 (cited previously) reveal an improvement in riparian vegetation can be expected from stabilized year-round flows.

Q. 35. Again, request the Park Service data that demonstrates the lesser variety of birds in the tamarisk growth in comparison to other parts of Yampa Canyon. This issue of Tamarisk, again illustrates a failure of the DOI to carry out its environmental protection duties. If Tamarisk is indeed a big problem and dams changing flow regimes favor the increase of tamarisk, then DOI should take one of two options: 1. come out against any future dams that may increase tamarisk, or, 2. conduct research on tamarisk control. If the problem is as urgent as implied, then I would assume some agency in DOI has a tamarisk control research project well under way and they can advise the district on flow regime that least favors tamarisk, or request mitigation funds for tamarisk control for x miles of riparian areas affected by the Project.

This same theme is applicable to the 2 million dollar endangered fishes research. They have not come up with the necessary data to instruct how future projects should be constructed and operated to avoid jeopardy to endangered species. The implied promise is a 1982 report that will tell how projects can be operated without jeopardizing endangered species. This fantasy will not become a reality, in my opinion.

Q.43. Aquatic ecology. - Site specific discussion needed. Why? As elaborated on in my scenario report, a change in the macroinvertebrates can be expected from new flow and temperature regimes. Species diversity will typically decrease but total abundance and biomass will increase (new actors filling the same role in ecosystem drama, but doing it better). The net result is more food for fishes. This is not challenged. It is mentioned that squawfish feed on other fishes therefore they wouldn't benefit from increased invertebrate abundance. What does the author of this question think the squawfish prey feeds on? If the base of a trophic level pyramid is broadened, the levels above respond in like manner.

I would ask for an example of precisely what is meant by ". . . a site specific discussion of aquatic ecology and the effect of the project is needed." - Does site specific mean the reservoir basins. If so, I believe my scenario discussion (converting a lotic environment into a lentic environment) is quite adequate. If not, why not?

Q. 44. States that table of oragnisms (I extracted from Holden's report to Bur. Rec. on Flaming Gorge Dam changes in intake releases) are mostly "drift organisms from Flaming Gorge Reservoir." Where do they get this information? It isnot in Holden's report. Then it is mentioned that species diversity increases downstream from Flaming Gorge (but total abundance and biomass decreases) . . ."which is related to the stability and viability of biotic communities." What is the basis of such a statement? I'd like to see them defend it in court. The fact remains that I put together the evidence that invertebrate abundance and biomass is much greater in the Green River than in the Yampa and it increases toward Flaming Gorge Dam. This is not refuted--only that the increase is due to organisms coming from Flaming Gorge Reservoir (but no evidence is presented to support this statement, and what difference does it make where they come from?), and that increased species diversity is "good" for the ecosystem. Why is it "good?" There's considerably more fish food available with less species diversity.

Q. 48. The Tennant method of correlating flows with fish habitat (developed by FWS) now "may not be appropriate for the Yampa R." because of its "unique" characteristics." I would request FWS to supply us with any flow evaluation method that would predict that base flows of 50 to 100% of the average daily flow (post project flows) would not be an improvement in relation to fish habitat in comparison to base flows of 10% to 20% of average daily flows (natural conditions). Request the flow regime deemed best by FWS.

I would agree that daily fluctuations from peaking power production may negate the beneficial aspects of higher base flows, but I would expect that the 2 million dollar endangered fishes study has critically evaluated this matter in the Green River below Flaming Gorge Dam and FWS will provide a well founded data base to fully evaluate project flows from Cross

Mountain Dam and will make recommendations on the operation of Cross Mountain Dam to minimize any potential negative impact (they have no such data, despite the very obvious significance of fluctuating flow impact).

The message that comes out very clearly in all of these questions (and a long series of previous questions and comments) is that FWS is committed to a strictly negative stance on the Juniper-Cross Mtn. Project. There has never been a single example of what I would call cooperation in a positive reference frame meant to truly lessen negative impacts and explore ways to improve positive impacts or enhancement measure that might be taken. The strategy, evidently seems to be that constant nitpicking will wear us down. The environment as a whole and especially the endangered fishes will not benefit from this type of attitude and way of doing business.

Summary of Colorado River Endangered Fishes Symposium,

Albuquerque, September 18, 1981.

Ron Lambertson (head of Endangered Species Program, FWS) described the FWS "conservation" program and its "conceptual" plan to save endangered species. Essentially, FWS considers "survival" and "recovery" aspects when making biological opinions for section 7 consultations. An impact that may impair "recovery" (potential to increase distribution and abundance) can be mitigated (ex. Windy Gap Project paying FWS $550,000 and Moon Lake Project paying $500,000 to mitigate for flow depletion) because, theoretically, funds can be spent for acquisition and improvement of habitat and to purchase water. An impact that affects "survival" can not be mitigated and jeopardizes the continued existence of endangered species. Of particular significance in this respect for Juniper-Cross Project (and Rangely's Taylor Draw Dam), is FWS's endangered fishes study team's position on the need to maintain "passage" for squawfish. With the new knowledge of squawfish freely moving up and down the Yampa River (and the capture of several squawfish about 20 miles above Rangely in the White River this summer), the team is emphasizing the great importance of maintaining free passageways for the continued existence of the squawfish. Obviously, if this viewpoint is adhered to, any dam on the Yampa or White rivers that interfers with squawfish movement can not be mitigated and would be a jeopardy to endangered species.

Margo Zallen told me that a definition of "cumulative" impact as it applies to Colorado RIver endangered species under the Endangered Species Act, had just been approved by the chief(?) solicitor (The person who is Margo's boss and formerly worked for Montana Power and Light Co.--Margo seemed confident that this person was firmly committed to strict enforcement of all provisions of the ESA). I would alert Bob McCarty on this matter and request he obtain copies of the "cumulative" impact definition and send them to us.

Lambertson also mentioned that the Reagan administration's official position on ESA is being developed. He predicted that the major change in the Act when it comes up for renewal next year will concern the exemption process--exemptions will be simplified and acted on more rapidly.

Paul Holden mentioned his "plan" to save squawfish--take all future depletions from San Juan River (dry up the San Juan and don't touch the Yampa is about the way he put it, in his typical unbiased, neutral opinion).

Reed Harris (Bur. Rec.) discussed Bur. Rec. projections of flow depletions in Colo. and Green rivers to years 2000 and 2030. These projections predict that the Green River will maintain 75% of its virgin flow and the Colorado 65%.

In my talk, I gave my opinion that the "trust fund" started by FWS for endangered species mitigation be developed but removed from federal control--set up in a similar manner to the whooping crane trust established as mitigation for ESA exemption of Grayrocks Dam. I discussed that if 75% of the Green River's virgin flow could be maintained from the Yampa River to the Colorado, and 65% of the Colorado's virgin flow could be maintained from the Gunnison to Lake Powell, such a flow would be quite adequate for endangered species if distributed in certain flow patterns. I admitted this would be difficult to achieve in view of state water laws and compacts. I added that the FWS' plan to buy water (with the mitigation funds) for endangered species is an illusion. Looking over the comments from Colorado, Utah, and Wyoming on this matter in the Moon Lake EIS, there is no way FWS will purchase a Colorado water right and sell it in Utah, or transfer a Utah right to Arizona.

A comprehensive basin-wide water plan to ensure adequate flows during critical periods in critical sections of the Green and Colorado Rivers would call for agreement among the upper basin states--but this may be the key for the ESA exemption process freeing the White and Yampa rivers for development. That is, the upper basin states and the water users, with the Bur. Rec. would devise their own endangered species plan approved by the Sec. Interior, and remove the matter from the FWS. I'll have to ask Rolly how feasible he thinks such a scheme might be, at least as a long range option? It is likely that such a plan would need additional storage.

At the Salt Lake City meeting (Aug., 1981) I requested a copy of the FWS progress report on their White River fishes study (funded by Colo. Office of BLM (Denver). I made oral and written requests but still have not received a copy. I request that the District make a formal request to the BLM or FWS for this progress report (request two and forward one to me).

There are two reports Holden wrote for Deseret Generation and Transmission Cooperative for the Moon Lake Power Plant EIS. They are:

Holden, P. B. and D. A.Selby. 1979. (1) An aquatic biology survey of the White River (Colorado) to assess potential impact of a proposed water withdrawal system, and (2) Aquatic biology study on a raw water intake structure in the Green River, Utah. The BLM and REA were the federal agencies responsible for this EIS. Perhaps they would have copies. I have written to Deseret requesting copies, but as yet have not received a reponse.

Holden also wrote a report for the Bureau of Reclamation concerning available habitat for squawfish in the San Juan River. Can the District obtain copies of this work?