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LIFE HISTORY AND PROSPECTS FOR RECOVERY OF THE RAZORBACK SUCKER

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ABSTRACT

Hybridization, reproduction, food, growth, habitat, and movements of the rare razorback sucker, *Xyrauchen texanus*, are summarized. Despite severe changes produced by dams, channelization, and water-use patterns in the Upper Colorado River System, adult razorbacks are capable of surviving. Reproduction, however, has failed for reasons not yet understood. Since razorbacks are easy to study and are not federally endangered, they can be the subject of innovative research to gain insight on all rare large-river fishes of the Upper Basin. Artificial propagation can provide time and specimens needed to study means of establishing self-sustaining wild razorback populations. Formation of a "razorback sucker recovery team" is urged, and a task outline for recovery of the species is presented. *(Editors' abstract)*

INTRODUCTION

The razorback sucker, *Xyrauchen texanus*, is one of many native fishes of the Colorado River Basin that have suffered population declines during the past century, primarily because of drastic modification of the river system. Several authors have addressed these modifications and their impacts on the native fish fauna (Minckley and Deacon 1968; Minckley 1973; Stalnaker and Holden 1973; Holden and Stalnaker 1975; Seethaler *et al.* 1979; Carlson and Carlson in this symposium). Because of concern for its survival, the razorback sucker was proposed for listing as threatened under the Endangered Species Act by the U.S. Fish and Wildlife Service (1978). However, that proposal was withdrawn after the Act was amended in 1978, probably because a critical habitat designation and an economic assessment must accompany the proposal (U.S. Fish and Wildlife Service 1980). The razorback is listed as endangered by the State of Colorado.

This paper emphasizes knowledge gained since 1975 and lists data gaps that should be targeted for continued research.

SYSTEMATICS

The razorback sucker is in a monotypic genus. Although many of the razorback's characteristics resemble those of the genus *Catostomus*, the sharp-edged hump on its back is so distinctive that the species was placed in its own genus, *Xyrauchen*, literally "razornape," by Eigenmann and Kirsch (Kirsch 1889).

Abbott (1860) first described the species from a single stuffed specimen collected from the Colorado River (LaRivers 1962). In his original description, Abbott named the species *Catostomus texanus;* the name "texanus," which denotes 'of Texas origin,' was used because he thought the specimen came from the Rio Colorado in Texas, a different river system (Baxter and Simon 1970). Minckley (1973) provided a good description of the razorback sucker.

The razorback sucker hybridizes with other catostomids in the Upper Colorado River Basin. A hybrid with the flannelmouth sucker *(Catostomus latipinnis)* was initially described as a new species, *Xyrauchen uncompahgre* (Jordan and Evermann 1896). The specimen, collected from the Uncompahgre River in Colorado, was redescribed as a hybrid by Hubbs and Miller (1953). Since then this hybrid has been reported in the Upper Basin on several occasions (Banks 1964; Vanicek *et al.* 1970; Holden and Stalnaker 1975; McAda and Wydoski 1980).

Hybridization with *C. ardens* and *C. insignis* has been reported in the Lower Basin by Gustafson (1975) and Hubbs and Miller (1953), respectively.

LIFE HISTORY

Reproduction

Spawning time and location

Although spawning has not been observed in the Upper Colorado River Basin, ripe razorback sucker have been collected at several locations. McAda and Wydoski (1980), during a 2-week period in May 1974, collected 14 razorback sucker in spawning condition over a gravel bar in the lower 0.6 km of the Yampa River. Two ripe males and one ripe female razorback sucker were collected over the same gravel bar 6-7 May 1981 by the U.S. Fish and Wildlife Service (Miller *et al.* 1982); this indicated a tendency to spawn in the same location over a period of years. In the Green River, 31 razorback sucker were collected at the confluence with Ashley Creek during a 3-day period in early May 1981 (Tyus *et al.* 1982); only one fish, a male, was ripe. Holden and Crist (1981) collected 38 razorbacks in June 1978 in the same area in backwaters formed at the mouth of Ashley Creek and Stewart Lake Drain. These fish could represent spawning aggregations.

Razorback sucker are apparently also spawning in the Colorado River, as suggested by collection of ripe fish in and near flooded gravel pits. In 1975, McAda and Wydoski (1980) collected ripe fish of both sexes in Walker Wildlife Area, a gravel pit connected to the Colorado River near Grand Junction. In addition, Colorado Division of Wildlife (CDOW) and U.S. Fish and Wildlife Service (FWS) personnel noted a few ripe male razorbacks in Walker Wildlife Area in May and early June 1979 and 1980. CDOW personnel noted aggregations of razorbacks in late May and early June 1979 and 1980 in backwater areas created by flooded gravel pit excavations on the Colorado River near Clifton, Colorado. To enter these off-stream impoundments, the razorbacks had to swim up drainage ditches and culverts. Some fish were spent, whereas others were not ripe or ready to spawn. It was not known whether the fish had spawned in the adjacent river and entered the warmer backwaters to rest and feed or were spawning in the backwaters.

Spawning requirements

Razorback sucker spawn in spring when water levels are rising and water temperatures are increasing. McAda and Wydoski (1980) reported ripe razorbacks in water temperatures of 7-16 C. Razorbacks in spawning condition were collected in the Yampa and Green rivers in 1981 at water temperatures of 12 C. Temperatures of 17-19 C were reported by CDOW and FWS personnel when they captured ripe razorbacks in gravel pits near Clifton, Colorado.

Ripe razorback sucker are often collected over or near gravel bars in flowing water. McAda and Wydoski (1980) reported collections from areas with water velocities of about 0.3 meters per second (m/s) and water depths of 0.7-1.0 m. Conditions in the Yampa River were similar in 1981; ripe fish were collected from areas with water velocity ranging from 0.1 to 0.6 m/s ($\bar{x}$ = 0.4 m/s, n = 4).

The single ripe male collected in 1981 in the Green River by FWS was in quiet water over sand substrate. Cobble substrate was available in small amounts in the general area. Other ripe razorbacks have been collected in the still water of flooded gravel pits where available substrates ranged from cobble to silt.

Spawning observations from Lower Basin reservoirs

Although detailed observations of reproductive behavior have not been made in Lower Basin rivers, Douglas (1952), Jonez and Sumner (1954), and Wood (personal communication cited by Minckley and Deacon 1968) observed spawning activities in several Lower Colorado River Basin reservoirs. Minckley (1973) summarized these spawning observations as follows: "Spawning occurs along shorelines or in bays. One female is attended by 2 to 12 males, and the group moves in circles less than two meters in diameter, randomly spiraling over the bottom. The males appear to herd the female by nudging with their heads and predorsal keels against her genital region. When a site is selected, the female simply settles to the bottom with a male closely pressed to each side. Vibrations then commence that culminate in a convulsive female, at which time gametes are presumably emitted. The three fish then move forward and upward, leaving a cloud of silt and sand, marking the spot of activity. Females spawn repeatedly with numerous males. The eggs are transparent and adhesive, attaching to the substrate upon which they are deposited."

Spawning success

Successful reproduction in the wild has never been documented for the Upper Basin. Numerous investigators have worked in the basin over the last 10 years, but a verified collection of small razorback suckers has not been reported. Recent success in artificial propagation of razorback sucker has provided specimens for comparison and will facilitate identification of young razorback sucker collected in the wild.

Food Habits

No new information has been collected concerning food habits of razorback sucker. McAda and Wydoski (1980) summarized information to date.

Minckley (1973) reported that razorbacks he examined from Lake Mojave had intestines filled with planktonic crustaceans in May. He observed razorbacks feeding in about 6 m of water and noted that: "The fish moved with mouths projecting forward and with a 'bouncing,' up-and-down pattern produced by slow, alternating sweeps of the caudal fin. The pectoral fins were held stiffly extended, producing a plane effect, and little lateral movement of the head was evident, perhaps as a result of the keel-like anterodorsal surface which may act as a lateral stabilizer."

Hubbs and Miller (1953) reported that razorbacks in riverine environments in the Upper Basin used plankton for food and described the length and fuzziness of their gill rakers. Razorbacks are apparently opportunistic in their feeding; razorback gut samples have included plant debris, larvae of Ephemeroptera, Trichoptera, and Diptera, and algae (Jonez and Sumner 1954; Banks 1964; Vanicek 1967).

Temperature Preferences of Razorbacks in Controlled Experiments

Recent experiments (Bulkley *et al.* 1981) involving use of a temperature preference chamber have provided information about the optimum temperature for most efficient body functioning for rare Colorado

River species. In these tests, razorbacks seemed to prefer warm water. Subadult razorback sucker raised in captivity preferred temperatures of 23-29 C, depending on prior acclimation temperature in the laboratory studies. Certain fish died in the tests when water temperature exceeded 34 C. This species also exhibited reduced activity levels at water temperatures of 14 C or lower. The proportion of razorbacks which were active in the temperature preference chamber was 20% for fish acclimated to 8 C and 48% for 14 C fish. In contrast, 91% of 20-C acclimated fish and 87% of fish acclimated to 26 C actively used the temperature control mechanism.

Age and Growth

McAda and Wydoski (1980) aged razorback sucker, using scales; the oldest fish they found was 9 years old and 592 mm in length. However, evidence that they presented and that has since been verified indicates that scales may be unreliable for ageing larger razorbacks. McAda and Wydoski (1980) recaptured one fish 1.5 years after its release; it had not increased in length, and they could not detect an additional annulus. A second fish, 504 mm in length when tagged had only increased 8 mm in length after 3.5 years (McAda and Wydoski 1980).

Disease and Parasites

Little information is available concerning diseases and parasites of razorback sucker. Flagg (1980) examined five specimens from the Colorado River and found a bacterium, *Erysipelothrix rhysiopathiae;* a protozoan, *Myxobolus* sp.; and a crustacean, *Lernaea cyprinacea. L. cyprinacea* was commonly found on exotic and endemic species from the Colorado River System. *Myxobolus* sp. was found on nearly every endemic fish examined but was not found on exotic species. *E. rhysiopathiae* was unique to razorback sucker. Flagg concluded that disease agents were likely not a factor in the decline of native fish populations.

Habitat Preferences

Razorback sucker are usually collected from quiet eddies and pools. In the Colorado, Green, and Yampa rivers, these fish are most commonly collected in spring during high water, when they apparently congregate in large backwaters or eddies out of the main current. They are less common in collections during other seasons but are still found in quiet water. In the Colorado River, razorback sucker have frequently been collected in flooded gravel pit excavations adjacent to the river near Clifton and Grand Junction, Colorado.

FWS (Tyus *et al.* 1982) recorded depth, velocity, and substrate at razorback sucker collection sites in the Green River over the last 3 years. Excluding fish collected on or near suspected spawning areas, razorback sucker were collected at an average depth of 1.1 m (n = 59, range = 0.18-2.07 m) and an average water velocity of 0.12 m/s (n = 59, range = 0.0-0.7 m/s). Fish were usually collected over sand or silt substrates.

Tyus *et al.* (1981) also studied habitat preferences of one razorback sucker by radiotelemetry. The fish was released in April and monitored until June. Depth, velocity, and substrate measurements were made whenever the fish was located. On two occasions, the fish was monitored for 24 hours and habitat parameters were recorded on a regular basis. Over the 3-month period, the fish selected an average water depth of 0.76 m and a water velocity of 0.13 m/s. It was always located over sand or silt substrate (Table 1).

Movement

McAda and Wydoski (1980) reported recaptures of 11 of 98 razorback sucker tagged with numbered anchor tags. Of these, 8 were recaptured at the original point of capture, a flooded gravel pit adjacent to the Colorado River near Grand Junction, Colorado (Walker Wildlife Area). This indicated a tendency for individual fish to remain in one area for periods up to 1 year. They also reported movements by fish of 21 km (in 2 weeks), 26 km (in 6 months), and 130 km (in 3.5 years).

Tyus *et al.* (1982) subsequently captured several razorback sucker tagged by McAda and Wydoski and other investigators. One razorback was initially tagged in the mouth of the Yampa River in the spring of 1975. It was recaptured 5.2 years later 207 km downstream in the Green River. A ripe female razorback sucker was captured in the lower Yampa River in spring 1981 after being tagged by BIO/WEST, Inc. (Logan, Utah) in the Green River about 20 km downstream in March 1978. While razorback sucker were congregated in and near Ashley Creek in 1981, four fish were recaptured in the same vicinity up to 3 weeks after initial capture.

During 1980, Tyus *et al.* (1981) followed movements of a single razorback sucker in the Green River, using radio equipment. After release in March, the fish moved downstream about 6 km and entered the Duchesne River (Fig. 1). It remained in the lower 1 km of the Duchesne River until early June, when flooding occurred. The fish then moved into a large eddy in the Green River at the mixing zone of the two rivers. It remained within 1 km of the Duchesne River until early July, when contact with the fish was lost. Contact was reestablished in late July about 11 km upstream from the Duchesne River. The fish remained in this area until surveillance was terminated in mid-August.

TABLE 1. Habitat preferences of a razorback sucker, determined by radiotelemetry, Duchesne and Green rivers, 1980. (From Tyus *et al.* 1981)

River	Month	Depth ($\bar{x}$) m	Velocity ($\bar{x}$) m/s	Primary substrate	Habitat
Duchesne	April (n=1)	1.34	.18	sand	shore
(n=37)	May (n=1)	1.37	.06	silt	shore
	May (n=1)	1.74	.18	sand	main channel
	May (n=34)	.61	.06	silt	shore
Green	June (n=6)	1.01	.49	sand	shore
(n=7)	June (n=1)	2.44	.21	sand	main channel
All observations (n=44)		.76	.13	sand/silt	shore/main channel

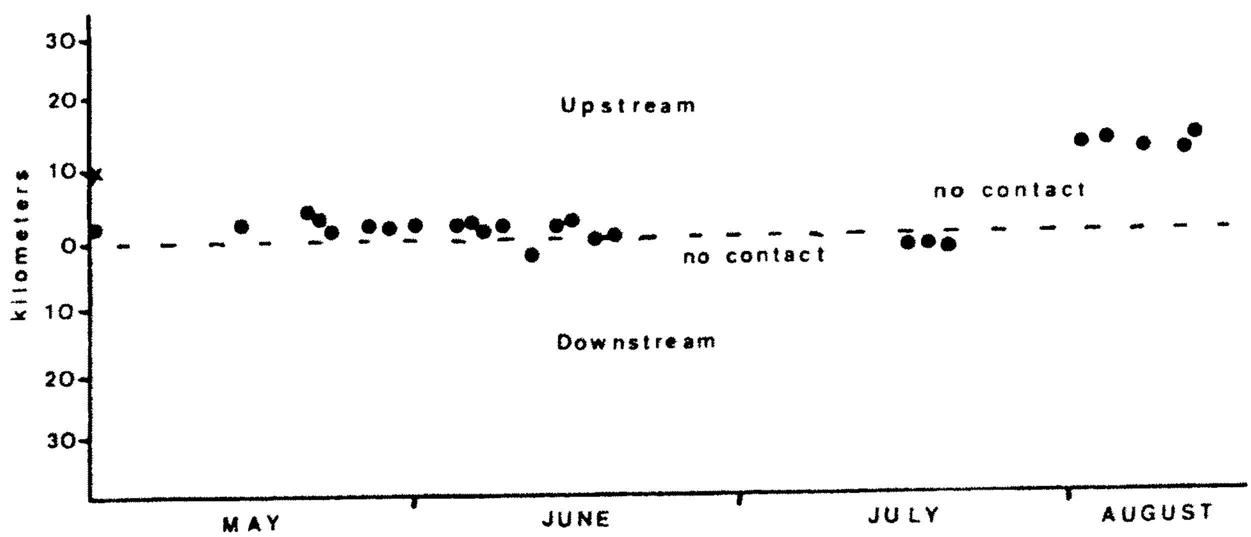

Figure 1. Long-distance movement of a razorback sucker in the Green and Duchesne rivers, as determined by radiotelemetry, 1980. The mouth of the Duchesne River is taken as zero. Points above the zero-line indicate upstream movement; points below the zero-line indicate downstream movement. The fish was in the Duchesne River until early June, when it moved into the Green River. (From Tyus *et al.* 1982b).

REASONS FOR DECLINE

Behnke and Benson (1980) summarized possible reasons for the decline of razorback sucker. They pointed out that dams, impoundments, and land- and water-use practices are probably major reasons for drastically-modified natural flows and river channel characteristics in the basin. Dams on the mainstem have essentially segmented the river system, blocking spawning migrations and drastically changing river characteristics, especially flows and temperatures. Channelization, dams, and water-use patterns in the main-stem and tributary streams have reduced or nearly eliminated embayments, backwaters, and off-stream impoundments.

In spite of the severe changes that have occurred in the river system, adult razorbacks may be able to survive. The real problem is the evident disruption of their reproductive cycle. The exact reasons for this disruption are not known, because optimum spawning requirements are not clearly understood and there could be various reasons for reproductive failure. Assuming that tributary streams were preferred to rivers and impoundments as spawning habitat, reduction in access to and quality of these streams may be an important factor in the decline of razorbacks, especially when combined with the loss of larval nursery habitat and competition and predation from introduced species.

Razorbacks may be attracted to off-stream impoundments by irrigation ditches and drains from these areas. They may swim up these outlets into the impoundments and become disoriented. Likewise, razorbacks inhabiting reservoirs may move shoreward during spawning time in search of a suitable spawning stream or substrate. Unable to find suitable spawning areas, razorbacks may spawn on marginal shoreline substrate in reservoirs and impoundments and be successful only to the degree to which requirements for developing eggs are met. Many impoundments are silty; eggs in these reservoirs may not receive sufficient oxygen. Predation by introduced species (i.e., carp, catfish, sunfish, bass, and mosquitofish) on eggs and larvae may severely reduce survival at these critical stages. Gustafson (1975) reported that developing razorback embryos deposited in water less than 1 m deep in river reaches below impoundments were destroyed by fluctuating water levels.

The reasons for reproductive failure must be identified, and means to correct this failure must be developed to preserve the razorback. Knowledge gained by studying the razorback may be applicable to the Colorado's other endangered fishes and provide valuable insights to their problems. Since razorback sucker are relatively easy to study and their current legal status is less controversial than those of federally-endangered species, they are a logical choice for bold and innovative studies.

Prospects for Recovery

If the present level of interest in conducting research and recovery efforts in the Upper Basin continues, the future of the razorback does not look promising. If reliable information is to be obtained, we must begin reproduction studies while we still have some razorbacks to study and a few relatively-natural river sections in which to study them. Recent studies have shown that artificial progagation of razorbacks is quite feasible. This is encouraging for short-term recovery efforts and experiments on competition and predation. Artificial propagation can provide the time needed to study the likelihood of establishing self-sustaining razorback populations in the wild.

At present, political roadblocks and attitudes of agencies charged with the razorback's protection are hindering progress in recovery efforts. Artificial propagation of the species is strongly discouraged by state agencies in the Upper Basin, and stocking of the species in Upper Basin waters probably would meet with resistance. Means to overcome these obstacles need to be developed. Funding is needed to support studies on the razorback.

What is urgently needed at this point is the formation of a group of concerned biologists and administrators to act as a recovery team with authority to guide research and recovery efforts and to obtain necessary funding. No such group is now acting on behalf of the razorback; recovery efforts are fragmented and uncoordinated. It would be advantageous to act quickly while equipment and experienced personnel from FWS and state agencies are available to conduct the research. Closer coordination between researchers in the Upper and Lower Basins is also needed. The following task outline is provided as a possible guide to future research efforts.

TASK OUTLINE: RECOVERY OF THE RAZORBACK SUCKER

Primary Goal: Describe, maintain, and enhance razorback sucker habitat and convert the razorback to non-threatened status in its native range.

A. Accurately describe larval and juvenile razorback sucker morphology to facilitate determination of recruitment and reproductive success.
   1. Obtain a series of early-life-history specimens of razorback sucker.
   2. Compare key characteristics of razorbacks to those of other native sucker.
   3. Prepare and distribute literature on identification of early life stages.
   4. Sample suspected spawning areas for larval razorbacks to determine if reproduction is occurring.

B. Identify and describe optimum spawning habitat.
   1. Radio-tag adult razorbacks prior to spawning and monitor activities before, during, and after spawning in river and backwater areas.
   2. Trap-net inlets to off-stream impoundments. Monitor movement in and out, determine activity patterns, and describe condition of fish.
   3. Sample suspected spawning areas for eggs and larvae.
   4. Describe spawning areas.

C. Identify river habitat modifications that select against or favor razorback sucker.
   1. Search for and monitor razorback populations in the Upper Basin.
   2. Describe habitat in which razorbacks are collected to determine habitat preferences.
   3. Compare in detail all areas used by the razorback; analyze depth, substrate, velocity, bottom contours, and water quality.
   4. Compare egg-hatching rates and larval survival in various habitats and physical conditions. Consider various combinations of substrates, temperatures, velocities, and water-quality parameters.
   5. Establish a coordinated habitat-improvement program.
   6. Monitor activity patterns in various habitat-improvement areas by radio-tagging.
   7. Conduct experiments with adult razorbacks under controlled spawning conditions, and evaluate spawning success under various conditions in specially-constructed areas.

D. Analyze interspecific relationships between non-native species and razorback sucker.
   1. Select existing sites or build backwater and gravel-pit situations in which to conduct experiments.
   2. Conduct experiments in field and laboratory to analyze competition and predator-prey relationships between various non-native species and razorback eggs, larvae, juveniles, and adults.

E. Develop culture and rearing techniques for razorback sucker.
   1. Develop procedures for taking eggs from wild stock.
   2. Analyze egg-hatching success under various laboratory and controlled field conditions.
   3. Experiment with feeding techniques and rearing densities to obtain maximum (or desired) growth rates.
   4. Rear razorbacks under various conditions in off-river impoundments and backwaters for possible release to the wild.

F. Develop an information and education program.
   1. Prepare list of all agencies and researchers studying the razorback sucker.
   2. Arrange regular meetings of key researchers and agency representatives to report research plans and results.
   3. Distribute progress reports and encourage special news releases and presentations of significant data and accomplishments.

G. Develop a regional management policy specific to the razorback sucker.
   1. Establish guidelines on how to protect razorback habitat.
   2. Review current local, state, and federal laws and regulations which may be applicable in various situations.
   3. Develop procedures for responses to development activities and establish monitoring programs.
   4. Train a special team of biologists in response procedures. Review procedures specific to the razorback and relationships to other endangered fishes.
   5. Prepare list of mitigation projects which may be useful to management and research activities.
   6. Develop goals for desired razorback population levels and establish a procedure to reach these goals.

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