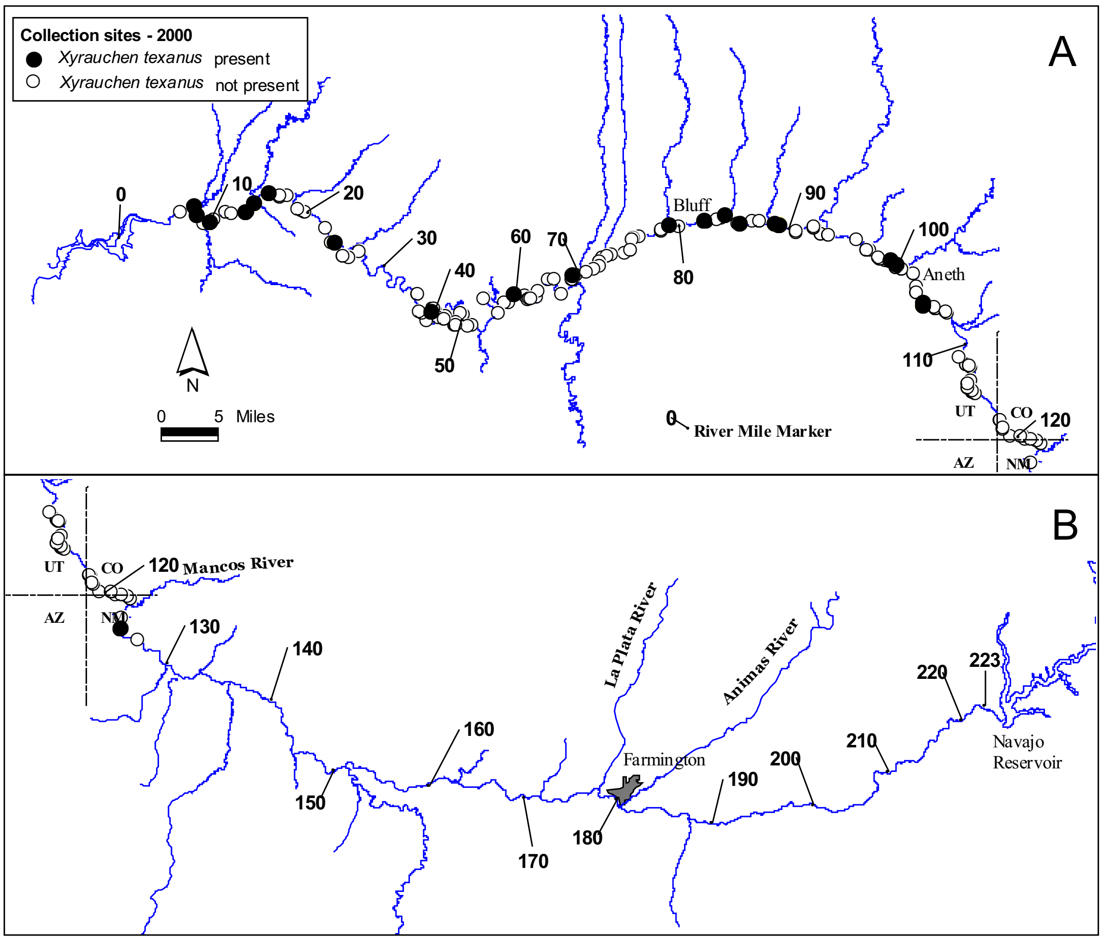
Razorback sucker larval fish survey
San Juan River

2000

DRAFT FINAL REPORT



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SAN JUAN RIVER RECOVERY IMPLEMENTATION PROGRAM

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submitted to:

San Juan River Biology Committee
under the direction of the
San Juan River Recovery Implementation Program

31 March 2001

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Executive Summary

There were 211 fish collections made between river miles 126.1 and 3.0 (=Clay Hills Crossing) under the 2000 razorback sucker larval fish study. The 2000 sampling effort yielded 11,473 fish representing six families and 13 species. Fish taxa present in year 2000 samples but absent from 1998 and 1999 collections were black bullhead, kokanee salmon, bluegill, and largemouth bass. None of these four species are native to the San Juan River. Conversely, roundtail chub and Colorado pikeminnow, both native fish species taken in 1998-1999 samples, were absent from 2000 collections.

The three native sucker species (flannelmouth, bluehead, and razorback sucker) collectively accounted for almost 67% of the total catch during 2000. Flannelmouth sucker was not only the most abundant sucker taken during the study but also the most abundant species in the 2000 collections comprising about 47% (n=5,400) of the total catch. Bluehead sucker was represented by over 2,100 specimens and was the second most common sucker and third most abundant species overall.

The 2000 project catch produced more than 14 times the number of larval razorback sucker than had been taken in 1998 and 1999 collectively. The 129 larval razorback sucker collected in 2000 were taken in 21 separate collections from 9 May 2000 to 2 June 2000. Larval razorback sucker were collected at sites from RM 124.8 to RM 8.1. The 2000 collections also documented an upstream extension in the range of larval razorback sucker of 28.6 river miles and a 3.4 river mile downstream range extension. About two-thirds of the 2000 catch of larval razorback sucker was from a single collection made on 26 May 2000 at RM 8.1. The number of larval razorback sucker taken in that sample (n=86) was greater than the cumulative total of all razorback sucker larvae that had been taken to date (n=50).

This study continues to provide unequivocal documentation of reproduction in the San Juan River by members of a razorback sucker cohort that had been stocked as part of the San Juan River Recovery Implementation Program. There has been a steady increase in the number of larval razorback sucker taken in the San Juan River since the first specimens (n=2) were collected in 1998 and seven individuals in 1999. The large number of larval razorback sucker collected in 2000 provide credible evidence indicative of continuing reproductive success of the augmented adult population. It is not known whether the increased number of 2000 larval razorback sucker specimens is indicative of an increase in the number of augmented razorback sucker recruited to the spawning cohort or greater success among previously spawning adults. Regardless, the number of stocked razorback sucker that recruit to the adult cohort (i.e., able to reproduce) are expected to continue to increase annually as should the number and spatial distribution of collections of larval razorback sucker. Future annual studies of larval razorback sucker distribution and abundance will provide extremely important information on the level of reproduction of this species and direction necessary to achieve recovery.

Introduction

There are few historic San Juan River records of razorback sucker despite that this is one of three endemic Colorado River basin catostomids native to the San Juan River drainage. Jordan (1891) conveyed anecdotal reports from the late 1800s of razorback sucker occurring in the Animas River as far upstream as Durango, Colorado. However, there were no specimens to substantiate this claim. The first verified records of razorback sucker in the San Juan River was in 1976 when two adult specimens were collected at an irrigation pond near Bluff, Utah (in VTN Consolidated, Inc., and Museum of Northern Arizona, 1978). A 1987 U.S. Bureau of Reclamation document (U.S. Bureau of Reclamation, 1987), citing personal communication from the Utah Division of Wildlife resources, reported the 1981-1984 spring occurrence of razorback sucker in the San Juan River arm of Lake Powell. The most recent San Juan River drainage occurrence of razorback sucker was the April 1988 collection of a single adult tuberculate male by Tom Chart (formerly of the Utah Division of Wildlife Resources) in the San Juan River near Bluff, Utah.

The extreme rarity of razorback sucker in the San Juan River drainage necessitated the experimentally stocking of a small number of individuals so that information on their habitat use, potential spawning areas, and survival and growth rates could be obtained. In 1994 personnel from the U.S. Fish and Wildlife Service's Colorado River Fishery Project (CRFP; Grand Junction, Colorado) stocked the first series of razorback sucker (n=672) in the San Juan River. Those fish, whose mean length and mass at the time of stocking were about 400 mm TL and 710 g, respectively, were released between Hogback, New Mexico and Bluff, Utah. In 1995, numerous individuals from the 1994 stocking effort were recaptured including 13 tuberculate males with six of those individuals being ripe. Four razorback sucker recaptured in 1995 were determined to be female but, unlike the males, none were sexually mature. By 1996, a total of 939 razorback sucker, all of which were progeny of paired matings between San Juan River arm of Lake Powell adults, had been stocked in the San Juan River. In their 1995 report of activities, Ryden and Pfeifer (1996) suggested that the majority of experimentally stocked 1994 San Juan River razorback sucker would achieve sexual maturity by 1996 thereby providing the potential for spawning during 1997-1998. The success of the experimental stocking study resulted in the development a full-scale augmentation program for razorback sucker in the San Juan River.

At the November 1996 San Juan River Biology Committee integration meeting, it was suggested that the Colorado pikeminnow larval fish drift study be expanded in an attempt to document spawning of razorback sucker. The MSB-NMGF larval fish drift study, which was designed to determine spawning period, identifying approximate location of spawning sites, and assess effects of annual hydrology (and temperature) on Colorado pikeminnow reproductive activities, was also successful in providing similar information for other members of the ichthyofaunal community (i.e., longnose dace and channel catfish). However, because reproduction by razorback sucker (March-May) occurred considerably earlier than Colorado pikeminnow (June-July), separate investigations of spawning periodicity and magnitude were deemed necessary for both of the aforementioned species.

The most important difference between the established Colorado pikeminnow study and proposed razorback sucker study, besides temporal, was that the razorback sucker larval fish study was attempting to provide the first documentation of reproduction by stocked members of this species in the San Juan River. Sampling for larval razorback sucker was to be conducted with no assurance that the stocked population of adult razorback sucker would spawn in this system. Conversely, previous studies demonstrated that Colorado pikeminnow reproduction had and was still occurring in the San Juan River. This certainty allowed the Colorado pikeminnow larval fish sampling efforts to be different (i.e., monitoring) than those for razorback sucker (searching).

Numerous Upper Colorado River basin researchers identified light-traps as one of the most efficient means of collecting larval razorback sucker. The 1994-1995 National Park Service - San Juan River fish investigation employed light-traps, near the San Juan River-Lake Powell confluence, as a larval fish collecting technique. That study produced an extremely large number of larval fish (ca. 25,000 per year) from a modest number of samples (n=20). Red shiner numerically dominated (>98%) the light-trap catch during both years but neither Colorado pikeminnow nor razorback sucker were collected. The success of Upper Basin researchers and potentially large number of fish that could be collected using this technique lead to the selection of light-traps as the sampling device during the first year (calendar year 1997) of San Juan River larval razorback sucker study.

Numerous locations, adjacent to U.S. Hwy 163 and Utah State Hwy 262 (which paralleled the San Juan River between Aneth and Bluff), that appeared suitable for sampling with light-traps were identified during March 1997. Light-traps were set nightly in low-velocity habitats between Aneth and Mexican Hat from late March through mid-June 1997. Traps were distributed at dusk and retrieved about four hours later with any fish taken in those samples preserved in the field. Sampling success during the 1997 razorback sucker larval fish study was quite poor. While there were over 200 light-trap sets, those sampling efforts produced only 297 fish. Of those, about 200 (66%) were larval sucker (either flannelmouth sucker or bluehead sucker). Larval razorback sucker were not present in the 1997 sampling survey.

While there were probably several variables that accounted for the poor light-trap catch rate, a principal factor was limited access to suitable habitats. Light-traps are most effective when set in habitats with little or no water velocity. Unfortunately, increased April-June flow in the San Juan River eliminated virtually all low velocity habitats identified in March 1997. Further reconnaissance from an automobile (April - May) of the snow-melt enhanced river failed to yield additional locations suitable for light-traps. One of the results of the 1997 study was the realization that being bound to specific collecting sites was an inefficient means of collecting the large number of larval fish necessary to document reproduction of a rare species.

In 1998 the razorback sucker larval fish sampling technique was modified to allow for collections over a longer portion of the San Juan River and capture of a considerably larger number of larval fish. An inflatable raft, which was used to travel the river, provided the opportunity to sample habitats that were formerly either inaccessible or unobservable under the constraints of the 1997 sampling protocol. Collecting trips were conducted at approximately bi-weekly intervals from mid-April until early-June along the river reach between Four Corners and Bluff. Both active and passive sampling techniques were employed to collect larval fish. The primary 1998 collecting method was sampling low-velocity habitats with a fine mesh seine. Light-traps were also employed in 1998 but set only when appropriate aquatic mesohabitats were located adjacent to that evenings campsite. This former technique yielded more larval sucker in a single sample than were taken cumulatively in 1997 light-trap samples. The only major change in sampling protocol between 1998 and 1999 was an expansion of the study area. In 1999 the reach of river sampled was increased from the former 46 river mile reach between Four Corners to Bluff to a 123 river segment between Four Corners and Clay Hills.

The changes in sampling protocol and study reach that were instituted in 1998 proved quite effective. Two larval razorback sucker were collected in the San Juan River during 1998 thereby providing the first unequivocal documentation of reproduction in the San Juan River by members of a razorback sucker cohort which had been stocked as part of the San Juan River Recovery Implementation Program. In 1999, seven additional larval razorback sucker were collected between RM 96.2 (near Aneth, Utah) and RM 11.5 (near Clay Hills Crossing, Utah). The increase in the number of larval razorback sucker collected between 1998 and 1999 was probably the result of many factors including an increase in the number of stocked razorback sucker that had recruited to the adult cohort (i.e., able to reproduce). As this developmental segment (adult) of the razorback sucker population increases, so should the number and spatial distribution of collections of larval razorback sucker.

The primary objective of this study continues to be to determine if razorback sucker reproduction occurred in the San Juan River (during 2000) and the relative level of any such effort. Additional goals were to determine the spawning periodicity of catostomids between mid-April-early June and provide comparative analysis of the reproductive effort of San Juan River catostomids. This document reports results of the 2000 larval razorback sucker sampling effort.

Study Area

The San Juan River is a major tributary of the Colorado River and drains 99,200 km2 in Colorado, New Mexico, Utah, and Arizona (Figure 1). From its origins in the San Juan Mountains of southwestern Colorado at elevations exceeding 4,250 m, the river flows westward for about 570 km before confluencing with the Colorado River. The major perennial tributaries to the San Juan River are (from upstream to downstream) Navajo, Piedra, Los Pinos, Animas, La Plata, and Mancos rivers, and McElmo Creek. In addition there are numerous ephemeral arroyos and washes that contribute relatively little flow annually but input large sediment loads.

Navajo Reservoir, completed in 1963, impounds and isolates the upper 124 km of the San Juan River and regulates downstream discharge. The completion of Glen Canyon Dam in 1966 and subsequent filling of Lake Powell ultimately inundated the lower 87 km of the San Juan River by the early 1980s. The San Juan River is now a 359 km lotic system bounded by two reservoirs (Navajo Reservoir near its head and Lake Powell at its mouth).

The San Juan River is canyon-bound and restricted to a single channel between its confluence with Chinle Creek (ca. 20 km downstream of Bluff, Utah) and Lake Powell. The river is predominately multi-channeled upstream of Chinle Creek with the highest density of secondary channels occurring between Bluff and the Hogback Diversion (ca. 13 km upstream of Shiprock, New Mexico). There is a general downstream decline in channel stability in the section of river between Bluff and Shiprock. Below the confluence with the Animas River near Farmington, New Mexico, the channel is less stable and more subject to floods from it largest and unregulated tributary, the Animas River. Conversely, the regulated reach of river between Farmington, New Mexico and Navajo Dam is relatively stable with few secondary channels.

From Lake Powell to Navajo Dam, the mean gradient of the San Juan River is 1.67 m/km. Examined in 30 km increments, river gradient ranges from 1.24 to 2.41 m/km but locally (i.e., <30 km reaches) can be as high as 3.5 m/km. Between Shiprock and Bluff, San Juan River substrate is primarily sand mixed among some cobble. The proportion of sand is greatest in the downstream most reaches and declines along an upstream gradient. From Farmington to Navajo Dam, the San Juan River substrate is dominated by embedded cobble. Although less embedded, cobble is also the most common substrate between Shiprock and Farmington. Except in canyon-bound reaches, the river is bordered by nonnative salt cedar (*Tamarix chinensis*) and Russian olive (*Elaeagnus angustifolia*) and native cottonwood (*Populus fremontii*) and willow (*Salix* sp.). Nonnative woody plants dominated nearly all sites and resulted in heavily stabilized banks. Cottonwood and willow accounted for less than 15% of the riparian vegetation.

The characteristic annual hydrographic pattern in the San Juan River is typical of rivers in the American Southwest with large flows during spring snowmelt, followed by low summer, autumn, and winter base flows. Summer and early autumn base flows are frequently punctuated by convective storm-induced flow spikes. Prior to closure of Navajo Dam, about 73% of the total annual San Juan River drainage discharge (based on USGS Gauge # 09379500; Bluff, Utah) occurred during spring runoff (1 March through 31 July). Median daily peak discharge during

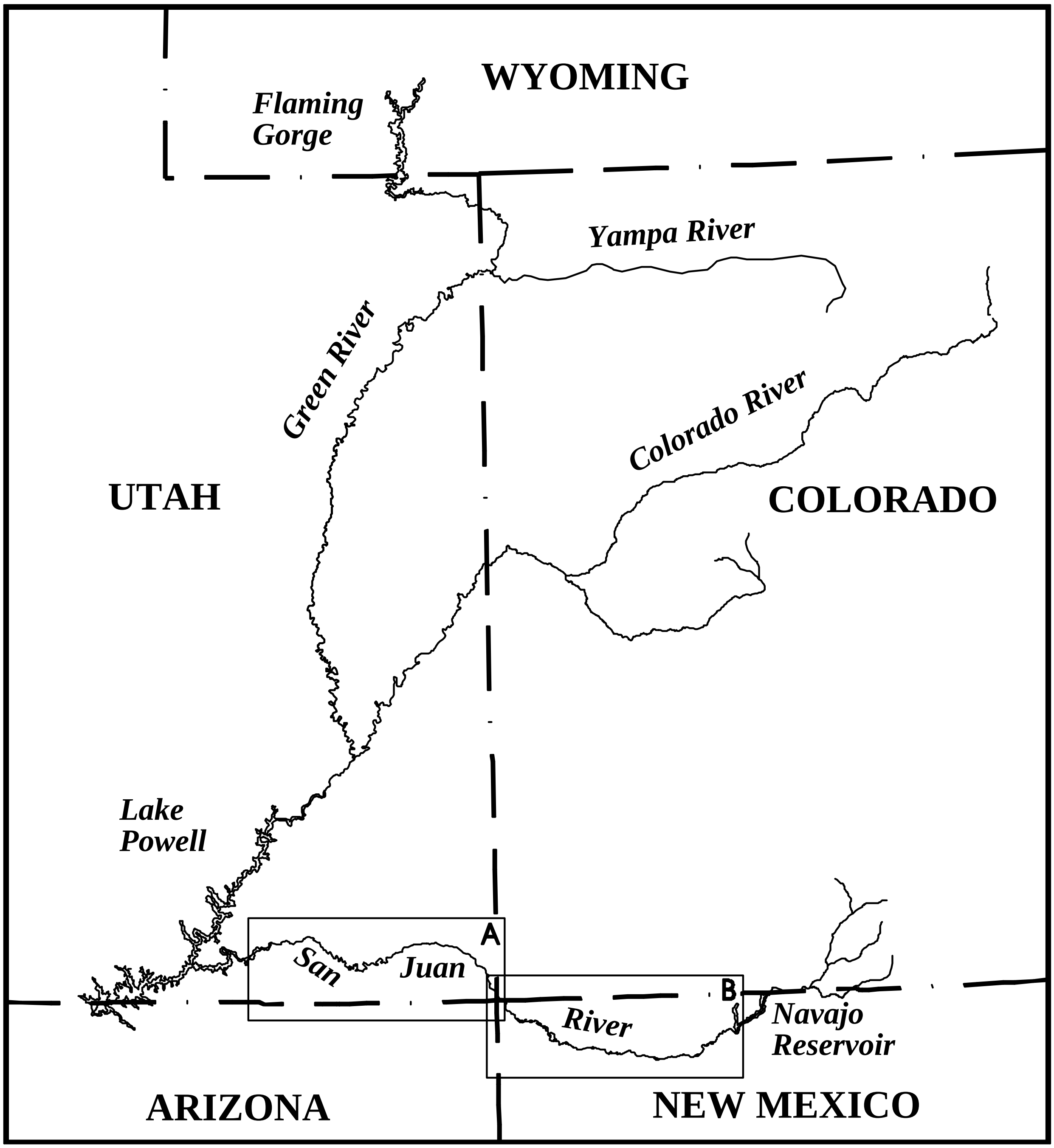


Figure 1. Location of the San Juan River within the Upper Colorado River Basin.

spring runoff was 10,400 cfs (range = 3,810 to 33,800 cfs). Although flows resulting from summer and autumn storms contributed a comparatively small volume to total annual discharge, the magnitude of storm-induced flows exceeded the peak snowmelt discharge about 30% of the years, occasionally exceeding 40,000 cfs (mean daily discharge). Both the magnitude and frequency of these storm induced flow spikes are greater than those recorded in the Green or Colorado rivers.

Closure of Navajo Dam altered the annual discharge pattern of the San Juan River. The natural flow of the Animas River ameliorated some aspects of regulated discharge by augmenting spring discharge. Regulation resulted in reduced magnitude and increased duration of spring runoff in wet years and substantially reduced magnitude and duration of spring flow during dry years. Overall, flow regulation by operation of Navajo Dam has resulted in post-dam peak spring discharge averaging about 54% of pre-dam values. Conversely, post-dam base flow increased markedly over pre-dam base flows.

Since 1992, Navajo Dam has been operated to mimic a “natural” San Juan River hydrograph with the volume of release during spring linked to the amount of precipitation recorded during the preceding winter. Thus in years with high spring snowmelt, reservoir releases were “large” and “small” in low runoff years. Base flows since 1992 were typically greater than during pre-dam years but less than those between 1964-1991.

The primary study area for most investigations conducted under the auspices of the San Juan River Seven Year Research Program, including that reported herein, were accomplished in the mainstem San Juan River and its immediate vicinity between Navajo Dam and Lake Powell. There is considerable human activity within the floodplain of the San Juan River between Shiprock and Navajo Dam. Irrigated agriculture is practiced throughout this portion of the San Juan River Valley and adjacent uplands. Much of the river valley not devoted to agriculture (crop production and grazing) consists of small communities (e.g., Blanco and Kirtland) and several larger towns (e.g., Bloomfield and Farmington).

The Animas River Valley is similarly developed. Small portions of the river valley and uplands from Shiprock to Bluff are farmed with dispersed livestock grazing as the primary land use. In the vicinity of Montezuma Creek and Aneth, petroleum extraction occurs in the floodplain and adjacent uplands. There are few human-caused modifications of the system from Bluff to Lake Powell.

A multivariate analysis of a suite of geomorphic features of the San Juan drainage was performed to segregate the river into distinct geomorphic reaches, enhance comparison between studies, and to provide a common reference for all research. This effort (Bliesner and Lamarra, 1999) resulted in the identification of eight reaches of the San Juan River between Lake Powell and Navajo Dam. A brief characterization of each reach (from downstream to upstream) follows.

Reach 1 (RM 0 to 16, Lake Powell confluence to near Slickhorn Canyon) has been greatly influenced by fluctuating reservoir levels of Lake Powell and its backwater effect. Fine sediment (sand and silt) has been deposited to a depth of about 12 m in the lowest end of this reach since the reservoir first filled in 1980. This deposition of suspended sediment into the delta-like environment of the river/reservoir transition makes it the lowest-gradient reach in the river. This portion of the river is canyon bound with an active sand bottom. Although an abundance of low-velocity habitat is present at certain flows, it is highly ephemeral, being influenced by both river flow and Lake Powell’s elevation.

Reach 2 (RM 17 to 67, near Slickhorn Canyon to confluence with Chinle Creek) is also canyon bound but is upstream of the influence of Lake Powell. The gradient in this reach is greater than in either adjacent reach and the fourth highest in the system. The channel is primarily bedrock confined and influenced by debris fans at ephemeral tributary mouths. Riffle-type habitat dominates, and the only major rapids in the San Juan River occur in this reach. Backwater abundance is low in this reach, usually occurring in association with debris fans.

Reach 3 (RM 68 to 105, Chinle Creek to Aneth, Utah) is characterized by higher sinuosity and lower gradient (second lowest) than the other reaches, a broad floodplain, multiple channels, high island count, and high percentage of sand substrate. While this reach has the second greatest density of backwater habitats after peak spring runoff, it is extremely vulnerable to change during summer and autumn storm events. After these storm events, this reach may have the second lowest density of backwaters of the eight reaches. The active channel distributes debris piles throughout the reach following spring runoff, leading to the nickname “Debris Field”.

Reach 4 (RM 107 to 130, Aneth, Utah, to below “the Mixer”) is a transitional zone between the upper cobble substrate-dominated reaches and the lower sand substrate-dominated reaches. Sinuosity is moderate compared with other reaches, as is gradient. Island area is higher than in Reach 3 but lower than in Reach 5, and the valley is narrower than in either adjacent reach. Backwater habitats are low overall in this reach (third lowest among reaches) and there is little clean cobble.

Reach 5 (RM 131 to 154, the Mixer to just below Hogback Diversion) is predominantly multi-channeled with the largest total wetted area and greatest secondary channel area of any of the reaches. Secondary channels in this section tend to be longer and more stable (but fewer) than in Reach 3. Riparian vegetation is more dense in this reach than in lower reaches but less dense than in upper reaches. Cobble and gravel are more common in channel banks than sand, and clean cobble areas are more abundant than in lower reaches. This is the lowermost reach containing a diversion dam (Cudei). Backwaters and spawning bars in this reach are much less subject to perturbation during summer and fall storm events than are the lower reaches.

Reach 6 (RM 155 to 180, below Hogback Diversion to confluence with the Animas River) is predominately a single channel, with 50% fewer secondary channels than Reaches 3, 4, or 5. Cobble and gravel are the dominant substrata with cobble bars containing clean interstitial spaces being most abundant in this reach. There are four diversion dams that may impede fish passage in this reach. Backwater habitat abundance is low in this reach, with only Reach 2 containing fewer of these habitats. The channel has been altered by dike construction in several areas to control lateral channel movement and over-bank flow.

Reach 7 (RM 181 to 213, Animas River confluence to between Blanco and Archuleta, New Mexico) is similar to Reach 6 in terms of channel morphology. The river channel is very stable, consisting primarily of embedded cobble substrate as a result of controlled releases from Navajo Dam. In addition, much of the river bank has been stabilized and/or diked to control lateral movement of the channel and over-bank flow. Water temperature is influenced by the hypolimnetic release from Navajo Dam and is colder during the summer and warmer in the winter than that of the river below the Animas confluence.

Reach 8 (RM 213 to 224, between Blanco and Archuleta and Navajo Dam) is the most directly influenced by Navajo Dam, which is situated at its uppermost end (RM 224). This reach is primarily a single channel, with only four to eight secondary channels, depending on the flow. Cobble is the dominant substrate type, and because lateral channel movement is less confined in this reach, some loose, clean cobble sources are available from channel banks. In the upper end of the reach, just below Navajo Dam, the channel has been heavily modified by excavation of material used in dam construction. In addition, the upper 10 km of this reach above Gobernador Canyon are essentially sediment free, resulting in the clearest water of any reach. Because of Navajo Dam, this area experiences much colder summer and warmer winter water temperatures. These cool, clear water conditions have allowed development of an intensively managed blue-ribbon trout fishery to the exclusion of native species in the uppermost portion of the reach.

The upper limit of the study area was not changed between 1999 and 2000 thereby encompassing reaches 1 through 4 (Figure 2). Seven razorback sucker larval fish collection trips were taken between 5 April and 23 June 2000. As in 1999, four of the sampling efforts were between RM 126.1 and Bluff and three were in the lower reach. For reporting purposes, the 2000 data were separated into upper and lower reaches with the former including collections between RM 127.5 and Bluff and the latter containing collections from Bluff downstream to Clay Hills Crossing.

Methods

Access to the river and sampling localities was gained through the use a 16' inflatable raft that transported both personnel and collecting gear. There was not a predetermined number of samples per river mile or geomorphic reach for this study. Instead, an effort was made to collect in as many suitable larval fish habitats as possible within the river reach being sampled. Previous San Juan River investigations have clearly demonstrated that larval fish most frequently occur and are most abundant in low velocity habitats such as isolated pools, backwaters, and secondary channels.

Sampling efforts for larval fish concentrated on low velocity habitats using small mesh seines (1 m x 1 m x 0.8 mm) and light-traps. Meso-habitat type, length, maximum depth, and substrate were recorded for each sample. For seine samples, the length of each seine haul was determined in addition to the number of seine hauls per site. The aforementioned habitat conditions were recorded at light-trap sampling sites in addition to the time of placement and retrieval of the light-trap.

All retained specimens were placed in plastic bags containing a solution of 5% buffered formalin and a tag inscribed with unique alpha-numeric code that was also recorded on the field data sheet. Samples were returned to the laboratory where they were sorted, specimens identified to species, enumerated, measured (minimum and maximum size [mm SL] for each species at each site), transferred to 70% ethyl alcohol, and catalogued in the Division of Fishes of the Museum of Southwestern Biology (MSB) at the University of New Mexico (UNM). Scientific and common names of fishes that are used in this report follow Robins et al. (1991) while six letter codes for species are derived from the first three letters of the genus followed by the first three letters of the species (Table 1). Common names, arranged in phylogenetic order, are presented in tables in this report.

River Mile, standardized for the San Juan River Basin Recovery Implementation Program, was used to designate the location of sampling sites. Coordinates identifying longitude and latitude were determined with a Garmin Navigation Geographic Positioning System (GPS) Instrument for each of the sampling localities and corrected for selective availability (intentionally induced error) in the laboratory. On 1 May 2000, the U.S. Government deactivated the selective availability component of the GPS system thereby providing more precise positioning information instantaneously. Starting with the fourth 2000 sampling trip (8 - 11 May 2000), Universal Transverse Mercator (UTM) coordinates of sampling sites were recorded instead of longitude and latitude.

Specimens whose species-specific identity was questionable were forwarded to Darrel E. Snyder (Larval Fish Laboratory, Colorado State University) for review. In addition, all specimens identified as razorback sucker (by MSB personnel) were sent to Darrel E. Snyder for verification. An electronic copy of the 1998 and 1999 fish collection data were submitted to Keller-Bliesner Engineering for inclusion in the San Juan River database.

This study was annually initiated prior to spring runoff and completed a few weeks before the cessation of spring run-off. Daily mean discharge during the study period was determined from U.S. Geological Survey Gauge (# 09368000). at Shiprock, New Mexico (Figure 3).

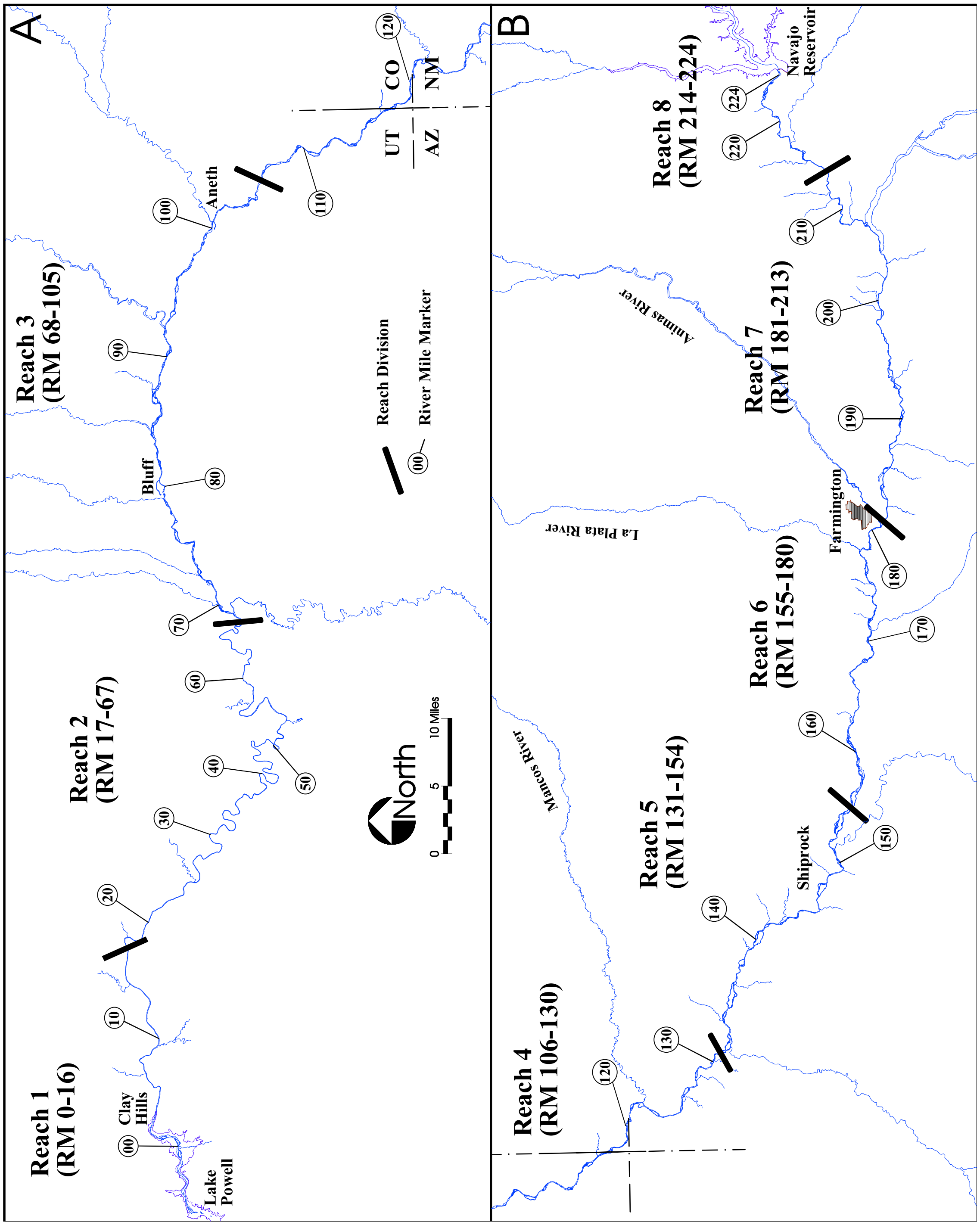


Figure 2. Map of the San Juan River study area.

Table 1. Scientific and common names and species codes of fish collected from the San Juan River during 2000.

Scientific Name	Common Name	Code
Order Cypriniformes		
Family Cyprinidae	carps and minnows	
Cyprinella lutrensis	red shiner	(CYPLUT)
Cyprinus carpio	common carp	(CYPCAR)
Pimephales promelas	fathead minnow	(PIMRPO)
Rhinichthys osculus	speckled dace	(RHIOSC)
Family Catostomidae	suckers	
Catostomus (Pantosteus) discobolus	bluehead sucker	(CATDIS)
Catostomus latipinnis	flannelmouth sucker	(CATLAT)
Xyrauchen texanus	razorback sucker	(XYRTEX)
Order Siluriformes		
Family Ictaluridae	bullhead catfishes	
Ameiurus melas	black bullhead	(AMEMEL)
Ictalurus punctatus	channel catfish	(ICTPUN)
Order Salmoniformes		
Family Salmonidae	trouts	
Oncorhynchus nerka	kokanee salmon	(ONCNER)
Order Atheriniformes		
Family Poeciliidae	livebearers	
Gambusia affinis	western mosquitofish	(GAMAFF)
Order Perciformes		
Family Centrarchidae	sunfishes	
Lepomis cyanellus	green sunfish	(LEPCYA)
Lepomis macrochirus	bluegill	(LEPMAC)
Micropterus salmoides	largemouth bass	(MICSAL)

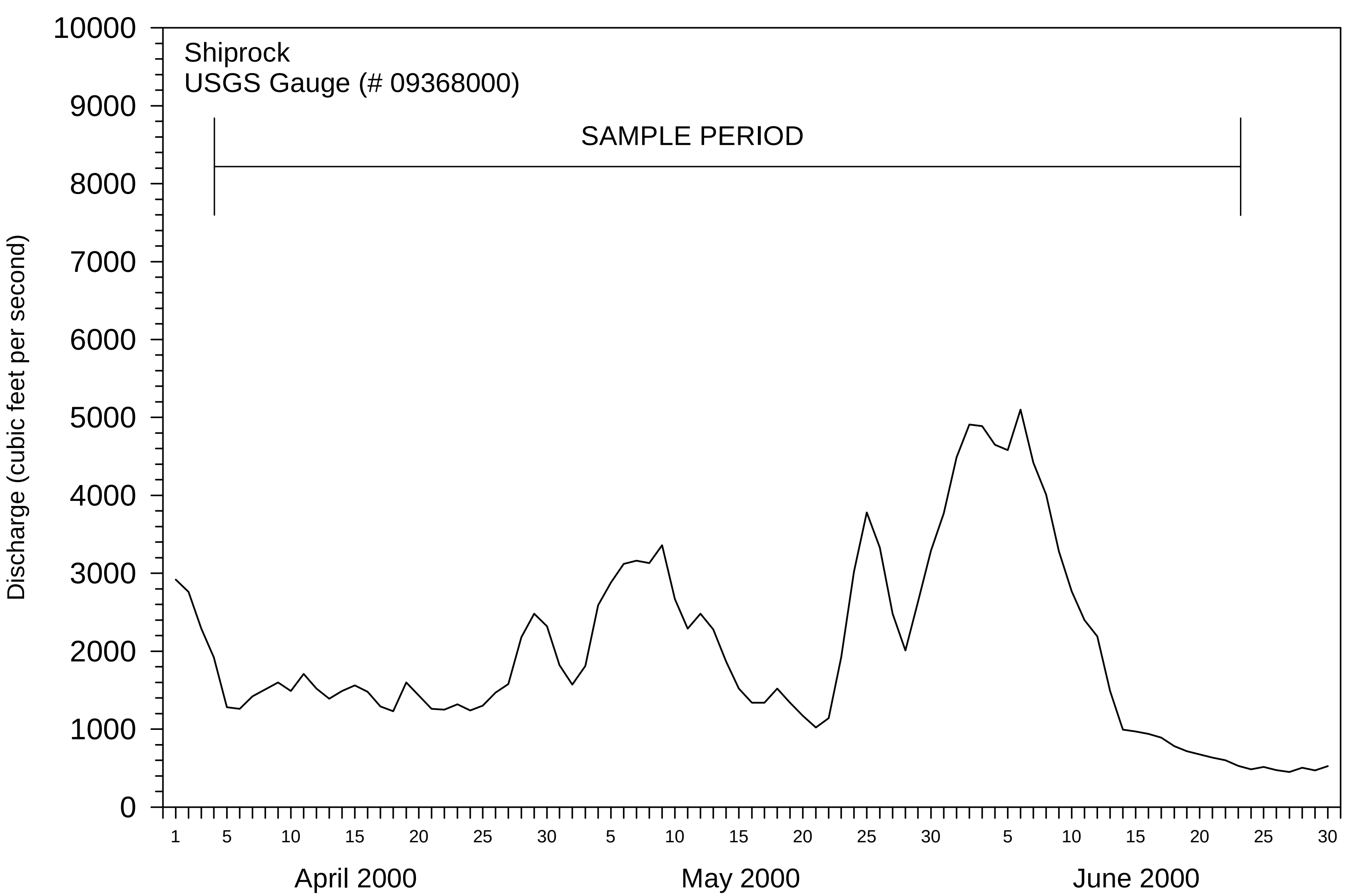


Figure 3. Hydrograph of the San Juan River at Shiprock, New Mexico during the 2000 sampling period.

Results

2000 Survey

In 2000, over 200 fish collections were taken at over 139 sites during the 4 April - 23 June 2000 study period (Figure 4). These samples resulted in the collection of 11,473 representing six families and 13 species (Table 2). Fish taxa present in year 2000 samples but absent from 1998 and 1999 collections were black bullhead, kokanee salmon, bluegill, and largemouth bass. None of these four species are native to the San Juan River. Conversely, roundtail chub and Colorado pikeminnow, both native fish species, were taken in 1998-1999 samples but absent from 2000 collections.

The three native sucker species collectively accounted for almost 67% of the total catch during 2000. Flannelmouth sucker was not only the most abundant sucker taken during the study but also the most abundant species in the 2000 collections comprising about 47% (n=5,400) of the total catch. Bluehead sucker was represented by over 2,100 specimens and was the second most common sucker and third most abundant species overall.

The non-native red shiner was the most frequently collected species as it was present in over 62% (n=132) of the collections. It was also the second most abundant fish collected (n= 2,957) accounting for about 26% of the total catch. The three most abundant species (flannelmouth sucker, red shiner, and bluehead sucker) comprised over 90% of the catch.

There were 20 light-trap samples made during 2000 nine of which yielded fish. There were fewer fish (n=364) taken in the 2000 light-trap samples than during either 1998 (n=721) or 1999 (n=1,738). However, the majority of fish collected in the light-traps (87%) were larval sucker (Table 3). Bluehead sucker was the most abundant species in these samples followed by flannelmouth sucker and red shiner. This method once again proved effective at catching primarily native taxa as only one of the five species taken and 12% of the catch were non-native fishes.

Sampling effort was relatively evenly divided between the upper and lower reach of the study area. Approximately 55% of the samples were taken in the reach between Shiprock, New Mexico and Bluff, Utah and 45% between Bluff, Utah and Clay Hills, Utah. The catch, however, was not as evenly distributed between reaches. About two-thirds (65.7%; n=7,533) of the catch by number was taken in the upper reach (Table 4) while 34.3% (n=3,940) was taken in the lower reach (Table 5). The most notable between reach differences in the ichthyofaunal composition were the numerical dominance of native sucker in the upper reach and abundance of non-native red shiner in lower reach collections. For example, bluehead sucker was over ten-times more abundant in collections made between Shiprock and Bluff than downstream of Bluff.

The first 2000 sampling trip of this study occurred in the upper reach from 4-7 April. Discharge in the San Juan River during that period was between 1,260-1,920 cfs and was still prior to spring run-off. Only 123 fish were collected in the 26 samples taken during this trip of which all except four were cyprinids (Figure 5; Table 6). The absence of larval sucker suggested that either spawning by the native sucker species had not begun in this reach of river or larval sucker had not yet emerged from their redds.

The second 2000 trip, made from 18-21 April in the upper reach of the study area, produced results very similar to that observed in the first trip. Relatively few fish were collected (n=308) and the majority (98.7%) of those individuals were cyprinids (Table 7). Red shiner numerically dominated the catch accounting for almost 74% of the fish taken. Only three sucker were collected all of which were flannelmouth sucker, two of which were larval fish. This trip also produced the first kokanee salmon (juvenile) taken during the tenure of this study.

The next sampling effort (26-30 April 2000) was the first conducted in the lower reach. The number of sucker in the lower reach was greater than that recorded upstream. A total of 41 sucker,

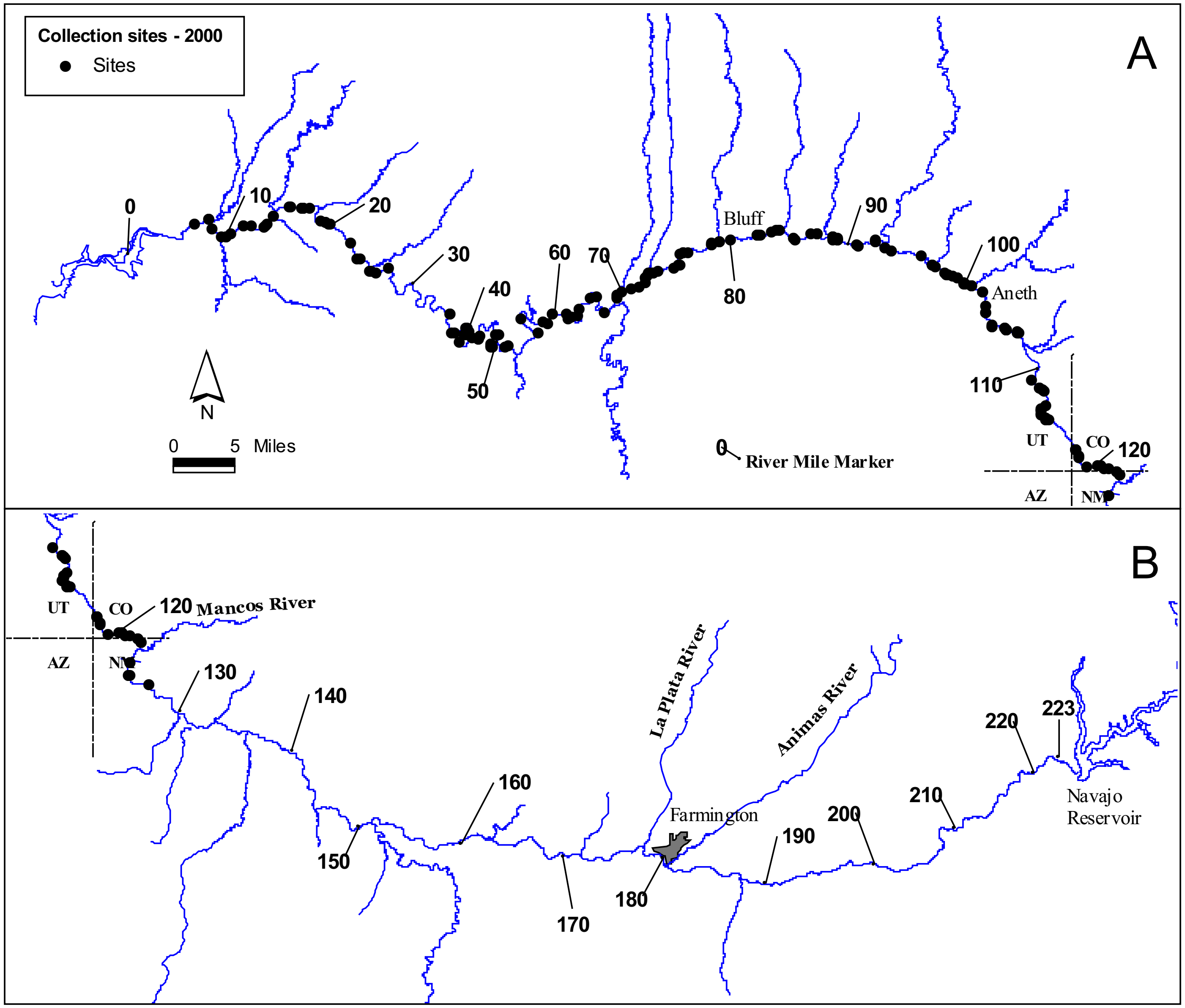


Figure 4. Distribution map of localities sampled during 2000.

Table 2. Summary of 2000 San Juan River larval razorback sucker project fish collections.

SPECIES	RESIDENCE STATUS[1]	TOTAL NUMBER OF SPECIMENS	PERCENT OF % OF TOTAL	FREQUENCY OF OCCURRENCE[2]	% FREQUENCY OF OCCURRENCE[2]
CARPS AND MINNOWS					
red shiner	I	2,957	25.77	132	62.56
common carp	I	5	0.04	5	2.37
fathead minnow	I	568	4.95	90	42.65
speckled dace	N	236	2.06	62	29.38
SUCKERS					
flannelmouth sucker	N	5,400	47.07	107	50.71
bluehead sucker	N	2,145	18.70	70	33.18
razorback sucker	N	129	1.12	21	9.95
BULLHEAD CATFISHES					
black bullhead	I	1	0.01	1	0.47
channel catfish	I	1	0.01	1	0.47
TROUT					
kokanee salmon	I	1	0.01	1	0.47
LIVEBEARERS					
western mosquitofish	I	19	0.17	12	5.69
SUNFISHES					
green sunfish	I	2	0.02	1	0.47
bluegill	I	1	0.01	1	0.47
largemouth bass	I	8	0.07	6	2.84
TOTAL		11,473			

[1] N = native; I = introduced

[2] Frequency and % frequency of occurrence are based on n=211 samples.

Table 3. Summary of 2000 San Juan River larval razorback sucker project light-trap collections.

SPECIES	RESIDENCE STATUS[1]	TOTAL NUMBER OF SPECIMENS	PERCENT OF % OF TOTAL	FREQUENCY OF OCCURRENCE[2]	% FREQUENCY OF OCCURRENCE[2]
CARPS AND MINNOWS					
red shiner	I	43	11.81	2	10.00
common carp	I	—	—	—	—
fathead minnow	I	1	0.27	1	5.00
speckled dace	N	3	0.82	2	10.00
SUCKERS					
flannelmouth sucker	N	120	32.97	8	40.00
bluehead sucker	N	197	54.12	4	20.00
razorback sucker	N	—	—	—	—
BULLHEAD CATFISHES					
black bullhead	I	—	—	—	—
channel catfish	I	—	—	—	—
TROUT					
kokanee salmon	I	—	—	—	—
LIVEBEARERS					
western mosquitofish	I	—	—	—	—
SUNFISHES					
green sunfish	I	—	—	—	—
bluegill	I	—	—	—	—
largemouth bass	I	—	—	—	—
TOTAL		364			

1 N = native; I = introduced
2 Frequency and % frequency of occurrence are based on n=20 samples.

Table 4. Summary of 2000 San Juan River larval razorback sucker project fish collections in the upper portion of the study area (between Shiprock, New Mexico and Bluff, Utah).

SPECIES	RESIDENCE STATUS[1]	TOTAL NUMBER OF SPECIMENS	PERCENT OF % OF TOTAL	FREQUENCY OF OCCURRENCE[2]	% FREQUENCY OF OCCURRENCE[2]
CARPS AND MINNOWS					
red shiner	I	637	8.46	66	56.90
common carp	I	1	0.01	1	0.86
fathead minnow	I	254	3.37	46	39.66
speckled dace	N	181	2.40	51	43.97
SUCKERS					
flannelmouth sucker	N	4,443	58.98	59	50.86
bluehead sucker	N	1,979	26.27	43	37.07
razorback sucker	N	27	0.36	11	9.48
BULLHEAD CATFISHES					
black bullhead	I	–	–	–	–
channel catfish	I	–	–	–	–
TROUT					
kokanee salmon	I	1	0.01	1	0.86
LIVEBEARERS					
western mosquitofish	I	8	0.11	5	4.31
SUNFISHES					
green sunfish	I	2	0.03	1	0.86
bluegill	I	–	–	–	–
largemouth bass	I	–	–	–	–
TOTAL		7,533			

[1] N = native; I = introduced
[2] Frequency and % frequency of occurrence are based on n=116 samples.

Table 5. Summary of 2000 San Juan River larval razorback sucker project fish collections in the lower portion of the study area (between Bluff and Clay Hills Crossing, Utah).

SPECIES	RESIDENCE STATUS[1]	TOTAL NUMBER OF SPECIMENS	PERCENT OF % OF TOTAL	FREQUENCY OF OCCURRENCE[2]	% FREQUENCY OF OCCURRENCE[2]
CARPS AND MINNOWS					
red shiner	I	2,320	58.88	68	71.28
common carp	I	4	0.10	4	4.19
fathead minnow	I	314	7.97	44	46.12
speckled dace	N	55	1.40	11	11.53
SUCKERS					
flannelmouth sucker	N	957	24.29	48	50.31
bluehead sucker	N	166	4.21	27	28.30
razorback sucker	N	102	2.59	10	10.48
BULLHEAD CATFISHES					
black bullhead	I	1	0.03	1	1.05
channel catfish	I	1	0.03	1	1.05
TROUT					
kokanee salmon	I	—	—	—	—
LIVEBEARERS					
western mosquitofish	I	11	0.28	7	7.34
SUNFISHES					
green sunfish	I	—	—	—	—
bluegill	I	1	0.03	1	1.05
largemouth bass	I	8	0.20	6	6.29
TOTAL		3,940			

[1] N = native; I = introduced
[2] Frequency and % frequency of occurrence are based on n=95 samples.

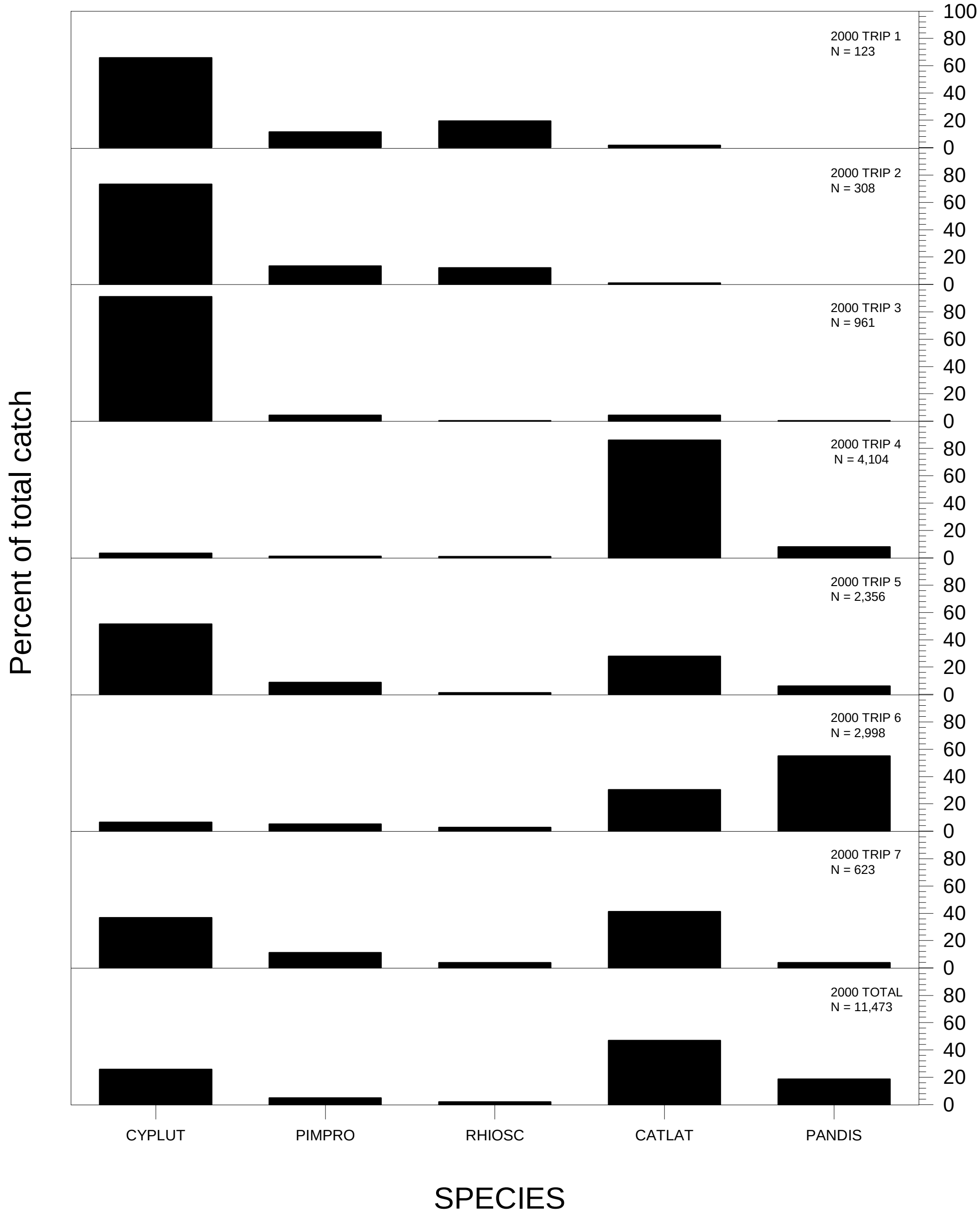


Figure 5. Ichthyofaunal composition of 2000 sampling efforts by trip.

Table 6. Summary of the 1st 2000 San Juan River larval razorback sucker project fish collection (4-7 April 2000; Four Corners to Bluff).

SPECIES	RESIDENCE STATUS[1]	TOTAL NUMBER OF SPECIMENS	PERCENT OF % OF TOTAL	FREQUENCY OF OCCURRENCE[2]	% FREQUENCY OF OCCURRENCE[2]
CARPS AND MINNOWS					
red shiner	I	81	65.85	9	65.85
common carp	I	—	—	—	—
fathead minnow	I	14	11.38	6	11.38
speckled dace	N	24	19.51	8	19.51
SUCKERS					
flannelmouth sucker	N	2	1.63	1	
bluehead sucker	N	—	—	—	—
razorback sucker	N	—	—	—	—
BULLHEAD CATFISHES					
black bullhead	I	—	—	—	—
channel catfish	I	—	—	—	—
TROUT					
kokanee salmon	I	—	—	—	—
LIVEBEARERS					
western mosquitofish	I	—	—	—	—
SUNFISHES					
green sunfish	I	2	1.63	1	1.63
bluegill	I	—	—	—	—
largemouth bass	I	—	—	—	—
TOTAL		123			

1 N = native; I = introduced

2 Frequency and % frequency of occurrence are based on n=26 samples.

Table 7. Summary of 2nd 2000 San Juan River larval razorback sucker project fish collection (18-21 April 2000; Four Corners to Bluff).

SPECIES	RESIDENCE STATUS[1]	TOTAL NUMBER OF SPECIMENS	PERCENT OF % OF TOTAL	FREQUENCY OF OCCURRENCE[2]	% FREQUENCY OF OCCURRENCE[2]
CARPS AND MINNOWS					
red shiner	I	226	73.38	22	73.38
common carp	I	—	—	—	—
fathead minnow	I	41	13.31	11	13.31
speckled dace	N	37	12.01	15	12.01
SUCKERS					
flannelmouth sucker	N	3	0.97	2	0.97
bluehead sucker	N	—	—	—	—
razorback sucker	N	—	—	—	—
BULLHEAD CATFISHES					
black bullhead	I	—	—	—	—
channel catfish	I	—	—	—	—
TROUT					
kokanee salmon	I	1	0.32	1	0.32
LIVEBEARERS					
western mosquitofish	I	—	—	—	—
SUNFISHES					
green sunfish	I	—	—	—	—
bluegill	I	—	—	—	—
largemouth bass	I	—	—	—	—
TOTAL		308			

[1] N = native; I = introduced
[2] Frequency and % frequency of occurrence are based on n=32 samples.

all larvae, were collected during this effort. The flannelmouth sucker taken were between 12-15 mm SL while the lone bluehead sucker collected during the third 2000 collecting trip was 12 mm SL.. Flannelmouth sucker comprised only 4.2% of the catch while bluehead sucker was <1% of the catch. Conversely, as was observed in the upper reach, red shiner numerically dominated the catch of the third sample (91%) resulting in 875 individuals (Table 8).

Sucker larvae abundance increased markedly between the second and the third upper reach sampling effort (fourth overall). Over 4,000 fish were collected in the 31 samples taken between 8-11 May 2000, of which 95% (n=3,885) were larval sucker. Flannelmouth sucker were ten-times more abundant that bluehead sucker, present in except one of the samples, and comprised 86% of the total catch. This sample trip produced the largest number of bluehead sucker (n=330) taken to date, during 2000 (Table 9). In addition, the first 2000 collection of larval razorback sucker occurred during this effort. A cumulative total of 25 razorback sucker were taken in nine samples with the number of individuals per collection ranging between 1-6.

The fifth 2000 collecting trip, the second in the lower reach, was conducted (22-26 May 2000) about one-month since the previous lower reach sampling effort. This trip yielded nine species and 2,356 specimens in the 34 samples taken (Table 10). The first collection of black bullhead made during this study was taken during this trip and as was observed in the previous sample, red shiner was numerically dominant (51%). The most notable change since the April 2002 lower reach collecting effort was the marked increase in the number of larval sucker present in the samples. The number of flannelmouth sucker taken increased from 40 in April to 661 in May while bluehead sucker larvae collected increased from 1 in April to 141 in May. There was, in addition to the large increase in the number of larval flannelmouth sucker and bluehead sucker, an extremely large catch of larval razorback sucker (n=102). This species was taken at 10 separate sites with the number of individuals per collection ranging between 1 and 6 in all except one sample. The tenth sample produced an unexpectantly large number (n= 86) larval razorback sucker.

The sixth sampling trip was the last to be conducted in the upper reach during 2000. The number of larval sucker taken during this trip (1-3 June 2000) was not as large as 8-11 May 2000 but still remained high (n=2,559). There was a marked change in the composition of larval sucker during the last two sampling dates. Bluehead sucker, which had comprised only 8% of the May sample, were 55% of the June collection (Table 11). Likewise, flannelmouth sucker decreased in relative abundance from 86% in May to 30% in June. One larval razorback sucker was collected at each of two sites in the upper reach during the June trip as compared with a total of 25 larval razorback sucker taken at nine sites in May. There was little difference in the absolute number or relative abundance of the remaining species (n=5) which collectively accounted for <15% of the 1-3 June 2000 catch.

The final 2000 sampling effort occurred between 20-23 June in the reach between Bluff, Utah and Clay Hills, Utah and yielded 623 specimens (Table 12). Red shiner exhibited the greatest reduction between trips declining by almost 1,000 individuals in absolute number and about 15% in percent of total catch. Larval sucker were still present in samples but were markedly reduced in number compared to the previous trip (22-26 May 2000). Flannelmouth sucker remained more abundant than bluehead sucker and the former species had increased from 28% (n=661) to 41% (n=256) of the total catch. Conversely, bluehead sucker catch decreased from 6% (n=141) to ca. 4% (n=24) of the total catch. While razorback sucker were not taken in this sample, two species (bluegill and largemouth bass) not previously been captured during this study, were collected.

Table 8. Summary of 3rd 2000 San Juan River larval razorback sucker project fish collection (26-30 April2000; Bluff to Clay Hills).

SPECIES	RESIDENCE STATUS[1]	TOTAL NUMBER OF SPECIMENS	PERCENT OF % OF TOTAL	FREQUENCY OF OCCURRENCE[2]	% FREQUENCY OF OCCURRENCE[2]
CARPS AND MINNOWS					
red shiner	I	875	91.05	27	91.05
common carp	I	—	—	—	—
fathead minnow	I	41	4.27	10	4.27
speckled dace	N	3	0.31	3	0.31
SUCKERS					
flannelmouth sucker	N	40	4.16	9	4.16
bluehead sucker	N	1	0.10	1	0.10
razorback sucker	N	—	—	—	—
BULLHEAD CATFISHES					
black bullhead	I	—	—	—	—
channel catfish	I	—	—	—	—
TROUT					
kokanee salmon	I	—	—	—	—
LIVEBEARERS					
western mosquitofish	I	1	0.10	1	0.10
SUNFISHES					
green sunfish	I	—	—	—	—
bluegill	I	—	—	—	—
largemouth bass	I	—	—	—	—
TOTAL		961			

[1] N = native; I = introduced
[2] Frequency and % frequency of occurrence are based on n=35 samples.

Table 9. Summary of 4th 2000 San Juan River larval razorback sucker project fish collection (8-11 May 2000; Four Corners to Bluff).

SPECIES	RESIDENCE STATUS[1]	TOTAL NUMBER OF SPECIMENS	PERCENT OF % OF TOTAL	FREQUENCY OF OCCURRENCE[2]	% FREQUENCY OF OCCURRENCE[2]
CARPS AND MINNOWS					
red shiner	I	135	3.29	16	3.29
common carp	I	—	—	—	—
fathead minnow	I	44	1.07	12	1.07
speckled dace	N	35	0.85	9	0.85
SUCKERS					
flannelmouth sucker	N	3,530	86.01	30	86.01
bluehead sucker	N	330	8.04	19	8.04
razorback sucker	N	25	0.61	9	0.61
BULLHEAD CATFISHES					
black bullhead	I	—	—	—	—
channel catfish	I	—	—	—	—
TROUT					
kokanee salmon	I	—	—	—	—
LIVEBEARERS					
western mosquitofish	I	5	0.12	2	0.12
SUNFISHES					
green sunfish	I	—	—	—	—
bluegill	I	—	—	—	—
largemouth bass	I	—	—	—	—
TOTAL		4,104			

1 N = native; I = introduced
2 Frequency and % frequency of occurrence are based on n=31 samples.

Table 10. Summary of 5th 2000 San Juan River larval razorback sucker project fish collection (22-26 May 2000; Bluff to Clay Hills).

SPECIES	RESIDENCE STATUS[1]	TOTAL NUMBER OF SPECIMENS	PERCENT OF % OF TOTAL	FREQUENCY OF OCCURRENCE[2]	% FREQUENCY OF OCCURRENCE[2]
CARPS AND MINNOWS					
red shiner	I	1,216	51.61	23	51.61
common carp	I	—	—	—	—
fathead minnow	I	204	8.66	16	8.66
speckled dace	N	28	1.19	5	1.19
SUCKERS					
flannelmouth sucker	N	661	28.06	24	28.06
bluehead sucker	N	141	5.98	18	5.96
razorback sucker	N	102	4.33	10	4.33
BULLHEAD CATFISHES					
black bullhead	I	1	0.04	1	0.04
channel catfish	I	1	0.04	1	0.04
TROUT					
kokanee salmon	I	—	—	—	—
LIVEBEARERS					
western mosquitofish	I	2	0.08	2	0.08
SUNFISHES					
green sunfish	I	—	—	—	—
bluegill	I	—	—	—	—
largemouth bass	I	—	—	—	—
TOTAL		2,356			

[1] N = native; I = introduced
[2] Frequency and % frequency of occurrence are based on n=34 samples.

Table 11. Summary of 6th 2000 San Juan River larval razorback sucker project fish collection (1-3 June 2000; Four Corners to Bluff).

SPECIES	RESIDENCE STATUS[1]	TOTAL NUMBER OF SPECIMENS	PERCENT OF % OF TOTAL	FREQUENCY OF OCCURRENCE[2]	% FREQUENCY OF OCCURRENCE[2]
CARPS AND MINNOWS					
red shiner	I	195	6.50	19	6.50
common carp	I	1	0.03	1	0.03
fathead minnow	I	155	5.17	17	5.17
speckled dace	N	85	2.84	19	2.84
SUCKERS					
flannelmouth sucker	N	908	30.29	26	30.29
bluehead sucker	N	1,649	55.00	24	55.00
razorback sucker	N	2	0.07	2	0.07
BULLHEAD CATFISHES					
black bullhead	I	–	–	–	–
channel catfish	I	–	–	–	–
TROUT					
kokanee salmon	I	–	–	–	–
LIVEBEARERS					
western mosquitofish	I	3	0.10	3	0.10
SUNFISHES					
green sunfish	I	–	–	–	–
bluegill	I	–	–	–	–
largemouth bass	I	–	–	–	–
TOTAL		2,998			

1 N = native; I = introduced
2 Frequency and % frequency of occurrence are based on n=28 samples.

Table 12. Summary of 7th 2000 San Juan River larval razorback sucker project fish collection (20-23 June 2000; Bluff to Clay Hills).

SPECIES	RESIDENCE STATUS[1]	TOTAL NUMBER OF SPECIMENS	PERCENT OF % OF TOTAL	FREQUENCY OF OCCURRENCE[2]	% FREQUENCY OF OCCURRENCE[2]
CARPS AND MINNOWS					
red shiner	I	229	36.76	18	36.76
common carp	I	4	0.64	4	0.64
fathead minnow	I	69	11.08	18	11.08
speckled dace	N	24	3.85	3	3.85
SUCKERS					
flannelmouth sucker	N	256	41.09	15	41.09
bluehead sucker	N	24	3.85	8	3.85
razorback sucker	N	–	–	–	–
BULLHEAD CATFISHES					
black bullhead	I	–	–	–	–
channel catfish	I	–	–	–	–
TROUT					
kokanee salmon	I	–	–	–	–
LIVEBEARERS					
western mosquitofish	I	8	1.28	4	1.28
SUNFISHES					
green sunfish	I	–	–	–	–
bluegill	I	1	0.16	1	0.16
largemouth bass	I	8	1.28	6	1.28
TOTAL		623			

1 N = native; I = introduced

2 Frequency and % frequency of occurrence are based on n=26 samples.

Razorback sucker - 2000

This 2000 sampling survey resulted in the collection of 129 larval razorback sucker (Figure 6). These fish were taken in 21 separate collections from 9 May 2000 to 2 June 2000 between river miles 124.8 and 8.1 (Figure 7). Over half of the samples (n=12; 57%) that contained razorback sucker yielded a single specimen while two samples produced five individuals and two produced six larvae. About two-thirds of the 2000 catch of larval razorback sucker was from a single collection made on 26 May 2000 at RM 8.1 (WHB00-156). The number of larval razorback sucker taken in that sample (n=86) was greater than the cumulative total of all razorback sucker larvae that had been taken to date (n=50).

While larval razorback sucker were generally distributed throughout the study area, they were notable rarest in the upper-most portion of the upper sampling reach. There were a total of 60 fish collections made in the San Juan River from Aneth (RM 101) to the upstream end of the study area (RM 126.7) resulting in the collection of three razorback sucker larvae, two of which were taken at RM 104. The 53 samples taken in 22.2 river mile reach between the aforementioned site and the upstream-most 2000 collection locality resulted in the collection of a single razorback sucker specimen. That individual was collected in June about 2.1 river miles below the upper-most sampling site. Interestingly, two of the three most upstream records of razorback sucker larvae were obtained during the (1-3 June) final upper-reach sampling effort.

Downstream of Aneth, at least one larval razorback sucker was collected in each 10-river mile segment except that of river mile 30-40. Of the 18 collections in this portion of the river (downstream of Aneth) that contained larval razorback sucker, eight were between river miles 82.3 and 99.7 (n=24) and six between river miles 8.1 and 15.4 (n=97). These two reaches, totaling 24.7 river miles, collectively accounted for 67% (n=14) of the samples containing razorback sucker larvae and 86% (n=111) of the total razorback sucker catch.

Razorback sucker ranged in size from 9.4 to 18.1 mm TL with all except one being at the mesolarval developmental stage. The earliest razorback sucker ontogenetic stage encountered was a 10.4 yolked-mesolarva taken on 10 May 2000 at RM 89.2 while the most derived was an 18.1 mm TL metalarval individual collected at RM 8.1 on 26 May 2000. Noteworthy was that the smallest and largest and razorback sucker collected during the 2000 segment of this study were taken in the same sample (WHB00-156) indicative of the wide range of growth rates within the 2000 larval cohort.

The sample site that produced (WHB00-156) the 86 larval razorback sucker was a large (ca. 5 m x 50 m), warm (26°C) backwater that has recently inundated stands of common reed (*Phragmites* sp.) and salt cedar (*Tamarix* sp.). Large schools of larval fish were distributed throughout the backwater with larval suckers apparently concentrated near submerged vegetation. Of the 437 fish taken at this site, 236 (n=56%) were Catostomids, all of which were Age 0 specimens. The number of flannelmouth sucker (n=79), bluehead sucker (n=81), and razorback sucker (n=86) collected at this site were nearly equal. Flannelmouth sucker in this sample were general the larger than the other two species taken (14.5 - 25 mm SL), followed by (in decreasing order of size) bluehead sucker (11 - 18 mm SL), and razorback sucker (8.9 - 15.2 mm SL).

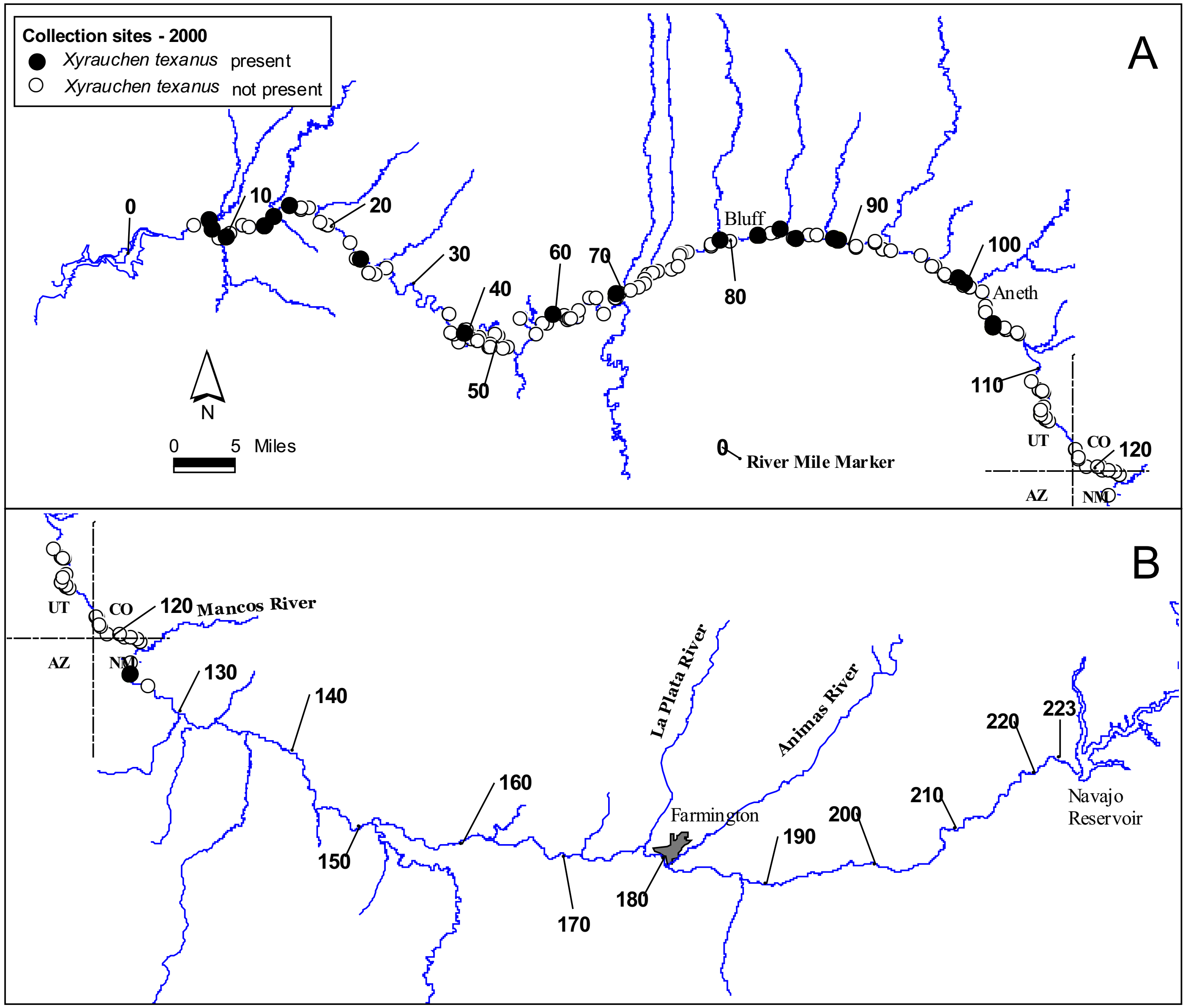
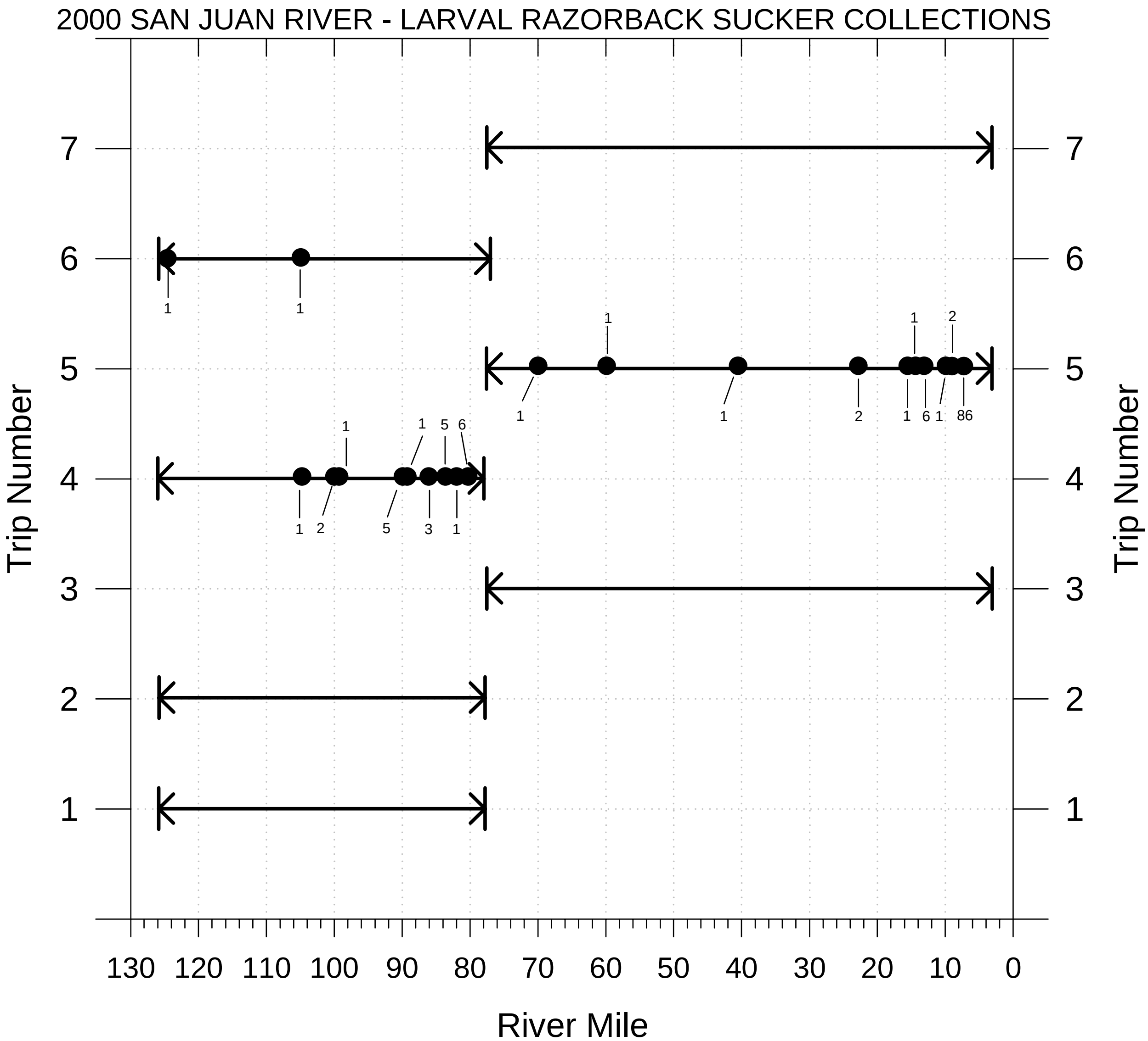


Figure 6. Distribution map of localities that yielded larval razorback sucker during 2000.



● = larval razorback sucker

Trip Number	START DATE	END DATE	
1	04 APR 00	07 APR 00	
2	18 APR 00	21 APR 00	
3	26 APR 00	30 APR 00	
4	08 MAY 00	11 MAY 00	● n = 25
5	22 MAY 00	26 MAY 00	● n = 102
6	01 JUN 00	03 JUN 00	● n = 2
7	20 JUN 00	23 JUN 00	

Figure 7. Diagrammatic representation of 2000 sampling effort.

Summary

A large portion of the approximately 1,000 razorback sucker that were introduced into the San Juan River since the 1994 initiation of the experimental stocking effort are believed to have survived. If this assumption is true, than the number of stocked razorback sucker that recruit to the adult cohort (i.e., able to reproduce) should be expected to continued to increase annually. It follows that as this segment of the population increases, so should the number and spatial distribution of collections of larval razorback sucker increase.

The 1998 sampling protocol resulted in the collection of over 13,000 specimens, the majority of which were larval catostomids. This 43-fold increase in number of specimens taken in 1998 provided the opportunity to determine, with a higher degree of confidence than in 1997, if razorback sucker reproduction occurred in the San Juan River during the study period. The high number of larval fish collected in combination with the large reach of river sampled also resulted in substantially better resolution of spawning periodicity of all San Juan River catostomids. The 1998-1999 results of the larval razorback sucker study provided unequivocal documentation of reproduction in the San Juan River by members of a razorback sucker cohort which had been stocked as part of the San Juan River Recovery Implementation Program.

The initial collection of larval razorback sucker in 1998 (n=2) occurred during a single sampling effort and (19 - 22 May) with the specimens being taken and in relatively close proximity to each other (ca. 8 river miles). The effort (1998 sampling) demonstrated that targeting sampling to collect relatively large numbers of larval sucker was an effective means at acquiring information on razorback sucker reproductive efforts. Unlike the 1997 light-trap sampling project, this effort yielded a sufficient number of larval sucker so that biologically meaningful interpretation of the data could be developed.

There were two important discoveries that resulted from the 1999 larval razorback sucker study. The first was the collection of individuals (n=3) from the lower portion of the San Juan River (between RM 10 - 20). As this reach of river was not sampled for larval razorback sucker in 1998, no conclusions could be made regarding expansion of the range of this species by this ontogenetic stage. The second noteworthy find in 1999 was the collection of larval razorback sucker in a single backwater (RM 96.2) in light-traps. This sampling technique (light-trapping) has been successfully employed in the Upper Colorado River Basin as a mechanism by which larval razorback sucker can be monitored. The aforementioned San Juan River collection suggests that this passive collecting technique may, one day, be suitable for monitoring of the San Juan River population of razorback sucker.

The 2000 project catch produced more than 14 times the number of larval razorback sucker than had been taken in 1998 and 1999 collectively. The 129 larval razorback sucker collected in 2000 were taken in 21 separate collections from 9 May 2000 to 2 June 2000. Larval razorback sucker were collected at sites from RM 124.8 to RM 8.1. The 2000 collections also documented an upstream extension in the range of larval razorback sucker of 28.6 river miles and a 3.4 river mile downstream range extension. About two-thirds of the 2000 catch of larval razorback sucker was from a single collection made on 26 May 2000 at RM 8.1. The number of larval razorback sucker taken in that sample (n=86) was greater than the cumulative total of all razorback sucker larvae that had been taken to date (n=50).

This study continues to provide unequivocal documentation of reproduction in the San Juan River by members of a razorback sucker cohort that had been stocked as part of the San Juan River Recovery Implementation Program. There has been a steady increase in the number of larval razorback sucker taken in the San Juan River since the first specimens (n=2) were collected in 1998 and seven individuals in 1999. The large number of larval razorback sucker collected in 2000 provide credible evidence indicative of continuing reproductive success of the augmented adult population. It is not known whether the increased number of 2000 larval razorback sucker specimens is indicative of an increase in the number of augmented razorback sucker recruited to the spawning cohort or greater success among previously spawning adults. Regardless, the number of stocked razorback sucker that recruit to the adult cohort (i.e., able to reproduce) are expected to continue to increase annually as should the number and spatial distribution of collections of larval razorback sucker. Future annual studies of larval razorback sucker distribution and abundance will provide extremely important information on the level of reproduction of this species and direction necessary to achieve recovery.

Acknowledgments

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Appendix 1. Summary of larval razorback sucker collected in the San Juan River.

Field Number	MSB Catalog Number	Number of Specimens	Total Length	Larval Stage	Date Collected	River Mile	Sampling Method
1998	**TOTAL**	**2**					
WHB98-143	42207	1	12.7	mesolarva	21 May 1998	88.8	larval fish seine
WHB98-147	42218	1	12.1	mesolarva	22 May 1998	80.2	larval fish seine
1999	**TOTAL**	**7**					
WHB99-075	44201	1	11.2	mesolarva/yolk	04 May 1999	82.5	larval fish seine
WHB99-105	44254	1	14.1	mesolarva	12-13 May 1999	96.2	light-trap
WHB99-106	44257	1	10.2	mesolarva	12-13 May 1999	96.2	light-trap
WHB99-112	44269	1	11.2	protolarva/yolk	13 May 1999	82.5	larval fish seine
WHB99-167	44421	1	17.9	mesolarva	14 June 1999	16.5	larval fish seine
WHB99-169	44428	1	20.7	metalarva	14 June 1999	13.1	larval fish seine
WHB99-170	44435	1	13.8	mesolarva	14 June 1999	11.5	larval fish seine
2000	**TOTAL**	**129**					
WHB00-104	47770	1	10.4	mesolarva	09 May 2000	104.6	larval fish seine
WHB00-108	47779	2	10.6 - 11.3	mesolarvae	10 May 2000	99.7	larval fish seine
WHB00-109	47784	1	10.9	mesolarva	10 May 2000	99.4	larval fish seine
WHB00-115	47805	5	10.4 - 11.3	mesolarvae/yolk	10 May 2000	89.2	larval fish seine
WHB00-116	47808	1	11.1	mesolarva	10 May 2000	88.8	larval fish seine
WHB00-118	47814	3	10.5 - 10.8	mesolarvae	11 May 2000	85.6	larval fish seine
WHB00-119	47819	5	10.6 - 11.8	mesolarvae	11 May 2000	84.1	larval fish seine
WHB00-121	47824	1	10.6	mesolarva	11 May 2000	82.3	larval fish seine
WHB00-122	47829	6	10.4 - 13.2	mesolarvae	11 May 2000	79.4	larval fish seine
WHB00-130	47855	1	15.2	mesolarva	23 May 2000	69.5	larval fish seine
WHB00-133	47864	1	10.0	mesolarva	23 May 2000	59.8	larval fish seine
WHB00-139	47878	1	14.9	mesolarva	24 May 2000	40.5	larval fish seine
WHB00-143	47882	2	9.3 - 18.6	mesolarvae	25 May 2000	23.3	larval fish seine
WHB00-149	47896	1	16.1	mesolarva	26 May 2000	15.4	larval fish seine
WHB00-150	47902	1	17.6	mesolarva	26 May 2000	14.0	larval fish seine
WHB00-152	47910	6	15.3 - 17.9	mesolarvae	26 May 2000	13.0	larval fish seine
WHB00-154	47918	1	12.2	mesolarva	26 May 2000	10.0	larval fish seine
WHB00-155	47924	2	13.6 - 16.4	mesolarvae	26 May 2000	8.8	larval fish seine
WHB00-156	47930	86	9.4 - 18.1	meso - metalarvae	26 May 2000	8.1	larval fish seine
WHB00-158	47937	1	16.4	mesolarva	01 June 2000	124.8	larval fish seine
WHB00-168	47978	1	12.0	mesolarva	02 June 2000	104.5	larval fish seine
TOTAL (1998-2000)		**138**					

Appendix 2. Detailed summary of larval razorback sucker collected in the San Juan River.

Field Number	MSB Catalog Number	Number of Specimens	Total Length	Larval Stage	Date Collected	River Mile	Sampling Method
1998	**TOTAL**	**2**					
WHB98-143	42207	1	12.7	mesolarva	21 May 1998	88.8	larval fish seine
WHB98-147	42218	1	12.1	mesolarva	22 May 1998	80.2	larval fish seine
1999	**TOTAL**	**7**					
WHB99-075	44201	1	11.2	mesolarva/yolk	04 May 1999	82.5	larval fish seine
WHB99-105	44254	1	14.1	mesolarva	12-13 May 1999	96.2	light-trap
WHB99-106	44257	1	10.2	mesolarva	12-13 May 1999	96.2	light-trap
WHB99-112	44269	1	11.2	protolarva/yolk	13 May 1999	82.5	larval fish seine
WHB99-167	44421	1	17.9	mesolarva	14 June 1999	16.5	larval fish seine
WHB99-169	44428	1	20.7	metalarva	14 June 1999	13.1	larval fish seine
WHB99-170	44435	1	13.8	mesolarva	14 June 1999	11.5	larval fish seine
2000	**TOTAL**	**129**					
WHB00-104	47770	1	10.4	mesolarva	09 May 2000	104.6	larval fish seine
WHB00-108	47779	2	10.6	mesolarva	10 May 2000	99.7	larval fish seine
			11.3	mesolarva	10 May 2000	99.7	larval fish seine
WHB00-109	47784	1	10.9	mesolarva	10 May 2000	99.4	larval fish seine
WHB00-115	47805	5	10.4	mesolarva/yolk	10 May 2000	89.2	larval fish seine
			10.0	mesolarva	10 May 2000	89.2	larval fish seine
			10.2	mesolarva	10 May 2000	89.2	larval fish seine
			10.3	mesolarva	10 May 2000	89.2	larval fish seine
			11.3	mesolarva	10 May 2000	89.2	larval fish seine
WHB00-116	47808	1	11.1	mesolarva	10 May 2000	88.8	larval fish seine
WHB00-118	47814	3	10.5	mesolarva	11 May 2000	85.6	larval fish seine
			10.8	mesolarva	11 May 2000	85.6	larval fish seine
			10.8	mesolarva	11 May 2000	85.6	larval fish seine
WHB00-119	47819	5	10.6	mesolarva	11 May 2000	84.1	larval fish seine
			10.8	mesolarva	11 May 2000	84.1	larval fish seine
			10.9	mesolarva	11 May 2000	84.1	larval fish seine
			11.1	mesolarva	11 May 2000	84.1	larval fish seine
			11.8	mesolarva	11 May 2000	84.1	larval fish seine
WHB00-121	47824	1	10.6	mesolarva	11 May 2000	82.3	larval fish seine
WHB00-122	47829	6	10.4	mesolarva	11 May 2000	79.4	larval fish seine
			10.7	mesolarva	11 May 2000	79.4	larval fish seine
			11.2	mesolarva	11 May 2000	79.4	larval fish seine
			11.2	mesolarva	11 May 2000	79.4	larval fish seine
			11.6	mesolarva	11 May 2000	79.4	larval fish seine
			13.2	mesolarva	11 May 2000	79.4	larval fish seine
WHB00-130	47855	1	15.2	mesolarva	23 May 2000	69.5	larval fish seine
WHB00-133	47864	1	10.0	mesolarva	23 May 2000	59.8	larval fish seine
WHB00-139	47878	1	14.9	mesolarva	24 May 2000	40.5	larval fish seine
WHB00-143	47882	2	9.3	mesolarva	25 May 2000	23.3	larval fish seine
			18.6	mesolarva	25 May 2000	23.3	larval fish seine
WHB00-149	47896	1	16.1	mesolarva	26 May 2000	15.4	larval fish seine
WHB00-150	47902	1	17.6	mesolarva	26 May 2000	14.0	larval fish seine
WHB00-152	47910	6	15.3	mesolarva	26 May 2000	13.0	larval fish seine
			15.8	mesolarva	26 May 2000	13.0	larval fish seine
			16.1	mesolarva	26 May 2000	13.0	larval fish seine
			17.0	mesolarva	26 May 2000	13.0	larval fish seine
			17.3	mesolarva	26 May 2000	13.0	larval fish seine
			17.9	mesolarva	26 May 2000	13.0	larval fish seine

Appendix 2. Detailed summary of larval razorback sucker collected in the San Juan River. (continued)

Field Number	MSB Catalog Number	Number of Specimens	Total Length	Larval Stage	Date Collected	River Mile	Sampling Method
WHB98-143	42207	1	12.7	mesolarva	21 May 1998	88.8	larval fish seine
WHB00-154	47918	1	12.2	mesolarva	26 May 2000	10.0	larval fish seine
WHB00-155	47924	2	13.6	mesolarva	26 May 2000	8.8	larval fish seine
			16.4	mesolarva	26 May 2000	8.8	larval fish seine
WHB00-156	47930	86			26 May 2000	8.1	larval fish seine
		(6)	9.4-10.1	mesolarvae/yolk	26 May 2000	8.1	larval fish seine
		(6)	10.0-11.7	mesolarvae	26 May 2000	8.1	larval fish seine
		(58)	11.8-15.4	mesolarvae	26 May 2000	8.1	larval fish seine
		(15)	15.5-17.4	mesolarvae	26 May 2000	8.1	larval fish seine
		(1)	18.1	metalarva	26 May 2000	8.1	larval fish seine
WHB00-158	47937	1	16.4	mesolarva	01 June 2000	124.8	larval fish seine
WHB00-168	47978	1	12.0	mesolarva	02 June 2000	104.5	larval fish seine

TOTAL (1998-2000) **138**