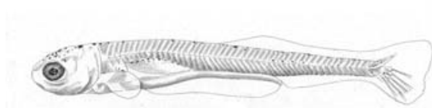
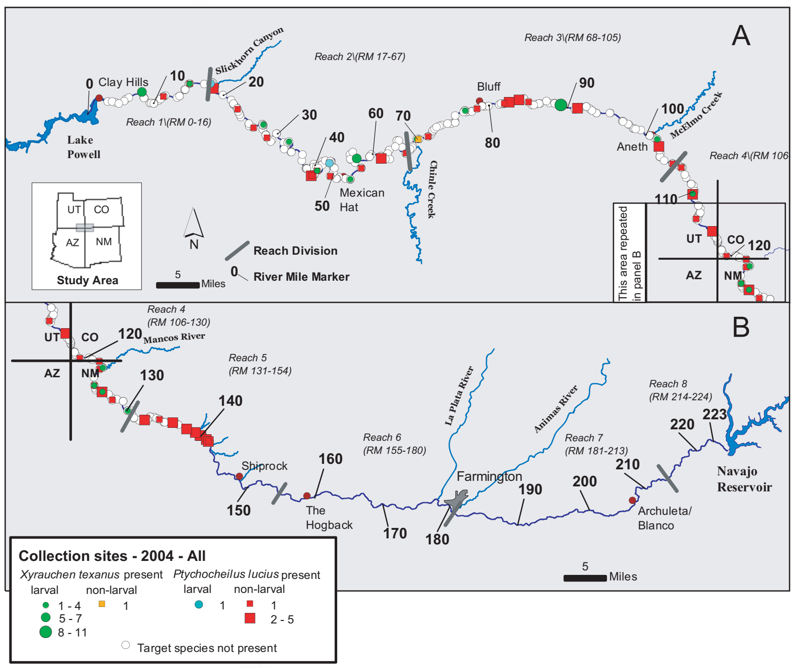
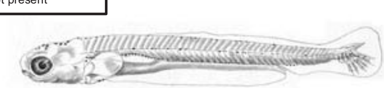
Colorado pikeminnow and razorback sucker larval fish survey in the San Juan River during 2004

FINAL REPORT



Ptychocheilus lucius larva, W.H. Brandenburg





Xyrauchen texanus larva, W.H. Brandenburg

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SAN JUAN RIVER BASIN RECOVERY IMPLEMENTATION PROGRAM

Colorado pikeminnow and razorback sucker larval fish survey in theSan Juan River during 2004

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submitted to:

San Juan River Basin Biology Committee
under the authority of the
San Juan River Basin Recovery Implementation Program

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Executive Summary

1. There were 353 fish collections at 273 unique sites between river miles 141.2 and 3.6 resulting in the collection of fish representing six families and 14 species with all but five collections producing fish under the auspices of the 2004 larval Colorado pikeminnow and 2004 larval razorback sucker surveys.

2. There were 35 fewer collections taken in 2004 than in 2003, however 2004 produced nearly 49,000 more fish than 2003 (n=160,288 and 111,534 respectively).

3. Non-native cyprinids accounted for 87.7% (n=140,572) of the 2004 catch by number. Red shiner was the numerically dominant (n=130,265) and most frequently encountered species occurring in 337 of the 348 samples that produced fish.

4. Native species accounted for 11.5% (n=18,421) of the 2004 catch by number. Speckled dace was the numerically dominant native species (n=8,641) with Flannelmouth sucker being the most frequently encountered native species occurring in 169 of the 348 samples that produced fish.

5. Catostomids accounted for 6.1% (n= 9,704) of the 2004 catch by number. Bluehead sucker was the numerically dominant catostomid taxon, accounting for 66.4% of all catostomids collected. Razorback sucker accounted for 0.4% of the 2004 catostomid catch by number.

6. Reach 5 had the highest CPUE (3,064.7 fish per 100 m^2) while reach 1 had the lowest CPUE (220.1 fish per 100 m^2) of any of the reaches sampled.

7. A total of 76 Colorado pikeminnow were collected in 2004, two of which were larval specimens. Previous to 2004, larval Colorado pikeminnow were last collected from the San Juan River in 2001.

8. The first larval Colorado pikeminnow was collected on 22 July 2004 at river mile 46.3 and measured 14.2 mm TL. The second larval Colorado pikeminnow was collected on 24 July 2004 at river mile 17.0 and measured 18.1 mm TL. The back-calculated spawning date (Nesler et al. 1988) for these two larval Colorado pikeminnow was 24 and 25 June 2004 respectively.

9. Reach 5 had the highest CPUE for juvenile Colorado pikeminnow (2.1 fish per 100 m^2) with Reach 1 having the lowest CPUE for juvenile Colorado pikeminnow (0.1 fish per 100 m^2)

10. A total of 41 larval razorback suckers were collected in 2004. One sub-adult (124 mm TL) razorback sucker was also collected in 2004.

11. There was a 91.3% decrease in the number of larval razorback suckers collected in 2004 compared to 2003.

12. A total of sixteen collections produced larval razorback suckers, with the largest collection yielding 11 individuals. Ten of the 16 collections that produced larval razorback sucker contained a single individual.

13. The first larval razorback sucker was collected on 15 May 2004 at river mile 77.1 with the last collection to produce larval razorback sucker taken on 15 June 2004 at river mile 8.1.

14. Seven larval razorback sucker were collected from Reach 4 in 2004; there were no larval razorback suckers collected from Reach 4 in 2003. Reach 3 produced the largest number of larval razorback suckers (n=15) and also produced the single sub-adult collected in 2004. Reach 5 was the only reach not to produce any razorback suckers.

Introduction

Background Information

The primary focus of the 2004 San Juan River larval fish survey is on two federally endangered species, Colorado pikeminnow, *Ptychocheilus lucius*, and razorback sucker, *Xyrauchen texanus.*

Colorado pikeminnow, belonging to the family Cyprinidae, was listed by the U.S. Department of the Interior in 1974. It is endemic to the Colorado River Basin where it was once abundant and widespread (Tyus, 1991). This species now occupies only about 20% of its historic range (Tyus, 1990). The Green River sub-basin apparently supports the majority of remaining Upper Basin individuals (Holden and Wick, 1982; Bestgen et al., 1998). Conversely, no Colorado pikeminnow have been reported in the Lower Basin since the 1960s (Minckley and Deacon, 1968; Minckley, 1973; Moyle, 1976).

A small but self-sustaining population of this species occurs in the lower-most 225 river km (between Cudei Diversion Dam and the inlet of Lake Powell Reservoir) of the San Juan River. The decline of this and other native fishes in the San Juan River has been attributed to flow modifications and the resultant changes to the thermal regime, instream barriers, and non-native predation-competition for habitat and resources. Understanding the conditions necessary for spawning in Colorado pikeminnow and other native fishes was deemed necessary to stabilize and increase the population size of this species.

Much has been reported regarding the life-history and reproductive behavior of Colorado pikeminnow (Vanicek and Kramer, 1969). Studies in the Upper Colorado River Basin (Yampa and Green rivers) have demonstrated that this species spawns as spring runoff is receding and at water temperatures between 18°C and 20°C (Haynes et al., 1984; Nesler et al., 1988). Larval Colorado pikeminnow employ drift as a dispersal mechanism and are presumed to begin this passive movement approximately five days after hatching. The five-day time-frame corresponds with the swim-up period of this fish as reported by Hamman (1981, 1986).

This life-history phase (drifting larvae), the focus of several investigations in the Upper Colorado River Basin, has been investigated to provide information on spawning bar location, reproductive success, and the effects of various flow-regimes on reproduction. The collection of a juvenile (177 mm TL) Colorado pikeminnow in 1978 (Minckley and Carothers, 1979) and rediscovery of a reproducing population of Colorado pikeminnow in the San Juan River in 1987 (Meyer and Moretti, 1988; Platania and Bestgen, 1988; Platania et al., 1991) demonstrated a need for studies to ascertain information such as that obtained for this species in the Upper Colorado River Basin. Such studies would also provide comparable information on other members of the ichthyofaunal community.

In 1991, passive drift-netting for larval and young-of-year (YOY) fish was initiated in the San Juan River. The primary objectives of the passive drift-netting study were to 1) determine the temporal distribution of San Juan River ichthyoplankton in relation to the hydrograph, 2) provide comparative analysis of the reproductive success of San Juan River fishes, 3) attempt to characterize downstream movement of ichthyoplankton, and 4) attempt to validate the presumed spawning period of Colorado pikeminnow.

Passive drift-netting on the San Juan River at Mexican Hat was conducted by the Utah Division of Wildlife Resources (UDWR) during 1991-1994, samples at Four Corners were taken by New Mexico Department of Game and Fish (NMGF) during 1991-1994, and both sites were sampled by personnel at the Museum of Southwestern Biology, Division of Fishes at the University of New Mexico (UNM) during 1995-2001. Results from the 1991-1997 portion of the drift-net study were presented in a report by Platania et al. (2000) and will not be discussed in this report.

In 2000 a different passive sampling device, the Moore Egg Collector (Altenbach et al., 2000), was used, with similar results to drift-nets (2,138 specimens were collected). Between 1991-2000, only 20,901 specimens (and few Colorado pikeminnow) were collected in the passive sampling effort (Table 1). Meanwhile, the larval seining method had proven successful in larval razorback sucker fish surveys by UNM personnel between 1998-2000. The sampling protocol in 2001 included a combination of passive drift-netting and active sampling with larval seines.

Table 1. Summary of larval and YOY Colorado pikeminnow collected in the San Juan River (1993-2004) and back calculated dates of spawning.

Field Number	MSB Catalog Number	Number specimen	Total Length	Date Collected	Date Spawned	River Mile	Sample Method
MH72693-2	18098	1	9.2	26 Jul 93	08 Jul 93	53.0	drift netting
MH72793-2	18099	1	9.2	27 Jul 93	09 Jul 93	53.0	drift netting
JPS95-205	26187	1	9.2	02 Aug 95	15 Jul 95	53.0	drift netting
JPS95-207	26191	1	9.0	03 Aug 95	17 Jul 95	53.0	drift netting
WHB96-037	29717	1	8.6	02 Aug 96	18 Jul 96	128.0	drift netting
FC01-054	50194	1	8.5	01 Aug 01	17 Jul 01	128.0	drift netting
MAF04-046	53090	1	14.2	22 Jul 04	24 Jun 04	46.3	larval seine
MAF04-059	53130	1	18.1	26 Jul 04	25 Jun 04	17.0	larval seine
TOTAL		8					

After a decade of passive sampling, these methods (with the exception of occasional use of light-traps) were discontinued in 2002 in favor of active sampling with larval seines. In 2002, over four times as many specimens were collected (n=90,518) than in the previous ten years combined. The new sampling protocol was continued during 2003 and resulted in the collection of over 70,000 specimens although there was no documentation of reproduction of Colorado pikeminnow.

The second species of interest, razorback sucker, a member of the family Catostomidae, was listed as a federally endangered species in 1991. 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 record of razorback sucker in the San Juan River was in 1976 when two adult specimens were collected at an irrigation pond near Bluff, Utah (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 in the San Juan River near Bluff, Utah (Roberts and Moretti, 1989).

The extreme rarity of razorback sucker in the San Juan River drainage necessitated the experimental 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 of a full-scale augmentation program for razorback sucker in the San Juan River.

At the November 1996 San Juan River Basin 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, identify approximate location of spawning sites, and assess the 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., speckled dace, *Rhinichthys osculus*, and channel catfish, *Ictalurus punctatus*). 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 each 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 a 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 led 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 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 snowmelt 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 larger portion of the San Juan River and capture of a considerably larger number of larval fish. An inflatable raft, which was used to travel on 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. The seining 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 46 river mile reach between Four Corners to Bluff to a 123 river mile reach between Four Corners and Clay Hills.

The changes in sampling protocol and study reach that were instituted in 1998 proved 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 Basin Recovery Implementation Program. In 1999, seven additional larval razorback sucker were collected between river mile (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).

There was a dramatic increase between 1999 and 2000 in the catch of larval razorback sucker. The 2000 sampling effort produced 129 larval razorback sucker in 21 separate collections from 9 May 2000 to 2 June 2000. Razorback sucker ranged from 9.4 to 18.1 mm TL with all except one being at the mesolarvae developmental stage. The apparent distribution of larval razorback sucker in 2000 expanded from RM 96.2 upstream to RM 124.8 and downstream from RM 11.5 to RM 8.1. 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 (n=86). While larval razorback sucker were generally distributed throughout the study area in 2000, they were notably rarest in the uppermost portion of the upper sampling reach.

In 2001 the study area was expanded upstream an additional fourteen miles to include nearly half of reach 5. A total of 50 larval razorback sucker was taken during the 2001 sampling effort. These collections were made between 16 May and 14 June 2001, with two being taken in light-traps on 17 May 2001. The distribution of larval razorback sucker remained the same in 2001, between RM 8.1 and RM 124.8, with the greatest numbers (>90%) being collected below Bluff, Utah. Razorback sucker collected during the first sampling trip were the smallest (10.1 to 15.5 mm TL) and least developed (all were mesolarvae) of the 2001 survey, while later collections included larger (13.0 to 28.8 mm TL) and more developed (metalarvae and juvenile) specimens.

Collecting protocols remained the same in 2002 as the previous year. There were 152 collections made between 15 April 2002 through 29 June 2002. Although the 2002 sampling efforts yielded 40% fewer fish compared to 2001, there was a 93.8% (n=813) increase in the number of larval and juvenile razorback sucker collected compared with 2001. A total of 67 collections yielded razorback sucker. Collections were made in 2002 that produced much larger juveniles than have been observed in previous years, the largest specimen was 62.4 mm TL. Juvenile specimens sucker comprised 15.9% of all razorback sucker collected. Rather than a clumped distribution as was seen in 2001, razorback sucker were collected uniformly throughout the study area from river mile 134.5 to 2.8, with the greatest concentrations found in reaches 3, 2, and 1. Light traps were successful in collecting 31 razorback sucker in 2002.

In 2003 a total of 472 razorback suckers were collected with 31 collections yielding razorback suckers. Five collections contained between ten and 29 individuals, three collections contained between 30 and 49 individuals, and three collections contained 50 or more individuals. The first larval razorback sucker (n=6) were collected in reach 3 (river mile 97.0) on 16 May 2003. The largest single collection of razorback sucker (n=99) was collected in reach 1 at river mile 8.1, Steer Gulch.

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 predominantly 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 reduction 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*

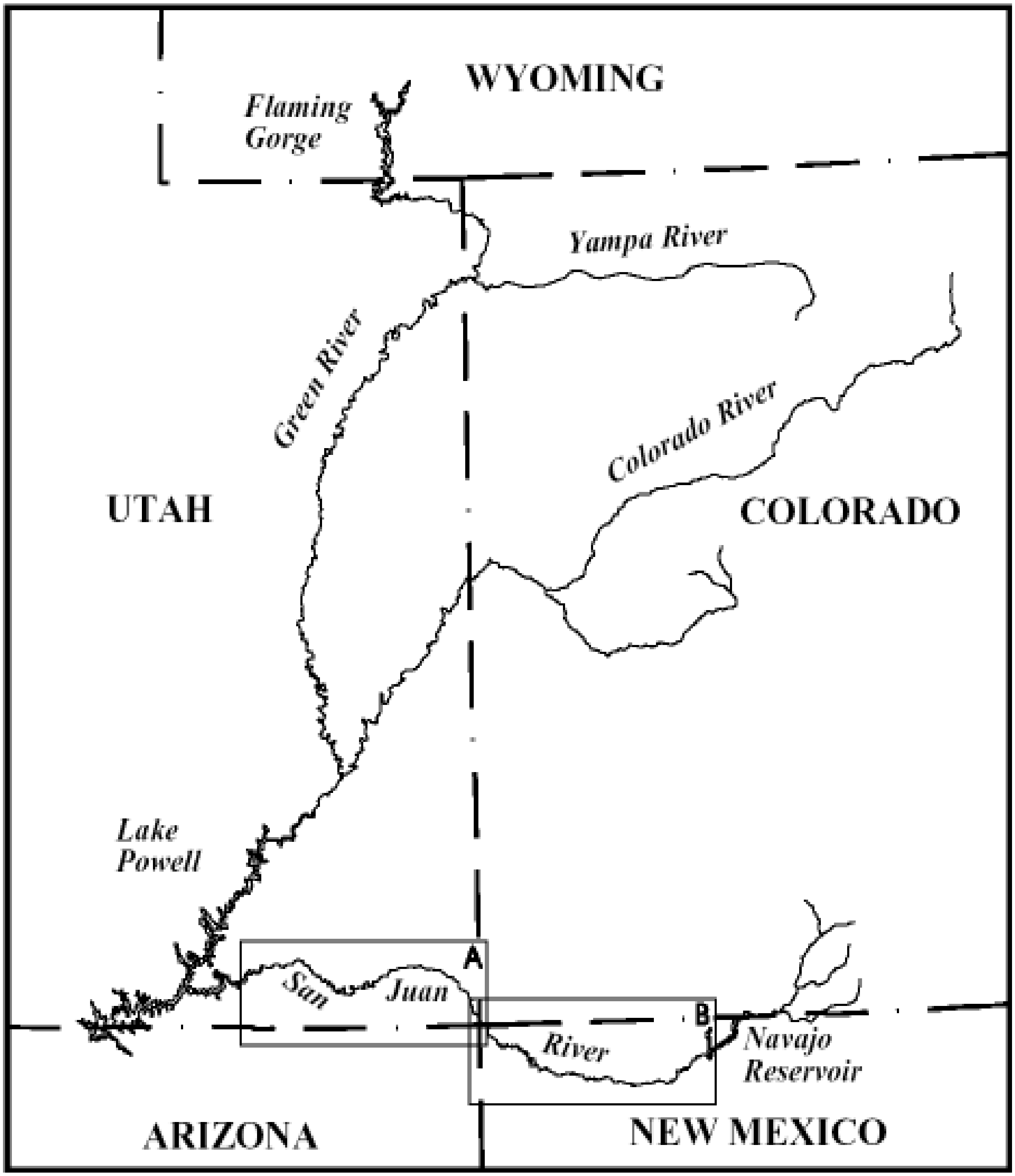

Figure 1. Location of the San Juan River within the Upper Colorado River Basin. The study area is outlined and labelled “A” and “B” with reference to subsequent maps in this report.

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). Mean daily peak discharge during 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.

Operation 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 San Juan 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 106 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. 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 predominantly 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's hypolimnetic release design, 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 study area for the razorback survey remained the same between 2001 and 2003 and encompassed reaches 1 through approximately 43% of reach 5 (Figure 2). In 2003 three razorback sucker larval fish collection trips were made between 15 April and 18 June 2003. These trips were not broken into upper and lower reaches as was done in previous years but rather the entire study area was sampled in each trip. This change was made in accordance with a new protocol for reporting on annual monitoring activities that was agreed to by the San Juan River Basin Biology Committee and initiated beginning with 2002 reports. One component of the new reporting was that data were to be presented and analyzed along the predesignated San Juan River Reaches (delineated in Study Area). This change in reporting did not work well for the larval San Juan River razorback sucker survey as that investigation was not conducted in the same format as the other monitoring activities (i.e., small bodied fish, adult monitoring, habitat, etc). In these other well established monitoring programs, sampling of the entire river was done during a single uninterrupted effort which allowed for meaningful between-reach comparisons. Conversely, the larval San Juan River razorback sucker survey project did not attempt to sample the entire study area under a single, continuous sample event until 2003. Instead, the river was divided into functional reaches (upper and lower) based solely on the distance that could be sampled in five to seven days and points of access. The period between sampling events of the upper and lower reaches of the San Juan River (under this study) were often one to two weeks. This sampling protocol allowed for a more efficient sampling of the San Juan River, especially given that the larval San Juan River razorback sucker survey project was still functioning primarily as a "search and capture" versus "monitoring" project. Given the marked increase in the number of razorback sucker taken in 2002 and the need to formalize the sampling protocol of this project with the other monitoring surveys, beginning in 2003, the entire larval razorback sucker study area was sampled during each individual (continuous) sampling trip.

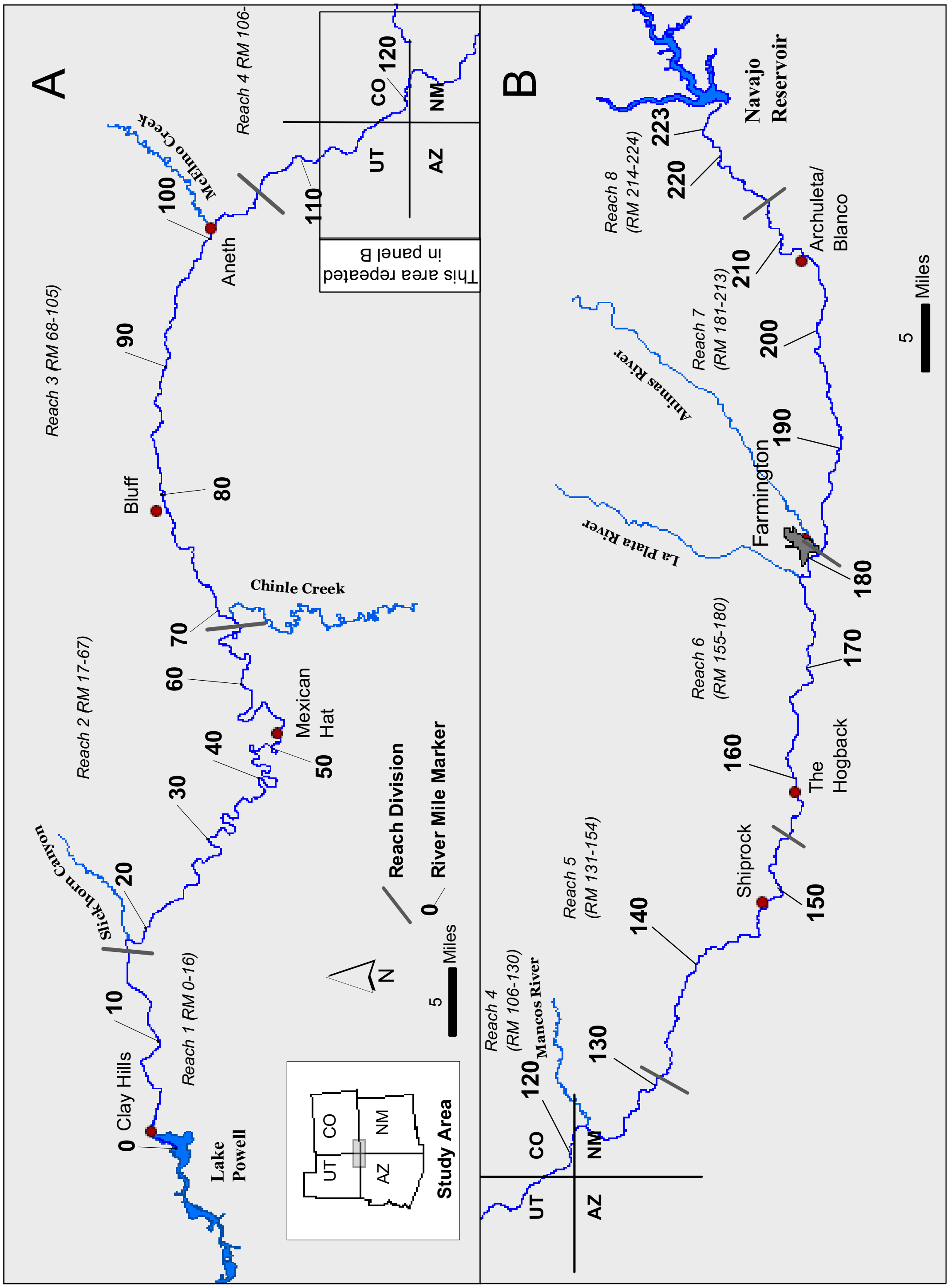

Figure 2. Map of the San Juan River study area.

Objectives

This work was conducted as required by the San Juan River Basin Implementation Program Monitoring Plan and Protocol dated 31 March 2000. The objectives of this specific monitoring effort are identified in the aforementioned document (1a, 3a, and 3b) and listed below:

- Determine if Colorado pikeminnow reproduction occurred in the San Juan River and the relative level of any such effort.
- Determine the spawning periodicity of catostomids between mid-April and early September and examine potential correlations with temperature and discharge
- Attempt to validate the presumed spawning period of San Juan River catostomids.
- Determine if reproduction by razorback sucker occurred in the San Juan River (upstream of Mexican Hat, Utah).
- Provide a comparative analysis of the reproductive effort of catostomids
- Determine the relative annual reproductive success of razorback sucker (1a).
- Provide annual summaries of monitoring results (3a).
- Provide detailed analysis of data collected to determine progress towards endangered species recovery in three years and thence every five years (3b).

Methods

Access to the river and collection localities was gained through the use a 16' inflatable raft that transported both personnel and collecting gear. There was not a predetermined number of collections per river mile nor 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 pools and backwaters.

Collecting efforts for larval fish concentrated on low velocity habitats using small mesh seines (1 m x 1 m x 0.8 mm). Several seine huals (between 3 and 12) were run through an individual collecting site depending on the size of the habitat. For each seine collection, the length of each seine haul was determined in addition to the number of seine hauls per site. Meso-habitat type, length, maximum depth, substrate, turbidity (using a secchi disk) were recorded in the field data sheet for the particular collecting site. Water quality measurements (dissolved oxygen, conductivity, salinity, and temperature) were also obtained using a multiparameter YSI-85 water quality meter. A minimum of one digital photograph was recorded at each collection site.

River Mile was determined to tenth of a mile using the 2003 standardized aerial maps produced for the San Juan River Basin Recovery Implementation Program and used to designate the location of collecting sites. In addition, geographic coordinates were determined at each site with a Garmin Navigation Geographic Positioning System (GPS) unit and were recorded in Universal Transverse Mercator (UTM) Zone 12 (NAD27). In instances where coordinates could not be obtained due to poor GPS satellite signal, coordinates were determined in the lab using a Geographic Information System based on the recorded river mile.

All retained specimens were placed in plastic bags (Whirl-Paks) containing a solution of 10% formalin and a tag inscribed with unique alpha-numeric code that was also recorded on the field data sheet (Appendix IV). Samples were returned to the laboratory where they were sorted, specimens identified to species, enumerated, measured (minimum and maximum size [mm standard length] 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 used in this report follow Robins et al. (1991) while six letter codes for species are those adopted by the San Juan River Basin Biology Committee (Table 2). Common names, arranged in phylogenetic order, are presented in the tables in this report. For Colorado pikeminnow and razorback sucker, a measure of total length (TL) was recorded for each individual in addition to standard length (SL, Appendix I, II, and III). This was done in an effort to provide a higher degree of consistency and comparability with information presented from the San Juan River Basin and Upper Colorado River Basin programs. Throughout this report, length of YOY razorback sucker are presented as TL.

Specimens were identified to species by MSB personnel with expertise in San Juan River Basin larval fish identification. The term young-of-year (YOY) can include both larval and juvenile fish. It refers to any fish, regardless of developmental stage, between hatching or parturition and the date (1 January) that they reach age 1 (i.e., YOY = age 0 fish). Larval fish is a specific developmental (morphogenetic) period between the time of hatching and when larval fish transform to juvenile fish. We have chosen to follow larval fish terminology as defined by Snyder (1981). There are three distinct sequential larval developmental stages: protolarvae, mesolarvae, and metalarvae. Fish in any of these developmental stages are referred to as larvae or larval fish. Juvenile fish are those that have progressed beyond the metalarvae stage and no longer retain traits characteristic of larval fishes. Juveniles were classified as individuals that 1) had completely absorbed their fin folds, 2) had developed the full adult complement of rays and spines, and 3) had developed segmentation in at least a few of the rays. Specimens whose species-specific identity was questionable were forwarded to Darrel E. Snyder (Larval Fish Laboratory, Colorado State University) for review.

An electronic copy of the 2004 fish collection data was formatted and submitted for inclusion in the San Juan River integrated database being developed at UNM.

This study was annually initiated prior to spring runoff and completed near the end of the summer season (late September). Daily mean discharge during the study period was acquired from U.S. Geological Survey Gauge (# 09379500) near Bluff, Utah (Figure 3). Temperature data (mean, max, min) was supplied by Keller_Bliesner Engineering and taken at Montezuma Creek, approximately 17.5 miles upstream of the Bluff gauging station (Figure 4).

Results

2004 Survey

There were 353 samples taken at 273 unique sites during the 2004 larval Colorado pikeminnow and larval razorback sucker surveys (Figure 5). All except five samples produced fish yielding 160,288 specimens representing six families and fourteen species (Table 3). Six separate trips were made between 19 April and 14 September 2004 with each trip starting at river mile 141.5 (Cudei, New Mexico) and ending at river mile 2.9 (Clay Hills, Utah). There were 35 fewer samples taken in 2004 than in 2003 with the total area sampled in 2004 approximately 1,700 m^2 less than that of 2003 (11,820.3 m^2 and 13,564.6 m^2 respectively). However, 2004 produced nearly 49,000 more fish than were collected in 2003 (n=160,288 and 111,534 respectively). This represents a 43.7% increase in fish collected in 2004 from 2003. Red shiner was the numerically dominant species accounting for 81.3% of all fish collected and was present in 337 of the 348 samples that produced fish. Fathead minnow was the second most dominant species collected and accounted for 6.3% of all fish collected. Combined, non-native species accounted for 88.5% of the 2004 catch by number with native species accounting for 11.5% of the 2004 catch (Figure 6). Colorado pikeminnow, speckled dace, flannelmouth sucker, *Catostomus latipinnis*, bluehead sucker, *Pantosteus discobolus*, and razorback sucker were the

Table 2. Scientific and common names and species codes of fish collected from the San Juan River. Asterisk (*) indicates species collected in previous years, but absent from 2004 samples.

Scientific Name	Common Name	Code
Order Cypriniformes		
Family Cyprinidae	carps and minnows	
Cyprinella lutrensis	red shiner	(CYPLUT)
Cyprinus carpio	common carp	(CYPCAR)
*Gila robusta**	roundtail chub	(GILROB)
Pimephales promelas	fathead minnow	(PIMPRO)
Ptychocheilus lucius	Colorado pikeminnow	(PTYLUC)
Rhinichthys osculus	specked dace	(RHIOSC)
Family Catostomidae	suckers	
Catostomus (Pantosteus) discobolus	bluehead sucker	(PANDIS)
Catostomus latipinnis	flannelmouth sucker	(CATLAT)
Xyrauchen texanus	razorback sucker	(XYRTEX)
Order Siluriformes		
Family Ictaluridae	catfishes	
Ameiurus melas	black bullhead	(AMEMEL)
Ictalurus punctatus	channel catfish	(ICTPUN)
Order Salmoniformes		
Family Salmonidae	trouts	
*Oncorhynchus nerka**	kokanee salmon	(ONCNER)
Order Atheriniformes		
Family Fundulidae	killifishes	
Fundulus zebrinus	plains killifish	(FUNZEB)
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)

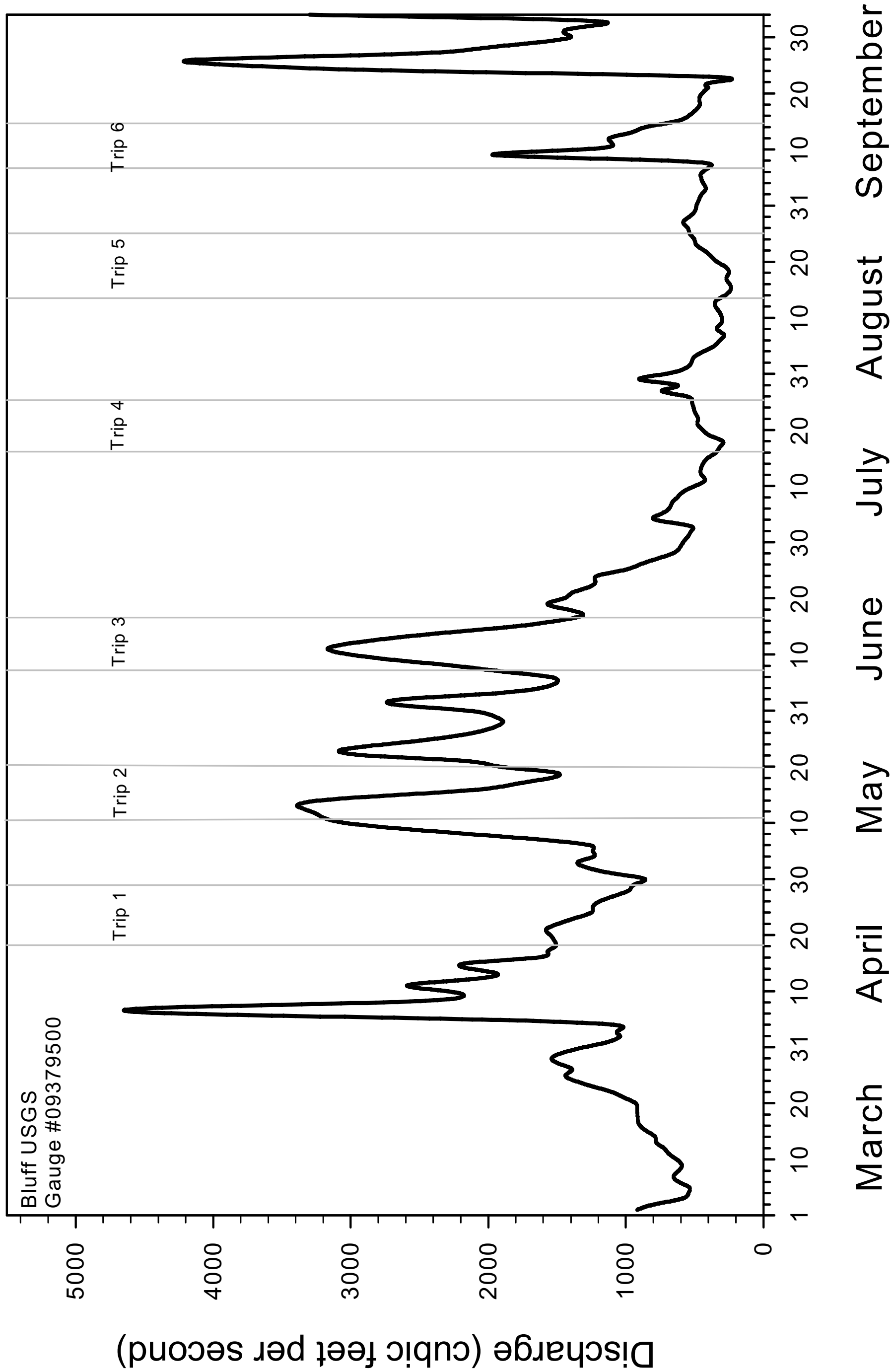

Figure 3. Hydrograph of the San Juan River at Bluff, Utah during the 2004 sampling period.

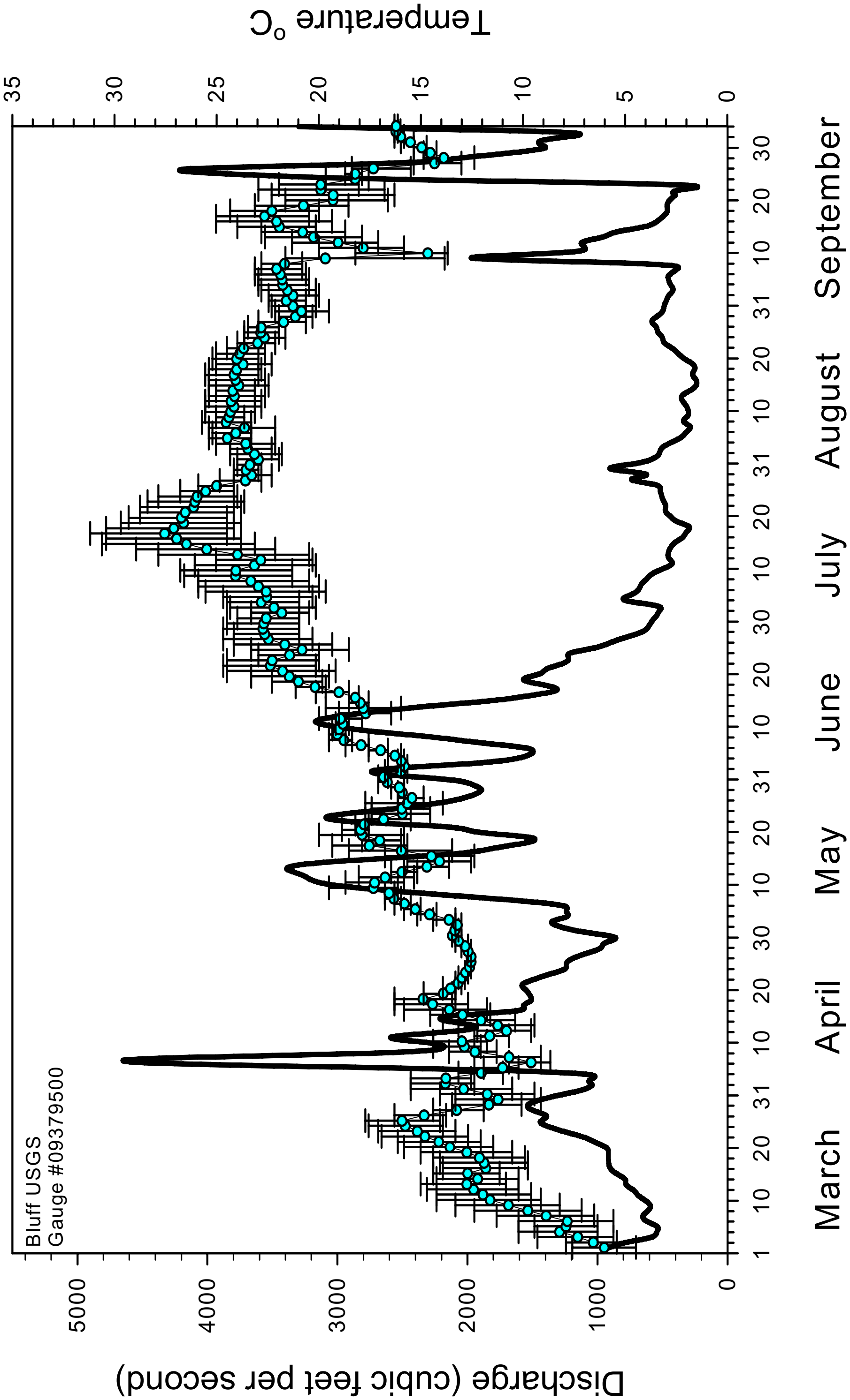

Figure 4. Hydrograph of the San Juan River at Bluff, Utah and temperature data (daily max, min, and average shown) taken at Montezuma Creek during the 2004 sampling period.

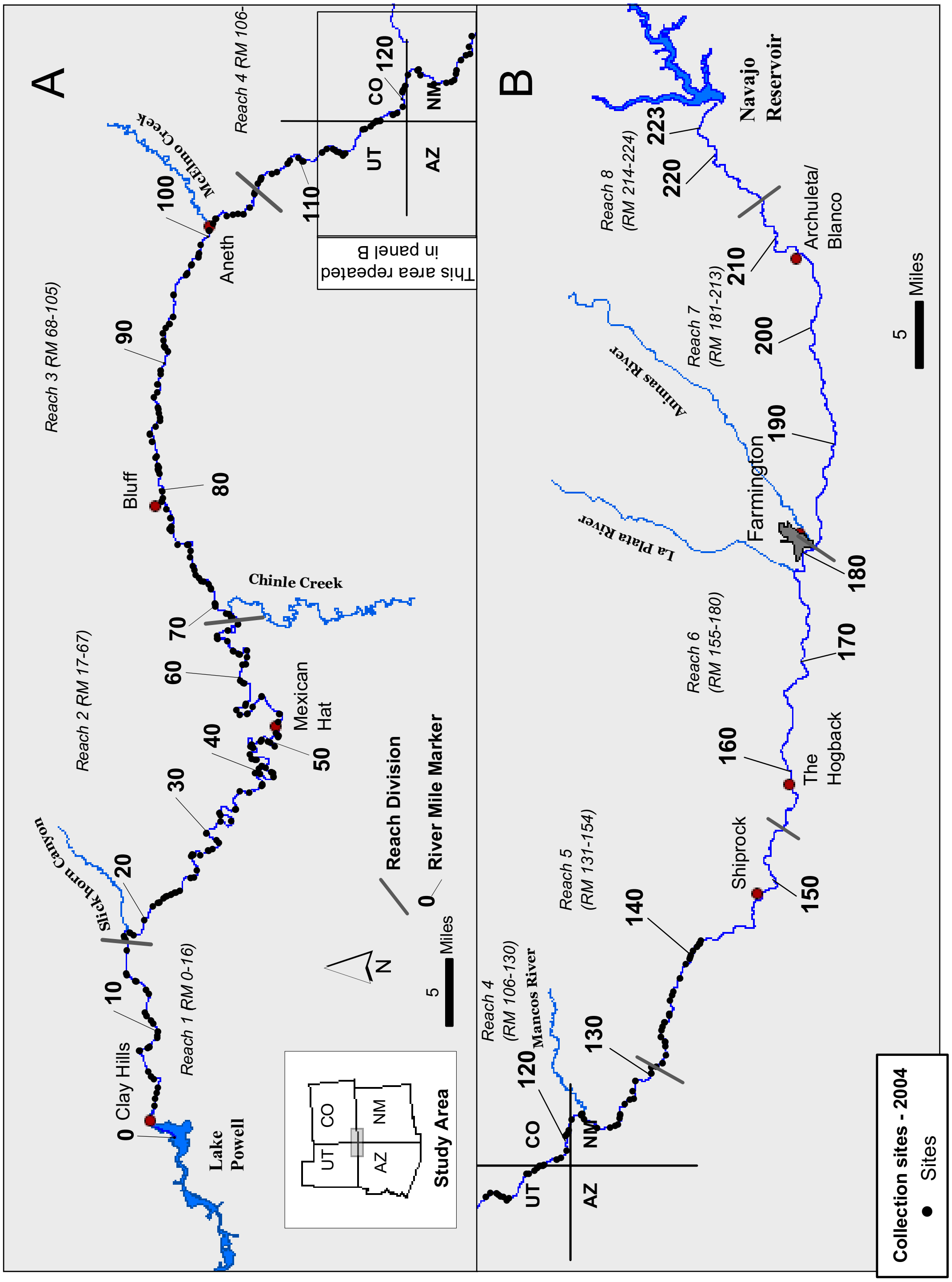

Figure 5. Map of all localities sampled during the 2004 San Juan River larval ichthyofaunal survey (19 April - 14 September 2004; Cudei to Clay Hills Crossing 141.5- 2.9).

Table 3. Summary of 2004 San Juan River larval Coloardo pikeminnow and razorback sucker seining collections (19 April -14 September 2004). Effort = 11,820.3 m^2.

SPECIES	RESIDENCE STATUS[1]	TOTAL NUMBER OF SPECIMENS	PERCENT OF TOTAL	CPUE[2]	FREQUENCY OF OCCURRENCE[3]	% FREQUENCY OF OCCURRENCE[3]
CARPS AND MINNOWS						
red shiner	I	130,265	81.3	1102.0	337	95.5
common carp	I	179	0.1	1.5	33	9.3
roundtail chub	N	-	-	-	-	-
fathead minnow	I	10,128	6.3	85.7	181	51.3
Colorado pikeminnow	N	76	*	0.6	44	12.5
speckled dace	N	8,641	5.4	73.1	156	44.2
SUCKERS						
flannelmouth sucker	N	3,224	2.0	27.3	169	47.9
bluehead sucker	N	6,438	4.0	54.5	130	36.8
razorback sucker	N	42	*	0.4	17	4.8
BULLHEAD CATFISHES						
black bullhead	I	20	*	0.2	8	2.3
channel catfish	I	159	0.1	1.3	37	10.5
TROUT						
kokanee salmon	I	-	-	-	-	-
KILLIFISHES						
plains killifish	I	88	0.1	0.7	54	15.3
LIVEBEARERS						
western mosquitofish	I	1,001	0.6	8.5	98	27.8
SUNFISHES						
green sunfish	I	8	*	0.1	4	1.1
bluegill	I	-	-	-	-	-
largemouth bass	I	19	*	0.2	16	4.5
TOTAL		160,288		1,356.0		

1 N = native; I = introduced
2 CPUE = catch per unit effort; value based on catch per 100 m^2 (surface area) sampled
3 Frequency and % frequency of occurrence are based on n=353 samples.

* Value is less than 0.05

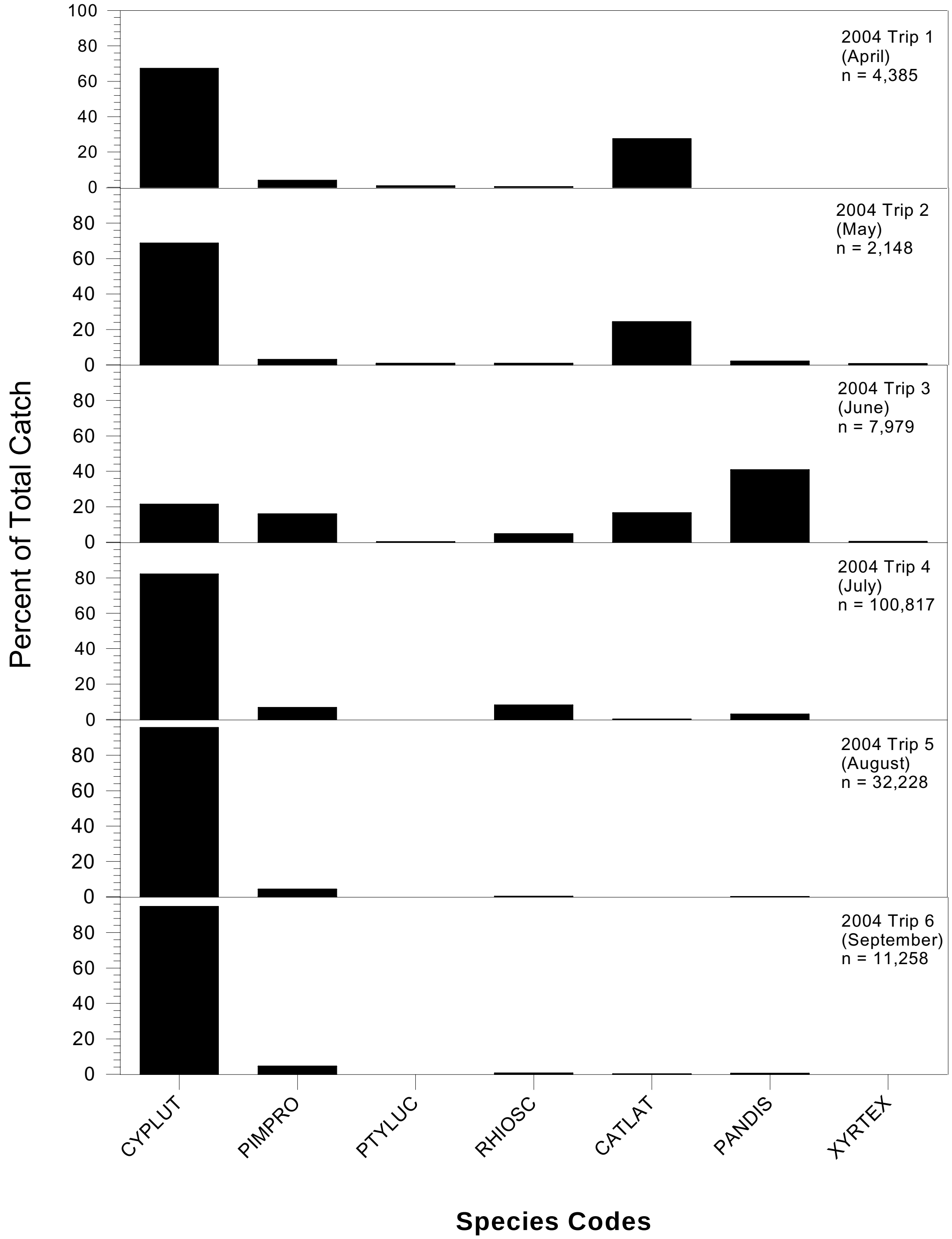

Figure 6. Ichthyofaunal composition of the most abundant species from 2004 sampling efforts by trip.

five native species collected. Of the native species collected, speckled dace was the numerically dominant species (n=8,641) with flannelmouth sucker being the most frequently encountered species occurring in 169 of the 348 samples that produced fish. Bluehead sucker was the numerically dominant catostomid taxon accounting for 66.4% of all catostomids collected.

Trip analysis

Trip 1

The first 2004 collecting effort took place between 19 and 27 April 2004 (Figures 7 and 8). A total of 64 samples were taken with 4,408 specimens collected. Non-native adult cyprinids accounted for 70.9% of the catch and were primarily comprised of red shiner , *Cyprinella lutrensis*,(n= 2,948). Red shiner had the highest CPUE in reach 3, (254.1 fish per 100 m^2). Fathead minnow, *Pimephales promelas*, had the highest CPUE in reach 5, (16.6 fish per 100 m^2; Figure 20). Native cyprinids comprised 1.3% of the catch in the first trip (2.3 fish per 100 m^2). Similar to the non-native cyprinids, none of the native cyprinids collected in the first trip were larval specimens. Trip 1 produced the largest number of Colorado pikeminnow collected during any single trip in 2004 (n=38) and also had the highest CPUE of any trip (1.6 fish per 100 m^2, Table 4). All of these specimens were fish that had been stocked in the San Juan River on 6 November 2003 under the auspices of the Colorado pikeminnow augmentation program. More Colorado pikeminnow were collected in reaches 5 and 4 than in reaches 3 and 2 while reach 1 produced no Colorado pikeminnow. Reach 5 had the highest CPUE for Colorado pikeminnow (3.7 fish per 100 m^2). Adult speckled dace were collected in low numbers in each reach in trip 1 with the greatest numbers collected in reach 4. Catostomids comprised 27.4% of the total catch in trip 1 and had a CPUE of 49.5 fish per 100 m^2. A total of 1,206 flannelmouth sucker were collected in trip 1 which represented the second highest species CPUE in trip 1 (49.5 fish per 100 m^2, Figure 23). Larval specimens represented the majority of flannelmouth sucker collected in trip 1. Larval flannelmouth sucker were first collected at river mile 100.5, (McElmo Creek) on 22 April 2005 and were subsequently collected in nearly every collection downstream. A single age 1 bluehead sucker was collected in reach 4 during this trip. No larval razorback sucker were collected in the first trip, although a sub-adult was found dead on the bank at a collection site at river mile 122.9, just upstream of the Mancos River confluence. The specimen was 240 mm SL and reared at the Six Pack Ponds #6 and stocked at RM 158.6 on 13 April 2004 (pit tag # 42692D5757). The specimen was retained and is cataloged at the Museum of Southwestern Biology.

Trip 2

A total of 59 collections were taken between 11 and 19 May 2004. There were nearly half as many fish specimens taken in trip 2 as compared to the first trip (n=2,161) and this trip had the lowest CPUE (99.1 fish per 100 m^2) of any trip during 2004 (Table 5). Adult non-native cyprinids dominated the collection and constituted 71.2% of the entire catch for trip 2. Red shiner accounted for 96.0% of the non-native cyprinids collected in trip 2 (n=1,476) and had the highest CPUE in reach 2 (100.4 fish per 100 m^2). Fathead minnow comprised the remaining 4.0% of the non-native cyprinid catch. The first documented fathead minnow larva was collected at river mile 112.1 on 13 May 2004. This was the only larval fathead collected in trip 2. There were equal numbers of speckled dace and Colorado pikeminnow collected in trip 2 (n=18). Combined, these two species represented 1.6% of the total catch during the second trip. Colorado pikeminnow were represented by age 1 fish, with the greatest CPUE in reach 5 (4.8 fish per 100 m^2, Figure 9 and Figure 21). Both larval and adult speckled dace were collected. On 16 May 2004 the first larval speckled dace was collected in reach 2 at river mile 61.8 (n=1, Figure

30). Reach 5 had the highest CPUE for speckled dace (3.9 fish per 100 m^2 sampled). Native catostomids comprised 26.6% of the total catch during the second trip and had a combined CPUE of 26.3 fish per 100 m^2. Larval specimens represented virtually all the catostomids collected during trip 2. Flannelmouth sucker accounted for 90.6% of the total catostomid catch and had the second highest CPUE of any fish species collected during trip 2 (23.8 fish per 100 m^2). The first larval bluehead sucker was collected on 13 May 2004 at river mile 101.5, just upstream of McElmo Creek. Bluehead sucker accounted for 7.1% of the catostomid catch during the second trip. The first larval razorback sucker collected in 2004 was collected on 15 May 2004 in reach 3 at river mile 77.1 (n=1). A total of 13 larval razorback sucker were collected during trip 2, eleven of which were collected in reach 2 (Figure 10). Larval razorback sucker comprised 2.3% of the total catostomid catch and 0.6% of the total trip 2 catch with a CPUE of 0.6 fish per 100 m^2.

Trip 3

The third trip occurred between 8 and 15 June 2004 with 59 samples taken. There was an almost three fold increase in the number of specimens collected compared to the second trip (n=8,073) as well as a substantial increase in the CPUE (398.4 fish per 100 m^2, Table 6). Non-native cyprinids comprised 37.2% of the catch and had a combined CPUE of 148.3 fish per 100 m^2. Red shiner were collected throughout all reaches and collections of this species were primarily comprised of adult individuals. This first documentation of larval red shiner was at river mile 122.5 on 9 June 2004 (reach 4). Red shiner comprised 56.6% of the non-native cyprinids collected in trip 3. Fathead minnow accounted for 42.5% of the non-native catch in trip 3. Larval fathead minnow were collected in every reach. The remaining 0.9% of non-native cyprinids were comprised of larval and YOY common carp, *Cyprinus carpio*, which were first collected at river mile 126.0 on 9 June 2004. There was a marked increase in native cyprinids in trip 3 (n=389) and trip 3 had the second highest CPUE of native cyprinids in 2004 (4.8 fish per 100 m^2). Speckled dace comprised 95.6% of the native cyprinid catch in trip 3, and collections of this species were dominated by larval individuals. Speckled dace were most abundant in reaches 3 and 4 with the greatest CPUE in reach 4 (32.2 fish per 100 m^2). Reach 5 had the largest CPUE for Colorado pikeminnow (3.8 fish per 100 m^2, Figure 11). Catostomids had the highest combined CPUE in trip 3 (227.6 fish per 100 m^2). Bluehead sucker comprised 70.7% of the catostomid catch and accounted for 40.4% of the total trip 3 catch. The CPUE for bluehead sucker was higher during trip 3 than any other trip (160.9 fish per 100 m^2, Figure 24). Reach 4 had the highest CPUE for bluehead sucker in trip 3 (440.7 fish per 100 m^2). The second most abundant catostomid in trip 3 was flannelmouth sucker which comprised 28.7% of the catostomid catch and had the third highest species CPUE (65.3 fish per 100 m^2). A total of 28 razorback sucker were collected in trip 3 with 50.0% of these specimens collected in reach 3 (Figure 12). Razorback sucker accounted for 0.3% of the entire catch in trip 3 and had the highest CPUE of any trip in 2004 (1.4 fish per 100 m^2; Figure 24).

Trip 4

Trip 4 was conducted between 16 and 26 July 2004. A total of 62 samples were taken yielding 101,321 specimens (Table 7). Trip 4 produced over 63% of all of the specimens collected in 2004 and produced over three times as many fish as the second most productive trip (trip 5). This trip had a higher CPUE (4,638.2 fish per 100 m^2) than all other trips combined. Trip 4 produced approximately 65% of all red shiner and fathead minnow collected in 2004. This trip also produced the largest single sample of any of the trips. Over 13,000 specimens were collected in a single sample from reach 5 (RM 133.5). Trip 4 was also the most productive for speckled dace, with 94.0% of the 2004 catch of this species occurring in trip 4. Nearly half of all speckled dace collected during trip 4 were collected in reach 3, however reach 4 had the highest CPUE for this species (723.6 fish per 100 m^2, Figure 22). This trip produced the only larval Colorado pikeminnow specimens collected in 2004 (n=2, Figure 13). Both larvae were collected in reach 2 (RM 46.3 and RM17.0). The larva collected on 22 July 2004 at RM 46.3 measured 14.2 mm TL and had a back calculated spawning date of 25 June 2004. The second larva collected on 26 July 2004 at RM17.0 measured 18.1 mm TL with a back calculated spawning date of 26 June 2004 (Figure 26). Only 163 flannelmouth sucker were collected during trip 4 (5.1% of the 2004 total), but over 3,000 bluehead sucker were collected making trip 4 the second most productive trip for this species. As was the case during trip 3, reach 4 had the highest CPUE for bluehead sucker (437.5 fish per 100 m^2). No razorback sucker were collected during trip 4 (Figure 14). Over 80% of all common carp, 90% of all channel catfish, and 75% of all centrarchids collected in 2004 were collected during trip 4.

Trip 5

Trip 5 began on 11 August and was discontinued on 16 August 2004 at Mexican Hat, Utah due to low flow conditions (272 mean cfs at Bluff, Utah). This trip was continued on 23 August and concluded on 26 August 2004. A total of 62 samples were taken yielding 32,823 specimens (Table 8). Trip 5 was the second most productive trip of 2004 generating over 20% of the total numeric catch. Trip 5 also had the second highest CPUE (1,813.7 fish per 100 m^2) of any of the trips. Red shiner comprised 93.7% of the total catch and a CPUE of 1,700 fish per 100 m^2 (Figure 19). This was the highest percent of total for red shiner for any of the six trips in 2004. Combined, red shiner and fathead minnow accounted for 97.9% of the total catch in trip 5. Native species accounted for 0.2% of the total catch, the lowest value for native species in any of the trips. Forty-nine speckled dace were collected with reaches 2 and 3 producing most of these fish (n=18 and 20 respectively). Only five flannelmouth suncker and 39 bluehead sucker were collected during trip 5. Twenty-four of the bluehead sucker collected were taken in reach 4. Combined, native fish had a CPUE of only 5.2 fish per 100 m^2, the lowest of any of the six trips. No Colorado pikeminnow or razorback sucker were collected (Figures 15 and 16). Nearly 60% of all western mosquitofish, *Gambusia affinis*, and 45% of all black bullhead, *Ameiurus melas*, collected in 2004 were taken during trip 5.

Trip 6

Trip 6 was conducted between 7 and 14 September 2004. A total of 11,502 specimens were collected in 47 separate samples. Trip 6 was the only trip in which red shiner was present in every collection made (Table 9). A single Colorado pikeminnow was collected at river mile 11.2 and measured 131mm SL (Figure 17). A partially decomposed channel catfish was found to be lodged in the mouth of the fish. The catfish was removed and preserved before the Colorado pikeminnow was released. Fifty-eight speckled dace were collected with no reach dominating the speckled dace catch. Only six flannelmouth sucker and 41 bluehead sucker were collected. Of the 41 bluehead taken, 31 were collected in reach 3. Reach 3 also produced the only razorback sucker collected during this trip (Figure 18). A single juvenile collected and released at river mile 70.0. It is assumed that this individual was a wild age-1 specimen. Trip 6 was the second most productive trip for western mosquitofish.

Table 4. Summary of 2004 San Juan River trip 1 larval Coloardo pikeminnow and razorback sucker seining collections (19-27 April 2004). Effort = 2,437.5 m^2.

SPECIES	RESIDENCE STATUS[1]	TOTAL NUMBER OF SPECIMENS	PERCENT OF TOTAL	CPUE[2]	FREQUENCY OF OCCURRENCE[3]	% FREQUENCY OF OCCURRENCE[3]
CARPS AND MINNOWS						
red shiner	I	2,948	66.9	120.9	62	96.9
common carp	I	-	-	-	-	-
roundtail chub	N	-	-	-	-	-
fathead minnow	I	175	4.0	7.2	27	42.2
Colorado pikeminnow	N	38	0.9	1.6	21	32.8
speckled dace	N	17	0.4	0.7	9	14.1
SUCKERS						
flannelmouth sucker	N	1,206	27.4	49.5	36	56.3
bluehead sucker	N	1	*	*	1	1.6
razorback sucker	N	-	-	-	-	-
BULLHEAD CATFISHES						
black bullhead	I	4	0.1	0.2	2	3.1
channel catfish	I	3	0.1	0.1	3	4.7
TROUT						
kokanee salmon	I	-	-	-	-	-
KILLIFISHES						
plains killifish	I	14	0.3	0.6	9	14.1
LIVEBEARERS						
western mosquitofish	I	2	*	0.1	2	3.1
SUNFISHES						
green sunfish	I	-	-	-	-	-
bluegill	I	-	-	-	-	-
largemouth bass	I	-	-	-	-	-
TOTAL		4,408		180.8		

[1] N = native; I = introduced
[2] CPUE = catch per unit effort; value based on catch per 100 m^2 (surface area) sampled
[3] Frequency and % frequency of occurrence are based on n=64 samples.

* Value is less than 0.05

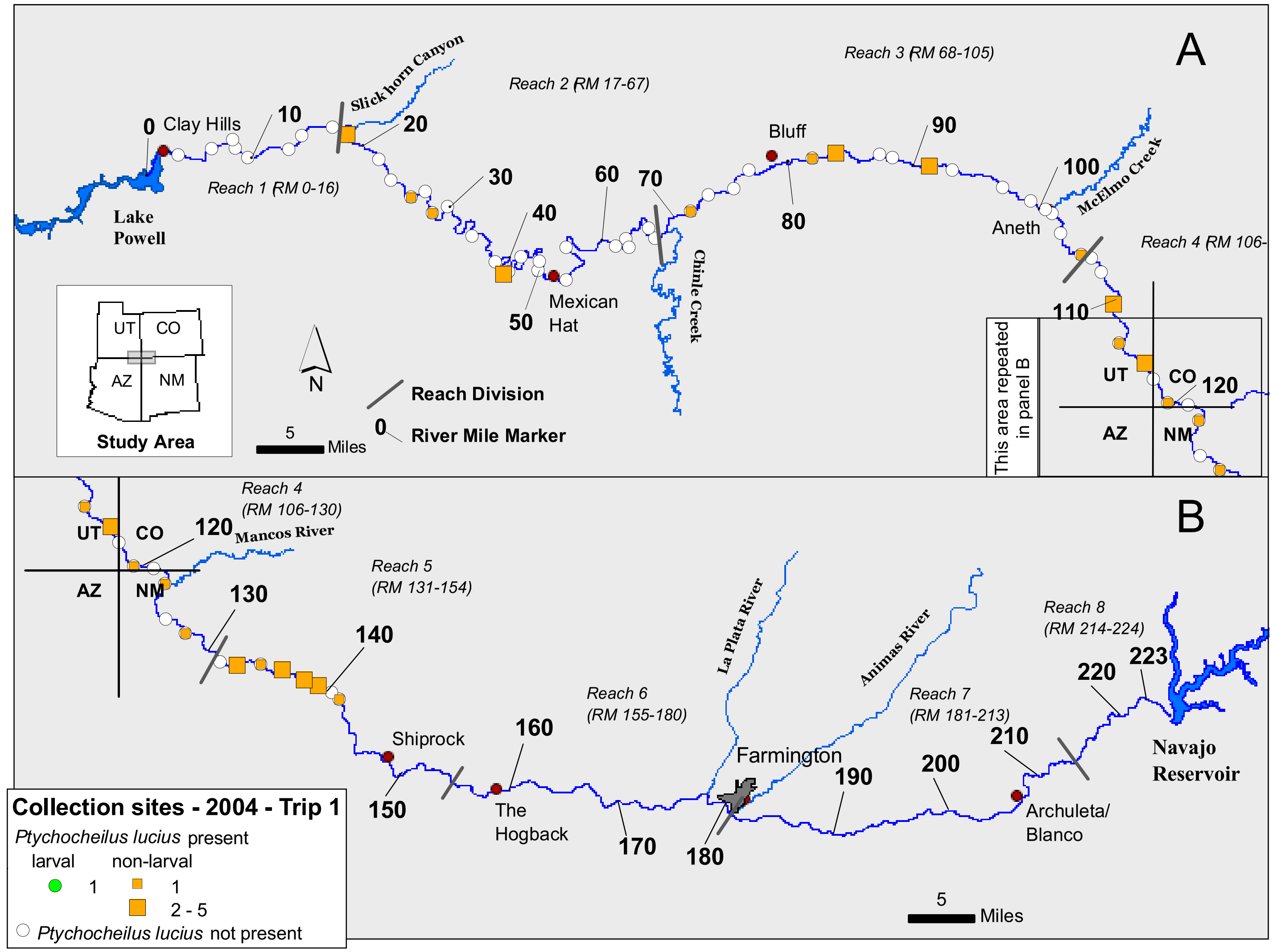

Figure 7. Map of localities sampled during trip 1 of the 2004 San Juan River larval ichthyofaunal survey (19-27 April 2004; Cudei to Clay Hills Crossing; RM 141.5-2.9) with Colorado pikeminnow collections highlighted.

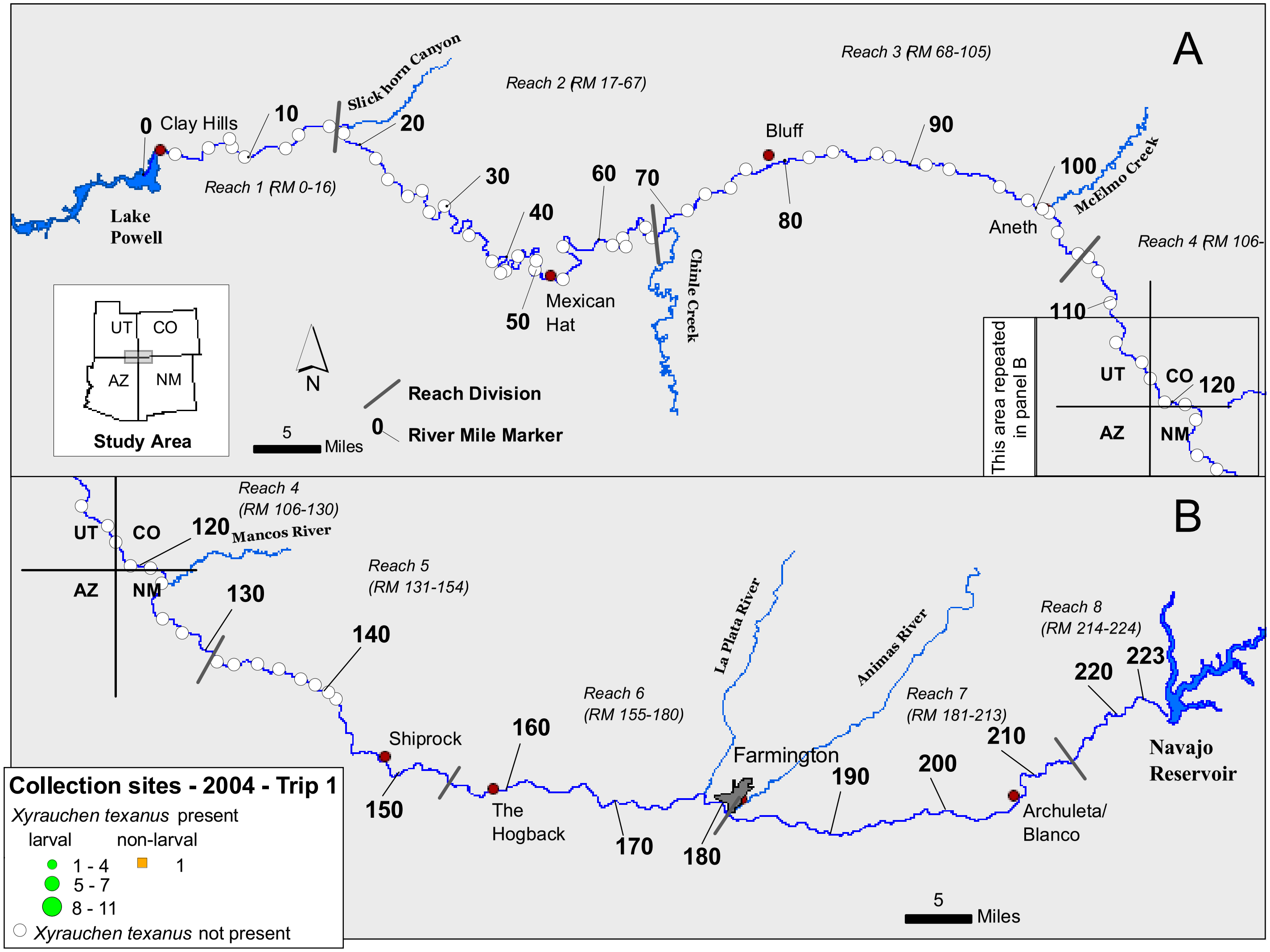

Figure 8. Map of localities sampled during trip 1 of the 2004 San Juan River larval ichthyofaunal survey (19-27 April 2004; Cudei to Clay Hills Crossing; RM 141.5-2.9) with razorback sucker collections highlighted.

Table 5. Summary of 2004 San Juan River trip 2 larval Coloardo pikeminnow and razorback sucker seining collections (11-19 May 2004). Effort = 2,181.5 m^2.

SPECIES	RESIDENCE STATUS[1]	TOTAL NUMBER OF SPECIMENS	PERCENT OF TOTAL	CPUE[2]	FREQUENCY OF OCCURRENCE[3]	% FREQUENCY OF OCCURRENCE[3]
CARPS AND MINNOWS						
red shiner	I	1,476	68.3	67.7	53	89.8
common carp	I	-	-	-	-	-
roundtail chub	N	-	-	-	-	-
fathead minnow	I	62	2.9	2.8	17	28.8
Colorado pikeminnow	N	18	0.8	0.8	11	18.6
speckled dace	N	18	0.8	0.8	11	18.6
SUCKERS						
flannelmouth sucker	N	520	24.1	23.8	43	72.9
bluehead sucker	N	41	1.9	1.9	16	27.1
razorback sucker	N	13	0.6	0.6	6	10.2
BULLHEAD CATFISHES						
black bullhead	I	2	0.1	0.1	1	1.7
channel catfish	I	2	0.1	0.1	2	3.4
TROUT						
kokanee salmon	I	-	-	-	-	-
KILLIFISHES						
plains killifish	I	8	0.4	0.4	5	8.5
LIVEBEARERS						
western mosquitofish	I	-	-	-	-	-
SUNFISHES						
green sunfish	I	1	*	*	1	1.7
bluegill	I	-	-	-	-	-
largemouth bass	I	-	-	-	-	-
TOTAL		2,161		99.1		

[1] N = native; I = introduced
[2] CPUE = catch per unit effort; value based on catch per 100 m^2 (surface area) sampled
[3] Frequency and % frequency of occurrence are based on n=59 samples.

* Value is less than 0.05

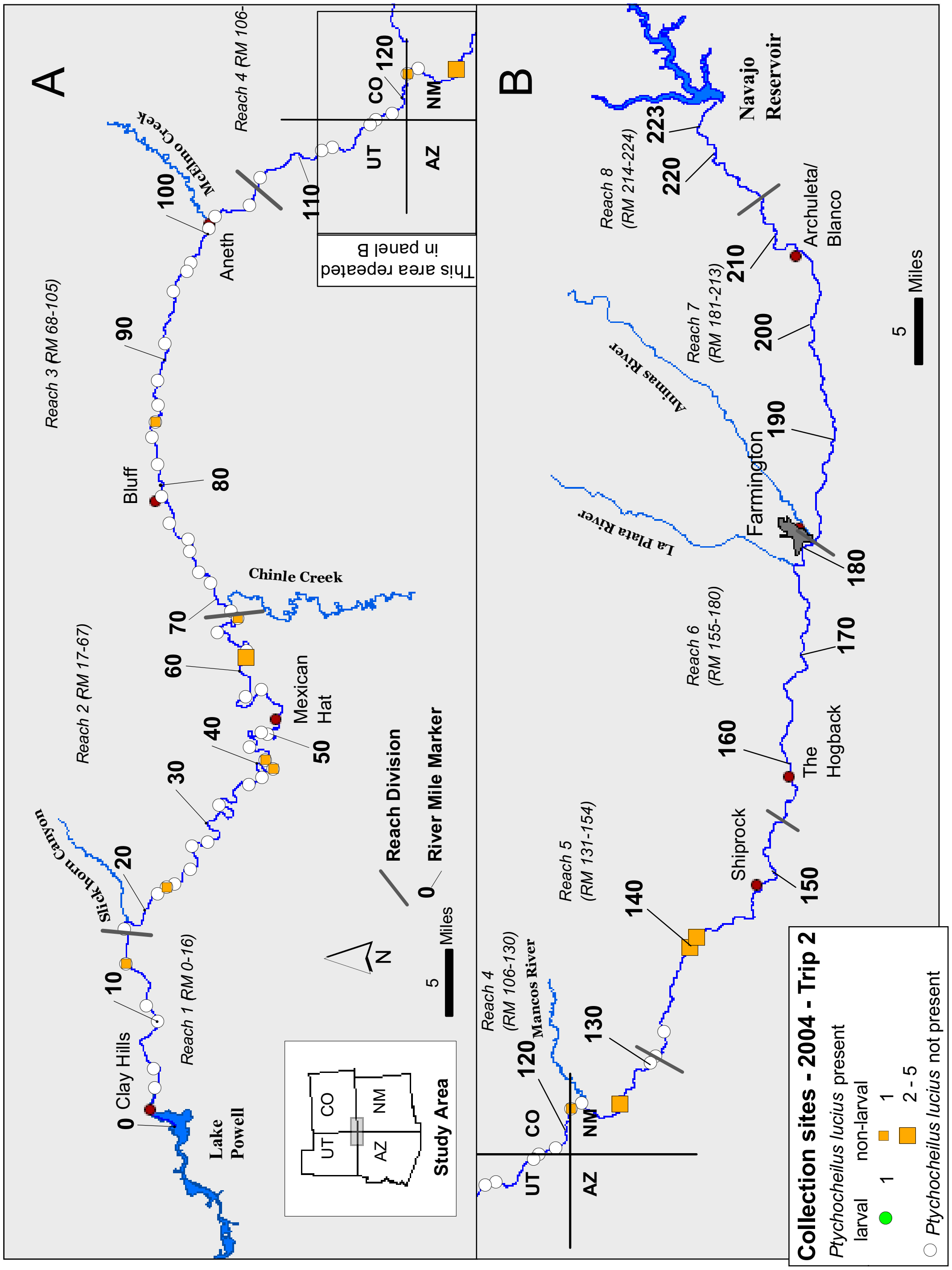

Figure 9. Map of localities sampled during trip 2 of the 2004 San Juan River larval ichthyofaunal survey (11-19 May 2004; Cudei to Clay Hills Crossing; RM 141.5-2.9) with Colorado pikeminnow collections highlighted.

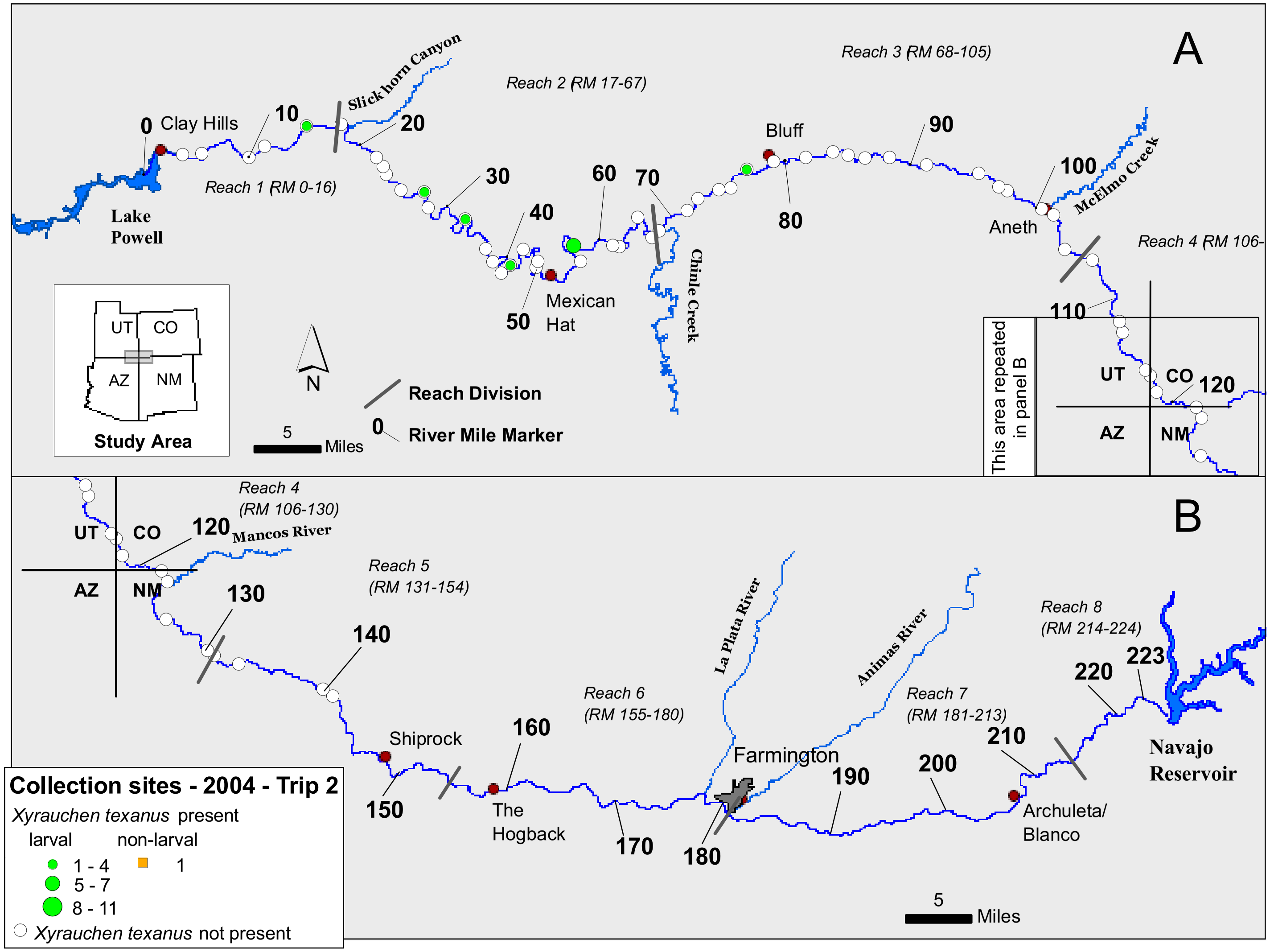

Figure 10. Map of localities sampled during trip 2 of the 2004 San Juan River larval ichthyofaunal survey (11-19 May 2004; Cudei to Clay Hills Crossing; RM 141.5-2.9) with razorback sucker collections highlighted.

Table 6. Summary of 2004 San Juan River trip 3 larval Coloardo pikeminnow and razorback sucker seining collections (8-15 June 2004). Effort = 2,026.3 m^2.

SPECIES	RESIDENCE STATUS[1]	TOTAL NUMBER OF SPECIMENS	PERCENT OF TOTAL	CPUE[2]	FREQUENCY OF OCCURRENCE[3]	% FREQUENCY OF OCCURRENCE[3]
CARPS AND MINNOWS						
red shiner	I	1,700	21.1	83.9	54	91.5
common carp	I	28	0.3	1.4	9	15.3
roundtail chub	N	-	-	-	-	-
fathead minnow	I	1,277	15.8	63.0	29	49.2
Colorado pikeminnow	N	17	0.2	0.8	9	15.3
speckled dace	N	372	4.6	18.4	32	54.2
SUCKERS						
flannelmouth sucker	N	1,324	16.4	65.3	50	84.7
bluehead sucker	N	3,260	40.4	160.9	44	74.6
razorback sucker	N	28	0.3	1.4	10	16.9
BULLHEAD CATFISHES						
black bullhead	I	-	-	-	-	-
channel catfish	I	3	*	0.1	3	5.1
TROUT						
kokanee salmon	I	-	-	-	-	-
KILLIFISHES						
plains killifish	I	6	0.1	0.3	6	10.2
LIVEBEARERS						
western mosquitofish	I	54	0.7	2.7	10	16.9
SUNFISHES						
green sunfish	I	-	-	-	-	-
bluegill	I	-	-	-	-	-
largemouth bass	I	4	*	0.2	4	6.8
TOTAL		8,073		398.4		

1 N = native; I = introduced
2 CPUE = catch per unit effort; value based on catch per 100 m^2 (surface area) sampled
3 Frequency and % frequency of occurrence are based on n=59 samples.

* Value is less than 0.05

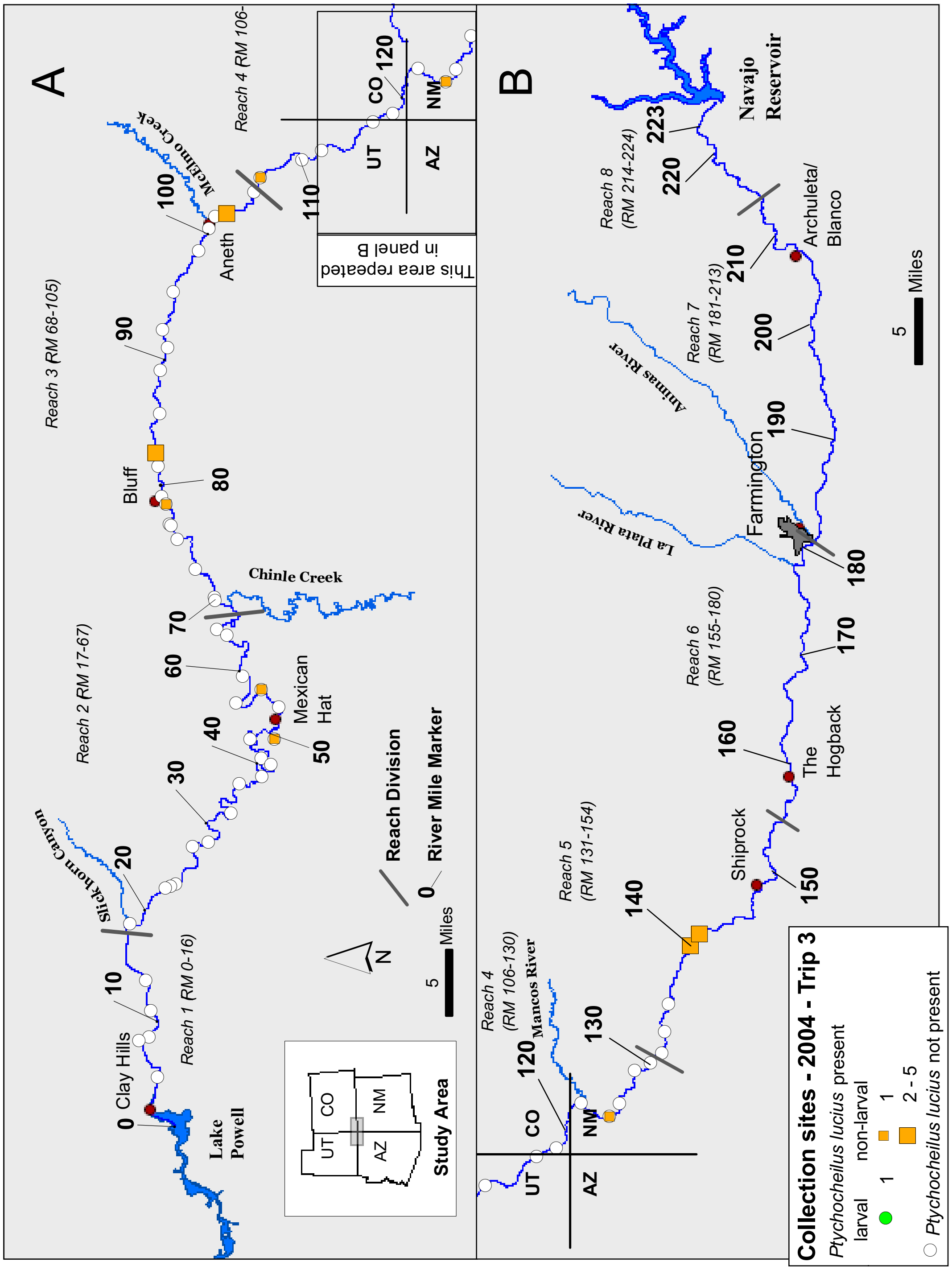

Figure 11. Map of localities sampled during trip 3 of the 2004 San Juan River larval ichthyofaunal survey (8-15 June 2004; Cudei to Clay Hills Crossing; RM 141.5-2.9) with Colorado pikeminnow collections highlighted.

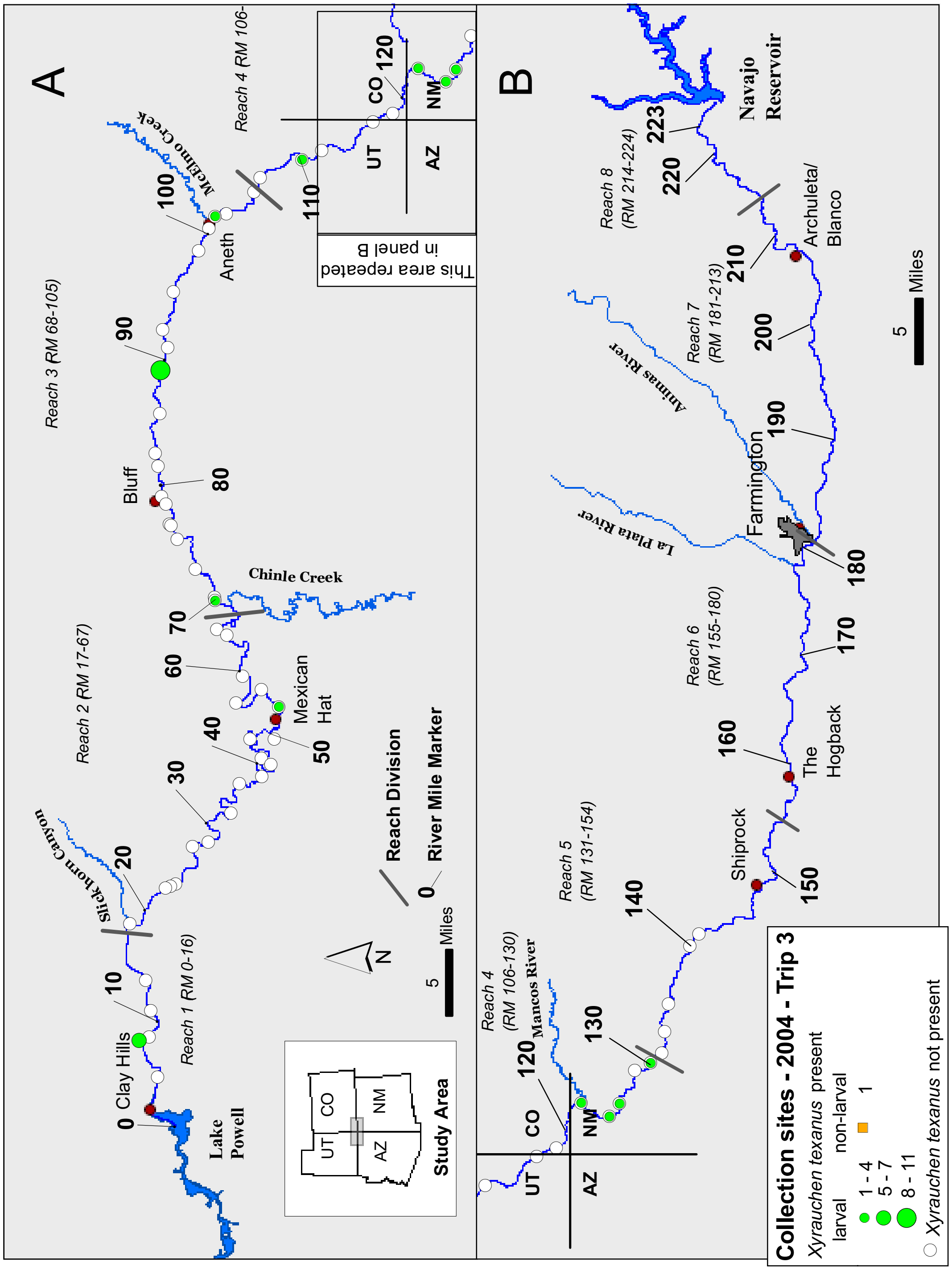

Figure 12. Map of localities sampled during trip 3 of the 2004 San Juan River larval ichthyofaunal survey (8-15 June 2004; Cudei to Clay Hills Crossing; RM 141.5-2.9) with razorback sucker collections highlighted.

Table 7. Summary of 2004 San Juan River trip 4 larval Coloardo pikeminnow and razorback sucker seining collections (16-26 July 2004). Effort = 2,184.5 m^2.

SPECIES	RESIDENCE STATUS[1]	TOTAL NUMBER OF SPECIMENS	PERCENT OF TOTAL	CPUE[2]	FREQUENCY OF OCCURRENCE[3]	% FREQUENCY OF OCCURRENCE[3]
CARPS AND MINNOWS						
red shiner	I	82,727	81.6	3,787.0	60	96.8
common carp	I	149	0.1	6.8	23	37.1
roundtail chub	N	-	-	-	-	-
fathead minnow	I	6,742	6.7	308.6	47	75.8
Colorado pikeminnow	N	2	*	0.1	2	3.2
speckled dace	N	8,127	8.0	372.0	59	95.2
SUCKERS						
flannelmouth sucker	N	163	0.2	7.5	30	48.4
bluehead sucker	N	3,056	3.0	139.9	47	75.8
razorback sucker	N	-	-	-	-	-
BULLHEAD CATFISHES						
black bullhead	I	3	*	0.1	2	3.2
channel catfish	I	145	0.1	6.6	23	37.1
TROUT						
kokanee salmon	I	-	-	-	-	-
KILLIFISHES						
plains killifish	I	29	*	1.3	14	22.6
LIVEBEARERS						
western mosquitofish	I	158	0.2	7.2	31	50.0
SUNFISHES						
green sunfish	I	7	*	0.3	3	4.8
bluegill	I	-	-	-	-	-
largemouth bass	I	13	*	0.6	10	16.1
TOTAL		101,321		4,638.2		

[1] N = native; I = introduced
[2] CPUE = catch per unit effort; value based on catch per 100 m^2 (surface area) sampled
[3] Frequency and % frequency of occurrence are based on n=62 samples.

* Value is less than 0.05

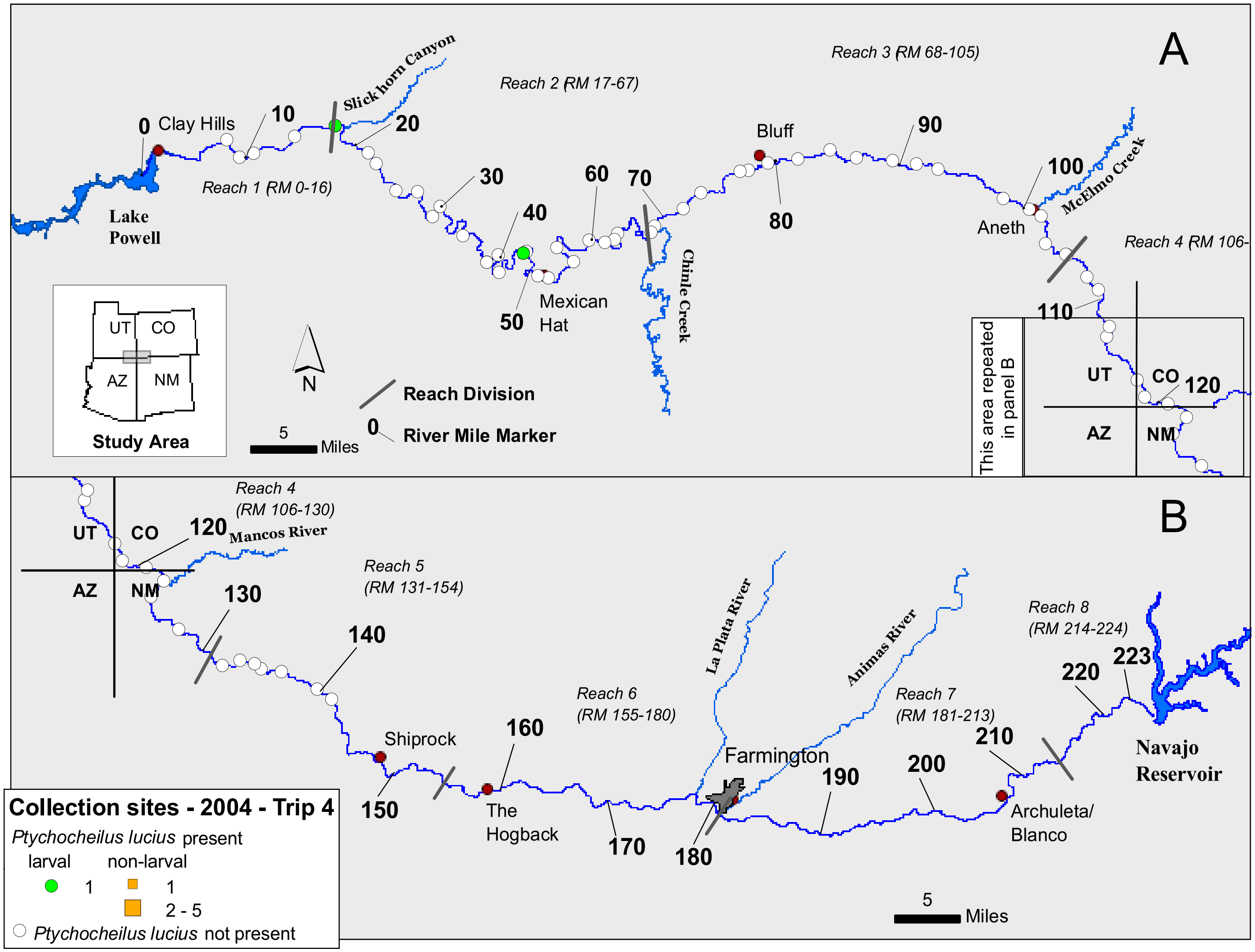

Figure 13. Map of localities sampled during trip 4 of the 2004 San Juan River larval ichthyofaunal survey (16-26 July 2004; Cudei to Clay Hills Crossing; RM 141.5-2.9) with Colorado pikeminnow collections highlighted.

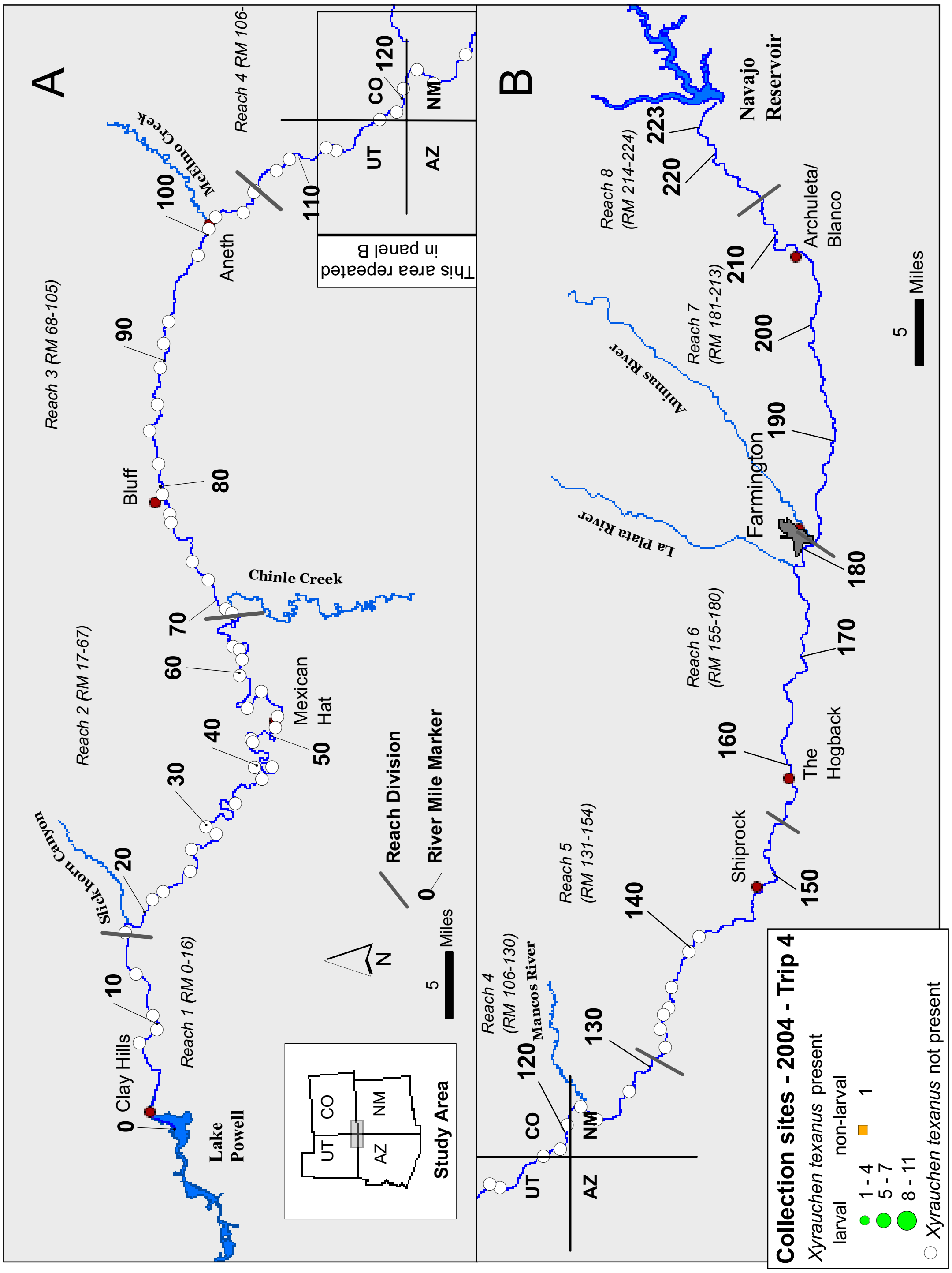

Figure 14. Map of localities sampled during trip 4 of the 2004 San Juan River larval ichthyofaunal survey (16-26 July 2004; Cudei to Clay Hills Crossing; RM 141.5-2.9) with razorback sucker collections highlighted.

Table 8. Summary of 2004 San Juan River trip 5 larval Coloardo pikeminnow and razorback sucker seining collections (11-26 August 2004). Effort = 1,809.7 m^2.

SPECIES	RESIDENCE STATUS[1]	TOTAL NUMBER OF SPECIMENS	PERCENT OF TOTAL	CPUE[2]	FREQUENCY OF OCCURRENCE[3]	% FREQUENCY OF OCCURRENCE[3]
CARPS AND MINNOWS						
red shiner	I	30,764	93.7	1700.0	61	98.4
common carp	I	2	*	0.1	1	1.6
roundtail chub	N	-	-	-	-	-
fathead minnow	I	1,371	4.2	75.8	35	56.5
Colorado pikeminnow	N	-	-	-	-	-
speckled dace	N	49	0.1	2.7	22	35.5
SUCKERS						
flannelmouth sucker	N	5	*	0.3	4	6.5
bluehead sucker	N	39	0.1	2.2	12	19.4
razorback sucker	N	-	-	-	-	-
BULLHEAD CATFISHES						
black bullhead	I	9	*	0.5	1	1.6
channel catfish	I	2	*	0.1	2	3.2
TROUT						
kokanee salmon	I	-	-	-	-	-
KILLIFISHES						
plains killifish	I	15	*	0.8	9	14.5
LIVEBEARERS						
western mosquitofish	I	567	1.7	31.3	32	51.6
SUNFISHES						
green sunfish	I	-	-	-	-	-
bluegill	I	-	-	-	-	-
largemouth bass	I	-	-	-	-	-
TOTAL		32,823		1,813.7		

1 N = native; I = introduced
2 CPUE = catch per unit effort; value based on catch per 100 m^2 (surface area) sampled
3 Frequency and % frequency of occurrence are based on n=62 samples.

* Value is less than 0.05

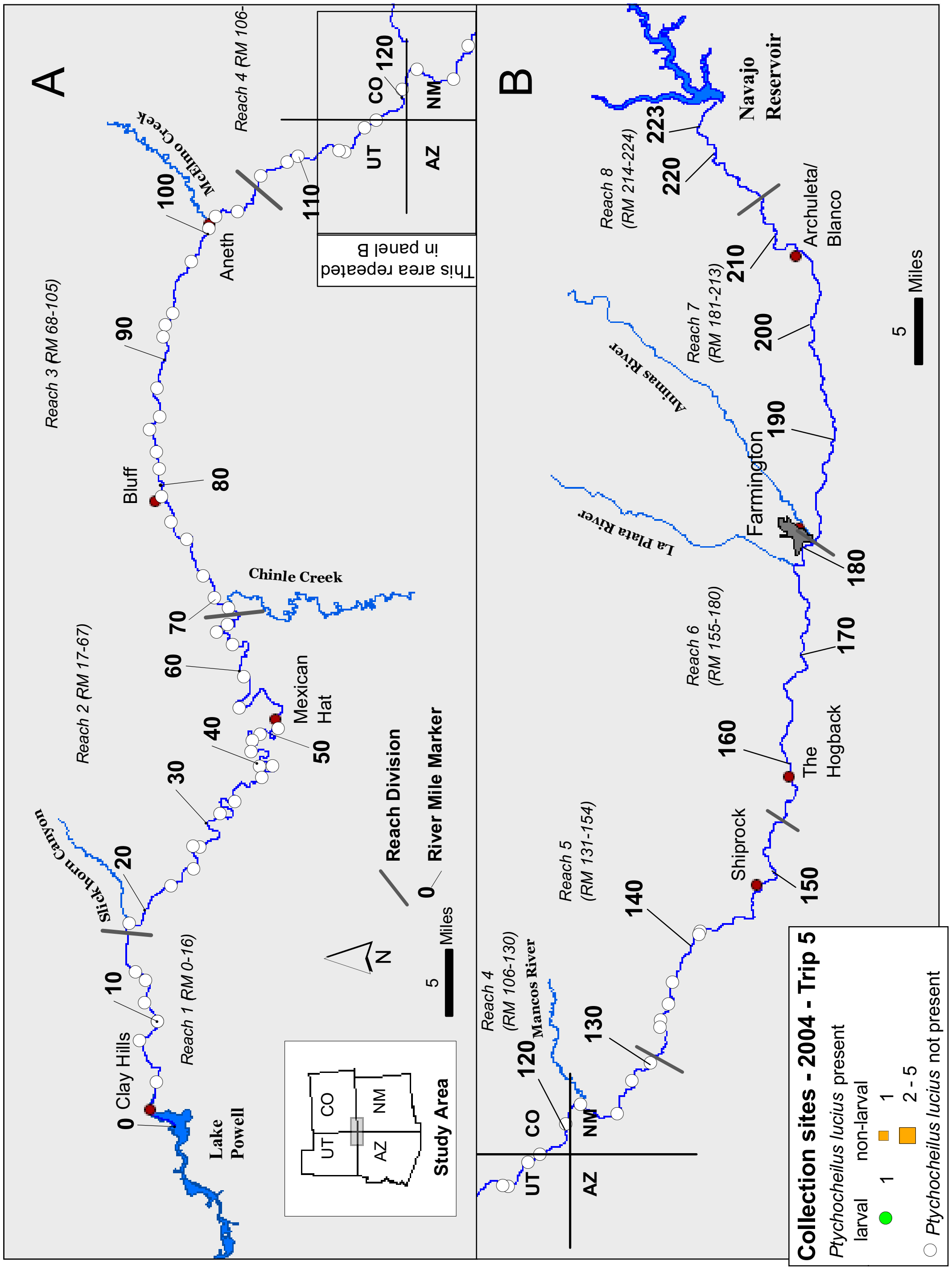

Figure 15. Map of localities sampled during trip 5 of the 2004 San Juan River larval ichthyofaunal survey (11-26 August 2004; Cudei to Clay Hills Crossing; RM 141.5-2.9) with Colorado pikeminnow collections highlighted.

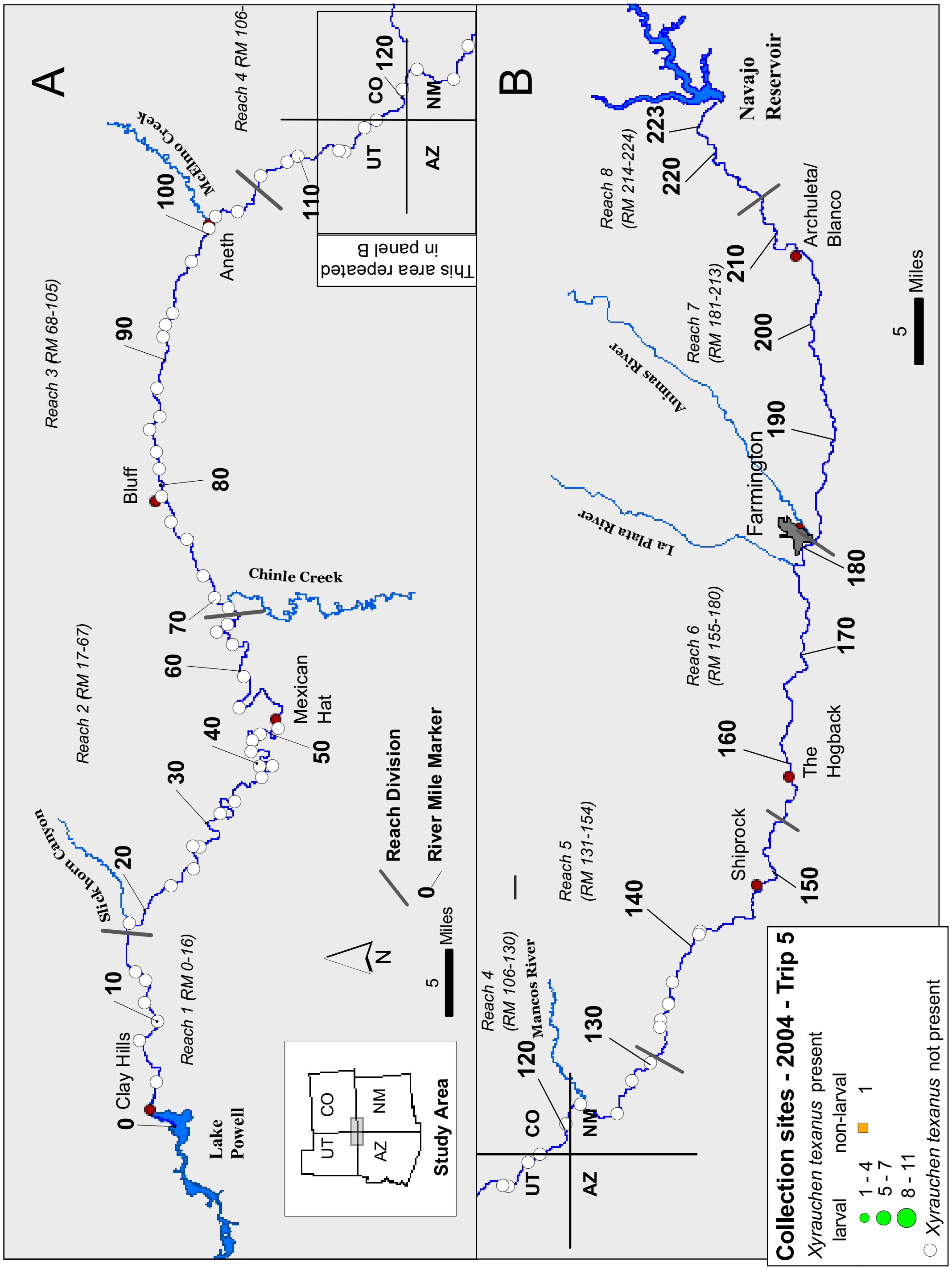

Figure 16. Map of localities sampled during trip 5 of the 2004 San Juan River larval ichthyofaunal survey (11-26 August 2004; Cudei to Clay Hills Crossing; RM 141.5-2.9) with razorback sucker collections highlighted.

Table 9. Summary of 2004 San Juan River trip 6 larval Coloardo pikeminnow and razorback sucker seining collections (7-14 September 2004). Effort = 1,180.8 m^2.

SPECIES	RESIDENCE STATUS[1]	TOTAL NUMBER OF SPECIMENS	PERCENT OF TOTAL	CPUE[2]	FREQUENCY OF OCCURRENCE[3]	% FREQUENCY OF OCCURRENCE[3]
CARPS AND MINNOWS						
red shiner	I	10,650	92.6	901.9	47	100.0
common carp	I	-	-	-	-	-
roundtail chub	N	-	-	-	-	-
fathead minnow	I	501	4.4	42.4	26	55.3
Colorado pikeminnow	N	1	*	0.1	1	2.1
speckled dace	N	58	0.5	4.9	23	48.9
SUCKERS						
flannelmouth sucker	N	6	0.1	0.5	6	12.8
bluehead sucker	N	41	0.4	3.5	10	21.3
razorback sucker	N	1	*	0.1	1	2.1
BULLHEAD CATFISHES						
black bullhead	I	2	*	0.2	2	4.3
channel catfish	I	4	*	0.3	4	8.5
TROUT						
kokanee salmon	I	-	-	-	-	-
KILLIFISHES						
plains killifish	I	16	0.1	1.4	11	23.4
LIVEBEARERS						
western mosquitofish	I	220	1.9	18.6	23	48.9
SUNFISHES						
green sunfish	I	-	-	-	-	-
bluegill	I	-	-	-	-	-
largemouth bass	I	2	*	0.2	2	4.3
TOTAL		11,502		974.1		

[1] N = native; I = introduced
[2] CPUE = catch per unit effort; value based on catch per 100 m^2 (surface area) sampled
[3] Frequency and % frequency of occurrence are based on n=47 samples.

* Value is less than 0.05

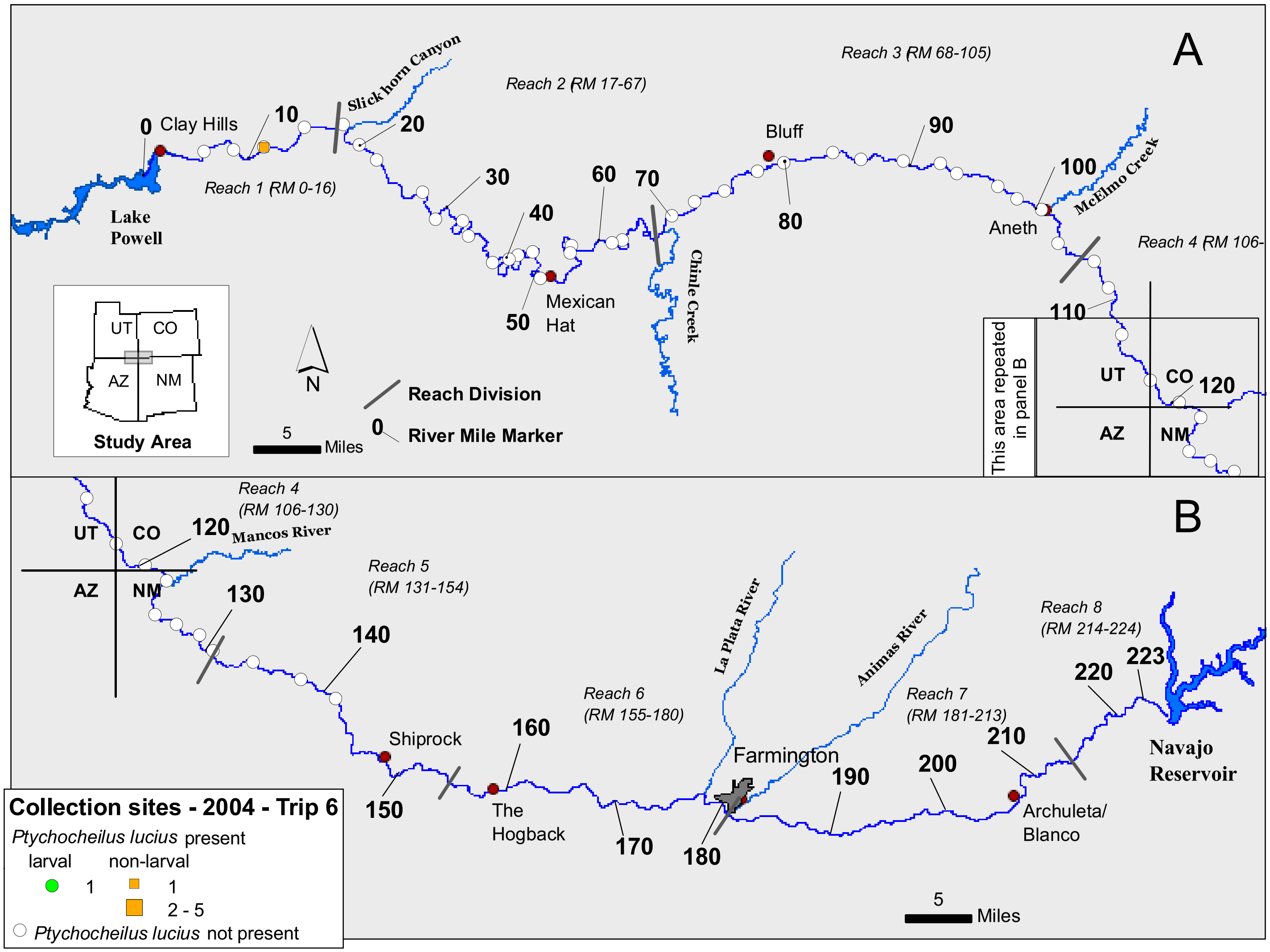

Figure 17. Map of localities sampled during trip 6 of the 2004 San Juan River larval ichthyofaunal survey (7-14 September 2004; Cudei to Clay Hills Crossing; RM 141.5-2.9) with Colorado pikeminnow collections highlighted.

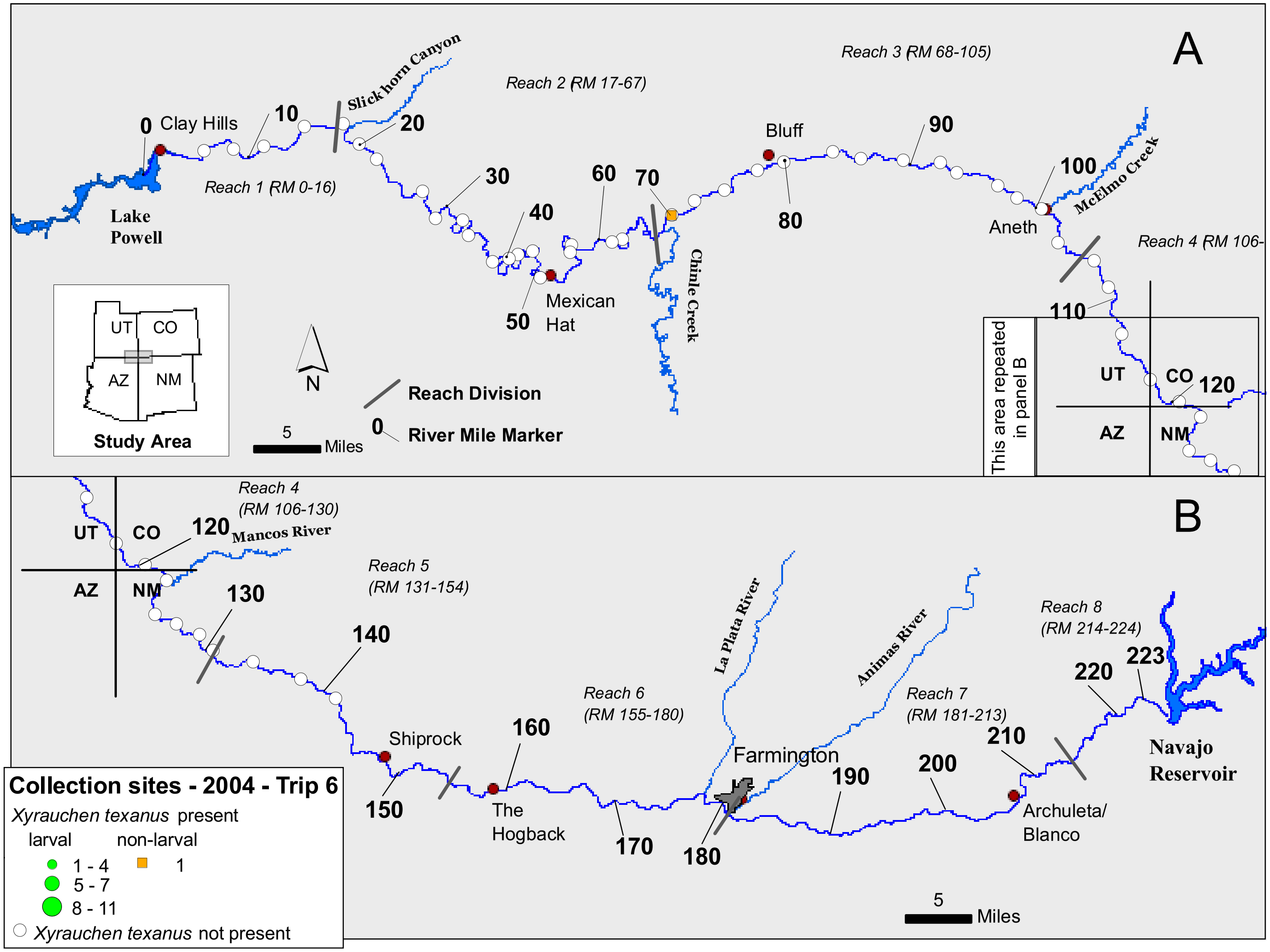

Figure 18. Map of localities sampled during trip 6 of the 2004 San Juan River larval ichthyofaunal survey (7-14 September 2004; Cudei to Clay Hills Crossing; RM 141.5-2.9) with razorback sucker collections highlighted.

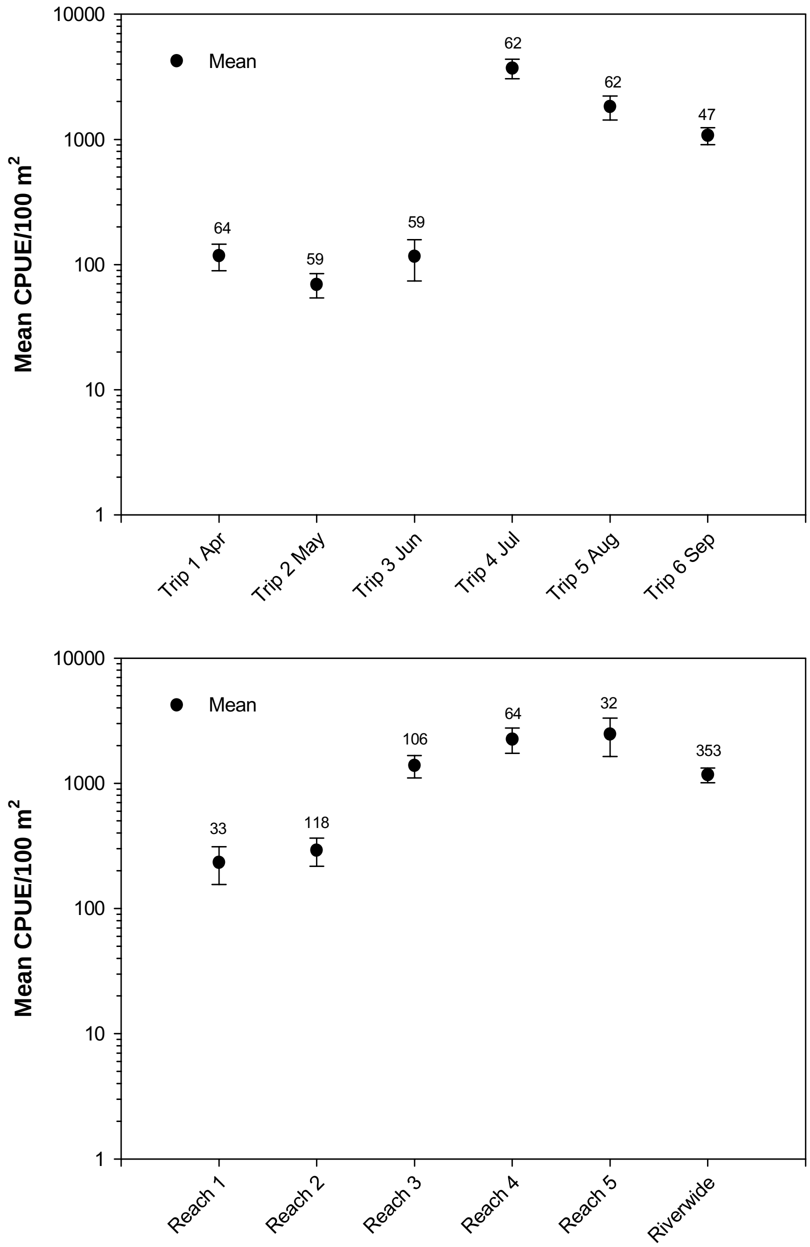

Figure 19. Mean CPUE / 100 m^2 (+/-1SE) for red shiner, *Cyprinella lutrensis* by trip, reach, and riverwide for 2004. Sample size reported above SE bars.

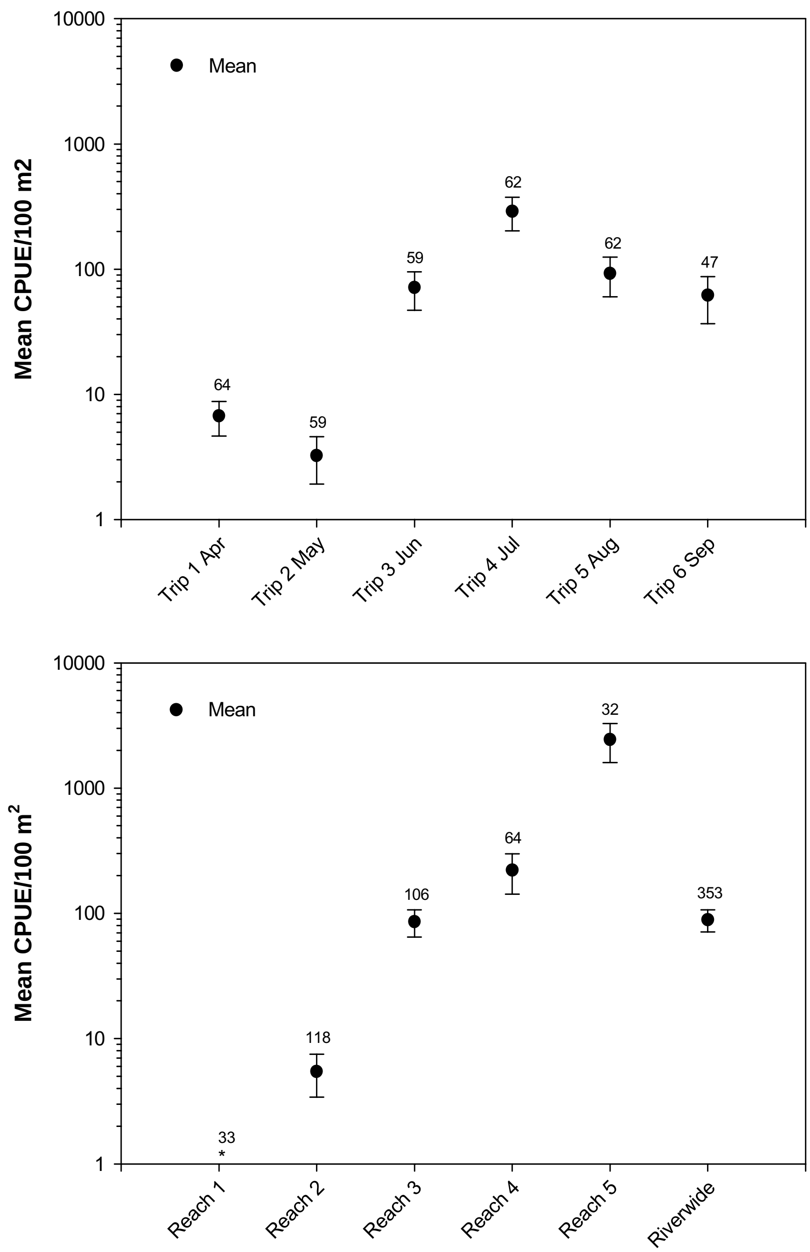

Figure 20. Mean CPUE / 100 m^2 (+/-1SE) for fathead minnow, *Pimephales promelas* by trip, reach, and riverwide for 2004. Sample size reported above SE bars.

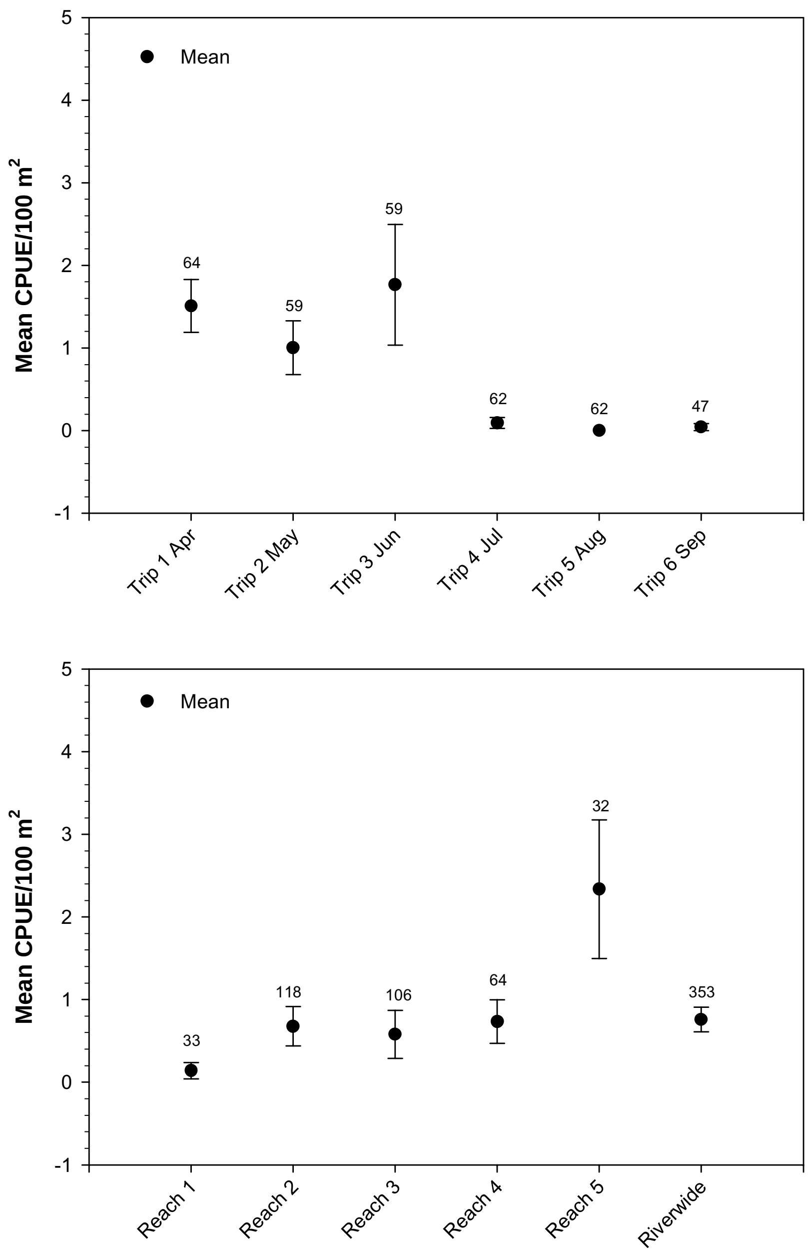

Figure 21. Mean CPUE / 100 m^2 (+/-1SE) for Colorado pikeminnow, *Ptychocheilus lucius* by trip, reach, and riverwide for 2004. Sample size reported above SE bars.

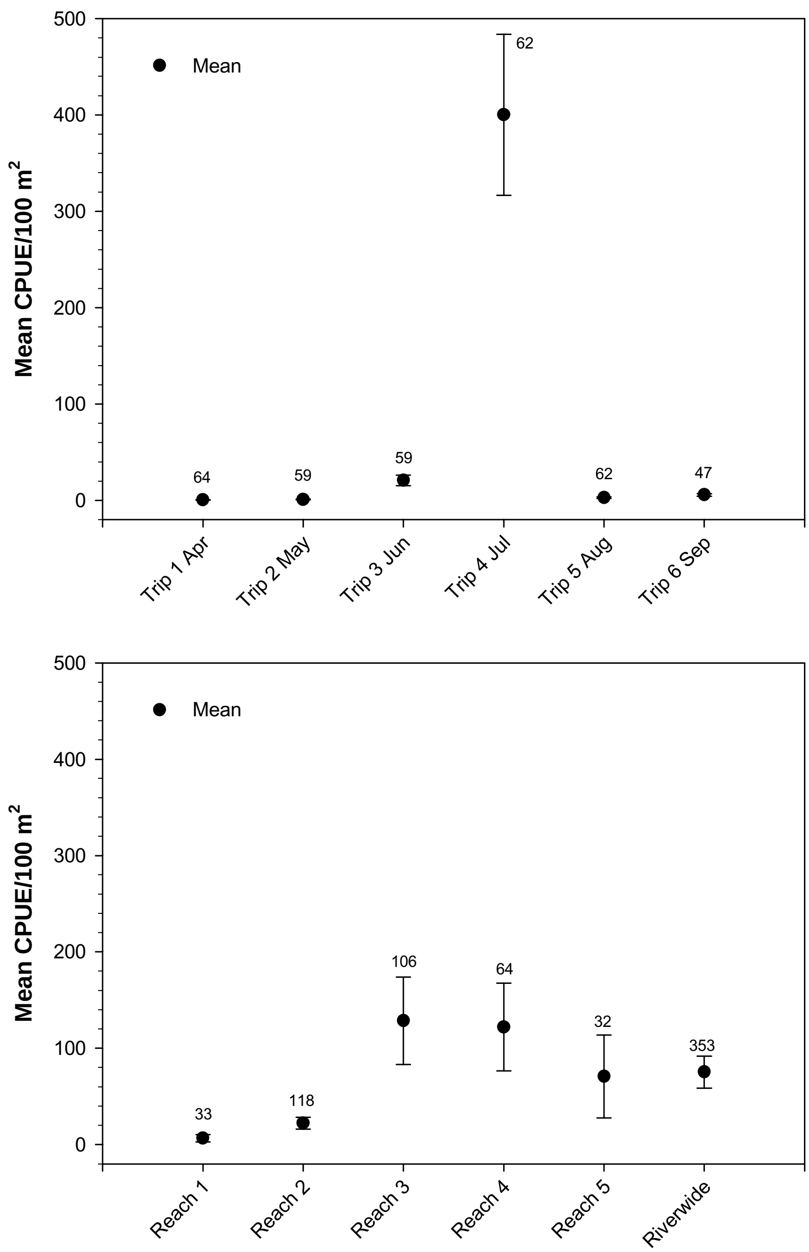

Figure 22. Mean CPUE / 100 m² (+/-1SE) for speckled dace, *Rhinichthys osculus* by trip, reach, and riverwide for 2004. Sample size reported above SE bars.

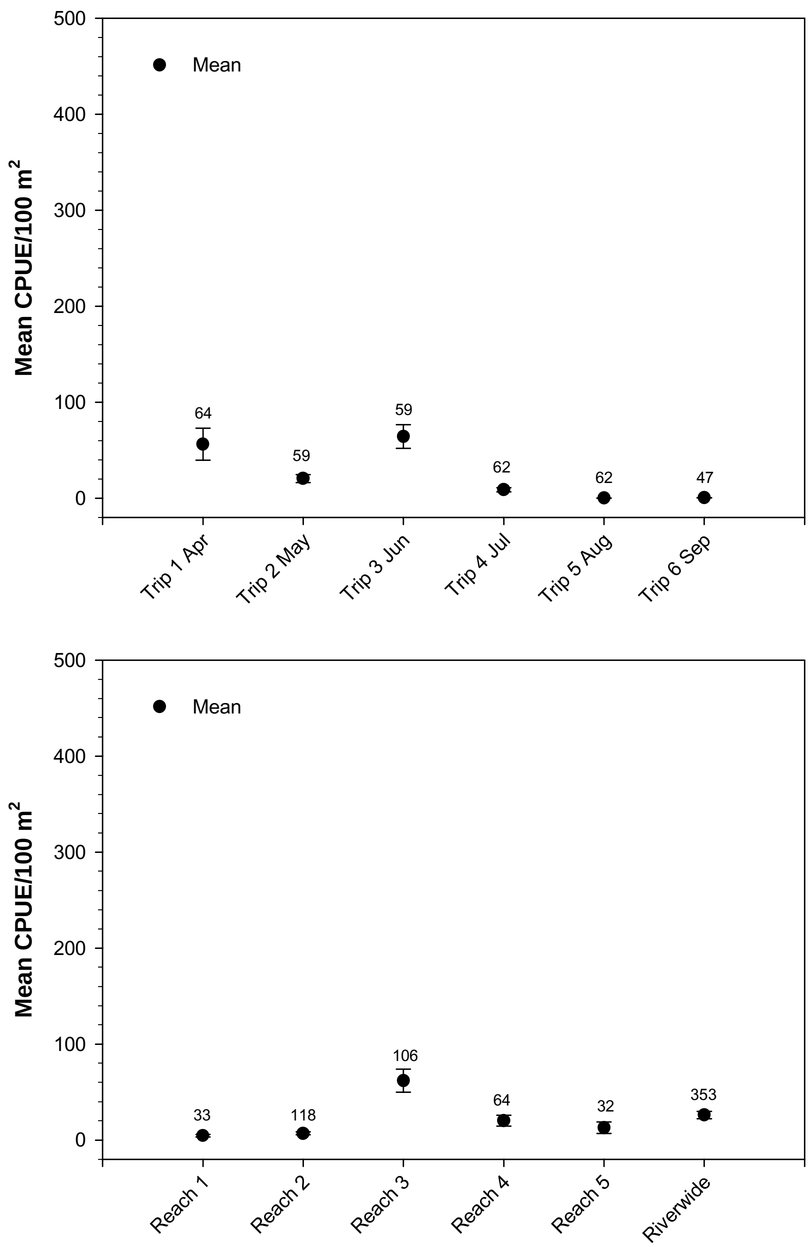

Figure 23. Mean CPUE / 100 m^2 (+/-1SE) for flannelmouth sucker, *Catostomus latipinnis* by trip, reach, and riverwide for 2004. Sample size reported above SE bars.

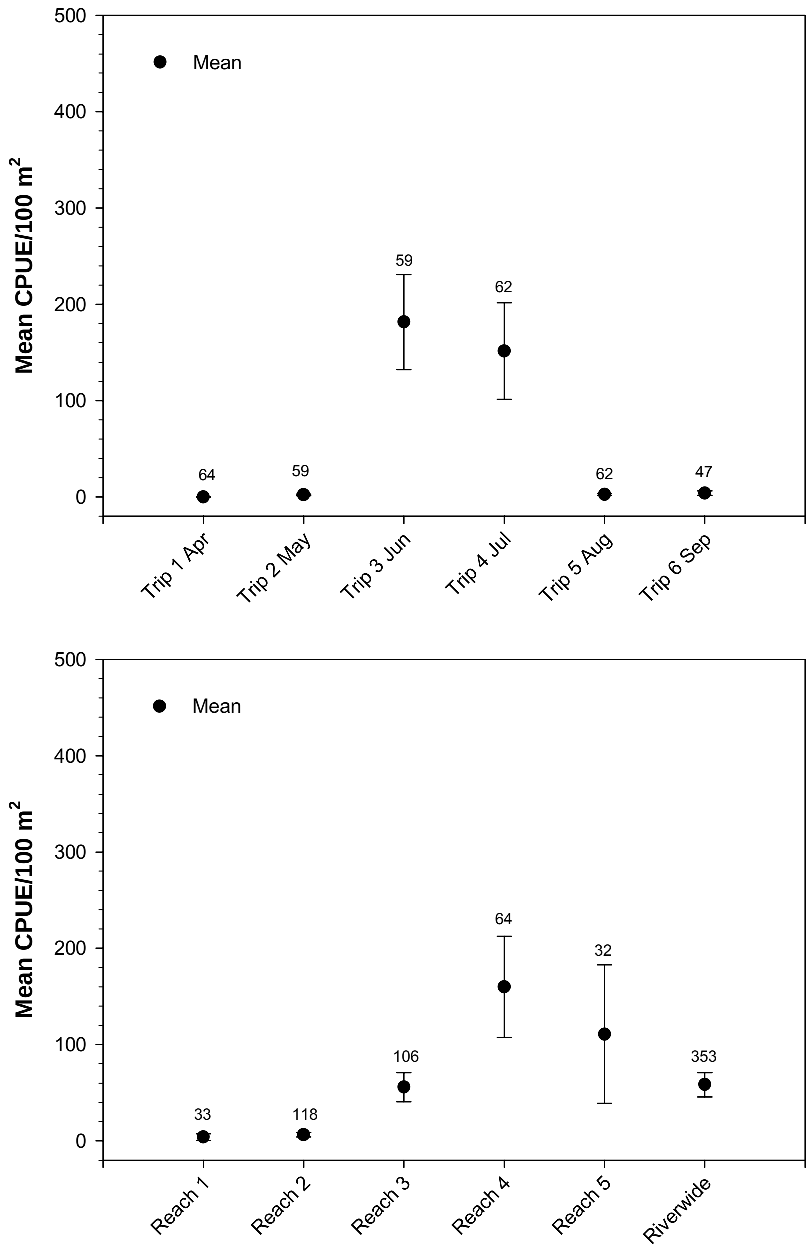

Figure 24. Mean CPUE / 100 m^2 (+/-1SE) for bluehead sucker, *Pantosteus discobolus* by trip, reach, and riverwide for 2004. Sample size reported above SE bars.

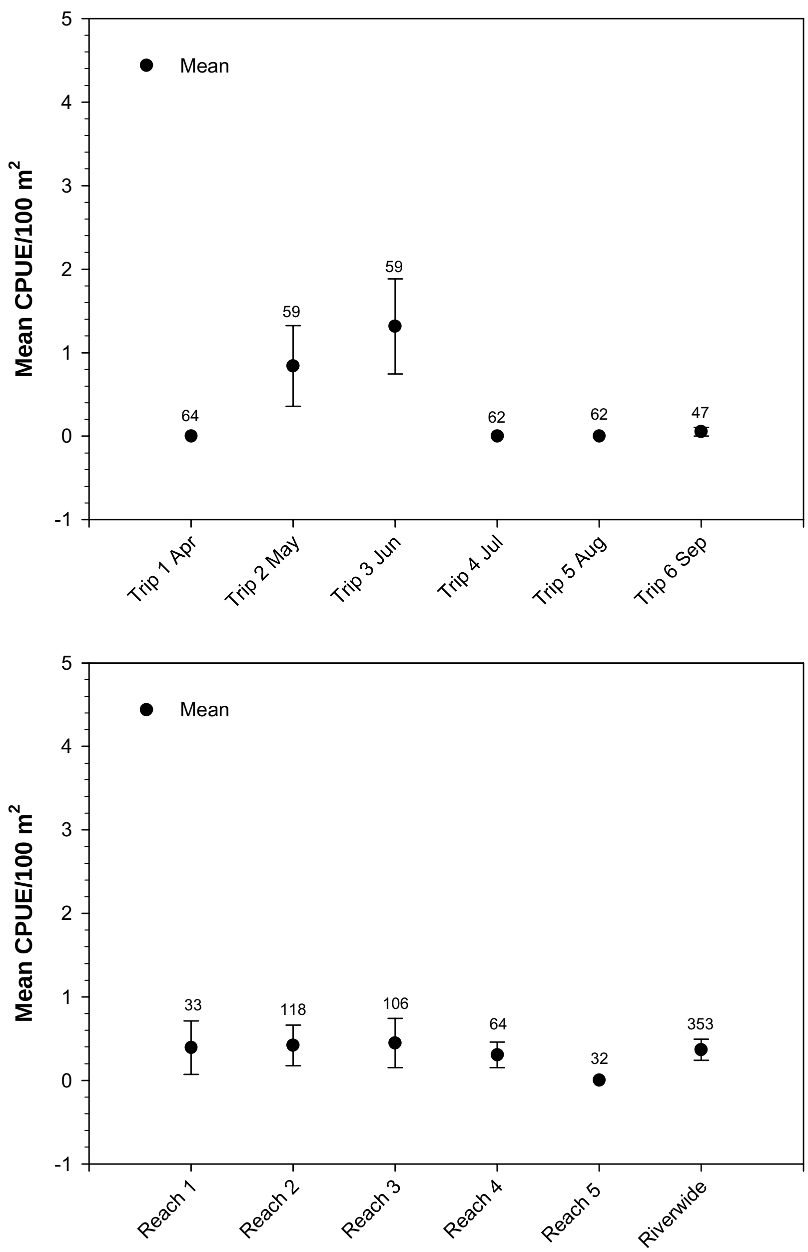

Figure 25. Mean CPUE / 100 m^2 (+/-1SE) for razorback sucker, *Xyrauchen texanus* by trip, reach, and riverwide for 2004. Sample size reported above SE bars.

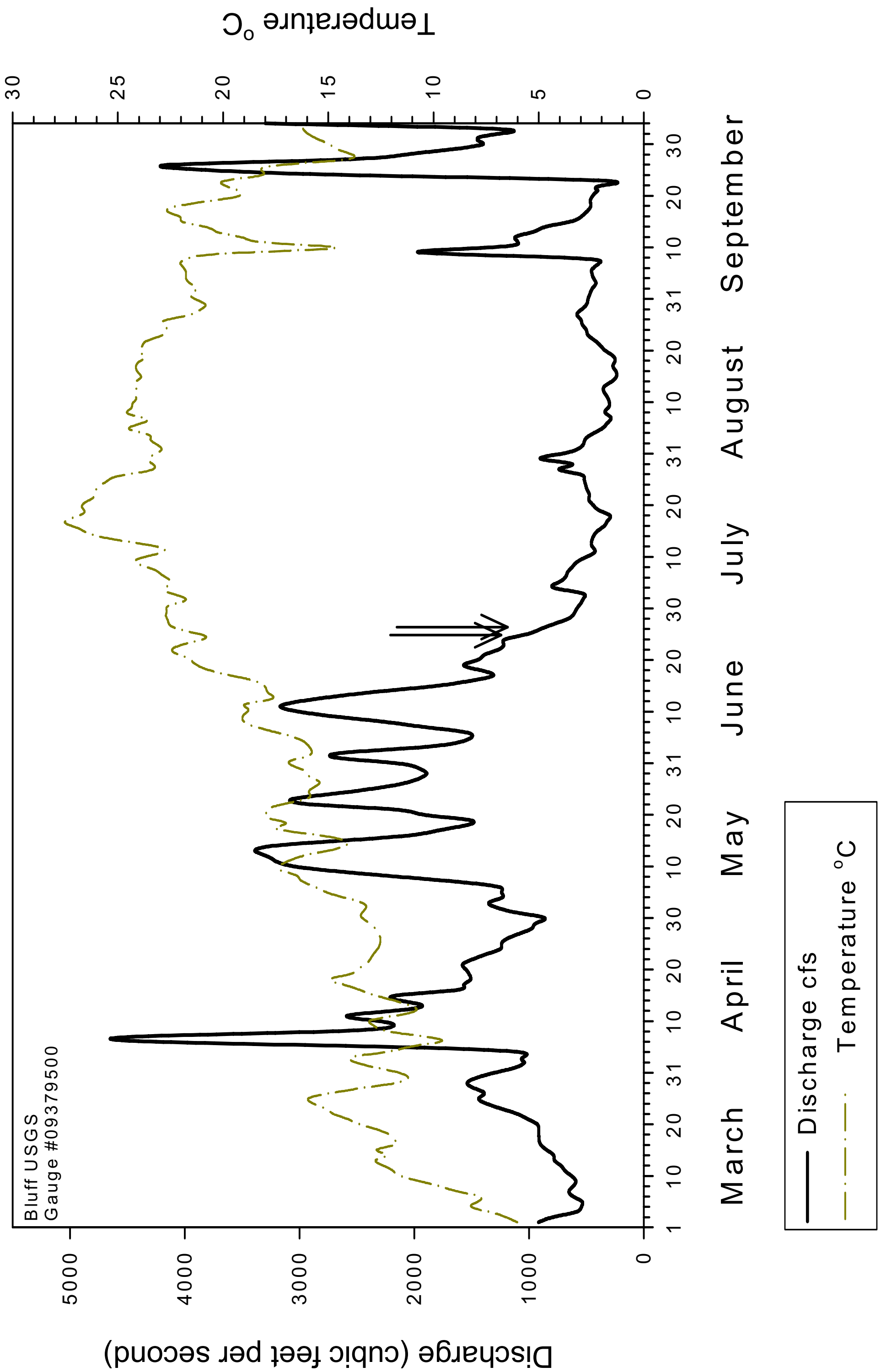

Figure 26. Back calculated spawning dates of Colorado pikeminnow (arrows indicate spawning dates).

Reach analysis

Reach 1

The least numerically productive reach in the 2004 larval ichthyofaunal survey was reach 1 (Table 10), and it also had the lowest CPUE (220.1 fish per 100 m^2) of any reach in 2004. This pattern was also observed in 2003. A total of 33 collections were taken in this reach. Non-native cyprinids comprised 90.2% of the fish collected. Red shiner represented 98.9% of all non-native cyprinids and had the highest CPUE of any other species collected, (197.8 fish per 100 m^2). Native cyprinids comprised 4.0% of the total catch (Figure 27). Speckled dace accounted for 45.1% of all native ichthyofauna collected. Speckled dace also had the highest CPUE of any native fish species in reach 1, (8.6 fish per 100 m^2). Colorado pikeminnow were represented by two individuals, neither were larval specimens. Native catostomids comprised 4.6% of the total catch and had a combined CPUE of 10.3 fish per 100 m^2. Flannelmouth sucker and bluehead sucker were represented in nearly equal numbers in (n=71 and 72 respectively). Seven larval razorback sucker were collected in reach 1 in 2004, compared with 190 collected in reach 1 in 2003.

Reach 2

Reach 2 had the second lowest number of specimens collected and CPUE (n=8,922 and 283.3 fish per 100 m^2 respectively) of all the reaches sampled in 2004 (Table 11). More collections were made in reach 2 (n=118) than any other reach. Similar to reach 1, non-native cyprinids dominated species collected in the reach and accounted for 86.9% of the total catch in this reach. Red shiner comprised 98.0% of the total non-native cyprinid catch. Fathead minnow, the second most abundant non-native cyprinid, comprised 1.6% (n=144) of the total catch in 2004. Native cyprinids comprised 7.4% of the total fish catch. Speckled dace comprised 97.3% of the native catch (n=643) and had the second highest CPUE of any fish species (20.6 fish per 100 m^2). Colorado pikeminnow comprised 0.2% of the total catch (n=18). Sixteen of the Colorado pikeminnow collected were age 1 fish that had been stocked in the San Juan River the previous year under the auspices of the Colorado pikeminnow Augmentation Program. The remaining two Colorado pikeminnow collected in reach 2 were larval specimens. These two individuals are the first documented reproduction of Colorado pikeminnow in the San Juan River since 2001. The larvae were collected at river miles 46.3 and 17.0. Catostomids accounted for 4.1% of the entire catch, with a combined CPUE of 11.7 fish per 100 m^2 sampled. Flannelmouth sucker was the numerically dominant catostomid (n=205) and had the third highest CPUE of all fish species i(6.5 fish per 100 m^2). A total of 151 larval bluehead sucker were collected in reach 2. Twelve larval razorback sucker were collected comprising 29.2% of the total 2004 larval razorback catch.

Reach 3

Reach 3 produced the largest number of specimens of any reach in 2004 (n=59,544), yet had the third highest CPUE of the five reaches (1,512.5 fish per 100 m^2). A total of 106 collections were made. Non-native cyprinids were numerically dominant in reach 3 comprising 84.4% of the entire catch (Table 12). Red shiner comprised 94.5% of the total non-native catch and had the highest CPUE of any species (1,206.6 fish per 100 m^2). Fathead minnow had the third highest CPUE (67.9 fish per 100 m^2) and comprised 4.5% of the total catch. Native cyprinids comprised 6.9% of the total catch and had a combined CPUE of 105.3 fish per 100 m^2. Speckled dace represented 99.5% of the native cyprinid catch, with the second highest CPUE of any species (104.8 fish per 100 m^2). Colorado pikeminnow (n=18) captured in reach 3 were all age 1 stocked fish from the previous fall for the augmentation effort. Catostomids accounted for

7.5% of the catch. Reach 3 had the second highest catostomid CPUE, (113.2 fish per 100 m^2). Flannelmouth sucker was the dominant catostomid species (n= 2,416). Fifteen larval and one juvenile razorback sucker were collected resulting in a CPUE of 0.4 fish per 100 m^2. The largest number of western mosquiotofish was collected in reach 3 (n=585) and accounted for the second highest CPUE of this species in the five reaches (14.9 fish per 100 m^2).

Reach 4

A total of 64 collections were taken in reach 4 producing 54,749 specimens (Table 13). This was the second largest number of specimens produced by any reach, with the CPUE of (2,526.1 fish per 100 m^2) also being the second highest of any reach. While red shiner was the numerically dominant species it accounted for 79.8% of the total catch. Along with reach 3 (also 79.8% of total catch), reach 4 had the lowest percent of total for red shiner of any of the reaches. Conversely, fathead minnow accounted for 8.4% of the total catch by number, the highest percent of total for any of the five reaches. Reach 4 produced more common carp than all other reaches combined (n= 117). A total of 15 juvenile Colorado pikeminnow were collected, with 9 of these specimens collected during the first trip (April). Reach 4 produced the second highest number of speckled dace (n=2,667) and had the highest speckled dace CPUE (123.1 fish per 100 m^2) of any reach. Nearly 95% (n=2,519) of speckled dace were collected during trip 4 (July). More bluehead sucker were collected in reach 4 than any other reach (n=3,066) and reach 4 also had the highest CPUE (141.5 fish per 100 m^2) for bluehead sucker. Of the 3,066 bluehead sucker that were collected, trip 3 (June) produced 1,517 and trip 4 (July) produced 1,523. Seven larval razorback suckers were collected in 2004; no larval razorback suckers were collected from this reach in 2003. All seven razorback sucker larvae were collected during trip 3 (June).

Reach 5

Thirty-two collections were taken yielding 33,856 specimens (Table 14). A total of 28,580 red shiner and 2,699 fathead minnow were collected accounting for 92.4% of all fishes collected. This combined total is the highest percent of total for these two species of any of the reaches. Twenty-three juvenile Colorado pikeminnow were collected, making it the most productive reach for this species in 2004. Approximately half (n=12) of all Colorado pikeminnow collected in this reach were collected during trip 1 (April) and no Colorado pikeminnow were collected from this reach after trip 3 (June). Reach 5 was one of three reaches to produce over 1,000 speckled dace and bluehead sucker (n=1,081 and 1,127 respectively) and had a CPUE of approximately 100 fish per 100m^2 for both of these species (97.9 and 102.0 respectively). Over 95% of all speckled dace and bluehead sucker collected were taken during trip 4 (July). Reach 5 produced the second lowest number of flannelmouth sucker (n=108) and was the only reach which did not to produce any razorback sucker.

Table 10. Summary of reach 1, 2004 San Juan River larval Coloardo pikeminnow and razorback sucker project seining collections. Effort = 1,461.8 m^2.

SPECIES	RESIDENCE STATUS[1]	TOTAL NUMBER OF SPECIMENS	PERCENT OF TOTAL	CPUE[2]	FREQUENCY OF OCCURRENCE[3]	% FREQUENCY OF OCCURRENCE[3]
CARPS AND MINNOWS						
red shiner	I	2,892	89.9	197.8	31	93.9
common carp	I	4	0.1	0.3	2	6.1
roundtail chub	N	-	-	-	-	-
fathead minnow	I	7	0.2	0.5	2	6.1
Colorado pikeminnow	N	2	0.1	0.1	2	6.1
speckled dace	N	125	3.9	8.6	11	33.3
SUCKERS						
flannelmouth sucker	N	71	2.2	4.9	16	48.5
bluehead sucker	N	72	2.2	4.9	7	21.2
razorback sucker	N	7	0.2	0.5	2	6.1
BULLHEAD CATFISHES						
black bullhead	I	-	-	-	-	-
channel catfish	I	1	*	0.1	1	3.0
TROUT						
kokanee salmon	I	-	-	-	-	-
KILLIFISHES						
plains killifish	I	1	*	0.1	1	3.0
LIVEBEARERS						
western mosquitofish	I	34	1.1	2.3	5	15.2
SUNFISHES						
green sunfish	I	-	-	-	-	-
bluegill	I	-	-	-	-	-
largemouth bass	I	1	*	0.1	1	3.0
TOTAL		3,217		220.1		

[1] N = native; I = introduced
[2] CPUE = catch per unit effort; value based on catch per 100 m^2 (surface area) sampled
[3] Frequency and % frequency of occurrence are based on n=33 samples.

* Value is less than 0.05

Table 11. Summary of reach 2, 2004 San Juan River larval Colorado pikeminnow and razorback sucker project seining collections. Effort = 3,149.6 m^2.

SPECIES	RESIDENCE STATUS[1]	TOTAL NUMBER OF SPECIMENS	PERCENT OF TOTAL	CPUE[2]	FREQUENCY OF OCCURRENCE[3]	% FREQUENCY OF OCCURRENCE[3]
CARPS AND MINNOWS						
red shiner	I	7,602	85.2	241.4	107	90.7
common carp	I	5	0.1	0.2	3	2.5
roundtail chub	N	-	-	-	-	-
fathead minnow	I	144	1.6	4.6	23	19.5
Colorado pikeminnow	N	18	0.2	0.6	13	11.0
speckled dace	N	643	7.2	20.6	46	39.0
SUCKERS						
flannelmouth sucker	N	205	2.3	6.5	49	41.5
bluehead sucker	N	151	1.7	4.8	36	30.5
razorback sucker	N	12	0.1	0.4	5	4.2
BULLHEAD CATFISHES						
black bullhead	I	8	0.1	0.3	4	3.4
channel catfish	I	56	0.6	1.8	23	19.5
TROUT						
kokanee salmon	I	-	-	-	-	-
KILLIFISHES						
plains killifish	I	1	*	*	1	0.8
LIVEBEARERS						
western mosquitofish	I	72	0.8	2.3	23	19.5
SUNFISHES						
green sunfish	I	-	-	-	-	-
bluegill	I	-	-	-	-	-
largemouth bass	I	5	0.1	0.2	4	3.4
TOTAL		8,922		283.3		

1 N = native; I = introduced
2 CPUE = catch per unit effort; value based on catch per 100 m^2 (surface area) sampled
3 Frequency and % frequency of occurrence are based on n=118 samples.

* Value is less than 0.05

Table 12. Summary of reach 3, 2004 San Juan River larval Colorado pikeminnow and razorback sucker project seining collections. Effort = 3,936.9 m^2.

SPECIES	RESIDENCE STATUS[1]	TOTAL NUMBER OF SPECIMENS	PERCENT OF TOTAL	CPUE[2]	FREQUENCY OF OCCURRENCE[3]	% FREQUENCY OF OCCURRENCE[3]
CARPS AND MINNOWS						
red shiner	I	47,503	79.8	1,206.6	103	97.2
common carp	I	31	0.1	0.8	11	10.4
roundtail chub	N	-	-	-	-	-
fathead minnow	I	2,672	4.5	67.9	73	68.9
Colorado pikeminnow	N	18	*	0.5	9	8.5
speckled dace	N	4,125	6.9	104.8	47	44.3
SUCKERS						
flannelmouth sucker	N	2,416	4.1	61.4	64	60.4
bluehead sucker	N	2,022	3.4	51.4	50	47.2
razorback sucker	N	16	*	0.4	5	4.7
BULLHEAD CATFISHES						
black bullhead	I	1	*	*	1	0.9
channel catfish	I	97	0.2	2.5	10	9.4
TROUT						
kokanee salmon	I	-	-	-	-	-
KILLIFISHES						
plains killifish	I	48	0.1	1.2	28	26.4
LIVEBEARERS						
western mosquitofish	I	585	1.0	14.9	40	37.7
SUNFISHES						
green sunfish	I	1	*	*	1	0.9
bluegill	I	-	-	-	-	-
largemouth bass	I	9	*	0.2	8	7.5
TOTAL		59,544		1,512.5		

[1] N = native; I = introduced
[2] CPUE = catch per unit effort; value based on catch per 100 m^2 (surface area) sampled
[3] Frequency and % frequency of occurrence are based on n=106 samples.

* Value is less than 0.05

Table 13. Summary of reach 4, 2004 San Juan River larval Colorado pikeminnow and razorback sucker project seining collections. Effort = 2,167.3 m^2.

SPECIES	RESIDENCE STATUS[1]	TOTAL NUMBER OF SPECIMENS	PERCENT OF TOTAL	CPUE[2]	FREQUENCY OF OCCURRENCE[3]	% FREQUENCY OF OCCURRENCE[3]
CARPS AND MINNOWS						
red shiner	I	43,688	79.8	2,015.8	64	100.0
common carp	I	117	0.2	5.4	12	18.8
roundtail chub	N	-	-	-	-	-
fathead minnow	I	4,606	8.4	212.5	55	85.9
Colorado pikeminnow	N	15	*	0.7	10	15.6
speckled dace	N	2,667	4.9	123.1	34	53.1
SUCKERS						
flannelmouth sucker	N	424	0.8	19.6	27	42.2
bluehead sucker	N	3,066	5.6	141.5	26	40.6
razorback sucker	N	7	*	0.3	5	7.8
BULLHEAD CATFISHES						
black bullhead	I	11	*	0.5	3	4.7
channel catfish	I	1	*	*	1	1.6
TROUT						
kokanee salmon	I	-	-	-	-	-
KILLIFISHES						
plains killifish	I	32	0.1	1.5	19	29.7
LIVEBEARERS						
western mosquitofish	I	112	0.2	5.2	16	25.0
SUNFISHES						
green sunfish	I	2	*	0.1	2	3.1
bluegill	I	-	-	-	-	-
largemouth bass	I	1	*	*	1	1.6
TOTAL		54,749		2,526.1		

1 N = native; I = introduced
2 CPUE = catch per unit effort; value based on catch per 100 m^2 (surface area) sampled
3 Frequency and % frequency of occurrence are based on n=64 samples.

* Value is less than 0.05

Table 14. Summary of reach 5, 2004 San Juan River larval Colorado pikeminnow and razorback sucker project seining collections. Effort = 1,104.7 m^2.

SPECIES	RESIDENCE STATUS[1]	TOTAL NUMBER OF SPECIMENS	PERCENT OF TOTAL	CPUE[2]	FREQUENCY OF OCCURRENCE[3]	% FREQUENCY OF OCCURRENCE[3]
CARPS AND MINNOWS						
red shiner	I	28,580	84.4	2,587.1	32	100.0
common carp	I	22	0.1	2.0	5	15.6
roundtail chub	N	-	-	-	-	-
fathead minnow	I	2,699	8.0	244.3	28	87.5
Colorado pikeminnow	N	23	0.1	2.1	10	31.3
speckled dace	N	1,081	3.2	97.9	18	56.3
SUCKERS						
flannelmouth sucker	N	108	0.3	9.8	13	40.6
bluehead sucker	N	1,127	3.3	102.0	11	34.4
razorback sucker	N	-	-	-	-	-
BULLHEAD CATFISHES						
black bullhead	I	-	-	-	-	-
channel catfish	I	4	*	0.4	2	6.3
TROUT						
kokanee salmon	I	-	-	-	-	-
KILLIFISHES						
plains killifish	I	6	*	0.5	5	15.6
LIVEBEARERS						
western mosquitofish	I	198	0.6	17.9	14	43.8
SUNFISHES						
green sunfish	I	5	*	0.5	1	3.1
bluegill	I	-	-	-	-	-
largemouth bass	I	3	*	0.3	2	6.3
TOTAL		33,856		3,064.7		

1 N = native; I = introduced
2 CPUE = catch per unit effort; value based on catch per 100 m^2 (surface area) sampled
3 Frequency and % frequency of occurrence are based on n=32 samples.

* Value is less than 0.05

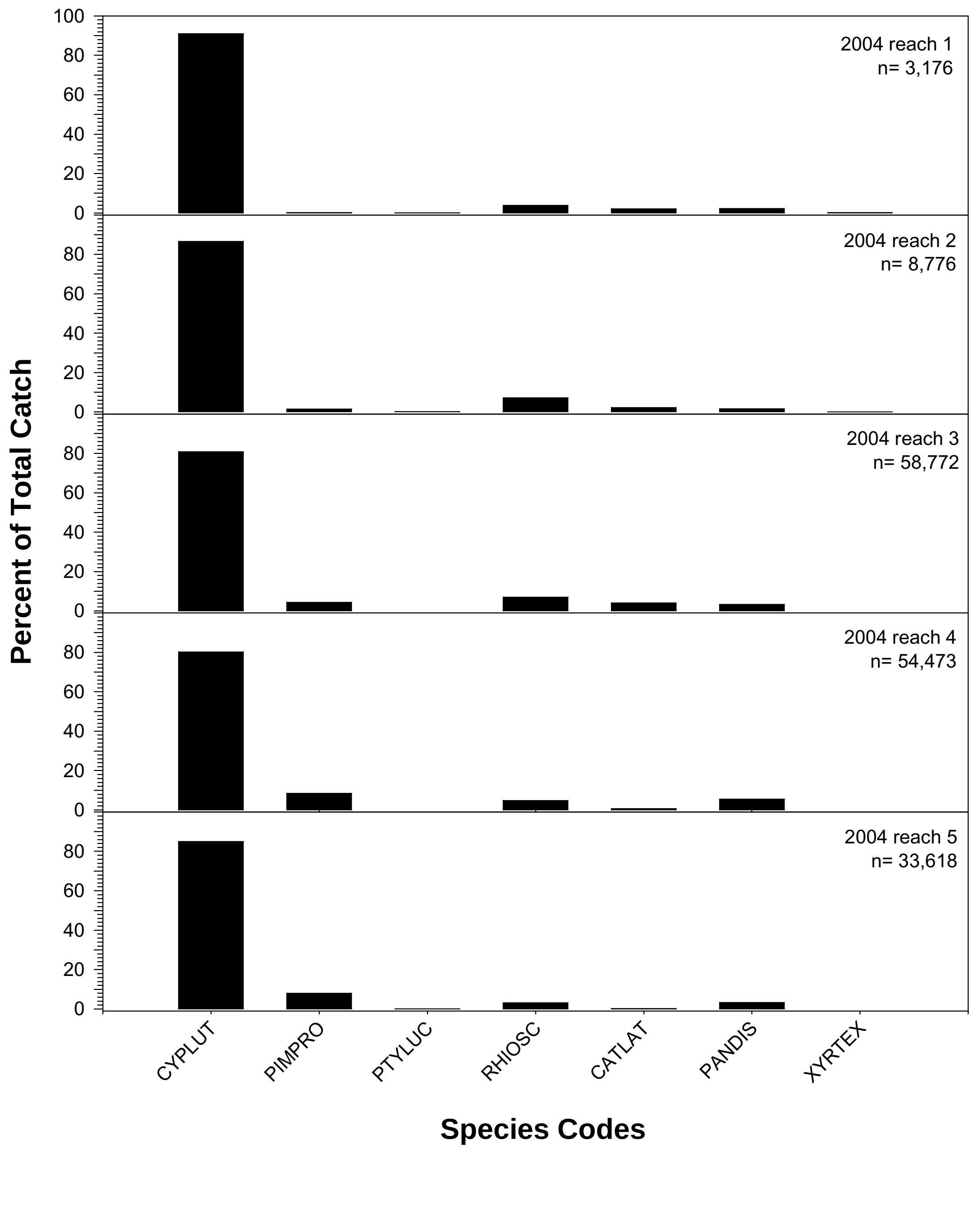

Figure 27. Ichthyofaunal composition of the most abundant species from 2004 sampling efforts by reach.

Colorado pikeminnow 2004 Riverwide Analysis

A total of 76 Colorado pikeminnow were collected in 2004 with 74 being juvenile (presumably stocked) fish. Reach 5 produced the greatest number of juvenile Colorado pikeminnow (n=23) with reach 1 producing the fewest (n=2). Two wild spawned larval pikeminnow were also collected. The first larval Colorado pikeminnow was collected on 22 July 2004 at river mile 46.3 and measured 14.2 mm TL. The second larval Colorado pikeminnow was collected on 24 July 2004 at river mile 17.0 and measured 18.1 mm TL. Using the formula:

$$\textit{Post-hatching age} = 76.7105+17.4949(L)-1.0555(L)^2+0.0221(L)^3$$

where L=length (mm TL) (Nesler et al. 1988) the post-hatching ages (in days) was determined. Date of spawning was subsequently determined by adding five days (estimated incubation time for eggs at water temperatures of 20-22^0 C) to post-hatching ages. Back-calculated spawning dates for the two larvae collected in 2004 were 25 June 2004 and 26 June 2004 respectively. Both larvae collected were staged in the laboratory as metalarvae.

Razorback sucker 2004 Riverwide Analysis

A total of 41 larval razorback sucker were collected in 2004 along with one juvenile (124 mm TL). This represents more than a ten-fold decrease in the number of larval razorback sucker collected in 2004 compared to 2003 (n=472). Larval razorback sucker were collected from 15 May to 15 June 2004 between river miles 130.1 and 8.1. In 2004 there was a broader spatial distribution of larval razorback sucker than in 2003. Seven individuals were collected in reach 4, while no specimens collected from above reach 3 during the 2003 survey. Sixteen collections produced larval razorback suckers with ten of the collections that produced larval razorback sucker containing a single individual. The largest collection of larval razorback sucker consisted of eleven individuals taken on 11 June 2004 at river mile 89.1. This site was characterized by a long narrow backwater at the downstream end of a dry side channel. For the fifth consecutive year, larval razorback sucker were collected at river mile 8.1 (Steer Gulch). This site produced the largest collection of larval razorback sucker in both 2000 and 2003 (n=86 and 99 respectively). Reach 3 produced the largest number of larval razorback sucker (n=15) of any reach and also produced a single 124 mm TL juvenile collected at RM 70.0 in a backwater in 2004. The juvenile was assumed to be an age-1 wild individual due to the size of the specimen and the much larger size of fish being stocked in the San Juan River. Reach 5 was the only reach not to produce any razorback suckers in 2004. Unlike 2003 when n=11 juvenile razorback sucker were collected, one juvenile razorback sucker were collected in 2004. Larval specimens ranged in development from yolked protolarvae to metalarvae, with the majority being mesolarvae (Figure 28).

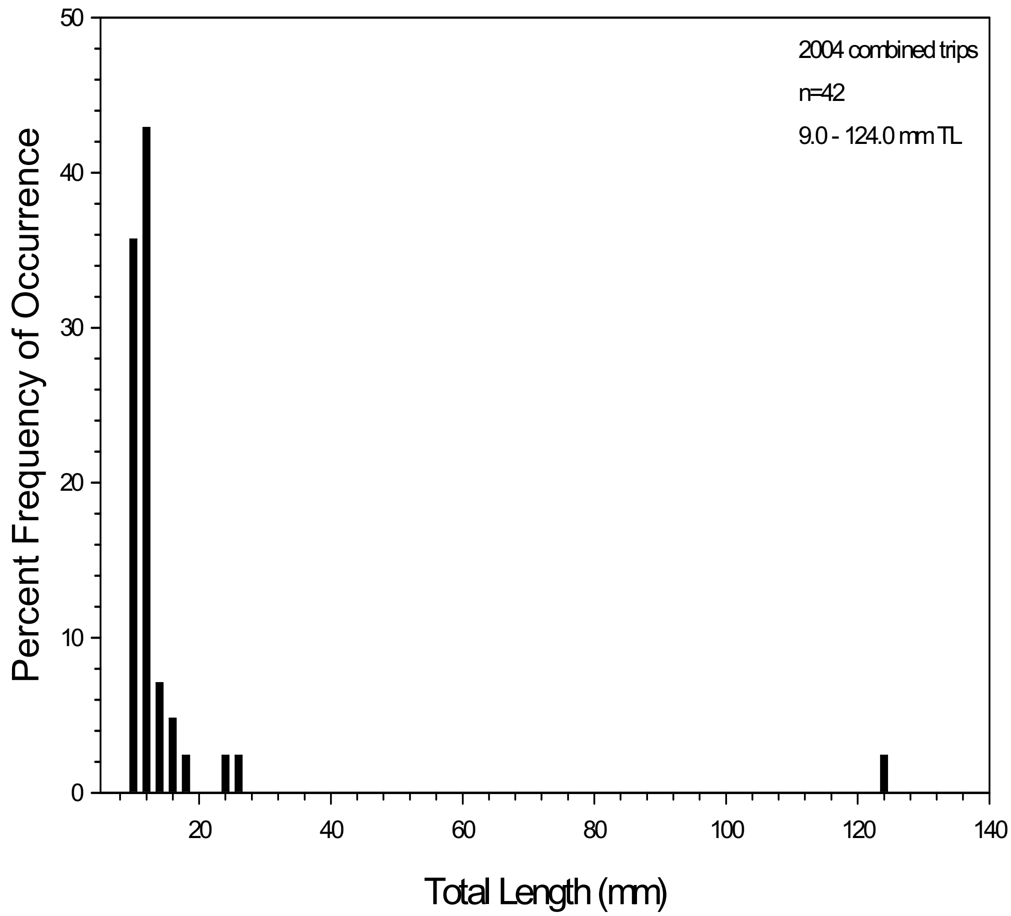

Figure 28. Length frequency histograms for razorback sucker collected from the San Juan River in 2004.

Summary

Colorado pikeminnow summary

Numerous adult and sub-adult pikeminnow have been stocked into the San Juan River over the last ten years in an effort to augment the diminished wild population. The Colorado pikeminnow augmentation plan calls for continued stocking efforts in the San Juan River over the next 10 years. The Biology Committee expects, as was documented with stocked razorback sucker, that reproduction among stocked Colorado pikeminnow will occur and can be documented through the sampling of larval fish. There are no means to differentiate between larval Colorado pikeminnow spawned by wild versus stocked adults.

As the number of adult (reproductively mature) Colorado pikeminnow in the San Juan River increases (due to both stocking and recruitment), so does the probability of elevated levels of spawning by this species. The San Juan River Biology Committee charged us with exploring the possibility of expanding the sampling effort for larval Colorado pikeminnow in fiscal year 2003. One suggestion for FY 2003 Colorado pikeminnow studies was to perform targeted sampling for Colorado pikeminnow similar to that being performed for larval razorback sucker. Collections targeting larval Colorado pikeminnow could be accomplished either by expanding the duration of the current larval razorback sucker survey (April-June) or through development of a discrete (new) project.

These and other items were considered and evaluated during the February 2002 San Juan Biology Committee meeting. The team recommended the immediate expansion of the larval razorback sucker survey (April-June) to encompass the months of June, July, and August with seining efforts to target sampling for Colorado pikeminnow. This change in sampling protocol required deviation from the FY 2002 Scope of Work was initiated July 2002 (using FY 2002 funds).

Approval for this change in sampling was acquired at the 19-21 February 2002 San Juan Biology Committee meeting in Farmington, New Mexico. This new sampling protocol resulted in the collection of over 95,000 specimens for the Colorado pikeminnow larval survey in 2002, and over 70,000 specimens in 2003. Unfortunately, no larval Colorado pikeminnow were collected in 2002 or 2003. Sampling during 2004 yielded over 145,000 specimens, including two larval Colorado pikeminnow (Figure 29). The first individual was collected on 22 July 2004 at river mile 46.3 while the second was collected on 26 July (Figure 29) at river mile 17.0. These two specimens measured 14.2 mm TL and 18.1 mm TL respectively and were in the late metalarvae stage. Back-calculated spawning dates for these two individuals was 25 June and 26 June 2004 respectively. These were the first larval Colorado pikeminnow collected using the new sampling protocol approved by the San Juan Biology Committee in February 2002.

Razorback sucker summary

A large portion of the approximately 10,800 razorback sucker introduced to the San Juan River since the 1994 initiation of the experimental stocking effort are believed to have survived. If this assumption is true, the number of stocked razorback sucker that recruit to the adult cohort (i.e., able to reproduce) should continue 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.

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, compared to 1997, 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

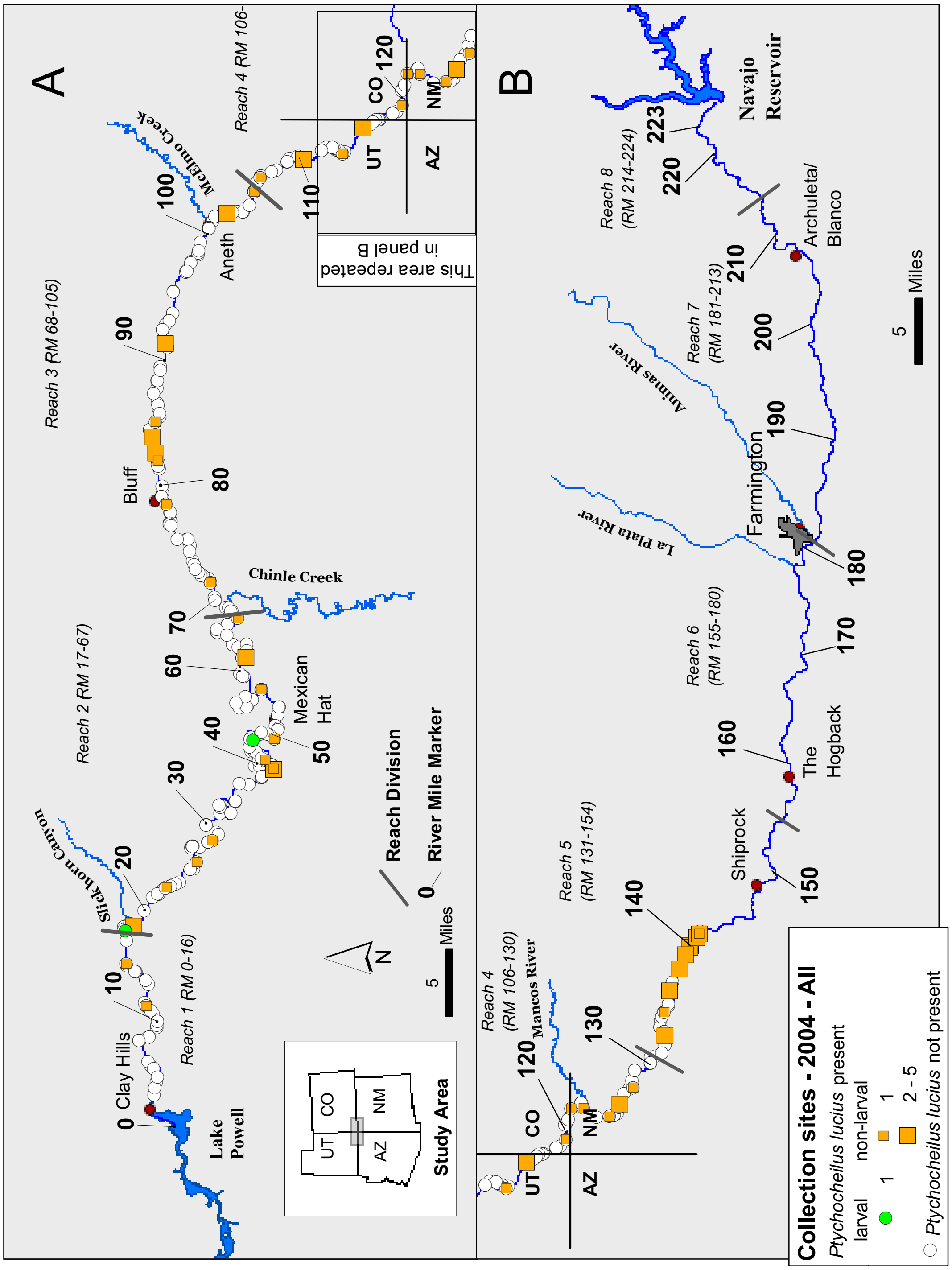

Figure 29. Map of localities sampled during the 2004 San Juan River larval ichthyofaunal survey (9 April - 14 September 2004; Cudei to Clay Hills Crossing; RM 141.5-2.9) with Colorado pikeminnow collections highlighted.

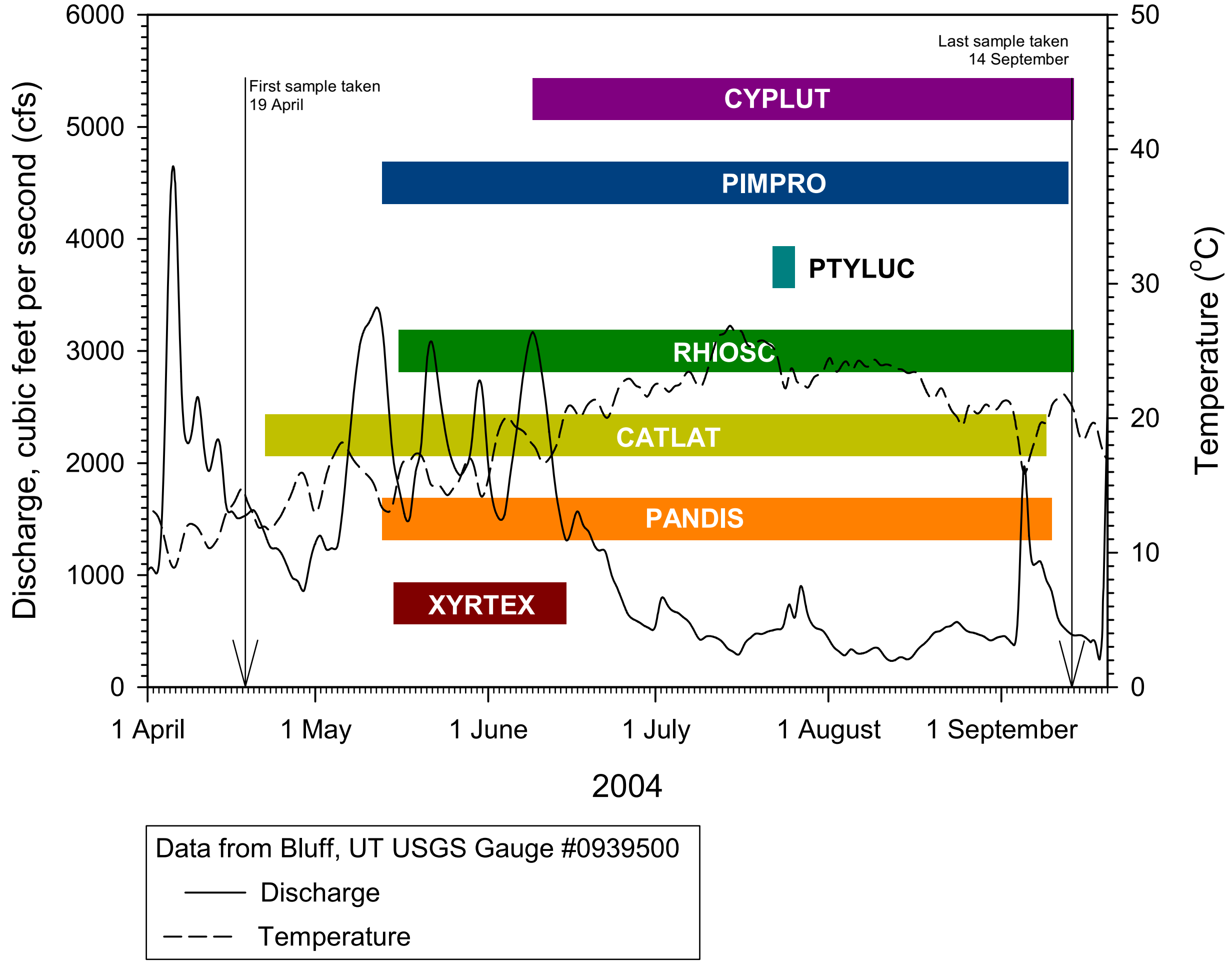

Figure 30. Occurrence of larval fishes in the San Juan River during 2004 (19 April - 14 September) plotted against temerature and discharge. Colored bars represent the period between date of first and last collection of larvae for each species.

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 that had been stocked as part of the San Juan River Basin Recovery Implementation Program.

The initial collection of larval razorback sucker in 1998 (n=2) occurred during a single sampling effort (19 - 22 May) with the specimens being taken 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 of acquiring information on razorback sucker reproductive activity. Unlike the 1997 light-trap sampling project, this effort yielded a sufficient number of larval sucker so that a 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 razorback sucker larvae (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 in this ontogenetic stage. The second noteworthy 1999 finding was the first collection of larval razorback sucker 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 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 combined. 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 prior to 2002 (n=50).

The 2001 collections provided continued documentation of reproduction by razorback sucker. Although their numbers had decreased from the 2000 collections, it is likely that the reduced number of larval razorback sucker taken in 2001 was within the normal boundaries of sample variation that would be experienced in annual fish collections of such a magnitude.

The most apparent and notable result of the 2002 study was the collection of over four times as many YOY razorback sucker than had been taken overall (1998-2001) during the tenure of this study. There were several other extremely important findings in 2002 besides the large number of individuals taken. The 2002 study documented an increase in both the longitudinal distribution and abundance of naturally spawned razorback sucker and provided preliminary data on growth and habitat association of YOY razorback sucker. Likewise, the 2002 collection of numerous late metalarvae and juvenile razorback sucker suggested an ontogenetic shift in habitat association and may yield insights to important distribution patterns of early life-history stages of this species. If the level of reproduction by razorback sucker continues to increase, the validity of the hypotheses will be able to be investigated during subsequent years.

Although there was a 41.9% decrease in larval razorback sucker collected in 2003 compared with 2002, there were 60.2% more individuals collected in 2003 than 1998 through 2001 combined. The distribution of razorback sucker in 2003 was reduced from previous years to reaches 3, 2, and 1, with reaches 3 and 1 producing the greatest numbers of individuals.

For the seventh consecutive year razorback sucker reproduction was documented in the San Juan River in 2004 (Figure 32). While there was a substantial decrease in the number of razorback sucker collected between 2003 and 2004, over four times as many razorback suckers were collected in 2004 than 1998 and 1999 combined. The spatial distribution of razorback sucker was also greater in 2004 than in 2003 but not as dispersed as what had been observed in 2002 (Figure 31). Razorback sucker were collected during four consecutive days (15-18 May) during trip 2, and in six out of seven days during trip 3 between 10 June and 15 June 2004. This suggests that while densities may have been low, the species persisted throughout large portions of the river during these time periods.

This study continues to provide unequivocal documentation of reproduction in the San Juan River by razorback sucker that have been stocked as part of the San Juan River Recovery Implementation Program. The large number of larval and juvenile razorback sucker collected since 1998 (n=1,514), along with the collection of wild age-1 fish (n=1), provides credible evidence indicative of continuing reproductive success of the augmented adult population.

As the number of stocked razorback sucker that recruit to the adult cohort (i.e., able to reproduce) continues to increase, so should the number and spatial distribution of collections of larval razorback sucker. Future 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.

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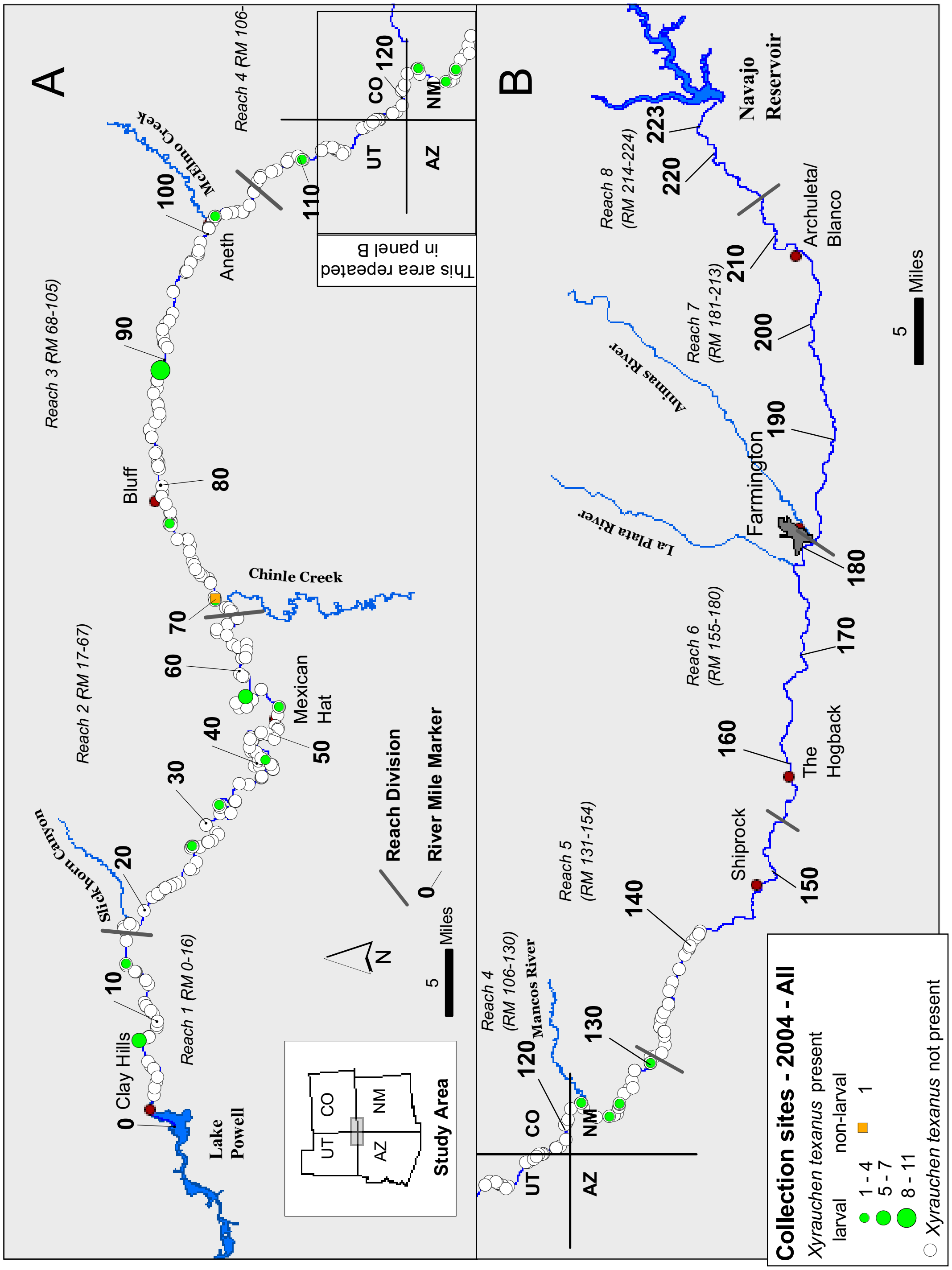

Figure 31. Map of localities sampled during the 2004 San Juan River larval ichthyofaunal survey (9 April - 14 September 2004; Cudei to Clay Hills Crossing; RM 141.5-2.9) with razorback sucker collections highlighted.

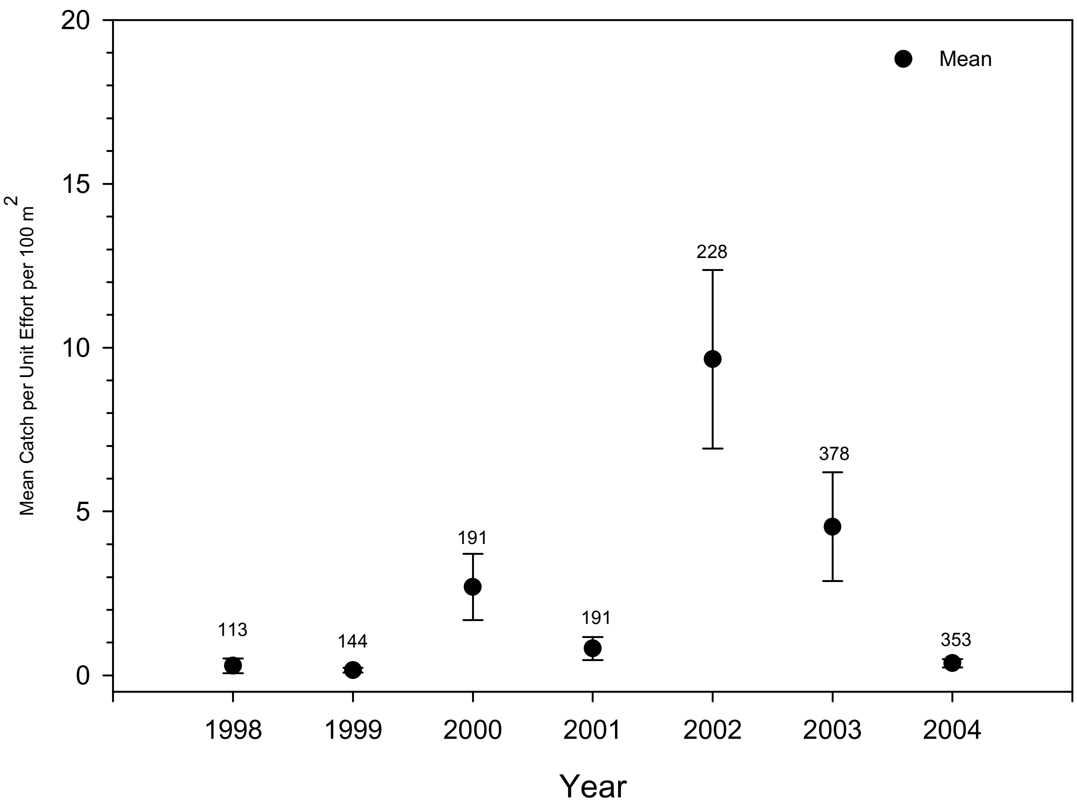

Figure 32. Mean CPUE / 100 m^2 (+/-1SE) for razorback sucker, *Xyrauchen texanus* by year. 1998 to 2001 include seine collection from April to June. 2002 to 2004 include seine collections from April to September Sample size reported above SE bars.

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Appendix I. 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
2001	**TOTAL**	**50**					
WHB01-123	48806	2	15.5 - 16.0	mesolarvae	16 May 2001	62.1	larval fish seine
WHB01-133	48832	1	13.8	mesolarva	17 May 2001	21.1	light-trap
WHB01-134	48834	1	13.5	mesolarva	17 May 2001	21.0	light-trap
WHB01-137	48843	1	11.3	mesolarva	18 May 2001	16.5	larval fish seine
WHB01-138	48846	1	15.5	mesolarva	18 May 2001	16.4	larval fish seine
WHB01-145	48873	11	10.1 - 14.8	mesolarvae	18 May 2001	9.5	larval fish seine
WHB01-146	48879	4	11.7 - 14.8	mesolarvae	18 May 2001	8.5	larval fish seine
WHB01-157	48918	1	14.3	mesolarva	30 May 2001	124.8	larval fish seine
WHB01-172	48978	1	17.5	metalarva	31 May 2001	89.2	larval fish seine
WHB01-173	48984	1	13.0	mesolarva	31 May 2001	88.8	larval fish seine
WHB01-175	48992	1	19.4	metalarva	1 June 2001	80.2	larval fish seine
WHB01-200	49078	4	22.0 - 26.3	metalarvae	14 June 2001	13.0	larval fish seine
WHB01-201	49082	1	17.2	metalarva	14 June 2001	11.9	larval fish seine
WHB01-203	49096	4	16.0 - 18.5	meso - metalarvae	14 June 2001	10.0	larval fish seine
WHB01-205	49108	16	16.1 - 28.8	metalarvae/juvenile	14 June 2001	8.1	larval fish seine
TOTAL (1998-2001)		**188**					

Appendix I. 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
2002 TOTAL		**812**					
WHB02-028		2	10.2- 11.0	protolarvae	29 April 2002	76.1	larval fish seine
WHB02-029		1	10.8	protolarva	29 April 2002	75.5	larval fish seine
WHB02-032		1	10.8	protolarva	29 April 2002	68.3	larval fish seine
WHB02-033		18	10.2- 11.5	proto - mesolarvae/yolk	29 April 2002	66.8	larval fish seine
WHB02-037		2	11.0- 11.1	mesolarvae	30 April 2002	58.2	larval fish seine
WHB02-039		1	10.5	mesolarva	30 April 2002	54.5	larval fish seine
WHB02-040		6	10.5- 12.8	proto - mesolarvae	30 April 2002	52.3	larval fish seine
WHB02-043		27	9.7- 12.3	proto - mesolarvae/yolk	1 May 2002	43.0	larval fish seine
WHB02-046		1	12.9	mesolarva	1 May 2002	25.0	larval fish seine
WHB02-047		12	10.9- 11.9	proto - mesolarvae	1 May 2002	23.5	larval fish seine
WHB02-048		91	10.0- 13.8	proto - mesolarvae/yolk	1 May 2002	21.2	larval fish seine
WHB02-051		1	10.7	mesolarva	2 May 2002	12.9	larval fish seine
WHB02-052		18	10.7- 13.3	mesolarvae	2 May 2002	11.6	larval fish seine
WHB02-053		2	11.3- 13.2	mesolarvae	2 May 2002	9.2	larval fish seine
WHB02-054		89	10.1- 13.9	mesolarvae	2 May 2002	8.7	larval fish seine
WHB02-055		24	10.1- 14.1	mesolarvae	2 May 2002	5.2	larval fish seine
WHB02-064		2	12.1- 13.7	mesolarvae	16 May 2002	129.1	larval fish seine
WHB02-066		3	12.4- 13.9	mesolarvae	16 May 2002	124.8	larval fish seine
WHB02-067		7	12.5- 15.5	mesolarvae	16 May 2002	122.6	larval fish seine
WHB02-070		5	11.0- 12.6	mesolarvae	16 May 2002	116.2	light-trap
WHB02-073		3	13.0- 13.6	mesolarvae	17 May 2002	110.1	larval fish seine
WHB02-078		5	13.5- 14.6	mesolarvae	17 May 2002	97.1	light-trap
WHB02-079		39	12.8- 18.3	meso - metalarvae	18 May 2002	95.8	larval fish seine
WHB02-080		1	18.7	metalarva	18 May 2002	93.7	larval fish seine
WHB02-081		36	12.6- 19.8	meso - metalarvae	18 May 2002	93.0	larval fish seine
WHB02-082		1	15.3	mesolarva	18 May 2002	88.8	larval fish seine
WHB02-083		2	13.4- 17.6	meso - metalarvae	18 May 2002	87.8	larval fish seine
WHB02-084		1	11.0	mesolarva	18 May 2002	85.8	larval fish seine
WHB02-085		3	13.4- 18.8	meso - metalarvae	18 May 2002	82.8	larval fish seine
WHB02-086		21	11.5- 18.8	meso - metalarvae	18 May 2002	78.9	light-trap
WHB02-087		4	11.9- 21.5	meso - metalarvae	19 May 2002	77.2	larval fish seine
WHB02-088		14	15.5- 26.4	meso - metalarvae	29 May 2002	75.7	larval fish seine
WHB02-090		4	17.8- 30.7	metalarvae - juvenile	29 May 2002	71.9	larval fish seine
WHB02-091		51	14.9- 26.8	meso - metalarvae	29 May 2002	71.3	larval fish seine
WHB02-093		19	16.8- 29.7	mesolarvae - juvenile	29 May 2002	60.6	larval fish seine
WHB02-094		1	20.3	metalarva	30 May 2002	58.2	larval fish seine
WHB02-096		71	12.4- 26.6	meso - metalarvae	30 May 2002	52.5	larval fish seine
WHB02-097		4	14.8- 24.3	meso - metalarvae	30 May 2002	50.7	larval fish seine
WHB02-098		1	20.6	metalarva	30 May 2002	48.0	larval fish seine
WHB02-100		11	10.9- 26.5	meso - metalarvae	30 May 2002	41.7	larval fish seine
WHB02-101		2	20.1- 26.7	metalarvae	31 May 2002	38.9	larval fish seine
WHB02-104		2	18.6- 21.0	metalarvae	31 May 2002	29.0	larval fish seine
WHB02-105		7	17.4- 29.7	meso - metalarvae	31 May 2002	25.2	larval fish seine
WHB02-106		50	14.5- 33.4	mesolarvae - juvenile	31 May 2002	23.4	larval fish seine
WHB02-107		1	33.3	juvenile	31 May 2002	17.6	larval fish seine
WHB02-109		1	14.6	mesolarva	1 June 2002	11.5	larval fish seine
WHB02-110		3	20.8- 25.3	metalarvae	1 June 2002	9.6	larval fish seine
WHB02-111		13	12.6- 35.4	mesolarvae - juvenile	1 June 2002	7.3	larval fish seine
WHB02-112		4	14.7- 24.3	meso - metalarvae	1 June 2002	2.8	larval fish seine
WHB02-118		1	35.8	juvenile	11 June 2002	134.5	larval fish seine
WHB02-121		1	33.1	juvenile	11 June 2002	128.1	larval fish seine
WHB02-126		2	29.4- 35.3	metalarvae - juvenile	12 June 2002	116.2	larval fish seine
WHB02-128		1	30.9	juvenile	12 June 2002	109.8	larval fish seine
WHB02-130		2	37.2- 49.0	juvenile	12 June 2002	103.2	larval fish seine
WHB02-133		3	32.4- 43.4	juvenile	13 June 2002	94.0	larval fish seine
WHB02-134		23	29.7- 55.2	metalarvae - juvenile	13 June 2002	93.0	larval fish seine
WHB02-135		48	20.4- 50.8	metalarvae - juvenile	13 June 2002	91.6	larval fish seine
WHB02-137		2	37.0- 38.1	juvenile	13 June 2002	84.6	larval fish seine

Appendix I. 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
2002 (cont.)							
WHB02-138		14	31.7 - 40.3	juvenile	13 June 2002	82.6	larval fish seine
WHB02-139		4	33.9 - 52.0	juvenile	13 June 2002	79.7	larval fish seine
WHB02-140		8	18.1 - 46.7	mesolarvae - juvenile	13 June 2002	77.1	larval fish seine
WHB02-141		1	53.1	juvenile	27 June 2002	75.4	larval fish seine
WHB02-142		2	35.6 - 49.3	juvenile	27 June 2002	74.9	larval fish seine
WHB02-146		1	51.1	juvenile	28 June 2002	68.7	larval fish seine
WHB02-148		2	59.5 - 62.4	juvenile	28 June 2002	62.3	larval fish seine
WHB02-149		8	41.8 - 54.4	juvenile	28 June 2002	61.3	larval fish seine
WHB02-150		1	39.8	juvenile	28 June 2002	60.2	larval fish seine
2003	**TOTAL**	**472**					
WHB03-096		6	12.6 - 15.8	mesolarvae	16 May 2003	97	larval fish seine
WHB03-099		33	9.5 - 14.6	proto - mesolarvae	17 May 2003	94.2	larval fish seine
WHB03-104		7	9.8 - 12.4	proto - mesolarvae	17 May 2003	85.6	larval fish seine
WHB03-105		19	10.1 - 14.5	proto - mesolarvae	17 May 2003	84.2	larval fish seine
WHB03-107		8	10.0 - 12.0	proto - mesolarvae	17 May 2003	80.2	light-trap
WHB03-108		7	9.9 - 14.1	proto - mesolarvae	18 May 2003	79.3	larval fish seine
WHB03-109		6	10.7 - 14.1	mesolarvae	18 May 2003	77.1	larval fish seine
MAF03-007		11	9.1 - 14.3	mesolarvae	18 May 2003	73.8	larval fish seine
MAF03-008		2	12.7 - 12.8	mesolarvae	18 May 2003	72.5	larval fish seine
MAF03-014		1	12.1	mesolarva	19 May 2003	57.9	larval fish seine
MAF03-016		31	10.2 - 13.9	mesolarvae	19 MAy 2003	50.9	larval fish seine
MAF03-017		3	11.2 - 11.8	mesolarvae	19 May 2003	48.3	larval fish seine
MAF03-021		1	12	mesolarva	20 May 2003	40.4	larval fish seine
MAF03-026		1	11.7	mesolarva	20 May 2003	24.5	larval fish seine
MAF03-027		5	10.2 - 13.2	mesolarvae	21 May 2003	23.8	light-trap
MAF03-029		4	10.1 - 13.6	mesolarvae	21 May 2003	21	larval fish seine
MAF03-031		34	10.6 - 19.2	meso - metalarva	21 May 2003	17.7	larval fish seine
MAF03-033		5	9.5 - 18.0	mesolarvae	22 May 2003	13.1	larval fish seine
MAF03-034		19	13 - 17.8	mesolarvae	22 May 2003	11.4	larval fish seine
MAF03-035		11	10.3 - 19.0	proto - mesolarvae	22 May 2003	9.6	larval fish seine
MAF03-036		99	10.2 - 22.1	meso - metalarvae	22 May 2003	8.1	larval fish seine
MAF03-037		50	10 - 21.1	meso - metalarvae	22 May 2003	6.9	larval fish seine
WHB03-141		16	18.3 - 23.7	meso - metalarvae	13 June 2003	90.1	larval fish seine
WHB03-142		1	33.1	juvenile	13 June 2003	88.1	larval fish seine
WHB03-145		81	15.4 - 29.4	mesolarvae - juvenile	13 June 2003	84.1	larval fish seine
WHB03-151		3	22.8 - 35.3	metalarva - juvenile	14 June 2003	75.1	larval fish seine
WHB03-168		1	26.0	juvenile	16 June 2003	33.5	larval fish seine
WHB03-169		1	26.7	juvenile	16 June 2003	28.8	larval fish seine
WHB03-178		3	26.9 - 36.1	juvenile	17 June 2003	15.4	larval fish seine
WHB03-180		2	30.2 - 37.3	juvenile	17 June 2003	12.3	larval fish seine
WHB03-183		1	22.4	mesolarvae	18 June 2003	3.3	larval fish seine
2004	**TOTAL**	**42**					
WHB04-092	52479	1	10.5	mesolarvae	15 May 2004	77.1	larval fish seine
WHB04-103	52504	7	10.2 13.5	mesolarvae	16 May 2004	57.9	larval fish seine
WHB04-108	52514	1	10.6	flexion mesolarvae	17 May 2004	43.4	larval fish seine
WHB04-112	52527	1	9.2	protolarvae	17 May 2004	33.6	larval fish seine
WHB04-114	52533	2	10.1 10.5	proto - mesolarvae	18 May 2004	26.4	larval fish seine
WHB04-120	52546	1	10.3	preflexion mesolarvae	18 May 2004	14.7	larval fish seine
WHB04-130	52579	1	10	preflexion mesolarvae	9 Jun 2004	130.1	larval fish seine
WHB04-132	52592	1	9.1	protolarvae	9 Jun 2004	126	larval fish seine
WHB)4-133	52597	1	9.1	protolarvae	9 Jun 2004	124.8	larval fish seine
WHB04-134	52604	1	9.9	flexion mesolarvae	9 Jun 2004	122.5	larval fish seine

Appendix I. 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
WHB04-138	52626	3	10.3 11.5	mesolarvae	10 Jun 2004	110.3	larval fish seine
WHB04-139	52648	1	9	protolarvae	10 Jun 2004	106.7	larval fish seine
WHB04-148	52684	11	9.4 16.3	meso - metalarvae	11 Jun 2004	89.1	larval fish seine
WHB04-159	52736	2	8.7 9.1	protolarvae	12 Jun 2004	69.9	larval fish seine
WHB04-165	52756	1	9.8	preflexion mesolarvae	13 Jun 2004	52.9	larval fish seine
WHB04-182	52798	6	11.3 25.9	meso - metalarvae	15 Jun 2004	8.1	larval fish seine

TOTAL 1,514

Appendix II. 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 II. 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
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
2001	**TOTAL**	**50**					
WHB01-123	48806	2	15.5 - 16.0	postflexion mesolarvae	16 May 2001	62.1	larval fish seine
WHB01-133	48832	1	13.8	postflexion mesolarva	17-18 May 2001	21.1	light-trap
WHB01-134	48834	1	13.5	postflexion mesolarva	17-18 May 2001	21.1	light-trap
WHB01-137	48843	1	11.3	flexion mesolarva	18 May 2001	16.5	larval fish seine
WHB01-138	48846	1	15.5	postflexion mesolarva	18 May 2001	16.4	larval fish seine
WHB01-145	48873	11			18 May 2001	9.5	larval fish seine
		(2)	10.1 - 10.2	preflexion mesolarvae	18 May 2001	9.5	larval fish seine
		(5)	10.8 - 13.0	flexion mesolarvae	18 May 2001	9.5	larval fish seine
		(4)	14.0 - 14.8	postflexion mesolarvae	18 May 2001	9.5	larval fish seine
WHB01-146	48879	4			18 May 2001	8.5	larval fish seine
		(1)	11.7	flexion mesolarva	18 May 2001	8.5	larval fish seine
		(3)	13.9 - 14.8	postflexion mesolarvae	18 May 2001	8.5	larval fish seine
WHB01-157	48918	1	14.3	postflexion mesolarva	30 May 2001	124.8	larval fish seine
WHB01-172	48978	1	17.5	metalarva	31 May 2001	89.2	larval fish seine
WHB01-173	48984	1	13	flexion mesolarva	31 May 2001	88.8	larval fish seine
WHB01-175	48992	1	19.4	metalarva	1 June 2001	80.2	larval fish seine
WHB01-200	49078	4	22.0 - 26.3	metalarvae	14 June 2001	13.0	larval fish seine
WHB01-201	49082	1	17.2	metalarva	14 June 2001	11.9	larval fish seine
WHB01-203	49096	4			14 June 2001	10.0	larval fish seine
		(2)	16.0 - 16.4	postflexion mesolarvae	14 June 2001	10.0	larval fish seine
		(2)	16.8 - 18.5	metalarvae	14 June 2001	10.0	larval fish seine
WHB01-205	49108	16			14 June 2001	8.1	larval fish seine
		(1)	16.1	postflexion mesolarva	14 June 2001	8.1	larval fish seine
		(13)	17.7 - 25.8	metalarvae	14 June 2001	8.1	larval fish seine
		(2)	26.8 - 28.8	juvenile	14 June 2001	8.1	larval fish seine
2002	**TOTAL**	**812**					
WHB02-028		2	10.2 - 11.0	protolarvae	29 April 2002	76.1	larval fish seine
WHB02-029		1	10.8	protolarva	29 April 2002	75.5	larval fish seine
WHB02-032		1	10.8	protolarva	29 April 2002	68.3	larval fish seine
WHB02-033		18			29 April 2002	66.8	larval fish seine
		(11)	10.1 - 11.1	protolarvae	29 April 2002	66.8	larval fish seine
		(6)	10.5 - 11.2	preflexion mesolarvae	29 April 2002	66.8	larval fish seine
		(1)	11.5	flexion mesolarvae	29 April 2002	66.8	larval fish seine
WHB02-037		2	11.0 - 11.1	preflexion mesolarvae	30 April 2002	58.2	larval fish seine
WHB02-039		1	10.5	preflexion mesolarva	30 April 2002	54.5	larval fish seine
WHB02-040		5			30 April 2002	52.3	larval fish seine
		(1)	10.5	protolarvae	30 April 2002	52.3	larval fish seine
		(2)	10.8 - 10.8	preflexion mesolarvae	30 April 2002	52.3	larval fish seine
		(3)	12.1 - 12.8	flexion mesolarvae	30 April 2002	52.3	larval fish seine

Appendix II. 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
WHB02-043		27			1 May 2002	43.0	larval fish seine
		(10)	9.7 - 10.3	protolarvae	1 May 2002	43.0	larval fish seine
		(12)	10.1 - 11.0	preflexion mesolarvae	1 May 2002	43.0	larval fish seine
		(1)	10.3	postflexion mesolarvae	1 May 2002	43.0	larval fish seine
		(4)	10.7 - 12.3	flexion mesolarvae	1 May 2002	43.0	larval fish seine
WHB02-046		1	12.9	flexion mesolarva	1 May 2002	25.0	larval fish seine
WHB02-047		12			1 May 2002	23.5	larval fish seine
		(7)	10.9 - 11.5	preflexion mesolarvae	1 May 2002	23.5	larval fish seine
		(2)	10.9 - 11.1	protolarvae	1 May 2002	23.5	larval fish seine
		(3)	11.8 - 11.9	flexion mesolarvae	1 May 2002	23.5	larval fish seine
WHB02-048		91			1 May 2002	21.2	larval fish seine
		(23)	10.0 - 11.5	protolarvae	1 May 2002	21.2	larval fish seine
		(34)	10.2 - 12.0	preflexion mesolarvae	1 May 2002	21.2	larval fish seine
		(32)	10.6 - 13.4	flexion mesolarvae	1 May 2002	21.2	larval fish seine
		(2)	12.7 - 13.8	postflexion mesolarvae	1 May 2002	21.2	larval fish seine
WHB02-051		1	10.7	preflexion mesolarva	2 May 2002	12.9	larval fish seine
WHB02-052		18			2 May 2002	11.6	larval fish seine
		(15)	10.7 - 13.3	flexion mesolarvae	2 May 2002	11.6	larval fish seine
		(1)	10.9	preflexion mesolarva	2 May 2002	11.6	larval fish seine
		(2)	12.7 - 13.2	postflexion mesolarvae	2 May 2002	11.6	larval fish seine
WHB02-053		2			2 May 2002	9.2	larval fish seine
		(1)	11.3	flexion mesolarva	2 May 2002	9.2	larval fish seine
		(1)	13.2	postflexion mesolarva	2 May 2002	9.2	larval fish seine
WHB02-054		89			2 May 2002	8.7	larval fish seine
		(69)	10.1 - 13.1	flexion mesolarvae	2 May 2002	8.7	larval fish seine
		(13)	10.2 - 11.2	preflexion mesolarvae	2 May 2002	8.7	larval fish seine
		(7)	12.5 - 13.9	postflexion mesolarvae	2 May 2002	8.7	larval fish seine
WHB02-055		24			2 May 2002	5.2	larval fish seine
		(1)	10.1	preflexion mesolarva	2 May 2002	5.2	larval fish seine
		(20)	10.5 - 13.0	flexion mesolarvae	2 May 2002	5.2	larval fish seine
		(3)	12.8 - 14.1	postflexion mesolarvae	2 May 2002	5.2	larval fish seine
WHB02-064		2			16 May 2002	129.1	larval fish seine
		(1)	12.1	flexion mesolarva	16 May 2002	129.1	larval fish seine
		(1)	13.7	postflexion mesolarva	16 May 2002	129.1	larval fish seine
WHB02-066		3			16 May 2002	124.8	larval fish seine
		(2)	12.4 - 13.9	postflexion mesolarvae	16 May 2002	124.8	larval fish seine
		(1)	12.7	flexion mesolarvae	16 May 2002	124.8	larval fish seine
WHB02-067		7			16 May 2002	122.6	larval fish seine
		(6)	12.5 - 15.5	postflexion mesolarvae	16 May 2002	122.6	larval fish seine
		(1)	12.6	flexion mesolarva	16 May 2002	122.6	larval fish seine
WHB02-070		5			16-17 May 2002	116.2	light-trap
		(3)	11.0 - 12.4	flexion mesolarvae	16-17 May 2002	116.2	light-trap
		(2)	12.0 - 12.6	postflexion mesolarvae	16-17 May 2002	116.2	light-trap
WHB02-073		3	13.0 - 13.6	postflexion mesolarvae	17 May 2002	110.1	larval fish seine
WHB02-078		5	13.5 - 14.6	postflexion mesolarvae	17-18 May 2002	97.1	light-trap
WHB02-079		39			18 May 2002	95.8	larval fish seine
		(4)	12.8 - 13.3	flexion mesolarvae	18 May 2002	95.8	larval fish seine
		(32)	13.5 - 18.0	postflexion mesolarvae	18 May 2002	95.8	larval fish seine
		(3)	17.6 - 18.3	metalarvae	18 May 2002	95.8	larval fish seine
WHB02-080		1	18.7	metalarva	18 May 2002	93.7	larval fish seine
WHB02-081		36			18 May 2002	93.0	larval fish seine
		(1)	12.6	flexion mesolarvae	18 May 2002	93.0	larval fish seine
		(30)	12.8 - 18.0	postflexion mesolarvae	18 May 2002	93.0	larval fish seine
		(5)	18.7 - 19.8	metalarvae	18 May 2002	93.0	larval fish seine
WHB02-082		1	15.3	postflexion mesolarva	18 May 2002	88.8	larval fish seine
WHB02-083		2			18 May 2002	87.8	larval fish seine
		(1)	13.4	postflexion mesolarva	18 May 2002	87.8	larval fish seine
		(1)	17.6	metalarva	18 May 2002	87.8	larval fish seine
WHB02-084		1	11.0	flexion mesolarva	18 May 2002	85.8	larval fish seine

Appendix II. 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
WHB02-085		3			18 May 2002	82.8	larval fish seine
		(2)	13.4 - 14.8	postflexion mesolarvae	18 May 2002	82.8	larval fish seine
		(1)	18.8	metalarva	18 May 2002	82.8	larval fish seine
WHB02-086		21			18-19 May 2002	78.9	light-trap
		(2)	11.5 - 12.0	flexion mesolarvae	18-19 May 2002	78.9	light-trap
		(16)	12.6 - 17.0	postflexion mesolarvae	18-19 May 2002	78.9	light-trap
		(3)	17.5 - 18.8	metalarvae	18-19 May 2002	78.9	light-trap
WHB02-087		4			19 May 2002	77.2	larval fish seine
		(1)	11.9	flexion mesolarva	19 May 2002	77.2	larval fish seine
		(2)	14.8 - 14.8	postflexion mesolarvae	19 May 2002	77.2	larval fish seine
		(1)	21.5	metalarva	19 May 2002	77.2	larval fish seine
WHB02-088		14			29 May 2002	75.7	larval fish seine
		(1)	15.5	postflexion mesolarva	29 May 2002	75.7	larval fish seine
		(13)	17.6 - 26.4	metalarvae	29 May 2002	75.7	larval fish seine
WHB02-090		4			29 May 2002	71.9	larval fish seine
		(3)	17.8 - 24.8	metalarvae	29 May 2002	71.9	larval fish seine
		(1)	30.7	juvenile	29 May 2002	71.9	larval fish seine
WHB02-091		51			29 May 2002	71.3	larval fish seine
		(7)	14.5 - 17.8	postflexion mesolarvae	29 May 2002	71.3	larval fish seine
		(44)	15.0 - 26.8	metalarvae	29 May 2002	71.3	larval fish seine
WHB02-093		19			29 May 2002	60.6	larval fish seine
		(4)	16.8 - 18.1	postflexion mesolarvae	29 May 2002	60.6	larval fish seine
		(13)	18.7 - 24.8	metalarvae	29 May 2002	60.6	larval fish seine
		(2)	28.3 - 29.7	juvenile	29 May 2002	60.6	larval fish seine
WHB02-094		1	20.3	metalarva	30 May 2002	58.2	larval fish seine
WHB02-096		71			30 May 2002	52.5	larval fish seine
		(6)	12.3 - 13.2	flexion mesolarvae	30 May 2002	52.5	larval fish seine
		(14)	14.3 - 18.8	postflexion mesolarvae	30 May 2002	52.5	larval fish seine
		(51)	17.9 - 26.6	metalarvae	30 May 2002	52.5	larval fish seine
WHB02-097		4			30 May 2002	50.7	larval fish seine
		(2)	14.8 - 15.3	postflexion mesolarvae	30 May 2002	50.7	larval fish seine
		(2)	20.2 - 24.3	metalarvae	30 May 2002	50.7	larval fish seine
WHB02-098		1	20.6	metalarva	30 May 2002	48.0	larval fish seine
WHB02-100		11			30 May 2002	41.7	larval fish seine
		(1)	10.9	flexion mesolarva	30 May 2002	41.7	larval fish seine
		(3)	13.7 - 17.8	postflexion mesolarvae	30 May 2002	41.7	larval fish seine
		(7)	17.3 - 26.5	metalarvae	30 May 2002	41.7	larval fish seine
WHB02-101		2	20.1 - 26.7	metalarvae	31 May 2002	38.9	larval fish seine
WHB02-104		2	18.6 - 21.0	metalarvae	31 May 2002	29.0	larval fish seine
WHB02-105		7			31 May 2002	25.2	larval fish seine
		(1)	17.4	postflexion mesolarva	31 May 2002	25.2	larval fish seine
		(6)	22.9 - 29.7	metalarvae	31 May 2002	25.2	larval fish seine
WHB02-106		50			31 May 2002	23.4	larval fish seine
		(1)	12.9	flexion mesolarva	31 May 2002	23.4	larval fish seine
		(9)	14.5 - 18.8	postflexion mesolarvae	31 May 2002	23.4	larval fish seine
		(34)	17.7 - 27.2	metalarvae	31 May 2002	23.4	larval fish seine
		(6)	28.0 - 33.4	juvenile	31 May 2002	23.4	larval fish seine
WHB02-107		1	33.3	juvenile	31 May 2002	17.6	larval fish seine
WHB02-109		1	14.6	postflexion mesolarvae	1 June 2002	11.5	larval fish seine
WHB02-110		3	20.8 - 25.3	metalarvae	1 June 2002	9.6	larval fish seine
WHB02-111		13			1 June 2002	7.3	larval fish seine
		(8)	12.6 - 16.7	postflexion mesolarvae	1 June 2002	7.3	larval fish seine
		(4)	17.1 - 22.8	metalarvae	1 June 2002	7.3	larval fish seine
		(1)	35.4	juvenile	1 June 2002	7.3	larval fish seine
WHB02-112		4			1 June 2002	2.8	larval fish seine
		(2)	14.7 - 15.6	postflexion mesolarvae	1 June 2002	2.8	larval fish seine
		(2)	23.5 - 24.3	metalarvae	1 June 2002	2.8	larval fish seine
WHB02-118		1	35.8	juvenile	11 June 2002	134.5	larval fish seine

Appendix II. 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
WHB02-121		1	33.1	juvenile	11 June 2002	128.1	larval fish seine
WHB02-126		2			12 June 2002	116.2	larval fish seine
		(1)	29.4	metalarva	12 June 2002	116.2	larval fish seine
		(1)	35.5	juvenile	12 June 2002	116.2	larval fish seine
WHB02-128		1	30.9	juvenile	12 June 2002	109.8	larval fish seine
WHB02-130		2	37.2 - 49.0	juvenile	12 June 2002	103.2	larval fish seine
WHB02-133		3	32.4 - 43.4	juvenile	13 June 2002	94.0	larval fish seine
WHB02-134		23			13 June 2002	93.0	larval fish seine
		(1)	29.7	metalarva	13 June 2002	93.0	larval fish seine
		(22)	31.5 - 55.2	juvenile	13 June 2002	93.0	larval fish seine
WHB02-135		48			13 June 2002	91.6	larval fish seine
		(7)	20.4 - 29.0	metalarvae	13 June 2002	91.6	larval fish seine
		(41)	28.5 - 53.1	juvenile	13 June 2002	91.6	larval fish seine
WHB02-137		2	37.0 - 38.1	juvenile	13 June 2002	84.6	larval fish seine
WHB02-138		14	31.7 - 40.3	juvenile	13 June 2002	82.6	larval fish seine
WHB02-139		4	33.9 - 52.0	juvenile	13 June 2002	79.7	larval fish seine
WHB02-140		8			14 June 2002	77.1	larval fish seine
		(1)	18.1	postflexion mesolarva	14 June 2002	77.1	larval fish seine
		(7)	34.1 - 46.7	juvenile	14 June 2002	77.1	larval fish seine
WHB02-141		1	53.1	juvenile	27 June 2002	75.4	larval fish seine
WHB02-142		2	35.6 - 49.3	juvenile	27 June 2002	74.9	larval fish seine
WHB02-146		1	51.1	juvenile	28 June 2002	68.7	larval fish seine
WHB02-148		2	59.5 - 62.4	juvenile	28 June 2002	62.3	larval fish seine
WHB02-149		8	41.8 - 54.4	juvenile	28 June 2002	61.3	larval fish seine
WHB02-150		1	39.8	juvenile	28 June 2002	60.2	larval fish seine
2003 TOTAL		**472**					
WHB03-096		6			16 May 2003	97.0	larval fish seine
		(2)	12.6 -12.8	flexion mesolarvae	16 May 2003		larval fish seine
		(4)	13.5 -15.8	postflex mesolarvae	16 May 2003		larval fish seine
WHB03-099		33			17 May 2003	94.2	larval fish seine
		(4)	9.5 -10.5	protolarvae	17 May 2003		larval fish seine
		(22)	10.4 -13.6	flexion mesolarvae	17 May 2003		larval fish seine
		(7)	12.6 -14.6	postflex mesolarvae	17 May 2003		larval fish seine
WHB03-104		7			17 May 2003	85.6	larval fish seine
		(3)	9.8 -10.4	protolarvae	17 May 2003		larval fish seine
		(4)	10.6 -12.4	flexion mesolarvae	17 May 2003		larval fish seine
WHB03-105		19			17 May 2003	84.2	larval fish seine
		(5)	10.1 -10.6	protolarvae	17 May 2003		larval fish seine
		(12)	10.7 -12.8	flexion mesolarvae	17 May 2003		larval fish seine
		(2)	13.9 -14.5	postflex mesolarvae	17 May 2003		larval fish seine
WHB03-107		8			17 May 2003	80.2	light-trap
		(2)	10 -10.3	protolarvae	17 May 2003		light-trap
		(6)	10.5 -12.0	flexion mesolarvae	17 May 2003		light-trap
WHB03-108		7			18 May 2003	79.3	larval fish seine
		(2)	9.9 -10.5	protolarvae	18 May 2003		larval fish seine
		(4)	11.0 -11.9	flexion mesolarvae	18 May 2003		larval fish seine
		(1)	14.1	postflex mesolarva	18 May 2003		larval fish seine
WHB03-109		6			18 May 2003	77.1	larval fish seine
		(5)	10.7 -12.0	flexion mesolarvae	18 May 2003		larval fish seine
		(1)	14.1	postflex mesolarvae	18 May 2003		larval fish seine
MAF03-007		11			18 May 2003	73.8	larval fish seine
		(10)	9.1 -12.1	flexion mesolarvae	18 May 2003		larval fish seine

Appendix II. 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
		(1)	14.3	postflex mesolarva	18 May 2003		larval fish seine
MAF03-008		2	12.7 -12.8	flexion mesolarvae	18 May 2003	72.5	larval fish seine
MAF03-014		1	12.1	flexion mesolarvae	19 May 2003	57.9	larval fish seine
MAF03-016		31			19 May 2003		larval fish seine
		(28)	10.2 -12.9	flexion mesolarvae	19 May 2003		larval fish seine
		(3)	13.1 -13.9	postflex mesolarvae	19 May 2003		larval fish seine
MAF03-017		3	11.2 -11.8	flexion mesolarvae	19 May 2003	48.3	larval fish seine
MAF03-021		1	12	flexion mesolarvae	20 May 2003	40.4	larval fish seine
MAF03-026		1	11.7	flexion mesolarvae	20 May 2003	24.5	light-trap
MAF03-027		5			21 May 2003	23.8	larval fish seine
		(4)	10.2 -12.8	flexion mesolarvae	21 May 2003		larval fish seine
		(1)	13.2	postflex mesolarva	21 May 2003		larval fish seine
MAF03-029		4			21 May 2003	21.0	larval fish seine
		(2)	10.1 -11.5	flexion mesolarvae	21 May 2003		larval fish seine
		(2)	13.4 -13.6	postflex mesolarvae	21 May 2003		larval fish seine
MAF03-031		34			21 May 2003	17.7	larval fish seine
		(12)	10.6 -12.7	flexion mesolarvae	21 May 2003		larval fish seine
		(21)	13.0 -17.2	postflex mesolarvae	21 May 2003		larval fish seine
		(1)	19.2	metalarva	21 May 2003		larval fish seine
MAF03-033		5			22 May 2003	13.1	larval fish seine
		(2)	9.5 -12.1	flexion mesolarvae	22 May 2003		larval fish seine
		(3)	15.9 -18.0	postflex mesolarvae	22 May 2003		larval fish seine
MAF03-034		19			22 May 2003	11.4	larval fish seine
		(12)	10.4 -12.7	flexion mesolarvae	22 May 2003		larval fish seine
		(7)	13.0 -17.8	postflex mesolarvae	22 May 2003		larval fish seine
MAF03-035		11			22 May 2003	9.6	larval fish seine
		(1)	10.3	protolarvae	22 May 2003		larval fish seine
		(4)	10.4 -13.2	flexion mesolarvae	22 May 2003		larval fish seine
		(6)	13.8 -19.0	postflex mesolarvae	22 May 2003		larval fish seine
MAF03-036		99			22 May 2003	8.1	larval fish seine
		(42)	10.2 -13.3	flexion mesolarvae	22 May 2003		larval fish seine
		(55)	13.0 -18.4	postflex mesolarvae	22 May 2003		larval fish seine
		(2)	18.8 -22.1	metalarvae	22 May 2003		larval fish seine
MAF03-037		50			22 May 2003	6.9	larval fish seine
		(13)	10.0 -13.2	flexion mesolarvae	22 May 2003		larval fish seine
		(32)	12.9 -18.5	postflex mesolarvae	22 May 2003		larval fish seine
		(5)	16.1 -21.1	metalarvae	22 May 2003		larval fish seine
WHB03-141		16			13 June 2003	90.1	larval fish seine
		(4)	18.3 -19.4	postflex mesolarvae	13 June 2003		larval fish seine
		(12)	19.8 -23.7	metalarvae	13 June 2003		larval fish seine
WHB03-142		1	33.1	juvenile	13 June 2003	88.1	larval fish seine
WHB03-145		81			13 June 2003	84.1	larval fish seine
		(7)	15.4 -17.9	postflex mesolarvae	13 June 2003		larval fish seine
		(73)	18.8 -27.1	metalarvae	13 June 2003		larval fish seine
		(1)	29.4	juvenile	13 June 2003		larval fish seine
WHB03-151		3			14 June 2003	75.1	larval fish seine
		(1)	22.8	metalarvae	14 June 2003		larval fish seine
		(2)	31.7 -35.3	juvenile	14 June 2003		larval fish seine
WHB03-168		1	26	juvenile	16 June 2003	33.5	larval fish seine
WHB03-169		1	26.7	juvenile	16 June 2003	28.8	larval fish seine
WHB03-178		3	26.9 -36.1	juvenile	17 June 2003	15.4	larval fish seine
WHB03-180		2	30.2 -37.3	juvenile	17 June 2003	12.3	larval fish seine
WHB03-183		1	22.4	postflex mesolarvae	18 June 2003	3.3	larval fish seine

Appendix II. 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
2004 TOTAL		**42**					
WHB04-092	52479	1	10.5	preflexion mesolarvae	15 May 2004	77.1	larval fish seine
WHB04-103	52504	7					
		(3)	10.2-10.6	preflexion mesolarvae	16 May 2004	57.9	larval fish seine
		(4)	11.1-13.5	flexion mesolarvae	16 May 2004	57.9	larval fish seine
WHB04-108	52514	1	10.6	flexion mesolarvae	17 May 2004	43.4	larval fish seine
WHB04-112	52527	1	9.2	protolarvae	17 May 2004	33.6	larval fish seine
WHB04-114	52533	2	10.1	protolarvae	18 May 2004	26.4	larval fish seine
			10.5	preflexion mesolarvae	18 May 2004	26.4	larval fish seine
WHB04-120	52546	1	10.3	preflexion mesolarvae	18 May 2004	14.7	larval fish seine
WHB04-130	52579	1	10	preflexion mesolarvae	9 Jun 2004	130.1	larval fish seine
WHB04-132	52592	1	9.1	protolarvae	9 Jun 2004	126	larval fish seine
WHB04-133	52597	1	9.1	protolarvae	9 Jun 2004	124.8	larval fish seine
WHB04-134	52604	1	9.9	flexion mesolarvae	9 Jun 2004	122.5	larval fish seine
WHB04-138	52626	3					
		(2)	10 .3-11.5	preflexion mesolarvae	10 Jun 2004	110.3	larval fish seine
			11.3	flexion mesolarvae	10 Jun 2004	110.3	larval fish seine
WHB04-139	52648	1	9	protolarvae	10 Jun 2004	106.7	larval fish seine
WHB04-148	52684	11					
		(4)	9.4-10.2	preflexion mesolarvae	11 Jun 2004	89.1	larval fish seine
		(3)	9.7-9.9	flexion mesolarvae	11 Jun 2004	89.1	larval fish seine
		(1)	12	postflexion mesolarvae	11 Jun 2004	89.1	larval fish seine
		(3)	15.8-16.3	metalarvae	11 Jun 2004	89.1	larval fish seine
WHB04-159	52736	2					
			8.7-9.1	protolarvae	12 Jun 2004	69.9	larval fish seine
WHB04-165	52756	1	9.8	preflexion mesolarvae	13 Jun 2004	52.9	larval fish seine
WHB04-182	52798	6					
		(3)	11.3-12.2	postflexion mesolarvae	15 Jun 2004	8.1	larval fish seine
		(1)	11.9	flexion mesolarvae	15 Jun 2004	8.1	larval fish seine
		(2)	23.8-25.9	metalarvae	15 Jun 2004	8.1	larval fish seine
TOTAL (1998-2004)		**1,514**					

Appendix III. Summary of larval Colorado pikeminnow collected in the San Juan River.

Field Number	MSB Catalog Number	Number of Specimens	Total Length	Larval Stage	Date Collected	River Mile	Sampling Method
2004	**TOTAL**	**2**					
MAF04-046	53090	1	14.2	metalarvae	22 July 2004	46.3	larval seine
MAF04-059	53130	1	17.0	metalarvae	24 July 2004	17.0	larval seine
TOTAL		**2**					

Appendix IV. Detailed sampling and fish identification protocol.

1. Determination and access to sampling sites

   a. Suitable habitats for larval fish, including areas of low velocity (pools, backwaters, and secondary channels) were identified by field personnel while floating the river.
   b. Access to the habitats was gained via 16' inflatable raft.
   c. River Mile was determined to tenth of a mile using the standardized map set 2003 aerial photos produced for the San Juan River Basin Recovery Implementation Program.
   d. Geographic coordinates were determined at each site with a Garmin Navigation Geographic Positioning System (GPS) Instrument and were recorded in Universal Transverse Mercator (UTM) Zone 12 NAD27 CONUS. In instances where coordinates could not be obtained due to poor GPS satellite signal, coordinates were determined in the lab using a Geographic Information System based on the recorded river mile.

2. Collection of larval fish samples via seine and associated data recorded

   a. Small-mesh seines (1m x 1m x 0.8 mm) were drawn through the sampling site.
   b. The number of seine hauls per site was recorded along with the length of each seine haul. This information was used to calculate effort (area sampled) using the equation:

$$\Sigma \text{ haul lengths (m)} \bullet \text{seine width (m)} = \text{effort } (m^2)$$

   c. Ecological data about each site were recorded, including meso-habitat type, length of habitat area, maximum depth, and substrate. A secchi disk was used to determine water clarity. Figure 16 illustrates data recorded at seining sites in the field.

4. Retention, identification, and permanent deposition of specimens

   a. Retained specimens at each site were placed in WhirlPak bags containing a solution of 10% formalin and a tag inscribed with a unique alpha-numeric code that was also recorded on the field data sheet.
   b. Samples were returned to the Division of Fishes, Museum of Southwestern Biology (MSB), University of New Mexico. The specimens were removed from the field bags, debris and silt was removed and they were transferred to glass museum jars containing a solution of 5% buffered formalin. Specimens from each site were sorted and identified to species, then the species series were enumerated, and measured for minimum and maximum size (mm SL) of that sample.
   c. Specimens were identified to species by MSB personnel with expertise in San Juan River Basin larval fish identification. Identifications were made using a polarized, underlit stereo microscope. Specimens whose species-specific identity was questionable were forwarded to Darrel E. Snyder (Larval Fish Laboratory, Colorado State University) for review.
   d. Specimens identified as razorback sucker were further examined for determination of developmental stage and minimum and maximum size (mm TL).
   e. All collections were transferred through a series of 35%, 50%, and ultimately 70% ethanol, catalogued, labeled, and placed on shelves in the in the collection archives of the MSB.

Appendix IV. Detailed sampling and fish identification protocol (continued).

Field No.: WHB04-027

Date: 22 Apr 2004 / Sample: Acc. No.: 2004-IV:19

State/Country: Utah USA Locality: San Juan River @ RM 91.3

County: San Juan Co. Drainage: San Juan Quad.:

Coordinate System: Nad 27 N/S: 4125550 E/W: 0646270 Zone: 12

Shore Description: sand and silt bank, Elaeagnus angustifolia Air Temp.: 15 °C

Water Description: shallow flowthrough channel two small backwaters

Substrate: sand & silt Water Depth: .02-.35 m

Aquatic Vegetation/Cover: none

Water Temp.: 13.2 °C Velocity (est.): Ø - .2 m/s Width (est.): 1 - 5 m

Secchi Depth: 12 cm D.O.: 7.16 mg/l Conductivity: 430/552 µS Salinity: 0.3 ppt pH:

Method of Capture: larval seine / 1m x 1m

No. Hauls: 4 Area: m^2 Shocking Sec.: Volts: Amps:

Distance from Shore (est.): m Depth of Capture: .02-.35 m

Collected by: WHBrandenburg & MAFarrington

Time: (start) 1545 h (stop) 1607 h Notes taken by: WHBrandenburg

Orig. Preservative: 10% formalin Photographs: 0037 (Phyluc) 0038

Released fishes: (Yes) No (list separately):

This was an interesting site. a series of small sand bars break up the river channel ~~dad~~ along the left bank. A variety of habitat is created here. The first two hauls were run in a very shallow ~ Avg .05 m flow through channel. Catostomid larvae were only collected in areas were water velocities were very low. The next haul was run in a very shallow backwater are ~14m long. Average depths were .03m. suprisingly lots of sucker larvae were collected here more so towards the terminal portion were average depths were .01m. The last haul was run in a backwater downstream of the flowthrough channel. This area was much deeper (.35m) few catostomid larvae were collected but quite a few Cyprinella lutrensis Pimephales promelas were captured along with Ptychocheilus lucius and a Fundulus zebrinus. This was the first collection of P. lucius all day, very different than reach 4 and 5.

Figure 33. Field sheet used to record seine collection data at a sampling site during the razorback sucker survey in the San Juan River in 2004.

Appendix IV. Detailed sampling and fish identification protocol (continued).

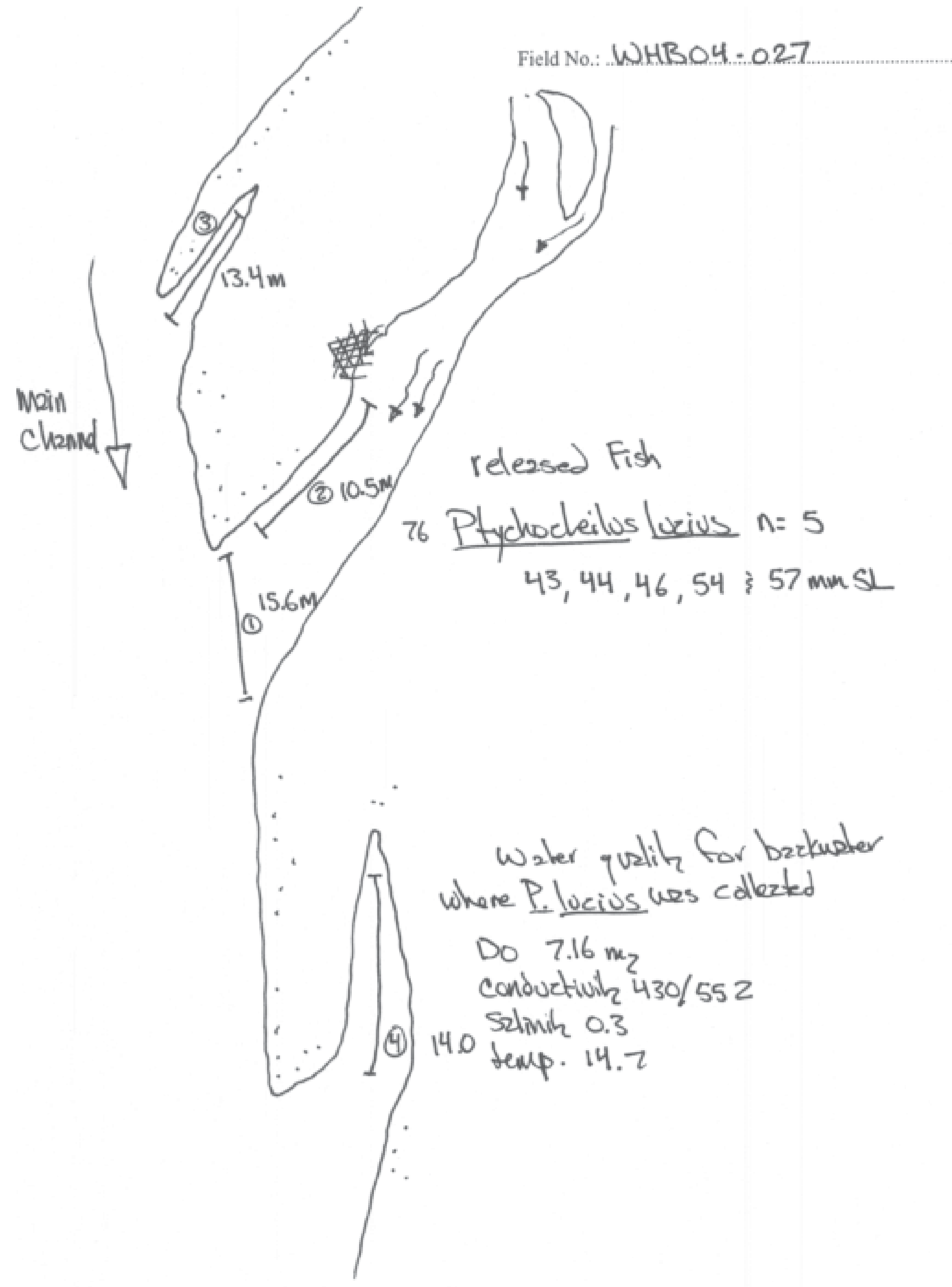

Figure 33. (continued) Field sheet used to record seine collection data at a sampling site during the razorback sucker survey in the San Juan River in 2004.

Appendix V. Water quality data for individual collection localities in the San Juan River, 2004.

Field Number	Date	RM	Dissolved Oxygen (mg/l)	Water Temp (°C)	Salinity (ppt)	Conductivity (ms)
WHB04-001	19-Apr-04	141.1	7.47	12.6	0.2	373.4
WHB04-002	19-Apr-04	140.4	7.42	12.6	0.2	368
WHB04-003	19-Apr-04	139.1	4.28	14.8	1.7	2554
WHB04-004	19-Apr-04	138.1	6.72	17.4	0.5	942
WHB04-005	20-Apr-04	136.3	7.81	9.5	0.2	344.4
WHB04-006	20-Apr-04	134.5	6.92	10.3	0.3	382
WHB04-007	20-Apr-04	132.8	5.17	15.5	0.3	823
WHB04-008	20-Apr-04	131.4	5.91	18.1	0.3	529
WHB04-009	20-Apr-04	127.6	7.64	12.3	0.2	374
WHB04-010	20-Apr-04	125.8	6.24	12.6	0.2	376
WHB04-011	20-Apr-04	122.9	5.37	14.7	0.2	396
WHB04-012	20-Apr-04	121	7.42	13.6	0.3	406
WHB04-013	21-Apr-04	119.4	6.27	10.2	0.2	367
WHB04-014	21-Apr-04	117.3	7.43	11.2	0.2	376
WHB04-015	21-Apr-04	116.1	6.94	12.9	0.1	231
WHB04-016	21-Apr-04	113.7	5.02	17.5	0.3	444
WHB04-017	21-Apr-04	110.4	6.11	19.2	0.2	471
WHB04-018	21-Apr-04	107.7	7.39	13.9	0.2	401
WHB04-019	21-Apr-04	106.8	7.46	13.9	0.2	403
WHB04-020	21-Apr-04	105.6	5.47	16	0.2	410
WHB04-021	22-Apr-04	102.9	7.41	11.4	0.3	392
WHB04-022	22-Apr-04	101.2	2.73	14.2	0.3	400
WHB04-023	22-Apr-04	100.5	6.11	14.4	1.6	2401
WHB04-024	22-Apr-04	99.3	7.5	12.5	0.3	424
WHB04-025	22-Apr-04	97	4.26	14.5	0.3	442
WHB04-026	22-Apr-04	93	6.93	13.1	0.3	424
WHB04-027	22-Apr-04	91.1	7.16	13.2	0.3	430
WHB04-028	22-Apr-04	88.3	6.3	14.1	0.2	353
WHB04-029	23-Apr-04	87.3	7.71	11.3	0.3	416
WHB04-030	23-Apr-04	83.7	7.04	16.9	0.3	560
WHB04-031	23-Apr-04	82	7.26	13.3	0.3	435
WHB04-032	23-Apr-04	77.1	7.46	13.3	0.3	434
WHB04-033	23-Apr-04	75.1	5.91	17.9	0.3	498
WHB04-034	23-Apr-04	73	1.48	16.6	0.3	514
WHB04-035	23-Apr-04	71.2	6.4	15.2	0.3	401
WHB04-036	24-Apr-04	67.7	6.57	16.8	0.3	462
WHB04-037	24-Apr-04	66.2	7.33	11.4	0.3	424
WHB04-038	24-Apr-04	63.1	7.38	11.7	0.3	428
WHB04-039	24-Apr-04	62.2	6.99	14.9	0.3	430
WHB04-040	24-Apr-04	61.2	7.3	12.6	0.3	438
WHB04-041	24-Apr-04	56	6.7	13.8	0.3	450
WHB04-042	24-Apr-04	52.8	6.60	25.7	0.3	684

Appendix V. Water quality data for individual collection localities in the San Juan River, 2004 (continued).

Field Number	Date	RM	Dissolved Oxygen (mg/l)	Water Temp (°C)	Salinity (ppt)	Conductivity (ms)
WHB04-043	24-Apr-04	49.9	6.22	15.6	0.3	474
WHB04-044	25-Apr-04	48.2	7.38	13.2	0.3	457
WHB04-045	25-Apr-04	44.7	6.92	13.8	0.3	462
WHB04-046	25-Apr-04	41.9	7.35	14.5	0.3	464
WHB04-047	25-Apr-04	41.5	3.69	14.9	0.7	1187
WHB04-048	25-Apr-04	38.7	0.38	16.1	0.3	546
WHB04-049	25-Apr-04	35.2	4.74	20.5	0.3	523
WHB04-050	26-Apr-04	29.8	7.19	14.7	0.3	488
WHB04-051	26-Apr-04	28.1	6.43	15.6	0.3	496
WHB04-052	26-Apr-04	26.3	3.74	19.5	0.3	536
WHB04-053	26-Apr-04	25.2	2.62	20.1	0.4	634
WHB04-054	26-Apr-04	23	6.77	16.6	0.3	510
WHB04-055	26-Apr-04	21.4	5.48	18.5	0.3	530
WHB04-056	26-Apr-04	18.2	7	17.9	0.3	524
WHB04-057	26-Apr-04	16.3	6.74	17.9	0.3	524
WHB04-058	27-Apr-04	14	5.75	15.6	0.3	491
WHB04-059	27-Apr-04	12.8	6.99	15.9	0.3	493
WHB04-060	27-Apr-04	9.8	6.71	17.9	0.3	479
WHB04-061	27-Apr-04	8.6	2.74	22.8	0.4	643
WHB04-062	27-Apr-04	8	5.74	19.3	0.3	533
WHB04-063	27-Apr-04	6.4	2.14	26.2	0.3	634
WHB04-064	27-Apr-04	3.6	6	19	0.3	531
WHB04-065	11-May-04	140.8	7.67	15.6	0.1	231
WHB04-066	11-May-04	139.85	7.23	15.5	0.1	230
WHB04-067	12-May-04	133.1	7.85	11.7	0.1	218
WHB04-068	12-May-04	130.9	7.63	12.3	0.1	221
WHB04-069	12-May-04	130.1	7.6	12.7	0.1	220
WHB04-070	12-May-04	126	7.63	14.1	0.1	221
WHB04-071	12-May-04	122.6	5.73	18.5	0.3	548
WHB04-072	12-May-04	121.8	7.5	14.8	0.1	234
WHB04-073	12-May-04	118.4	7.06	15.2	0.1	240
WHB04-074	13-May-04	117.1	7.87	11.7	0.1	230
WHB04-075	13-May-04	116.7	7.53	11.9	0.1	231
WHB04-076	13-May-04	112.9	7.82	12.8	0.1	236
WHB04-077	13-May-04	112.1	6.88	16.1	0.2	263
WHB04-078	13-May-04	106.8	7.53	14.6	0.1	247
WHB04-079	13-May-04	104.3	6.73	19.2	0.2	294
WHB04-080	13-May-04	101.5	6.67	16.5	0.2	261
WHB04-081	13-May-04	100.5	4.69	23.4	1.2	2300
WHB04-082	14-May-04	97.6	7.58	12.8	0.2	255
WHB04-083	14-May-04	97	7.35	14	0.2	261

Appendix V. Water quality data for individual collection localities in the San Juan River, 2004 (continued).

Field Number	Date	RM	Dissolved Oxygen (mg/l)	Water Temp (^{o}C)	Salinity (ppt)	Conductivity (ms)
WHB04-084	14-May-04	95.2	7.13	14.9	0.2	269
WHB04-085	14-May-04	91.1	7.13	16.2	0.2	276
WHB04-086	14-May-04	88.4	7.01	16.6	0.2	280
WHB04-087	14-May-04	86.3	7.34	17.3	0.2	284
WHB04-088	14-May-04	85	7.15	17.3	0.2	285
WHB04-089	14-May-04	83.7	6.85	17.6	0.2	287
WHB04-090	15-May-04	81.8	7.4	14.1	0.2	285
WHB04-091	15-May-04	79.4	6.25	16.5	0.2	323
WHB04-092	15-May-04	77.1	6.65	16.8	0.2	360
WHB04-094	15-May-04	75.1	6.52	18.6	0.2	317.2
WHB04-095	15-May-04	74	6.25	20.9	0.2	338.3
WHB04-096	15-May-04	72.3	6.1	20	0.2	331.2
WHB04-097	15-May-04	71.2	6.37	19.2	0.2	325.3
WHB04-098	15-May-04	68.4	4.49	26.2	0.2	466.5
WHB04-099	16-May-04	67.7	5.32	21.6	0.2	338.5
WHB04-100	16-May-04	65	6.42	16.9	0.2	334.2
WHB04-101	16-May-04	61.75	5.4	20.6	0.2	366.2
WHB04-102	16-May-04	61.2	5.74	20.8	0.2	360.1
WHB04-103	16-May-04	57.9	0.35	26.3	1.9	3795
WHB04-104	16-May-04	54.5	6.35	18.8	0.2	352.2
WHB04-105	16-May-04	48.9	6.23	19.6	0.2	355.2
WHB04-106	16-May-04	48.3	5.72	20.6	0.2	425.5
WHB04-107	17-May-04	45.5	6.46	17.7	0.2	383.6
WHB04-108	17-May-04	43.4	5.56	17.8	0.2	366.3
WHB04-109	17-May-04	41.6	6.03	18.2	0.2	420.2
WHB04-110	17-May-04	38.7	6.91	20	0.2	385.4
WHB04-111	17-May-04	37.7	5.03	19	0.2	413.2
WHB04-112	17-May-04	33.6	6.01	18.8	0.2	391.5
WHB04-113	18-May-04	27.8	6.7	16.7	0.2	382.6
WHB04-114	18-May-04	26.4	6.33	17.8	0.2	393.3
WHB04-115	18-May-04	24.4	6.86	17.7	0.2	389.2
WHB04-116	18-May-04	22.6	6.26	17.7	0.2	391.6
WHB04-117	18-May-04	22	6.26	20.6	0.2	419.8
WHB04-118	18-May-04	21.3	5.09	19.3	0.2	405.6
WHB04-119	18-May-04	17.2	4.69	29.3	0.2	514
WHB04-120	18-May-04	14.8	5.56	24.1	0.2	467
WHB04-121	19-May-04	11.2	6.73	18.5	0.2	403.9
WHB04-122	19-May-04	10	5.44	15.6	0.2	349.1
WHB04-123	19-May-04	5.7	5.88	21.1	0.2	425.8
WHB04-124	19-May-04	4.2	6.1	20.7	0.2	422.3
WHB04-125	08-Jun-04	141.1	7.05	18.8	0.1	243.8
WHB04-126	08-Jun-04	140	5.44	29.1	0.2	355.1

Appendix V. Water quality data for individual collection localities in the San Juan River, 2004 (continued).

Field Number	Date	RM	Dissolved Oxygen (mg/l)	Water Temp (°C)	Salinity (ppt)	Conductivity (ms)
WHB04-127	08-Jun-04	135.2	6.45	20	0.1	239
WHB04-128	08-Jun-04	133.1	5.15	24.3	0.1	270.4
WHB04-129	09-Jun-04	131.4	6.52	20.3	0.1	241.1
WHB04-130	09-Jun-04	130.1	5.68	16.1	0.1	230.1
WHB04-131	09-Jun-04	128.9	5.01	16.4	0.1	257.1
WHB04-132	09-Jun-04	126	4.38	16.9	0.1	252.7
WHB04-133	09-Jun-04	124.8	4.94	24.1	0.2	366
WHB04-134	09-Jun-04	122.5	5.68	19.4	0.2	315.8
WHB04-135	09-Jun-04	118.5	5.15	25	0.1	305.5
WHB04-136	09-Jun-04	116.9	6.09	19.4	0.1	241.6
WHB04-137	10-Jun-04	112.1	6.9	15.9	0.1	222.4
WHB04-138	10-Jun-04	110.3	4.85	18.6	0.1	255.3
WHB04-139	10-Jun-04	106.7	6.97	17.2	0.1	230.1
WHB04-140	10-Jun-04	105.6	5.7	19.3	0.1	261.8
WHB04-141	10-Jun-04	102.4	6.64	24.5	0.1	276.4
WHB04-142	10-Jun-04	101.5	6.82	22.7	0.1	260.9
WHB04-143	10-Jun-04	100.5	4.9	26.3	1.2	232.3
WHB04-144	10-Jun-04	98.6	6.53	20.9	0.1	257.6
WHB04-145	11-Jun-04	95.1	7.05	16.5	0.1	233.2
WHB04-146	11-Jun-04	92.2	5.53	16.5	0.1	241.8
WHB04-147	11-Jun-04	90.8	6.72	21	0.1	265.1
WHB04-148	11-Jun-04	89.1	6.27	21.6	0.1	270.6
WHB04-149	11-Jun-04	85.6	6.19	22.4	0.1	268.9
WHB04-150	11-Jun-04	82.6	6.32	20.1	0.1	254.5
WHB04-151	11-Jun-04	81.6	5.86	23.2	0.1	275.8
WHB04-152	11-Jun-04	79.4	5.96	21.7	0.1	276.2
WHB04-153	12-Jun-04	78.7	6.28	18.4	0.1	271.3
WHB04-154	12-Jun-04	77.1	6.81	17.7	0.1	256.7
WHB04-155	12-Jun-04	76.9	6.04	18.3	0.1	261.9
WHB04-156	12-Jun-04	75.8	5.9	23.2	0.2	423
WHB04-157	12-Jun-04	72.7	5.35	25.3	0.1	308
WHB04-158	12-Jun-04	70.2	6	22	0.1	288
WHB04-159	12-Jun-04	69.9	7.2	24.4	0.2	315
WHB04-160	13-Jun-04	65.3	5.82	17.7	0.2	294
WHB04-161	13-Jun-04	64.3	4.98	18.4	0.2	276
WHB04-162	13-Jun-04	59.6	6.64	18.7	0.2	277
WHB04-163	13-Jun-04	57.1	2.49	19.8	0.2	282
WHB04-164	13-Jun-04	54.5	6.24	20.2	0.2	287
WHB04-165	13-Jun-04	52.8	6.35	24.3	0.2	313
WHB04-166	13-Jun-04	49.5	6	23	0.2	300
WHB04-167	13-Jun-04	46.5	6.28	22.1	0.2	298
WHB04-168	14-Jun-04	43.2	5.85	20.5	0.2	209

Appendix V. Water quality data for individual collection localities in the San Juan River, 2004 (continued).

Field Number	Date	RM	Dissolved Oxygen (mg/l)	Water Temp (°C)	Salinity (ppt)	Conductivity (ms)
WHB04-169	14-Jun-04	41.9	5.62	20.4	0.2	307
WHB04-170	14-Jun-04	38.8	5.9	20.5	0.2	307
WHB04-171	14-Jun-04	36.7	5.76	19.3	0.2	297
WHB04-172	14-Jun-04	32.4	6.18	21.1	0.2	311
WHB04-173	14-Jun-04	27.9	6.31	21.9	0.2	315
WHB04-174	14-Jun-04	26.4	5.69	23.5	0.2	327
WHB04-175	14-Jun-04	22.7	5.5	24.1	0.2	336
WHB04-176	15-Jun-04	22.3	5.96	22.3	0.2	340
WHB04-177	15-Jun-04	21.9	4.14	21.4	0.2	312
WHB04-178	15-Jun-04	17.9	5.84	22.3	0.2	339
WHB04-179	15-Jun-04	13.1	5.95	23	0.2	341
WHB04-180	15-Jun-04	10.8	5.87	24	0.2	346
WHB04-181	15-Jun-04	8.8	4.45	25.1	0.2	354
WHB04-182	15-Jun-04	8	5.42	25.4	0.2	357
WHB04-183	15-Jun-04	4.8	5.64	26.4	0.2	362
MAF04-001	16-Jul-04	141	6.96	32.7	0.3	804
MAF04-002	16-Jul-04	139.8	4.13	31	0.3	606
MAF04-003	16-Jul-04	136.8	5.56	31	0.3	697
MAF04-004	17-Jul-04	135.1	5.14	22.9	0.4	821
MAF04-005	17-Jul-04	134.5	3.47	22.9	0.4	736
MAF04-006	17-Jul-04	133.5	4.93	24.3	0.6	1136
MAF04-007	17-Jul-04	132	4.85	24.7	0.4	831
MAF04-008	17-Jul-04	127.4	3.7	28.2	0.5	1037
MAF04-009	17-Jul-04	124	3.83	30.5	0.5	1160
MAF04-010	17-Jul-04	122.6	4.27	27	0.5	1075
MAF04-011	18-Jul-04	120.7	4.1	26.1	0.5	983
MAF04-012	18-Jul-04	118.8	4.82	23	0.4	728
MAF04-013	18-Jul-04	117.4	5.34	24.4	0.4	751
MAF04-014	18-Jul-04	113.2	4.39	30.1	0.4	799
MAF04-015	18-Jul-04	112.4	5.35	31.1	0.4	872
MAF04-016	18-Jul-04	109.3	0.32	27.4	0.4	844
MAF04-017	18-Jul-04	108.1	4.38	29.7	0.4	791
MAF04-018	18-Jul-04	105.7	3.85	31.5	0.4	849
MAF04-019	19-Jul-04	105.6	4.19	32.5	0.4	858
MAF04-020	19-Jul-04	103.6	1.18	23.3	0.4	827
MAF04-021	19-Jul-04	101.5	5.49	23.6	0.3	650
MAF04-022	19-Jul-04	100.5	5.7	24	0.9	1730
MAF04-023	19-Jul-04	98.4	5.39	26.6	0.4	800
MAF04-024	19-Jul-04	92.9	4.68	30.4	0.4	898
MAF04-025	19-Jul-04	91.2	0.18	27.5	0.4	854
MAF04-026	19-Jul-04	98.4	5.07	30.3	0.4	822
MAF04-027	20-Jul-04	86.4	4.56	20.9	0.4	801

Appendix V. Water quality data for individual collection localities in the San Juan River, 2004 (continued).

Field Number	Date	RM	Dissolved Oxygen (mg/l)	Water Temp (°C)	Salinity (ppt)	Conductivity (ms)
MAF04-028	20-Jul-04	84.2	1.31	24	0.5	904
MAF04-029	20-Jul-04	81.9	0.53	26.1	0.4	903
MAF04-030	20-Jul-04	79.6	4.34	26.8	0.5	982
MAF04-031	20-Jul-04	78	5.47	32.9	0.5	1100
MAF04-032	20-Jul-04	77.3	7.11	33.5	0.4	912
MAF04-033	20-Jul-04	73.3	5.06	29.4	0.4	977
MAF04-034	20-Jul-04	71.5	6.32	31.4	0.4	902
MAF04-035	21-Jul-04	68.9	5.68	23.1	0.4	724
MAF04-036	21-Jul-04	68.4	5.38	24.2	0.4	724
MAF04-037	21-Jul-04	63.4	4.63	26.2	0.4	843
MAF04-038	21-Jul-04	63	0.85	27.7	0.4	833
MAF04-039	21-Jul-04	61.1	4.49	28	0.4	841
MAF04-040	21-Jul-04	59.8	5.72	29.8	0.4	846
MAF04-041	22-Jul-04	56	5.57	24.4	0.3	694
MAF04-042	22-Jul-04	54.5	5.3	24.4	0.4	799
MAF04-043	22-Jul-04	52	5.65	27.2	0.3	731
MAF04-044	22-Jul-04	51.1	5.53	26.6	0.3	749
MAF04-045	22-Jul-04	47.5	5.56	28.9	0.3	748
MAF04-046	22-Jul-04	46.3	5.64	29.7	0.3	767
MAF04-048	22-Jul-04	41.8	4.04	28.4	0.3	743
MAF04-049	23-Jul-04	39.8	4.31	20.8	0.4	730
MAF04-050	23-Jul-04	38.7	3.38	24.2	0.5	918
MAF04-051	23-Jul-04	38.7	3.98	24.2	0.3	692
MAF04-052	23-Jul-04	35.1	6.46	28.1	0.3	749
MAF04-053	23-Jul-04	29.8	5.17	28.1	0.02	718
MAF04-054	23-Jul-04	28.9	5.3	28	0.3	713
MAF04-055	24-Jul-04	26.4	5.42	27	0.3	701
MAF04-056	24-Jul-04	24.4	4.99	22.3	0.4	721
MAF04-057	24-Jul-04	21.7	4.52	23.3	0.4	734
MAF04-058	24-Jul-04	20.9	5.19	25.2	0.4	769
MAF04-059	26-Jul-04	17	-	25	-	-
MAF04-060	26-Jul-04	13.9	-	31	-	-
MAF04-061	26-Jul-04	10.5	-	33	-	-
MAF04-062	26-Jul-04	9.6	-	29	-	-
MAF04-063	26-Jul-04	8.1	-	30	-	-
MAF04-064	11-Aug-04	141.2	5.11	22.3	0.6	1097
MAF04-065	11-Aug-04	141	5.86	30.7	0.2	571
MAF04-066	11-Aug-04	137	6.44	27.6	0.3	662
MAF04-067	11-Aug-04	135.3	5.98	27.2	0.3	660
MAF04-068	12-Aug-04	133.9	2.47	16.6	0.3	542
MAF04-069	12-Aug-04	133.5	4.53	18.7	0.6	1200
MAF04-070	12-Aug-04	130.1	5.39	22.3	0.3	608

Appendix V. Water quality data for individual collection localities in the San Juan River, 2004 (continued).

Field Number	Date	RM	Dissolved Oxygen (mg/l)	Water Temp (°C)	Salinity (ppt)	Conductivity (ms)
MAF04-071	12-Aug-04	128.1	5.56	24.9	0.3	648
MAF04-072	12-Aug-04	125.3	5.33	28.7	0.2	352
MAF04-073	12-Aug-04	122.6	5.21	29.7	0.2	353
MAF04-074	12-Aug-04	120.5	5.26	30.5	0.3	721
MAF04-075	12-Aug-04	117.2	5.81	29.9	0.3	709
MAF04-076	13-Aug-04	116.2	4.18	28.2	0.4	866
MAF04-077	13-Aug-04	113.9	5.14	27.3	0.3	679
MAF04-078	13-Aug-04	113.4	6.1	20	0.3	592
MAF04-079	13-Aug-04	110	4.32	21.3	0.3	658
MAF04-080	13-Aug-04	109	4.76	22.5	0.3	644
MAF04-081	13-Aug-04	106.8	7.03	29.1	0.3	708
MAF04-082	13-Aug-04	103.3	5.98	27.2	0.3	687
MAF04-083	13-Aug-04	101.5	5.49	33.4	0.3	777
MAF04-084	13-Aug-04	100.5	4.65	30.5	0.8	1652
MAF04-085	13-Aug-04	97.7	4.67	31.2	0.3	810
MAF04-086	14-Aug-04	93.6	4.97	28.4	0.4	790
MAF04-087	14-Aug-04	92.6	3.77	27.1	0.4	765
MAF04-088	14-Aug-04	91.7	4.9	21	0.4	671
MAF04-089	14-Aug-04	87.7	5.57	21.9	0.4	691
MAF04-090	14-Aug-04	85.4	5.17	23.9	0.4	711
MAF04-091	14-Aug-04	84.3	6.55	27.4	0.4	786
MAF04-092	14-Aug-04	82.7	5.06	27.2	0.4	760
MAF04-093	14-Aug-04	81.4	5.83	31.4	0.4	844
MAF04-094	14-Aug-04	79.3	5.62	28.9	0.4	805
MAF04-095	14-Aug-04	77.3	5.29	30.4	0.4	802
MAF04-096	15-Aug-04	75.2	5.75	28.1	0.4	806
MAF04-097	15-Aug-04	71.9	4.79	24.9	0.4	737
MAF04-098	15-Aug-04	70.1	5.14	22.7	0.4	705
MAF04-099	15-Aug-04	68.7	5.66	23.2	0.4	710
MAF04-100	15-Aug-04	66.1	5.81	24.5	0.4	728
MAF04-101	15-Aug-04	65.1	4.86	24.9	0.4	733
MAF04-102	15-Aug-04	63.5	5.55	26.4	0.4	753
MAF04-103	15-Aug-04	59.5	5.95	26.2	0.4	754
MAF04-104	16-Aug-04	56.6	4.13	23.7	0.2	545
MAF04-105	23-Aug-04	50.8	4.26	27	0.4	921
MAF04-106	23-Aug-04	48.2	4.8	23.6	0.4	705
MAF04-107	24-Aug-04	46.3	5.15	23.4	0.4	704
MAF04-108	24-Aug-04	45	4.19	18.4	0.4	857
MAF04-109	24-Aug-04	41.8	6.47	20.2	0.4	657
MAF04-110	24-Aug-04	40.3	5.57	21.2	0.5	986
MAF04-111	24-Aug-04	38.7	5.61	22	0.4	685
MAF04-112	24-Aug-04	35.1	7.1	24.3	0.4	718

Appendix V. Water quality data for individual collection localities in the San Juan River, 2004 (continued).

Field Number	Date	RM	Dissolved Oxygen (mg/l)	Water Temp (^oC)	Salinity (ppt)	Conductivity (ms)
MAF04-113	25-Aug-04	31.2		22.6	0.4	686
MAF04-114	25-Aug-04	27.1	6.43	19.2	0.4	639
MAF04-115	25-Aug-04	26.5	5.37	18	0.4	631
MAF04-116	25-Aug-04	24.6	4.63	19.9	0.4	696
MAF04-117	25-Aug-04	22.4	5.89	20.7	0.4	661
MAF04-118	25-Aug-04	17.9	6.65	22.3	0.4	685
MAF04-119	25-Aug-04	13.9	6.5	24.4	0.4	727
MAF04-120	25-Aug-04	13.1	4.13	24.6	0.4	724
MAF04-121	26-Aug-04	11.4	4.61	20.2	0.4	698
MAF04-122	26-Aug-04	10	6.33	20.1	0.3	645
MAF04-123	26-Aug-04	10	5.12	20.4	0.3	637
MAF04-124	26-Aug-04	8	-	24	-	-
MAF04-125	26-Aug-04	4.5	-	28	-	-
MAF04-126	07-Sep-04	141	9.2	23.4	0.4	632
MAF04-127	07-Sep-04	138	7.2	29.2	0.1	615
MAF04-128	08-Sep-04	134.2	5.1	25.7	0.3	641
MAF04-129	08-Sep-04	130.6	5.92	17.3	0.3	516
MAF04-130	08-Sep-04	128.8	6.4	17.8	0.3	263
MAF04-131	08-Sep-04	126.9	6.6	19.5	0.1	270
MAF04-132	08-Sep-04	125.1	6.2	21.1	0.2	279
MAF04-133	08-Sep-04	122.6	5.2	22	0.4	963
MAF04-134	08-Sep-04	120.4	7	26.2	0.1	314
MAF04-135	08-Sep-04	117.4	5.4	27.1	0.2	167
MAF04-136	09-Sep-04	113	5.6	15.9	0.1	149
MAF04-137	09-Sep-04	109	6.2	19.5	0.2	310
MAF04-138	09-Sep-04	106.8	6.19	21.3	0.3	603
MAF04-139	09-Sep-04	103.6	5.62	24.6	0.1	168
MAF04-140	09-Sep-04	100.5	5.4	24.4	0.1	701
MAF04-141	09-Sep-04	98.5	5.6	23.6	0.1	437
MAF04-142	09-Sep-04	96.9	4.2	18.4	0.1	366
MAF04-143	10-Sep-04	93.6	6.8	24.2	0.1	353
MAF04-144	10-Sep-04	92.2	5.9	21.4	0.2	347
MAF04-145	10-Sep-04	89.4	5.6	25.1	0.4	377
MAF04-146	10-Sep-04	86	5.2	24.1	0.2	450
MAF04-147	10-Sep-04	83.7	5.66	25.4	0.2	383
MAF04-148	11-Sep-04	80.1	5.8	20.1	0.2	339
MAF04-149	11-Sep-04	78	6.88	21.2	0.2	371
MAF04-150	11-Sep-04	74.4	5.25	27.2	0.4	794
MAF04-151	11-Sep-04	72.1	5.5	25.5	0.4	758
MAF04-152	11-Sep-04	70	4.98	26.6	0.4	782
MAF04-153	12-Sep-04	63	5.26	21.5	0.4	729
MAF04-154	12-Sep-04	61.1	5.36	22.8	0.4	733

Appendix V. Water quality data for individual collection localities in the San Juan River, 2004 (continued).

Field Number	Date	RM	Dissolved Oxygen (mg/l)	Water Temp (^{o}C)	Salinity (ppt)	Conductivity (ms)
MAF04-155	12-Sep-04	57.8	6.16	24.4	0.4	759
MAF04-156	12-Sep-04	55.4	5.36	28.9	0.4	808
MAF04-157	12-Sep-04	50.7	5.87	26.4	0.4	780
MAF04-158	12-Sep-04	47.5	5.77	24.9	0.4	754
MAF04-159	13-Sep-04	44.8	4.52	22.7	0.4	731
MAF04-160	13-Sep-04	42.8	4.7	18.5	0.4	671
MAF04-161	13-Sep-04	38.7	6.66	17.8	0.6	1002
MAF04-162	13-Sep-04	35.1	5.69	23.7	0.4	748
MAF04-163	13-Sep-04	33.4	5.19	22.8	0.4	748
MAF04-164	13-Sep-04	28.7	5.7	22.9	0.4	740
MAF04-165	13-Sep-04	26.3	5.68	22.8	0.4	763
MAF04-166	13-Sep-04	21.4	5.52	22.9	0.4	736
MAF04-167	14-Sep-04	19.8	5.38	19.7	0.4	714
MAF04-168	14-Sep-04	17.3	5.76	21	0.4	733
MAF04-169	14-Sep-04	14.6	4.96	21.5	0.4	738
MAF04-170	14-Sep-04	11.2	6.14	22.1	0.4	747
MAF04-171	14-Sep-04	8.8	5.44	22.5	0.4	751
MAF04-172	14-Sep-04	6.1	5.87	24.6	0.4	783