LONG TERM MONITORING OF SUB-ADULT AND ADULT LARGE-BODIED FISHES IN THE SAN JUAN RIVER: 2003

Interim Progress Report

(**Final**)

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EXECUTIVE SUMMARY

Long term monitoring of the sub-adult and adult large-bodied fish community (called “adult monitoring” for short) in the San Juan River began in 1999. This monitoring study annually samples RM 180.0-2.9 between mid-September and Mid-October via raft-borne electrofishing. Calendar year 2003 was the fifth year that data was collected under the long-term monitoring program. The long-term monitoring program was based on the main channel adult fish community monitoring study which preceded it (i.e., 1991-1997). The sampling protocols for long-term monitoring were designed to allow for data comparisons between these two studies.

In 2003, adult monitoring took place between 22 September and 14 October. Total effort of was 94.42 hours of electrofishing and sampled covered RM 180.0 to RM 0.0. A total of 7,876 individual fish were collected during fall 2003 adult monitoring. The mean daily flow (measured at the Shiprock USGS gage) during sampling was 450 CFS, the lowest mean flow at which riverwide long-term monitoring has taken place. A late summer rainstorm , which peaked above 20,000 CFS (at the Bluff gage) on 10 September 2002, shortly before the fall 2003 adult monitoring trip occurred, may have had a major impact on the San Juan River fish community.

Thirty-two Colorado pikeminnow were collected during fall 2003 adult monitoring. All of these were fish that had been stocked as juvenile fish in October 2002, at either RM 180.2 or RM 158.6. No wild Colorado pikeminnow were collected in 2003. Following the stocking of 210,418 age-0 Colorado pikeminnow in October 2002, Colorado pikeminnow on the fall 2003 adult monitoring trip CPUE rose to virtually the same level as was observed on the fall 1997 adult monitoring trip (i.e., after UDWR had stocked approximately 100,000 age-0 Colorado pikeminnow in fall 1996).

Nineteen razorback sucker were collected during fall 2003 adult monitoring. All 19 were stocked fish. Collections ranged from RM 158.0-7.0. One of these collections was a 249 mm TL fish that is assumed to be a wild-produced offspring of stocked razorback sucker. Riverwide, razorback sucker CPUE fell slightly between 2002 (0.25 fish/hr of electrofishing) and 2003 (0.20 fish/hr of electrofishing). Recapture rates for stocked razorback sucker continue to be much higher than those for Colorado pikeminnow, especially when considering the difference in total numbers of fish stocked (i.e., only 7,863 razorback sucker have been stocked since 1994).

No roundtail chub were collected during fall 2003 adult monitoring. Roundtail chub continue to be extremely rare in adult monitoring collections. The few roundtail chub that are collected in the San Juan River are likely transient members of the fish community that enter the river from one of its upstream tributaries that have resident roundtail chub populations.

Flannelmouth sucker continues to be the species that is most commonly-collected during fall adult monitoring trips. During fall 2003 adult monitoring, flannelmouth sucker accounted for 48.4% (n = 3,814 individuals) of all fish collected in 2003. For the third year in a row, flannelmouth sucker total CPUE declined riverwide. This phenomenon was also seen in two other common large-bodied fish species (channel catfish and common carp) in 2003. Proportionally, numbers of flannelmouth sucker compared to other common large-bodied fish species in the San Juan River in 2003 remained essentially the same. So, whatever is causing these declines, seems to be effecting the large-bodied fish community as a whole. The decreasing trend in flannelmouth sucker total CPUE observed over the last two years may be partially due to the storm-induced, late summer, high-flow events which occurred immediately prior to the adult monitoring trips in both 2002 and 2003. Likewise, large numbers of flannelmouth sucker utilizing the newly-constructed PNM Fish Ladder in 2003

may have effected total CPUE for this species in Reach 6 in 2003. A fairly strong cohort of age-1 flannelmouth sucker (spawned in 2002) were collected in 2003. The strong cohort of flannelmouth sucker that were spawned in 2000 are now large sub-adult fish (i.e., 376-400 mm TL) and should recruit into the adult population beginning in 2004.

Bluehead sucker were the second most-commonly collected species during fall 2003 adult monitoring. Bluehead sucker accounted for 22.1% (n = 1,738 individuals) of all fish collected in 2003. The bluehead sucker population within our study area is largely centered in Reach 6 and the large-scale fluctuations in juvenile, adult, and total CPUE observed in Reach 6 since 1996 are (at least in part) likely an artifact of the Reach 6 population being heavily influenced (i.e., via immigration and emigration) by upstream river reaches (i.e., Reach 7 and the Animas River). Total CPUE for bluehead sucker riverwide decreased between 2002 and 2003 due to a decrease in juvenile CPUE. For the first time ever during the adult monitoring studies (i.e., since 1991), two bluehead sucker were collected in Reach 1, adjacent to Lake Powell. The same factors that are thought to have effected flannelmouth sucker CPUE between 2002 and 2003 are likely reasons for the decline in bluehead sucker total CPUE riverwide between 2002 and 2003. Like flannelmouth sucker, a fairly strong cohort of age-1 bluehead sucker (spawned in 2002) were collected in 2003. The strong cohort of bluehead sucker that were spawned in 2000 have recruited into adulthood (i.e., 301-325 mm TL) and compose the major part of the adult bluehead sucker population in the San Juan River.

Channel catfish were the third most-commonly collected species during fall 2003 adult monitoring. Channel catfish accounted for 16.0% (n = 1,262 individuals) of all fish collected in 2003. Channel catfish total CPUE riverwide dropped again in 2003 to the lowest level ever observed. This is likely due to a combination of factors, including the effects of expanded nonnative fish removal efforts in 2002 and 2003 (in Reaches 5, 2, and 1) and the late summer storm spikes in September 2002 and 2003. Like the two common native suckers, a large cohort of age-1 channel catfish (spawned in 2002) were collected during 2003 adult monitoring.

Common carp were the fourth most commonly-collected species during fall 2003 adult monitoring. Common carp accounted for 6.8% (n = 535 individuals) of all fish collected in 2003. Common carp total CPUE riverwide declined for the fourth straight year, to the lowest level ever observed. As with channel catfish, the causes for this decline is likely due to a combination of factors, including expanded nonnative fish removal efforts in 2002 and 2003 as well as the September 2002 and 2003 storm spikes.

Only two largemouth bass were collected during 2003 adult monitoring collections. No striped bass or walleye were collected during fall 2003 adult monitoring.

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INTRODUCTION

Research performed between 1991 and 1997 led to the initiation of several major management actions by the San Juan River Recovery Implementation Program (SJRIP) that are intended to have long-term positive impacts on the native fish community. These included the development of flow recommendations for the reoperation of Navajo Reservoir, the initiation of a mechanical removal program for nonnative fishes, modification or removal of several instream water diversion structures to provide fish passage and minimize entrainment, and augmentation efforts for both federally-listed endangered fish species (i.e. Colorado pikeminnow and razorback sucker). To assess the effects of these management actions over the duration of the SJRIP, a long-term monitoring program (Propst et al. 2000) was initiated. Standardized data collection following long-term monitoring protocols began in 1999 and will continue at least until the termination of the SJRIP.

One component of the long-term monitoring program, the "sub-adult and adult large-bodied fish monitoring," is the primary responsibility of the U.S. Fish and Wildlife Service's (USFWS) Colorado River Fishery Project (CRFP) office in Grand Junction, CO. However, numerous other state and federal agencies supply manpower, equipment, and logistical support for these monitoring efforts.

The objectives of the sub-adult and adult large-bodied fish community monitoring study (referred to hereafter as "adult monitoring") are as follows:

1) Monitor the San Juan River's main channel fish community, specifically the large-bodied fish species, to identify shifts in fish community structure, species abundance and distribution, and length/weight frequencies that are occurring corresponding to management actions that are being implemented by the San Juan River Recovery Implementation Program. These include:
    a) reoperation of Navajo Reservoir
    b) mechanical removal of nonnative fishes
    c) modification or removal of instream water diversion structures to provide fish passage and minimize entrainment
    d) augmentation efforts for both federally-listed endangered fish species (i.e., Colorado pikeminnow and razorback sucker)

2) Monitor population trends (e.g., distribution and abundance, habitat use, staging and spawning areas, growth rates, recruitment) of the rare San Juan River fish species -- Colorado pikeminnow, razorback sucker, and roundtail chub.

The study area for adult monitoring begins just downstream of the Animas River confluence (river mile {RM} 180.0) and continues downstream to Clay Hills boat landing (RM 2.9) just upstream of Lake Powell. This study area encompasses six of the eight major geomorphic reaches identified (by Bliesner and Lamarra 2000) in the San Juan River between Navajo Reservoir and Lake Powell. The six geomorphic reaches in our study area are: Reach 6 (RM 180.0-155.0); Reach 5 (RM 155.0-131.0); Reach 4 (RM 131.0-106.0); Reach 3 (RM 106.0-68.0); Reach 2 (RM 68.0-17.0); and Reach 1 (RM 17.0-0.0). Although our study area actually ends 2.9 RM short of the end of Reach 1, it is assumed herein that the data collected from RM 17.0-2.9 are representative of the entirety of Reach 1.

METHODS

Sampling conducted in 2003 followed the protocols for long-term monitoring set forth in Propst et al. (2000). The entire study area was sampled between mid-September and the end of October. Electrofishing was performed in a continuous downstream direction from put-in to take-out. One electrofishing raft sampled each shoreline. Electrofishing crews consisted of one rower and one netter. Rafts shocked perpendicular to the shoreline at a fairly constant rate of speed, with an effort being made to net all fishes stunned by the electrofishing equipment. Electrofishing was done in one-RM increments, with two of every three RM being sampled. At the end of each sampled RM, all fish were identified and enumerated by species and life stage. At the end of every fourth sampled RM (known as a designated mile, or "DM" for short), all fish were weighed ($\pm$ 5 grams {g}) and measured ($\pm$ 1 mm total length {TL} and standard length {SL}). All nonnative fishes were then removed from the river. All common native fishes were returned alive to the river. Rare native fishes (Colorado pikeminnow, razorback sucker, and roundtail chub) were weighed, measured, had distinguishing characteristics noted (e.g., sex, external parasites), and were scanned for PIT tags. If no PIT tag was found, one was implanted before the fish was returned to the river. Sampling effort was recorded as elapsed time (in seconds) fished by each raft in each sampled RM.

The descriptions of the analyses that follow apply only to the four most common large-bodied fish species collected during adult monitoring trips. These species are flannelmouth sucker (Catostomus latipinnis), bluehead sucker (Catostomus discobolus), channel catfish (Ictalurus punctatus), and common carp (Cyprinus carpio). These are the only four fish species present in the San Juan River in large enough numbers to yield sufficient sample sizes (via electrofishing) from which statistically valid conclusions can be drawn on an annual basis.

Electrofishing data were pooled for all rafts to obtain total catch numbers for each sampling trip. Numbers of fish (juvenile and adult life stages) collected by all rafts were combined to obtain total catch for each species. Numbers of fish collected for each species were then divided by the number of seconds (converted to hours) fished by all rafts combined to obtain "riverwide" (i.e., Reaches 6-1 {RM 180.0-0.0} combined) catch per unit effort (CPUE) values for juvenile and adult life stages and for all life stages combined (i.e., juvenile + adult; referred to hereafter as "total" CPUE). CPUE values for each of the four most common species collected was then partitioned by whole geomorphic reach and compared to 1991-1998 electrofishing data to evaluate long-term trends.

Length data obtained from fish measured at DM's were used to examine changes in mean TL for all life stages of a species in a reach, combined. As with CPUE data, mean TL data were compared to 1991-1998 data to evaluate long-term trends. TL data were also used to develop riverwide length frequency histograms for the for most common species from 1996-2003.

A few notes of explanation about 1991-1998 data sets are warranted here. Adult monitoring studies performed from 1991-1998 followed protocols (detailed in Ryden 2000a) very similar to those in Propst et al. (2000). The only two differences between these two sets of sampling protocols were: 1) from 1991-1998, electrofishing was done every RM (instead of two out of every three RM); and 2) DM's were done every fifth sampled RM (instead of every fourth sampled RM). However, from 1991-1998 adult monitoring studies did not always sample the entirety of the study area (Reaches 6-1) contiguously in a given year. It was only from 1996 on that the entirety of the study area was sampled during

similar time-frames (i.e., late-summer through late-October) and flow conditions to allow for valid riverwide comparisons of data sets between years. Data collected prior to 1996 were only included in comparative analyses for this report if data were available from an entire geomorphic reach. Therefore, appropriate comparative data sets were available for Reach 6 from 1996-1998, for Reaches 5-3 from 1991-1998, and for Reaches 2-1 from 1993 and 1995-1998.

Additionally, it was not until 1994 that fish species collected in non-DM samples were characterized by life stage (i.e., juvenile or adult). Before 1994, fishes collected in non-DM samples were enumerated only by the total numbers collected per species. Therefore, juvenile and adult CPUE comparisons can only be made from 1994 on, while CPUE comparisons for all life stages combined (i.e., total CPUE) can be made for all years in which data are available for a given geomorphic reach, since total CPUE is based on data from all fish of a given species, regardless of age, collected in an electrofishing sample. Therefore, in this report, no juvenile or adult CPUE data are presented for Reaches 5-3 from 1991-1993 or for Reaches 2 or 1 in 1993, but total CPUE data are presented for these reaches in these years.

RESULTS

Mean river flows (as determined from the Shiprock USGS gage #09368000) during the 2003 adult monitoring trip were lower than in any previous year during which riverwide sampling was conducted, although it was very close to the flow level during 2002 sampling (Table 1). River flows during the 2003 adult monitoring trip (450 CFS) were only 20.7% of those encountered during the 1999 adult monitoring trip (2,177 CFS; Table 1). The low mean river flows during the 2003 adult monitoring trip were an artifact of a very poor snowpack level during the previous winter, which resulted in a low overall river discharge throughout 2003.

Sixteen different fish species and hybrid forms were collected from the San Juan River during the 2003 adult monitoring trip (Table 2). This included six native species and two native sucker X native sucker hybrids, as well as seven nonnative species and one native X nonnative sucker hybrid (Tables 2 and 3). Flannelmouth sucker was the most commonly-collected species (n = 3,814 individuals), followed in descending order by bluehead sucker (n = 1,738), channel catfish (n = 1,262), and common carp (n = 535; Table 3). These four species accounted for 93.3% (7,349 individuals) of the total catch during the 2003 adult monitoring trip. The other nine species (and three hybrids) contributed only 527 individuals, or 6.7%, to the total catch in 2003 (Table 3).

Native fishes accounted for 5,974 specimens or 75.85% of the total catch in 2003 (n = 221 individual electrofishing collections riverwide). Nonnative fishes accounted for 1,902 specimens or 24.15% of the total catch in 2003 (n = 221 individual electrofishing collections riverwide). The overall native to nonnative fish ratio riverwide was 3.14:1 in 2003 (Figure 1). This is the highest riverwide native:nonnative fish ratio observed in the last seven years (Figure 1), although it was essentially the same as that observed during 2002 adult monitoring (i.e., 3.13:1; Ryden 2003a).

Endangered fishes continue to be rare during adult monitoring collections. In 2003, only 32 Colorado pikeminnow and 19 razorback sucker were collected during adult monitoring (Table 3). No roundtail chub were collected during 2003 adult monitoring.

Table 1. Summary of dates, river miles (RM) sampled, and mean flow during riverwide adult/juvenile large-bodied fish community monitoring (i.e., “adult monitoring”) trips in the San Juan River, New Mexico, Colorado, and Utah, 1996-2003.

Beginning Date Of Sampling	Ending Date Of Sampling	River Miles Sampled	Mean Trip Flow At The Shiprock, New Mexico USGS Gage (#09368000) in CFS and (cubic meters/second)
17 June 1996	25 October 1996	RM 180.0-2.9	1,531 CFS (43.3 m^3/sec)
11 August 1997	9 October 1997	RM 180.0-2.9	1,753 CFS (49.6 m^3/sec)
10 August 1998	7 October 1998	RM 180.0-2.9	767 CFS (21.7 m^3/sec)
20 September 1999	7 October 1999	RM 180.0-2.9	2,177 CFS (61.6 m^3/sec)
18 September 2000	10 October 2000	RM 180.0-2.9	657 CFS (18.6 m^3/sec)
25 September 2001	19 October 2001	RM 180.0-2.9	611 CFS (17.3 m^3/sec)
20 September 2002	7 October 2002	RM 180.0-2.9	458 CFS (12.9 m^3/sec)
22 September 2003	14 October 2003	RM 180.0-2.9	450 CFS (12.7 m^3/sec)

Table 2. Scientific and common names, status, and database codes for fish species collected from the San Juan River during the 2003 adult monitoring trip (following Robins et al. 1991 and Nelson et al. 1998[a]).

SCIENTIFIC NAME	COMMON NAME	STATUS	CODE
Class Actinopterygii			
Order Cypriniformes			
Family Catostomidae-suckers			
Catostomus discobolus	bluehead sucker	native	Catdis
C.commersoni X C.latipinnis	hybrid	introduced	comXlat
Catostomus latipinnis	flannelmouth sucker	native	Catlat
C.latipinnis X C.discobolus	hybrid	native	latXdis
Xyrauchen texanus	razorback sucker	native	Xyrtex
X.texanus X C.latipinnis	hybrid	native	texXlat
Family Cyprinidae-carps and minnows			
Cyprinella lutrensis	red shiner	introduced	Cyplut
Cyprinus carpio	common carp	introduced	Cypcar
Pimephales promelas	fathead minnow	introduced	Pimpro
Ptychocheilus lucius	Colorado pikeminnow	native	Ptyluc[a]
Rhinichthys osculus	speckled dace	native	Rhiosc
Order Perciformes			
Family Centrarchidae-sunfishes			
Micropterus salmoides	largemouth bass	introduced	Micsal
Order Salmoniformes			
Family Salmonidae-trouts			
Salmo trutta	brown trout	introduced	Saltru
Order Scorpaeniformes			
Family Cottidae-sculpins			
Cottus bairdi	mottled sculpin	native	Cotbai
Order Siluriformes			
Family Ictaluridae-bullhead catfishes			
Ameiurus melas	black bullhead	introduced	Amemel
Ictalurus punctatus	channel catfish	introduced	Ictpun

Table 3. Total number of fish collected during the 2003 adult monitoring trip.

Species (Status)[a]	Total number of specimens	Percent of total[b]	Rank	Frequency of occurrence
flannelmouth sucker(N)	3,814	48.4	1	214
bluehead sucker(N)	1,738	22.1	2	193
channel catfish(I)	1,262	16.0	3	180
common carp(I)	535	6.8	4	150
speckled dace(N)	332	4.2	5	93
red shiner(I)	84	1.1	6	39
bluehead sucker X flannelmouth sucker(H,N)	36	0.5	7	27
Colorado pikeminnow(N)	32	0.4	8	25
razorback sucker(N)	19	0.2	9	16
black bullhead(I)	8	0.1	10	7
white sucker X flannelmouth sucker(H,I)	5	---	11	5
fathead minnow(I)	4	---	12	3
brown trout(I)	2	---	13	2
largemouth bass(I)	2	---	13	2
razorback sucker X flannelmouth sucker(H,N)	2	---	13	2
mottled sculpin(N)	1	---	14	1
GRAND TOTAL	7,876		2003 collections = 221	

2003 Native Fishes 5,974 (75.85% of total catch)
2003 Introduced Fishes 1,902 (24.15% of total catch)
2003 Native:Introduced Fishes Ratio = 3.14:1

a: (N) = Native species; (I) = Introduced species; (H,N) = A hybrid of two species, considered to be a native fish; (H,I) = A hybrid of two species, considered to be an introduced fish

b: ---- = less than 0.1%

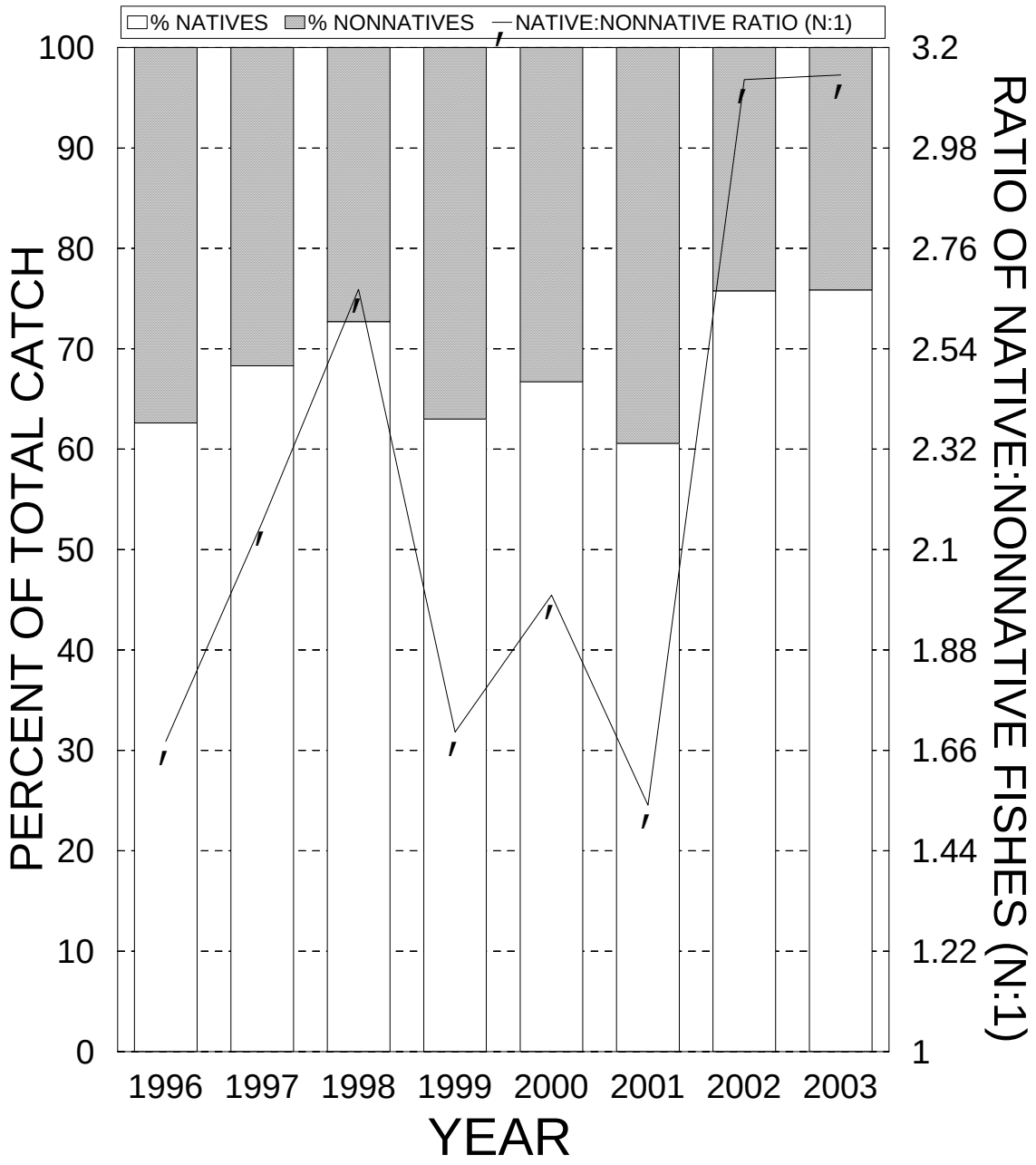

Figure 1. The bars represent the percent of the total catch accounted for by native fishes (white bars) versus nonnative fishes (shaded bars), riverwide (RM 180.0-0.0), on adult monitoring trips, 1996-2003. The line represents the ratio of native to nonnative fishes (N:1) collected on the same trips.

Colorado Pikeminnow

Fish Stocked As Part Of An Augmentation Effort

A total of 176,933 age-0 and age-1 Colorado pikeminnow were stocked into the San Juan River on 6 November 2003 (Table 4). These fish were stocked in three distinct groupings.

The first group, consisting of approximately 155,764 age-0 Colorado pikeminnow were stocked by crews from USFWS-CRFP (Table 4). These fish were further subdivided into two smaller, roughly equal groups. Each of these two sub-groups were transported downstream by raft in aerated live wells and stocked into numerous backwaters and other low-velocity habitats. The first sub-group was stocked between RM 180.2 and 170.5 (i.e., immediately downstream of Farmington, NM) while the second sub-group was stocked between RM 158.6 and 148.5 (i.e. between Hogback Diversion and Shiprock, NM). These age-0 fish came from Dexter NFH in Dexter, NM. All of these fish, were 2003 year-class progeny of the "1991 broodstock" being held at Dexter NFH. None of these fish were PIT-tagged or otherwise individually-marked before release.

The second group, consisting of approximately 20,164 age-0 Colorado pikeminnow were stocked by crews from BIO/WEST, Inc. at various backwaters between RM 188.35 and RM 159.0 (Table 4). The habitats these 20,000 age-0 fish were stocked into were blocked off by holding nets prior to introducing fish into them. This was done as part of an acclimation study aimed at improving retention of stocked age-0 pikeminnow in upstream sections of the San Juan River. The premise of the study was that if age-0 Colorado pikeminnow were allowed to acclimate for a period in the river after stocking, then once allowed free access to the river, they would be less likely to exhibit the long downstream displacements typically observed among newly-stocked age-0 Colorado pikeminnow. These age-0 fish came from Dexter NFH in Dexter, NM. All of these fish, were 2003 year-class progeny of the "1991 broodstock" being held at Dexter NFH. None of these fish were PIT-tagged before release. However, all of them were marked with calcein dye prior to stocking.

The third group, consisting of 1,005 age-1 fish, were stocked en masse at RM 180.2 (Table 4). These age-1 fish were excess to the UCRB-RIP's Colorado pikeminnow augmentation efforts and were made available to the SJRIP through the J.W. Mumma Native Species Hatchery in Alamosa, CO. These fish, though reared at Mumma, were 2002 year-class progeny of the "1991 broodstock" being held at Dexter NFH. All of these age-1 fish were individually PIT-tagged before release into the river.

Table 4. Stockings of Colorado pikeminnow in the San Juan River, 1996-2003.

Date	Number Stocked	River Mile Stocked At	Mean Total Length (mm)	Range Of Total Lengths (mm)	Responsible Agency[a]
11/04/1996	~50,000	148.0	55	25-85	UDWR
11/04/1996	~50,000	52.0	55	25-85	UDWR
08/15/1997	62,578	148.0	45	35-55	UDWR
08/15/1997	54,300	52.0	45	35-55	UDWR
09/23/1997	49	180.2	644	550-753	USFWS
07/02/1998	10,571	148.0	24	18-28	UDWR
07/07/1999	~500,000	158.6	"Larvae"	Not Specified	UDWR
06/11/2000	~105,000	141.9	"Larvae"	Not Specified	UDWR
04/11/2001	148	180.2	540	442-641	USFWS
10/24/2002	~105,209	180.2	51	32-127	USFWS
10/24/2002	~105,209	158.6	51	32-127	USFWS
11/06/2003	175,928	188.35 to 148.5	58	38-100	USFWS & BIO/WEST
11/06/2003	1,005	180.2	180	125-280	CDOW

[a] UDWR = Utah Division of Wildlife Resources - Moab Field Station, Moab, Utah; USFWS = U.S. Fish and Wildlife Service - Colorado River Fishery Project, Grand Junction, Colorado; BIO/WEST = BIO/WEST, Inc., Logan, Utah; CDOW = Colorado Division of Wildlife, J.W. Mumma Native Species Hatchery, Alamosa, Colorado

2003 Collections

There were a total of 628 recapture events (that I know of) with Colorado pikeminnow during all field studies in calendar year 2003 (Table 5). These 628 collections were made via raft-mounted electrofishing, seining, and in the PNM Fish Ladder. These 628 recaptures all occurred with Colorado pikeminnow that had been stocked into the San Juan River since 1996. No wild Colorado pikeminnow were collected in 2003.

Table 5. A summary of all known Colorado pikeminnow collections, by study, in the San Juan River during calendar year 2003. This table includes multiple recapture events.

Study[a] and (Responsible Agency)	Total Number Of Colorado Pikeminnow Collections In 2003	Number Of Adult Pikeminnow Collections	Number of Juvenile/YOY Pikeminnow Collections
Spring Larval Razorback Sucker Monitoring (UNM)	76	0	76
Adult Monitoring (USFWS-CRFP)	32	0	32
Nonnative Fish Removal (UDWR-Moab)	62	3	59
Nonnative Removal (USFWS-NMFRO)	40	4	36
PNM Fish Ladder (Navajo Nation)	10	9	1
Monitoring Of Stocked Colorado Pikeminnow (BIO/WEST)	408	0	408

a: UNM = University of New Mexico, Museum of Southwestern Biology, Division of Fishes, Albuquerque, NM
USFWS-CRFP = U.S. Fish and Wildlife Service, Colorado River Fishery Project, Grand Junction, CO
UDWR-Moab = Utah Division of Wildlife Resources, Moab Utah
USFWS-NMFRO = U.S. Fish and Wildlife Service, New Mexico Fishery Resources Office, Albuquerque, NM
Navajo Nation = Navajo Department of Game and Fish, Window Rock, AZ
BIO/WEST = BIO/WEST Inc., Logan, UT

Of these 628 recapture events, only 32 (5.1%) occurred during the fall 2003 adult monitoring trip (Tables 5 and 6). These 32 recaptures ranged from RM 155.0-19.0, with the majority (n = 20 or 62.5%) occurring downstream of RM 68.0 in the canyon-bound reaches of the river (Table 6).

Thirteen (2.1%) of the 628 recapture events with Colorado pikeminnow were with fish that had been stocked as adults in April 2001 (Tables 4 and 5). Since their stocking, numerous of these fish have demonstrated an affinity to the river section between the PNM Weir (RM 166.6) and Hogback Diversion (RM 158.6). In 2003, a total of eight different individual pikeminnow stocked as adults in April 2001 were collected, with four of these fish being collected two or more times during 2003 (Table A-1 in Appendix A). Seven of these eight adult pikeminnow used the newly constructed PNM Fish Ladder during an 16-day period between 18 June and 3 July (Table A-1 in Appendix A). Two of these adults were captured in the fish ladder a second time and another was later collected downstream during a nonnative fish removal trip, indicating that a fairly high rate of "fall back" of fish over the PNM Weir may be occurring after native fish are released via the upstream outlet pipe (Table A-1 in Appendix A).

By far, the large majority of recapture events with Colorado pikeminnow in calendar year 2003 (n = 615 or 97.9%) were with fish that had been stocked as juveniles either on 24 October 2002 (n = 310 recapture events) or on 6 November 2003 (n = 302 recapture events; Tables A-1 - A-3 in Appendix A). However, the UDWR did recapture three adult Colorado pikeminnow in 2003 that I am assuming are recruits (i.e., age-7 fish) from the stocking of age-0 fish that took place back on 4 November 1996 (Table 4). The size of these three fish (530, 535, and 590 mm TL) and the lack of a PIT tag at the time of recapture seem to support this assumption (Table A-1 In Appendix A).

The 2003 recapture of one Colorado pikeminnow, stocked as juvenile on 24 October 2002, was of particular interest. This fish was found "stuck in the grates of the fish ladder" at the PNM Fish Ladder on 29 September 2003 (Table A-1 in Appendix A; Lapahie 2003a, A. Lapahie pers. comm.). This age-1 fish (143 mm SL) had a black bullhead (34 mm SL) lodged in its throat (UNM unpublished data). That is a predator to prey size ratio of 4.21:1. Both fish were dead at the time of collection (A. Lapahie pers. comm.). The gape dimensions (11.3 mm; UNM unpublished data) of the young pikeminnow were apparently inadequate to allow it to completely ingest (or expel) the bullhead. While it cannot be proven that the bullhead in question caused this Colorado pikeminnow's death, the evidence makes it seem almost certain.

This is the second time since 1999 that a stocked juvenile Colorado pikeminnow has been collected with an ictalurid lodged in its throat. The other incident occurred on 1 October 1999, when a 346 mm TL Colorado pikeminnow was collected with a 111 mm TL channel catfish lodged in its throat (Ryden and Smith 2002). That is a predator to prey size ratio of 3.12:1. Unfortunately, the gape dimensions of this Colorado pikeminnow were not measured. While this Colorado pikeminnow was not dead when collected, it had suffered severe trauma, including having the dorsal spine of the channel catfish protruding through the roof of its mouth and into the right eye socket, causing the eye to severely distend (Ryden and Smith 2002, pers. obs.). In addition, both of the channel catfish's pectoral spines had penetrated the pikeminnow's mandibular bones (J. Smith pers. comm.). Although this pikeminnow was returned alive to the river, it has not been recaptured since. Given the extent of the trauma suffered by this fish, it seems likely that it was a delayed mortality following its release.

Table 6. Colorado pikeminnow collected from the San Juan River on the fall 2003 adult monitoring trip (n = 32).

Date of Capture	PIT Tag Number	Radio Frequency	Total Length (mm)	Weight (grams)	Sex[a]	River Mile
09/22/2003	NONE	NONE	150	18	I	155.0
09/23/2003	4214587A17	NONE	181	35	I	134.0
10/06/2003	42415A4A4A	NONE	171	30	I	118.0
10/07/2003	416C467C06	NONE	186	50	I	107.0
10/07/2003	426873031F	NONE	182	32	I	104.7
10/07/2003	42692B750B	NONE	215	68	I	104.1
10/07/2003	425C226824	NONE	214	70	I	103.9
10/08/2003	223F61245B	NONE	209	70	I	82.1
10/09/2003	42415C7B7F	NONE	216	70	I	76.0
10/09/2003	423D0E6D1F	NONE	197	52	I	76.0
10/09/2003	423D1A2F32	NONE	195	55	I	71.0
10/10/2003	425B7A5D75	NONE	223	80	I	70.0
10/11/2003	425C1D0A39	NONE	259	130	I	56.0
10/11/2003	426931163A	NONE	232	85	I	52.0
10/12/2003	4241566A12	NONE	200	50	I	44.0
10/12/2003	423D0A6642	NONE	181	50	I	41.0
10/12/2003	420F2F0615	NONE	211	55	I	41.0
10/12/2003	423D024038	NONE	192	40	I	40.0
10/12/2003	423D19512D	NONE	200	65	I	37.0
10/12/2003	423C662E34	NONE	207	75	I	37.0
10/12/2003	426853647F	NONE	197	50	I	35.0
10/12/2003	4268715C34	NONE	208	55	I	31.0
10/13/2003	522A49574A	NONE	226	82	I	28.0
10/13/2003	42417C4167	NONE	186	45	I	28.0
10/13/2003	423D185B45	NONE	235	75	I	26.9
10/13/2003	423C697364	NONE	218	70	I	25.9
10/13/2003	4241793E30	NONE	178	40	I	25.2
10/13/2003	4241692F01	NONE	173	40	I	25.2
10/13/2003	423E280D0A	NONE	224	70	I	20.4
10/13/2003	423C695836	NONE	172	40	I	19.0
10/13/2003	423D077B0C	NONE	235	75	I	19.0
10/13/2003	42416D6F74	NONE	230	80	I	19.0

a: I = Indeterminate

Population Trends

Collections of wild Colorado pikeminnow continue to be extremely rare in the San Juan River. The last wild Colorado pikeminnow to be collected was an 846 mm TL female that was captured on 25 July 2000 at RM 138.9. This fish had also been captured each of the previous two years - at RM 131.5 on 23 March 1999 and at RM 137.6 on 29 September 1998.

Recaptures of stocked Colorado pikeminnow also continue to be relatively rare, especially when compared to the overall number of fish that have been stocked (i.e., over one million) since 1996 (Table 4). However, over the past two years, the UDWR has collected seven small adult Colorado pikeminnow that are believed to be recruits from the 1996 and 1997 stockings of Colorado pikeminnow (Table 7; Jackson 2003, UDWR unpublished data).

Table 7. Colorado pikeminnow that were stocked into the San Juan River as juvenile fish and recaptured during UDWR's 2002 and 2003 nonnative fish removal efforts in the lower San Juan River after they had recruited to adulthood.

PIT Tag Number	Date Of Last Recapture	Assumed Year Stocked	Times Fish Has Been Recaptured Since Stocking	Total Length At Recap	Sex[a]	Recap River Mile	Days In River Since Stocking
5312122813	04/16/2002	1996	1	539 mm	I	45.8	1989
51247F0B49	06/12/2002	1996	2[b]	507 mm	M	21.4	2046
423D133353	06/26/2002	1997	1	475 mm	I	23.7	1776
5228305F22	06/27/2002	1997	1	460 mm	I	19.8	1777
53180D4E7E	03/27/2003	1996	1	530 mm	I	16.0	2334
522A213C40	04/29/2003	1996	1	535 mm	I	34.0	2367
4269392329	04/30/2003	1996	1	590 mm	F	21.4	2368

a: I = indeterminate, M = male, F = female

b: This fish was first recaptured on 10/01/1999 at RM 86.0. At that time, its TL = 346 mm.

While the presence of recruiting adults from UDWR's 1996-2000 stocking efforts is encouraging, the overall numbers of these recruits observed so far remains relatively low. In addition, the occurrence of these fish so far downstream in the river, places them at a relatively high risk of being stranded in Lake Powell, now that there is a new waterfall that divides the lake from the river. If these fish move downstream into Lake Powell in response to events such as the high, turbid flow spikes that occurred in fall 2002 and 2003, they would be unable to return to the river until the new waterfall becomes inundated by a rising water level in Lake Powell. Given the present, extremely low level of Lake Powell, this may not occur for several years.

Several adult Colorado pikeminnow stocked at RM 180.2 in April 2001 continue to occupy the section of river from PNM Weir to Hogback Diversion (RM 166.6-158.6) up to two and a half years after stocking (Table A-1 in Appendix A). In 2003, eight of these individuals also used the newly-constructed PNM Fish Ladder. The willingness of these fish to negotiate the fish ladder offers great hope for range expansion of Colorado pikeminnow into the sections of river upstream of Hogback Diversion.

In 1997 and 1998 it appeared that Colorado pikeminnow that had been stocked since 1996 were becoming well-established and would successfully recruit into the adult population, giving it a large, much-needed, and observable boost. CPUE of Colorado pikeminnow had increased steadily between spring 1997 and fall 1998 to the highest level observed for this species since studies began in 1991 (Figure 2). In fact 95 individual Colorado pikeminnow were collected on the fall 1998 adult monitoring trip -- an unprecedented number (Ryden 2000a). Several of the Colorado pikeminnow that had originally been stocked in 1996 at an average size of 55 mm TL (Table 4) had reached

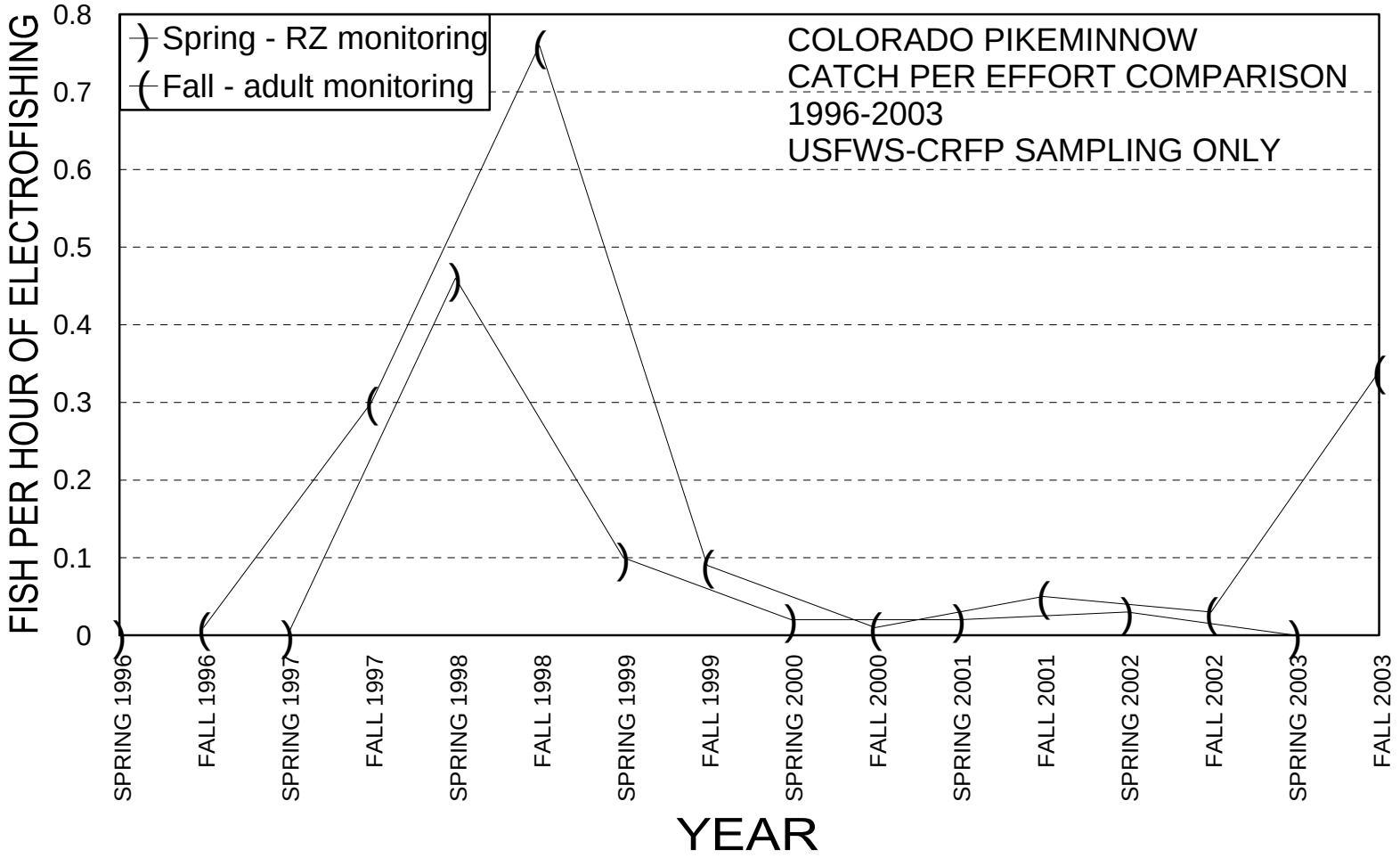

Figure 2. Colorado pikeminnow catch per unit effort (CPUE) on fall adult monitoring trips and spring razorback sucker monitoring trips, 1996-2003. This graph includes all Colorado pikeminnow collected by USFWS-CRFP during these trips, including both captures of wild fish and recaptures of stocked fish (juveniles and adults).

sizes as large as 367 mm TL by fall 1998 (Ryden 2000b). Then, after the fall 1998 adult monitoring trip, these fish essentially disappeared from collections (Figure 2; Ryden 2001a). The reason for this sudden, marked drop-off is unknown. Starting with the spring 1999 razorback sucker monitoring trip, CPUE for Colorado pikeminnow (both wild and stocked) has remained low through the spring 2003 razorback sucker monitoring trip (Figure 2). However, the captures of a small number of unmarked young adult Colorado pikeminnow by UDWR crews in the lower river in 2002 and 2003 (Table 7) would seem to indicate that some of these stocked fish did indeed retain in the San Juan River and recruit to adulthood. Where these fish were in the interim time period between 1998 and 2002 (i.e., whether they were in Lake Powell or in the river, but were able to avoid detection) remains a mystery. Regardless, the low numbers of young adult fish collected by the UDWR in 2002 and 2003 would seem to indicate that the loss of fish between the time they are stocked and the time they recruit into adulthood is very high.

Sometime in the early- to mid-summer of 2003, somewhere around 100+ mm TL, age-1 Colorado pikeminnow (stocked in October 2002) exhibited the ability to avoid capture by seines and at the same time became more susceptible to collection via electrofishing (Table 6, Tables A-1 - A-3 in Appendix A). This shift in gear susceptibility is almost certainly an artifact of age-1 fish becoming strong enough swimmers to avoid capture by seining. However, it likely also represents a fundamental shift in habitat selection/use by this age-class fish.

CPUE for age-1 Colorado pikeminnow during fall 2003 adult monitoring was slightly higher (0.34 versus 0.30 fish/hr) than that observed for age-1 Colorado pikeminnow during the fall 1997 adult monitoring trip (i.e., the first adult monitoring trip during which either cohort was susceptible to capture by electrofishing; Figure 2). However, the fact that over twice as many age-0 pikeminnow were stocked in fall 2002 (n = 210,418) as were stocked in fall 1996 (n = 100,000) would seem to indicate that retention/survival of age-1 fish was only about half as good in 2003 (Table 4, Figure 2). However, the large flow spike in September 2003 (an event that almost certainly caused downstream displacement of newly-stocked pikeminnow) is a confounding factor when trying to compare CPUE between years, since the 2003 adult monitoring trip took place immediately following this event. It is anticipated that with the continued stocking of age-0 Colorado pikeminnow over the next several years, the CPUE trend for Colorado pikeminnow will once again begin to rise (and hopefully continue to rise) much as it did in 1997 and 1998 (Figure 2).

Razorback Sucker

Fish Stocked As Part Of An Augmentation Effort

Between March 1994 and October 2003, a total of 7,863 razorback sucker were stocked into the San Juan River (Table 8). All of the 7,863 fish were individually-implanted with PIT tags before being released into the wild. That total includes 887 razorback that were stocked into the San Juan during four separate stocking efforts in 2003.

The first of these four stockings occurred between 14 and 17 April 2003 (Table 8), when a total of 70 razorback sucker were harvested from the Avocet and 6-Pack ponds and stocked into the river just downstream of Hogback Diversion (RM 158.6). The mean TL of these fish was 380 mm (range = 255-495 mm TL).

Table 8. All known stockings of razorback sucker into either the San Juan River or the San Juan River arm of Lake Powell and subsequent first-time recaptures from both locales, 1994-2003.

Date(s) Stocked	Stocking Number	River Miles Fish Were Stocked At	Number Of Fish Stocked	Mean TL (Range)	Number Of Individuals Recaptured	Percent Of All Individuals Stocked That Have Been Recaptured
Experimental Stocking Study, 1994-1996: n = 940 fish stocked						
29-30 March 1994	1	136.6-79.6	15	277(251-316)	2	13.3%
27 October 1994	2	136.6-79.6	16	403(384-435)	2	12.5%
16-17 November 1994	3	158.6-79.6	478	190(100-374)	4	0.8%
18 November 1994	4	158.6-79.6	178	400(330-446)	60	33.7%
27 September 1995	5	158.6	16	424(397-482)	7	43.8%
3 October 1996	6	158.6	237	335(204-434)	4	1.7%
Five-Year Augmentation Effort, 1997-2001: n = 5,896 fish stocked						
3 September 1997	1	158.6	1,027	193(193-240)	6	0.6%
17 September 1997	2	158.6	227	229	1	0.4%
19 September 1997	3	158.6	1,631	185(104-412)	4	0.2%
22 April 1998	4	158.6	57	420(380-460)	9	15.8%
28 May 1998	5	158.6	67	417(341-470)	8	11.9%
14-15 October 1998	6	158.6	1,155	232(185-315)	6	0.5%
3 August 1999	7	170.8	Unknown	Unknown	8	Unknown
17-20 October 2000	8	158.6	1,044	214(111-523)	38	3.6%
30 October to 1 November 2001	9	158.6	688	409(288-560)	82	11.9%

Table 8, continued.

Date(s) Stocked	Stocking Number	River Miles Fish Were Stocked At	Number Of Fish Stocked	Mean TL (Range)	Number Of Individuals Recaptured	Percent Of All Individuals Stocked That Have Been Recaptured
Interim Period Between "Official" Augmentation Efforts In The San Juan River: n = 1,026 fish stocked						
11 April 2002	1	178.2	13	137(110-170)	0	0.0%
22 April 2002	2	158.6	102	335(240-470)	13	12.7%
5-6 November 2002	3	158.6	25	351(295-456)	1	4.0%
14 April 2003	4	158.6	121	413(341-491)	8	6.6%
14-17 April 2003	5	158.6	70	380(255-495)	8	11.4%
19 May 2003	6	178.2	11	124(100-150)	0	0.0%
28-30 October 2003	7	158.6	684	309(253-396)	0	0.0%
Eight-Year Augmentation Effort, 2004-2011: n = no fish stocked yet						
2004	1	N/A	N/A	N/A	N/A	N/A
Known Stockings By Other Agencies Into The San Juan River Arm Of Lake Powell, 1995: n = 164 fish stocked						
8 August 1995	1	0.0	65	405(348-428)	3	4.6%
15 August 1995	2	0.0	65	409(369-437)	2	3.1%
1 November 1995	3	Lake Powell	34	446(419-495)	0	0.0%

The second stocking consisted of 121 fish stocked on 14 April 2003 (Table 8). These 121 fish had been reared by UDWR in the golf course ponds at Page, AZ. These fish were also stocked into the San Juan at RM 158.6, immediately downstream of the Hogback Diversion. The mean TL of these 121 fish was 413 mm (range = 341-491 mm TL).

The third stocking of razorback sucker occurred on 19 May 2003. On that date, 11 juvenile razorback sucker that were being reared by students at Ignacio High School as part of the Upper Colorado River Basin's I&E program were stocked into the San Juan River at RM 178.2 (Table 8). The mean TL of these 11 fish was 124 mm (range = 100-150 mm TL).

The last stocking of razorback sucker occurred between 28 and 30 October 2003. During that week, 685 razorback sucker were harvested from 6-Pack Pond #'s 1 and 2, and were stocked at RM 158.6, immediately downstream of the Hogback Diversion (Table 8). The mean TL of these 25 fish was 310 mm (range = 253-396 mm TL).

2003 Collections

Two juvenile razorback sucker, suspected to be wild-spawned progeny of stocked razorback sucker, were collected in 2003. The first of these two fish (PIT tag # 425B63072F, TL = 274 mm, WT = 202 g) was collected on 25 July 2003 at RM 4.8 during one of UDWR's nonnative fish removal trips (Table B-1 in Appendix B). The second fish (PIT tag # 4121492F55, TL = 249 mm, WT = 125 g) was collected on 12 October 2003 at RM 35.7 on the fall adult monitoring trip (Table 9). Comparing the size of these two juvenile fish with numerous known-age razorback reared in grow-out ponds near Farmington, it is assumed that the smaller of these two fish (249 mm TL) was either an age-1 or age-2 fish (i.e., 2001 or 2002 year-class), while the larger of the two would likely be an age-2 or age-3 fish (i.e., 2000 or 2001 year-class; USFWS unpublished data). While wild-produced larval razorback sucker have been collected in each of the last six years (1998-2003), the collection of these two juvenile fish represents the first evidence that some of these wild-produced larvae are surviving and starting to recruit.

In addition to these two (assumed) wild razorback sucker, there were 178 recapture events (that I know of) with stocked razorback sucker during all 2003 field studies. Of these 180 total recapture events, 19 occurred during the 2003 adult monitoring trip (Table 9). The large majority of these collections (n = 174, 97.2 %) were made via raft-mounted electrofishing units. However, four razorback sucker (2.2 %) were collected in the newly-constructed PNM Fish Ladder, while one individual (0.6 %) was collected in Lake Powell in a gill net, and another individual (0.6%) was collected in a seine (Table 9, Table B-1 in Appendix B). Recaptures of razorback sucker collected during all studies in 2003 ranged from RM 166.6 (The PNM Fish Ladder) to RM -10.0 (in Lake Powell), while the 19 collected during the fall 2003 adult monitoring trip ranged from RM 158.0 to 7.0 (Table 9, Table B-1 in Appendix B).

Of the 178 recapture events with stocked fish, three were with fish originally stocked in 1994, one was with a fish that was stocked in 1995, three were with fish that were stocked in 1998, 11 were with fish that were stocked in 2000, 84 were with fish that were stocked in 2001, 14 were with fish that were stocked in 2002, and 57 were with fish that were stocked in 2003. Another five razorback sucker were recaptured for which no PIT tag was detectable, therefore the year of their stocking could not be determined. These five fish were implanted with a PIT tags before being returned to the river (Table 9, Table B-1 in Appendix B).

Table 9. Razorback sucker collected from the San Juan River on the fall 2003 adult monitoring trip (n = 19).

Date Of Capture	PIT Tag Number	Radio Freq.	Total Length (mm)	Weight (grams)	Sex[a]	Capture River Mile	Days In River Since Stocking
09/22/2003	423F0D5520	791	463	940	M	158.0	690
09/22/2003	423F031672	071	500	1400	M	155.0	691
09/22/2003	42400C0D3C	742	461	800	I	155.0	691
09/22/2003	5229107403	701	444	890	I	151.0	518
09/23/2003	423E541450	781	502	1370	F	146.0	692
09/23/2003	423F6C1E6A	711	455	850	M	137.0	693
09/23/2003	423F6C4E6D	771	495	1150	F	137.0	693
10/06/2003	5325724805	NONE	459	925	I	110.0	1083
10/06/2003	423E560E3B	NONE	475	995	F	109.9	705
10/06/2003	53254A7E7A	NONE	432	838	M	109.7	1081
10/07/2003	423C262A4F	NONE	397	700	F	107.0	706
10/07/2003	423F0F6966	NONE	493	1140	F	101.2	707
10/07/2003	1F435F1728	NONE	513	1320	F	100.0	3245
10/07/2003	423E752F7F	NONE	452	840	M	100.0	Unknown[b]
10/07/2003	42400D333D	NONE	472	1020	F	97.0	707
10/08/2003	1F74343F7A	NONE	465	980	M	85.0	3246
10/09/2003	5325740172	NONE	466	1120	M	80.1	1084
10/12/2003	4121492F55	NONE	249	125	I	35.7	Unknown[c]
10/14/2003	522A4C4A53	NONE	410	670	I	7.0	540

a: I = indeterminate; M = male; F = female

b: This fish did not have a detectable PIT tag at the time of recapture, therefore the number of days it had been in the river since stocking could not be determined. A PIT tag was implanted in this fish before it was released back into the river.

c: This juvenile fish is suspected to be a wild-spawned offspring of stocked razorback sucker.

Among the 180 razorback sucker captures/recaptures in 2003, 44 were males, 31 were females, and 105 were of indeterminate sex (Table 9, Table B-1 in Appendix B). Tuberculate males were collected from 27 March through 11 November, while ripe males were collected from 27 March through 9 October. No ripe females were collected during 2003.

Population Trends

In contrast to the marked increases in CPUE observed for stocked Colorado pikeminnow in 1997 and 1998 (Figure 2), CPUE for stocked razorback sucker remained fairly low, but steady between 1996 and 2000 (Figure 3). Then, between spring 2001 and spring 2003, razorback sucker CPUE increased steadily during both the spring razorback sucker monitoring trips and fall adult monitoring trips. During the spring 2003 razorback sucker monitoring trip, CPUE for this species was at the highest value ever observed (i.e., 0.74 fish/hr; Figure 3). Then between the spring 2003 and fall 2003 monitoring trips, razorback sucker CPUE showed a sudden and marked decline (Figure 3). This decline may be linked to the large storm-induced flow spike that occurred in September 2003.

Even though the razorback sucker CPUE value has remained under 1.0 fish per hour, CPUE for stocked razorback sucker has been consistently higher over time than that for stocked Colorado pikeminnow, especially when compared to overall numbers of fish stocked for each species (razorback sucker = 7,863 stocked individuals through 2003 versus more than one million Colorado pikeminnow stocked through 2003; Tables 4 and 8).

Spawning Aggregations

No aggregations of spawning razorback sucker were identified the San Juan River in 2003.

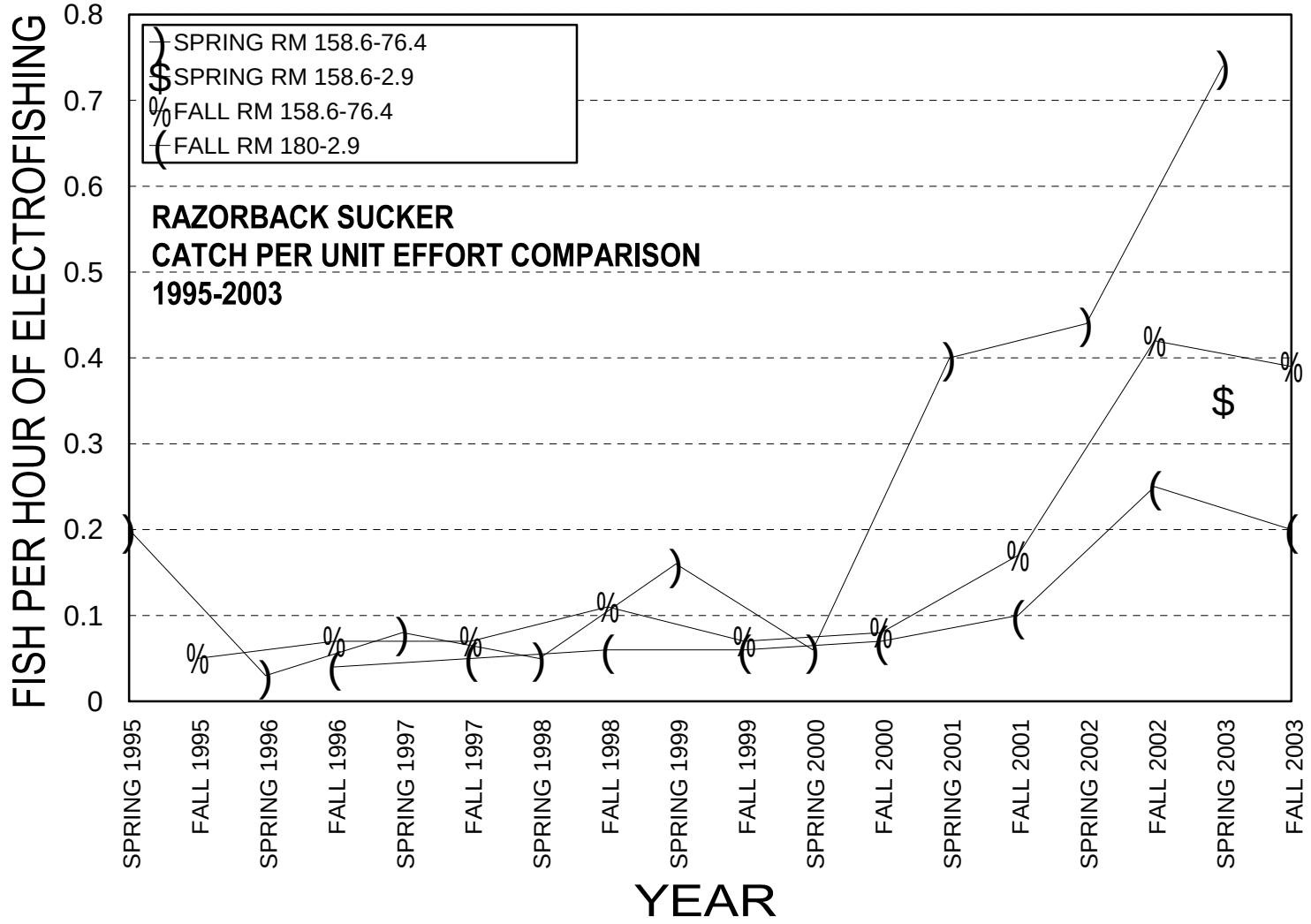

Figure 3. Razorback sucker catch per unit effort (CPUE) on fall adult monitoring trips and spring razorback sucker monitoring trips, 1995-2003.

Roundtail Chub

2003 Collections

No roundtail chub were collected during 2003 adult monitoring. Only one roundtail chub (that I know of) was collected during all sampling performed during 2003. This fish, a 390 mm TL adult (PIT tag number 512D5F2B33), was collected in the PNM Fish Ladder (RM 166.6) on 19 June 2003 (Lapahie 2003b). This same fish was collected during the fall 2002 adult monitoring trip between RM 161.0 and 160.0 on 11 October 2002 (Ryden 2003a). This fish showed no growth between the two collections.

Population Trends

Roundtail chub, a state-listed endangered species in both New Mexico and Utah, continue to be the most rarely-collected of the three rare fish species on adult monitoring trips. Based on plots of all known roundtail chub collections on all sampling trips for all studies between 1987 and 2003 (n = 191), collections of roundtail chub tend to be concentrated mostly in areas downstream of the LaPlata and Mancos river confluences (Figure 4; SJRIP Integrated Database). These two small rivers, along with the Animas River, are the only three tributaries of the San Juan River that are known to have resident populations of roundtail chub (Miller and Rees 2000). The large majority of the roundtail chub collections between 1987 and 2003 (n = 191) consisted of subadult fish (Figure 4; Ryden 2000a).

Between 1991 and 2003, a total of 25 roundtail chub (TL range = 116-414 mm) have been implanted with PIT tags (SJRIP Integrated Database). Of these 25, only three individuals have been recaptured a second time after their initial capture and release. One individual (PIT tag number 7F7D142D70, TL = 278 mm), of indeterminate sex, was originally collected on 13 May 1992 at RM 147.9 and was recaptured later that same year at RM 137.7 on 8 October 1992 (294 mm TL; Ryden and Pfeifer 1993). The second individual (PIT tag number 1F6D185B01, TL = 414 mm), a female, was originally collected on 15 April 1996 at RM 131.3 and was recaptured again on 5 May 1998 at RM 133.4 (414 mm TL; Ryden 2000a, 2000c). The third was discussed earlier.

The dearth of adult roundtail chub in the San Juan River, combined with a lack of recaptures among PIT-tagged fish over time, and the fact that most roundtail chub captures in the mainstem San Juan River occur downstream of major tributaries known to have resident populations of roundtail chub, would seem to suggest that the roundtail chub being collected in the mainstem San Juan are only transient members of the mainstem river’s fish community. It seems plausible that roundtail chub collected in the mainstem San Juan River get flushed out of tributaries during high flow events and either perish or move up- or downstream out of the mainstem river fairly quickly after entering it.

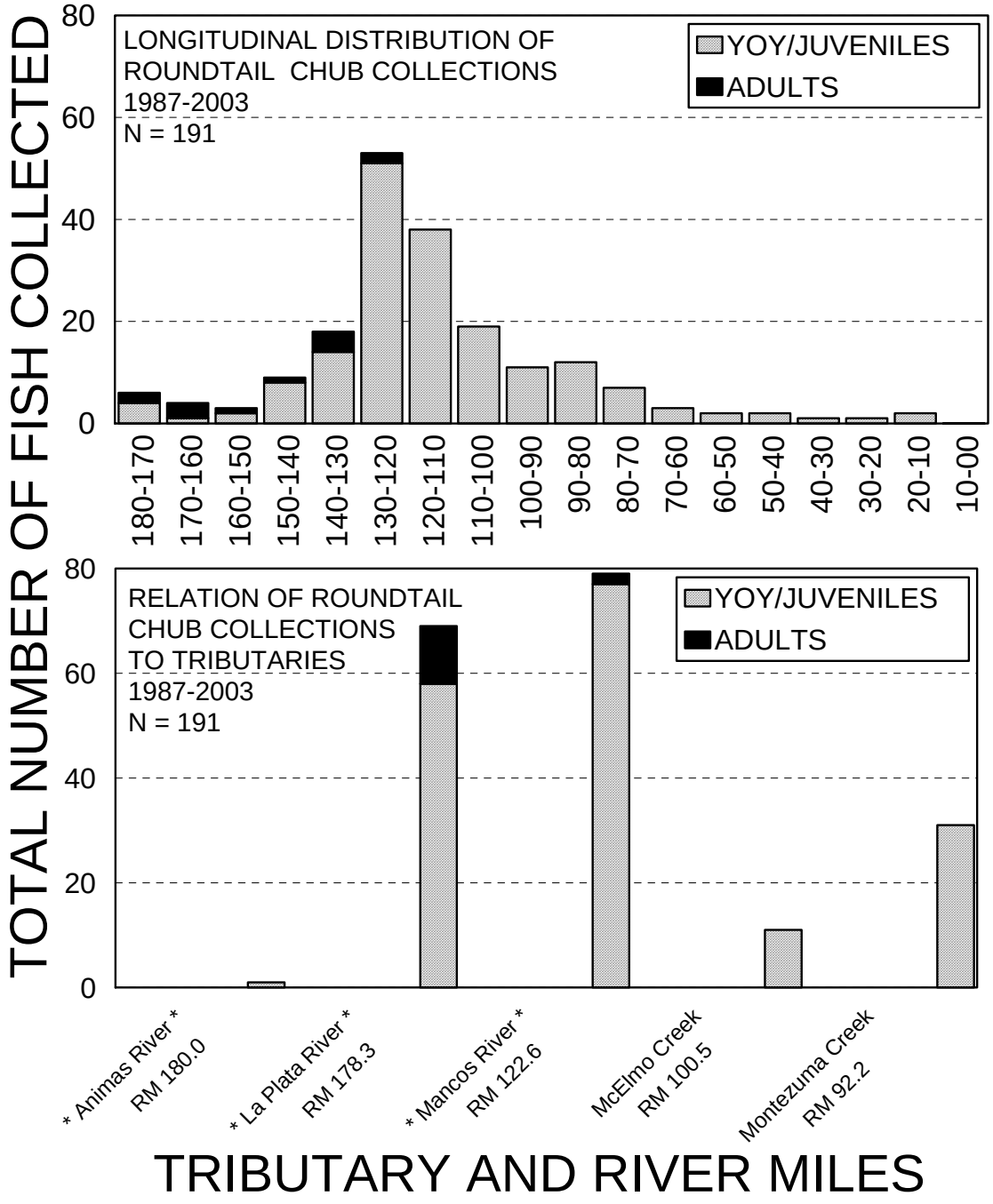

Figure 4. Spatial distribution of all roundtail chub collections from all studies in the San Juan River, 1987-2003 (top). Relation of all roundtail chub collections from all studies to major tributaries of the San Juan River, 1987-2003 (bottom). Tributaries that have asterisks by their names are those known to have resident populations of roundtail chub (Miller and Rees 2000).

Flannelmouth Sucker

Catch Per Unit Effort (CPUE)

Flannelmouth sucker continue to be the most common large-bodied fish collected riverwide during adult monitoring trips (Table 3; Ryden 2000a, 2001a, 2003b). While numbers of this fish have fluctuated both riverwide and in individual geomorphic reaches over the years, flannelmouth sucker have remained numerically dominant in both overall numbers of specimens collected and in frequency of occurrence in electrofishing samples (Table 3, Ryden 2000a, 2001a, 2003b).

After a marked influx of age-0 fish in 2000, juvenile flannelmouth sucker CPUE has declined noticeably over the last three years (2001-2003), reaching the lowest point observed over the last seven years in fall 2003 (Figure 5). In addition, adult flannelmouth sucker CPUE riverwide, which had remained very stable over between 2000 and 2002 also declined markedly in fall 2003 (Figure 5). This has caused the trend for flannelmouth sucker total CPUE riverwide to follow suit, showing a steady downward trend between 2000 and 2003 (Figure 5).

In Reach 6, juvenile flannelmouth sucker CPUE has been relatively stable in six of the last eight years (1996-1999, 2001, and 2003; Figure 6). During the other two years (2000 and 2002) there were marked increases in juvenile CPUE (Figure 6). However, the effect of these influxes of juvenile fish appear to be short-term in Reach 6, lasting only a single year. Like juvenile flannelmouth sucker CPUE, adult flannelmouth sucker CPUE has remained fairly stable in Reach 6, with the exception on 1999 when there was a marked increase in adult CPUE and 2003 when there was a marked decrease in adult CPUE (Figure 6). In most years, numbers of juvenile and adult flannelmouth sucker collected in Reach 6 have very close to a 1:1 ratio. The fluctuations observed in flannelmouth sucker total CPUE in Reach 6 over the last eight years tend to track the years when one life stage or the other demonstrates a marked variation from this (close to) 1:1 ratio pattern.

The flannelmouth sucker population in Reach 5 has demonstrated the most dramatic shifts in total CPUE observed for this species since our studies began in 1991 (Figure 6). The marked decline in total CPUE between 1992 and 1997 led to some concern that the flannelmouth sucker population was in a long-term decline (Figure 6; Ryden 2000a). Then, between 1997 and 2001, flannelmouth sucker total CPUE increased again markedly, with this increase occurring in both in juvenile and adult life stages (Figure 6). However, in 2002 and again in 2003, both juvenile and adult flannelmouth sucker CPUE once again declined in Reach 5 (Figure 6).

Flannelmouth sucker total CPUE in Reach 4 demonstrated a decline between 1992 and 1997, very similar to that observed in adjacent Reach 5 (Figure 7). Again, like Reach 5, total CPUE in Reach 4 increased markedly between 1997 and 1999 and remained relatively stable from 1999-2001 (Figure 7). Then again, as was observed in Reach 5, flannelmouth sucker CPUE for both juvenile and adult fish declined noticeably in Reach 4 in 2002 (Figure 7). In fact, juvenile CPUE dropped almost seven-fold to the lowest ever observed value in this reach (Figure 7). CPUE for both adult and juvenile flannelmouth sucker increased again slightly in 2003. This was one of the only reaches in which CPUE for both life stages increased between 2002 and 2003.

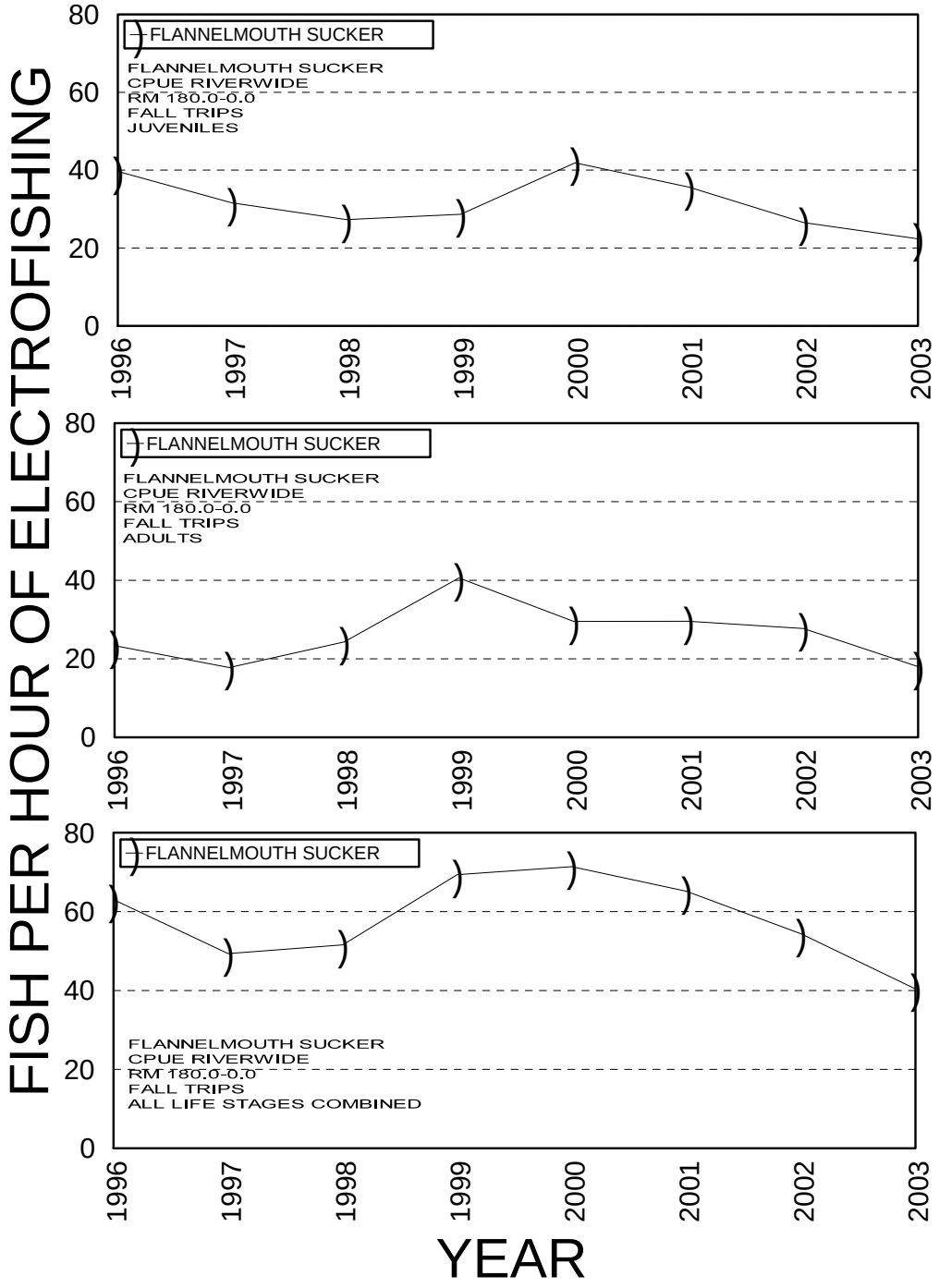

Figure 5. Flannelmouth sucker catch per unit effort (CPUE) riverwide (RM 180.0-0.0) on fall adult monitoring trips, for juvenile fish (< 410 mm TL; top), adult fish (≥ 410 mm TL; middle), and for all life stages combined (juveniles + adults; bottom).

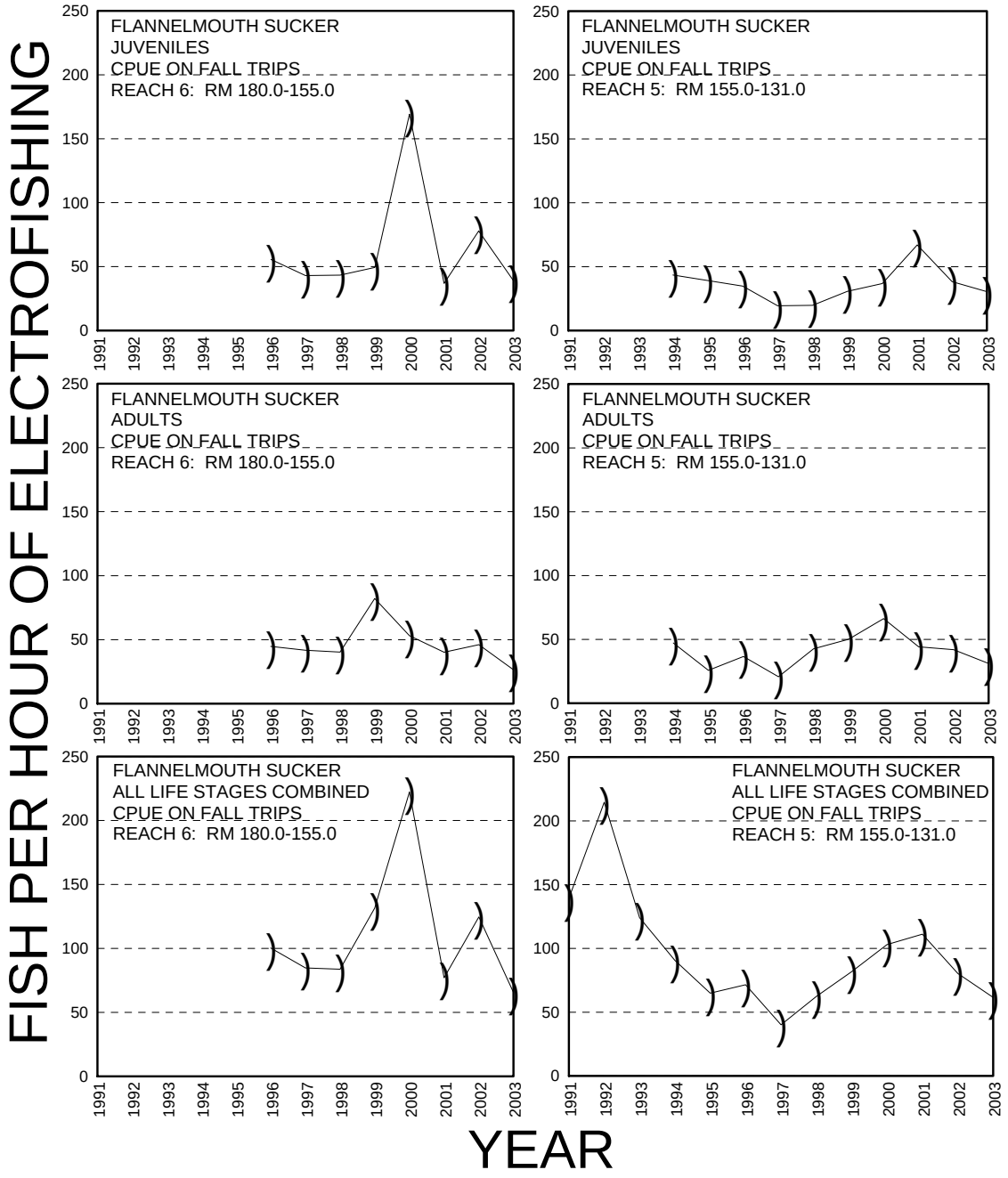

Figure 6. Flannelmouth sucker catch per unit effort (CPUE) in Reach 6 and Reach 5 on fall adult monitoring trips for juvenile fish (< 410 mm TL; top), adult fish (≥ 410 mm TL; middle), and for all life stages combined (juveniles + adults; bottom).

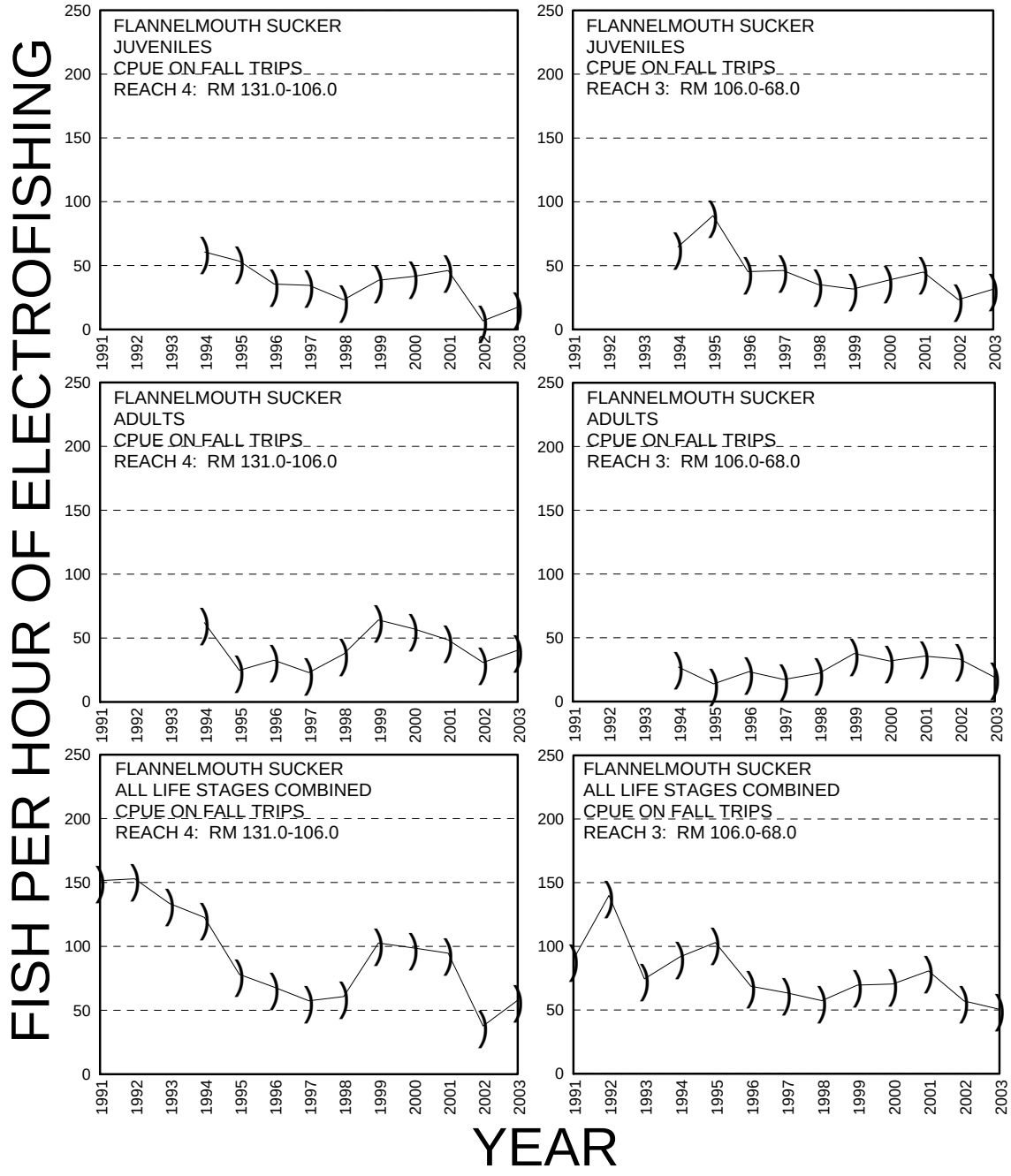

Figure 7. Flannelmouth sucker catch per unit effort (CPUE) in Reach 4 and Reach 3 on fall adult monitoring trips for juvenile fish (< 410 mm TL; top), adult fish (≥ 410 mm TL; middle), and for all life stages combined (juveniles + adults; bottom).

In Reach 3 (and adjoining Reach 2 downstream), juvenile fish become the numerically dominant life stage in the flannelmouth sucker population (Figure 7). In Reach 3, there was also a decline in total CPUE between 1992 and 1998 (Figure 7). However, unlike upstream in Reaches 5 and 4, total CPUE has not risen again markedly since its low in 1998 (Figure 7). In 2002, juvenile CPUE dropped to the lowest value ever observed in this reach, but in 2003 juvenile CPUE rose again slightly in 2003 (Figure 7). Although flannelmouth sucker adult CPUE declined slightly in Reach 3 in 2003, there has been no persistent declining trend in flannelmouth sucker adult CPUE in this reach over the last nine years (Figure 7).

Starting in Reach 6 and proceeding downstream to Reach 2, there is a generally declining trend in total CPUE for flannelmouth sucker (Figures 6-8). In addition, Reach 2 is the most downstream reach in which flannelmouth sucker are regularly collected in any kind of appreciable numbers. Like Reach 3 directly upstream, the flannelmouth sucker population in Reach 2 is numerically dominated by juvenile fish, but to an even greater degree than in Reach 3 (Figure 8). Therefore, total CPUE values in Reach 2 tend to track those of juvenile fish much more closely than those of adult fish. The overall trend for flannelmouth sucker total CPUE in Reach 2 between 1995 and 2000 was a steady decline (Figure 8). Then between 2000 and 2002, juvenile, adult, and total CPUE have all rose steadily, though not dramatically in Reach 2 (Figure 8). Flannelmouth sucker total CPUE in Reach 2 declined in 2003, mainly because of a corresponding decline in numbers of adult fish (Figure 8). However, flannelmouth sucker juvenile CPUE has remained low, but steady over the last three years (2001-2003; Figure 8).

Flannelmouth sucker remain rare in electrofishing collections in Reach 1, relative to CPUE values for more upstream reaches (Figures 6-8). This remained true in 2003 (Figure 8). It is intriguing that even though flannelmouth sucker have always been less common in Reach 1 than in upstream reaches, they were relatively more abundant in Reach 1 before the waterfall at RM 0.0 became inundated in spring 1995 (Figure 8). Now that a new waterfall has formed where the San Juan River enters Lake Powell, it will be interesting to see if flannelmouth sucker begin to again become more abundant in Reach 1.

Length Frequency And Mean Total Length

Histograms of riverwide length-frequency distributions show a trend towards the flannelmouth sucker population becoming increasingly dominated by adult fish (i.e., > 410 mm TL) between 1996 and 1999 with over half of all flannelmouth sucker measured in 1999 being between 376 and 475 mm TL 1999 (Figure 9). During October 2000 sampling, there was a large influx of small (76-100 mm TL, assumed to be age-0) flannelmouth sucker, causing the length-frequency of the flannelmouth sucker population to become strongly bimodal in 2000, 2001, and 2002 (Figure 9). In 2003, another group of what are assumed to be age-1 fish (i.e., spawned in 2002) were evident in the flannelmouth sucker length-frequency histograms (Figure 9). This caused the 2003 flannelmouth sucker length-frequency histogram to have at least three distinct modes, representing multiple year-classes of fish. The middle mode, centered around 376-400 mm TL (i.e., fish spawned in 2000), were large sub-adults in 2003 and should begin recruiting into the adult population in 2004.

As was evidenced by the length-frequency histograms, flannelmouth sucker mean TL values riverwide (for all life stages combined) increased markedly between 1996 and 1999 (Figure 10). Mean TL for flannelmouth sucker then dropped markedly riverwide in 2000 due to the large influx of age-0 juveniles

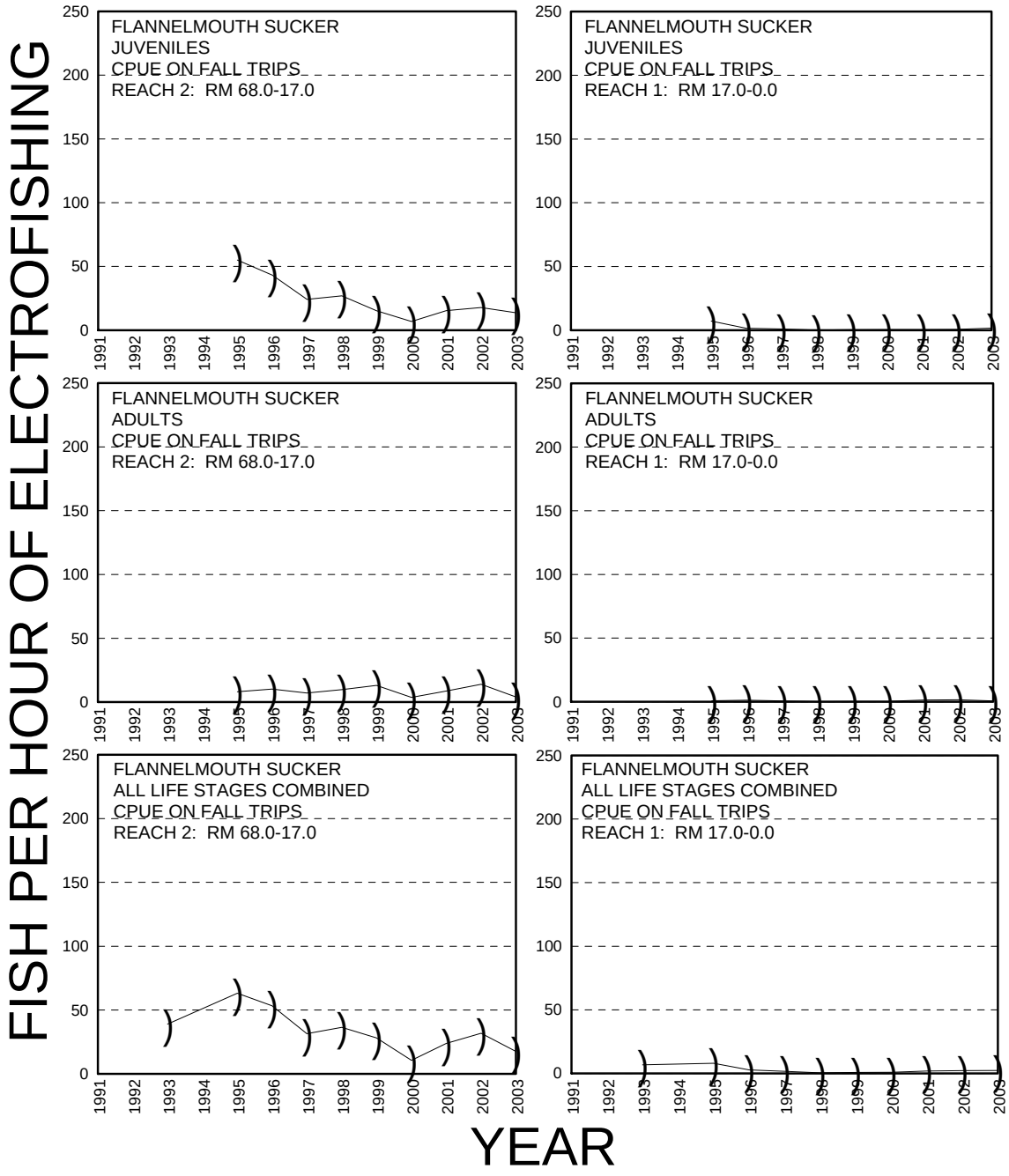

Figure 8. Flannelmouth sucker catch per unit effort (CPUE) in Reach 2 and Reach 1 on fall adult monitoring trips for juvenile fish (< 410 mm TL; top), adult fish (≥ 410 mm TL; middle), and for all life stages combined (juveniles + adults; bottom).

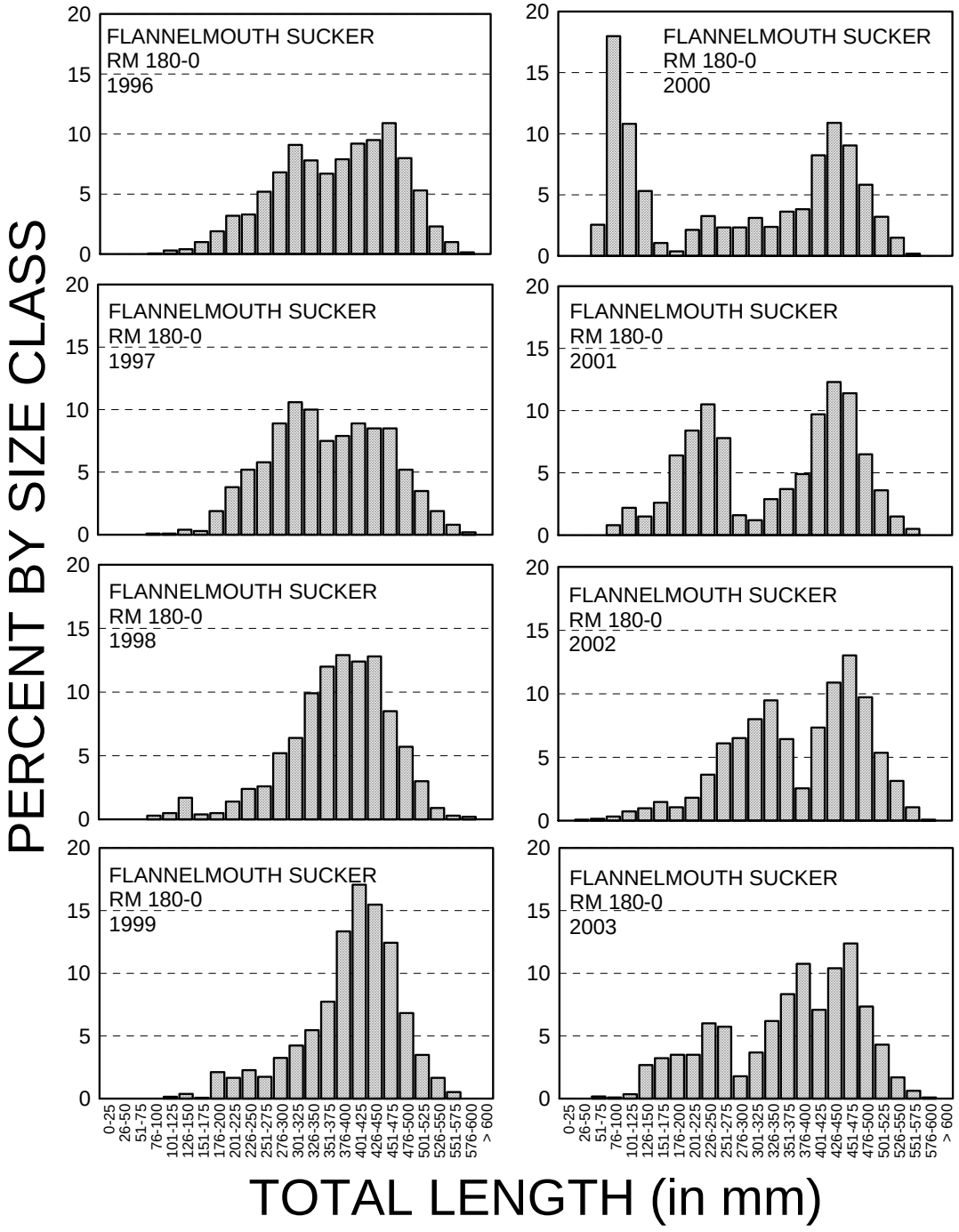

Figure 9. Length-frequency histograms showing the riverwide (RM 180.0-0.0) size-class distribution of flannelmouth sucker on fall adult monitoring trips in the San Juan River.

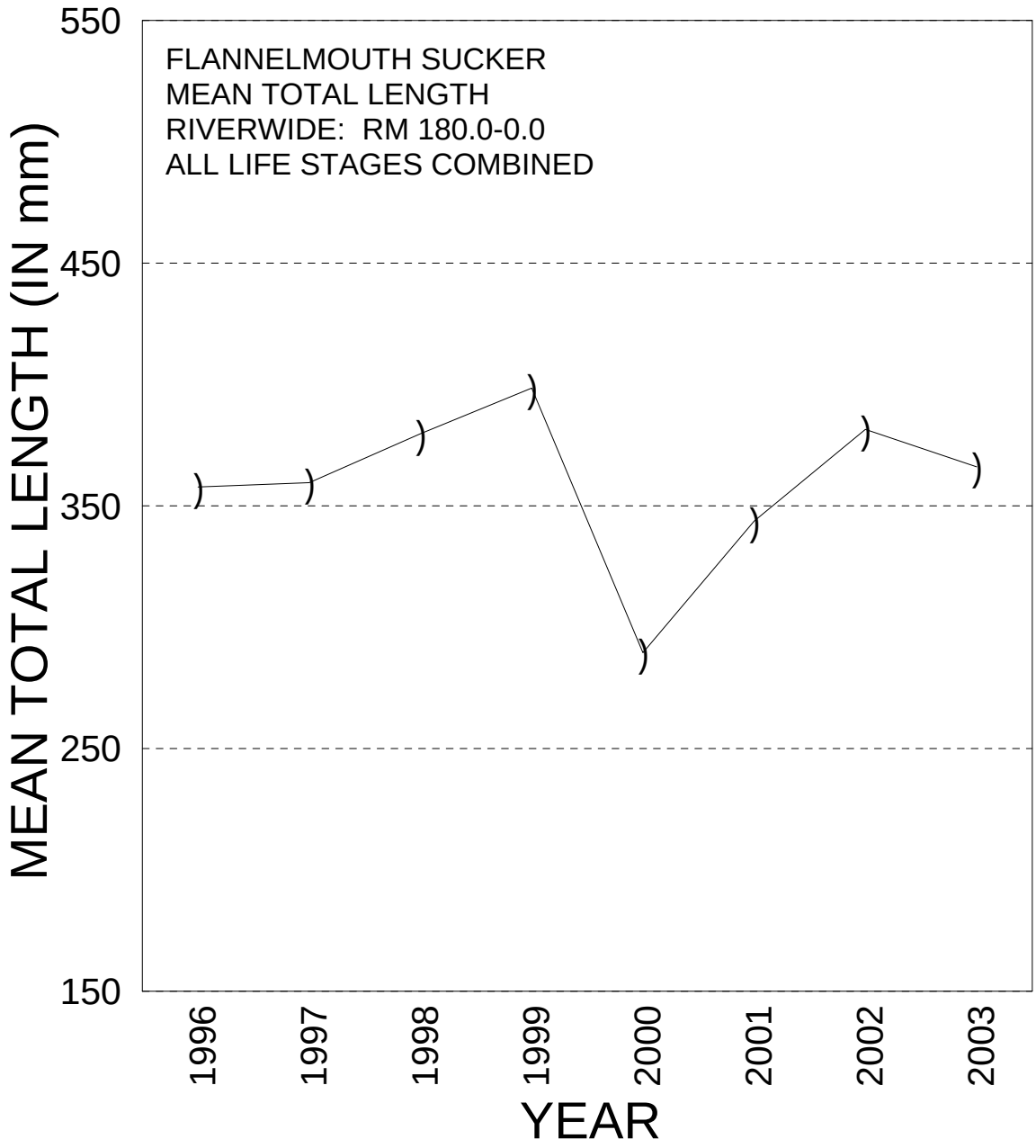

Figure 10. Mean total length (in mm) of flannelmouth sucker riverwide (RM 180.0-0.0) on fall adult monitoring trips in the San Juan River.

(Figure 10). The increase in mean TL of flannelmouth sucker riverwide between 2000 and 2002 (Figure 10), tracks right along with the 2000 year-class attaining larger sizes and beginning to recruit (Figure 9). Then, in 2003, mean TL of flannelmouth sucker riverwide dropped markedly again as another sizeable cohort of age-1 fish entered the population (Figure 10).

Mean TL of flannelmouth sucker decreased in every reach except Reach 1 between 2002 and 2003 (Figure 11). This corresponds with the influx of age-1 fish into the population observed in the length-frequency histogram. The fact that mean TL dropped in all river reaches except Reach 1 would seem to indicate that age-1 flannelmouth sucker were distributed throughout most of the San Juan River upstream of Slickhorn Canyon in 2003.

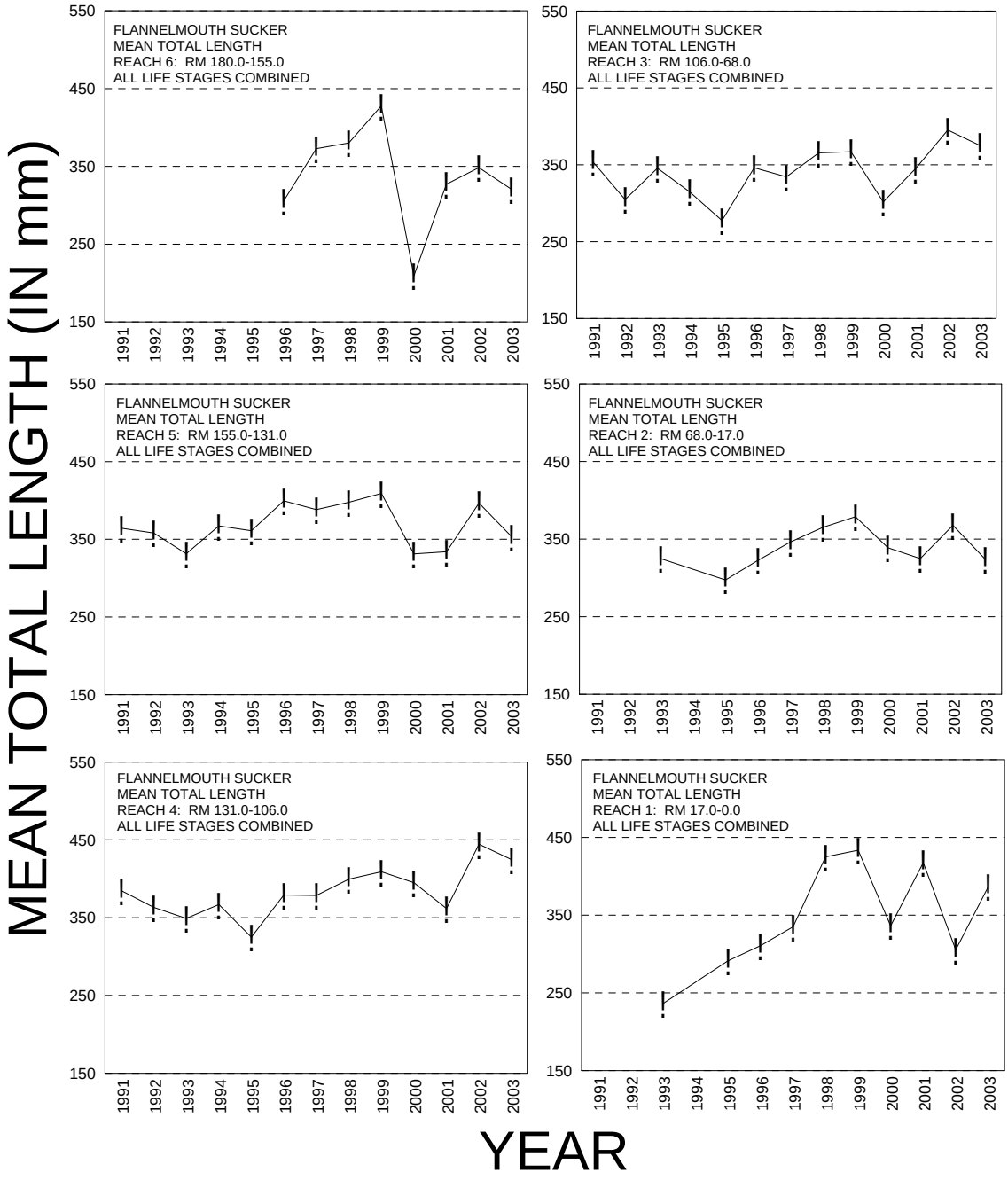

Figure 11. Mean total length (in mm) of flannelmouth sucker in Reaches 6-1 on fall adult monitoring trips in the San Juan River.

Bluehead Sucker

Catch Per Unit Effort (CPUE)

Since 1991, bluehead sucker have been the second most commonly-collected native fish and either the second or third most commonly-collected large-bodied fish overall (following flannelmouth sucker and alternating with channel catfish) during the adult monitoring studies (Table 3). Between 1996 and 1999, the bluehead sucker population in the San Juan River was split roughly equally between adult and juvenile fish riverwide, then between 2000 and 2002 juvenile became the dominant life stage in riverwide collections (Figure 12). However, in 2003, numbers of juveniles and adults once again showed an almost 1:1 ratio. This could be due to the recruitment of the large cohort of fish that were spawned in 2000 (Figure 13).

The San Juan River bluehead sucker population, within our study area, is largely centered in Reach 6 and the upstream portion of Reach 5 (Figure 13-15). Collections of bluehead sucker are over twice as common in Reach 6 as in adjacent Reach 5 downstream and the differential increases dramatically versus reaches even further downstream (Figures 13-15). In Reach 6, bluehead sucker are very often the most common large-bodied fish species collected. In Reach 6 in 2003, adult bluehead sucker CPUE increased slightly over 2002, but juvenile bluehead sucker CPUE decreased very markedly over 2002 (Figure 13). Total CPUE for bluehead sucker in Reach 6 is very unpredictable, demonstrating large up- and downswings between years in both juvenile and adult CPUE. It is very possible that numbers of bluehead sucker in Reach 6 are heavily effected on an annual basis by either immigration of fish from or emigration of fish to upstream river reaches and/or the Animas River.

As in Reach 6, CPUE for adult bluehead sucker in Reach 5 increased slightly in 2003 over 2002, but juvenile CPUE decreased more markedly when compared to 2002 (Figure 13). Overall, total CPUE for bluehead in Reach 5 has been relatively stable (possibly even showing a slightly increasing trend) since 1997 (Figure 13).

Even more so than flannelmouth sucker, bluehead sucker CPUE declines noticeably in each contiguous downstream reach (Figures 13-15). By Reach 2, bluehead sucker have become relatively rare in samples. No bluehead sucker of any life stage were collected in Reach 1 during the period 1991-2002. However, in 2003, two bluehead sucker were collected in Reach 1 (Figure 15). These are the first bluehead sucker ever collected in Reach 1 during adult monitoring collections (Figure 15). One of these two individuals (a 168 mm TL juvenile) was collected between RM 17.0 and RM 16.0, while the other (an unmeasured adult; i.e., > 300 mm TL) was collected between RM 15.0 and 14.0.

Length Frequency And Mean Total Length

Like flannelmouth sucker, the riverwide bluehead sucker length-frequency histogram in 2003 had at least three distinct modes. The largest of these modes was centered around age-3 (2000 year-class) fish that had just recruited into the adult population (i.e., 301-325 mm TL). However, there was also a noticeable group of age-1 (2002 year-class) fish centered around the 176-225 mm TL range. Although this cohort was not as dramatically obvious as the 2000 cohort, they do represent one of the more prominent influxes of age-1 fish observed during adult monitoring collections over the last eight years (Figure 16).

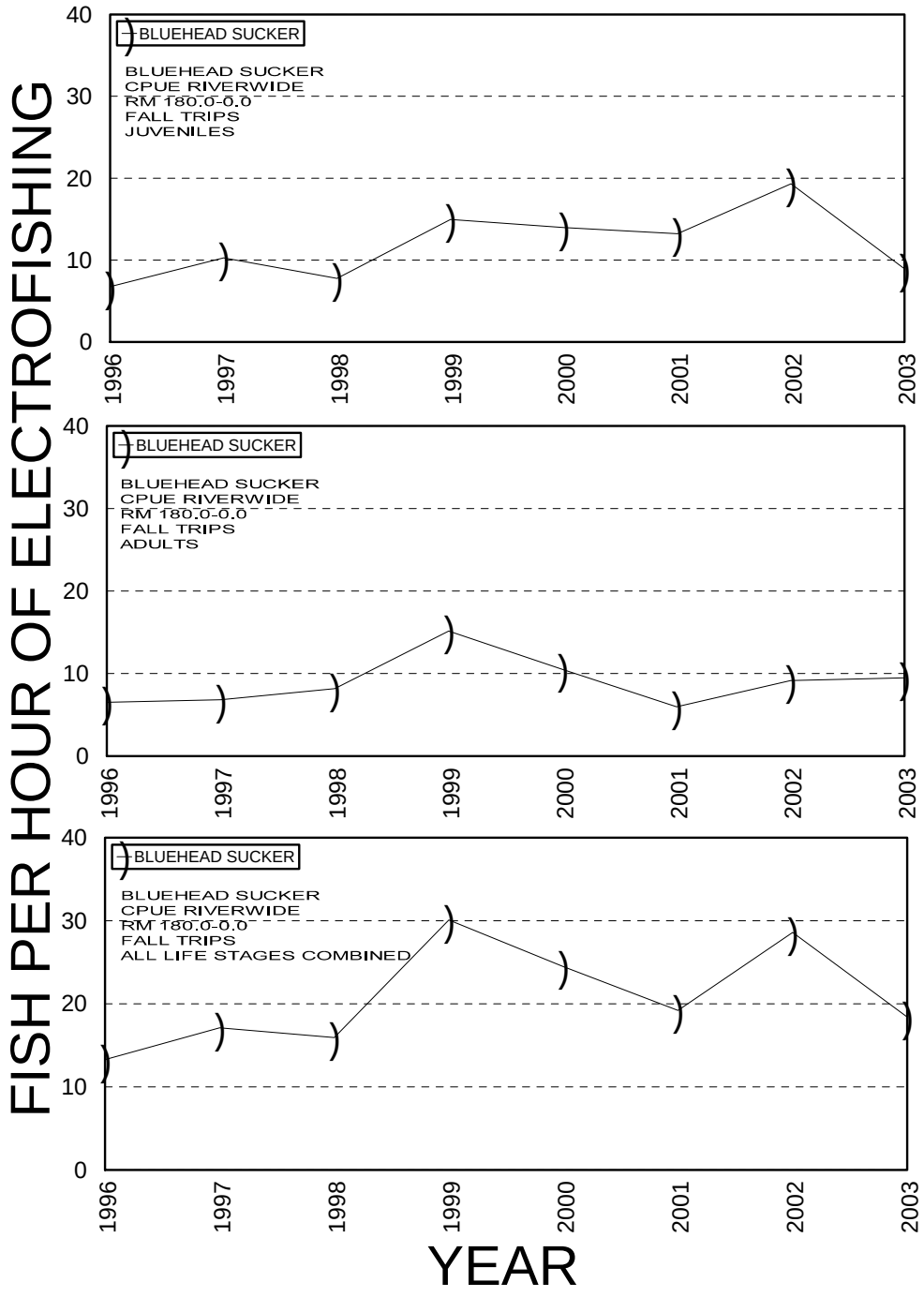

Figure 12. Bluehead sucker catch per unit effort (CPUE) riverwide (RM 180.0-0.0) on fall adult monitoring trips, for juvenile fish (< 300 mm TL; top), adult fish (≥ 300 mm TL; middle), and for all life stages combined (juveniles + adults; bottom).

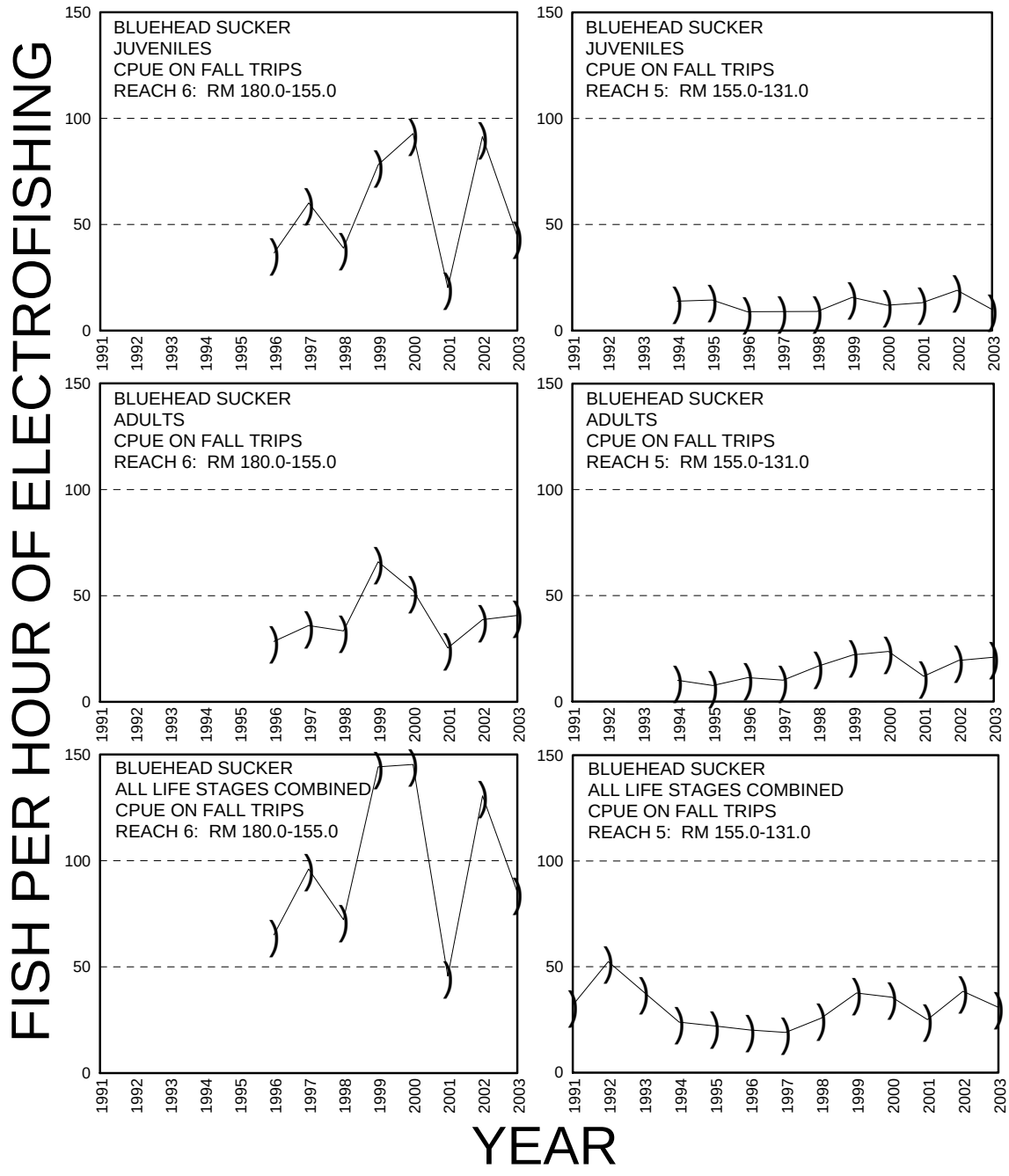

Figure 13. Bluehead sucker catch per unit effort (CPUE) in Reach 6 and Reach 5 on fall adult monitoring trips for juvenile fish (< 300 mm TL; top), adult fish (≥ 300 mm TL; middle), and for all life stages combined (juveniles + adults; bottom).

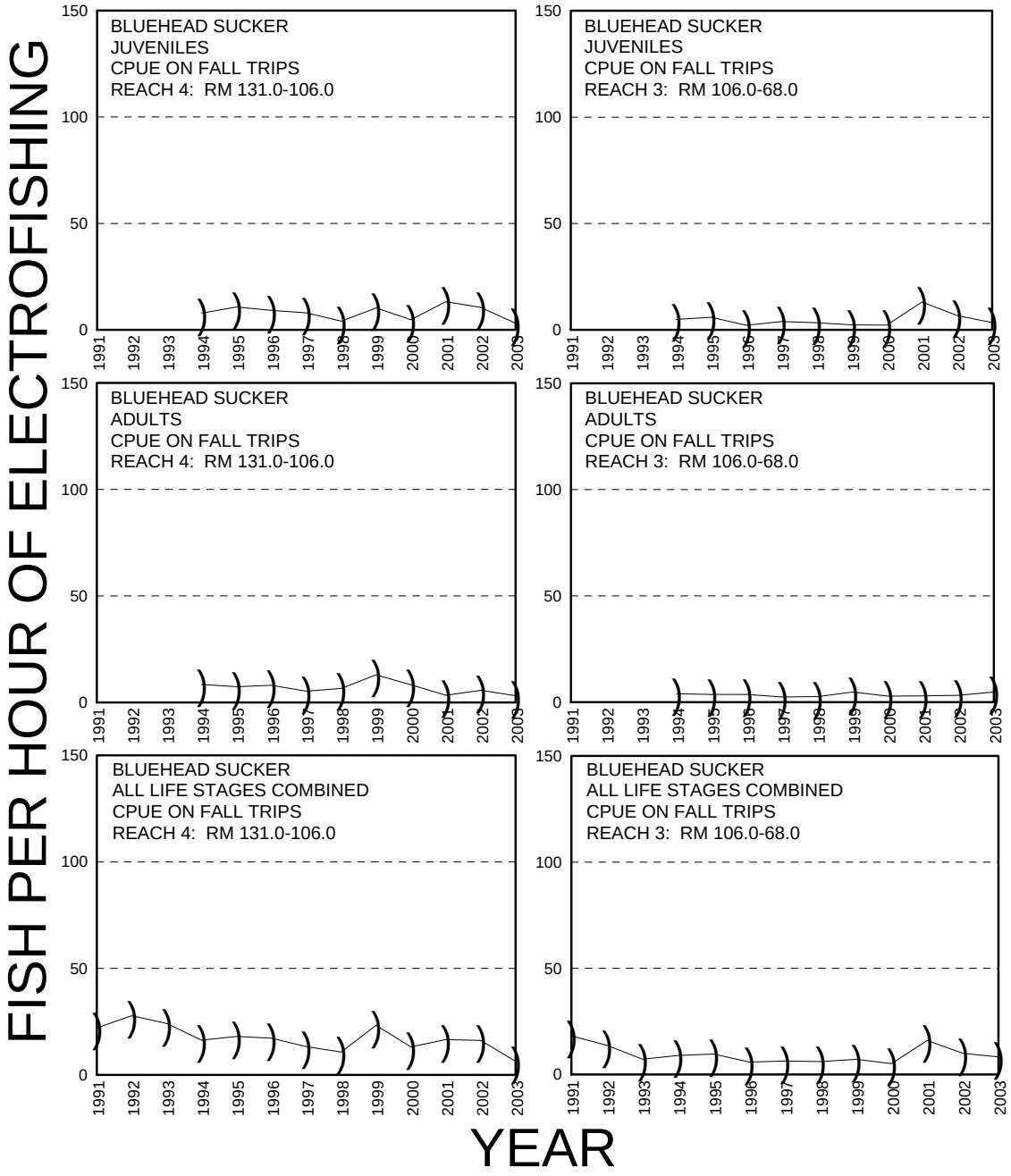

Figure 14. Bluehead sucker catch per unit effort (CPUE) in Reach 4 and Reach 3 on fall adult monitoring trips for juvenile fish (< 300 mm TL; top), adult fish (≥ 300 mm TL; middle), and for all life stages combined (juveniles + adults; bottom).

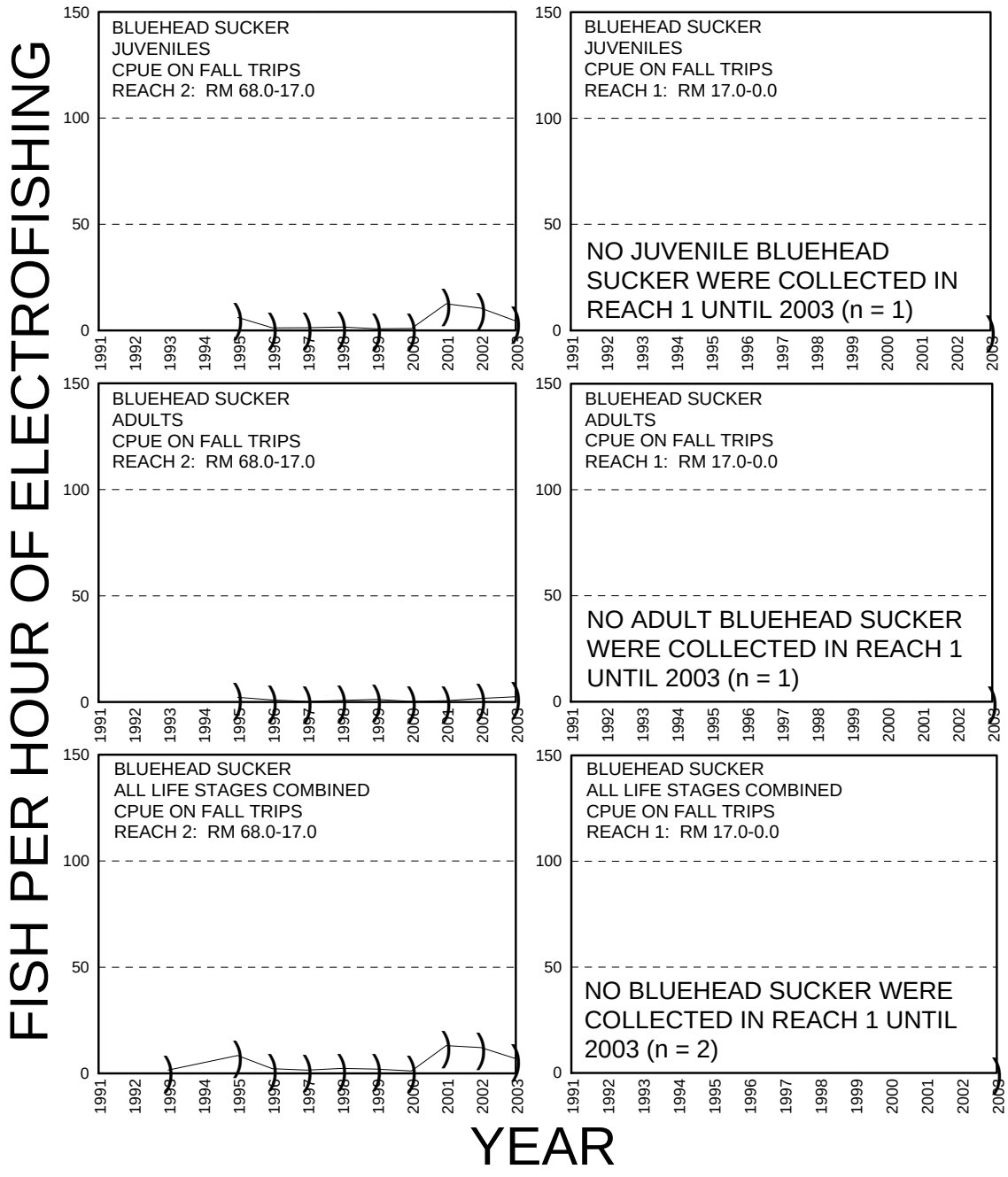

Figure 15. Bluehead sucker catch per unit effort (CPUE) in Reach 2 and Reach 1 on fall adult monitoring trips for juvenile fish (< 300 mm TL; top), adult fish (≥ 300 mm TL; middle), and for all life stages combined (juveniles + adults; bottom).

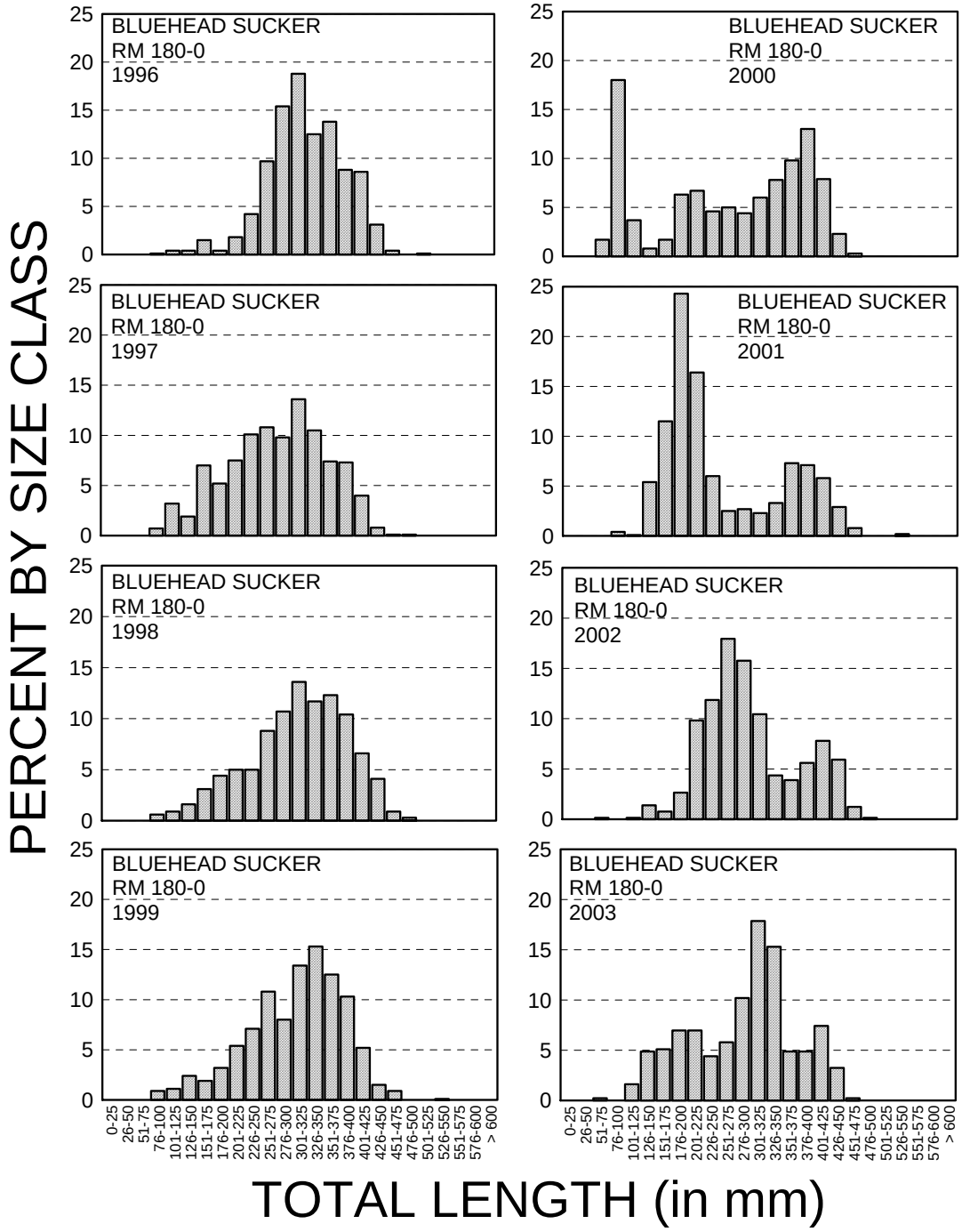

Figure 16. Length-frequency histograms showing the riverwide (RM 180.0-0.0) size-class distribution of bluehead sucker on fall adult monitoring trips in the San Juan River.

With the large influxes of young fish, bluehead sucker mean TL values (for all life stages combined) dropped markedly riverwide between 1999 and 2000 and again between 2000 and 2001 (Figure 17). Riverwide, bluehead sucker mean TL values in 2001 were lower than in any of the five preceding years (i.e., 1996-2000; Figure 17). Then, as young fish from the 2000 cohort grew larger and became large sub-adults in 2002, the riverwide mean TL value increased (Figure 17). In 2003, the riverwide mean TL fro bluehead sucker dropped again. This is due to the influx of age-1 (2002 year-class) fish that were observed in the length-frequency histograms (Figures 16 and 17).

It appears that juvenile bluehead sucker were prominent in Reaches 6-4 and in Reach 2, since mean TL dropped in all four of those reaches between 2002 and 2003 (Figure 18). This was not the case for Reach 3 however, where mean TL increased to the highest value ever observed (i.e., 312 mm TL; Figure 18).

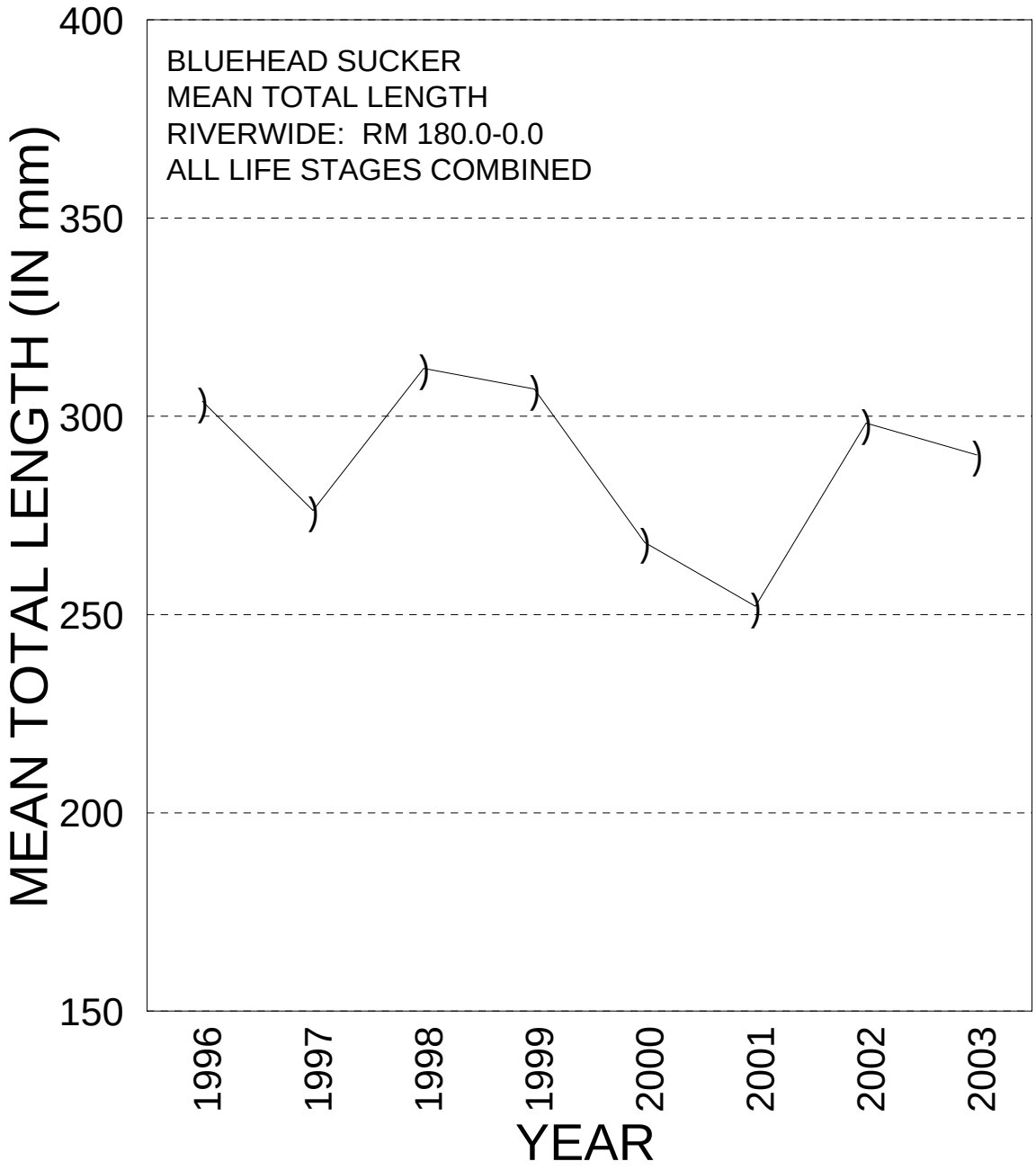

Figure 17. Mean total length (in mm) of bluehead sucker riverwide (RM 180.0-0.0) on fall adult monitoring trips in the San Juan River.

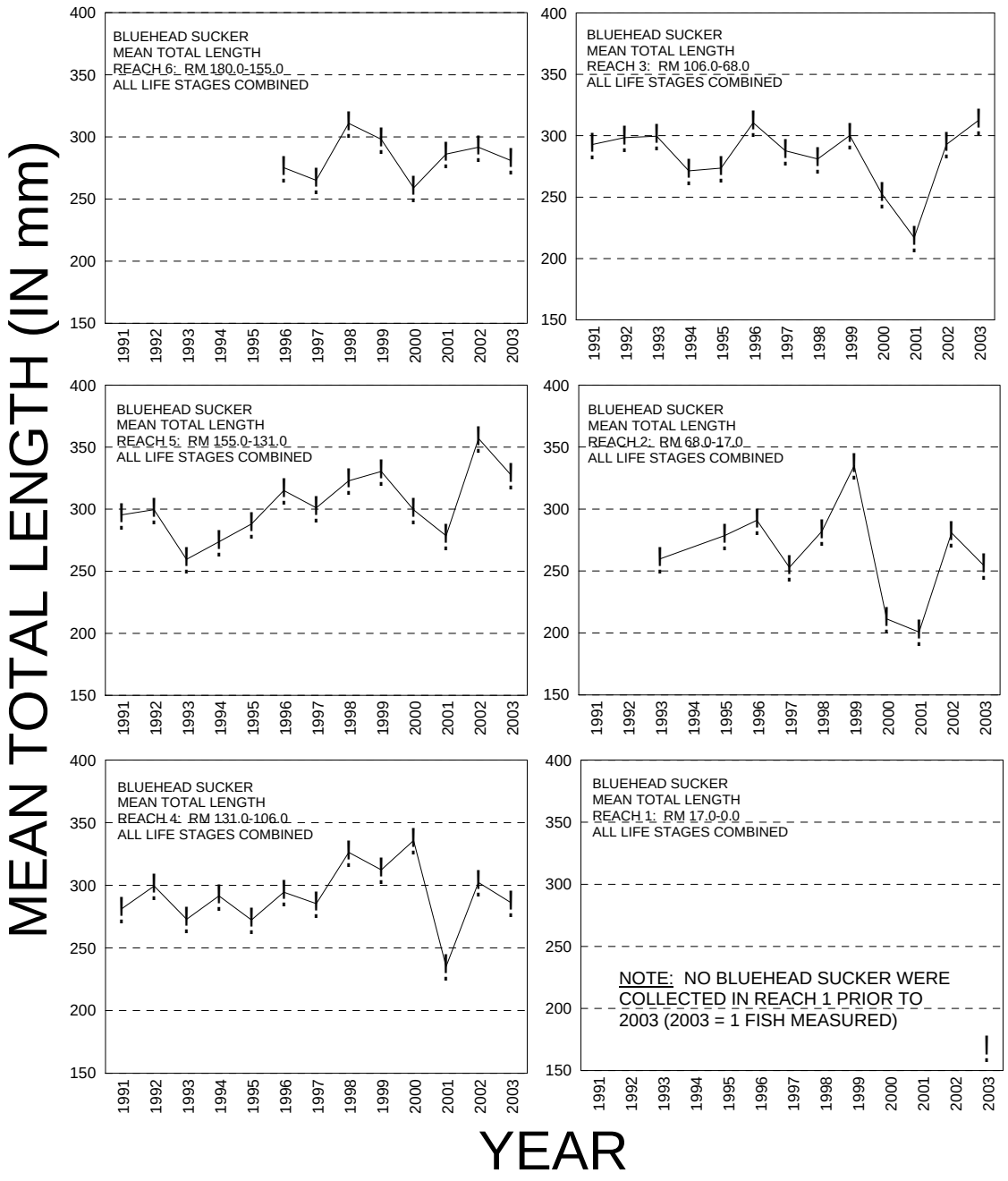

Figure 18. Mean total length (in mm) of bluehead sucker in Reaches 6-1 on fall adult monitoring trips in the San Juan River.

Common Nonnative Fishes

Channel Catfish

Catch Per Unit Effort (CPUE)

Channel catfish are the most common nonnative fish collected on adult monitoring trips (Table 3). Channel catfish are ubiquitous, being collected in a myriad of habitat types (pers. obs.) and occasionally being collected in more individual electrofishing samples than even flannelmouth sucker (Ryden 2003b). Riverwide, total CPUE for channel catfish had risen markedly between 1998 and 2001 (Figure 19). That increase was predominantly caused by an increase in juvenile fish riverwide, although adult channel catfish CPUE riverwide had also risen slightly every year since 1997 (Figure 19). Then in 2002 and again in 2003, channel catfish CPUE dropped markedly (Figure 19). Again, this was mostly caused by a large decline in numbers of juvenile fish, although numbers of adult fish collected in 2002 and again in 2003 were down as well (Figure 19). The result of this was that riverwide, total CPUE for channel catfish was at the lowest value ever observed (i.e., 13.37 fish/hr; Figure 19).

Since 1991, trends in channel catfish CPUE over time among individual reaches have been hard to discern, at best. This is mostly due to very pronounced fluctuations in juvenile channel catfish CPUE, although adult CPUE can fluctuate markedly as well. Therefore, it was no surprise when 2003 again provided very mixed results in channel catfish CPUE among reaches. Adult channel catfish CPUE was down in five of six reaches when compared to 2002, but juvenile CPUE rose in four of six reaches when compared to 2002 (Figures 20-22).

Length Frequency And Mean Total Length

The 2003 channel catfish length-frequency histogram shows several distinct year-classes of fish (Figure 23). The large cohort of channel catfish that were spawned in 2000 are now age-3 fish (centered around the 226-250 mm TL range) and currently compose about one third of the channel catfish population, riverwide (Figure 23). Like flannelmouth sucker and bluehead sucker, it appears channel catfish had a fairly successful spawning effort again in 2002, as is evidenced by the large group of fish centered around the 126-150 mm TL size-class (Figure 23). Looking at several years of length-frequency histograms, it now appears that channel catfish recruit into the adult population (i.e., $\geq$ 300 mm TL) beginning at about age-4 (Figure 23).

Channel catfish mean TL riverwide (for all life stages combined) has risen steadily over the last four years (1999-2003) as fish spawned in the mid- to late 1990's (e.g., 1996-1998) have begun recruiting into the larger adult size-classes (i.e., > 400 mm TL; Figures 23 and 24). These fish are beginning to replace the larger size-class channel catfish that were removed when mechanical removal efforts were initiated, beginning in 1996.

However, this increase in channel catfish mean TL riverwide seems to be mostly reflective of what is happening in the upstream river reaches (Reaches 6-4), most specifically in Reach 5 (Figure 25). In Reaches 2 and 1, the trend in channel catfish mean TL over time has actually been declining, while the trend in Reach 3 has essentially been flat (Figure 25).

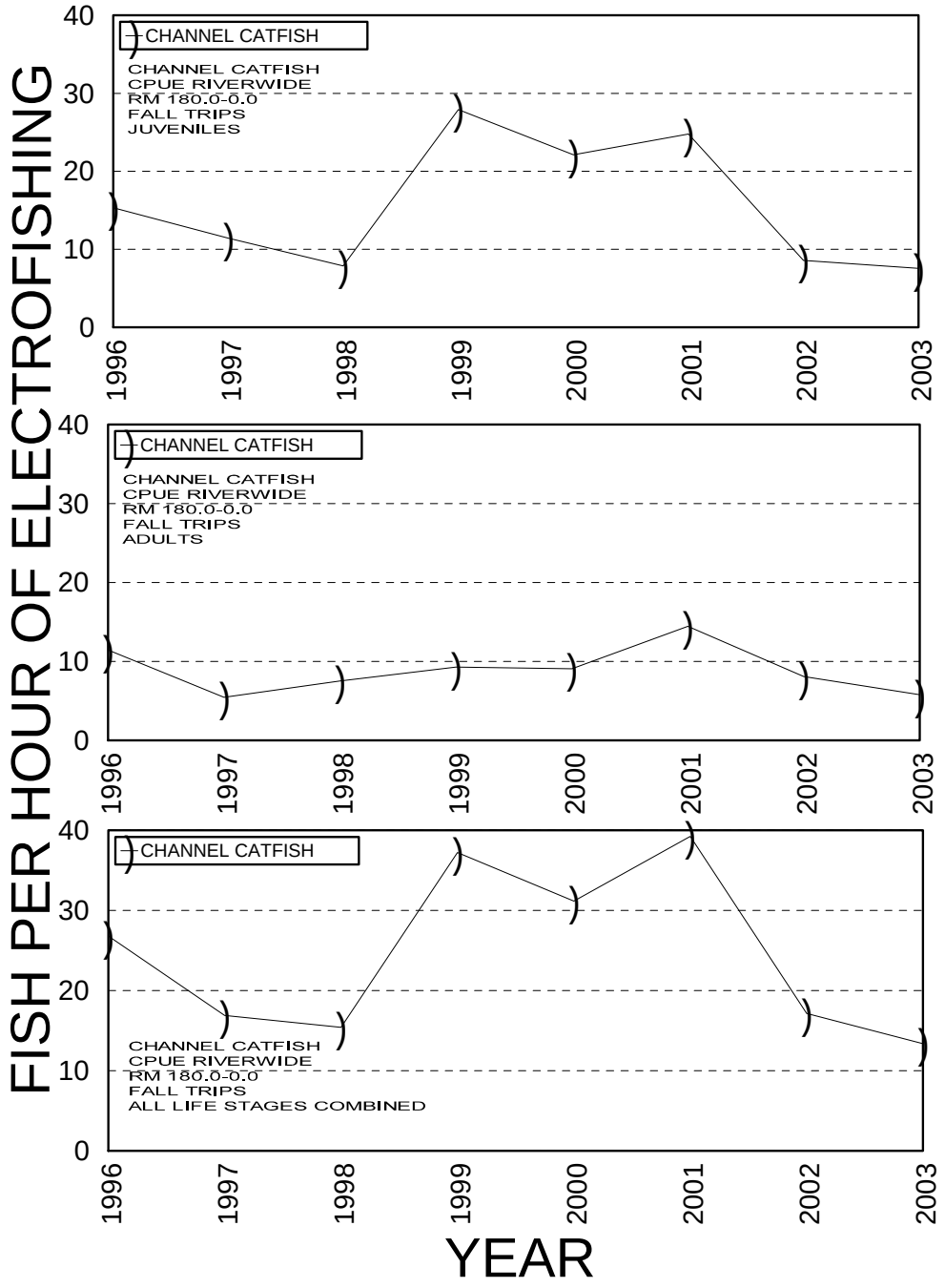

Figure 19. Channel catfish catch per unit effort (CPUE) riverwide (RM 180.0-0.0) on fall adult monitoring trips, for juvenile fish (< 300 mm TL; top), adult fish (≥ 300 mm TL; middle), and for all life stages combined (juveniles + adults; bottom).

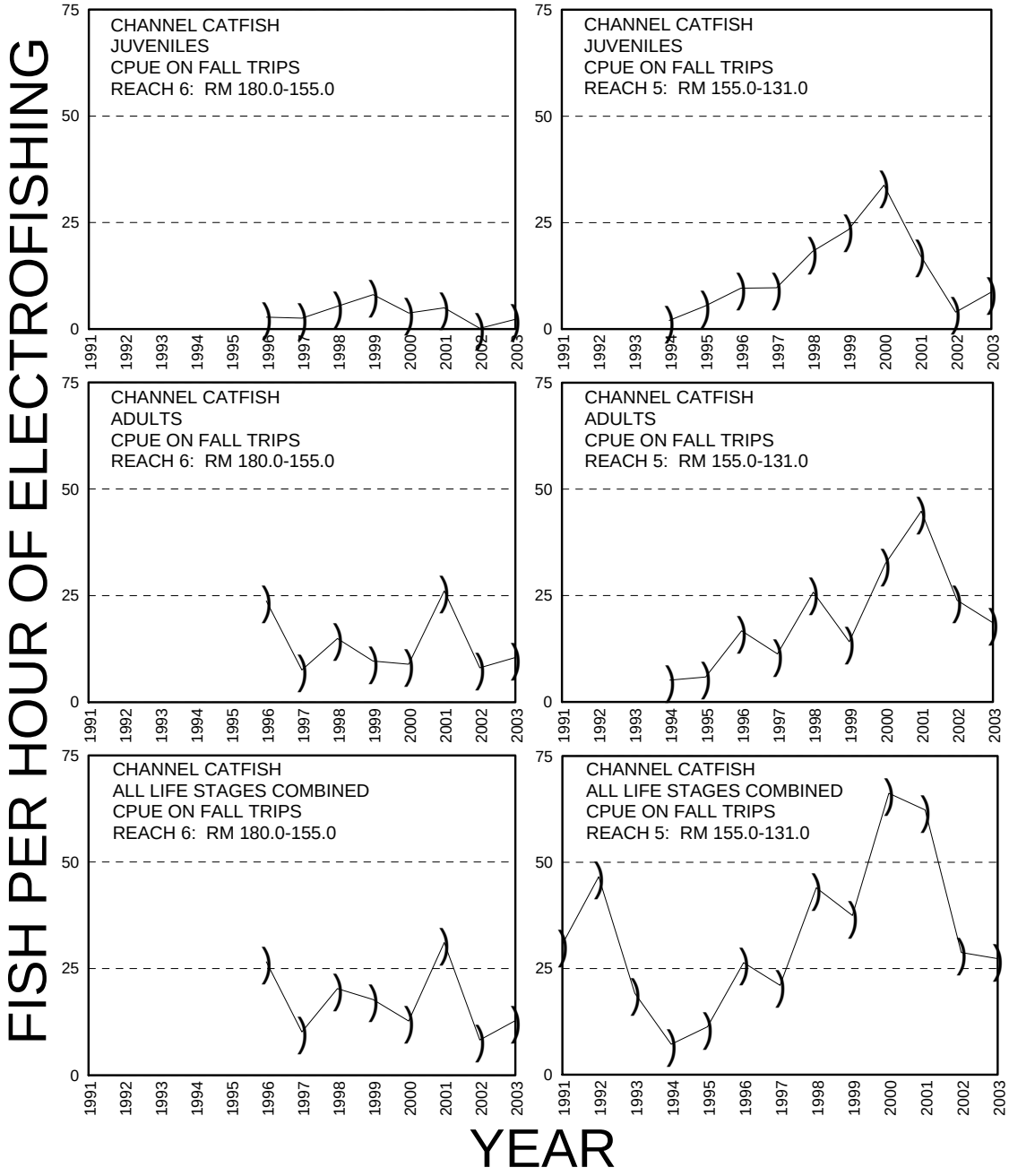

Figure 20. Channel catfish catch per unit effort (CPUE) in Reach 6 and Reach 5 on fall adult monitoring trips for juvenile fish (< 300 mm TL; top), adult fish (≥ 300 mm TL; middle), and for all life stages combined (juveniles + adults; bottom).

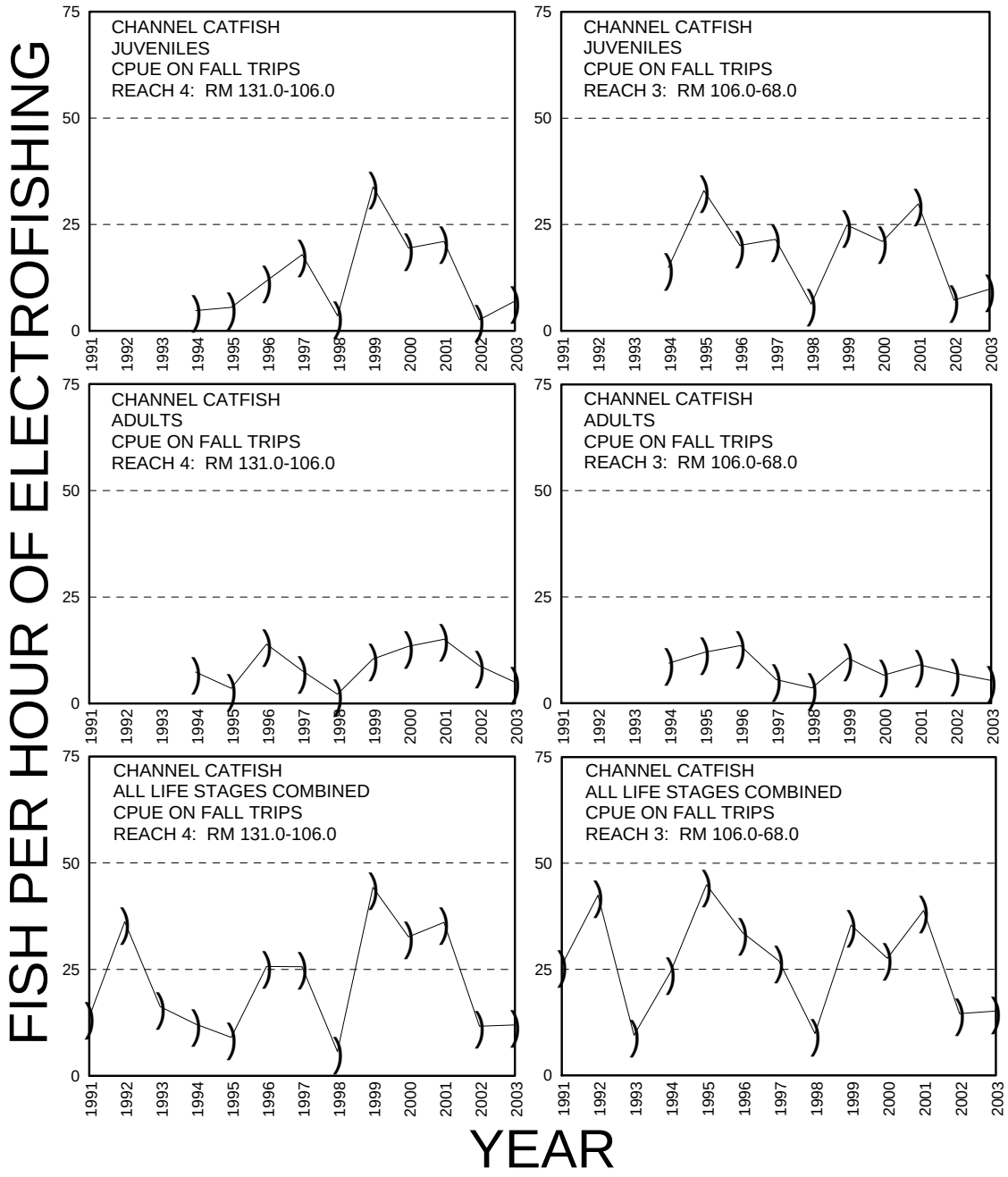

Figure 21. Channel catfish catch per unit effort (CPUE) in Reach 4 and Reach 3 on fall adult monitoring trips for juvenile fish (< 300 mm TL; top), adult fish (≥ 300 mm TL; middle), and for all life stages combined (juveniles + adults; bottom).

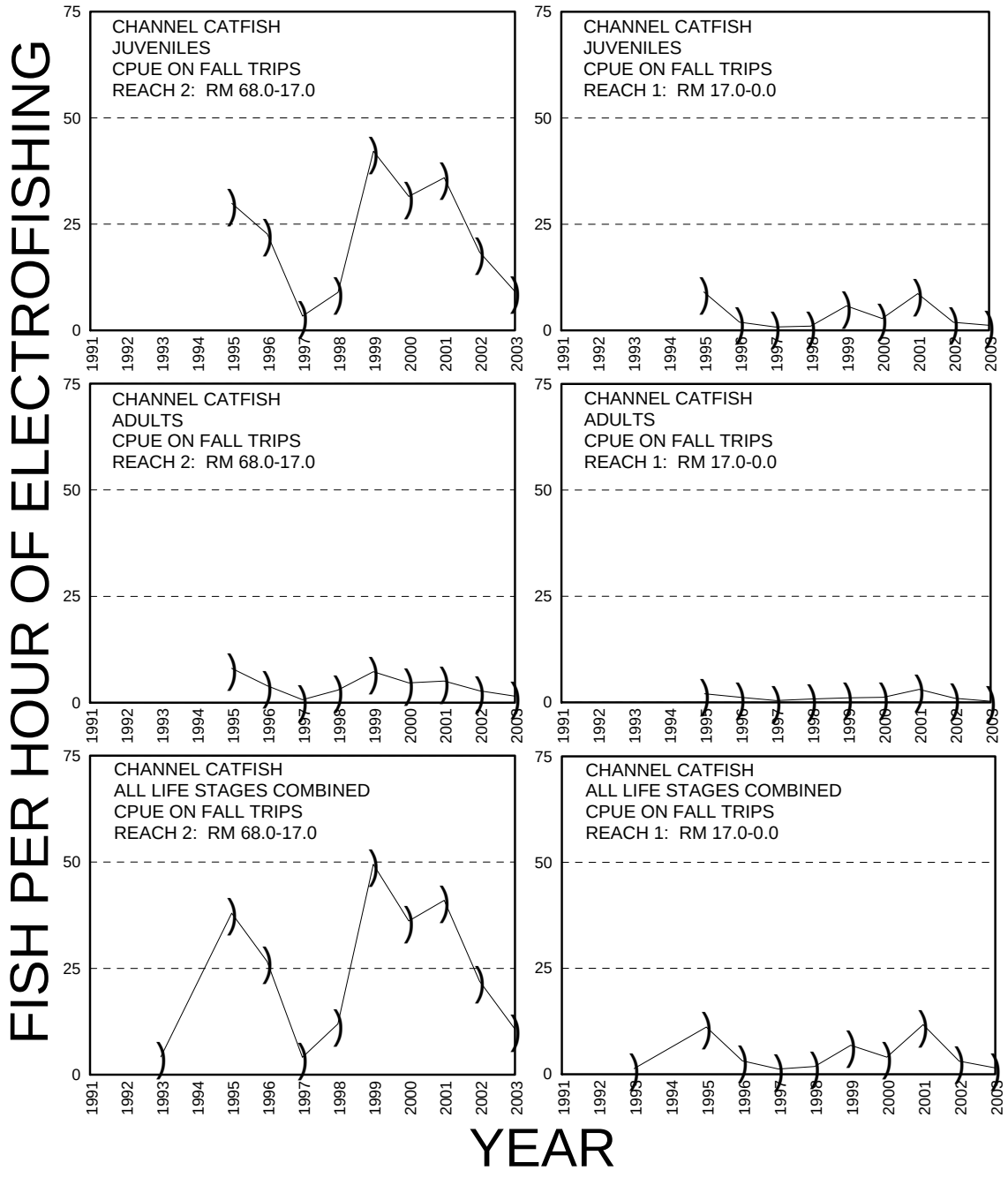

Figure 22. Channel catfish catch per unit effort (CPUE) in Reach 2 and Reach 1 on fall adult monitoring trips for juvenile fish (< 300 mm TL; top), adult fish (≥ 300 mm TL; middle), and for all life stages combined (juveniles + adults; bottom).

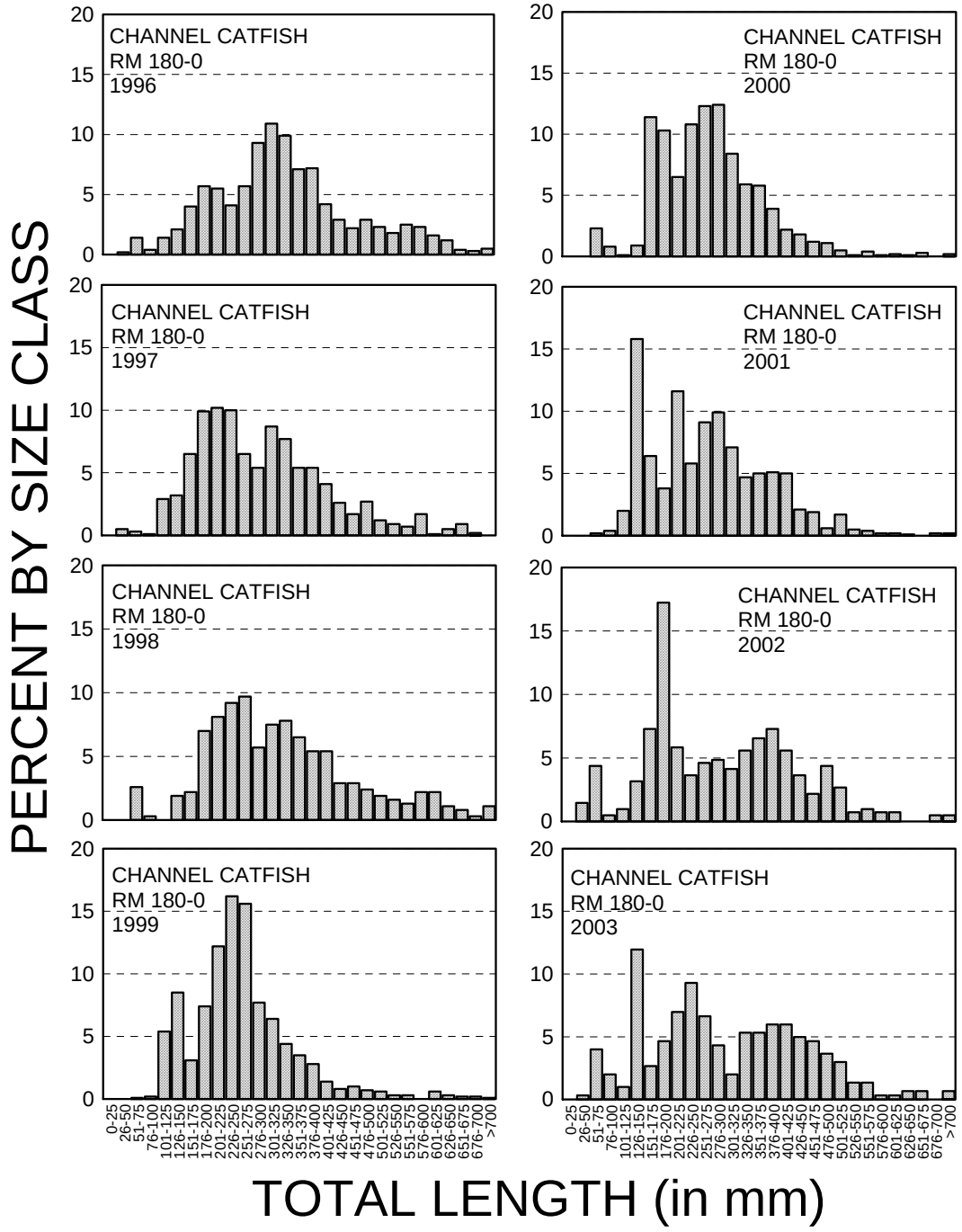

Figure 23. Length-frequency histograms showing the riverwide (RM 180.0-0.0) size-class distribution of channel catfish on fall adult monitoring trips in the San Juan River.

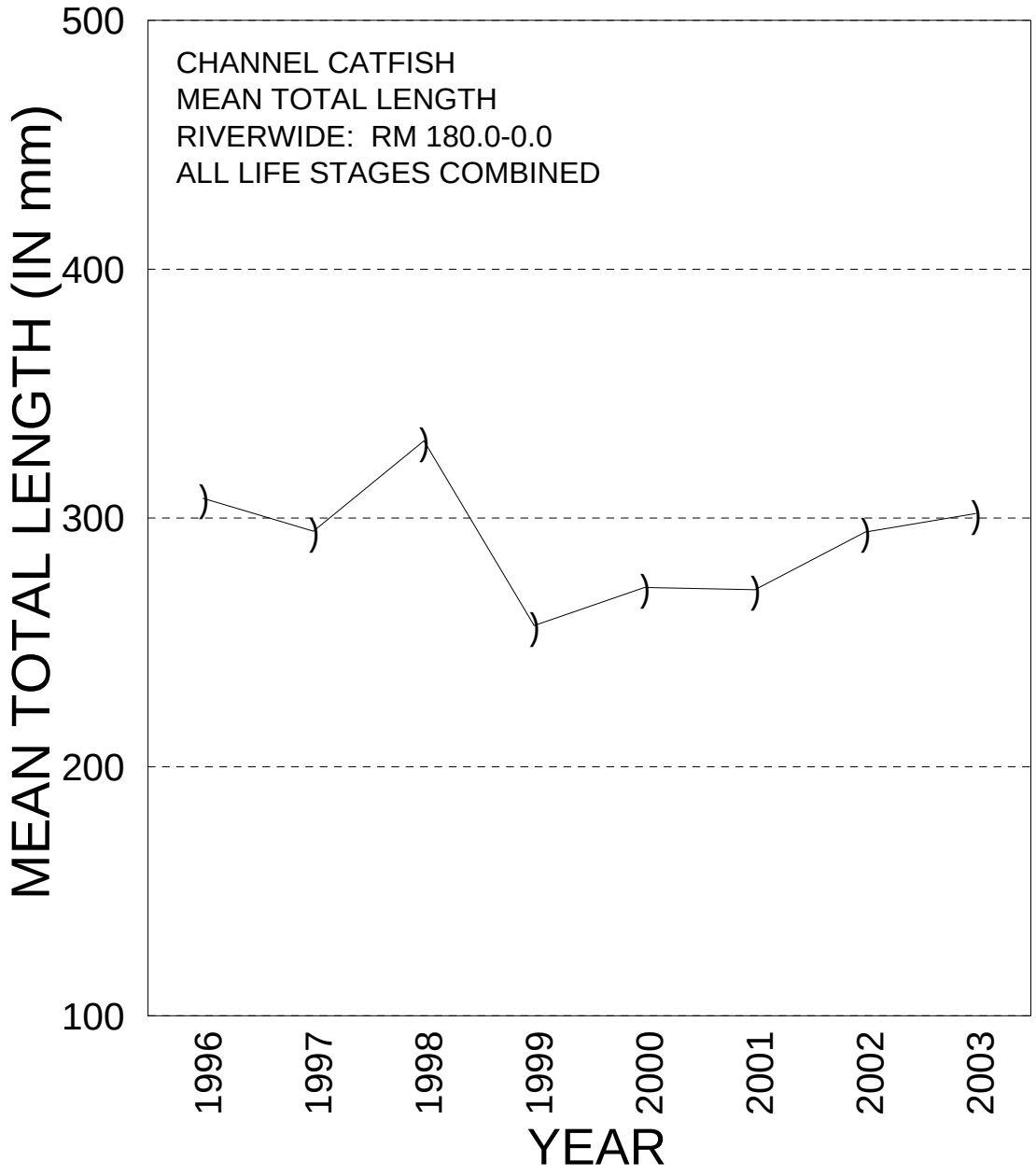

Figure 24. Mean total length (in mm) of channel catfish riverwide (RM 180.0-0.0) on fall adult monitoring trips in the San Juan River.

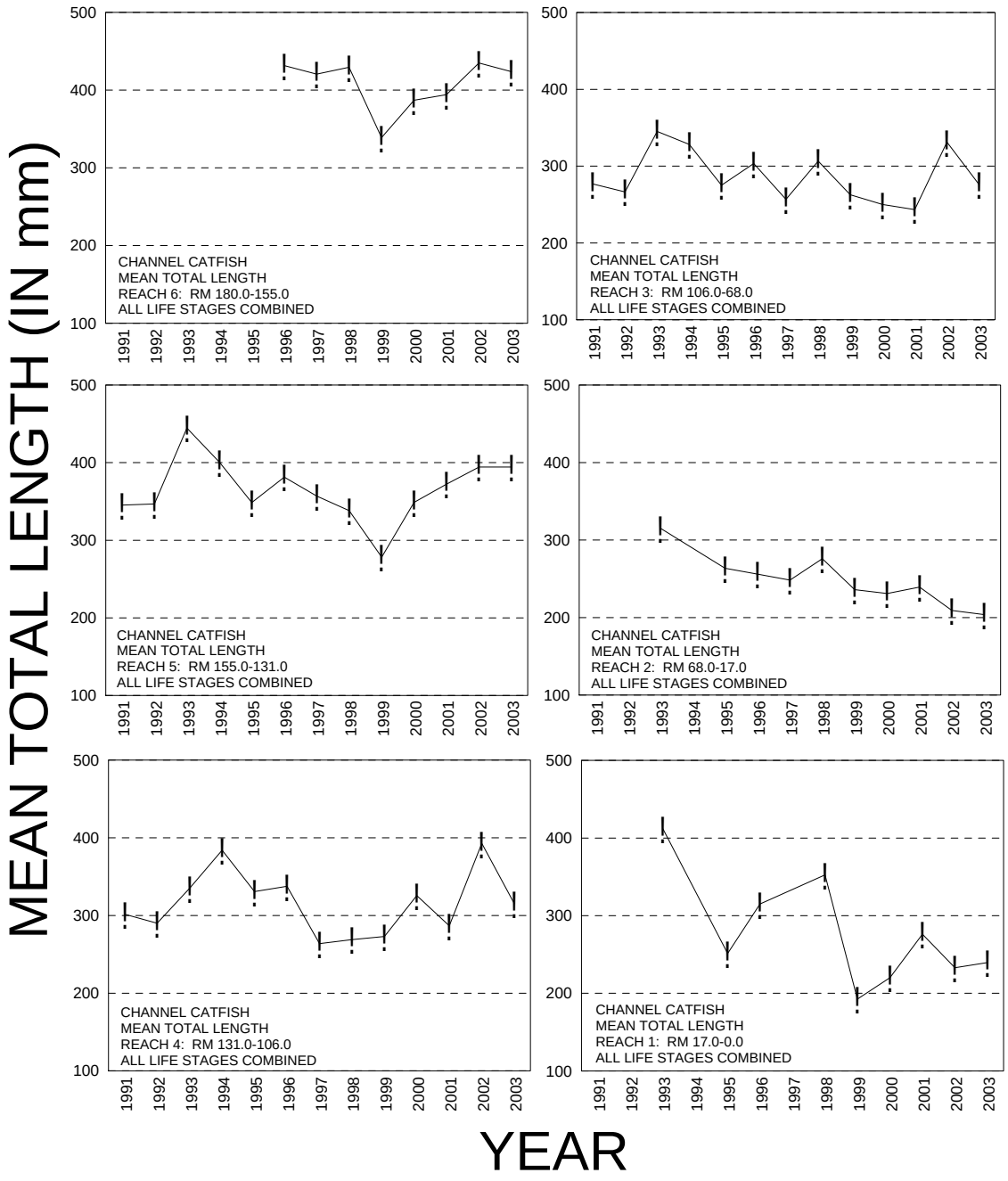

Figure 25. Mean total length (in mm) of channel catfish in Reaches 6-1 on fall adult monitoring trips in the San Juan River.

Common Carp

Catch Per Unit Effort (CPUE)

Riverwide, common carp total CPUE has declined steadily over the last four years, reaching the lowest value ever observed (5.67 fish/hr) in 2003 (Figure 26). This is due to an almost three-fold drop in CPUE among adult common carp (by far the most commonly-collected life-stage among common carp in the San Juan River) over the 1996-2003 time period (Figure 26). Despite their rarity when compared to adult fish, relatively large numbers of juvenile common carp were collected in 2000 and again in 2002 when compared to other years (Figure 26).

Trying to discern trends in adult common carp CPUE in individual reaches over the years has been difficult. Numbers of adult common carp in any given reach tend to fluctuate dramatically between years, making overall trends hard to fathom. It is possible that this could be an indication of fairly large-scale movements of adult common carp between reaches. However, even with the variable adult CPUE's, there are two trends that seem to stand out.

In Reach 6, CPUE among adult common carp steadily declined between 1996 (i.e., when nonnative removal efforts began) and 2003 (Figure 27). This trend would seem to indicate that fisheries managers were able to achieve a marked reduction in numbers of adult common carp through mechanical removal efforts. The other trend that is noticeable is that common carp total CPUE dropped in all six river reaches between 2002 and 2003 (Figures 27-29). In most river reaches this drop in common carp total CPUE has been ongoing for multiple years (Figures 27 and 28). Whether these declines in total CPUE among common carp observed between 2002 and 2003 are linked to mechanical removal efforts, to the large flow spikes which immediately preceded both the 2002 and 2003 adult monitoring trips, or to some other factor is unknown.

Length Frequency And Mean Total Length

Typically, riverwide length-frequency histograms of common carp show a population whose main channel component is based almost completely around large, adult fish (> 375 mm TL) in every year except 2000 and 2002 (Figure 30). The length-frequency histogram in 2003 was no exception to this. Even in 2000 and 2002, when relatively large numbers of age-0 common carp (based around the 51-100 mm TL size-classes in 2002 and the 76-125 mm size-classes in 2002) were collected, causing bimodal length-frequency distributions, the larger of the two modes in both years were still based around large, adult fish (Figure 30).

Declines in common carp mean TL riverwide observed in 2000 and again in 2002 (Figure 31) were a direct result of the collection of large numbers of age-0 fish in Reaches 6-4 in these two years (Figures 27 and 28). If these two years are excised from the data set, there has been a generally increasing trend in common carp mean TL riverwide between 1996 and 2003, with the average size of common carp riverwide in 2003 being the largest ever observed. In every river reach, mean TL was greater in 2003 than it was when riverwide studies began in 1996 (Figure 32). Mean TL rose in every river reach between 2002 and 2003, although only slightly in Reach 2. This trend towards a larger mean body length in common carp has been a long-developing trend in most river reaches since the early 1990's (Figure 32).

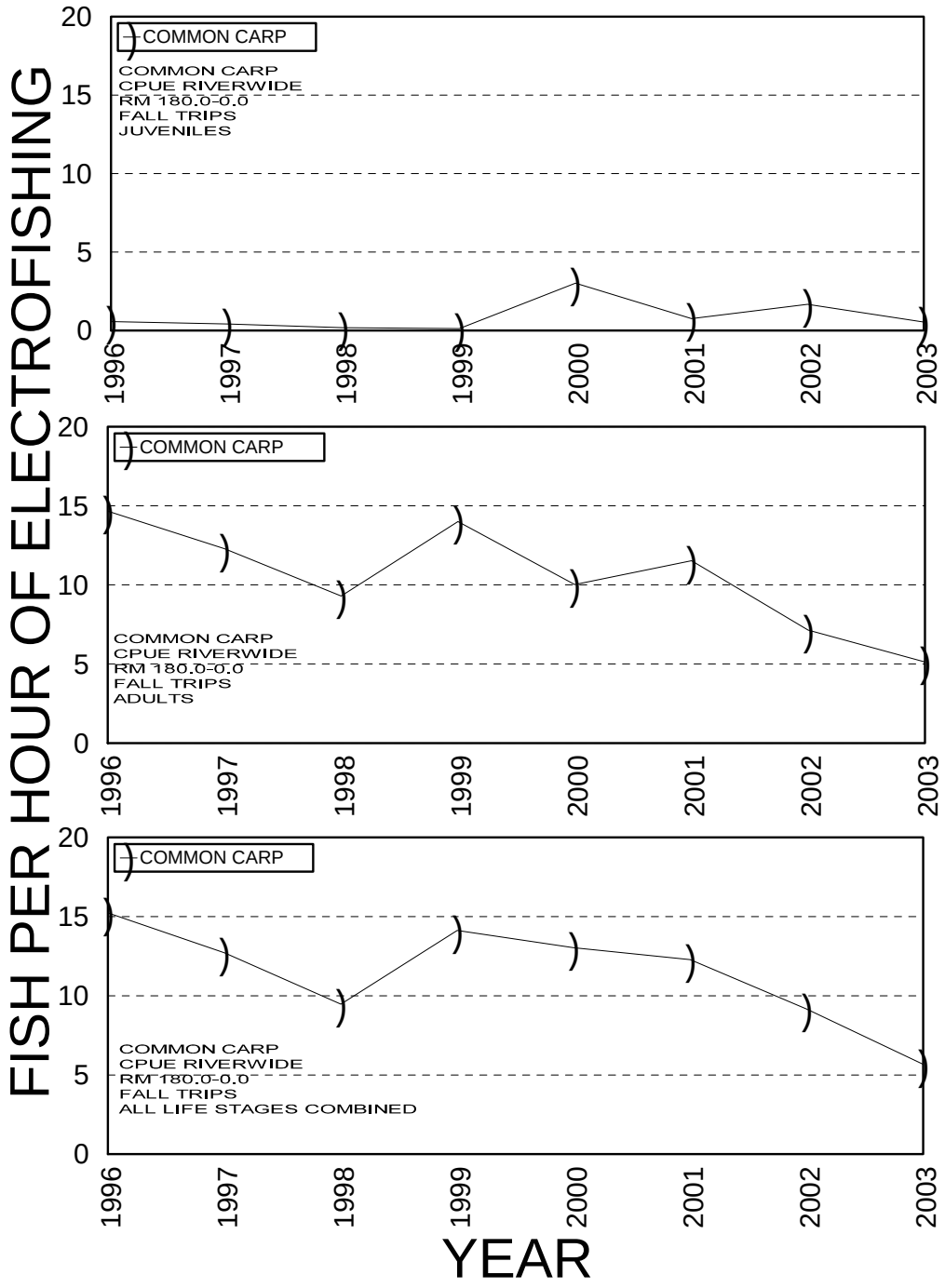

Figure 26. Common carp catch per unit effort (CPUE) riverwide (RM 180.0-0.0) on fall adult monitoring trips, for juvenile fish (< 250 mm TL; top), adult fish (≥ 250 mm TL; middle), and for all life stages combined (juveniles + adults; bottom).

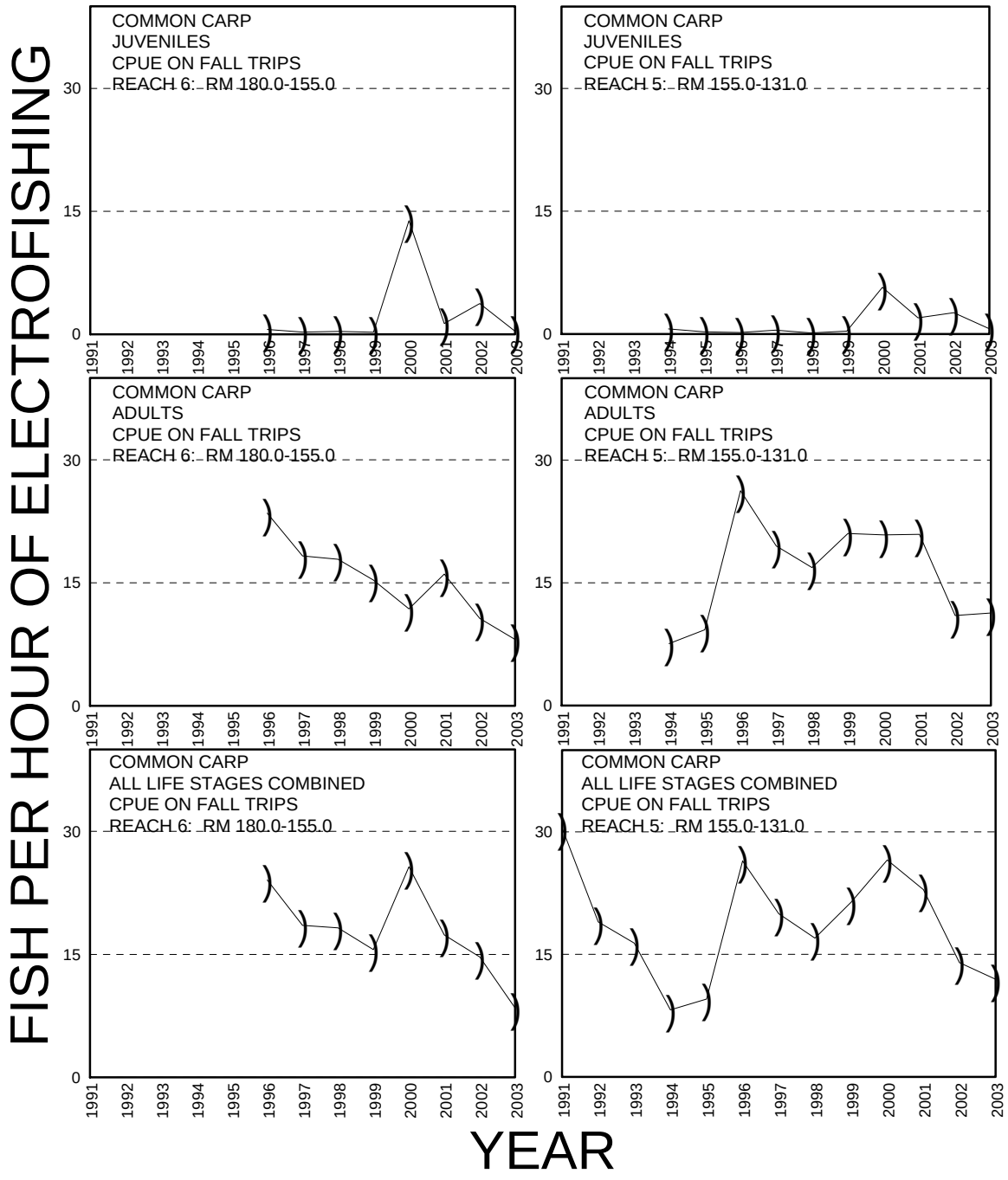

Figure 27. Common carp catch per unit effort (CPUE) in Reach 6 and Reach 5 on fall adult monitoring trips for juvenile fish (< 250 mm TL; top), adult fish (≥ 250 mm TL; middle), and for all life stages combined (juveniles + adults; bottom).

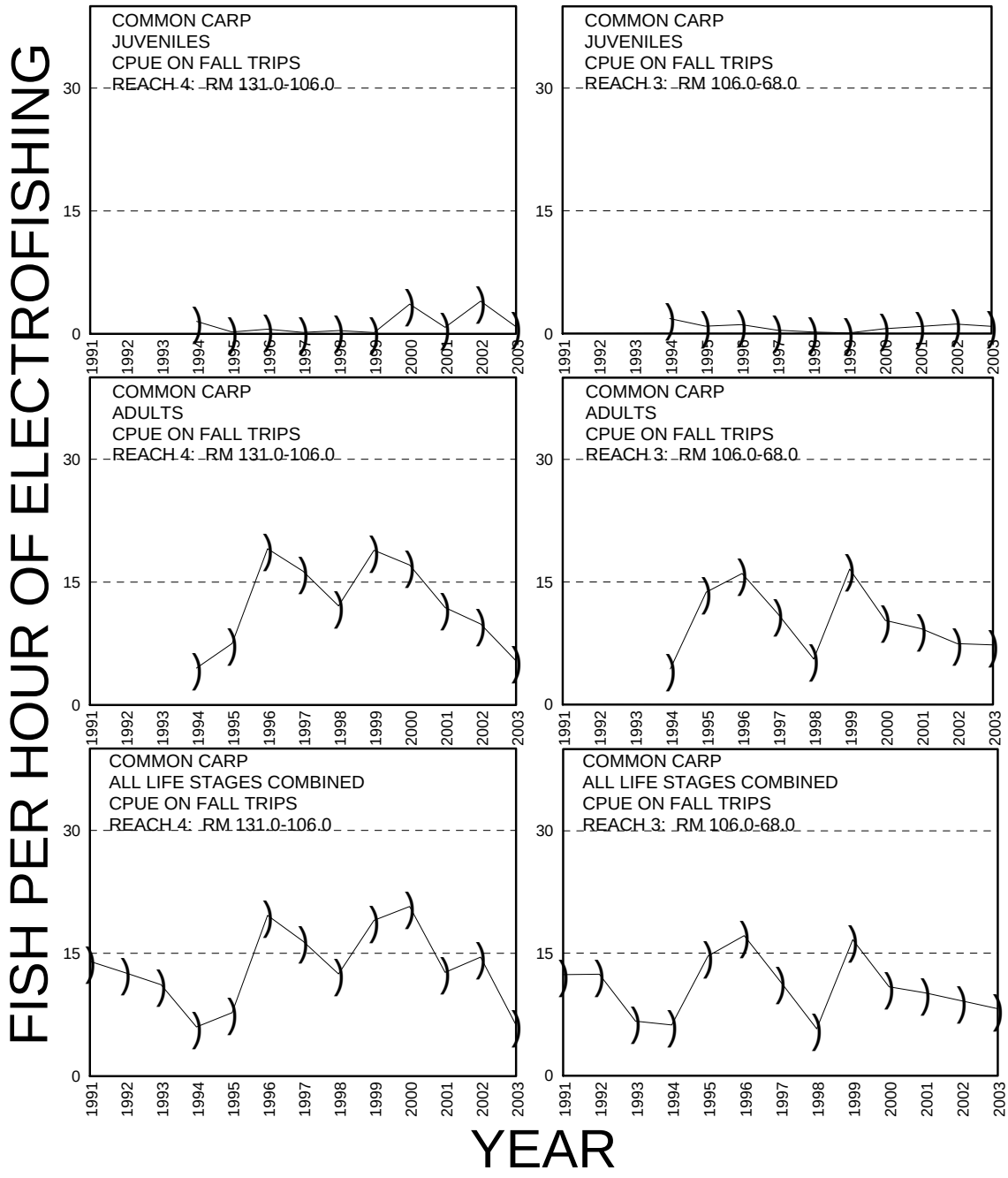

Figure 28. Common carp catch per unit effort (CPUE) in Reach 4 and Reach 3 on fall adult monitoring trips for juvenile fish (< 250 mm TL; top), adult fish (≥ 250 mm TL; middle), and for all life stages combined (juveniles + adults; bottom).

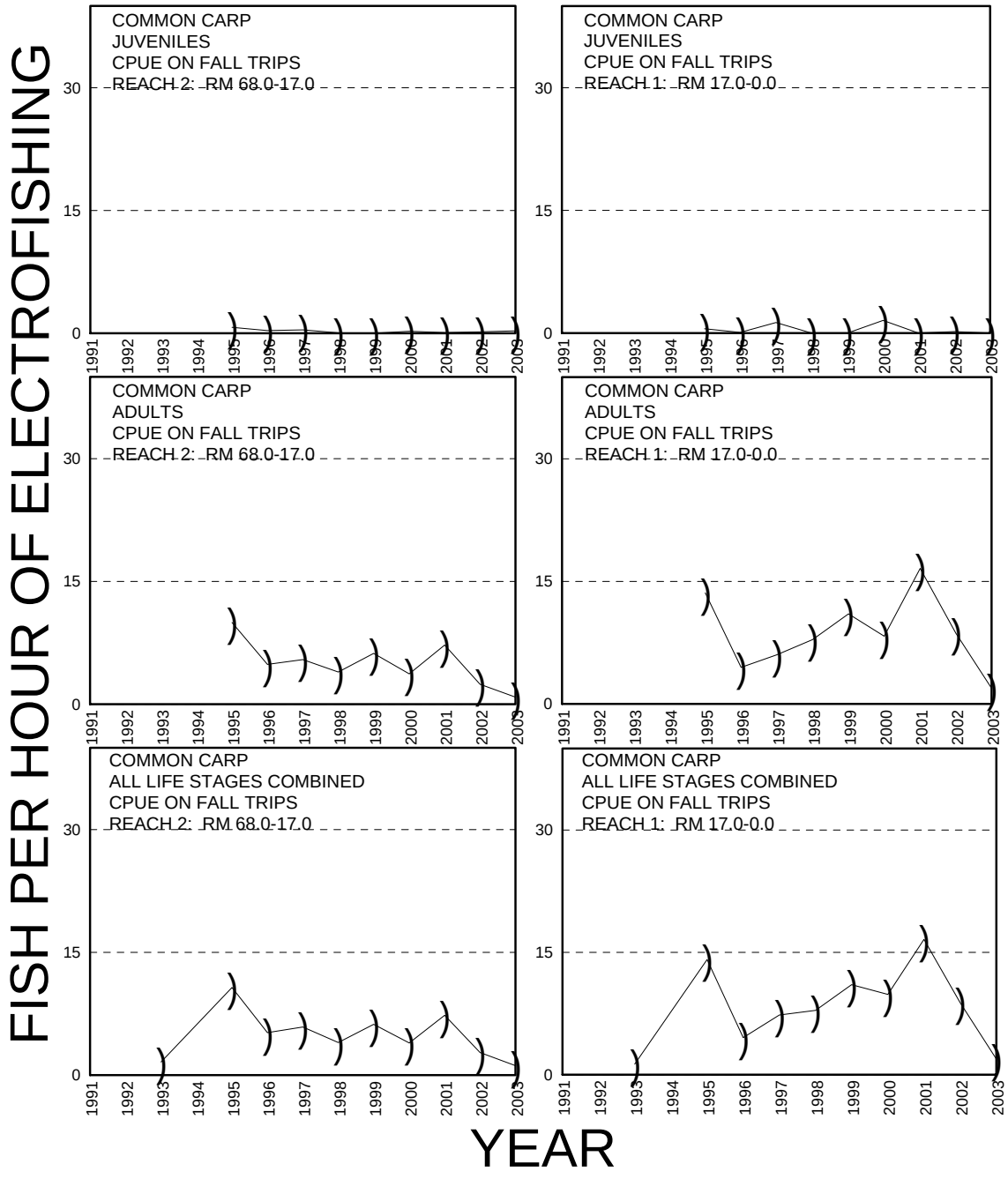

Figure 29. Common carp catch per unit effort (CPUE) in Reach 2 and Reach 1 on fall adult monitoring trips for juvenile fish (< 250 mm TL; top), adult fish (≥ 250 mm TL; middle), and for all life stages combined (juveniles + adults; bottom).

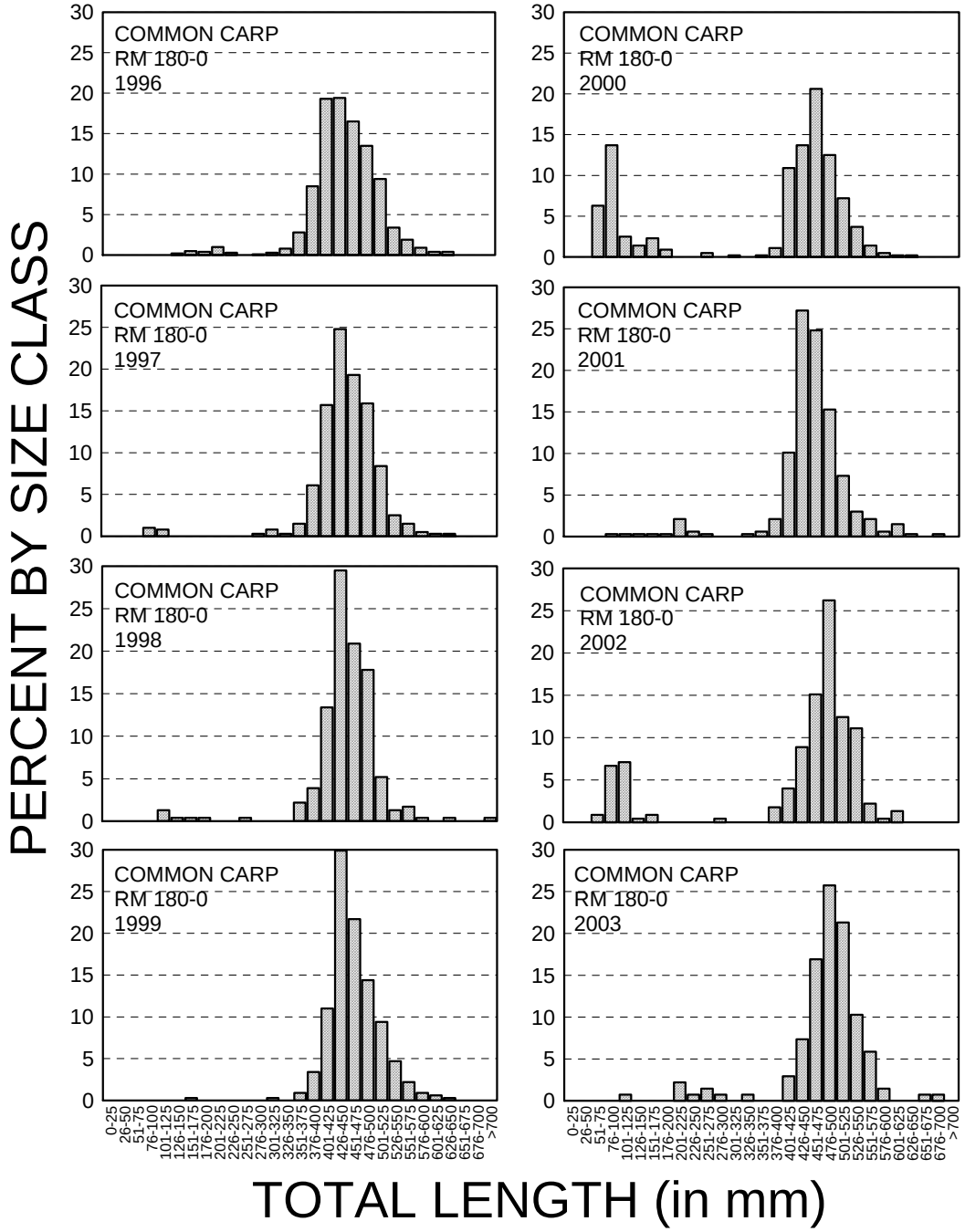

Figure 30. Length-frequency histograms showing the riverwide (RM 180.0-0.0) size-class distribution of common carp on fall adult monitoring trips in the San Juan River.

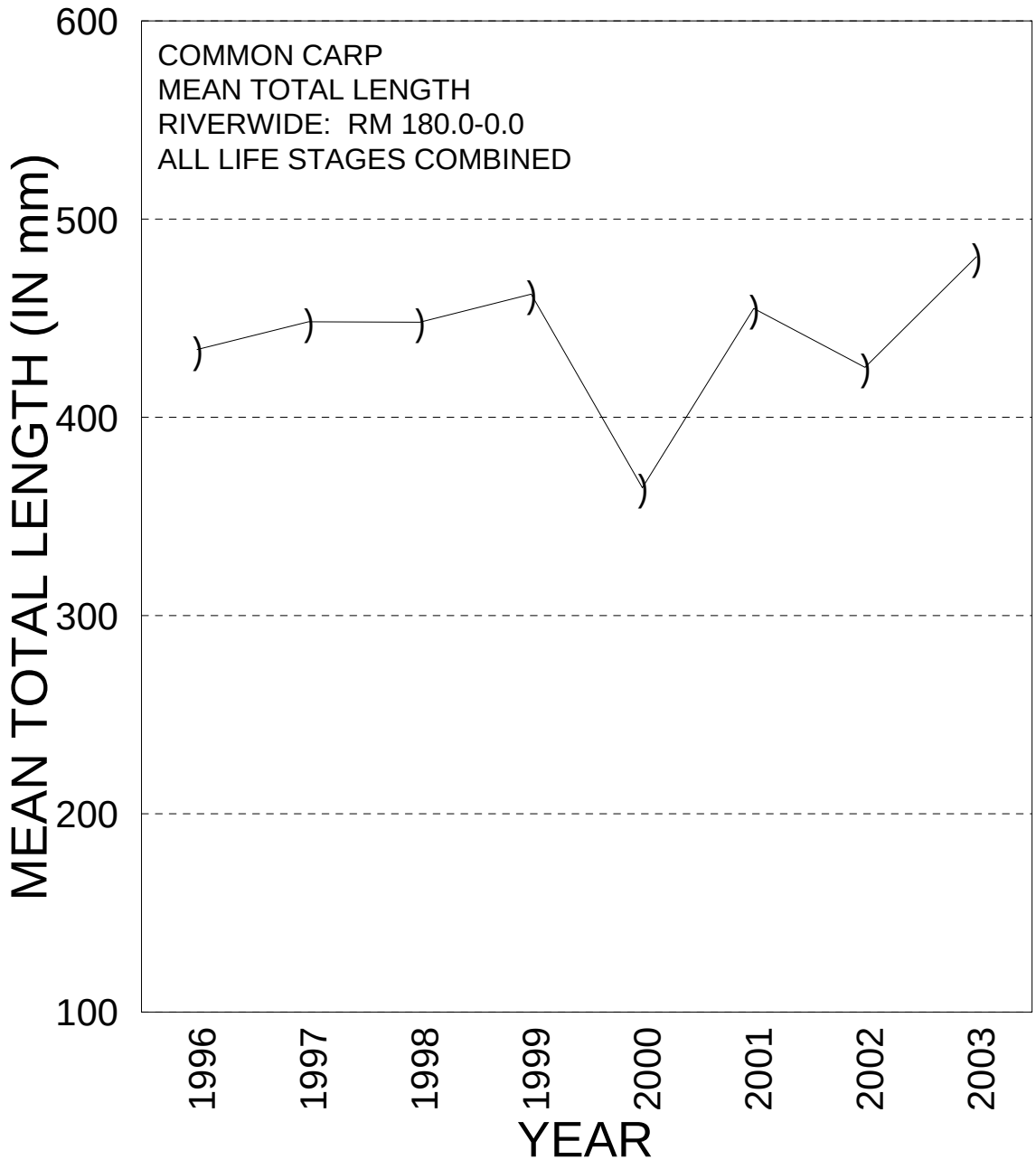

Figure 31. Mean total length (in mm) of common carp riverwide (RM 180.0-0.0) on fall adult monitoring trips in the San Juan River.

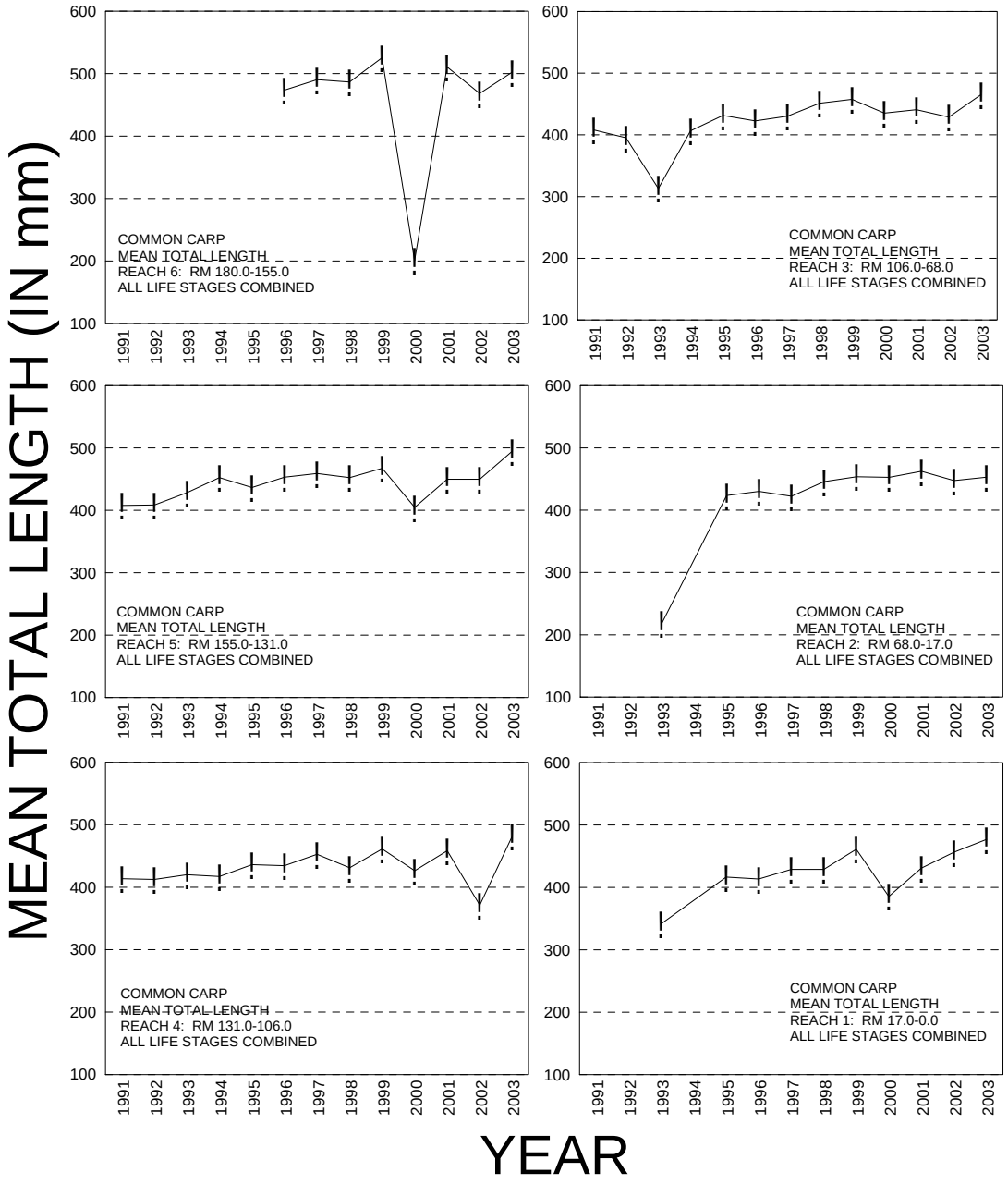

Figure 32. Mean total length (in mm) of common carp in Reaches 6-1 on fall adult monitoring trips in the San Juan River.

Other Nonnative Fishes

Largemouth Bass, Striped Bass, and Walleye

In most years, largemouth bass, striped bass, and walleye tend to be very rare in adult monitoring collections (Table 10). In fact in six of the seven years preceding 2003 (excluding 2000), the total CPUE for these three species combined in any given year never exceeded 0.31 fish/hr of electrofishing (Table 10). This was the case again in 2003. No striped bass or walleye were collected during 2003 adult monitoring collections (Table 10). In addition, only two largemouth bass, both juvenile fish, were collected (Table 10). One juvenile (135 mm TL) was collected in Reach 6, between RM 156.0 and RM 155.0. This fish had a 39 mm SL speckled dace in its stomach. The second juvenile (148 mm TL) was collected in Reach 3, between RM 102.0 and RM 101.0. This fish had unidentifiable fish parts in its stomach.

Table 10. A comparison of numbers of fish collected and riverwide catch per unit effort (CPUE), for largemouth bass, striped bass, and walleye collected during adult monitoring trips in the San Juan River.

Year	Number Of Hours Of Electrofishing	Total Numbers Collected, Life Stages and (CPUE) by Species		
		Largemouth Bass	Striped Bass	Walleye
1996	165.41	Total = 16 16 juveniles (0.10/hr)	Total = 14 14 adults (0.08/hr)	Total = 21 21 adults (0.13/hr)
1997	166.01	Total = 2 2 adults (0.01/hr)	Total = 0 (0.00/hr)	Total = 9 5 juveniles 4 adults (0.05/hr)
1998	137.15	Total = 5 5 juveniles (0.04/hr)	Total = 17 6 juveniles 11 adults (0.12/hr)	Total = 6 1 juvenile 5 adults (0.04/hr)
1999	88.36	Total = 0 (0.00/hr)	Total = 0 (0.00/hr)	Total = 9 9 adults (0.10/hr)
2000	116.89	Total = 111 109 juveniles 2 adults (0.95/hr)	Total = 109 1 juvenile 108 adults (0.93/hr)	Total = 7 7 adults (0.06/hr)
2001	109.61	Total = 2 2 juveniles (0.02/hr)	Total = 2 2 adults (0.02/hr)	Total = 1 1 adult (0.01/hr)
2002	92.17	Total = 7 1 YOY/2 juv.'s 4 adults (0.08/hr)	Total = 0 (0.00/hr)	Total = 0 (0.00/hr)
2003	94.42	Total = 2 2 juveniles (0.02/hr)	Total = 0 (0.00/hr)	Total = 0 (0.00/hr)

DISCUSSION

Rare Native Fishes

Colorado Pikeminnow

Collections of wild adult Colorado pikeminnow have been extremely rare since 1995. Numbers of recaptures among stocked juvenile Colorado pikeminnow increased in 2003, but not as much as was anticipated, given the number of age-0 fish that were stocked in October 2002. It is assumed that the large flow spike which almost immediately preceded the fall 2003 adult monitoring trip caused at least some downstream displacement among stocked Colorado pikeminnow. It is entirely possible that this event, which was > 20,000 CFS downstream of Bluff, Utah transported many of these fish downstream into Lake Powell. Once in the lake, these fish would be unable to return upstream due to the formation of a new waterfall just upstream of Piute Farms (RM 0.0). It is anticipated that with the fall 2003 stocking of age-0 Colorado pikeminnow, that Colorado pikeminnow CPUE on the fall 2004 adult monitoring trip should roughly double over that seen on the fall 2003 trip.

A small percentage of Colorado pikeminnow that were stocked as juveniles between 1996 and 2000 continue to persist in the San Juan River. A few of these have recruited into the adult population. Colorado pikeminnow that were stocked as adults at RM 180.2 in April 2001 were still being recaptured in Reach 6 between the PNM Weir and Hogback Diversion (RM 166.6-158.6) in 2003, although not as frequently as in the previous two years. Eight of these fish used the newly-constructed PNM Fish Ladder in 2003, all within 16-day period between 18 June and 3 July. This matches what has been found at the Redlands Fish Ladder on the Gunnison River near Grand Junction. Adult Colorado pikeminnow tend to move through the fish ladders in a very short period of time on the descending limb of the hydrograph. The fact that two of these fish used the PNM Fish Ladder twice and that another of the fish that used the PNM Fish Ladder was later recaptured downstream of it, indicates that there is possibly a high rate of "fall back" of fish over the PNM Weir occurring after fish are released from the upstream outlet pipe. This also matches what has been documented at the Redlands Fish Ladder.

Under the auspices of the Colorado pikeminnow augmentation plan (finalized early in 2003) a total of 210,418 age-0 Colorado pikeminnow were stocked into the San Juan River on 24 October 2002. Another 176,933 age-0 Colorado pikeminnow were stocked into the San Juan River on 6 November 2003. The Colorado pikeminnow augmentation plan calls for a minimum of 300,000 age-0 Colorado pikeminnow to be stocked into the San Juan River for each of the next six years (2004-2009).

For the second time since 1999, a Colorado pikeminnow that was stocked as a juvenile fish has been recaptured with an ictalurid lodged in its throat. In 2003, a 143 mm SL Colorado pikeminnow was found stuck in the grates of the PNM Fish Ladder with a 34 mm SL black bullhead lodged in its throat. This fish was dead at the time it was collected. This incident, combined with numerous other pieces of evidence collected over the years, provides further evidence that nonnative fishes in the San Juan River are a detriment to native fishes no matter how big or small they are.

Razorback Sucker

Stocked razorback sucker continue to persist throughout the San Juan River. Unfortunately, due to difficulties in obtaining and rearing razorback sucker for stocking, many fewer razorback sucker have been stocked to date than were originally planned (Ryden 1997, 2000c, 2000d, 2001b). This was the case again in 2003, when only 887 razorback sucker were stocked into the San Juan River. However, the comparatively few razorback sucker that have been stocked into the San Juan River continue to persist and grow. These fish have successfully spawned for six consecutive years. Larval razorback sucker were collected in every year from 1998-2003 (Brandenburg 2000, Brandenburg et al. 2001, 2002, and 2003, H. Brandenburg pers. comm.). Unfortunately, despite the collection of larval razorback sucker again in 2003, no spawning aggregations of adult razorback sucker were identified in the San Juan River in 2003.

Despite the relatively small numbers of fish that have been stocked since 1994, trends in CPUE among stocked razorback sucker have been encouraging. Between 2000 and 2002, razorback sucker CPUE riverwide had increased over three-fold on fall adult monitoring trips. In 2003, this CPUE value dropped slightly. As with stocked Colorado pikeminnow, this sudden decrease in razorback sucker CPUE on the fall 2033 adult monitoring trip may be an artifact of the high flow event in September 2003. Prior to that trip, CPUE for razorback sucker on both the spring razorback sucker monitoring trips and fall adult monitoring trips had been steadily rising.

Razorback sucker are now found, longitudinally, throughout the San Juan River. Razorback sucker now inhabit the river from the PNM Weir to Lake Powell. Four razorback sucker were collected in the newly-constructed PNM Fish Ladder in 2003. Unlike Colorado pikeminnow, the times at which razorback sucker used this structure were much more widely spread.

Roundtail Chub

Roundtail chub collections continue to be very rare during adult monitoring collections in the San Juan River. No roundtail chub were collected in the San Juan River during 2003 adult monitoring collections. However, one roundtail chub was collected in the newly-constructed PNM Fish Ladder on 19 June 2003. This fish was originally collected and PIT-tagged on the fall 2002 adult monitoring trip. With the collection of this fish, it has been documented that adults of all three San Juan River rare fish species (Colorado pikeminnow, razorback sucker, and roundtail chub) can successfully negotiate the newly-constructed PNM Fish Ladder.

Common Native Fishes

Flannelmouth Sucker

Flannelmouth sucker total CPUE riverwide has been slowly declining for the last three years. In fact, the riverwide total CPUE value for flannelmouth sucker in 2003 was the lowest ever observed. This declining trend in numbers was evident among both juvenile and adult flannelmouth sucker. However, the same type of declining trend in CPUE has been evident among both channel catfish and common carp as well, for the last couple of

years. So, whatever is happening, it seems to be happening to several species in the large-bodied fish community. Proportionally, flannelmouth sucker are still the most abundantly-collected large-bodied fish species in the San Juan River. Flannelmouth sucker are still found throughout all six river reaches in our study area and continue to occupy a multitude of habitat types. In addition, flannelmouth sucker of all life stages continue to be collected with regularity, showing that reproduction and recruitment are still occurring.

It is possible that at least some of the decline in total CPUE observed among flannelmouth sucker over the last two years can be directly attributed to the large storm spike flow events that immediately preceded both the 2002 and 2003 adult monitoring trips. However, these events are almost certainly not responsible for all of the observed changes in the San Juan River fish community over that period. In Reach 6, it is possible that some of the decline in CPUE could be associated with the newly-constructed PNM Fish Ladder. In 2003, a total of 6,193 flannelmouth sucker moved upstream through the PNM Fish Ladder (Lapahie 2003c). If these fish continued to move upstream and out of Reach 6 after passing through the ladder, this could have effected flannelmouth sucker CPUE in this river reach. Again though, this does nothing to help explain the declining flannelmouth sucker CPUE in other downstream river reaches.

The 2003 flannelmouth sucker length-frequency histogram showed a fairly sizeable group of age-1 fish (spawned in 2002). Although this cohort of fish was not as impressively-large as the 2000 cohort, it does appear that flannelmouth sucker had a relatively successful spawning effort again in 2002. The 2000 cohort of flannelmouth sucker are now large sub-adult fish that should begin recruiting into the adult population in 2004.

Bluehead Sucker

Bluehead sucker in the San Juan River are heavily concentrated in upstream reaches of the river, specifically in Reach 6 in our study area. In most years, bluehead sucker total CPUE in Reach 6 is twice as high (sometimes as much as three times as high as in adjacent Reach 5, where they are next most abundant. In reaches downstream of Reach 5, bluehead sucker CPUE drops off very rapidly, with bluehead sucker usually becoming completely absent from adult monitoring collections by Reach 1. Therefore "riverwide" trends in bluehead sucker CPUE are really driven by what occurs in Reach 6 and to a lesser extent in Reach 5. Given their heavy concentration in the most upstream reach of our study area, it seems likely that the dramatic fluctuations in bluehead sucker CPUE observed in Reach 6 over the last seven years are, at least in part, an artifact of the population in this reach being heavily influenced (e.g., via immigration and emigration) by bluehead sucker from adjacent upstream river sections (i.e., the Animas River and/or Reach 7).

Unlike the other three common large-bodied fish species, bluehead sucker have not demonstrated declining trends in total CPUE over the last several years. Instead the riverwide trend in bluehead sucker total CPUE up until 2002 was generally increasing, mainly due to increases in juvenile CPUE, but to lesser degree in adult CPUE as well. In 2003 however, bluehead sucker total CPUE riverwide did decline in all river reaches. As with flannelmouth sucker, some of the decline in bluehead sucker CPUE in Reach 6 may be linked to operation of the PNM Fish Ladder. In 2003, a total of 10,076 bluehead sucker moved upstream through the PNM Fish Ladder (Lapahie 2003c). Again, if these fish continued to move upstream and out of Reach 6 after negotiating the ladder, this could have effected the CPUE for bluehead sucker in Reach 6 in 2003. In downstream reaches, bluehead sucker CPUE may have also been effected

by the aforementioned storm spikes in 2002 and 2003. In 2003, two bluehead sucker were collected in Reach 1. These were the first collections of this species ever during adult monitoring collections in Reach 1. Given the absence of appropriate bluehead sucker habitat in Reach 1 and the large flow event which immediately preceded 2003 sampling, it seems likely that these two individuals had been displaced downstream into Reach 1 by the high flows.

As with flannelmouth sucker, the 2003 bluehead sucker length-frequency histogram showed a noticeable group of age-1 fish (spawned in 2002). As with flannelmouth sucker, this group of age-1 bluehead sucker was not as prominent as that observed in 2001 (i.e., spawned in 2000), but it does show that bluehead sucker had a relatively successful spawning effort in 2002. The majority of adult bluehead sucker observed in 2003 seem to be young adults from the 2000 cohort (i.e., age-3 fish), that are just now recruiting into the adult population.

Common Nonnative Fishes

Channel Catfish

For the second year in a row, channel catfish total CPUE declined riverwide. This decline is mainly tied to adult channel catfish CPUE, which declined in Reaches 5-1 between 2002 and 2003 (it increased slightly in Reach 6). Juvenile channel catfish CPUE only decreased in Reaches 2 and 1 between 2002 and 2003 (it increased slightly in Reaches 6-3). Be that as it may, the overall trend in total CPUE riverwide is headed in the right direction.

The are likely several reasons for the declining channel catfish total CPUE riverwide over the last two years. First, beginning in 2002, the intensive nonnative fish removal effort (being performed by USFWS, Albuquerque) which had heretofore been limited to Reach 6 was expanded downstream into Reach 5. This was done because it had been demonstrated (through mark-recapture technique) that channel catfish and common carp from Reach 5 were moving upstream and invading Reach 6 in the warmer months of the year, thus serving to repopulate losses in that reach incurred by nonnative fish removal efforts. Also in 2002, a second intensive nonnative fish removal study (being performed by the UDWR, Moab) was initiated in the river downstream of Mexican Hat, UT. In addition, opportunistic nonnative fish removal continued riverwide on both razorback sucker monitoring and adult monitoring trips in 2003.

However, another factor in the declines observed in channel catfish CPUE in 2002 and again in 2003 could very well be the late summer storm spikes that occurred just prior to these two adult monitoring trips.

Whatever the case, if the observed declines in channel catfish CPUE in 2002 and again in 2003 can be nothing but good for native fishes in the San Juan River. While nonnative fish removal efforts may not have been the single driving factor in the declines observed in channel catfish CPUE's, they were almost certainly a contributing factor. These efforts to mechanically remove nonnative fishes are also the only control method that can actually be controlled by the SJRIP. It is my recommendation that nonnative fish removal efforts continue for the foreseeable future.

Common Carp

Common carp showed declines in CPUE both riverwide and in most river reaches/life stages in 2003. Both adult and juvenile common carp CPUE were down riverwide and in five of six individual river reaches in 2003. Likewise, total CPUE was down riverwide and in all six individual river reaches in 2003.

The exact cause(s) of the large-scale decline in adult common carp CPUE riverwide in 2003 is unknown. As was stated above, while nonnative fish removal efforts may not have been the single driving factor in the decline in common carp CPUE's observed in 2003, they were almost certainly a contributing factor. Again, these efforts to mechanically remove nonnative fishes are the only control method that can actually be controlled by the SJRIP and it is my recommendation that they continue unabated for the foreseeable future.

As with the other common large-bodied fish species, common carp had what appears to be a fairly successful spawning effort in 2002. These 2002 year-class fish were observed as age-1 fish in 2003, although their numbers were considerably less than observed in the previous year.

Other Nonnative Fishes

As in most past years, very few largemouth bass were collected in the San Juan River during the 2003 adult monitoring trip. Only two largemouth bass, both juveniles, were collected in 2003. However, even at the small sizes at which these fish were collected, they had already begun to be piscivorous.

No striped bass or walleye were collected during 2003 adult monitoring collections. In 2002, the level of Lake Powell started to fall causing a long, wide, shallow (less than a foot deep in most places) sand delta to form where the San Juan River entered the lake (Q. Bradwisch and G. Mueller pers. comm.). Then in 2003, personnel from the UDWR observed the formation of a new waterfall near Piute Farms (J. Jackson pers. comm.). The San Juan River now flows as a narrow, turbid, sand-bottomed channel for several miles downstream of this new waterfall. Given the present low water level in Lake Powell, the presence of a multi-year dry cycle in the desert southwest, and the formation of this new waterfall, it seems unlikely that predatory fishes from Lake Powell will be a cause for concern in the lower San Juan River for at least a few years to come.

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APPENDIX A

Tables summarizing Colorado pikeminnow collections made during other calendar year 2003 studies in the San Juan River.

Table A-1. Colorado pikeminnow collected from the San Juan River in 2003, either from the PNM Fish Ladder or during nonnative fish removal efforts.

Date of Capture	PIT Tag Number	Radio Frequency	Total Length (mm)	Weight (grams)	Sex[a]	River Mile
In the PNM Fish Ladder (Navajo Nation):						
06/18/2003	7F7D476661	NONE	560	1530	I	166.6
06/20/2003	7F7B122152	NONE	521	1288	M	166.6
06/20/2003	7F7B1B0B31	NONE	527	1008	I	166.6
06/20/2003	7F7D317958	NONE	550	1120	I	166.6
06/24/2003	7F7B0E4C63	NONE	532	1400	M	166.6
06/24/2003	7F7B14375A	NONE	533	1186	I	166.6
06/26/2003	7F7B14375A	NONE	533	1186	I	166.6
07/03/2003	7F7B122152	NONE	521	1266	M	166.6
07/03/2003	7F7D11472D	NONE	640	1984	I	166.6
09/29/2003	NONE-MORTALITY	NONE	185	155	I	166.6
On nonnative fish removal trips - electrofishing (USFWS-NMFRO):						
04/08/2003	7F7B1B0B31	NONE	524	1100	I	159.0[b]
04/08/2003	7F7B12420E	NONE	530	1100	I	159.0[b]
05/07/2003	7F7D11472D	NONE	637	2050	I	157.0
06/10/2003	NONE	NONE	90	----[c]	I	155.8
07/16/2003	NONE	NONE	111	10	I	159.0[b]
07/17/2003	NONE	NONE	114	----	I	159.0[b]
07/17/2003	NONE	NONE	102	----	I	159.0[b]
07/17/2003	NONE	NONE	107	----	I	159.0[b]
09/03/2003	423C7D771E	NONE	130	13	I	154.2
09/03/2003	423D101951	NONE	152	25	I	154.2
09/04/2003	NONE	NONE	137	20	I	155.0
10/28/2003	423D1A4419	NONE	181	35	I	164.0[b]
10/28/2003	7F7B1B0B31	NONE	531	1250	I	163.3
10/29/2003	423C7F3F46	NONE	168	42	I	159.0[b]
11/11/2003	NONE	NONE	69	3	I	157.0
11/11/2003	NONE	NONE	60	2	I	157.0
11/11/2003	NONE	NONE	49	2	I	156.0
11/11/2003	NONE	NONE	59	2	I	156.0
11/11/2003	NONE	NONE	57	2	I	156.0
11/11/2003	NONE	NONE	145	23	I	155.0
11/11/2003	NONE	NONE	62	2	I	155.0
11/11/2003	NONE	NONE	69	3	I	155.0
11/11/2003	NONE	NONE	72	4	I	155.0
11/11/2003	NONE	NONE	55	2	I	152.0
11/12/2003	NONE	NONE	58	2	I	157.0
11/12/2003	NONE	NONE	50	2	I	157.0
11/12/2003	NONE	NONE	69	3	I	157.0
11/12/2003	NONE	NONE	121	16	I	156.0
11/12/2003	NONE	NONE	65	5	I	155.0

a: F = Female, M = Male, I = Indeterminate

b: In some instances, NMFRO's nonnative fish removal crews didn't record specific RM's of capture for rare fish they collected. Instead, they recorded whether a fish was collected upstream or downstream of the APS diversion (RM 163.7). In such cases, rare fish collected upstream of APS diversion were noted as being released at RM 164.0, while those collected downstream of APS diversion were noted as being released at RM 159.0. These were the two locations at which NMFRO crews worked up the fish they collected in the section of river between PNM Weir and Hogback diversion (i.e., RM 166.6-158.6).

c: This value was not measured.

Table A-1, continued.

Date of Capture	PIT Tag Number	Radio Frequency	Total Length (mm)	Weight (grams)	Sex[a]	River Mile
On nonnative fish removal trips - electrofishing (USFWS-NMFRO):						
11/12/2003	NONE	NONE	60	2	I	154.0
11/12/2003	NONE	NONE	69	3	I	152.0
12/02/2003	4415221419	NONE	167	40	I	164.0[b]
12/02/2003	423D083C50	NONE	155	20	I	163.4
12/02/2003	423D016C14	NONE	171	40	I	161.2
12/02/2003	423C68185B	NONE	168	33	I	159.0[b]
12/02/2003	423C695F3B	NONE	153	20	I	159.0[b]
12/03/2003	423D17104B	NONE	174	39	I	159.0[b]
12/03/2003	44170A027E	NONE	183	65	I	159.0[b]
12/09/2003	NONE	NONE	61	3	I	157.0
12/10/2003	NONE	NONE	64	3	I	151.0
On nonnative fish removal trips - electrofishing (UDWR-Moab):						
03/27/2003	53180D4E7E	NONE	530	1250	I	16.0
04/29/2003	522A213C40	NONE	535	1350	I	34.0
04/30/2003	4269392329	NONE	590	1600	F	21.4
05/09/2003	NONE	NONE	74	----[c]	I	49.8
05/19/2003	NONE	NONE	61	----	I	48.7
05/21/2003	NONE	NONE	67	----	I	26.0
06/11/2003	NONE	NONE	105	----	I	25.0
06/12/2003	NONE	NONE	123	15	I	17.6
06/26/2003	NONE	NONE	106	----	I	17.4
07/21/2003	NONE	NONE	133	16	I	47.5
07/21/2003	NONE	NONE	138	17	I	46.3
07/22/2003	42695F072D	NONE	160	25	I	44.0
07/22/2003	425B64443E	NONE	141	16	I	40.6
07/22/2003	5309125474	NONE	165	32	I	37.8
07/23/2003	NONE	NONE	127	14	I	25.5
07/24/2003	NONE	NONE	172	32	I	19.6
07/24/2003	5309170245	NONE	157	22	I	19.4
07/25/2003	NONE	NONE	177	31	I	4.0
08/04/2003	NONE	NONE	143	17	I	51.7
08/04/2003	53210C2D7A	NONE	181	42	I	51.5
08/04/2003	5309577719	NONE	188	48	I	51.2
08/04/2003	5312215677	NONE	174	35	I	49.4
08/04/2003	53095E310D	NONE	160	25	I	48.0
08/04/2003	53120E0E09	NONE	155	25	I	47.0
08/05/2003	5309685749	NONE	176	36	I	43.8
08/05/2003	530966653C	NONE	189	38	I	40.2
08/05/2003	5309532526	NONE	156	22	I	38.8
08/05/2003	NONE	NONE	149	22	I	38.0

a: F = Female, M = Male, I = Indeterminate

b: In some instances, NMFRO's nonnative fish removal crews didn't record specific RM's of capture for rare fish they collected. Instead, they recorded whether a fish was collected upstream or downstream of the APS diversion (RM 163.7). In such cases, rare fish collected upstream of APS diversion were noted as being released at RM 164.0, while those collected downstream of APS diversion were noted as being released at RM 159.0. These were the two locations at which NMFRO crews worked up the fish they collected in the section of river between PNM Weir and Hogback diversion (i.e., RM 166.6-158.6).

c: This value was not measured.

Table A-1, continued.

Date of Capture	PIT Tag Number	Radio Frequency	Total Length (mm)	Weight (grams)	Sex[a]	River Mile
On nonnative fish removal trips - electrofishing (UDWR-Moab):						
08/06/2003	522A49574A	NONE	184	39	I	26.8
08/06/2003	552A61383B	NONE	176	36	I	25.5
08/06/2003	NONE	NONE	148	23	I	22.1
08/06/2003	NONE	NONE	145	19	I	22.1
08/06/2003	NONE	NONE	143	16	I	20.3
08/06/2003	NONE	NONE	139	15	I	20.3
08/06/2003	NONE	NONE	141	19	I	19.5
08/06/2003	52290C2B78	NONE	154	27	I	18.5
08/06/2003	522A206F44	NONE	178	39	I	18.5
08/06/2003	NONE	NONE	142	20	I	18.4
08/06/2003	5309566C22	NONE	155	23	I	17.0
08/07/2003	5309696720	NONE	164	19	I	16.7
08/07/2003	522A237C5E	NONE	190	46	I	15.2
08/07/2003	NONE	NONE	135	16	I	15.0
08/18/2003	53095B5741	NONE	162	26	I	51.8
08/19/2003	42417C4167	NONE	164	20	I	47.0
08/19/2003	530B432E6C	NONE	158	26	I	46.1
08/19/2003	53120C2D7A	NONE	191	54	I	45.2
08/19/2003	530B511D0D	NONE	161	29	I	45.2
08/19/2003	531227416F	NONE	170	34	I	45.1
08/19/2003	4242033B30	NONE	206	75	I	40.6
08/19/2003	530916313B	NONE	186	46	I	39.8
08/19/2003	530B3B5457	NONE	171	37	I	37.3
08/19/2003	423C662E34	NONE	173	40	I	37.0
08/19/2003	423D0B5231	NONE	202	60	I	36.0
08/20/2003	423D031F60	NONE	178	38	I	26.9
08/20/2003	423D08384A	NONE	169	31	I	25.8
08/20/2003	53091A703A	NONE	182	38	I	23.5
08/20/2003	423C655431	NONE	212	53	I	19.8
08/20/2003	530B3C1D34	NONE	184	35	I	19.5
08/21/2003	423D1D1461	NONE	162	35	I	17.5
08/21/2003	NONE	NONE	135	18	I	16.5
08/21/2003	NONE	NONE	133	12	I	15.0
08/21/2003	5309604F26	NONE	174	34	I	13.8

a: F = Female, M = Male, I = Indeterminate

Table A-2. Colorado pikeminnow collected from the San Juan River by crews from the University of New Mexico, during spring/summer 2003 larval razorback sucker seining efforts.

Date Of Capture	Number Collected	Standard Length (range in mm)		River Mile
		Size From	Size To	
04/17/2003	3	33	45	117.2
04/17/2003	2	35	37	113.2
04/17/2003	1	40		108.5
04/18/2003	1	35		94.0
04/18/2003	1	45		90.0
04/18/2003	2	40	41	87.1
04/19/2003	1	39		84.1
04/19/2003	1	39		75.2
04/20/2003	1	41		52.3
04/21/2003	5	34	46	43.8
04/21/2003	12	37	56	39.8
04/21/2003	5	39	53	35.2
04/22/2003	1	44		25.1
04/22/2003	2	42	55	21.1
05/14/2003	1	51		137.2
05/14/2003	2	44	61	132.0
05/15/2003	1	43		116.2
05/16/2003	1	49		101.5
05/16/2003	2	44	63	100.5
05/19/2003	5	61	72	57.9
05/20/2003	3	57	64	41.6
05/20/2003	1	72		28.6
05/21/2003	1	51		17.7
05/22/2003	2	54	55	13.1
05/22/2003	3	52	64	11.4
05/22/2003	1	64		9.6
05/22/2003	1	57		6.9

Table A-2, continued.

Date Of Capture	Number Collected	Standard Length (range in mm)		River Mile
		Size From	Size To	
06/10/2003	2	55	71	135.7
06/10/2003	1	57		132.8
06/10/2003	1	52		131.8
06/10/2003	2	56	67	129.7
06/12/2003	1	81		102.5
06/15/2003	1	69		62.9
06/15/2003	2	63	66	61.2
06/17/2003	2	69	75	21.5
06/17/2003	1	68		17.5
07/15/2003	1	201		54.5

Table A-3. Colorado pikeminnow collected from the San Juan River by crews from BIO/WEST, Inc., during their monitoring (via seining) of stocked early life-stage pikeminnow, throughout 2003.

Date Of Capture	Number Collected	Standard Length (range in mm)		River Mile
		Size From	Size To	
03/18/2003	1	49		171.1
03/19/2003	2	39	41	148.5
03/19/2003	1	43		148.4
03/19/2003	3	41	59	147.0
03/19/2003	1	39		146.7
03/19/2003	1	41		144.7
03/21/2003	4	42	52	159.6
03/21/2003	1	63		159.5
03/21/2003	4	43	51	158.7
03/21/2003	4	41	64	158.6
03/21/2003	2	41	46	157.6
03/21/2003	3	42	44	156.6
03/21/2003	2	38	45	155.2
03/22/2003	7	39	50	128.4
03/22/2003	2	35	46	128.0
03/22/2003	1	38		127.2
03/22/2003	2	40	44	126.8
03/22/2003	5	41	46	125.8
03/22/2003	1	47		124.9
03/22/2003	1	37		123.7
03/22/2003	17	35	54	122.9
03/23/2003	2	41	50	104.6
03/23/2003	1	36		103.5
03/23/2003	1	40		101.9
03/23/2003	1	35		101.6
03/23/2003	1	45		99.7
03/23/2003	2	31	36	99.1

Table A-3, continued.

Date Of Capture	Number Collected	Standard Length (range in mm)		River Mile
		Size From	Size To	
03/23/2003	2	37	44	98.8
03/23/2003	2	36	45	98.0
03/24/2003	1	38		83.9
03/24/2003	1	56		83.8
03/24/2003	1	42		83.6
03/24/2003	1	42		82.9
03/24/2003	6	32	45	82.5
03/24/2003	2	35	36	81.9
03/24/2003	10	36	55	81.2
03/24/2003	18	33	56	79.8
07/25/2003	2	90	99	148.6
12/02/2003	1	150	PIT tag # = 441D624B3E	43.7
12/03/2003	1	60		179.3
12/03/2003	1	52		178.3
12/03/2003	1	49		177.6
12/03/2003	32	39	66	177.3
12/03/2003	2	51	60	177.0
12/03/2003	5	42	55	?????
12/03/2003	1	28		174.3
12/03/2003	13	41	63	173.4
12/03/2003	3	49	59	173.1
12/04/2003	2	54	62	164.4
12/04/2003	4	38	53	163.9
12/04/2003	5	40	55	163.6
12/04/2003	2	41	43	163.3
12/04/2003	32	35	79	161.9
12/05/2003	1	51		148.9
12/05/2003	1	47		147.8

Table A-3, continued.

Date Of Capture	Number Collected	Standard Length (range in mm)		River Mile
		Size From	Size To	
12/05/2003	1	44		145.9
12/05/2003	5	47	54	145.1
12/05/2003	4	44	50	144.9
12/05/2003	1	??		144.7
12/05/2003	3	40	53	143.1
12/06/2003	4	37	52	124.9
12/06/2003	4	47	149	123.1
12/06/2003	74	38	140	123.0
12/07/2003	12	42	54	104.1
12/07/2003	2	51	52	101.1
12/08/2003	41	41	81	80.3
12/08/2003	1	48		79.4
12/08/2003	2	51	54	79.3
12/08/2003	2	34	53	78.3
12/08/2003	4	33	48	77.8
12/09/2003	1	26		45.3
12/10/2003	1	56		42.8
12/11/2003	4	35	68	24.8
12/11/2003	1	51		24.1
12/11/2003	1	54		23.0
12/12/2003	2	49	53	13.9
12/12/2003	2	25	48	12.8
12/12/2003	3	43	48	11.8
12/12/2003	2	51	53	10.5
12/13/2003	1	48		9.4
12/13/2003	3	42	50	8.2
12/13/2003	1	51		8.1

APPENDIX B

Tables summarizing razorback sucker collections made during other calendar year 2003 studies in the San Juan River.

Table B-1. Razorback sucker collected during other studies in the San Juan River in 2003 (n = 161).

Date Of Capture	PIT Tag Number	Radio Freq.	Total Length (mm)	Weight (grams)	Sex[a]	Capture River Mile	Days In River Since Stocking
In the PNM Fish Ladder (Navajo Nation):							
06/19/2003	423F03051B	NONE	330	709	I	166.6	597
07/19/2003	423E69336A	NONE	402	652	I	166.6	625
10/07/2003	423F0E6851	NONE	454	988	M	166.6	707
10/08/2003	423F5F1624	NONE	460	948	I	166.6	707
On nonnative fish removal trips - electrofishing (USFWS-NMFRO):							
05/07/2003	423E446022	NONE	428	900	F	158.4	553
05/07/2003	423F171D43	NONE	408	900	F	158.4	553
05/07/2003	42421C7E34	NONE	465	1100	I	158.3	Unknown[b]
05/07/2003	423F6E6558	NONE	405	600	I	157.1	553
05/07/2003	423E633457	NONE	425	1050	F	157.1	553
05/07/2003	423F0D5520	NONE	459	1150	M	156.6	554
05/07/2003	423F5D406A	NONE	443	810	F	156.5	552
05/07/2003	4240181B0C	NONE	435	840	I	156.5	553
05/07/2003	426A237242	NONE	427	840	M	156.5	20
05/07/2003	426A2B6D20	NONE	373	850	I	156.5	21
05/07/2003	53245D7146	NONE	481	1480	I	156.5	931
05/07/2003	4242324D75	NONE	453	800	I	156.3	552
05/07/2003	52283B0450	NONE	426	900	M	156.0	23
05/07/2003	423E682972	NONE	425	900	I	155.6	554
05/07/2003	423E5D0D08	NONE	443	1350	M	155.5	554
05/07/2003	42417F735D	NONE	460	1200	M	155.4	554
05/07/2003	5228404A7F	NONE	440	950	M	155.1	23
05/07/2003	532405032C	NONE	428	1100	M	155.1	931
05/08/2003	4269582672	NONE	318	450	I	158.5	24
05/08/2003	425C030138	NONE	372	870	I	158.4	22
05/08/2003	423E744C06	NONE	432	1000	I	158.3	553
05/08/2003	42696B386C	NONE	301	300	I	158.0	24
05/08/2003	423E40602E	NONE	423	1200	I	156.0	554

a: I = indeterminate; M = male; F = female

b: This fish did not have a detectable PIT tag at the time of recapture, therefore the number of days it had been in the river since stocking could not be determined. A PIT tag was implanted in this fish before it was released back into the river.

Table B-1, continued.

Date Of Capture	PIT Tag Number	Radio Freq.	Total Length (mm)	Weight (grams)	Sex[a]	Capture River Mile	Days In River Since Stocking
On nonnative fish removal trips - electrofishing (USFWS-NMFRO):							
05/08/2003	423E25020E	NONE	432	990	I	155.9	555
05/08/2003	5326034D21	NONE	460	1220	I	155.9	932
05/09/2003	426926224E	NONE	328	400	I	158.5	23
05/09/2003	4240122A62	NONE	434	820	F	158.1	556
05/09/2003	4268707839	NONE	454	1250	I	157.5	23
05/09/2003	4240010F47	NONE	436	820	M	156.0	556
05/09/2003	423F7F6019	NONE	431	920	I	155.9	556
05/09/2003	52290D4047	NONE	402	680	F	155.8	382
05/09/2003	53245A7C46	NONE	449	1150	F	155.5	933
06/10/2003	423E5E570E	NONE	415	1000	I	158.4	586
06/10/2003	423F1A154A	NONE	468	1350	M	157.3	588
06/11/2003	5228752719	NONE	430	700	M	154.0	58
06/12/2003	4242473622	NONE	450	1075	I	157.1	590
06/12/2003	423F0E4F5F	NONE	413	770	M	156.5	590
06/12/2003	52392E670B	NONE	400	950	M	152.0	59
07/16/2003	5228604717	NONE	435	850	I	164.0	93
07/16/2003	423F6C1D7D	NONE	439	900	I	164.0	624
09/03/2003	423E38730A	NONE	432	920	I	158.0	673
09/03/2003	423F7E7469	NONE	440	1100	M	158.0	673
09/03/2003	423E654D5D	NONE	537	1500	I	156.2	671
09/03/2003	532405032C	NONE	433	900	M	151.4	1050
09/04/2003	522A575300	NONE	403	620	I	158.0	500
10/28/2003	425B650B18	NONE	445	1050	M	159.0	195
10/28/2003	5239306E3E	NONE	385	510	I	159.0	197
11/11/2003	423F5D406A	NONE	445	860	F	158.6	740
11/11/2003	423F035D5A	NONE	435	1600	I	158.6	740
11/11/2003	425B6A1A6D	NONE	336	-----[b]	I	158.6	14
11/11/2003	426956485C	NONE	320	295	I	158.6	12
11/11/2003	42695B6262	NONE	311	290	I	158.6	12

a: I = indeterminate; M = male; F = female

b: This value was not obtained due to equipment failure.

Table B-1, continued.

Date Of Capture	PIT Tag Number	Radio Freq.	Total Length (mm)	Weight (grams)	Sex[a]	Capture River Mile	Days In River Since Stocking
On nonnative fish removal trips - electrofishing (USFWS-NMFRO):							
11/11/2003	426A261D6B	NONE	318	321	I	158.6	12
11/11/2003	423E725455	NONE	518	1410	I	157.0	740
11/11/2003	423F633E41	NONE	462	1250	I	157.0	742
11/11/2003	425B733110	NONE	295	200	I	157.0	14
11/11/2003	426A40196C	NONE	300	285	I	157.0	14
11/11/2003	42423D5E34	NONE	440	1300	M	157.0	742
11/11/2003	4269025C39	NONE	299	215	I	157.0	14
11/11/2003	423D073604	NONE	435	1500	I	156.3	Unknown[b]
11/11/2003	423E557862	NONE	510	1550	I	156.3	742
11/11/2003	42686F5C64	NONE	440	1850	I	156.3	209
11/11/2003	423F0D5520	791	463	1650	M	156.0	742
11/11/2003	42695E7955	NONE	327	310	I	156.0	12
11/11/2003	423E6F352E	NONE	448	930	I	155.0	741
11/11/2003	42694D0D54	NONE	287	225	I	154.0	14
11/11/2003	426B245C32	NONE	337	360	I	154.0	13
11/11/2003	425B744666	NONE	367	380	I	152.0	13
11/11/2003	42686E2511	NONE	338	320	I	152.0	14
11/11/2003	42693C4E34	NONE	308	250	I	152.0	12
11/12/2003	423F7E0831	NONE	467	1010	I	157.0	742
11/12/2003	425B68262B	NONE	320	260	I	157.0	15
11/12/2003	4268795611	NONE	285	165	I	157.0	15
11/12/2003	426A090E3D	NONE	316	240	I	155.0	13
11/12/2003	426B2B3208	NONE	307	240	I	154.0	14
11/12/2003	4268577300	NONE	322	320	I	152.0	15
11/12/2003	4269581102	NONE	315	250	I	151.0	13
11/12/2003	42685B592A	NONE	310	280	I	151.0	15
11/12/2003	4269044367	NONE	325	340	I	151.0	15
12/09/2003	4240033016	NONE	456	1150	M	157.0	770

a: I = indeterminate; M = male; F = female

b: This fish did not have a detectable PIT tag at the time of recapture, therefore the number of days it had been in the river since stocking could not be determined. A PIT tag was implanted in this fish before it was released back into the river.

Table B-1, continued.

Date Of Capture	PIT Tag Number	Radio Freq.	Total Length (mm)	Weight (grams)	Sex[a]	Capture River Mile	Days In River Since Stocking
On nonnative fish removal trips - electrofishing (USFWS-NMFRO):							
12/09/2003	426A3B7928	NONE	286	175	I	157.0	42
12/09/2003	----------[b]	NONE	325	230	M	157.0	Unknown[b]
12/09/2003	423E454C69	NONE	444	800	I	157.0	770
12/09/2003	425B733110	NONE	295	225	I	157.0	42
12/09/2003	42694A6A5C	NONE	320	300	I	157.0	41
12/09/2003	42694D4C0E	NONE	275	200	I	157.0	42
12/09/2003	42694E4215	NONE	311	275	I	157.0	42
12/09/2003	426B3F043B	NONE	286	200	I	157.0	42
12/09/2003	42687E4733	NONE	295	225	I	157.0	40
12/09/2003	426B10597C	NONE	309	140	I	156.0	42
12/09/2003	522A215F2D	NONE	410	700	I	156.0	596
12/09/2003	522A616543	NONE	445	990	I	156.0	596
12/10/2003	426A295045	NONE	312	320	I	149.0	42
12/11/2003	425B6F7467	NONE	324	310	I	150.0	44
12/11/2003	426B360141	NONE	306	270	I	150.0	44
12/11/2003	425B687F49	NONE	281	215	I	148.6	44
On nonnative fish removal trips - electrofishing (UDWR-Moab):							
03/27/2003	5324566328	NONE	438	980	M	18.8	890
03/27/2003	7F7B10402D	NONE	551	1500	F	18.8	1764
03/27/2003	7F7B106C67	NONE	476	1100	M	18.8	1764
04/28/2003	42424F2863	NONE	497	1000	F	50.7	544
05/01/2003	423E673807	NONE	460	980	M	19.0	546
05/01/2003	4240072250	NONE	445	960	M	18.4	548
05/01/2003	51247B6557	NONE	485	1150	M	17.6	1659
05/01/2003	423F5C3654	NONE	394	770	I	12.9	547
05/21/2003	4240072250	NONE	445	1960	M	15.2	568
06/09/2003	52283A1D5F	NONE	449	870	I	47.6	413
06/10/2003	52290D016E	NONE	410	620	I	45.0	57
06/12/2003	52285E1A28	NONE	410	700	M	18.7	59

a: I = indeterminate; M = male; F = female

b: This value was not obtained due to equipment failure.

Table B-1, continued.

Date Of Capture	PIT Tag Number	Radio Freq.	Total Length (mm)	Weight (grams)	Sex[a]	Capture River Mile	Days In River Since Stocking
On nonnative fish removal trips - electrofishing (UDWR-Moab):							
06/12/2003	423F7E5A02	NONE	462	1000	I	18.0	590
06/26/2003	5128465837	NONE	475	1000	I	20.2	430
06/26/2003	423F7E5A02	NONE	471	1010	I	17.8	604
07/24/2003	423F167345	NONE	410	755	I	18.5	631
07/25/2003	425863072F	NONE	274	202	I	4.8	Unknown[b]
08/07/2003	507E667172	NONE	441	890	I	11.5	472
08/19/2003	423E696E12	NONE	472	1230	I	42.5	658
On FLOY-tagging trips - electrofishing (USFWS-NMFRO):							
02/19/2003	4242312966	NONE	489	1200	I	157.8	477
02/19/2003	53245A7C46	NONE	446	950	I	156.8	854
03/04/2003	5324111728	NONE	423	1200	I	157.1	867
03/04/2003	423E78024C	NONE	459	1180	I	156.7	489
03/04/2003	522A4D342B	NONE	360	650	I	156.3	316
03/04/2003	423E78141C	NONE	418	820	I	155.7	490
03/04/2003	424004437A	NONE	425	900	I	154.6	489
05/14/2003	42301B1B41	NONE	569	2000	I	157.6	Unknown[c]
05/14/2003	423E7E4D15	NONE	435	850	M	156.9	560
05/14/2003	423F712672	NONE	498	1450	I	156.8	560
05/14/2003	423E25020E	NONE	432	850	I	156.6	561
05/14/2003	425B650B18	NONE	443	850	M	155.2	28
05/14/2003	423F633E41	NONE	462	1250	I	154.9	561
05/14/2003	423F031672	NONE	487	1400	M	154.8	560
05/14/2003	522A47736F	NONE	435	800	I	154.4	388
05/14/2003	423F5E0F2B	NONE	409	750	I	154.1	560

a: I = indeterminate; M = male; F = female

b: This juvenile fish is suspected to be a wild-spawned offspring of stocked razorback sucker.

c: This fish did not have a detectable PIT tag at the time of recapture, therefore the number of days it had been in the river since stocking could not be determined. A PIT tag was implanted in this fish before it was released back into the river.

Table B-1, continued.

Date Of Capture	PIT Tag Number	Radio Freq.	Total Length (mm)	Weight (grams)	Sex[a]	Capture River Mile	Days In River Since Stocking
On trips to monitor stocked Colorado pikeminnow - seining (BIO/WEST):							
12/06/2003	Unknown[b]	NONE	253	316	I	127.6	Unknown[b]
On research trips in Lake Powell - gill-netting (UDWR - Wahweap):							
08/28/2003	1F5B36222E	NONE	500	1421	I	-10.0	2942
On trips to monitor stocked razorback sucker - electrofishing (USFWS-CRFP):							
04/28/2003	423F773E21	NONE	464	1300	F	158.2	544
04/28/2003	42421B2941	NONE	459	1100	F	158.2	543
04/28/2003	4242364628	NONE	443	1000	F	158.2	545
04/28/2003	423F5D406A	NONE	442	850	F	158.0	543
04/28/2003	523713037E	NONE	430	1000	F	158.0	14
04/28/2003	423E527E33	NONE	457	890	F	157.0	545
04/28/2003	423E763D46	NONE	413	900	I	157.0	543
04/28/2003	42400D333D	NONE	466	1400	F	157.0	544
04/28/2003	522A4D0929	NONE	449	1200	F	157.0	371
04/28/2003	423C7A6305	NONE	446	900	F	156.0	543
04/28/2003	423E644036	NONE	429	905	F	156.0	544
04/28/2003	423F7E7469	NONE	439	900	M	156.0	545
04/28/2003	42684B1563	NONE	414	790	M	156.0	173
04/28/2003	424217215C	NONE	482	1150	M	154.0	544
04/28/2003	523931203B	NONE	430	810	M	154.0	14
04/28/2003	423E3F2F2E	NONE	454	1150	M	149.0	545
04/29/2003	5228663833	NONE	390	-----[c]	I	139.0	15
04/29/2003	423F1A4C28	NONE	455	1000	M	136.0	546
04/29/2003	423F691523	NONE	417	690	F	136.0	546
04/30/2003	5229132259	NONE	364	780	I	126.0	373
04/30/2003	423F643C0A	NONE	440	925	F	125.9	547
04/30/2003	4269750841	NONE	458	1100	F	125.1	13
05/01/2003	52393F624A	NONE	460	-----[c]	M	110.0	17
05/02/2003	1F41386B7D	NONE	505	1450	F	95.1	3087

a: I = indeterminate; M = male; F = female

b: This value was not obtained due to the lack of a PIT tag reader on the trip.

c: This value was not obtained due to equipment failure.

APPENDIX C

Graphs showing the storm-induced, late summer (i.e., September) flow spikes that occurred just prior to the 2002 and 2003 adult monitoring trips.

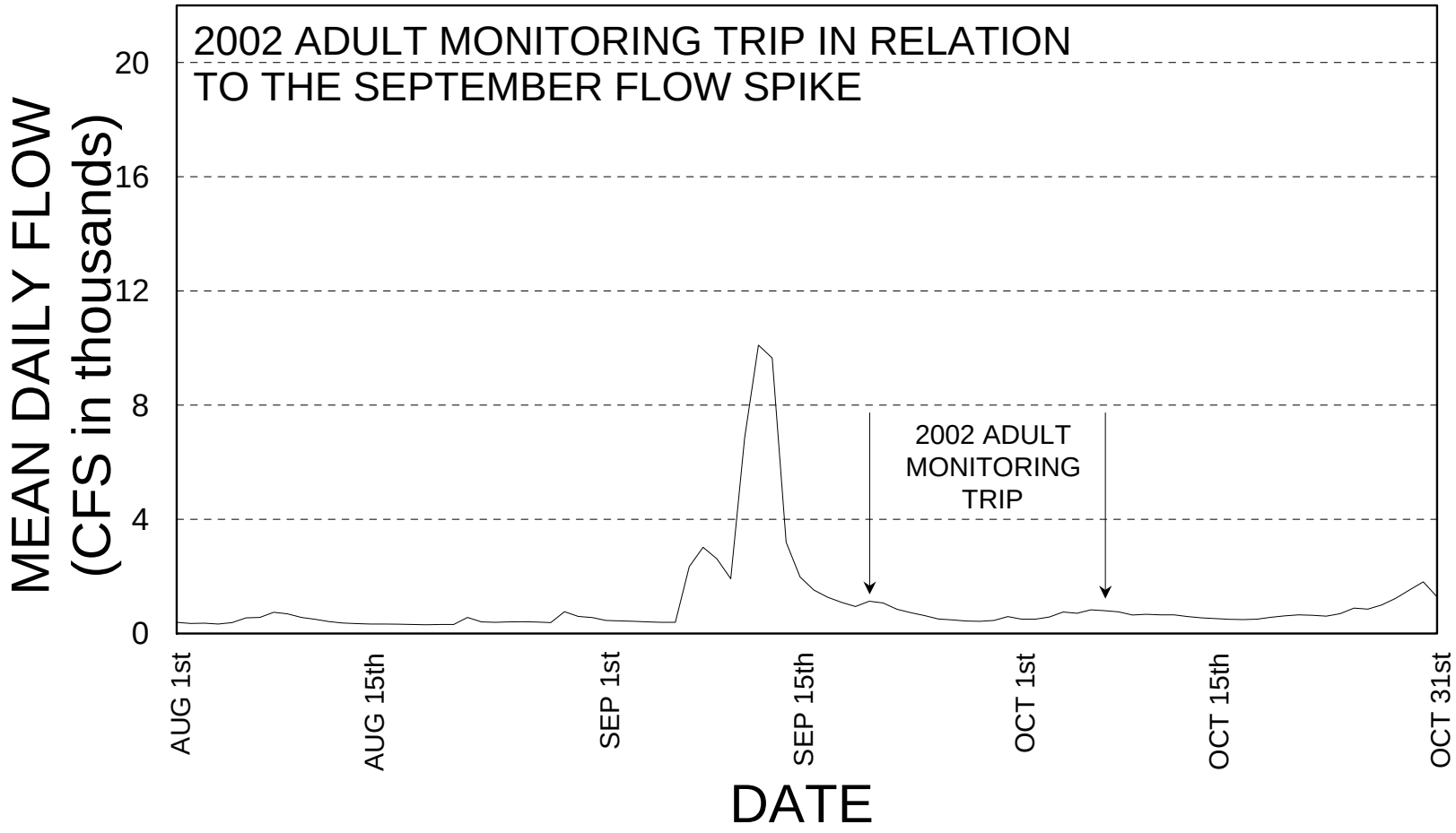

Figure C-1. Dates of the 2002 adult monitoring trip (marked by arrows) in relation to the September 2002 flow spike (flows measured at the Bluff USGS gage # 09379500). During this flow spike mean daily streamflow at the Bluff gage was 396 CFS on 6 September, 10,100 CFS on 12 September, and 944 CFS on 19 September. The 2002 adult monitoring trip began on 20 September (Table 1).

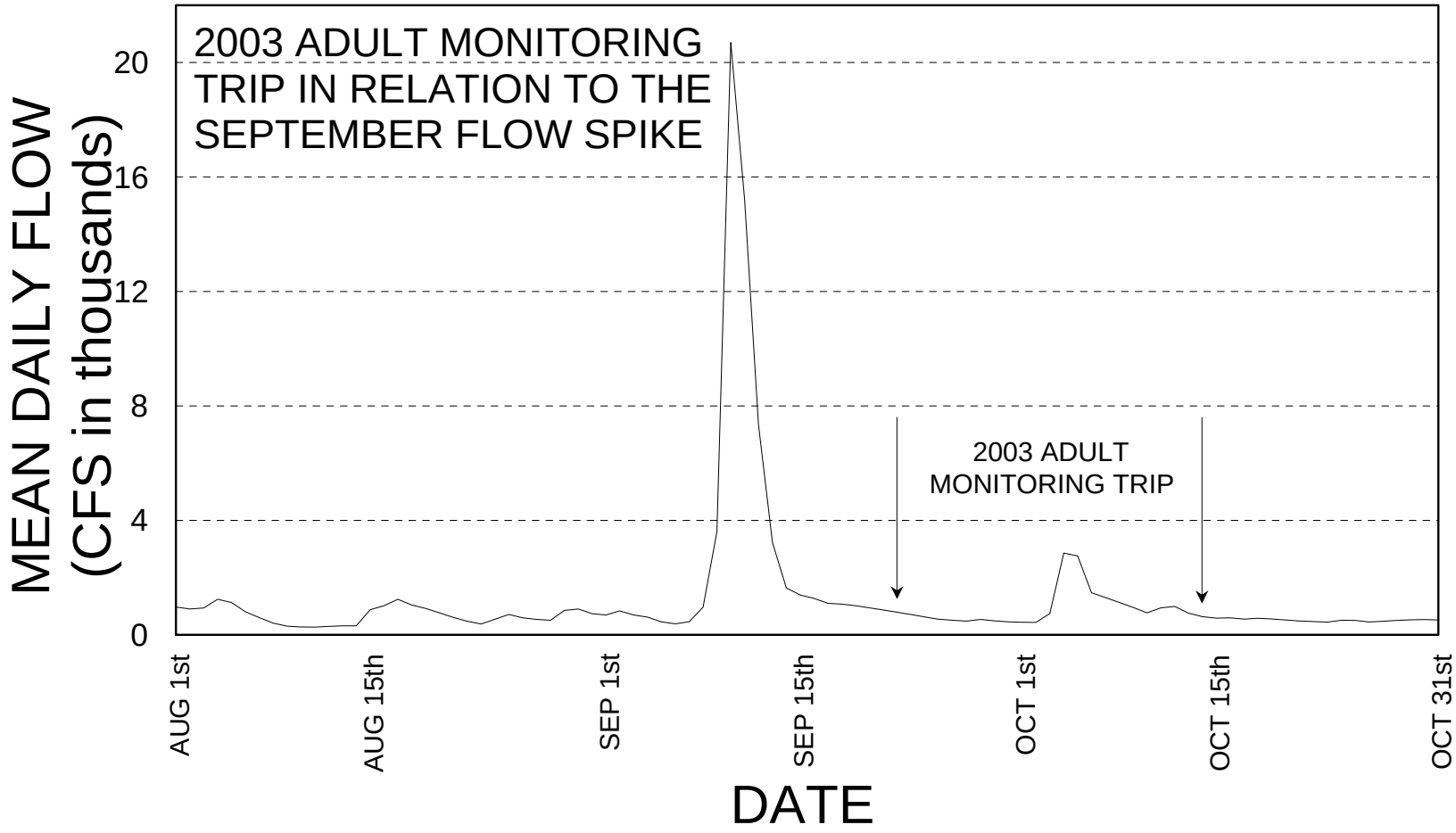

Figure C-2. Dates of the 2003 adult monitoring trip (marked by arrows) in relation to the September 2003 flow spike (flows measured at the Bluff USGS gage # 09379500). During this flow spike mean daily streamflow at the Bluff gage was 459 CFS on 7 September, 20,700 CFS on 10 September, and 1,640 CFS on 14 September. The 2003 adult monitoring trip began on 22 September (Table 1).