

LONG TERM MONITORING OF SUB-ADULT
AND ADULT LARGE-BODIED FISHES IN
THE SAN JUAN RIVER: 2002

Interim Progress Report
(Final)

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8 December 2003

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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 2002 was the fourth 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 2002, adult monitoring took place between 20 September and 7 October. Total effort of was 92.17 hours of electrofishing and sampled covered RM 180.0 to RM 0.0. A total of 10,394 individual fish were collected during fall 2002 adult monitoring. The mean daily flow (measured at the Shiprock USGS gage) during sampling was 458 CFS, the lowest mean flow at which riverwide long-term monitoring has taken place. A late summer rainstorm, which peaked above 8,000 CFS on 12 September 2002, may have had a major impact on the San Juan River fish community, especially nonnative fishes, shortly before the fall adult monitoring trip occurred.

Three Colorado pikeminnow were collected during fall 2002 adult monitoring. All three of these were fish that had originally been stocked as adults in April 2001 at RM 180.2. All three recaptures occurred upstream of the Hogback Diversion. No wild Colorado pikeminnow were collected in 2002. Colorado pikeminnow CPUE in the San Juan River continues to be low (< 0.1 fish/hr of electrofishing), despite over a million fish having been stocked since 1996.

Twenty-three razorback sucker were collected during fall 2002 adult monitoring. All 23 were stocked fish. Collections ranged from RM 158.0-14.0 and included 21 adults and two sub-adults. No wild razorback sucker were collected in 2002. Riverwide, razorback sucker CPUE rose markedly between 2001 (0.1 fish/hr of electrofishing) and 2002 (0.25 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 6,975 razorback sucker have been stocked since 1994).

One roundtail chub was collected during fall 2002 adult monitoring. This was a wild adult. It was collected between RM 161.0 and RM 160.0. 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.

Flannemouth sucker continues to be the species that is most commonly-collected during fall adult monitoring trips. During fall 2002 adult monitoring, flannemouth sucker accounted for 48.2% (n = 5,011 individuals) of all fish collected in 2002. The strong cohort of flannemouth sucker that were spawned in 2000 have now reached the sub-adult life-stage and should recruit into the adult population within the next couple of years.

Bluehead sucker were the second most-commonly collected species during fall 2002 adult monitoring. Bluehead sucker accounted for 25.3% (n = 2,634 individuals) of all fish collected in 2002. 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 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). Over the last three years, juvenile bluehead sucker have become the dominant life-stage in riverwide collections, usually outnumbering adult fish by about two to one. Like flannelmouth sucker, the strong cohort of bluehead sucker that were spawned in 2000 have now reached the sub-adult life-stage and should recruit into the adult population within the next couple of years.

Channel catfish were the third most-commonly collected species during fall 2002 adult monitoring. Channel catfish accounted for 15.2% (n = 1,581 individuals) of all fish collected in 2002. Channel catfish CPUE (juvenile, adult, and total CPUE) dropped in every single river reach between 2001 and 2002. The cause for this blanket decline is unknown. However, I feel that it is a combination of the effects of expanded nonnative fish removal efforts in 2002 (in Reaches 5, 2, and 1) and the late summer storm spike in September 2002.

Common carp were the fourth most commonly-collected species during fall 2002 adult monitoring. Common carp accounted for 8.1% (n = 844 individuals) of all fish collected in 2002. Common carp total CPUE declined in five of six river reaches (and common carp adult CPUE declined in all six river reaches) between 2001 and 2002. As with channel catfish, the cause for these declines is unknown, but again it is likely a combination of the effects of expanded nonnative fish removal efforts in 2002 and the September 2002 storm spike.

Largemouth bass were very rare in fall 2002 adult monitoring collections. Only seven largemouth bass were collected in 2002, all in upstream reaches of the study area. These fish are likely entering the San Juan River from upstream sources. No striped bass or walleye were collected during fall 2002 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, and augmentation efforts for both endangered fish species -- 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 under long-term monitoring plan guidelines began in 1999 and will continue 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. Numerous other state and federal agencies supplied manpower, equipment, and logistical support for these sampling efforts.

The objectives of the sub-adult and adult large-bodied fish community monitoring (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
 - d) augmentation efforts for both federally-listed endangered fish species -- Colorado pikeminnow and razorback sucker.
- 2) Monitor population trends (e.g., distribution and abundance, habitat use, spawning and staging 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 at 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 2002 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 1996-2002.

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 2002 adult monitoring trip were lower than in any previous year during which riverwide sampling was conducted (Table 1). In fact mean river flows during the 2002 adult monitoring trip (458 CFS) were only 21.0% of those encountered during the 1999 adult monitoring trip (2,177 CFS; Table 1). The low mean river flows during the 2002 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 2002.

Eighteen different fish species and hybrid forms were collected from the San Juan River during the 2002 adult monitoring trip (Table 2). This included six native species and one native sucker X native sucker hybrid, as well as ten nonnative species and one native X nonnative sucker hybrid (Tables 2 and 3). Flannelmouth sucker was the most commonly-collected species (n = 5,011 individuals), followed in descending order by bluehead sucker (n = 2,634), channel catfish (n = 1,581), and common carp (n = 844; Table 3). These four species accounted for 96.9% of the total catch during the 2002 adult monitoring trip. The other 12 species (and two hybrids) contributed only 324 individuals, or 3.1%, to the total catch in 2002 (Table 3).

Native fishes accounted for 7,875 specimens or 75.76% of the total catch in 2002 (n = 217 individual electrofishing collections riverwide). Nonnative fishes accounted for 2,519 specimens or 24.24% of the total catch in 2002 (n = 217 individual electrofishing collections riverwide). The overall native to nonnative fish ratio riverwide was 3.13:1 in 2002 (Figure 1). This is the highest riverwide native:nonnative fish ratio observed in the last seven years (Figure 1).

Endangered fishes continue to be very rare during adult monitoring collections. In 2002, only 23 razorback sucker, three Colorado pikeminnow, and one roundtail chub were collected during adult monitoring (Table 3).

Table 1. Summary of dates, river miles (RM) sampled, and mean river flows during riverwide sub-adult and adult large-bodied fish community monitoring (i.e., "adult monitoring") trips in the San Juan River, New Mexico, Colorado, and Utah, 1996-2002.

| 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) |

Table 2. Scientific and common names, status, and database codes for fish species collected from the San Juan River during the 2002 adult monitoring trip (following Robins et al. 1991, Nelson et al. 1998^a, and the California Academy of Sciences Catalog of Fishes website).

| SCIENTIFIC NAME | COMMON NAME | STATUS | CODE |
|---|----------------------------------|------------|---------|
| Class Actinopterygii | | | |
| Order Cypriniformes | | | |
| Family Catostomidae-suckers | | | |
| <u>Catostomus commersoni</u> | white sucker | introduced | Catcom |
| <u>Catostomus discobolus</u> | bluehead sucker | native | Catdis |
| <u>Catostomus latipinnis</u> | flannelmouth sucker | native | Catlat |
| <u>C.commersoni</u> X <u>C.discobolus</u> | hybrid | introduced | comXdis |
| <u>C.latipinnis</u> X <u>C.discobolus</u> | hybrid | native | latXdis |
| <u>Xyrauchen texanus</u> | razorback sucker | native | Xyrtex |
| Family Cyprinidae-carps and minnows | | | |
| <u>Cyprinella lutrensis</u> | red shiner | introduced | Cyplut |
| <u>Cyprinus carpio</u> | common carp | introduced | Cypcar |
| <u>Gila robusta</u> | roundtail chub | native | Gilrob |
| <u>Pimephales promelas</u> | fathead minnow | introduced | Pimpro |
| <u>Ptychocheilus lucius</u> | Colorado pikeminnow ^a | native | Ptyluc |
| <u>Rhinichthys osculus</u> | speckled dace | native | Rhiosc |
| Order Perciformes | | | |
| Family Centrarchidae-sunfishes | | | |
| <u>Lepomis cyanellus</u> | green sunfish | introduced | Lepcya |
| <u>Micropterus salmoides</u> | largemouth bass | introduced | Micsal |
| Order Salmoniformes | | | |
| Family Salmonidae-trouts | | | |
| <u>Oncorhynchus mykiss</u> | rainbow trout | introduced | Oncmyk |
| <u>Salmo trutta</u> | brown trout | introduced | Saltru |
| Order Siluriformes | | | |
| Family Ictaluridae-bullhead catfishes | | | |
| <u>Ameiurus melas</u> | black bullhead | introduced | Amemel |
| <u>Ictalurus punctatus</u> | channel catfish | introduced | Ictpun |

Table 3. Total number of fish collected during the 2002 adult monitoring trip.

| Species (Status) ^a | Total number of specimens | Percent of total | Rank | Frequency of occurrence |
|---|-------------------------------|------------------|------------------------|-------------------------|
| flannelmouth sucker(N) | 5,011 | 48.2 | 1 | 210 |
| bluehead sucker(N) | 2,634 | 25.3 | 2 | 201 |
| channel catfish(I) | 1,581 | 15.2 | 3 | 191 |
| common carp(I) | 844 | 8.1 | 4 | 182 |
| speckled dace(N) | 176 | 1.7 | 5 | 82 |
| red shiner(I) | 48 | 0.5 | 6 | 33 |
| bluehead sucker X flannelmouth sucker(H,N) | 27 | 0.3 | 7 | 20 |
| brown trout(I) | 23 | 0.2 | 8 | 16 |
| razorback sucker(N) | 23 | 0.2 | 8 | 17 |
| largemouth bass(I) | 7 | --- ^b | 9 | 6 |
| fathead minnow(I) | 4 | --- | 10 | 3 |
| black bullhead(I) | 4 | --- | 10 | 4 |
| white sucker(I) | 4 | --- | 10 | 3 |
| Colorado pikeminnow(N) | 3 | --- | 11 | 2 |
| white sucker X bluehead sucker(H,I) | 2 | --- | 12 | 2 |
| green sunfish(I) | 1 | --- | 13 | 1 |
| rainbow trout(I) | 1 | --- | 13 | 1 |
| roundtail chub(N) | 1 | --- | 13 | 1 |
| GRAND TOTAL | 10,394 | | 2002 collections = 217 | |
| 2002 Native Fishes | 7,875 (75.76% of total catch) | | | |
| 2002 Introduced Fishes | 2,519 (24.24% of total catch) | | | |
| 2002 Native:Introduced Fishes Ratio = 3.13:1 | | | | |

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%

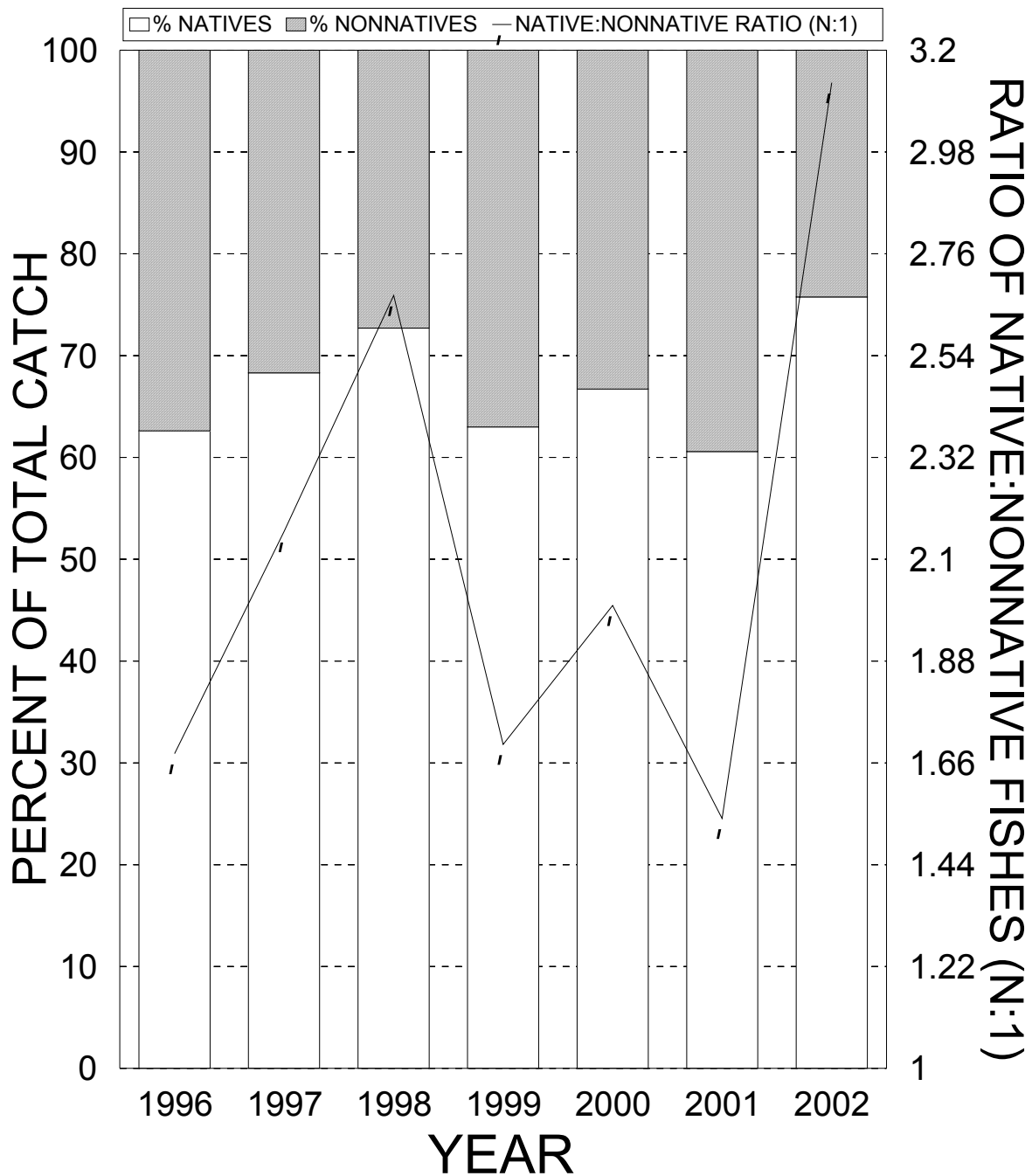


Figure 1. The bars represent the percent of the total catch accounted for by native fishes (white bars) versus nonnative fishes (shaded bars), riverwide (RM 180.0-0.0), on adult monitoring trips, 1996-2002. The line represents the ratio of native to nonnative fishes (N:1) collected on the same trips.

Rare Native Fishes

Colorado Pikeminnow

Fish Stocked As Part Of An Augmentation Effort

A total of 210,418 age-0 Colorado pikeminnow were stocked into the San Juan River on 24 October 2002. Roughly half of these fish were stocked at the Farmington stocking site (RM 180.2), while the other half were stocked immediately downstream of Hogback Diversion (RM 158.6; Table 4). The mean size of stocked Colorado pikeminnow in 2002 was 51 mm TL (range = 32-127 mm TL; Table 4). The 210,418 age-0 fish stocked in 2002 were the first of eight consecutive years' stockings to take place under the auspices of the new Colorado pikeminnow augmentation plan (Ryden 2003a). These fish were progeny of the "1981 Broodstock" being held at Dexter National Fish Hatchery. None of these fish were PIT-tagged or otherwise individually-marked before release.

Table 4. Stockings of Colorado pikeminnow in the San Juan River, 1996-2002.

| 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 |

^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

2002 Collections

There were a total of 39 recapture events with Colorado pikeminnow during all 2002 field studies. All 39 of these collections were made via raft-mounted electrofishing. These 39 recaptures all occurred with Colorado pikeminnow that had been stocked into the San Juan River since 1996. No wild Colorado pikeminnow were collected in 2002.

Of these 39 recapture events, only three occurred during the fall 2002 adult monitoring trip. These three recaptures all occurred on 11 October 2002. The first occurred at RM 166.5 (PIT tag # 7F7B107B59), just downstream of the PNM Weir on river left. The other two recaptures occurred almost simultaneously along opposite river banks at RM 163.2 (PIT tag #'s 7F7B0E4C63 and 7F7B122152), just downstream of the APS Weir. Two of the three Colorado pikeminnow collected on the fall 2002 adult monitoring trip would be collected again (in late October 2002) during a nonnative fish removal trip (Table 5).

Thirty-six of the 39 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 fact out of the 36 collections among adult Colorado pikeminnow in 2002, only one took place downstream of Hogback Diversion during the spring razorback sucker monitoring trip (Table 5). In 2002, a total of 20 different adult pikeminnow were collected, with nine of these fish being collected two or more times during 2002 (Table 5).

The other three Colorado pikeminnow collections in 2002 were with fish that had been stocked between 1996 and 2000 by UDWR (Table 6). These three fish, all collected in the river downstream of Mexican Hat, included two fish that were likely stocked in 1996 (539 mm TL, 507 mm TL) and one fish that was likely from the 2000 stocking (246 mm TL; Tables 4 and 6). These fish were all collected during nonnative fish removal trips.

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, several adult Colorado pikeminnow stocked at RM 180.2 in April 2001 have been documented using the section of river from PNM Weir to Hogback Diversion (RM 166.6-158.6) up to a year and half after stocking (Table 5). Small numbers Colorado pikeminnow stocked as juveniles or larvae between 1996 and 2000 continue to be captured sporadically on adult monitoring and other sampling trips (Table 6).

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 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

Table 5. Information on Colorado pikeminnow that were stocked into the San Juan River as adult fish and subsequently recaptured during 2002 sampling efforts. These 20 adult fish were all stocked on 11 April 2001 at RM 180.2 by the U.S. Fish and Wildlife Service. All of these fish were implanted with PIT tags prior to being stocked.

| PIT Tag Number | Date Of Last Recapture | Times Fish Was Captured In 2002 | Total Length | Sex | River Mile (Or Section Occupied) ^a | Days In River Since Stocking |
|-------------------------|------------------------|---------------------------------|--------------|---------|---|------------------------------|
| 7F7D137454 | 02/06/2002 | 1 | 496 mm | Unknown | 163.4-159.0 | 301 |
| 7F7B124128 | 02/07/2002 | 1 | 587 mm | Unknown | 166.6-163.4 | 302 |
| 7F7B1B0B31 | 02/28/2002 | 1 | 515 mm | Unknown | 163.4-159.0 | 323 |
| 7F7B105D64 | 02/28/2002 | 3 | 565 mm | Unknown | 166.6-163.4 | 323 |
| 7F7D486622 | 03/12/2002 | 1 | 510 mm | Unknown | 166.6-163.4 | 335 |
| 7F7D11472D | 03/13/2002 | 1 | 635 mm | Unknown | 166.6-163.4 | 336 |
| 7F7D154556 | 03/13/2002 | 1 | 558 mm | Male | 163.4-159.0 | 336 |
| 7F7B13071A | 03/13/2002 | 2 | 500 mm | Male | 166.6-163.4 | 336 |
| 7F7D154613 | 03/13/2002 | 2 | 621 mm | Female | 163.4-159.0 | 336 |
| 7F7D506D04 | 04/03/2002 | 1 | 480 mm | Unknown | 163.4-159.0 | 357 |
| 7F7D477548 | 04/03/2002 | 1 | 554 mm | Unknown | 163.4-159.0 | 357 |
| 7F7D131841 | 04/30/2002 | 1 | 525 mm | Unknown | 129.4 | 384 |
| 7F7B025D78 ^b | 06/11/2002 | 2 | 526 mm | Unknown | 163.4-159.0 | 426 |
| 7F7D401014 | 06/12/2002 | 1 | 486 mm | Unknown | 166.6-163.4 | 427 |
| 7F7D481D3C | 06/12/2002 | 1 | 564 mm | Unknown | 166.6-163.4 | 427 |
| 7F7D15303F | 06/13/2002 | 4 | 605 mm | Unknown | 166.6-163.4 | 428 |
| 7F7B0E4C63 | 10/11/2002 | 3 | 532 mm | Male | 163.2 | 548 |
| 7F7B122152 | 10/22/2002 | 2 | 521 mm | Male | 166.6-163.4 | 559 |
| 7F7B12420E | 10/22/2002 | 3 | 515 mm | Unknown | 163.3 | 559 |
| 7F7B107B59 | 10/23/2002 | 4 | 618 mm | Male | 163.3 | 560 |

a: In the majority of instances, these fish were recaptured by nonnative fish removal crews. These crews, for the most part, did not report specific RM's of capture for Colorado pikeminnow. Rather they reported the river section that the fish was collected in, either: PNM Weir to APS Diversion (RM 166.6-163.4) or APS Diversion to the take-out on Buck Wheeler's property (RM 163.4-159.0).

b: This fish died due to handling stress.

Table 6. Information on Colorado pikeminnow that were stocked into the San Juan River as juvenile fish and subsequently recaptured during 2002 sampling efforts. These three fish were all stocked as age-0 fish by the Utah Division of Wildlife Resources (UDWR). None of the Colorado pikeminnow stocked by UDWR were implanted with PIT tags prior to being stocked.

| PIT Tag Number | Date Of Last Recapture | Year Stocked | Times Fish Has Been Recaptured Since Stocking | Total Length | Sex ^a | River Mile | Days In River Since Stocking |
|----------------|------------------------|--------------|---|--------------|------------------|------------|------------------------------|
| 5312122813 | 04/16/2002 | 1996 | 1 | 539 mm | I | 45.8 | 1989 |
| 530A454D0E | 04/19/2002 | 2000 | 1 | 246 mm | I | 8.5 | 677 |
| 51247F0B49 | 06/12/2002 | 1996 | 2 ^b | 507 mm | M | 21.4 | 2046 |

a: I = indeterminate, M = male

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

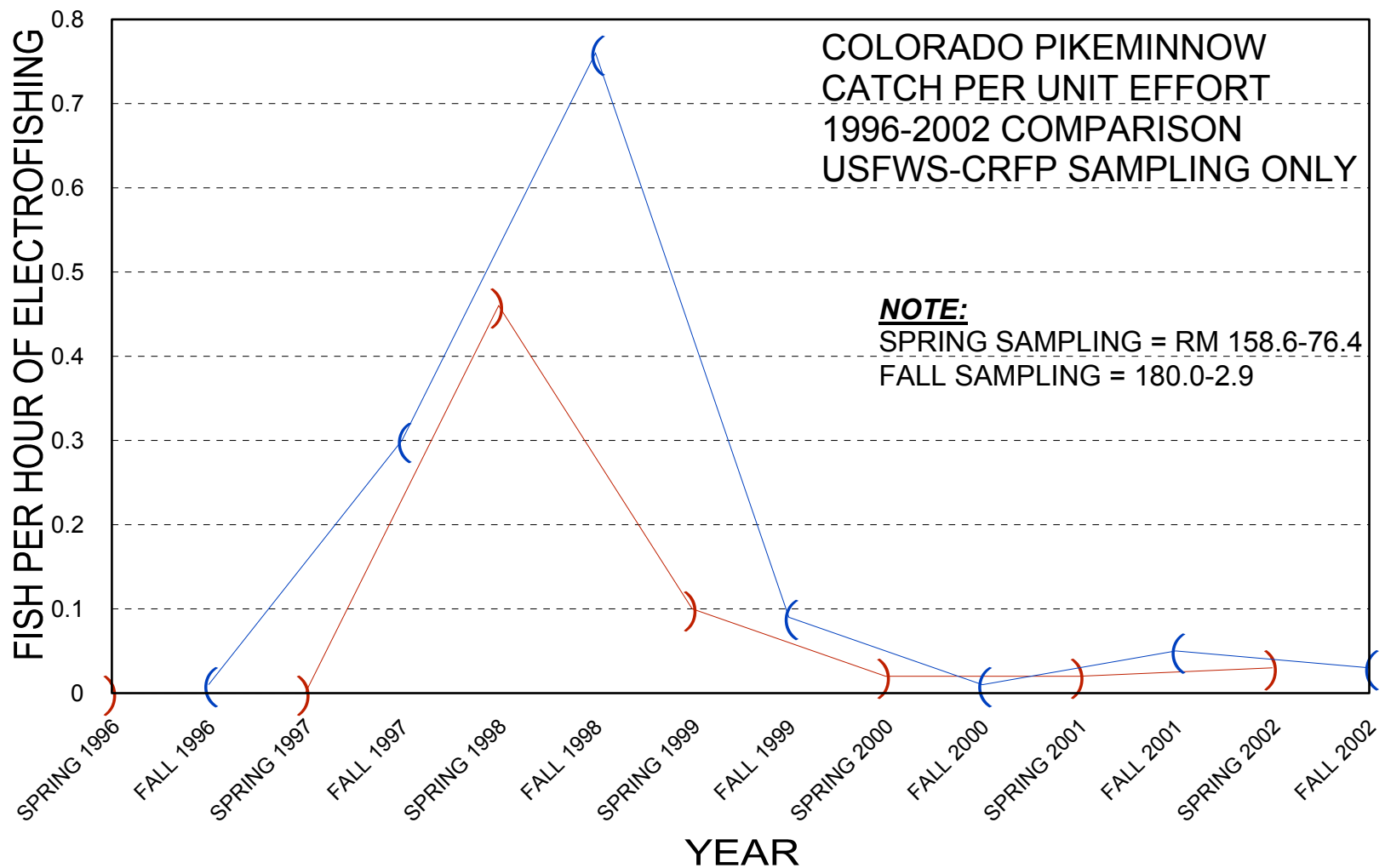


Figure 2. Colorado pikeminnow catch per unit effort (CPUE) on fall adult monitoring trips and spring razorback sucker monitoring trips, 1996-2002. This graph includes all Colorado pikeminnow collected by USFWS-CRFP during these trips, including both captures of wild fish and recaptures of stocked fish (juveniles and adults).

stocked in 1996 at an average size of 55 mm TL (Table 4) had reached 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. Since the fall 1999 adult monitoring trip, CPUE for Colorado pikeminnow (both wild and stocked) has remained low. It is hoped that with the renewed stocking of age-0 Colorado pikeminnow which began in October 2002, this CPUE trend will once again begin to rise as it did in 1997 and 1998. However, only time will tell.

Razorback Sucker

Fish Stocked As Part Of An Augmentation Effort

Between March 1994 and November 2002, a total of 6,975 razorback sucker were stocked into the San Juan River (Table 7). All of the 6,975 fish were individually-implanted with PIT tags before being released into the wild.

That total includes 139 razorback that were stocked into the San Juan in three separate stockings in 2002. The first of these three stockings occurred on 11 April, when 13 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 7). The mean TL of these 13 fish was 137 mm (range = 110-170 mm TL).

The second stocking in 2002 consisted of 101 fish stocked on 22 April (Table 7). These 101 fish had been reared by UDWR in the golf course ponds at Page, AZ. These fish were stocked into the San Juan at RM 158.6 (i.e., immediately downstream of the Hogback Diversion). The mean TL of these 101 fish was 334 mm (range = 240-470 mm TL).

The last stocking of razorback sucker in 2002 occurred during the week of 6 November. During that week, fish harvested from three grow-out ponds (East Avocet, West Avocet, and Hidden ponds) were stocked at RM 158.6 (Table 7). Unfortunately, very cold weather conditions and subsequent pond water temperatures hindered the efficiency of the passive fyke-netting efforts in the grow-out ponds during this week and only 25 individuals were harvested and stocked. The mean TL of these 25 fish was 351 mm (range = 295-456 mm TL).

2002 Collections

No wild razorback sucker were collected in 2002. However, a total of 62 individual stocked razorback sucker were recaptured, with one of these fish being collected twice during 2002 (Tables 8 and 9). Thus, there were a total of 63 recapture events with razorback sucker during the 2002 field season (Tables 8 and 9). All 63 of these collections were made via raft-mounted electrofishing. Of the 63 recaptures, 23 occurred during the fall 2002 adult monitoring trip (Table 8). Recaptures of razorback sucker collected during all studies in 2002 ranged from RM 164.0 to 7.3, while those collected during the fall 2002 adult monitoring trip ranged from RM 158.0 to 14.0 (Tables 8 and 9).

All 63 recaptures occurred with razorback sucker that had been stocked into the San Juan River since 1994. Of the 63 recaptures, four were with fish originally stocked in 1994, two were with fish originally stocked in 1995, two were with fish originally stocked in 1997, six were with fish originally

Table 7. Stockings of razorback sucker in the San Juan River, 1994-2002.

| Date | Number Stocked | River Miles Stocked At ^a | Mean Total Length (mm) | Range Of Total Lengths (mm) | Responsible Agency ^b |
|------------|----------------|-------------------------------------|------------------------|-----------------------------|---------------------------------|
| 03/30/1994 | 15 | 136.6-79.6 | 277 | 239-316 | USFWS |
| 10/27/1994 | 16 | 136.6-79.6 | 403 | 384-435 | USFWS |
| 11/17/1994 | 478 | 158.6-79.6 | 190 | 100-374 | USFWS |
| 11/18/1994 | 178 | 158.6-79.6 | 400 | 330-446 | USFWS |
| 08/08/1995 | 65 | 0.0 | 405 | 348-431 | UDWR ^c |
| 08/15/1995 | 65 | 0.0 | 409 | 369-437 | UDWR ^c |
| 09/27/1995 | 16 | 158.6 | 424 | 397-482 | USFWS |
| 10/03/1996 | 237 | 158.6 | 335 | 204-434 | USFWS |
| 09/03/1997 | 1027 | 158.6 | 193 | Not Specified | USFWS |
| 09/17/1997 | 227 | 158.6 | 229 | Not Specified | USFWS |
| 09/19/1997 | 1631 | 158.6 | 185 | 104-412 | USFWS |
| 04/22/1998 | 57 | 158.6 | 420 | 380-460 | UDWR |
| 05/28/1998 | 67 | 158.6 | 417 | 341-470 | UDWR |
| 10/15/1998 | 1155 | 158.6 | 232 | 185-315 | USFWS |
| 08/03/1999 | Unknown | 170.8 | Unknown | Unknown | ----- ^d |
| 10/20/2000 | 1044 | 158.6 | 214 | 111-523 | USFWS |
| 11/01/2001 | 688 | 158.6 | 410 | 288-560 | USFWS |
| 04/11/2002 | 13 | 178.2 | 137 | 110-170 | CDOW |
| 04/22/2002 | 101 | 158.6 | 334 | 240-470 | UDWR |
| 11/06/2002 | 25 | 158.6 | 351 | 295-456 | USFWS |

^a In 1994, fish were stocked at one of four stocking sites (RM 158.6, 136.6, 117.5, or 79.6). When groups of fish were stocked at multiple sites, they were stocked in roughly equal numbers at each site (i.e., on 03/30/1994 each of the three stocking sites got five of the 15 fish stocked).

^b CDOW = Colorado Division of Wildlife - Information and Education Program, Grand Junction, Colorado; UDWR = Utah Division of Wildlife Resources - Wahweap Warmwater Fish Hatchery, Big Water, Utah; USFWS = U.S. Fish and Wildlife Service - Colorado River Fishery Project, Grand Junction, Colorado

^c These fish were stocked in Lake Powell at Piute Farms (RM 0.0). They are listed here because three of them have been recaptured in the San Juan River (one at RM 58.0 on 05/21/1996; one at RM 1.1 on 10/05/1999; and, one at RM 71.1 on 09/28/2001).

^d This was an unintentional stocking that occurred when heavy rains caused the earthen dam on a grow-out pond near Ojo Amarillo, NM to wash out. The pond completely drained washing an unknown number of fish down Ojo Wash to its confluence with the San Juan River (RM 170.8). Twelve of these fish were recaptured between 09/21/2000 and 02/07/2002.

Table 8. Razorback sucker collected from the San Juan River on the fall 2002 adult monitoring trip (n = 23).

| Date Of Capture | PIT Tag Number | Radio Freq. | Total Length (mm) | Weight (grams) | Sex ^a | Capture River Mile | Days In River Since Stocking |
|-----------------|----------------|-------------|-------------------|-------------------|------------------|--------------------|------------------------------|
| 09/21/2002 | 1F43647A40 | 761 | 463 | 1160 | M | 106.0 | 2864 |
| 09/21/2002 | 423E640D30 | 800 | 428 | 700 | F | 100.0 | 326 |
| 09/21/2002 | 1F75165303 | 976 | 483 | 1200 | F | 98.9 | 2551 |
| 09/21/2002 | 1F743A347F | 091 | 574 | 2150 | F | 97.8 | 2864 |
| 09/24/2002 | 7F7B106C67 | NONE | 468 | 1200 | M | 64.7 | 1580 |
| 09/25/2002 | 5229167B23 | NONE | 415 | 775 | I | 58.2 | 156 |
| 09/25/2002 | 531A7F0D1A | NONE | 420 | 650 | M | 47.0 | 706 |
| 09/28/2002 | 423D082F39 | NONE | 530 | 1300 | F | 17.0 | Unknown ^b |
| 09/28/2002 | 423E5D7247 | NONE | 497 | 1150 | I | 14.0 | 332 |
| 10/07/2002 | 423E7E4D15 | NONE | 435 | 1150 | M | 158.0 | 341 |
| 10/07/2002 | 4240181B0C | NONE | 435 | 1050 | I | 158.0 | 341 |
| 10/07/2002 | 423E66702C | NONE | 445 | 1250 | I | 158.0 | 340 |
| 10/07/2002 | 4242335143 | NONE | 442 | ---- ^c | I | 158.0 | 342 |
| 10/07/2002 | 423F083F30 | NONE | 440 | 900 | M | 158.0 | 341 |
| 10/07/2002 | 5325750920 | NONE | 455 | 1500 | I | 156.0 | 719 |
| 10/07/2002 | 53257F7548 | NONE | 430 | 750 | M | 156.0 | 719 |
| 10/07/2002 | 52296F6261 | NONE | 367 | 590 | I | 156.0 | 168 |
| 10/07/2002 | 424217215C | NONE | 481 | 1600 | M | 156.0 | 341 |
| 10/07/2002 | 522A505F23 | NONE | 337 | 500 | I | 155.0 | 168 |
| 10/07/2002 | 423E78141C | NONE | 435 | 940 | I | 155.0 | 342 |
| 10/07/2002 | 423F5C3543 | NONE | 425 | 900 | I | 152.0 | 342 |
| 10/08/2002 | 4240191570 | 721 | 420 | 925 | I | 143.0 | 342 |
| 10/09/2002 | 416D4F3B55 | NONE | 468 | 1080 | M | 128.0 | 1846 |

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 value was not obtained due to equipment failure

Table 9. Razorback sucker collected from the San Juan River during sampling efforts for other studies in 2002.

| Date Of Capture | PIT Tag Number | Radio Freq. | Total Length (mm) | Weight (grams) | Sex ^a | Capture River Mile | Days In River Since Stocking |
|---|----------------|-------------|-------------------|----------------|------------------|--------------------|------------------------------|
| Captures by USFWS-Grand Junction in 2002 (n = 7): | | | | | | | |
| 04/29/2002 | 42421E4C1A | NONE | 384 | 700 | I | 140.0 | 180 |
| 04/30/2002 | 423F7B6136 | NONE | 406 | 750 | F | 129.0 | 180 |
| 04/30/2002 | 423E643B63 | NONE | 401 | 775 | F | 130.5 | 182 |
| 04/30/2002 | 4240070D18 | NONE | 429 | 900 | M | 129.0 | 181 |
| 05/02/2002 | 423E5C4C46 | NONE | 382 | 600 | I | 110.5 | 182 |
| 05/02/2002 | 53240C4D7E | NONE | 405 | 850 | I | 102.5 | 561 |
| 05/02/2002 | 1F4143510C | 131 | 505 | 1475 | I | 102.1 | 2722 |
| Captures by USFWS-Albuquerque in 2002 (n = 12): | | | | | | | |
| 02/07/2002 | 7F7B0E0F09 | NONE | 430 | 850 | I | 164.0 | 919 |
| 04/04/2002 | 423F031672 | NONE | 479 | 1300 | I | 158.5 | 155 |
| 04/04/2002 | 423F0E6C4B | NONE | 506 | 1350 | I | 158.4 | 155 |
| 04/04/2002 | 423E5F1B3F | NONE | 351 | 510 | I | 158.3 | 156 |
| 04/04/2002 | 4242364628 | NONE | 402 | 790 | I | 157.6 | 156 |
| 04/04/2002 | 423F712672 | NONE | 485 | 1500 | I | 157.6 | 155 |
| 04/04/2002 | 53262F225C | NONE | 331 | 380 | I | 156.4 | 156 |
| 06/11/2002 | 522A50237B | NONE | 400 | 600 | I | 159.0 | 50 |
| 06/11/2002 | 423E760C18 | NONE | 496 | 1000 | M | 159.0 | 224 |
| 06/11/2002 | 423F6E7D60 | NONE | 470 | 1450 | I | 159.0 | 224 |
| 06/12/2002 | 42423D5E34 | NONE | 408 | 650 | I | 159.0 | 225 |
| 06/12/2002 | 531C417968 | NONE | 415 | 1000 | I | 159.0 | 601 |

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

Table 9, continued. Razorback sucker collected from the San Juan River during sampling efforts for other studies in 2002.

| Date Of Capture | PIT Tag Number | Radio Freq. | Total Length (mm) | Weight (grams) | Sex ^a | Capture River Mile | Days In River Since Stocking |
|---|----------------|-------------|-------------------|----------------|------------------|--------------------|------------------------------|
| Captures by UDWR-Moab in 2002 (n = 21): | | | | | | | |
| 03/14/2002 | 507F727F1E | NONE | 516 | 1500 | M | 18.6 | 1247 |
| 03/14/2002 | 7F7B12307C | NONE | 491 | 1250 | M | 18.5 | 1386 |
| 03/14/2002 | 4240152E07 | NONE | 468 | 1200 | M | 12.2 | 135 |
| 03/15/2002 | 1F41612C13 | NONE | 513 | 1600 | M | 7.3 | 2361 |
| 04/18/2002 | 512A724849 | NONE | 480 | 1100 | M | 18.0 | 1282 |
| 04/18/2002 | 1F414E3E14 | NONE | 487 | 1150 | M | 17.9 | 2708 |
| 04/18/2002 | 42151C0F23 | NONE | 500 | 1150 | I | 17.8 | 1688 |
| 04/18/2002 | 203E3F3C27 | NONE | 495 | 1125 | M | 17.8 | 1421 |
| 04/18/2002 | 1F750B7869 | NONE | 505 | 1275 | M | 17.8 | Unknown ^b |
| 04/18/2002 | 423F635449 | NONE | 478 | 1175 | M | 17.5 | 170 |
| 04/19/2002 | 4240132127 | NONE | 490 | 1350 | I | 7.8 | 170 |
| 05/07/2002 | 5324612161 | NONE | 392 | 620 | I | 41.9 | 564 |
| 05/09/2002 | 423E77433E | NONE | 453 | 900 | M | 18.3 | 191 |
| 05/09/2002 | 423F0F0F32 | NONE | 443 | 1100 | M | 18.3 | 190 |
| 05/20/2002 | 42424E135B | NONE | 383 | 510 | I | 45.3 | 201 |
| 05/21/2002 | 423E793225 | NONE | 518 | 1500 | I | 40.6 | 202 |
| 05/21/2002 | 51337C3546 | NONE | 445 | 650 | I | 35.0 | 1314 |
| 05/22/2002 | 423F057A3F | NONE | 470 | 1200 | I | 24.5 | 202 |
| 05/23/2002 | 4240132127® | NONE | 490 | 1350 | I | 17.2 | 204 |
| 06/12/2002 | 4240072250 | NONE | 445 | 850 | M | 27.2 | 225 |
| 06/13/2002 | 53256E784F | NONE | 452 | 1250 | I | 14.1 | 601 |

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.

®: This was the second recapture of this fish in 2002. The first recapture was on 04/19/2002 at RM 7.8.

stocked in 1998, one was with a fish originally stocked in 1999, seven were with fish originally stocked in 2000, 35 were with fish originally stocked in 2001, and four were with fish that had been stocked on 22 April 2002. Two other razorback sucker were recaptured for which no PIT tag was detectable, therefore the year of their stocking could not be determined. Both of these fish were implanted with a PIT tag before being returned to the river (Tables 8 and 9).

Among the 63 recaptures, 22 were males, six were females, and 35 were of indeterminate sex (Tables 8 and 9). Tuberculate males were collected from 14 March through 9 October, while ripe males were collected from 18 April through 9 October. No ripe females were collected during 2002.

Population Trends

Over time, it has become apparent that razorback sucker stocked at > 300 mm TL have a much higher recapture (= survival) rate than fish stocked at smaller sizes (Table 10). Between 1994 and 2002, razorback sucker stocked at > 300 mm TL (n = 1,553) represented just 22.3% of all stocked fish (n = 6,975). However, fish stocked at > 300 mm TL accounted for 88.7% (150 of 169) of all first-time recaptures through 2002 (Table 10). Even razorback sucker recaptured from lots of stocked fish that had mean TL's < 300 mm at the time of stocking (Table 7) tended to be the few individuals that were larger than their lot's mean TL and more often than not, these individuals were themselves > 300 mm TL at time of stocking. For this reason, beginning in 2001, the SJRIP decided to avoid stocking razorback sucker < 300 mm TL whenever possible.

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). However, in 2001 and then again in 2002, razorback sucker CPUE for both the spring razorback sucker monitoring trip and the fall adult monitoring trip were at the highest values ever observed (Figure 3). Even though this 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 = 6,975 stocked individuals through 2002 versus more than one million Colorado pikeminnow stocked through 2002; Tables 4 and 7).

Spawning Aggregations

No aggregations of spawning razorback sucker were identified in upstream sections of the San Juan River in 2002. The spawning bar that had been identified at RM 100.2 (just downstream of Aneth, UT) was not even underwater during the April/May 2002 razorback sucker monitoring trip and the habitat surrounding this site consisted of a shifting sand bottom with no exposed cobble (pers. obs.).

However, a suspected spawning aggregation of razorback sucker was identified by the UDWR, in the lower San Juan River, adjacent to Slickhorn Canyon in 2002. On 18 April 2002, UDWR crews collected six razorback sucker from RM 18.0-17.5 (Tables 9 and 11; Jackson 2003). Approximately ten other razorback sucker were also sighted but not collected (Jackson 2003). All six of the razorback sucker collected were large adults (478-505 mm TL), with five

Table 10. Numbers, by size-class at time of stocking, of razorback sucker stocked into the San Juan River between 1994 and 2002 and recaptured as of 31 December 2002. Note: This table is for first-time recaptures only.

| Total Length In mm | Of 6975 Stocked Fish | | Of 169 Known-Origin Recaptures | |
|-----------------------|---|----------------------|---|---------------------|
| | Percent of Total Represented By This Size-Class | Total Number Stocked | Percent of Total Represented By This Size-Class | Total Number Caught |
| < 51 | 0.0% | 0 | 0.0% | 0 |
| 51-100 | <0.1% | 1 | 0.0% | 0 |
| 101-150 | 6.7% | 467 | 0.0% | 0 |
| 151-200 | 40.9% | 2849 | 2.4% | 4 |
| 201-250 | 27.3% | 1906 | 5.9% | 10 |
| 251-300 | 2.9% | 199 | 3.0% | 5 |
| 301-350 | 3.4% | 235 | 6.5% | 11 |
| 351-400 | 8.0% | 557 | 33.1% | 56 |
| 401-450 | 9.1% | 638 | 39.6% | 67 |
| 451-500 | 1.5% | 107 | 6.5% | 11 |
| >500 | 0.2% | 16 | 3.0% | 5 |
| Totals | 100.0% | 6975 | 100.0% | 169 |

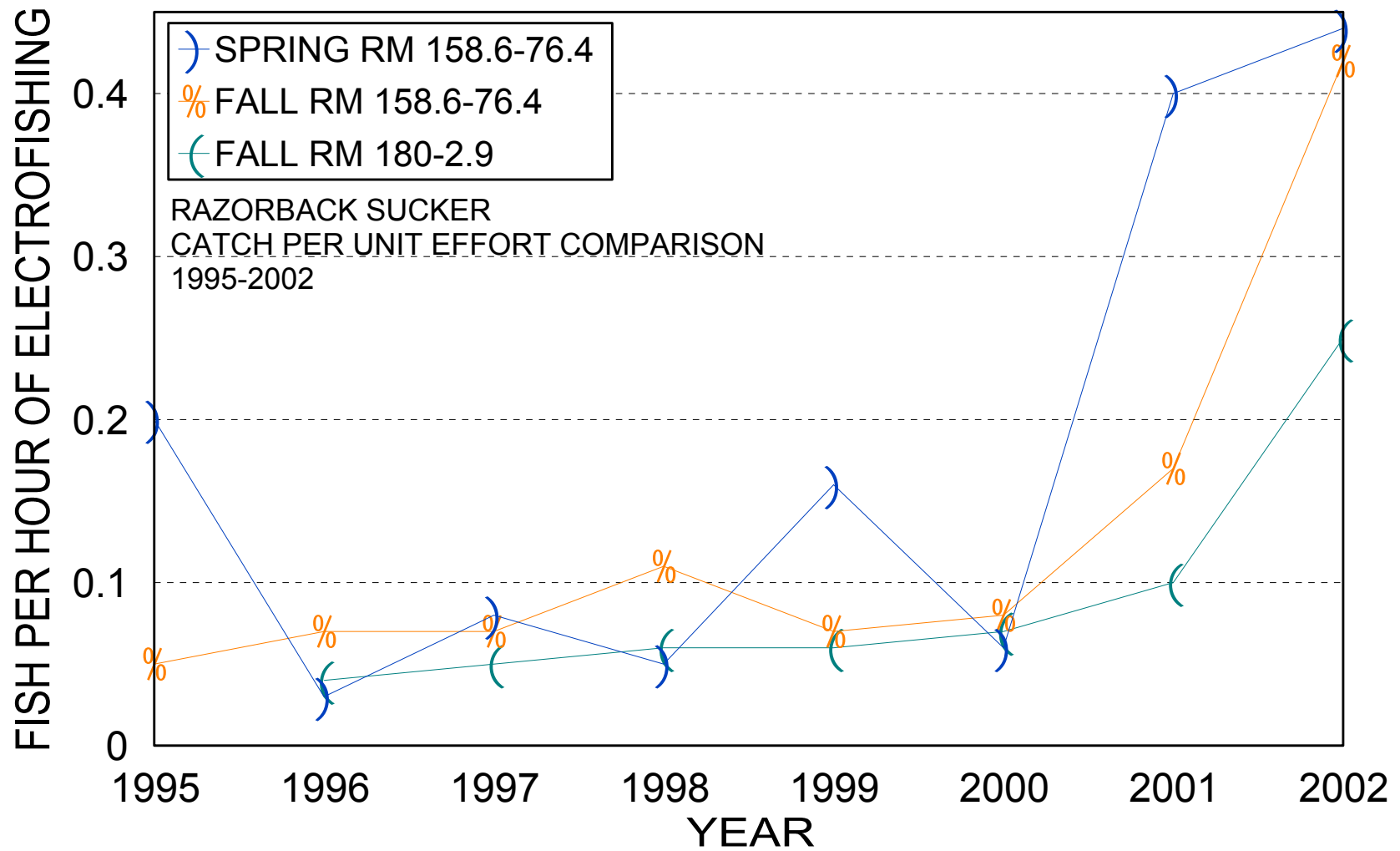


Figure 3. Razorback sucker catch per unit effort (CPUE) on fall adult monitoring trips and spring razorback sucker monitoring trips, 1995-2002.

Table 11. Details of six individual razorback sucker recaptured via raft-mounted electrofishing in a suspected spawning aggregation adjacent to Slickhorn Canyon on 18 April 2002.

| RM Recaptured At | PIT Tag Number | Total Length (in mm) | Weight (in g) | Sex ^a | Days Since Stocking | Date Stocked | RM Fish Was Stocked At | Year-Class & (Age At Recapture) |
|---|-------------------------|----------------------|---------------|------------------|---------------------|--------------|------------------------|---------------------------------|
| Suspected spawning aggregation on 18 April 2002 (documented by UDWR-Moab's nonnative fish removal crews): | | | | | | | | |
| 18.0 | 512A724849 | 480 | 1100 | Male, tb/r | 1282 | 10/14/1998 | 158.6 | 1997 (5) |
| 17.9 | 1F414E3E14 | 487 | 1150 | Male, tb/r | 2708 | 11/18/1994 | 79.6 | 1992 (10) |
| 17.8 | 1F750B7869 ^b | 505 | 1275 | Male, tb/r | Unknown | Unknown | Unknown | Unknown |
| 17.8 | 203E3F3C27 | 495 | 1125 | Male, tb/r | 1421 | 05/28/1998 | 158.6 | 1993 (9) |
| 17.8 | 42151C0F23 | 500 | 1150 | Indeterminate | 1688 | 09/03/1997 | 158.6 | 1996 (6) |
| 17.5 | 423F635449 | 478 | 1175 | Male, tb/r | 170 | 10/30/2001 | 158.6 | 1999 (3) |

a: tb = tuberculate, r = ripe (i.e., freely expressing milt)

b: No PIT tag could be detected in this fish, so a previous stocking history could not be determined. A new PIT tag was implanted in this fish before it was returned to the river.

of them being tuberculate, ripe (i.e., freely expressing milt) males (Tables 9 and 11). The other was of indeterminate sex, but given the time of year, its size (500 mm TL), its proximity to numerous ripe male fish, and its lack of tubercles, it was likely a female fish. One of the six fish did not have a PIT tag detectable upon capture, but was implanted with one before it was released (Tables 9 and 11). As had been observed with spawning aggregations at RM 100.2 in the past, the razorback sucker collected at Slickhorn Canyon had originally been stocked on several different stocking dates (ranging from 1994-2001) and at more than one stocking site (RM 79.6 and 158.6 in this case; Table 11). In addition, the razorback sucker collected in this particular aggregation represented a wide range of age-classes (age-3 to age-10; Table 11). All but one of these six fish were first-time recaptures - PIT tag number 1F414E3E14 had been recaptured once before at RM 86.3 on 17 April 1999.

On 18 April 2002, there was clean cobble habitat in this area both up- and downstream of Slickhorn Rapid (J. Jackson pers. comm.). The flows recorded at the nearest USGS river gage (i.e., the Bluff gage, #09379500) during this general time period were 667 CFS on 15 March, 537 CFS on 1 April, 438 CFS on 15 April, and 420 CFS on 18 April. So, at the time this supposed spawning aggregation occurred, the flows had been dropping steadily for over a month. This is in direct contrast to previous razorback spawning aggregations documented at RM 100.2 in 1997, 1999, and 2001, all of which occurred on the ascending limbs of those years' hydrographs (Ryden 2003b).

Roundtail Chub

2002 Collections

Only one roundtail chub was collected during 2002 adult monitoring. This was an adult fish (TL = 390 mm, WT = 600 g) of indeterminate sex. It was collected between RM 161.0 and 160.0 on 1 October 2002 via raft-mounted electrofishing. This was a wild fish that had not been previously captured. It was implanted with a PIT tag (512D5F2B33) and released at RM 160.0.

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 2002 (n = 190), 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 of the San Juan's tributaries 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 2002 (n = 190) consisted of subadult fish (Figure 4; Ryden 2000a).

Between 1991 and 2002, a total of 25 roundtail chub (TL range = 116-414 mm) have been implanted with PIT tags (SJRIP Integrated Database). Of these 25, only two 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

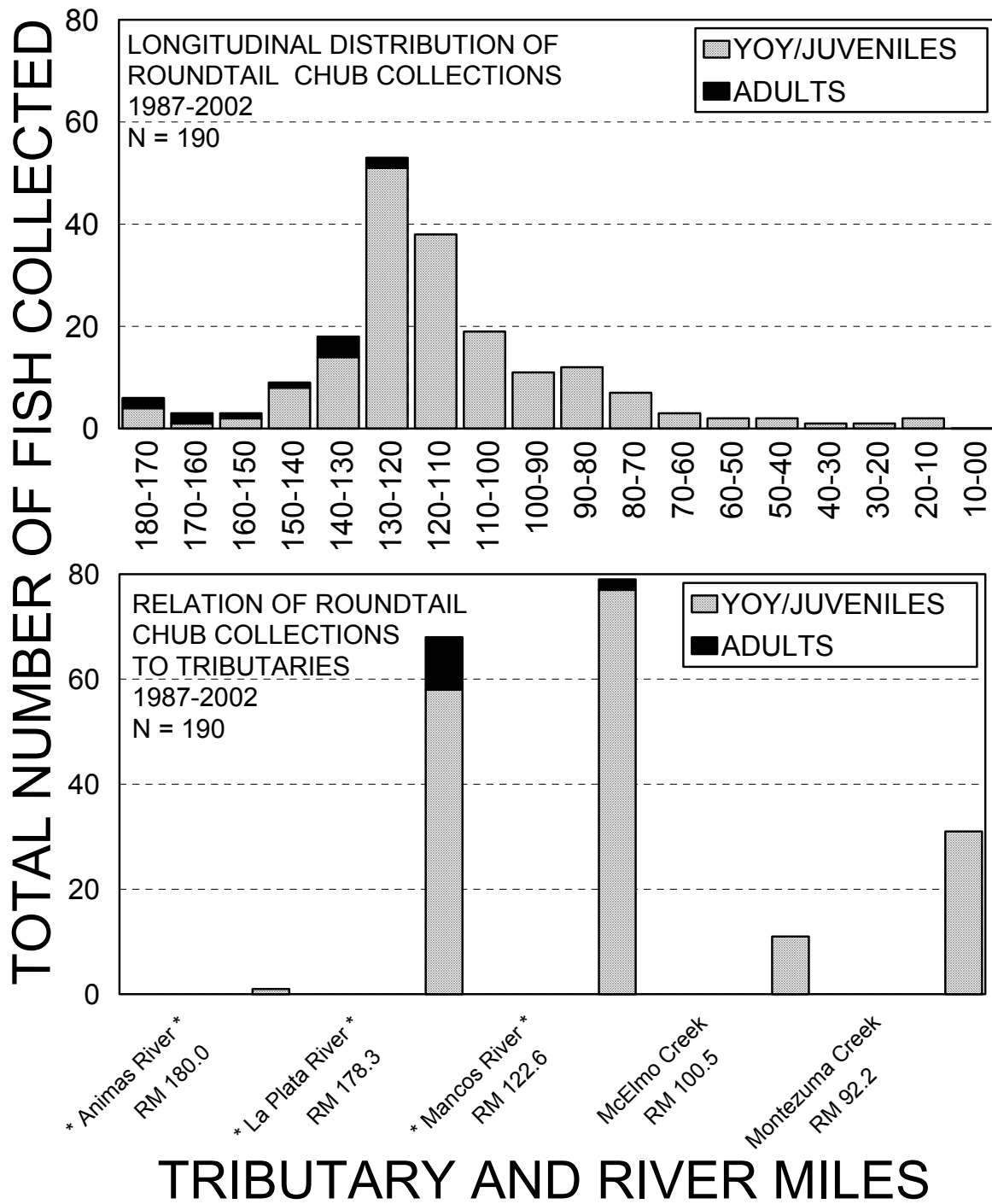


Figure 4. Spatial distribution of all roundtail chub collections from all studies in the San Juan River, 1987-2002 (top). Relation of all roundtail chub collections from all studies to major tributaries of the San Juan River, 1987-2002 (bottom). Tributaries that have asterisks by their names are those known to have resident populations of roundtail chub (Miller and Rees 2000).

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 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 argue that the roundtail chub being collected in the mainstem San Juan are transient members of the fish community at best. 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.

Common Native Fishes

Flannemouth Sucker

Catch Per Unit Effort (CPUE)

Flannemouth sucker continue to be the most common large-bodied fish collected riverwide during adult monitoring trips (Table 3; Ryden 2000a, 2001a, 2003c). While numbers of this fish have fluctuated both riverwide and in individual geomorphic reaches over the years, flannemouth 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, 2003c).

After a marked influx of age-0 fish in 2000, juvenile flannemouth sucker CPUE has declined noticeably in the last two years (2001-2002), reaching the lowest point observed over the last seven years in fall 2002 (Figure 5). This has caused the trend for flannemouth sucker total CPUE riverwide to follow suit, despite the fact that adult flannemouth sucker CPUE riverwide has remained very stable over the last three years (200-2002; Figure 5).

Flannemouth sucker occur throughout Reach 6, both up- and downstream of all the various major and minor water diversion structures, including PNM Weir (RM 166.6; Ryden 2000a, 2001a, 2003c). Between 1996 and 2001, total CPUE for flannemouth sucker in Reach 6 remained relatively constant, with exceptions of 1999 and 2000 (Figure 6). Total CPUE for flannemouth sucker in 1999 was higher when compared to previous years and 2001, due to an increase in CPUE among adult fish (Figure 6). Then in 2000, total CPUE for flannemouth sucker rose again dramatically to the highest value ever recorded for this species in any river reach or year since our studies began in 1991 (Figure 6). This was due to the enormous number of juvenile flannemouth sucker collected in Reach 6 in 2000, the majority of which were collected upstream of the PNM Weir (Ryden 2001a). In 2002, there was once again a marked increase in Juvenile CPUE in Reach (Figure 6). However, this was the only river reach in which numbers of juvenile flannemouth sucker demonstrated any marked positive increase in 2002 (Figures 6-8). Adult flannemouth sucker CPUE has remained relatively unchanged in six of the last seven years (Figure 6).

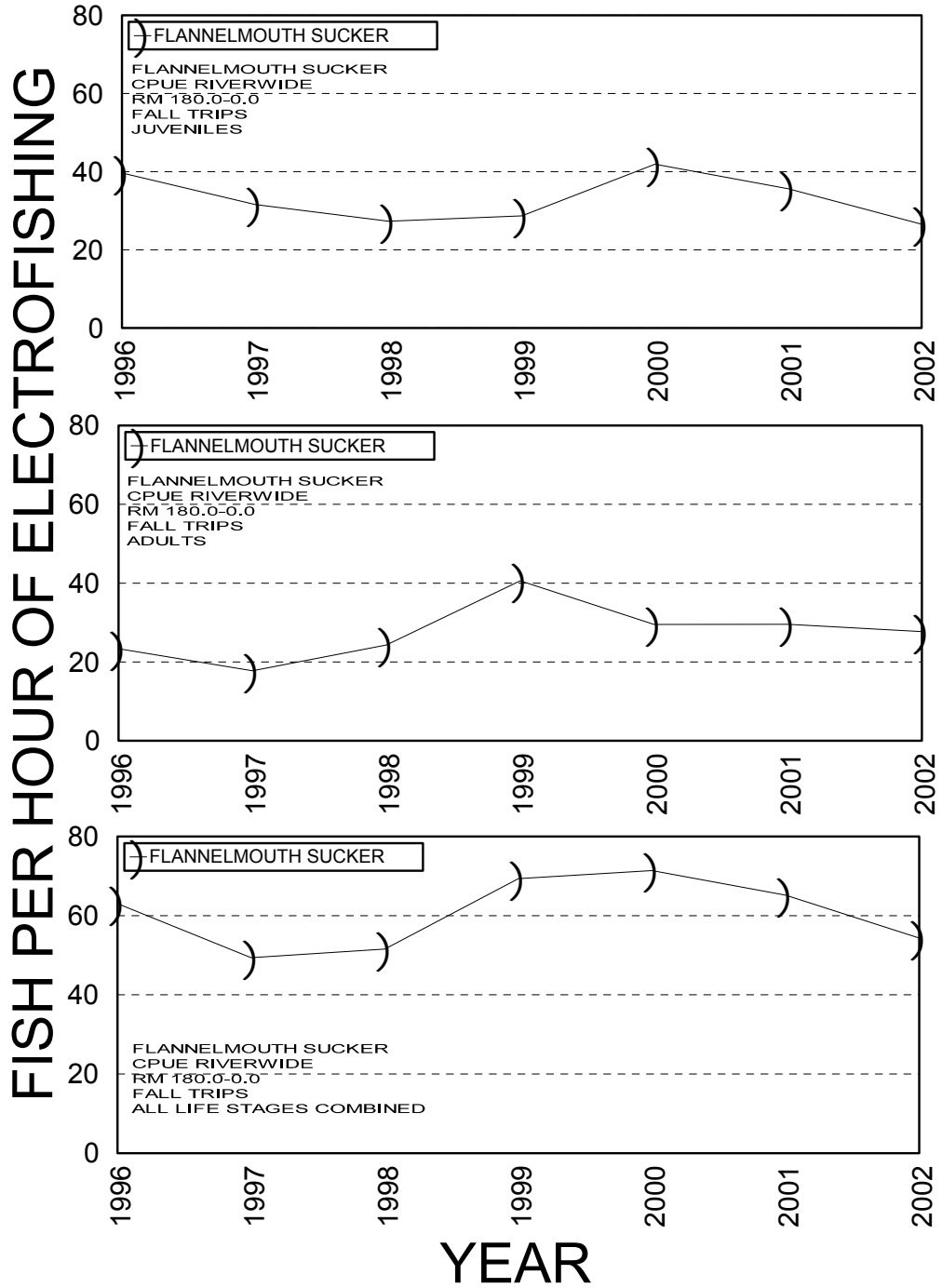


Figure 5. Flannemouth sucker catch per unit effort (CPUE) riverwide (RM 180.0-0.0) on fall adult monitoring trips, for juvenile fish (< 410 mm TL; top), adult fish (\geq 410 mm TL; middle), and for all life stages combined (juveniles + adults; bottom). Error bars represent the standard error values.

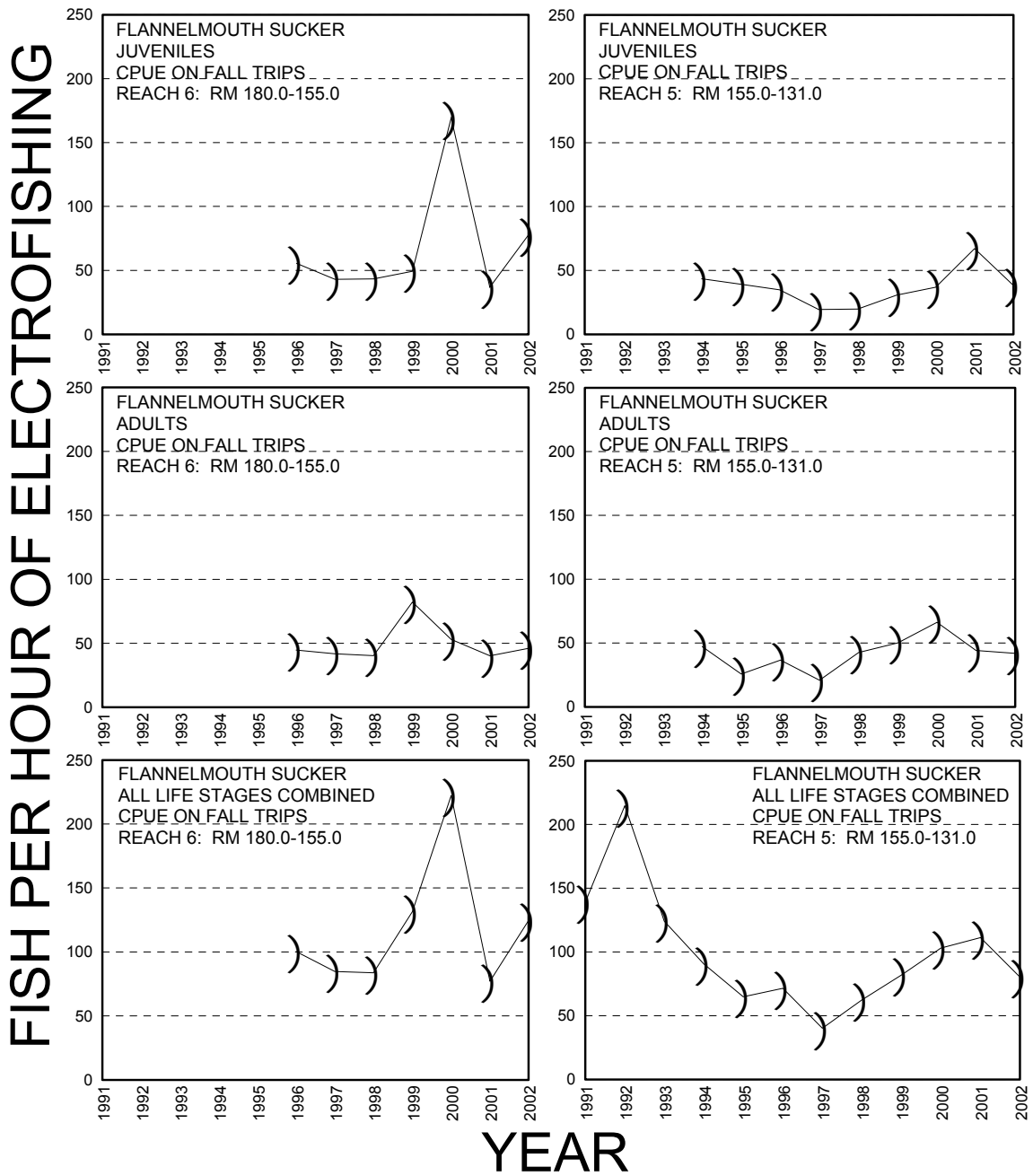


Figure 6. Flannemouth sucker catch per unit effort (CPUE) in Reach 6 and Reach 5 on fall adult monitoring trips for juvenile fish (< 410 mm TL; top), adult fish (\geq 410 mm TL; middle), and for all life stages combined (juveniles + adults; bottom). Error bars represent the standard error values.

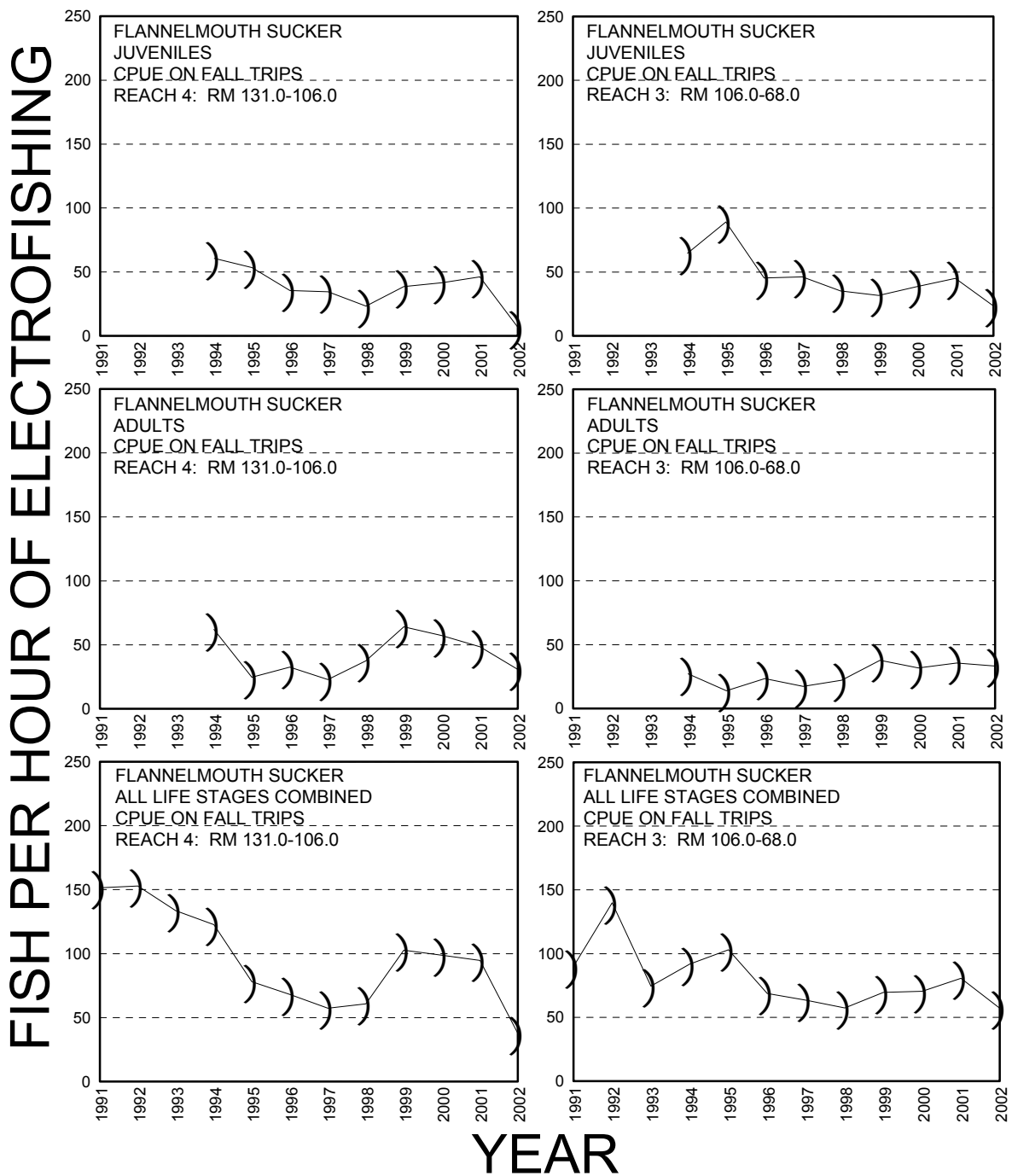


Figure 7. Flannemouth sucker catch per unit effort (CPUE) in Reach 4 and Reach 3 on fall adult monitoring trips for juvenile fish (< 410 mm TL; top), adult fish (\geq 410 mm TL; middle), and for all life stages combined (juveniles + adults; bottom). Error bars represent the standard error values.

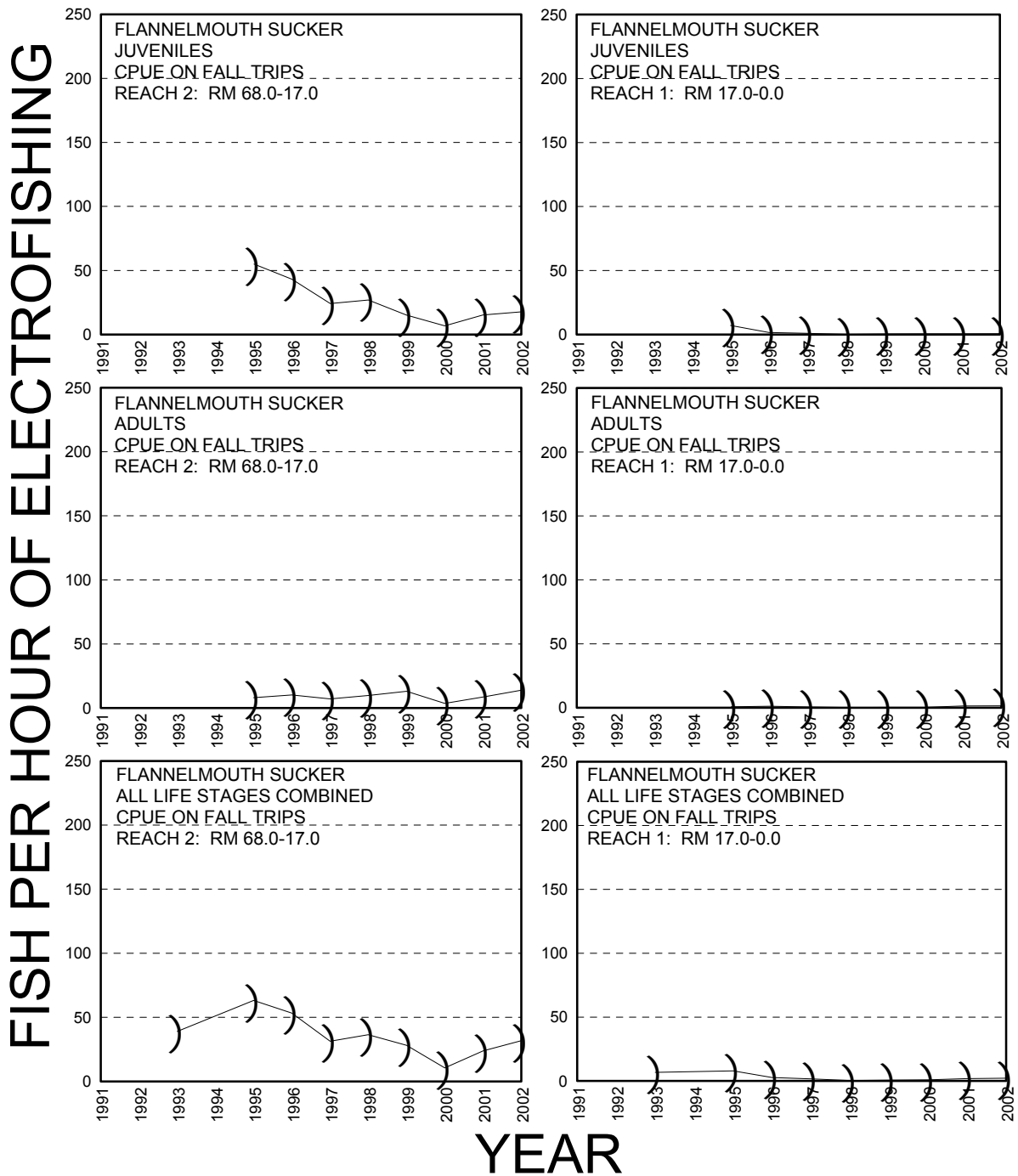


Figure 8. Flannemouth sucker catch per unit effort (CPUE) in Reach 2 and Reach 1 on fall adult monitoring trips for juvenile fish (< 410 mm TL; top), adult fish (\geq 410 mm TL; middle), and for all life stages combined (juveniles + adults; bottom). Error bars represent the standard error values.

The flannemouth sucker population in Reach 5 has demonstrated the most dramatic shift 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 flannemouth sucker population was in a long-term decline (Figure 6; Ryden 2000a). However, between 1997 and 2001, flannemouth sucker total CPUE increased again markedly, with this increase occurring in both in juvenile and adult life stages (Figure 6). However, in 2002, both juvenile and adult flannemouth sucker CPUE once again declined in Reach 5, but not alarmingly so (Figure 6).

Flannemouth sucker total CPUE in Reach 4 demonstrated a decline between 1992 and 1997 that was very similar to that observed in Reach 5 immediately upstream (Figure 7). However, like Reach 5, total CPUE in Reach 4 increased markedly between 1997 and 1999 and remained relatively stable from 1999-2001 (Figure 7). Then, as was observed in Reach 5 immediately upstream, flannemouth 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). Thus, despite the increases in flannemouth sucker total CPUE observed in Reach 4 in 1999-2001, it appears that the long-term decline of flannemouth sucker total CPUE in this reach may be continuing (Figure 7).

In Reach 3 (and adjoining Reach 2 downstream), juvenile fish become the numerically dominant life stage in the flannemouth sucker population (Figure 7). In Reach 3, there was also a decline in total CPUE between 1992 and 1998 in the case of this reach (Figure 11). However, unlike upstream in Reaches 5 and 4, total CPUE has not risen again markedly since its low in 1998 (Figure 7). In fact, in 2002, juvenile CPUE dropped to the lowest value ever observed in this reach, causing total CPUE to follow suit (Figure 7). However, unlike Reach 4 upstream, there has been no discernable decline in adult CPUE for 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 flannemouth sucker (Figures 6-8). In addition, Reach 2 is the most downstream reach in which flannemouth sucker are regularly collected in any kind of appreciable numbers. Like Reach 3 directly upstream, the flannemouth 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 flannemouth sucker total CPUE in Reach 2 between 1995 and 2000 was a steady decline (Figure 8). However, since 2000, juvenile, adult, and total CPUE have all risen steadily, if not dramatically in Reach 2 (Figure 8).

Flannemouth sucker remain rare in electrofishing collections in Reach 1, relative to CPUE values for more upstream reaches (Figures 6-8). It is intriguing that even though flannemouth sucker have always been less common in Reach 1 than in other upstream reaches, they were markedly more abundant in Reach 1 before the waterfall at RM 0.0 became inundated in spring 1995 (Figure 8).

Length Frequency And Mean Total Length

Histograms of riverwide length-frequency distributions show a trend towards the flannemouth sucker population becoming increasingly dominated by adult fish (i.e., > 410 mm TL) between 1996 and 1999 with over half of all flannemouth 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

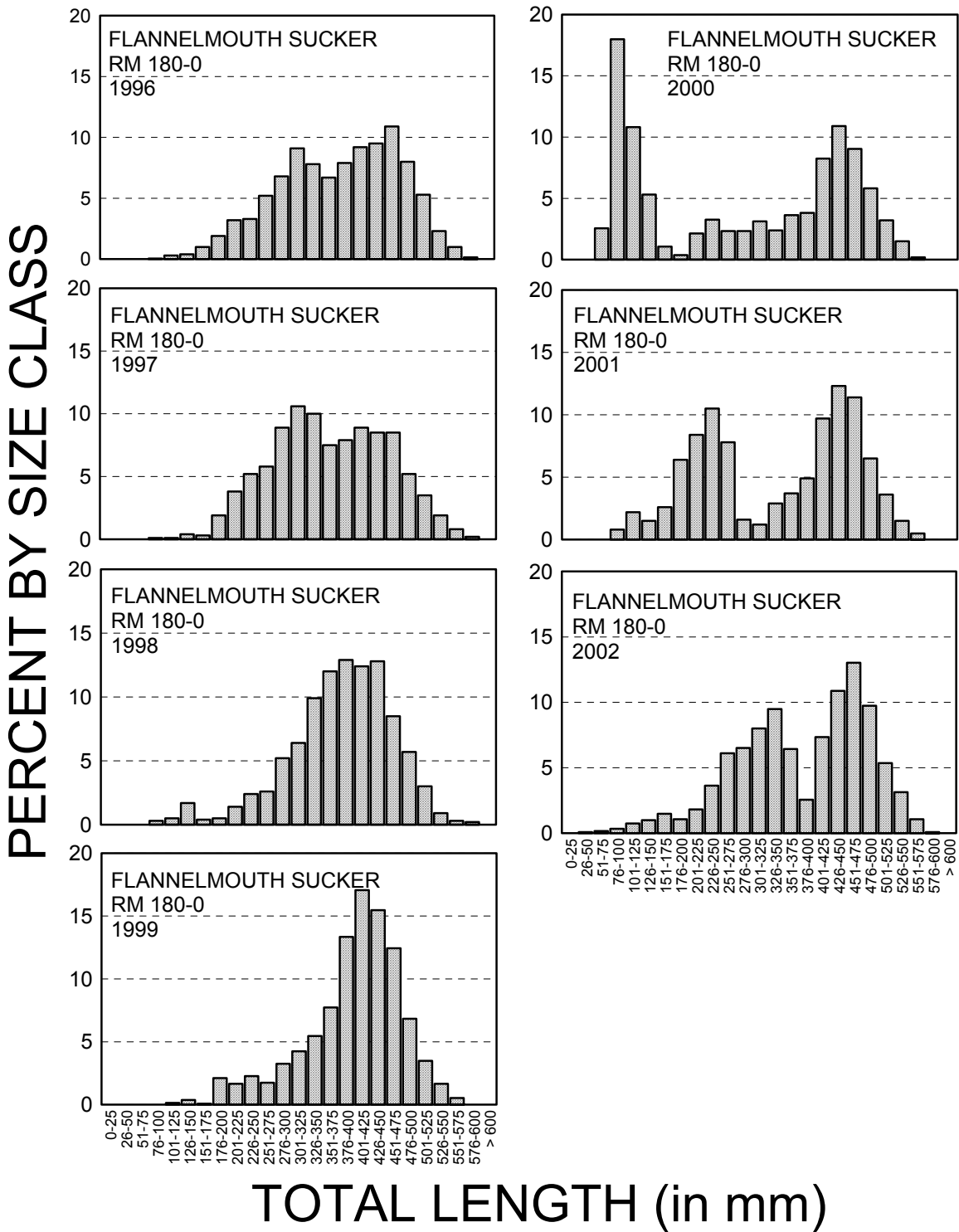


Figure 9. Length-frequency histograms showing the riverwide (RM 180.0-0.0) size-class distribution of flannemouth sucker on fall adult monitoring trips in the San Juan River.

(76-100 mm TL, assumed to be age-0) flannemouth sucker, causing the length-frequency of the flannemouth sucker population to become strongly bimodal in 2000, 2001, and 2002 (Figure 9). It appears as though small, age-0 flannemouth sucker (76-100 mm TL) from the October 2000 length-frequency histogram had grown approximately 150 mm by October 2001 (i.e., age-1 fish; Figure 9). Then, between 2001 (age-1) and 2002 (age-2) it appears as though the average growth of this cohort of fish was about another 100 mm (Figure 9). Looking at the rate of growth among young flannemouth sucker from 2000-2002 (given that age-2 flannemouth sucker in 2002 have a mean TL centered around the 326-350 mm size-class), one could reasonably argue that the group of flannemouth sucker centered around the 301-325 mm TL mark in the 1996 and 1997 length-frequency histograms were probably age-2 to age-3 fish that were spawned in 1993 or 1994 (Figure 9).

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

Mean TL of flannemouth sucker increased noticeably in Reaches 6-2 between 2001 and 2002 (Figure 11). The decreases in juvenile flannemouth sucker CPUE documented in Reaches 5-3 in 2002 (Figures 6 and 7) are reflected in the mean TL plots for these reaches (Figure 11). In fact in Reaches 4 and 3 as juvenile flannemouth sucker CPUE reached the lowest value ever observed (Figure 7), flannemouth sucker mean TL in these same reaches was at the highest value ever observed (Figure 11). Only in Reach 1 did mean TL for flannemouth sucker decline between 2001 and 2002.

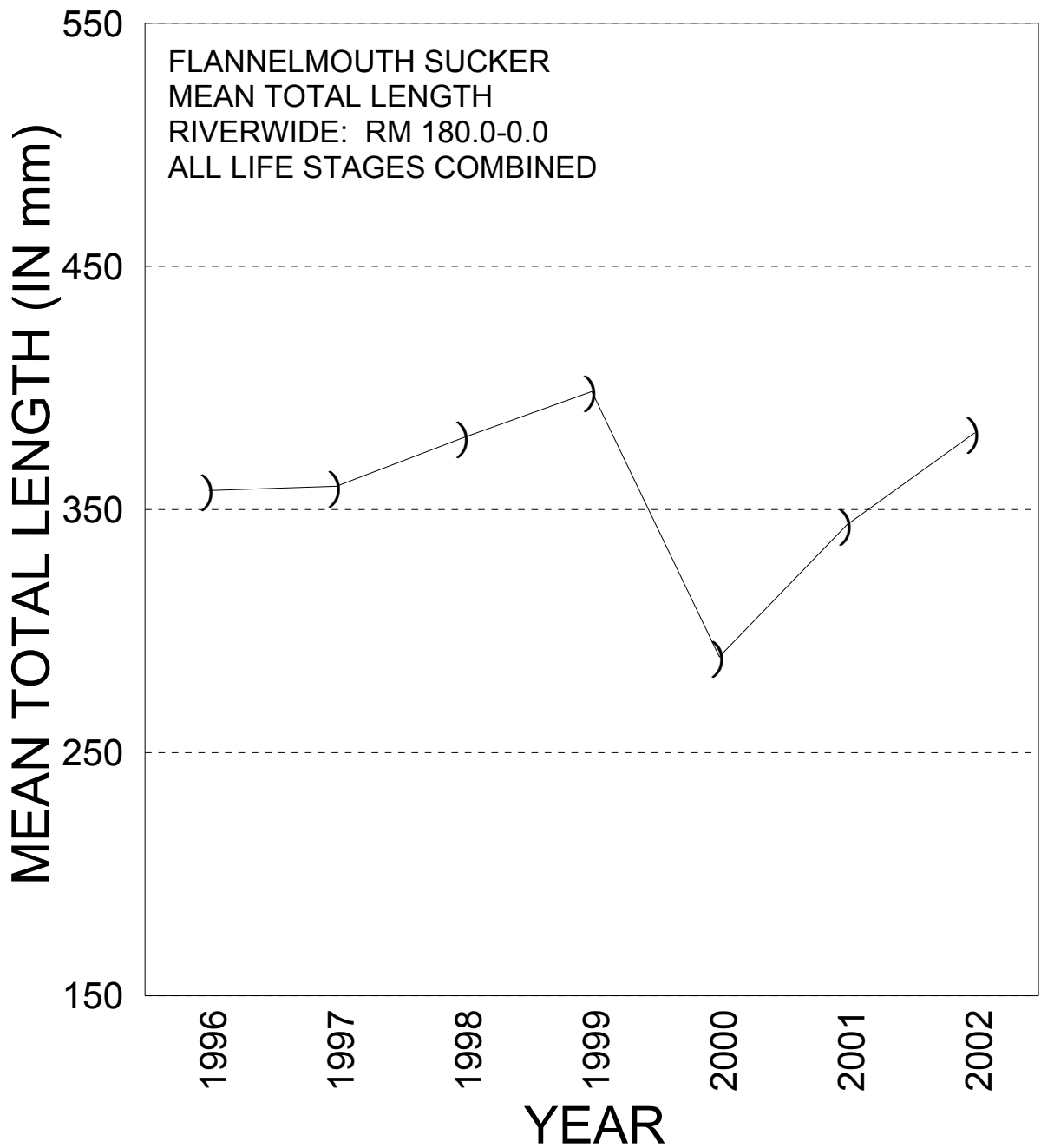


Figure 10. Mean total length (in mm) of flannelmouth sucker riverwide (RM 180.0-0.0) on fall adult monitoring trips in the San Juan River. Error bars represent the standard error values.

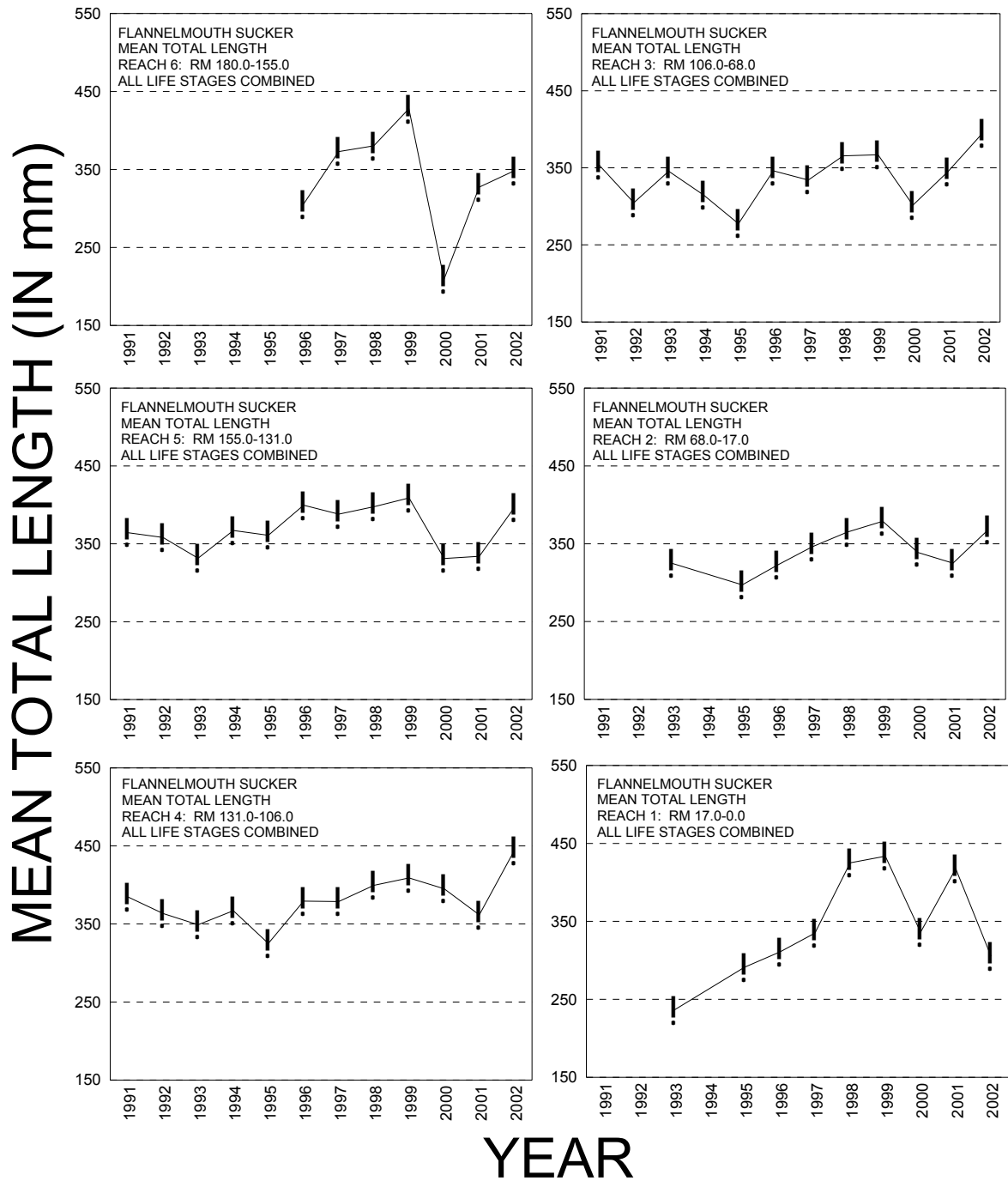


Figure 11. Mean total length (in mm) of flannelmouth sucker in Reaches 6-1 on fall adult monitoring trips in the San Juan River. Error bars represent the standard error values.

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, but since that time juvenile fish have become increasingly dominant in riverwide collections (Figure 12). Overall, bluehead sucker of all life stages were over twice as abundant in electrofishing collections riverwide in 2002 (28.6 fish/hr) as they were in 1996 (13.3 fish/hr; Figure 12).

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 2002, both juvenile and adult bluehead sucker CPUE increased markedly over 2001 (Figure 13). Total CPUE for bluehead sucker in Reach 6 is very unpredictable, demonstrating large up- and downswings. 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 both juvenile and adult bluehead sucker increased markedly in 2002 when compared to 2001 (Figure 13). Overall, total CPUE for bluehead in Reach 5 has been relatively stable (and even slightly increasing) since 1994 (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 and before Reach 1, they disappear from fish electrofishing collections altogether (Figure 15). No bluehead sucker of any life stage were collected in Reach 1 during the period 1991-2002.

Length Frequency And Mean Total Length

Histograms of bluehead sucker length-frequency distributions riverwide between 1996 and 1999 show a fairly stable trend with sampled populations being centered around the 301-325 mm TL size-class from 1996-1998 and shifting upwards slightly to being centered around the 326-350 mm TL size-class in 1999 (Figure 16). Then, much like what was observed in flannelmouth sucker, there was a large influx of small (76-100 mm TL, assumed to be age-0) bluehead sucker in Reach 6 in 2000 (mostly upstream of the PNM Weir at RM 166.6; Ryden 2001a), causing the length-frequency of the bluehead sucker population to become strongly bimodal in 2000 (Figure 24). In 2001, the bluehead sucker population was largely centered around the 176-200 mm TL size-class (Figure 16). Then, in 2002, the bluehead sucker population was even more strongly centered around the 251-300 mm TL size-classes (i.e., the 2000 cohort of fish; Figure 16).

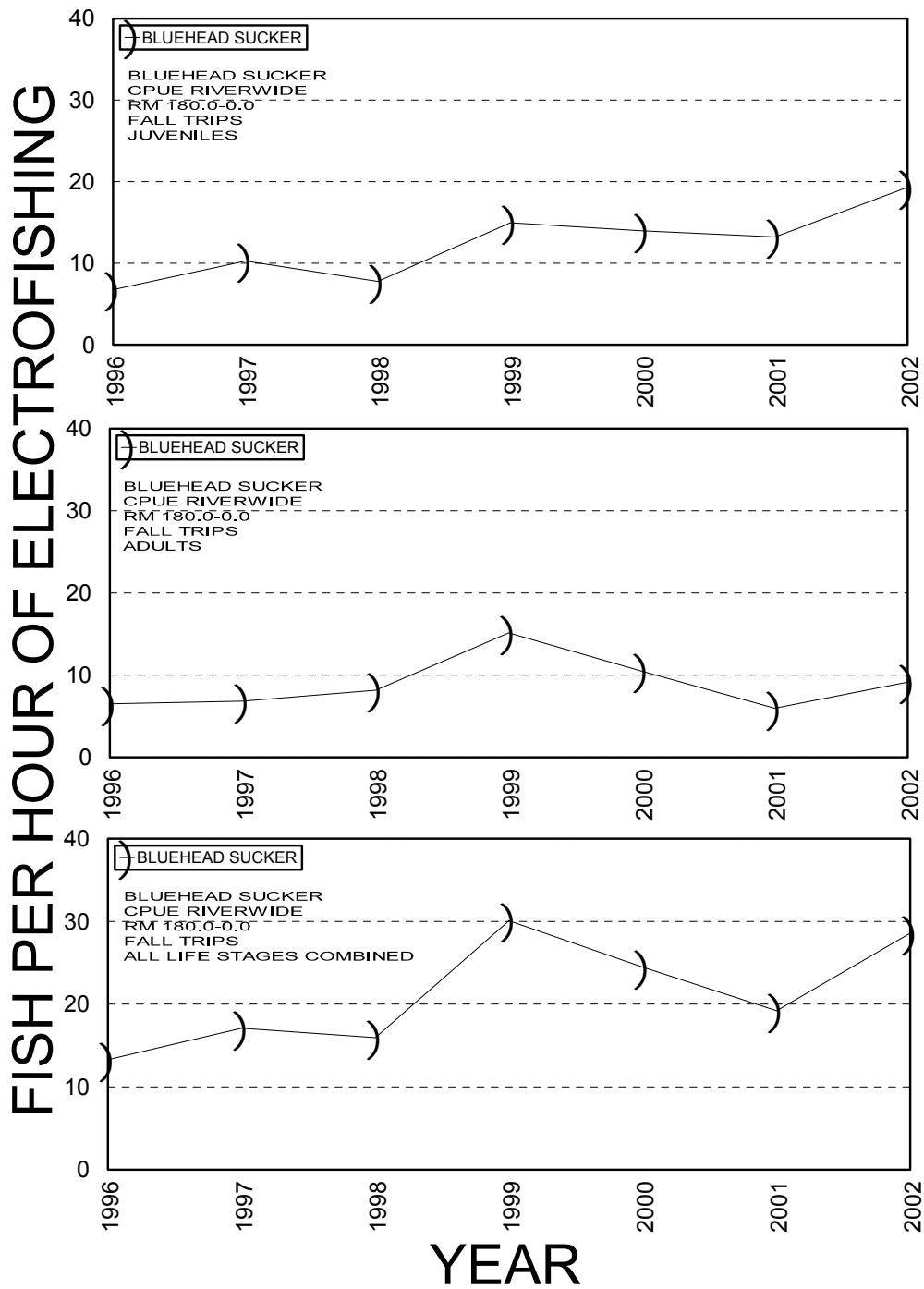


Figure 12. Bluehead sucker catch per unit effort (CPUE) riverwide (RM 180.0-0.0) on fall adult monitoring trips, for juvenile fish (< 300 mm TL; top), adult fish (\geq 300 mm TL; middle), and for all life stages combined (juveniles + adults; bottom). Error bars represent the standard error values.

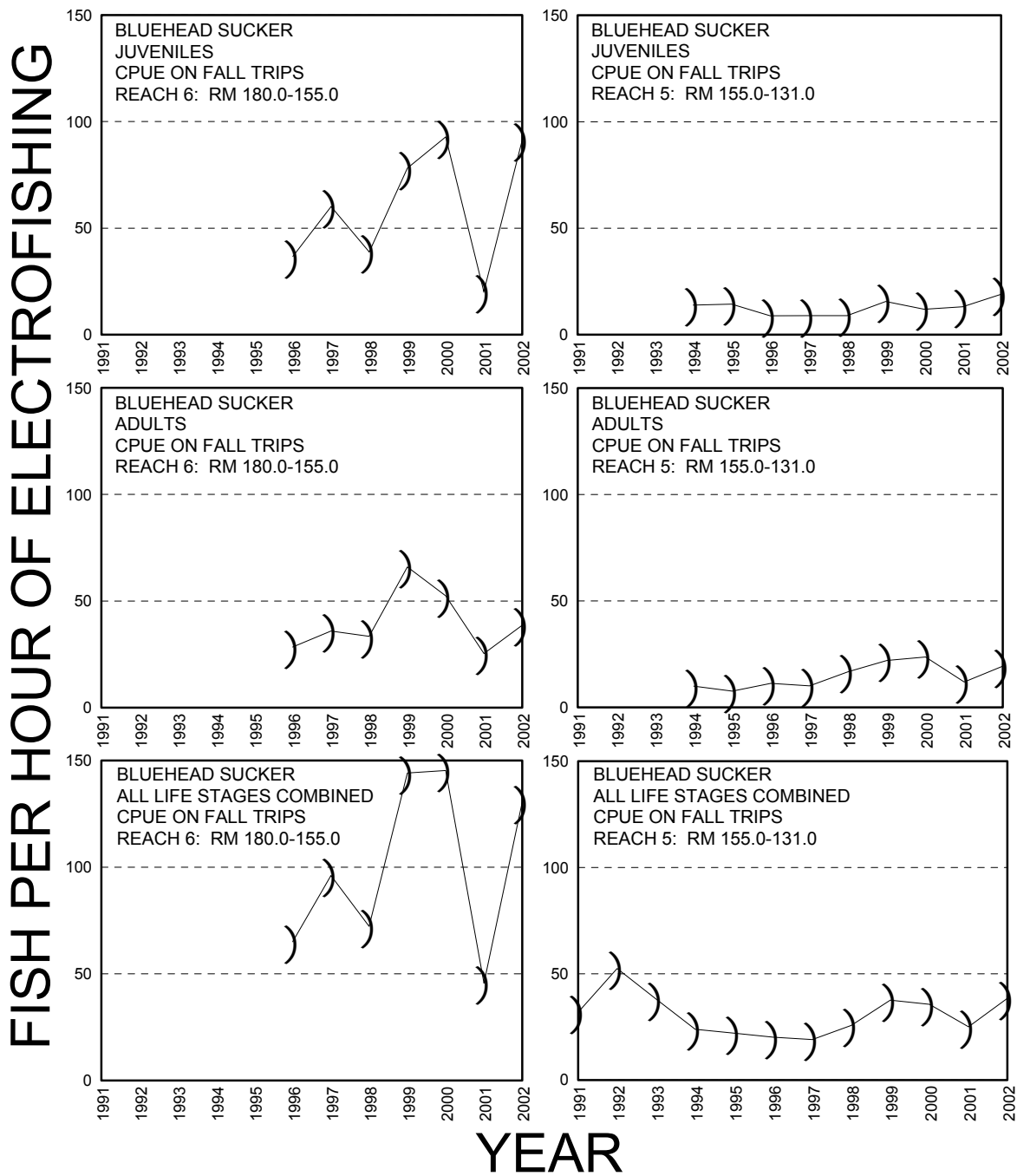


Figure 13. Bluehead sucker catch per unit effort (CPUE) in Reach 6 and Reach 5 on fall adult monitoring trips for juvenile fish (< 300 mm TL; top), adult fish (\geq 300 mm TL; middle), and for all life stages combined (juveniles + adults; bottom). Error bars represent the standard error values.

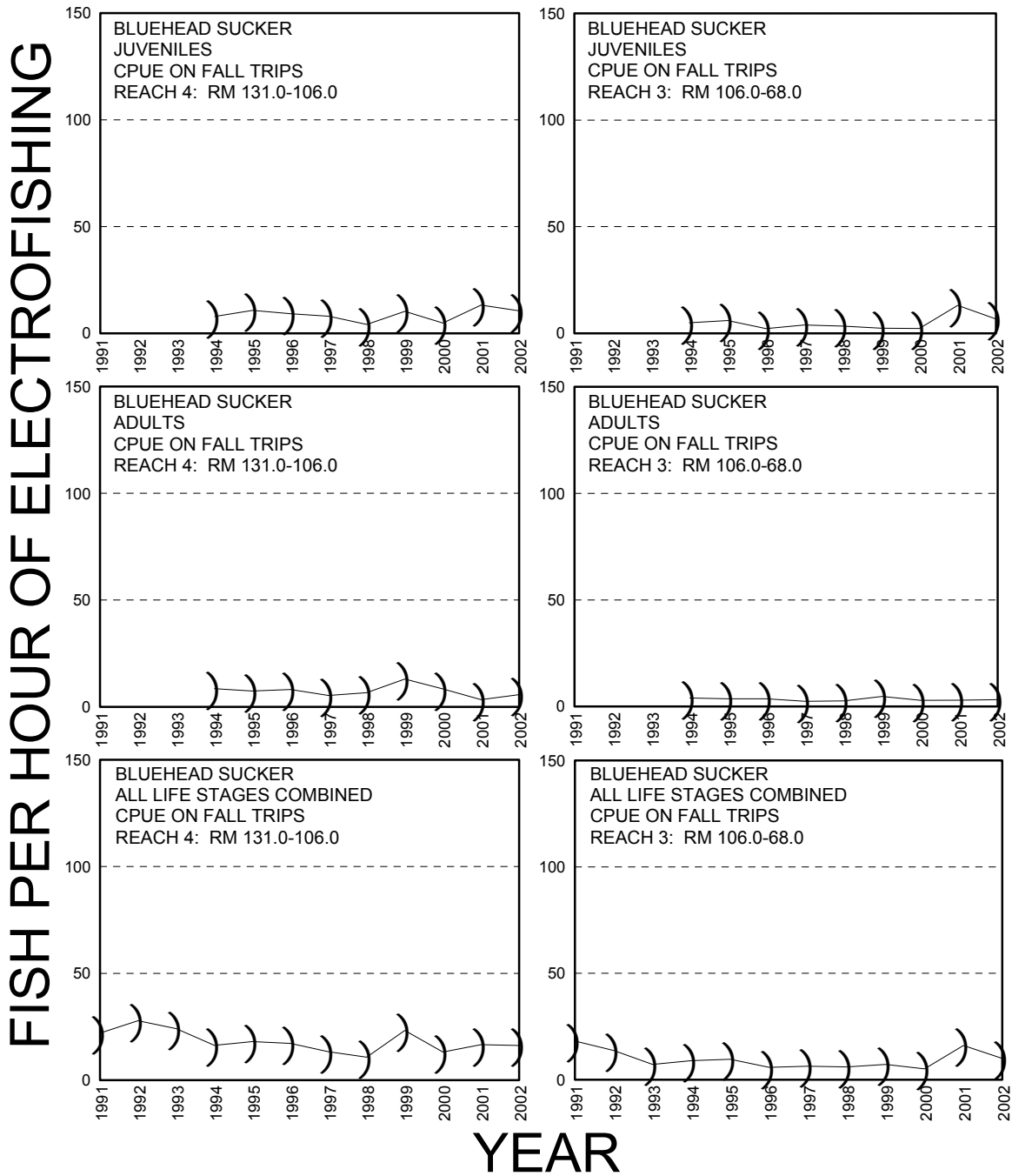


Figure 14. Bluehead sucker catch per unit effort (CPUE) in Reach 4 and Reach 3 on fall adult monitoring trips for juvenile fish (< 300 mm TL; top), adult fish (\geq 300 mm TL; middle), and for all life stages combined (juveniles + adults; bottom). Error bars represent the standard error values.

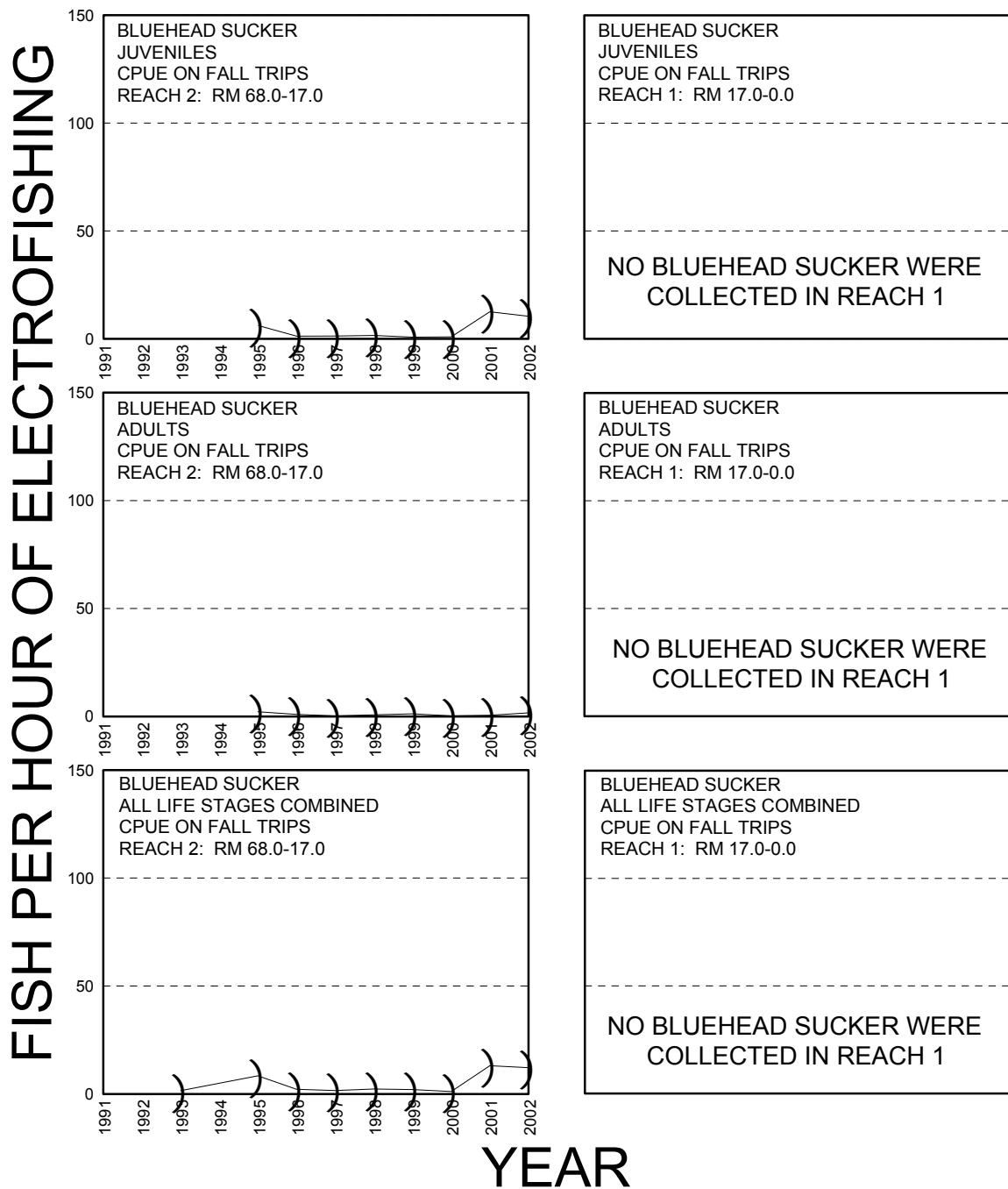


Figure 15. Bluehead sucker catch per unit effort (CPUE) in Reach 2 and Reach 1 on fall adult monitoring trips for juvenile fish (< 300 mm TL; top), adult fish (\geq 300 mm TL; middle), and for all life stages combined (juveniles + adults; bottom). Error bars represent the standard error values.

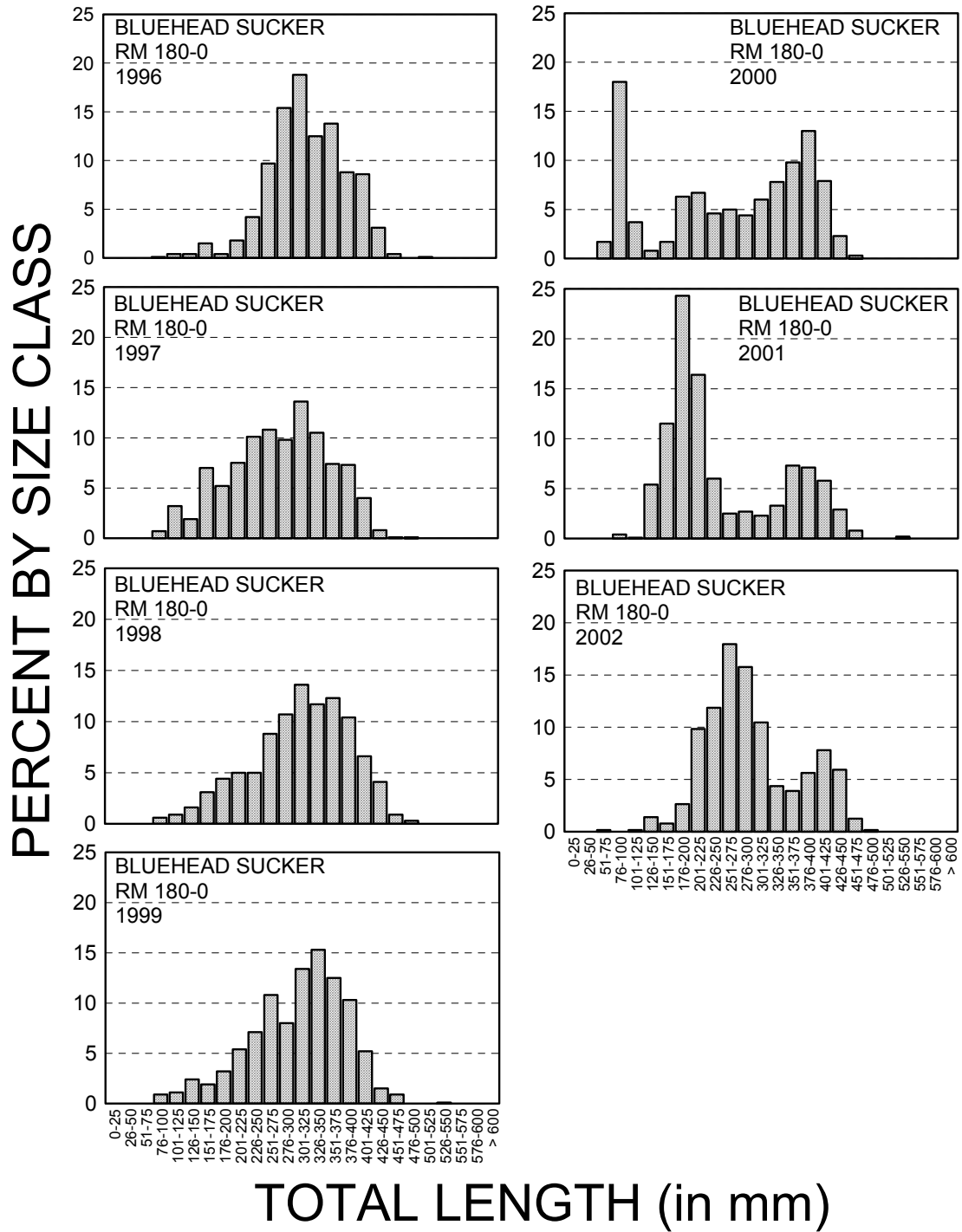


Figure 16. Length-frequency histograms showing the riverwide (RM 180.0-0.0) size-class distribution of bluehead sucker on fall adult monitoring trips in the San Juan River.

It appears as though small bluehead sucker (76-100 mm TL) from the October 2000 length-frequency histogram had grown approximately 100 mm by October 2001 and another 75-100 mm by October 2002 (Figure 16). It also appears that the 200 cohort of bluehead sucker may be recruiting in larger numbers than the 200 cohort of flannelmouth sucker are. This preliminary assumption is based on the fact over the last three years, bluehead sucker from the 2000 cohort are accounting for a dominant percentage of fish being collected and characterized among this species, where as the relative percent of fish accounted for by the 2000 cohort of flannelmouth sucker has decreased over the last two years (Figures 9 and 16).

Based on rates of recruitment observed among the 2000 cohort of bluehead sucker, it is not unreasonable to assume that the numerically dominant group of fish based around the 301-325 mm TL size-class in the 1996 size-frequency histogram were either age-3 or age-4 fish that had been spawned in either 1992 or 1993 (Figure 16).

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 significantly 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). However, as young fish from the 2000 cohort are getting larger, the riverwide mean TL value has once again increased (Figure 17).

Mean TL of bluehead sucker rose noticeably in 2002 in every river reach in which these fish are found (Figure 18). So, while the riverwide CPUE for bluehead sucker has become numerically dominated by juvenile fish over the last three years, it is a group of juveniles that is steadily increasing in size. The majority of these sub-adult fish (from the 2000 cohort) should recruit into the adult population within the next two years.

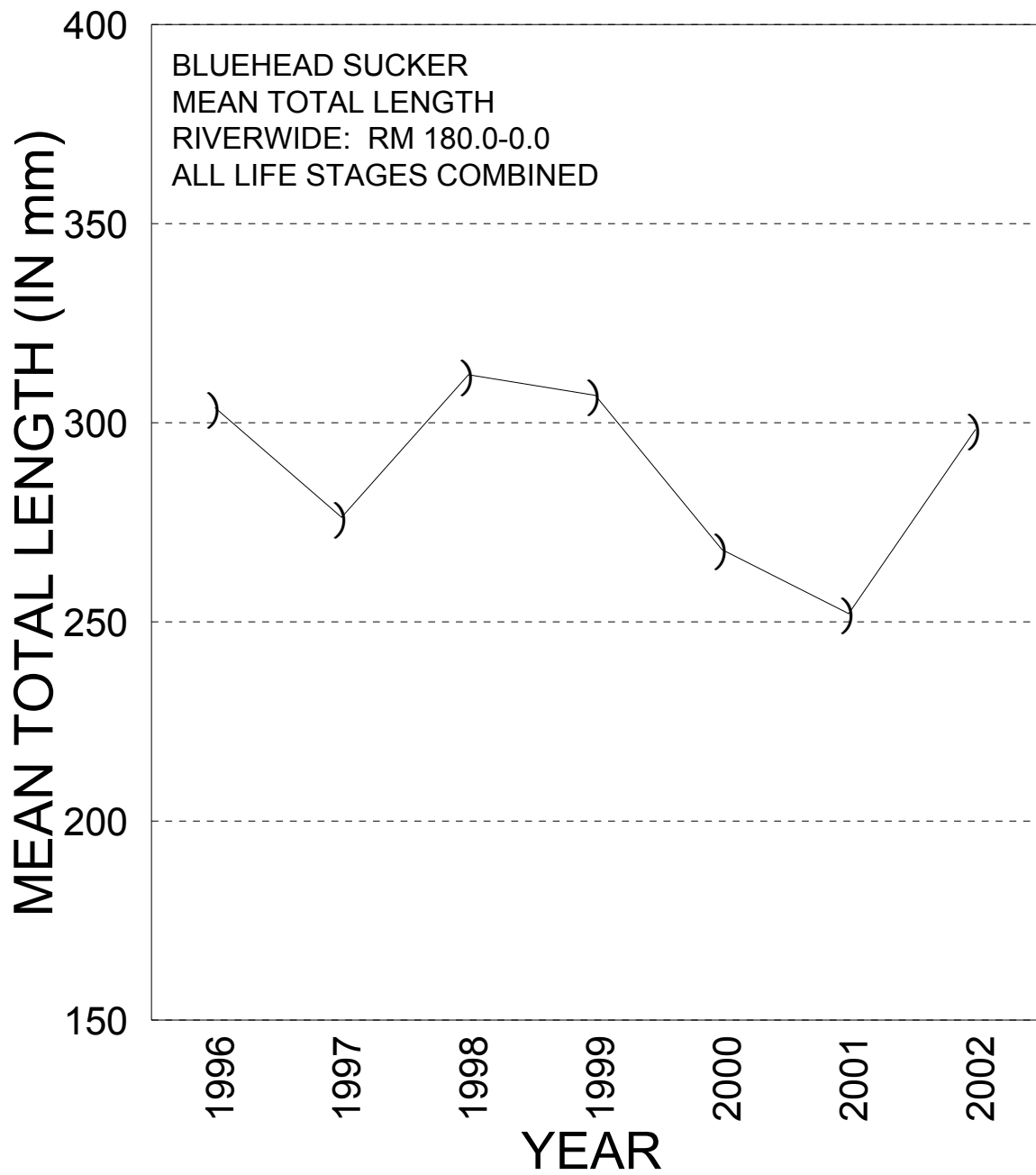


Figure 17. Mean total length (in mm) of bluehead sucker riverwide (RM 180.0-0.0) on fall adult monitoring trips in the San Juan River. Error bars represent the standard error values.

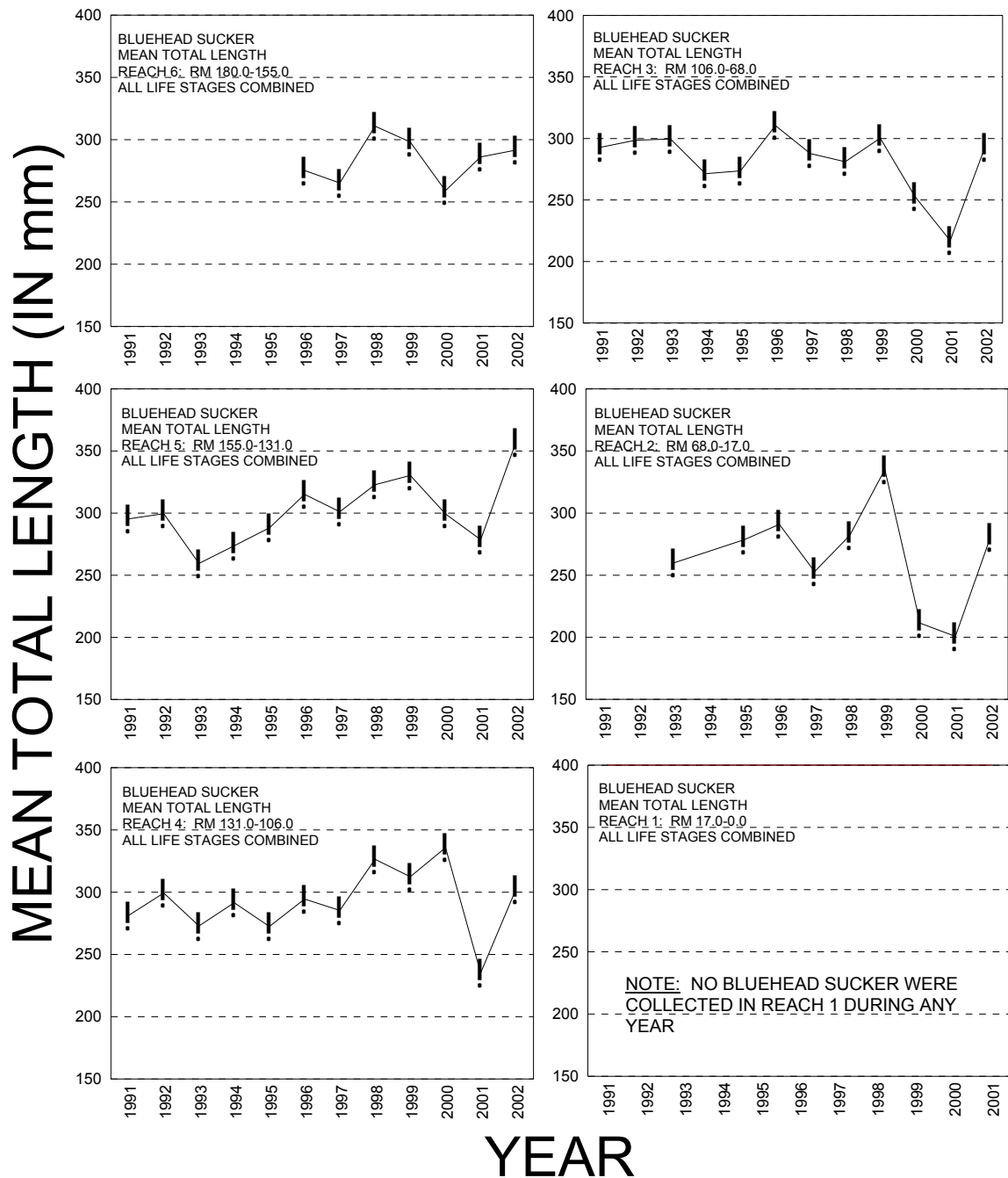


Figure 18. Mean total length (in mm) of bluehead sucker in Reaches 6-1 on fall adult monitoring trips in the San Juan River. Error bars represent the standard error values.

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 2003c). 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, channel catfish CPUE dropped markedly (Figure 19). Again, this was mostly caused by an almost three-fold decline in numbers of juvenile fish, although numbers of adult fish collected in 2002 were down as well (Figure 19).

Among reaches, trends in channel CPUE have been hard to discern at best. This has been due to very pronounced fluctuations in CPUE, especially among juvenile channel catfish. The one trend that was evident when analyzing 2002 data was that CPUE for all life stages of channel catfish had declined visibly in all six river reaches between 2001 and 2002 (Figures 20-22). In Reach 6, where intensive mechanical efforts to remove channel catfish have been underway for several years, total CPUE dropped to the lowest level ever observed (Figure 20). Whether this riverwide decline in channel catfish CPUE is related to riverwide efforts to mechanically remove this species (or possibly even to the high flow spike that immediately preceded the 2002 adult monitoring trip) is unknown. However, it is encouraging.

Length Frequency And Mean Total Length

As was the case with channel catfish CPUE, identifying clear-cut patterns in channel catfish length-frequency histograms is difficult. In 1996, the San Juan River channel catfish population was centered around the 301-325 mm TL size-class (Figure 23). However, channel catfish > 425 mm TL were regularly collected. By 1999, the channel catfish population had shifted to being centered around smaller size-classes and many fewer fish > 425 mm TL were being collected (Figure 23). Unlike native flannelmouth sucker and bluehead sucker and nonnative common carp, large numbers of age-0 channel catfish were not observed in fall 2000 adult monitoring collections, although a small groups of channel catfish in the 51-75 mm TL size-class were collected in 2000 (Figure 23). Then, in 2001 the dominant size-class for channel catfish was 126-150 mm TL (Figure 23). These fish were likely spawned late in 2000, but were, for the most part, too small to be collected in the fall 2000 adult monitoring samples (i.e., via electrofishing), although the few 51-75 mm TL fish that were collected in 2000 were likely age-0 fish. Thus it seems channel catfish had as successful a reproductive year in 2000 as did the other three common, large-bodied fishes. This is further evidenced by the 2001 and

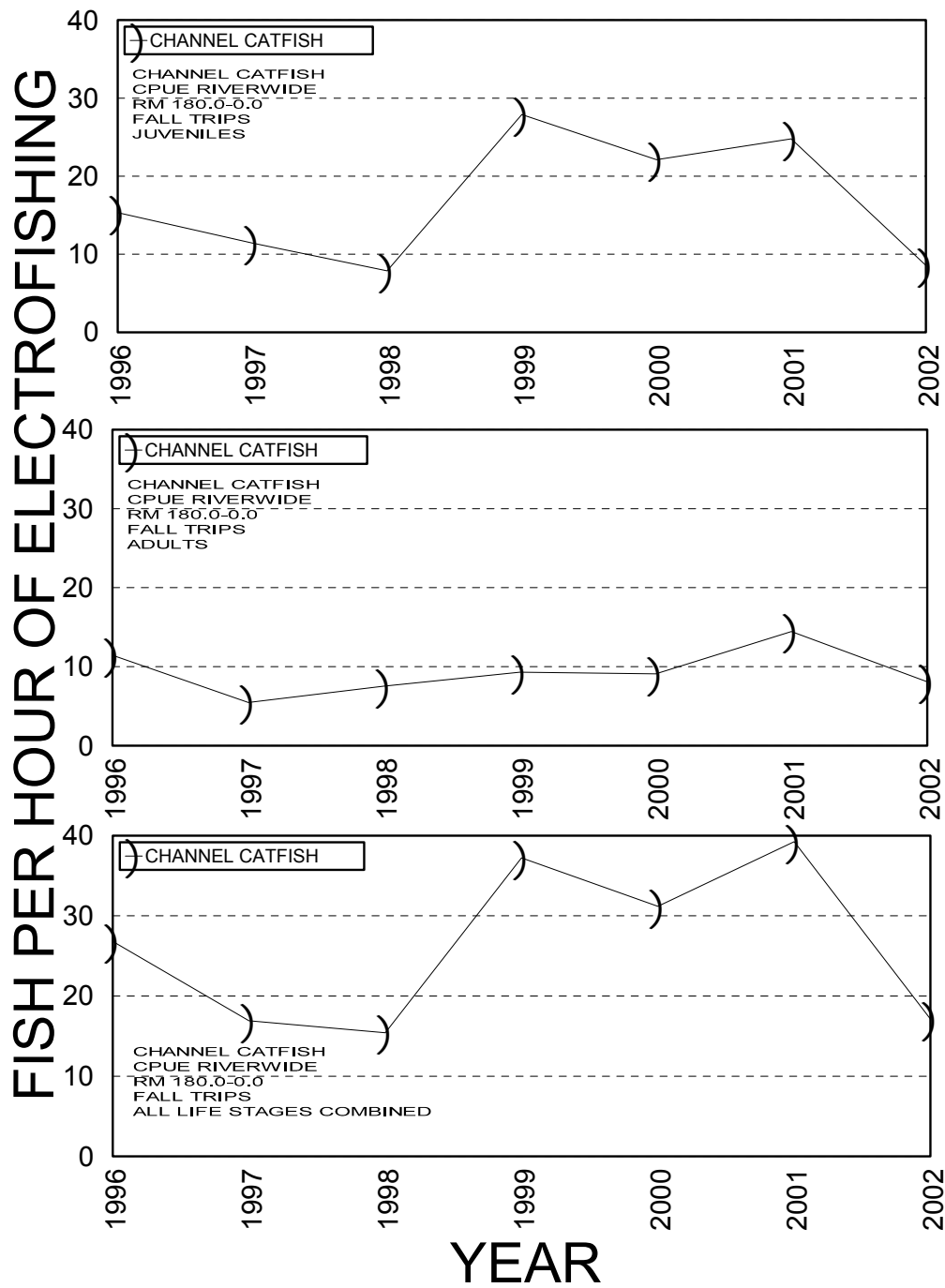


Figure 19. Channel catfish catch per unit effort (CPUE) riverwide (RM 180.0-0.0) on fall adult monitoring trips, for juvenile fish (< 300 mm TL; top), adult fish (\geq 300 mm TL; middle), and for all life stages combined (juveniles + adults; bottom). Error bars represent the standard error values.

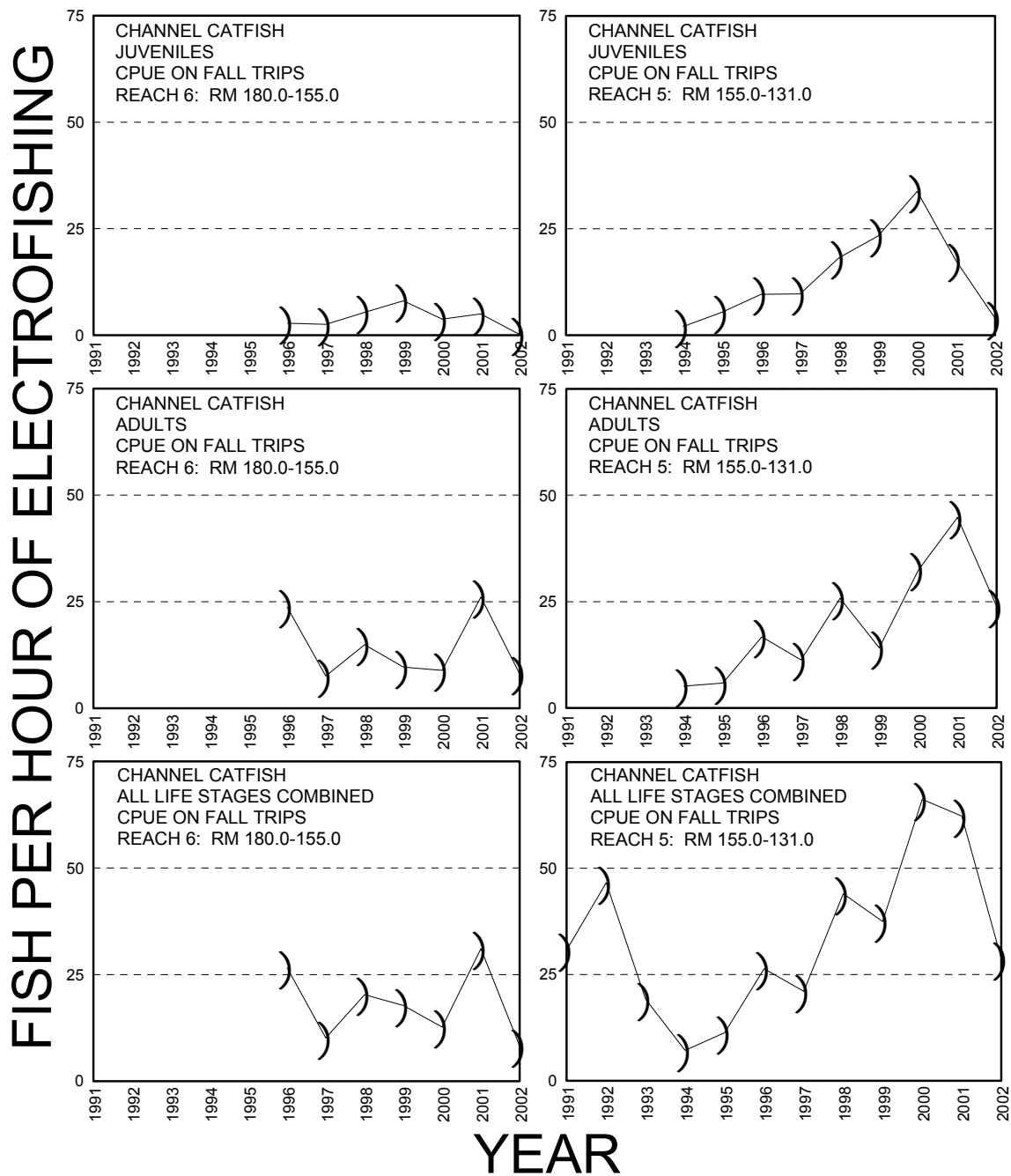


Figure 20. Channel catfish catch per unit effort (CPUE) in Reach 6 and Reach 5 on fall adult monitoring trips for juvenile fish (< 300 mm TL; top), adult fish (\geq 300 mm TL; middle), and for all life stages combined (juveniles + adults; bottom). Error bars represent the standard error values.

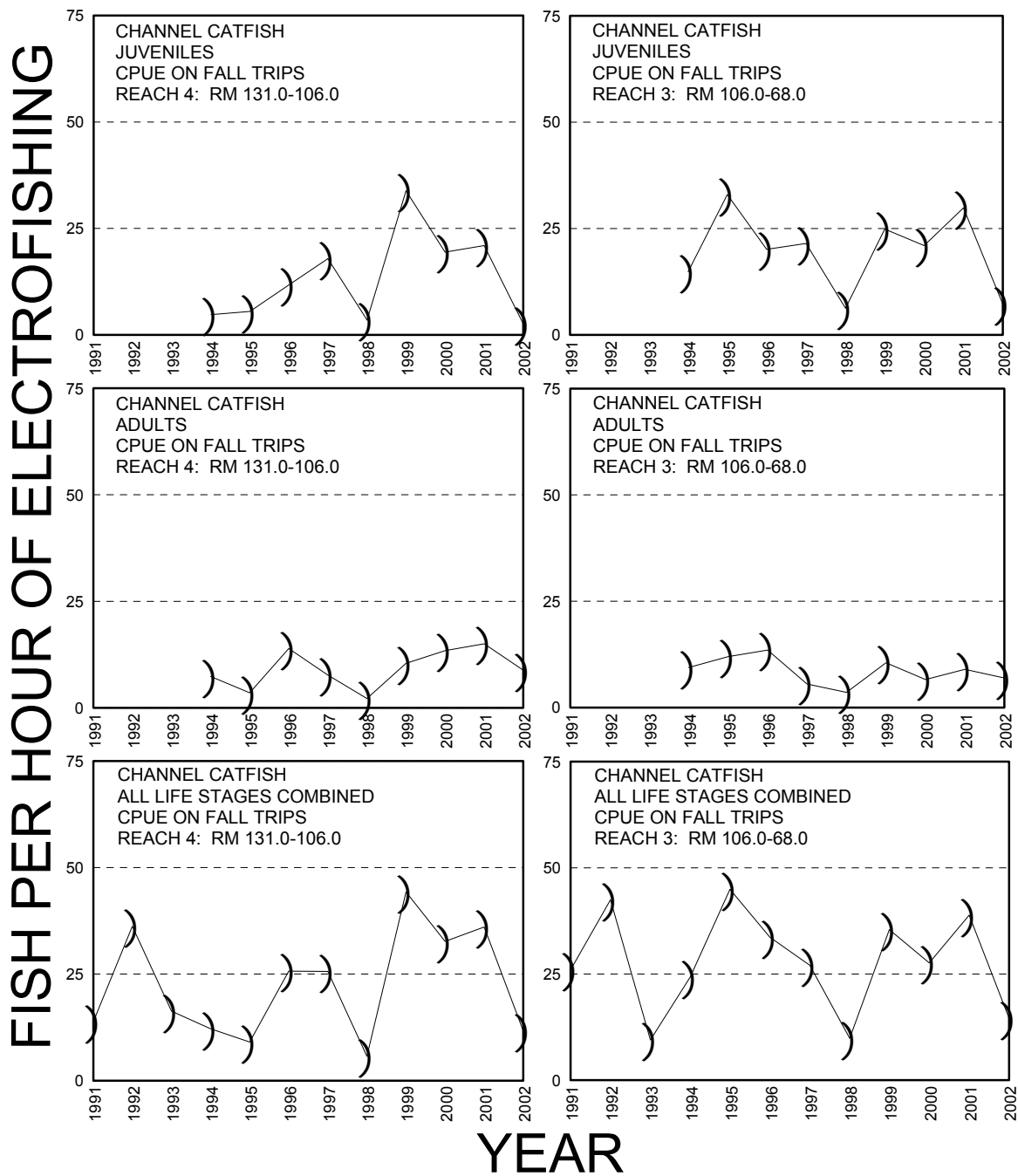


Figure 21. Channel catfish catch per unit effort (CPUE) in Reach 4 and Reach 3 on fall adult monitoring trips for juvenile fish (< 300 mm TL; top), adult fish (\geq 300 mm TL; middle), and for all life stages combined (juveniles + adults; bottom). Error bars represent the standard error values.

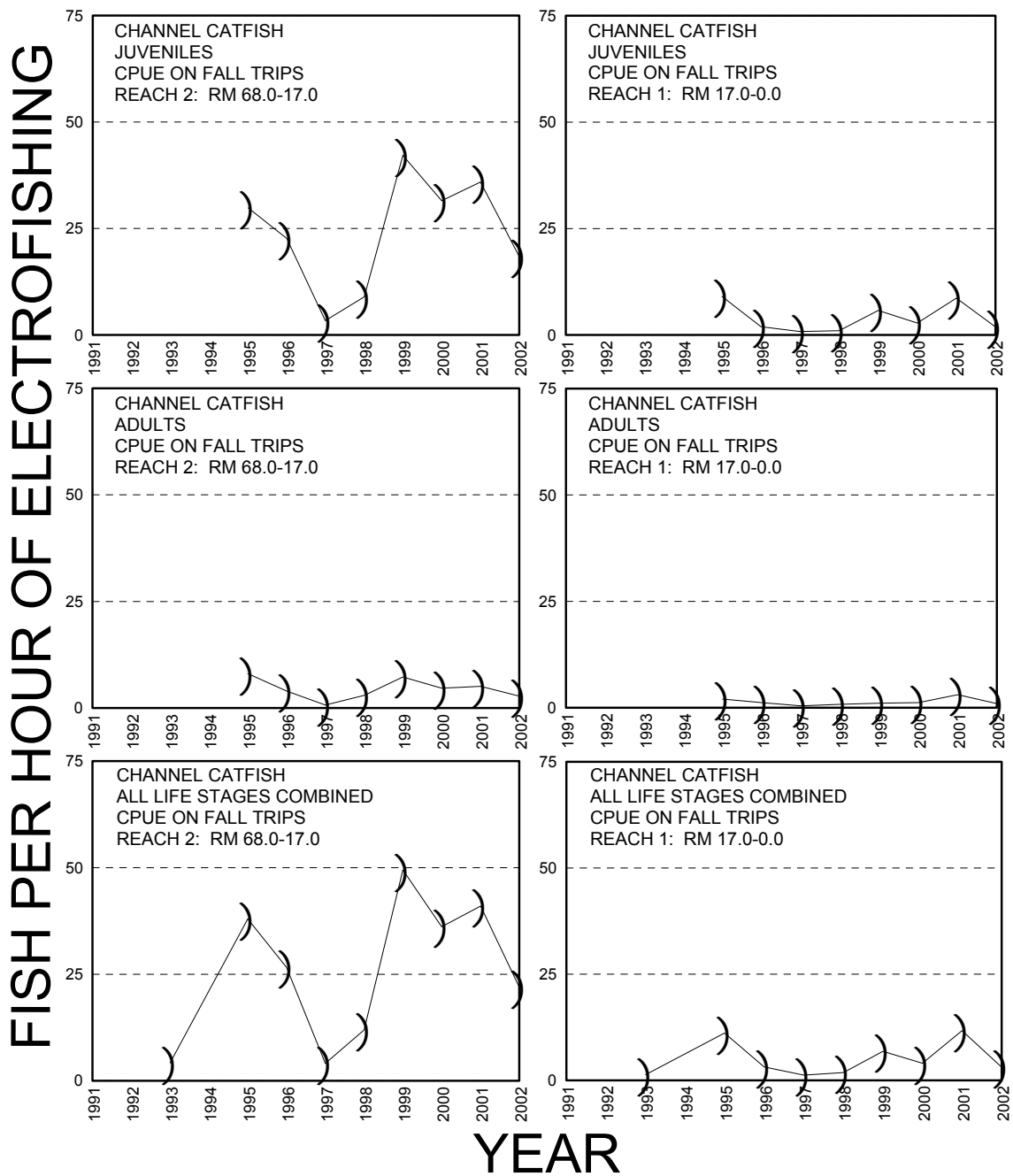


Figure 22. Channel catfish catch per unit effort (CPUE) in Reach 2 and Reach 1 on fall adult monitoring trips for juvenile fish (< 300 mm TL; top), adult fish (\geq 300 mm TL; middle), and for all life stages combined (juveniles + adults; bottom). Error bars represent the standard error values.

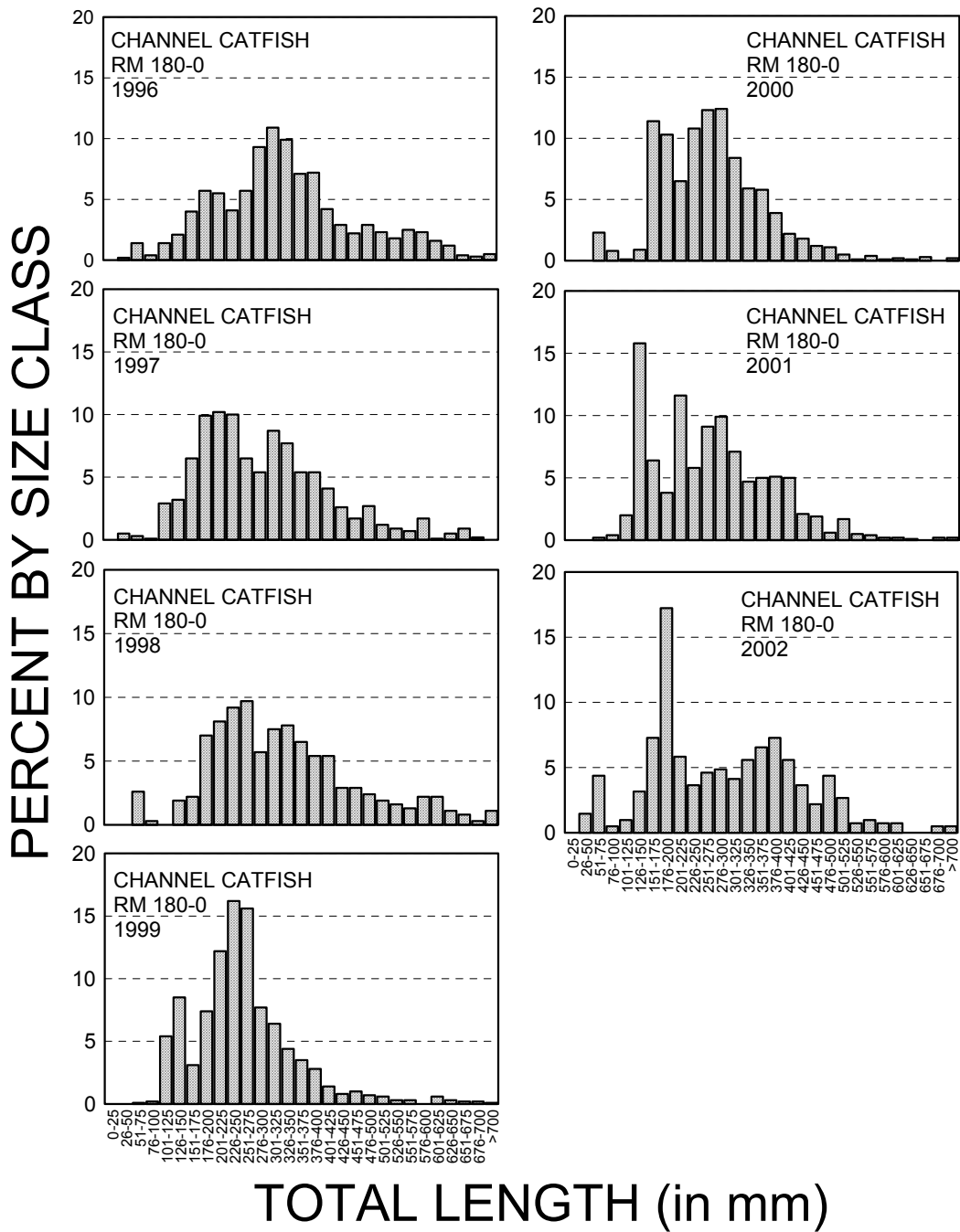


Figure 23. Length-frequency histograms showing the riverwide (RM 180.0-0.0) size-class distribution of channel catfish on fall adult monitoring trips in the San Juan River.

2002 length-frequency histograms which continue to track the relatively large numbers of channel catfish that are part of this 2002 cohort (Figure 23). These fish that were 51-75 mm TL in 2000 (age-0), averaged 126-150 mm TL in 2001 (age-1), and 176-200 mm TL in 2002 (age-2; Figure 23).

Intuitively, this seems like fairly slow growth for young fish. However, if we follow a previous cohort of channel catfish, apparently spawned in 1998, their growth seems to have been almost identical. These channel catfish, which again were in the 51-75 mm TL size-class in 1998 (age-0), reached 101-150 mm TL by 1999 (age-1), 151-200 mm TL by 2000 (age-2), 201-225 mm TL by 2001 (age-3), and somewhere in the 251-300 mm TL range by 2002 (age-4; Figure 23). So, it appears that channel catfish reach adulthood (defined here as being > 300 mm TL) in the San Juan River somewhere between age-4 (for fast-growing fish) and age-6 (for slow-growing fish).

Lastly, there appears to be a somewhat bimodal distribution in the channel catfish length-frequency histogram for 2002. In 2002, there was a fairly distinct group of adult fish ranging in size from 326-425 mm TL, one of the more noticeable groupings of fish in this size-class over the last several years (Figure 23). It is not clear exactly when this particular group (or groups) of adult fish were spawned. There does not seem to be a clearly discernable cohort that can be followed through the length-frequency histograms, as was the case with the 2000 cohort (and to a lesser degree, the 1998 cohort) of channel catfish, as discussed above. It is possible that the group of 325-426 mm TL adult channel catfish observed in 2002 adult monitoring collections were spawned as early as 1994. There is a group of fish in the 1996 histogram that seem to correspond to an age-2 size range (i.e., 176-225 mm TL). However, with the intensive removal of all channel catfish collected riverwide, beginning in 1996, it is just as likely that the group of 325-426 mm TL adult observed in 2002 are the survivors of several different year-classes from the early- to mid-1990's.

Channel catfish mean TL values riverwide (for all life stages combined) from 1999-2002 have risen steadily over the last four years (1999-2002) so that the mean TL value observed in 2002 (294 mm TL) is very close to that observed in 1997 (295 mm TL; Figure 24). Among reaches, channel catfish mean TL (like channel catfish CPUE values) fluctuated greatly depending upon the reach. In Reaches 6-4, channel catfish mean TL gradually declined until either 1999 or 2000 (Figure 25). Since that time however, it has risen markedly in these three reaches. This same trend of gradually declining mean TL was observed in Reach 3 until 2001, however, as in upstream reaches, channel catfish mean TL rose markedly in Reach 3 in 2002 (Figure 25). In Reaches 2 and 1, the trend of declining mean TL over time continued through 2002 (Figure 25).

The difference in mean TL between the beginning and end sampling years in any given river reach was also a mixed bag. There was virtually no difference between 1996 and 2002 mean TL values in Reach 6 (431 mm vs. 435 mm TL; Figure 25). In Reaches 5-3, the 2002 mean TL values were all greater (by 49 mm, 91 mm, and 54 mm TL respectively) than they were in 1991 (Figure 25). In Reaches 2 and 1 however, channel catfish mean TL dropped markedly between 1993 and 2002 (by 107 mm and 180 mm TL respectively; Figure 25).

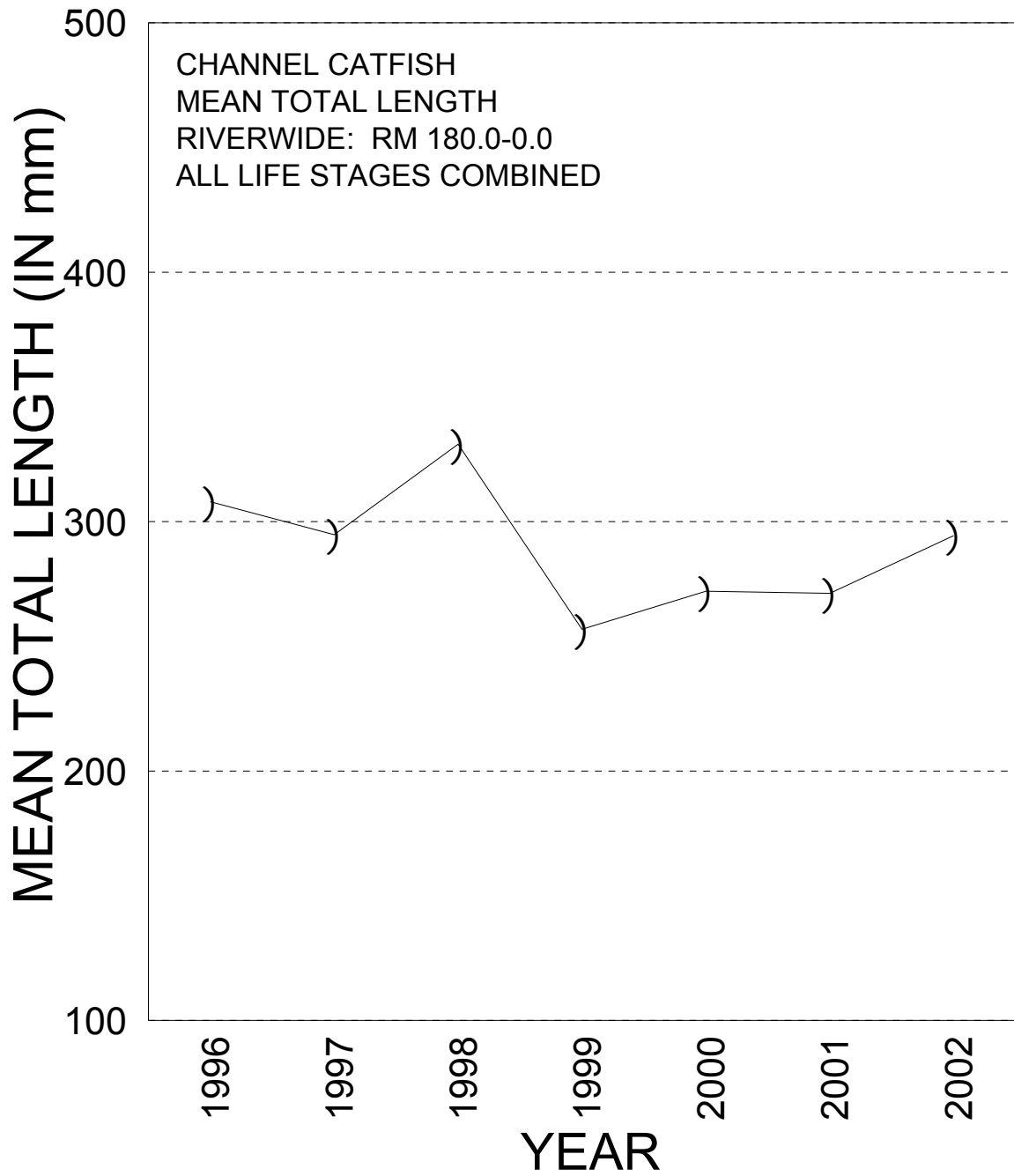


Figure 24. Mean total length (in mm) of channel catfish riverwide (RM 180.0-0.0) on fall adult monitoring trips in the San Juan River. Error bars represent the standard error values.

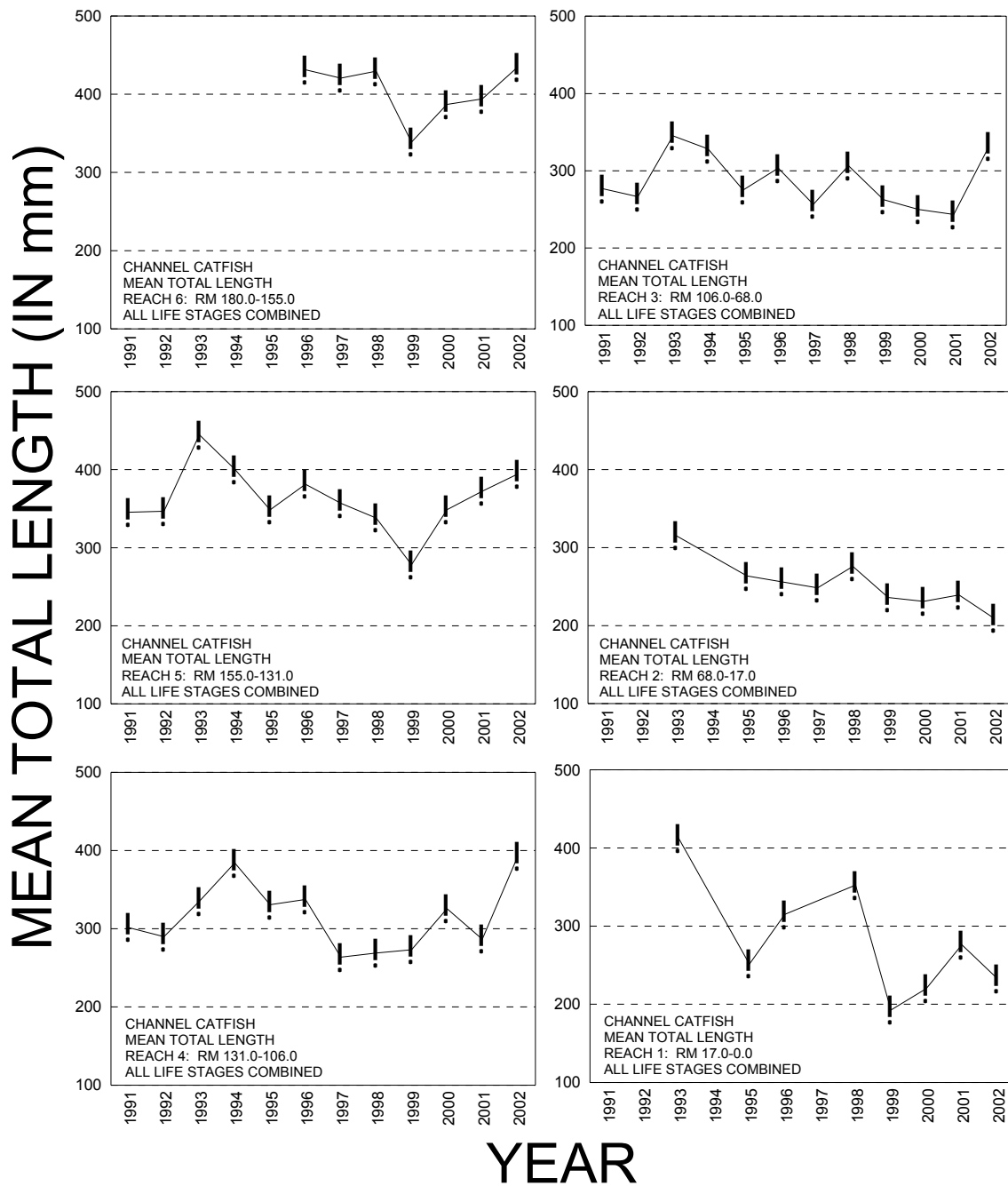


Figure 25. Mean total length (in mm) of channel catfish in Reaches 6-1 on fall adult monitoring trips in the San Juan River. Error bars represent the standard error values.

Common Carp

Catch Per Unit Effort (CPUE)

Riverwide, common carp total CPUE has declined steadily over the last three years, reaching the lowest value ever observed (9.2 fish/hr) in 2002 (Figure 26). This was due to a 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 1999-2002 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). Juvenile common carp are usually very rare to completely absent from electrofishing samples (Figures 27-29). However, in 2000 and 2002 juvenile common carp were conspicuous in their relative abundance in Reaches 6-4 (Figures 27-29). Numerically, the majority of the juvenile common carp collected in 2000 were collected in Reach 6, upstream of the PNM Weir (RM 166.6), mirroring the phenomenon that was observed among flannelmouth sucker and bluehead sucker in 2000 (Figure 27; Ryden 2000a, 2003c). In 2002 however, juvenile common carp were collected in more equal numbers throughout Reaches 6-4 (Figures 27-29).

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 seems somewhat odd that riverwide, adult CPUE remains relatively stable between years (Figure 26) while adult CPUE among reaches varies so considerably from year to year (Figures 27-29). 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 (when nonnative removal efforts began) and 2002 (Figure 27). If this trend is linked to the intensive mechanical removal efforts that are ongoing in that reach, it would be the first indication that fisheries managers are able to have a profound effect on the numbers of common carp through mechanical manipulation. The other trend that is noticeable is that common carp total CPUE dropped in five of the six river reaches (Reach 4 being the only exception) between 2001 and 2002 (Figures 27-29). In Reaches 6, 5, and 3 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 in 2002 are linked to mechanical removal efforts, to the flow spike which immediately preceded the 2002 adult monitoring trip, 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). 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).

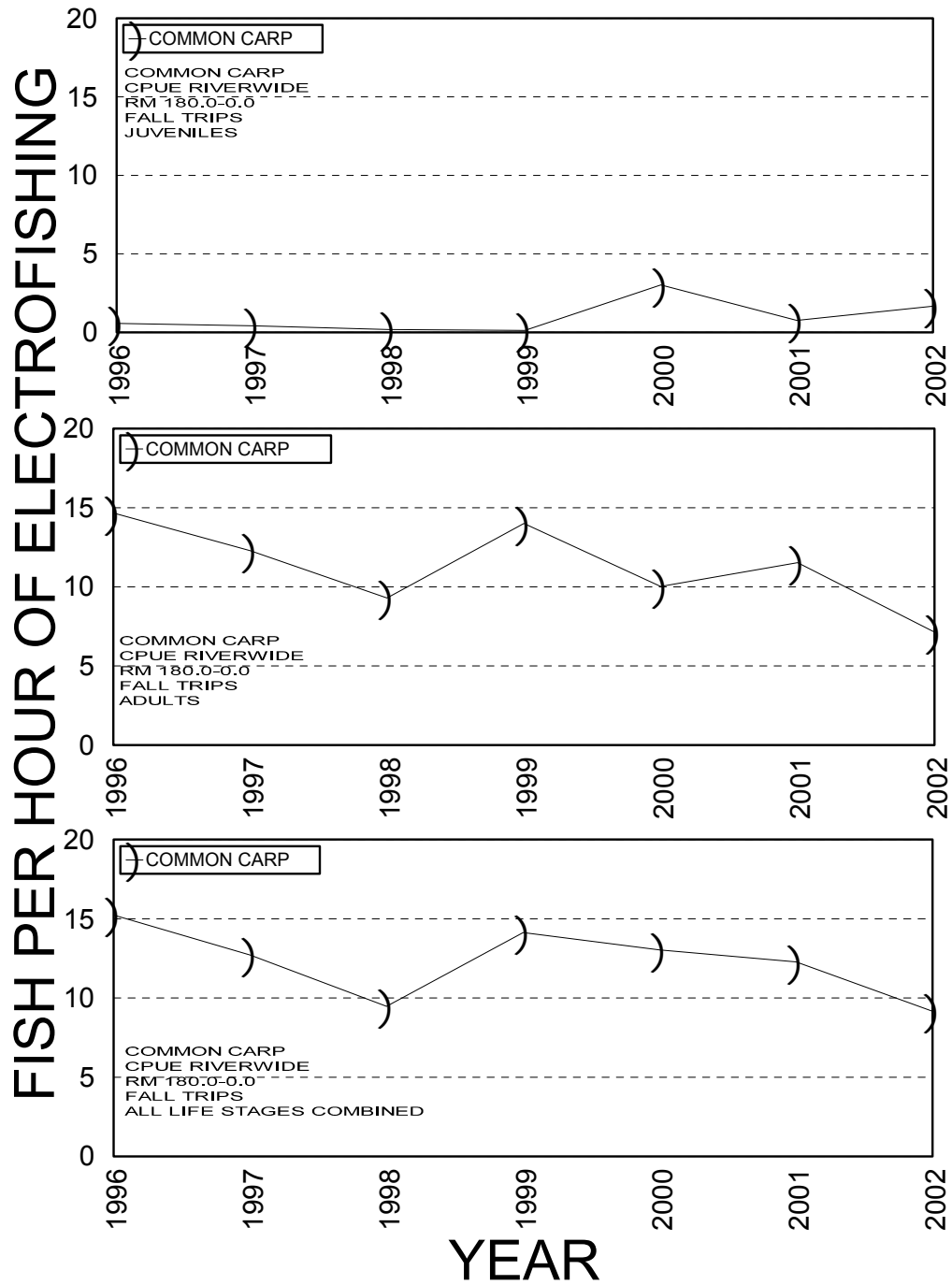


Figure 26. Common carp catch per unit effort (CPUE) riverwide (RM 180.0-0.0) on fall adult monitoring trips, for juvenile fish (< 250 mm TL; top), adult fish (\geq 250 mm TL; middle), and for all life stages combined (juveniles + adults; bottom). Error bars represent the standard error values.

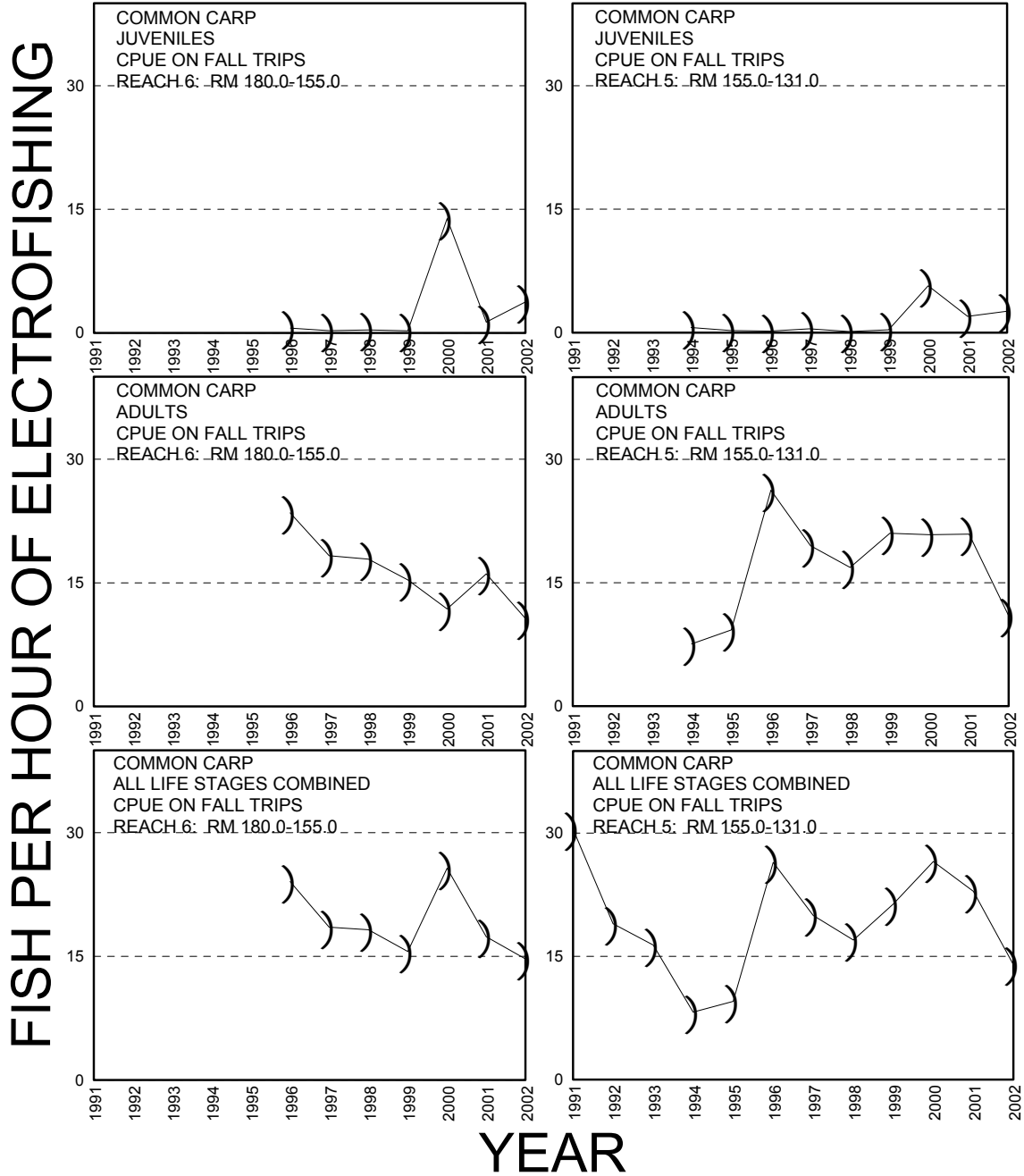


Figure 27. Common carp catch per unit effort (CPUE) in Reach 6 and Reach 5 on fall adult monitoring trips for juvenile fish (< 250 mm TL; top), adult fish (\geq 250 mm TL; middle), and for all life stages combined (juveniles + adults; bottom). Error bars represent the standard error values.

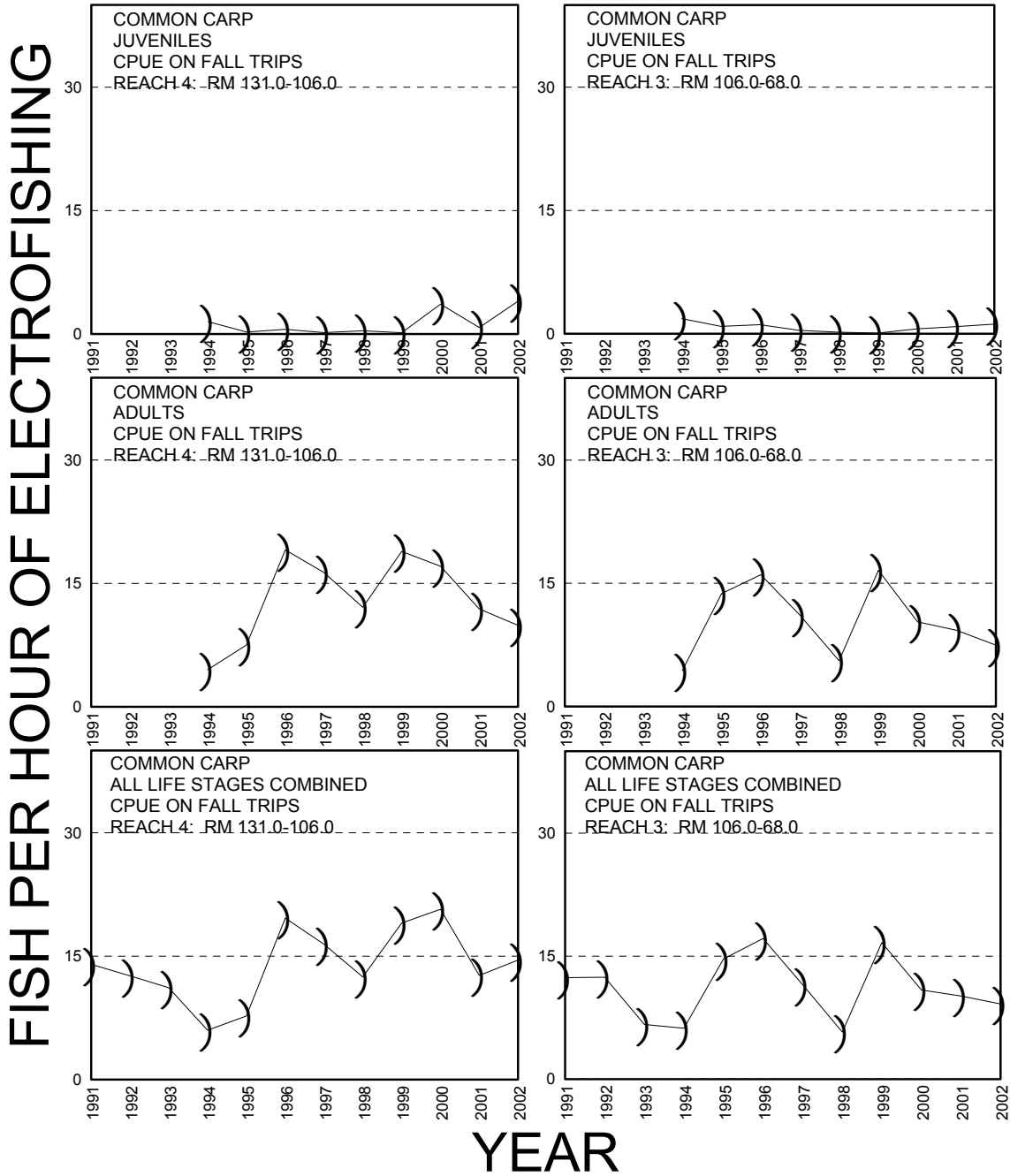


Figure 28. Common carp catch per unit effort (CPUE) in Reach 4 and Reach 3 on fall adult monitoring trips for juvenile fish (< 250 mm TL; top), adult fish (\geq 250 mm TL; middle), and for all life stages combined (juveniles + adults; bottom). Error bars represent the standard error values.

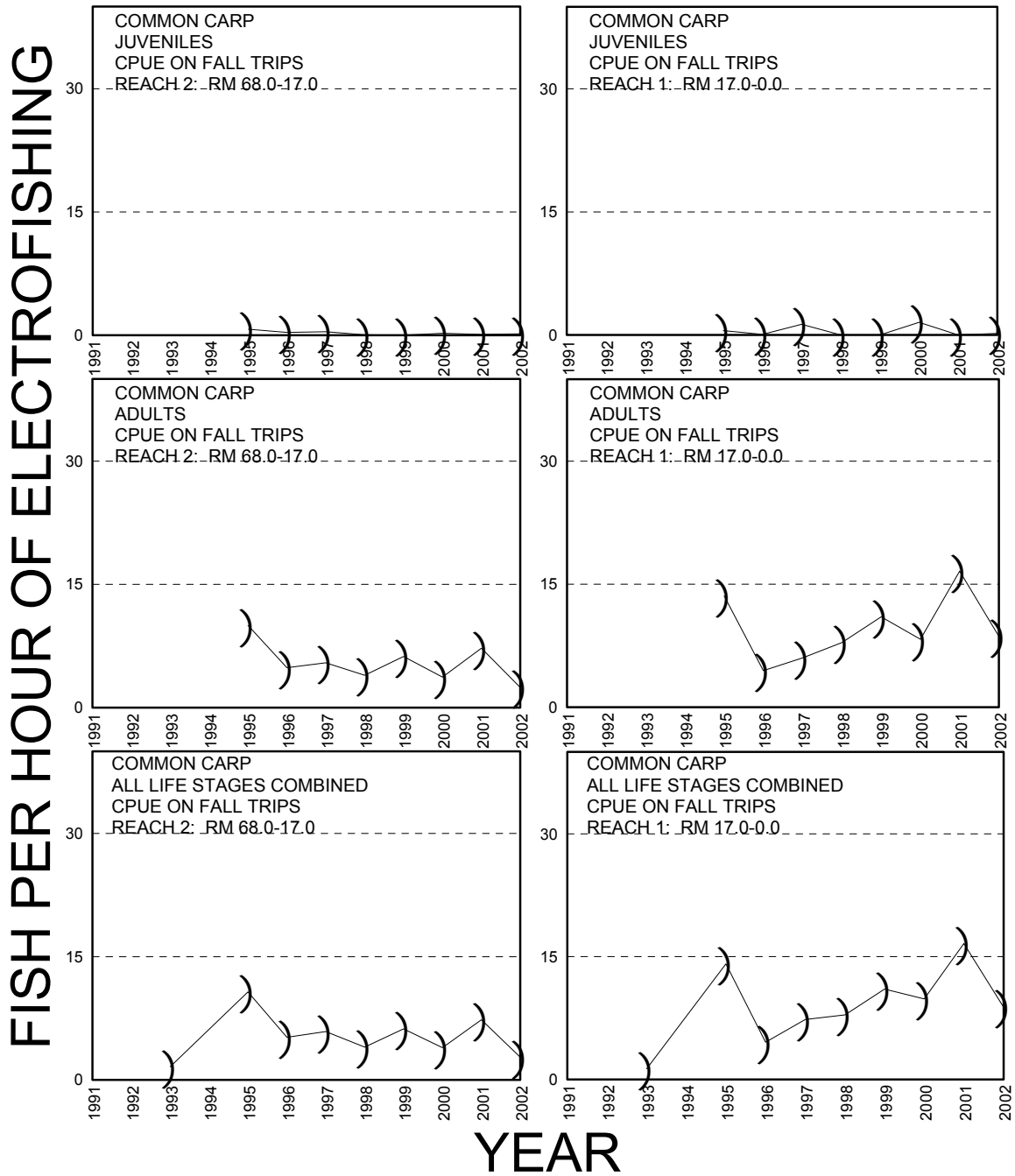


Figure 29. Common carp catch per unit effort (CPUE) in Reach 2 and Reach 1 on fall adult monitoring trips for juvenile fish (< 250 mm TL; top), adult fish (\geq 250 mm TL; middle), and for all life stages combined (juveniles + adults; bottom). Error bars represent the standard error values.

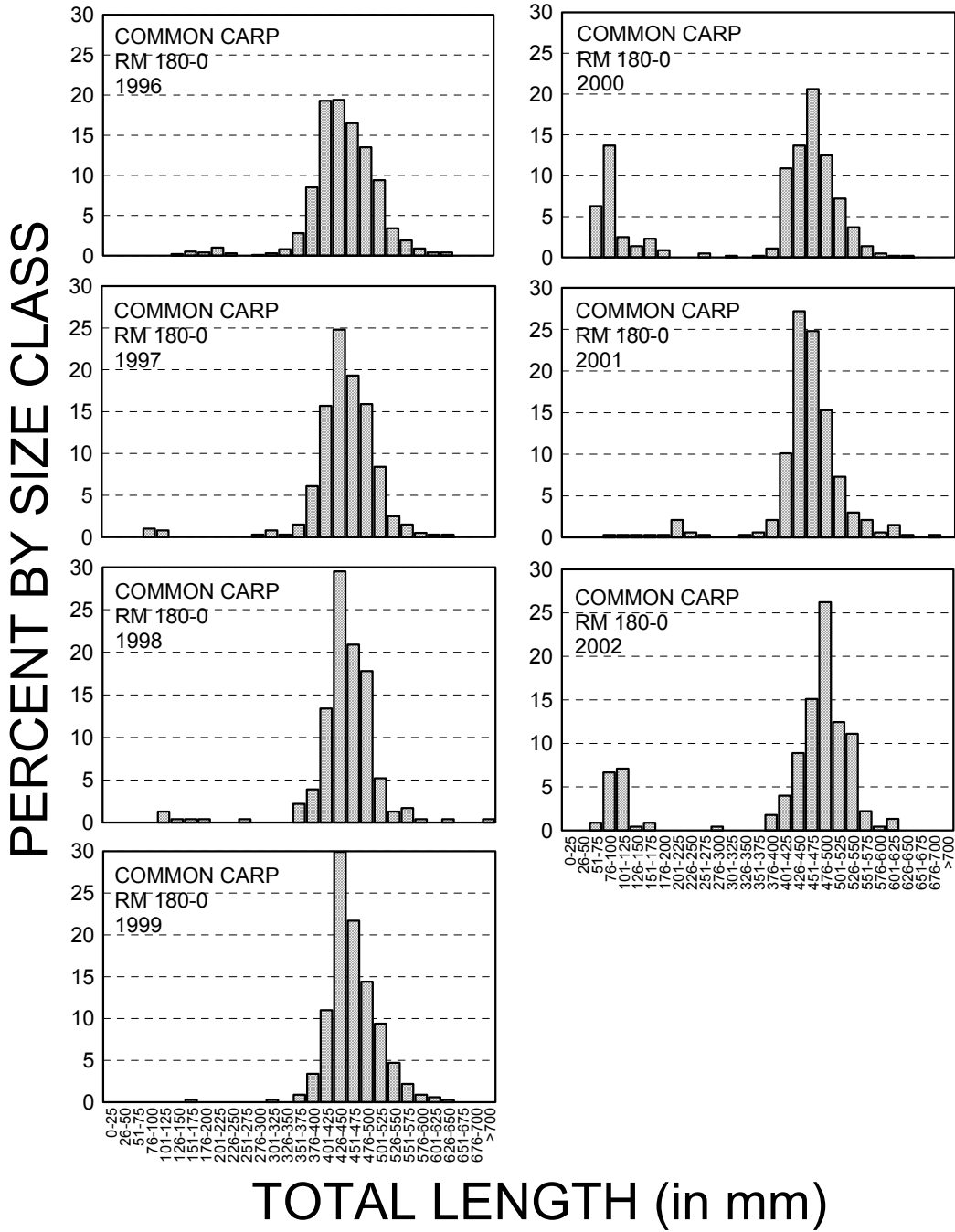


Figure 30. Length-frequency histograms showing the riverwide (RM 180.0-0.0) size-class distribution of common carp on fall adult monitoring trips in the San Juan River.

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). Other than these two years, common carp mean TL riverwide has varied only slightly, remaining between 434 mm TL (in 1996) and 462 mm TL (in 1999; Figure 31). Among reaches, common carp mean TL trends were very mixed in 2002. Common carp mean TL dropped markedly in two reaches (6 and 4) in 2002, dropped slightly in two others reaches (3 and 2), rose slightly in Reach 5, and rose markedly in Reach 1 (Figure 32). Over time, the long term trend in Reaches 5-1 has been slightly upward from near 400 mm TL in the early 1990's to near 450 mm TL in the early 2000's (Figure 32). Mean TL over time in Reach 6 has been more susceptible to influxes of age-0 fish, but overall, common carp in Reach tend to be larger than those in downstream river reaches (Figure 32). One other notable change in common carp mean TL trends occurred in Reach 2 and to a lesser degree in Reach 1, between 1993 and 1995, when mean TL values increased greatly, essentially doubling in Reach 2 at the same time the lower San Juan River became reconnected with Lake Powell (Figure 32; Ryden 2000a, 2003c). This may indicate that there was an invasion of the lower San Juan River by larger size-class common carp from Lake Powell when the waterfall at RM 0.0 became inundated.

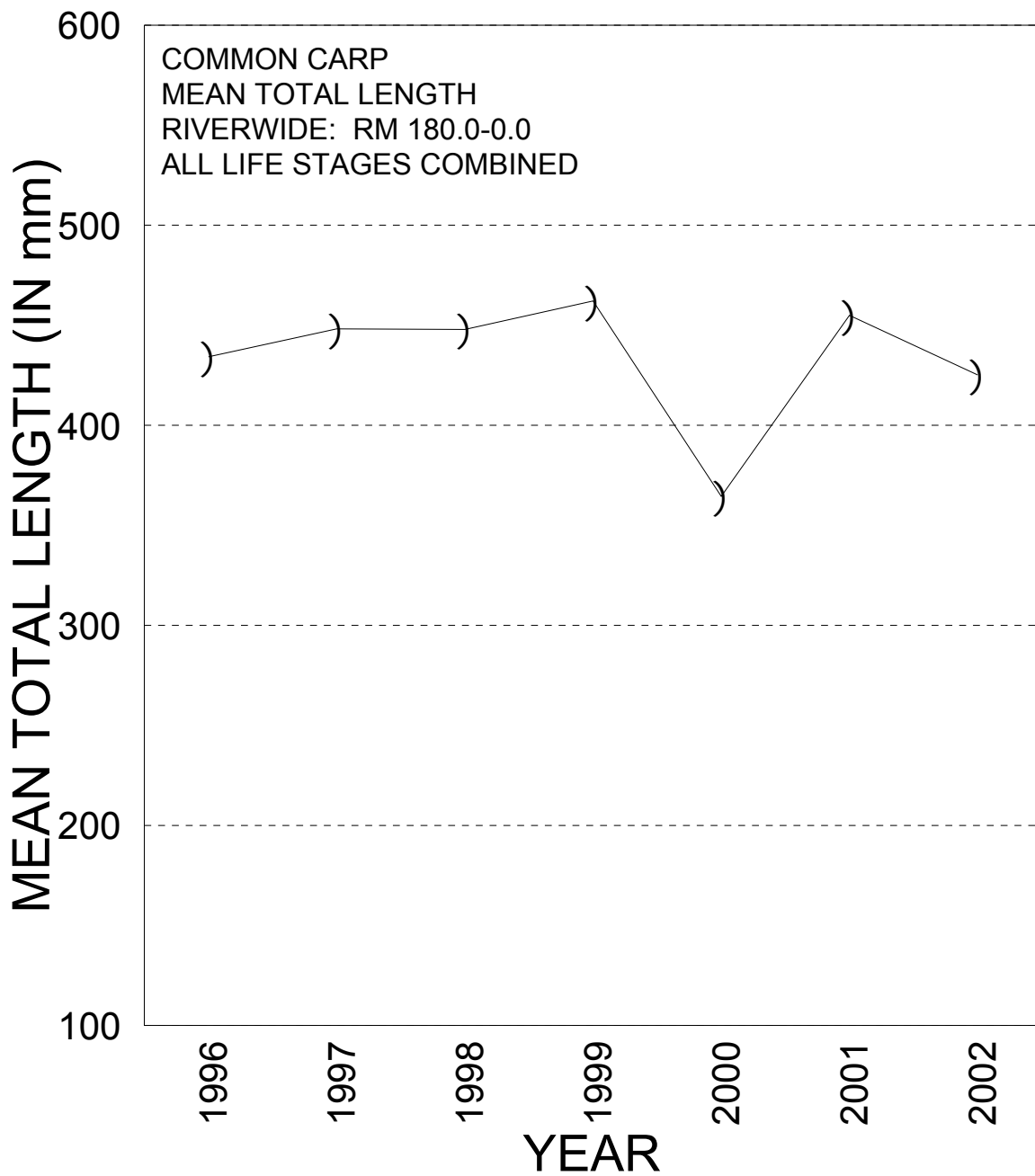


Figure 31. Mean total length (in mm) of common carp riverwide (RM 180.0-0.0) on fall adult monitoring trips in the San Juan River. Error bars represent the standard error values.

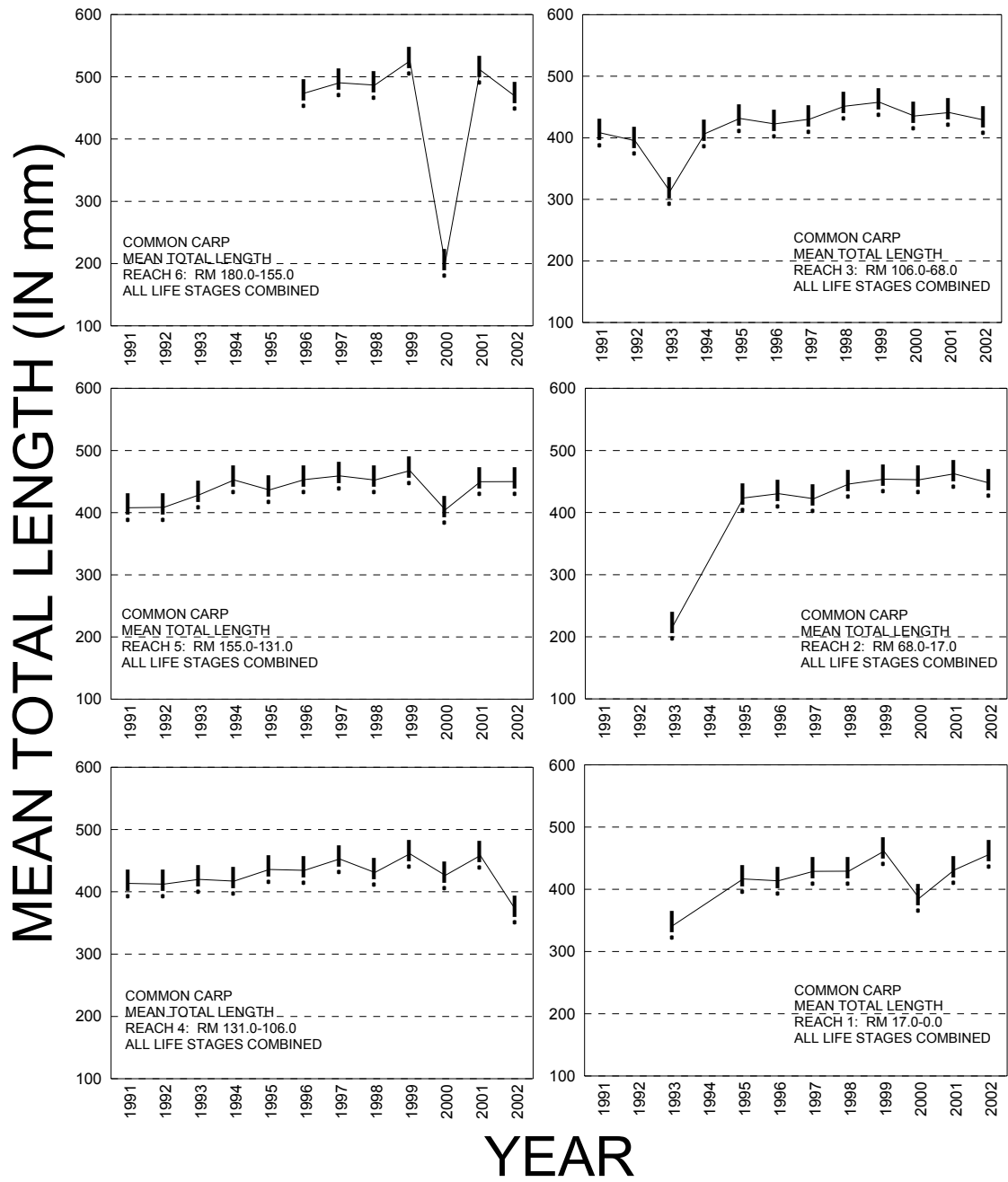


Figure 32. Mean total length (in mm) of common carp in Reaches 6-1 on fall adult monitoring trips in the San Juan River. Error bars represent the standard error values.

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 12). In fact in five of the six years preceding 2002 (excluding 2000), the total CPUE for these three species combined in any given year never exceeded 0.31 fish/hr of electrofishing (Table 12). This was the case again in 2002. Only seven largemouth bass were collected during 2002 adult monitoring collections (Table 12). Six largemouth bass were collected in Reach 6, four upstream of the PNM Weir (three adults and one juvenile) and two between the PNM Weir and Hogback Diversion (one adult and one juvenile). In addition, one YOY largemouth bass was collected in Reach 5 between RM 145.0 and 144.0. Neither striped bass or walleye were collected during 2002 adult monitoring collections (Table 12).

However, in 2000 there was a dramatic increase in the number of nonnative predatory fishes collected in the San Juan River (Table 12). The 2000 calendar year (up through mid-August) was characterized by very low, stable river flows, very clear water conditions riverwide, and by Lake Powell being at a high enough level that it still inundated the waterfall which was present at RM 0.0 from 1989 through spring 1995. During 2000 large numbers of adult striped bass invaded the San Juan River (as far upstream as the PNM Weir at RM 166.6; J. Brooks pers. comm.) from Lake Powell, while numerous juvenile largemouth bass (mostly collected upstream of RM 100.0) invaded the river, probably from upstream sources (Ryden 2001a).

Based on observational data, nonnative predatory fishes, especially striped bass, tend to invade the lower San Juan River on an annual basis, usually around the runoff period, remaining in the river and continuing to move upstream as long as turbidity remains low (pers. obs.). However, numbers of these three fishes become greatly reduced when turbidity is high, particularly following summer storm spikes. Almost all nonnative predatory fishes collected in turbid water conditions tend to have empty stomachs, while those collected during 2000 (i.e., in clear water conditions) largely had full stomachs (Ryden 2001a). Also, it does not appear that large numbers of nonnative predatory fishes overwinter in the San Juan River as numbers collected on spring razorback sucker sampling trips are always low (Ryden unpublished data).

Table 12. 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) |

DISCUSSION

Rare Native Fishes

Colorado Pikeminnow

Collections of wild adult Colorado pikeminnow have been extremely rare since 1995. Stocked juvenile Colorado pikeminnow continue to be recaptured, but numbers recaptured in 2002 were very low. It is evident that a very small percentage (relative to total numbers stocked) of stocked juvenile Colorado pikeminnow continue to persist in the San Juan River and apparently some few of these have begun to reach adulthood, as was evidenced by the collection of two 500+ mm TL individuals in the lower canyon by UDWR in 2002.

Adult Colorado pikeminnow stocked at RM 180.2 in April 2001 were still being recaptured fairly frequently in Reach 6 between the PNM Weir and Hogback Diversion (RM 166.6-158.6) by nonnative fish removal crews in 2002. However, no stocked adult Colorado pikeminnow were collected between the stocking site (RM 180.2) and the PNM Weir in 2002 and only one stocked adult was collected downstream of Hogback Diversion in 2002, at RM 129.4.

An augmentation plan for Colorado pikeminnow was finalized early in 2003 (Ryden 2003a). Under the guidance of this plan, stocking of age-0 Colorado pikeminnow began in October 2002 (while the plan was still in draft final form). Stocking of age-0 Colorado pikeminnow will continue with annual stockings of 300,000 to 350,000 fish each fall through 2009 (Ryden 2003a).

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 2002, when only 139 razorback sucker were stocked into the San Juan River. However, the comparatively few razorback sucker that have been stocked continue to grow and have successfully spawned for five consecutive years. Larval razorback sucker were collected in 1998, 1999, 2000, 2001, and 2002 (Brandenburg 2000, Brandenburg et al. 2001, 2002, and 2003).

Despite the relatively small numbers of fish that have been stocked since 1994, trends in CPUE among stocked razorback sucker have been encouraging. Riverwide, razorback sucker CPUE has increased over three-fold on fall adult monitoring trips since 2000. Razorback sucker are now found, longitudinally, throughout the San Juan River and adult fish from several different years' stockings are of a sufficient age to contribute to spawning efforts.

No spawning aggregations of razorback sucker were identified in upstream reaches of the San Juan River in 2002, however UDWR crews did identify a presumed spawning aggregation adjacent to Slickhorn Canyon on 18 April 2002. This came as a fairly big surprise. The downstream, canyon-bound reaches of the San Juan River have, heretofore, been largely written off as less than optimal habitat for sub-adult and adult life stages of endangered fish. In this case however, there seems to have been enough suitable habitat available

to attract a goodly number of razorback intent on spawning. Unfortunately, even if these adult fish did manage to successfully spawn at this site, the likelihood of the larvae thus produced retaining in the river seems low, given the close proximity of Lake Powell just downstream.

Roundtail Chub

Roundtail chub collections continue to be very rare during adult monitoring collections in the San Juan River. Only one adult roundtail chub was collected in the San Juan River during 2002 adult monitoring collections.

Common Native Fishes

Flannemouth Sucker

CPUE data for flannemouth sucker from 2002 adult monitoring collections was a mixed bag and somewhat confusing. Riverwide and in Reaches 5-3, flannemouth sucker total CPUE declined between 2001 and 2002, while at the same time rising in reaches 6 and 2. One disconcerting trend observed in 2002 flannemouth sucker data was the decline of both juvenile and total CPUE in Reaches 4 and 3 to the lowest levels ever observed. However, this trend was not reflected riverwide and only following years data will tell whether or not this is a point for concern. So far, it would seem so however. Flannemouth continue to be the most abundant species collected from the San Juan River during adult monitoring collections and riverwide, total CPUE levels are still above those observed in the late 1990's.

The strong cohort of young flannemouth sucker spawned in 2000 have now reached the sub-adult life-stage and should recruit into the adult population within the next couple of years.

Bluehead Sucker

Bluehead sucker in the San Juan River are heavily concentrated in upstream reaches of the river, specifically 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, e.g., in 1999 and 2000) as in adjacent Reach 5, where they are next most abundant. It seems likely that the dramatic fluctuations in bluehead sucker CPUE (especially juvenile CPUE) observed in Reach 6 over the last seven years are an artifact of the population in this reach being heavily influenced (e.g., via immigration and emigration) by fish from adjacent upstream river sections (i.e., the Animas River and Reach 7).

Riverwide, bluehead sucker adult CPUE changed little between 1996 and 2002, but juvenile CPUE has risen steadily. For the last two years, juvenile bluehead sucker have been about twice as abundant as adults during adult monitoring collections. This is due to the large influx of young bluehead sucker from the 2000 cohort. As was observed among flannemouth sucker, the large majority of young bluehead sucker from the 2000 cohort have reached the sub-adult life-stage and should recruit into the adult population within the next two years.

Common Nonnative Fishes

Channel Catfish

Channel catfish CPUE's remained highly variable in individual reaches. However, in 2002 there was a very marked decline in juvenile, adult, and total CPUE among channel catfish in every single river reach and riverwide when compared to 2001 values. Whether this blanket decline was due to nonnative fish removal efforts or to the elevated flow spike that occurred in September 2002 just before adult monitoring, to a combination of these two events, or to some completely unrelated event is unknown.

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 2002.

However, it could be that the blanket declines observed in channel catfish CPUE in 2002 were caused by a late summer storm spike that occurred just before adult monitoring took place. On 12 September 2002, flows associated with this storm spike peaked at 8,090 CFS at the Shiprock USGS gage (#09368000), 8,850 CFS at the Four Corners USGS gage (#09371010), and 10,100 at the USGS gage near Bluff (#09379500).

Whatever the case, if this riverwide decline in channel catfish in 2002 can be somehow translated into a downward trend, it 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 in channel catfish CPUE's observed in 2002, 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 full-force for the foreseeable future.

Common Carp

Like channel catfish, common carp showed declines in CPUE in most river reaches in 2002. Adult CPUE was down in all six reaches and riverwide in 2002. Likewise, total CPUE was down in five of six reaches and riverwide in 2002. Unfortunately, juvenile common carp did not follow suit in 2002, as it increased in four of six reaches and remained virtually the same in the other two.

As with channel catfish, the exact cause of the large-scale decline in adult common carp CPUE riverwide in 2002 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 2002, 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.

Other Nonnative Fishes

As in most past years, very few largemouth bass were collected in the San Juan River during the 2002 adult monitoring trip. Six of seven largemouth bass collected in 2002 were captured in Reach 6. Once again, it seems probable that largemouth bass are entering the San Juan River from upstream sources.

No striped bass or walleye were collected during 2002 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.). This may be the reason why striped bass and walleye apparently failed to invade the San Juan River in as large of numbers as were anticipated (like those seen in spring and summer 2000; e.g., Ryden 2001a), even though 2002 was a low water year. Those striped bass and walleye that did enter the San Juan River were apparently driven out by the summer storm spike in September 2002 (Jackson 2003).

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