LONG TERM MONITORING OF SUB-ADULT AND ADULT LARGE-BODIED FISHES IN THE SAN JUAN RIVER: 2004

Interim Progress Report
(Final)

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EXECUTIVE SUMMARY

Long-term monitoring of the sub-adult and adult large-bodied fish community (called "Adult Monitoring" for short) in the San Juan River began in 1999. This monitoring study annually samples RM 180.0-2.9 between mid-September and Mid-October via raft-borne electrofishing. 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 2004, Adult Monitoring took place between 20 September and 13 October. Total effort of was 93.75 hours of electrofishing and sampled covered RM 180.0 to RM 2.9. A total of 11,573 individual fish were collected during the fall 2004 Adult Monitoring trip. The mean daily flow (measured at the Shiprock, NM USGS gage) during sampling was 1,432 CFS. However, there were distinct differences in sampling flows between the first week of sampling, (20–24 September 2004) when sampling flows ranged from 1,600-4,220 CFS and the last ten days of sampling (4-13 October) when sampling flows ranged from 615-987 CFS).

The native to nonnative fish ratio during the fall 2004 Adult Monitoring trip was the highest ever observed since riverwide sampling (i.e., continuous sampling from RM 180.0-2.9) began in 1996. On the fall 2004 Adult Monitoring trip, 77.53% of all fishes collected were native fishes (n = 8,973), while only 22.47% of all fish collected were nonnative fishes (n = 2,600). This represents a native to nonnative fish ratio of 3.45:1.

A total of 159 Colorado pikeminnow were collected during the fall 2004 Adult Monitoring trip. This was only the second time that > 100 Colorado pikeminnow were collected on an Adult Monitoring trip (n = 104 in 1998). All 159 of these fish had been stocked as juveniles in either 2002 or 2003. The large majority (n = 130; 81.8%), however, were age-1 fish that were stocked on 6 November 2003. No wild Colorado pikeminnow were collected on the fall 2004 Adult Monitoring trip. The CPUE for Colorado pikeminnow on the fall 2004 Adult Monitoring trip (1.78 fish/hr of electrofishing) rose to the highest level ever observed during Adult Monitoring collections. Collections of Colorado pikeminnow ranged from RM 179.0-7.0, with the large majority (n = 105; 65.4%) occurring upstream of the canyon-bound reaches of the river (i.e., upstream of RM 68.0). It appears as if stocked Colorado are surviving fairly well for the first two to three years post-stocking. However, after the first couple of years, the number of Colorado pikeminnow remaining in the San Juan River from any given stocking seems to dwindle quickly. A few older stocked fish are occasionally collected, but not in any large numbers. The Colorado pikeminnow augmentation plan anticipates that repeatedly stocking large numbers of Colorado pikeminnow over a long enough time period will help to establish a healthy, multiple year-class population. However, given the relatively low observed retention rates among any given stocking, this may take numerous years to accomplish, or conversely, may not happen at all. Therefore, trying to understand and address the factors responsible for low long-term retention of stocked fish will be crucial in trying to shorten the duration of, and insure the success of, the Colorado pikeminnow augmentation effort.

A total of 117 razorback sucker were collected during the fall 2004 Adult Monitoring trip. This was the first time that > 100 razorback sucker had ever been collected on an Adult Monitoring trip and was a six-fold increase over the 19 fish collected on the fall 2003 Adult Monitoring trip. All 117 razorback sucker collected on the fall 2004 Adult Monitoring trip were stocked fish. Collections ranged from RM 160.0-2.9. On the fall 2004 Adult

Monitoring trip, total CPUE for razorback sucker (1.44 fish/hr of electrofishing) was over five times higher than any previously observed value on an Adult Monitoring trip. Despite the high CPUE observed for razorback sucker in 2004, there is some cause for concern. Like stocked Colorado pikeminnow, the majority of stocked razorback sucker do not seem to be retaining in the river for longer than about four years post-stocking, although a few older stocked fish are collected from time to time. As with Colorado pikeminnow, the razorback sucker augmentation plan anticipates that repeatedly stocking large numbers of razorback sucker over a long enough time period will help to establish a healthy, multiple year-class population. However, given the relatively low densities at which these fish are currently being stocked and the apparent low observed retention rates among any given stocking, this may take several years to accomplish, or again, may not happen at all. Therefore, trying to understand and address the factors responsible for low long-term retention of stocked fish will be crucial in trying to shorten the duration of, and insure the success of, the razorback sucker augmentation effort.

No roundtail chub were collected during the fall 2004 Adult Monitoring trip. Roundtail chub continue to be extremely rare (or more commonly completely absent) in Adult Monitoring collections. The few roundtail chub that are collected in the San Juan River are likely transient members of the fish community that enter the river from one of its upstream tributaries that have resident roundtail chub populations.

Flannelmouth sucker continues to be the most commonly-collected species during fall Adult Monitoring trips. During the fall 2004 Adult Monitoring trip, flannelmouth sucker accounted for 49.9% (n = 5,775 individuals) of all fish collected. Despite some fluctuation in riverwide CPUE, the San Juan River flannelmouth sucker population has remained relatively stable over the last nine years (1996-2004). However, data collected in Reaches 5-3 from 1991-1995 appear to indicate that while this population has been stable at its current level for the last nine years, flannelmouth sucker are probably less abundant riverwide now than they were in the early 1990's.

Bluehead sucker were the second most-commonly collected species during the fall 2004 Adult Monitoring trip. Bluehead sucker accounted for 16.2% (n = 1,874 individuals) of all fish collected in 2004. The bluehead sucker population within our study area is still largely centered in Reach 6. However, the distribution of bluehead sucker is becoming more widespread in the San Juan River. In 2004, bluehead sucker were present in 96.61% of all electrofishing collections riverwide. Riverwide CPUE for bluehead sucker has shown an increasing trend over the last nine years, with the riverwide increases between 1996 and 2004 being significant for both juvenile CPUE and total CPUE ($p = 0.044$ and 0.046, respectively). For the second year in a row, bluehead sucker were collected in Reach 1, adjacent to Lake Powell.

Channel catfish were the third most-commonly collected species during the fall 2004 Adult Monitoring trip. Channel catfish accounted for 14.4% (n = 1,662 individuals) of all fish collected in 2004. Between 2001 and 2004, channel catfish total CPUE has dropped markedly. This was mostly caused by a large decline in numbers of juvenile fish between 2001 and 2004. However, more encouraging than the declines in juvenile and total channel catfish CPUE over that time period is the three-year decreasing trend in riverwide adult CPUE between 2001 and 2004. Channel catfish adult CPUE riverwide has been declining steadily and consistently for the last three years, dropping to an all-time low of 2.98 fish/hr of electrofishing on the fall 2004 Adult Monitoring trip. Channel catfish distribution has also been somewhat reduced. On the fall 2004 Adult Monitoring trip, channel catfish were collected in only 75.42% of all electrofishing collections riverwide. This contrasts to 2001, when channel catfish were collected in 94.38% of all electrofishing collections riverwide. The San Juan River has also become heavily dominated by juvenile fish (i.e., < 300 mm TL). The relative percentage of juvenile fish in the San Juan River channel catfish population, riverwide, reached an observed high in 2004 of 78.34%. The heavy numeric dominance of juvenile channel catfish coupled with the lowest ever observed numbers of adult fish riverwide should, hopefully, have a negative effect on the reproductive potential of this species in the San Juan River. The markedly declining numbers of adult channel catfish, coupled with the increasing numeric dominance of juvenile fish would argue that nonnative fish removal efforts are having an effect on this population. Given these encouraging population trends, it is recommended that nonnative fish removal efforts be, at least, continued at current levels, or possibly even expanded (especially into Reaches 5-3) for the foreseeable future.

Common carp fell to being the fifth most commonly-collected species during the fall 2004 Adult Monitoring trip (speckled dace, a small-bodied fish species, were the fourth most commonly-collected species). Common carp accounted for only 4.7% (n = 547 individuals) of all fish collected in 2004. Like channel catfish, the distribution of common carp has become less widespread in the last two years. Common carp were collected in only 69.07% of all electrofishing collection riverwide in 2004 (and 67.87% in 2003). In the last nine years, common carp adult and total CPUE has shown a noticeable declining trend riverwide. In 2004, common carp adult CPUE fell to the lowest value ever observed, 3.62 fish/hr of electrofishing. Over the last several years, juvenile common carp have become relatively more common in Adult Monitoring collections, until in 2004 they composed 39.9% of all common carp collected. Despite this however, the majority of common carp collected on Adult Monitoring trips are still adult fish. As with channel catfish, the markedly declining numbers of adult common carp, coupled with the increasing numeric presence of juvenile fish would argue that nonnative fish removal efforts are having an effect on this population. It is recommended that nonnative fish removal efforts be, at least, continued at current levels, or possibly even expanded (especially into Reaches 5-3) for the foreseeable future.

A total of 59 juvenile largemouth bass were collected on the fall 2004 Adult Monitoring trip. This is the second largest number of largemouth bass ever collected on a riverwide fall Adult Monitoring trip. However, all 59 of these fish were juveniles. Circumstantial evidence points to these fish being transient residents of the San Juan River and not part of a healthy, reproducing population. Given their longitudinal distribution, it is likely that these fish are entering the San Juan River from an off-channel source, possibly near Farmington, NM. No striped bass or walleye were collected on the fall 2004 Adult Monitoring trip.

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INTRODUCTION

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

One component of the long-term monitoring program, the ***Sub-Adult And Adult Large-Bodied Fish Community Monitoring*** (referred to hereafter as "Adult Monitoring" for short), is the primary responsibility of the U.S. Fish and Wildlife Service's (USFWS) Colorado River Fishery Project (CRFP) office in Grand Junction, CO. However, numerous other state and federal agencies supply manpower, equipment, and logistical support for these monitoring efforts.

The objectives of the Adult Monitoring study are as follows:

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

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

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

METHODS

Sampling conducted in 2004 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. The netter attempted to net all fishes (regardless of species, fish's body size, or life-stage) 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 (± 5 grams {g}) and measured (± 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 both a riverwide and by-reach basis) annually.

Electrofishing data were pooled for both 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 1991-2003 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 1991-2003 data to evaluate long-term trends. TL data were also used to develop riverwide length frequency histograms for the four most common species from 1996-2004.

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 2000) 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 entire study area was sampled contiguously 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 1996-2004, for Reaches 5-3 from 1991-2004, and for Reaches 2-1 from 1993 and 1995-2004.

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 2004 Adult Monitoring trip were higher than they had been since the 1999 Adult Monitoring trip and were the fourth highest sampling flows overall since riverwide sampling began in 1996 (Table 1). However, there were distinct differences in sampling flows between the first week of sampling, (i.e., 20—24 September 2004; during which RM 180.0-119.2 were sampled) when sampling flows ranged from 1,600-4,220 CFS and the last ten days of sampling (i.e., 4-13 October; during which RM 119.2-2.9 were sampled) when sampling flows ranged from 615-987 CFS).

Twenty different fish species and hybrid forms were collected from the San Juan River during the 2004 Adult Monitoring trip (Table 2). This included five native species and two native sucker X native sucker hybrids, as well as eleven nonnative species and two native X nonnative sucker hybrids (Tables 2 and 3). Flannelmouth sucker was the most commonly-collected species (n = 5,775 individuals), followed in descending order by bluehead sucker (n = 1,874), channel catfish (n = 1,662), speckled dace (n = 991), and common carp (n = 547), red shiner (n = 253), Colorado pikeminnow (n = 159), and razorback sucker (n = 117; Table 3). These eight species accounted for 98.32% (11,378 individuals) of the total catch during the 2004 Adult Monitoring trip. The other eight species (and four hybrids) contributed only 195 individuals, or 1.68%, to the total catch in 2004 (Table 3). This was the first year, since Adult Monitoring trips began in 1991, that common carp were not among the four most commonly-collected fish species.

Native fishes accounted for 8,973 specimens or 77.53% of the total catch in 2004 (among 236 individual electrofishing collections riverwide). Nonnative fishes accounted for 2,600 specimens or 22.47% of the total catch in 2004 (among 236 individual electrofishing collections riverwide). The overall native to nonnative fish ratio riverwide was 3.45:1 in 2004 (Figure 1). This is the highest riverwide native:nonnative fish ratio observed in the last nine years (Figure 1).

Although endangered fishes continue to be relatively rare during Adult Monitoring collections, more Colorado pikeminnow (n = 159) and razorback sucker (n = 117) were collected during the fall 2004 Adult Monitoring trip than during any previous year’s Adult Monitoring trip(s). This was only the second time that > 100 Colorado pikeminnow had been collected on an Adult Monitoring trip (n = 104 in 1998) and it was the first time that > 100 razorback sucker were collected on an Adult Monitoring trip. This was also the first time that both Colorado pikeminnow and razorback sucker comprised > 1.00% of the total catch on the same Adult Monitoring trip (Table 3). Unfortunately, no roundtail chub were collected during the 2004 Adult Monitoring trip.

Table 1. Summary of dates, river miles (RM) sampled, and mean flow during riverwide Adult Monitoring trips in the San Juan River in New Mexico, Colorado, and Utah, 1996-2004.

Beginning Date Of Sampling	Ending Date Of Sampling	River Miles Sampled	Mean Trip Flow At The Shiprock, New Mexico USGS Gage (#09368000) In CFS And (Cubic Meters/Second)
17 June 1996	25 October 1996	RM 180.0-2.9	1,531 CFS ($43.3\ m^3$/sec)
11 August 1997	9 October 1997	RM 180.0-2.9	1,753 CFS ($49.6\ m^3$/sec)
10 August 1998	7 October 1998	RM 180.0-2.9	767 CFS ($21.7\ m^3$/sec)
20 September 1999	7 October 1999	RM 180.0-2.9	2,177 CFS ($61.6\ m^3$/sec)
18 September 2000	10 October 2000	RM 180.0-2.9	657 CFS ($18.6\ m^3$/sec)
25 September 2001	19 October 2001	RM 180.0-2.9	611 CFS ($17.3\ m^3$/sec)
20 September 2002	7 October 2002	RM 180.0-2.9	458 CFS ($12.9\ m^3$/sec)
22 September 2003	14 October 2003	RM 180.0-2.9	450 CFS ($12.7\ m^3$/sec)
20 September 2004	13 October 2004	RM 180.0-2.9	1,432 CFS ($40.5\ m^3$/sec)

Table 2. Scientific and common names, status, and database codes for fish species collected from the San Juan River during the 2004 adult monitoring trip (following Nelson et al. 2004).

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

Table 3. Total number of fish collected during the 2004 Adult Monitoring trip.

Species (Status)[a]	Total number of specimens	Percent of total[b]	Rank	Frequency of occurrence
flannelmouth sucker(N)	5,775	49.90	1	228
bluehead sucker(N)	1,874	16.19	2	228
channel catfish(I)	1,662	14.36	3	178
speckled dace(N)	991	8.56	4	149
common carp(I)	547	4.73	5	163
red shiner(I)	253	2.19	6	56
Colorado pikeminnow(N)	159	1.37	7	102
razorback sucker(N)	117	1.01	8	52
largemouth bass(I)	59	0.51	9	34
bluehead sucker X flannelmouth sucker(H,N)	56	0.48	10	38
fathead minnow(I)	31	0.27	11	15
brown trout(I)	19	0.16	12	13
white sucker X flannelmouth sucker(H,I)	10	----	13	10
white sucker(I)	8	----	14	8
black bullhead(I)	7	----	15	6
bluegill(I)	1	----	16	1
green sunfish(I)	1	----	16	1
razorback sucker X flannelmouth sucker(H,N)	1	----	16	1
smallmouth bass(I)	1	----	16	1
white sucker X bluehead sucker(H,I)	1	----	16	1
GRAND TOTAL	11,573		2004 collections = 236	

2004 Native Fishes 8,973 (77.53% of total catch)
2004 Introduced Fishes 2,600 (22.47% of total catch)
2004 Native:Introduced Fishes Ratio = 3.45:1

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%

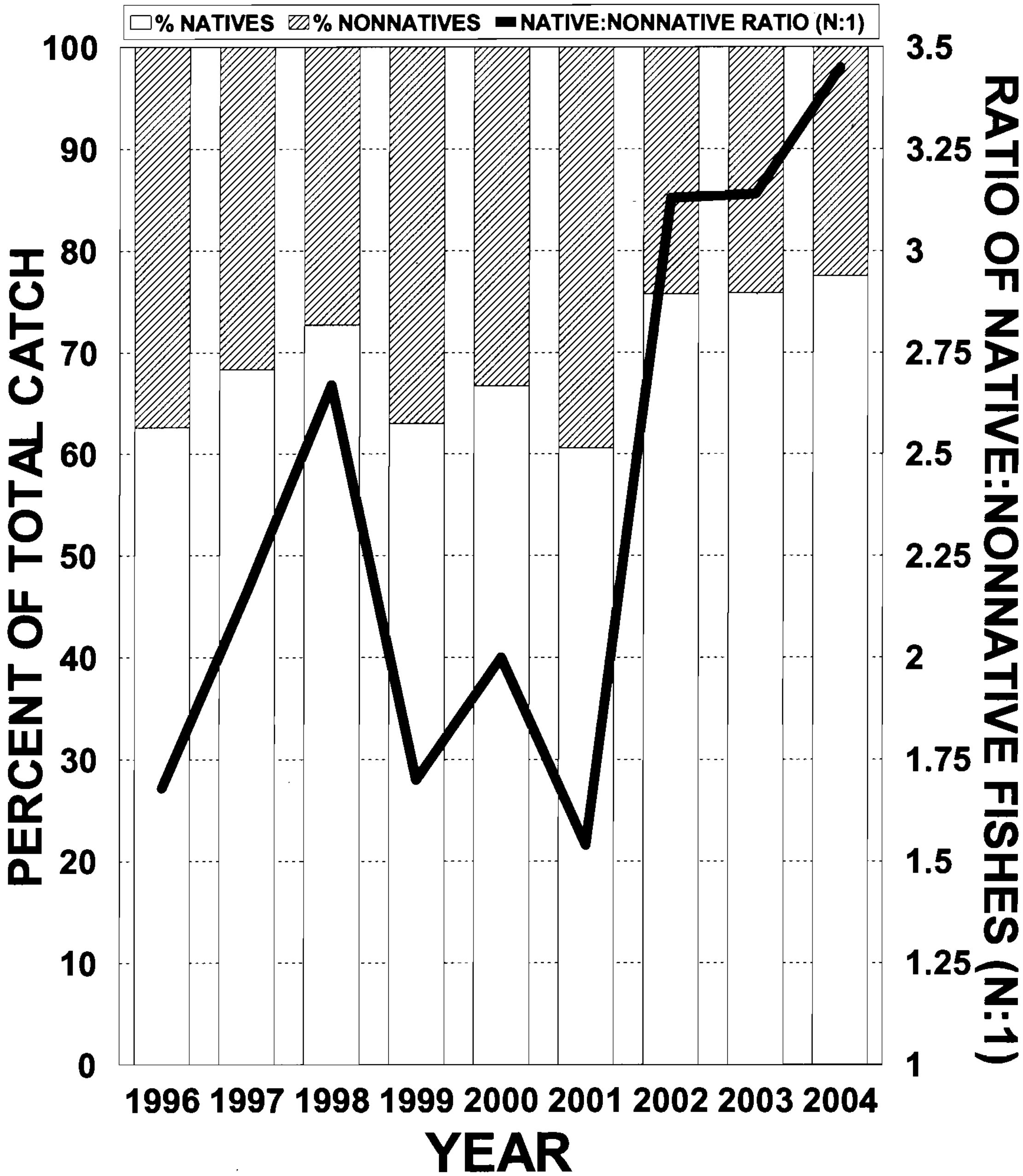

Figure 1. The bars represent the percent of the total catch accounted for by native fishes (white bars) versus nonnative fishes (shaded bars), riverwide (RM 180.0-0.0), on Adult Monitoring trips, 1996-2004. The line represents the ratio of native to nonnative fishes (N:1) collected on the same trips.

Rare Native Fishes

Colorado Pikeminnow

<u>Fish Stocked As Part Of An Augmentation Effort</u>

A total of 281,219 age-0 and age-2 Colorado pikeminnow were stocked into the San Juan River in 2004 (Table 4). These fish were stocked in three distinct groupings.

The first group, consisting of 1,219 age-2 fish, were stocked en masse at RM 180.2 on 9 June 2004 (Table 4). These age-2 fish were excess to the UCRB-RIP's Colorado pikeminnow augmentation efforts and were made available to the SJRIP through the J.W. Mumma Native Species Hatchery in Alamosa, CO. These fish, though reared at Mumma, were 2002 year-class progeny of the "1991 broodstock" being held at Dexter NFH. All of these age-2 fish were individually PIT-tagged before release into the river.

The second group, consisting of approximately 30,000 age-0 Colorado pikeminnow were stocked by crews from BIO-WEST, Inc. into various low-velocity habitats from RM 178.6-169.5 and from RM 163.7-159.2 on 21 October 2004 (Table 4). The habitats these 30,000 age-0 fish were stocked into were blocked off by holding nets prior to introducing fish into them. This was done as part of an acclimation study aimed at improving retention of stocked age-0 pikeminnow in upstream sections of the San Juan River. The premise of the study was that if age-0 Colorado pikeminnow were allowed to acclimate for a period in the river after stocking, then once allowed free access to the river, they would be less likely to exhibit the long downstream displacements typically observed among newly-stocked age-0 Colorado pikeminnow. These age-0 fish came from Dexter NFH in Dexter, NM. All of these fish, were 2004 year-class progeny of the "1991 broodstock" being held at Dexter NFH. None of these fish were PIT-tagged before release. However, 20,000 of them were marked with VIE tags (two different colors) prior to stocking.

The third group, consisting of approximately 250,000 age-0 Colorado pikeminnow were stocked by crews from USFWS-CRFP (Table 4). Stocking took place on two separate days, 21 and 28 October 2004. Upon arrival at the river, these fish were subdivided into two smaller, roughly equal groups. Each of these two sub-groups were transported downstream by raft in aerated live wells and stocked into numerous backwaters and other low-velocity habitats. The first sub-group was stocked between RM 180.2 and 170.5 (i.e., immediately downstream of Farmington, NM) while the second sub-group was stocked between RM 158.6 and 148.5 (i.e. between Hogback Diversion and Shiprock, NM). These age-0 fish came from Dexter NFH in Dexter, NM. All of these fish were 2004 year-class progeny of the "1991 broodstock" being held at Dexter NFH. None of these fish were PIT-tagged or otherwise individually-marked before release.

Table 4. Stockings of Colorado pikeminnow in the San Juan River, 1996-2004.

Date	Number Stocked	River Mile Stocked At	Mean Total Length (mm)	Range Of Total Lengths (mm)	Responsible Agency[a]
Experimental Stocking Period (1996-2001):					
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
Beginning Of Eight-Year Augmentation Period (2002-2009):					
10/24/2002	105,209	180.2	51	32-127	USFWS
10/24/2002	105,209	158.6	51	32-127	USFWS
11/06/2003	155,764	180.2 to 170.5 and 158.6 to 148.5	58	38-100	USFWS
11/06/2003	20,164	188.4 to 180.7 and 163.7 to 159.2	58	Not Specified	BIO-WEST
11/06/2003	1,005	180.2	180	125-280	CDOW
06/09/2004	1,219	180.2	218	144-278	CDOW
10/21/2004	30,000	178.6 to 169.5 and 163.7 to 159.2	50	Not Specified	BIO-WEST
10/21/2004 & 10/28/2004	250,000	180.2 to 170.5 and 158.6 to 148.5	50	35-116	USFWS (assisted by BIO-WEST)

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

2004 Collections

There were a total of 159 recapture events with stocked juvenile Colorado pikeminnow during the 2004 Adult Monitoring trip (Table 5). This marked only the second time since Adult Monitoring began in 1991 that > 100 Colorado pikeminnow had been collected during a single Adult Monitoring trip (n = 104 in 1998). In addition, several hundred more Colorado pikeminnow collections (including two wild YOY; Brandenburg et al. 2005) occurred during other field studies in calendar year 2004 (e.g., Brandenburg et al. 2005, Davis 2005, Golden and Holden 2005, Jackson 2005). Colorado pikeminnow collections were made via raft-mounted electrofishing, seining, and in the PNM Fish Ladder during calendar year 2004. Several Colorado pikeminnow were also collected from the Hogback Irrigation Canal in the fall of 2004 (UNM unpublished data). In addition, five recently-stocked Colorado pikeminnow were collected in the lower Animas River (Zimmerman 2005). Unfortunately however, no wild adult Colorado pikeminnow were collected in 2004, during any study effort.

The 159 Colorado pikeminnow recaptures that occurred during the fall 2004 Adult Monitoring trip ranged from RM 179.0-7.0. Unlike 2003 Adult Monitoring trip, when the majority (n = 20 {62.5%} of 32 total recaptures) of Colorado pikeminnow recaptures occurred downstream of RM 68.0 in the canyon-bound reaches of the river, on the 2004 Adult Monitoring trip 65.4% (n = 104 of 159 total recaptures) of Colorado pikeminnow recaptures occurred upstream of the canyon-bound reaches of the San Juan River (i.e., > RM 68.0).

During the 2004 Adult Monitoring trip, there were several year-classes and size-classes of Colorado pikeminnow that had been stocked into the San Juan River that had the potential to be recaptured (Table 4). However, of the 159 recaptures on the 2004 Adult Monitoring trip, 130 (81.8%) were age-1 "Dexter" fish that were stocked on 6 November 2003. These age-1 fish were collected from RM 176.0-7.0. The remainder of the 159 recaptures on the 2004 Adult Monitoring trip were with age-2 fish (n = 26) or fish of unknown age (n = 3). Of the 26 age-2 fish, almost half (n = 12) were "Mumma" fish that had been stocked on 9 June 2004 (Table 4). These age-2 "Mumma" fish were collected from RM 179.0-50.0. That means that only 14 (8.8%) of the 159 total recaptures on the 2004 Adult Monitoring trip were "Dexter" fish that had been stocked on 24 October 2002 (Table 4). These age-2 "Dexter" fish were collected from RM 149.0-7.0. Although the widespread distribution of stocked Colorado pikeminnow from different stocking dates in the San Juan River is encouraging, the recent collections of numerous Colorado pikeminnow from the Hogback Irrigation Canal (UNM unpublished data) point to a potentially significant source of loss for fish that are stocked upstream of RM 158.6 and then move downstream following stocking.

Survival of Colorado pikeminnow in the San Juan River may be compromised by the presence of nonnative ictalurids, either through direct predation by larger channel catfish or by Colorado pikeminnow attempting to consume smaller channel catfish and subsequently choking on them. For instance, on 21 June 2004, nonnative fish removal crews working in the lower San Juan River collected a 416 mm TL channel catfish that had consumed a stocked 212 mm TL Colorado pikeminnow (Jackson 2005). This age-2 fish was stocked from Mumma Hatchery on 9 June 2004 (at RM 180.2) and was in the river less than 12 days before it was eaten. In addition, two juvenile Colorado pikeminnow, one collected in 1999 and the other in 2003, had small ictalurids (a channel catfish and a black bullhead, respectively) lodged in their buccal cavities at the time of capture (Ryden and Smith 2002, Lapahie 2003, Ryden 2004).

Table 5. Colorado pikeminnow collected from the San Juan River on the fall 2004 Adult Monitoring trip (n = 159).

Date Of Capture	PIT Tag Number	Total Length (in mm)	Weight (in grams)	Recapture River Mile
09/20/2004	52290B102B	175	38	158.0
09/20/2004	53275A6D08	162	20	158.0
09/20/2004	NONE	260	135	158.0
09/20/2004	5327000A42	177	35	157.0
09/20/2004	5327627332	165	28	157.0
09/20/2004	441E387731	245	100	157.0
09/20/2004	522A532859	185	40	157.0
09/20/2004	5324730F01	264	130	155.0
09/20/2004	NONE	170	50	152.0
09/20/2004	NONE	185	65	152.0
09/20/2004	441E26090D	295	230	151.0
09/20/2004	423F762023	360	320	149.0
09/20/2004	5327373E21	280	150	148.3
09/21/2004	4364192655	218	91	145.1
09/21/2004	441E48617B	310	225	143.0
09/21/2004	NONE	267	37	139.0
09/21/2004	53246C0414	351	315	137.0
09/21/2004	4368734A63	304	222	137.0
09/21/2004	441E1C4D25	301	210	136.0
09/21/2004	NONE	195	38	134.0
09/22/2004	441B141428	342	325	131.0
09/22/2004	424069086B	250	100	130.0
09/22/2004	44207D0950	304	225	128.0
09/22/2004	53246C165E	236	100	128.0
09/22/2004	5326732E56	193	60	128.0
09/22/2004	53275D1E64	206	62	128.0
09/22/2004	53276B3F54	190	45	128.0
09/22/2004	4365536619	235	105	128.0
09/22/2004	5324721020	191	40	127.0
09/22/2004	53275C6A6E	204	65	127.0
09/22/2004	434F2E040C	220	78	127.0
09/22/2004	43650D4D7A	200	64	127.0
09/22/2004	43652E522B	212	60	127.0
09/22/2004	4365546E20	207	62	127.0
09/22/2004	4369156645	209	70	127.0
09/22/2004	5327501E64	202	70	127.0
09/22/2004	UNKNOWN	195	57	127.0
09/22/2004	4365166454	178	41	125.0
09/22/2004	4365530E25	198	53	125.0
09/22/2004	532470366A	186	40	122.0
09/22/2004	532751094C	212	55	122.0
09/22/2004	53275E4462	218	70	122.0
09/22/2004	5327665727	214	65	122.0
09/22/2004	43650E2D73	200	152	122.0
09/22/2004	522A2F6B76	270	155	122.0

Table 5. Continued.

Date Of Capture	PIT Tag Number	Total Length (in mm)	Weight (in grams)	Recapture River Mile
09/22/2004	436719082D	220	89	121.0
09/22/2004	43641D1B5B	316	219	119.2
09/23/2004	441A54350D	254	140	179.0
09/23/2004	53275A6C2B	130	13	176.0
09/23/2004	441E485D5A	293	259	175.0
09/23/2004	441E2B4D21	295	230	173.0
09/23/2004	532754335B	171	35	173.0
09/23/2004	43686B5C08	146	23	173.0
09/23/2004	441A6E2E69	257	154	172.0
09/23/2004	441E481446	265	162	172.0
09/23/2004	43641D6537	158	34	170.0
09/23/2004	43650E7128	182	56	170.0
09/23/2004	441E2F2A5A	270	180	170.0
09/23/2004	UNKNOWN	312	295	170.0
09/23/2004	43655E7963	190	63	169.0
09/24/2004	521E1B7104	170	37	163.7
09/24/2004	4365714802	185	50	163.0
09/24/2004	43685D611A	186	45	162.0
09/24/2004	4364275753	201	70	160.0
09/24/2004	436932653A	166	23	159.4
10/04/2004	4364111F1A	206	65	118.0
10/04/2004	4364384F49	185	65	118.0
10/04/2004	4366072C00	187	45	118.0
10/04/2004	522A243842	186	45	116.0
10/04/2004	441F066376	303	300	115.7
10/04/2004	522A205072	227	80	115.0
10/04/2004	522A49195B	195	50	113.0
10/04/2004	43650D1121	180	54	113.0
10/04/2004	4368630C58	208	84	113.0
10/04/2004	UNKNOWN	230	110	113.0
10/04/2004	43656F537D	175	35	112.0
10/04/2004	43657D197D	213	65	112.0
10/04/2004	43671B0B5D	164	34	112.0
10/04/2004	434E7E4840	191	62	109.0
10/05/2004	43684E081A	186	45	107.0
10/05/2004	43685D4119	177	38	107.0
10/05/2004	4368647546	185	50	106.0
10/05/2004	436904206A	259	155	106.0
10/05/2004	52290C667E	223	90	104.0
10/06/2004	522912341D	210	68	89.0
10/06/2004	522A1E750F	231	109	89.0
10/06/2004	522A300714	191	60	89.0
10/06/2004	4368477A69	210	73	89.0
10/06/2004	52290A6D44	204	72	88.0
10/06/2004	522A1F076D	213	70	86.0

Table 5. Continued.

Date Of Capture	PIT Tag Number	Total Length (in mm)	Weight (in grams)	Recapture River Mile
10/06/2004	4364261A27	196	62	86.0
10/06/2004	43685B7C70	217	67	85.0
10/06/2004	4368535541	256	150	83.0
10/06/2004	52296C4B74	247	120	82.2
10/06/2004	522A26176D	268	148	82.2
10/06/2004	436407667C	194	70	82.2
10/06/2004	4365154D41	198	62	82.2
10/06/2004	436846296D	219	80	82.2
10/07/2004	43686B7340	314	265	80.0
10/07/2004	522A514844	212	95	79.0
10/07/2004	4365674A31	210	82	79.0
10/07/2004	43687B3355	211	57	77.0
10/07/2004	522A612E6B	204	70	75.0
10/08/2004	522A620150	240	120	71.0
10/08/2004	4364241B63	324	230	66.0
10/08/2004	43687C1329	291	163	66.0
10/08/2004	43657D1521	236	85	63.0
10/09/2004	434F272056	190	60	57.0
10/09/2004	434011262D	186	50	56.0
10/09/2004	43671B523F	189	50	56.0
10/09/2004	4368471558	198	60	56.0
10/09/2004	4369015658	253	130	56.0
10/09/2004	43690A5266	251	130	56.0
10/09/2004	4369254F58	218	85	56.0
10/09/2004	52283D7106	277	145	56.0
10/09/2004	5228442655	237	90	56.0
10/09/2004	43446A2142	183	61	54.0
10/09/2004	53275C4F54	179	35	53.0
10/09/2004	436933671A	216	75	51.0
10/09/2004	4364490241	219	85	51.0
10/09/2004	4365165429	245	135	51.0
10/09/2004	433F56321E	232	85	50.0
10/09/2004	4369176B5D	213	85	50.0
10/09/2004	4364333947	235	110	50.0
10/09/2004	43691C3601	198	45	50.0
10/09/2004	441F033F35	289	165	50.0
10/09/2004	43655D5242	173	32	48.0
10/09/2004	4368724843	193	55	48.0
10/09/2004	4365692D7A	205	65	48.0
10/10/2004	4365510109	215	35	46.0
10/10/2004	4367382766	197	48	46.0
10/10/2004	43685D557D	187	45	46.0
10/10/2004	43653F555E	194	45	45.0
10/10/2004	436851022C	303	85	45.0
10/10/2004	43670B330A	215	54	43.0

Table 5. Continued.

Date Of Capture	PIT Tag Number	Total Length (in mm)	Weight (in grams)	Recapture River Mile
10/10/2004	5228416300	239	90	42.0
10/10/2004	43655E407B	175	32	40.0
10/10/2004	4341030829	183	48	39.0
10/10/2004	43692E2928	240	115	39.0
10/10/2004	5228411858	262	120	39.0
10/10/2004	4368710318	179	44	37.0
10/10/2004	5228454853	237	86	37.0
10/11/2004	4365742331	190	47	33.0
10/11/2004	4367215040	205	58	33.0
10/11/2004	4244246C79	212	60	30.0
10/11/2004	522A020005	211	60	30.0
10/11/2004	5228315A0F	215	64	28.0
10/11/2004	5229185F06	180	43	27.0
10/11/2004	522842540E	162	33	24.0
10/11/2004	5228765906	168	39	22.0
10/12/2004	441E521A72	254	140	19.0
10/12/2004	441E295F0C	234	80	19.0
10/12/2004	52296D2746	199	48	19.0
10/12/2004	52285D3513	182	39	18.0
10/12/2004	522970725B	270	122	16.0
10/12/2004	5228315770	167	23	15.0
10/12/2004	5229740370	262	98	13.0
10/13/2004	4369251014	245	110	7.0
10/13/2004	441E595C01	292	142	7.0

Population Trends

Collections of wild Colorado pikeminnow continue to be extremely rare in the San Juan River. No wild adult Colorado pikeminnow were collected in 2004. The last wild adult 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. Two wild larval Colorado pikeminnow were collected in 2004 (Brandenburg et al. 2005). These were the first wild Colorado pikeminnow larvae collected since 1991 (Brandenburg et al. 2005).

Very few stocked adult Colorado pikeminnow were collected in 2004, and none of these were collected during the 2004 Adult Monitoring trip. Three individual Colorado pikeminnow that were stocked as adults on 11 April 2001 at RM 180.2 were recaptured during 2004 (Lapahie 2004, Davis 2005). One of these fish was collected five separate times during 2004. These three fish were all collected in the river section between the PNM Weir (RM 166.6) and the take-out on Buck Wheeler’s property (RM 159.4). Additionally, one adult Colorado pikeminnow (547 mm TL, 1280 g) was recaptured in the lower canyon (at RM 16.4) in 2004 (Jackson 2005). This fish was originally stocked as an age-0 fish on 15 August 1997 and had subsequently recruited into adulthood (i.e., was age-7 at the time of recapture).

CPUE for stocked juvenile Colorado pikeminnow during the fall 2004 Adult Monitoring trip (1.78 fish/hr of electrofishing) was markedly higher than that observed for stocked juvenile Colorado pikeminnow during any previous year's Adult Monitoring effort (Figure 2). This included both age-1 (stocked on 6 November 2003) and age-2 fish (stocked on either 24 October 2002 or on 9 June 2004). However, as was mentioned previously, the catch for stocked juvenile Colorado pikeminnow during the fall 2004 Adult Monitoring trip was dominated by age-1 fish (Figure 3).

A length-frequency histogram showed that the large majority (n = 130; 81.8%) of the 159 Colorado pikeminnow collected during the fall 2004 Adult Monitoring trip were age-1 fish (following USFWS 2002 and Ryden 2005a) that were stocked on 6 November 2003 (Figure 3). This represents a fairly stark contrast to what was seen in fall 1998 Adult Monitoring collections. In both fall 1998 and fall 2004, there had been two years of age-0 fish being stocked prior to the fall sampling trip (i.e., stockings in 1996 and 1997 versus stockings in 2002 and 2003). Also, in 1998 and 2004, the numbers of young Colorado pikeminnow were higher than anything previously documented by scientific collections in the San Juan River up to that point. In fact, these were the only two years during which $\geq$ 100 Colorado pikeminnow were collected on fall Adult Monitoring trips (Figure 3). However, when total lengths of Colorado Pikeminnow collected on the fall 1998 Adult Monitoring trip were plotted, they demonstrated a heavily bimodal distribution, indicating relatively good survival by both the 1996 and 1997 year-classes into the fall of 1998 (Figure 3). This was not seen in the 2004 length-frequency plots. Thus, it would appear that the Colorado pikeminnow from the 2002 stocking (2002 year-class) did not survive into the fall of 2004 (their age-2 year) in as great of numbers as was anticipated. Analysis of 1997-1998 versus 2003-2004 seining data by Golden and Holden (2005) also seems to support this conclusion.

The Colorado pikeminnow augmentation plan (Ryden 2003b) anticipates that repeatedly stocking large numbers of Colorado pikeminnow over a long enough period of time will help to establish a healthy, multiple year-class population. However, given the relatively low observed retention rates among any given stocking, this may take numerous years to accomplish, or conversely, may not happen at all. Therefore, trying to understand and address the factors responsible for low long-term retention of stocked fish will be crucial in trying to shorten the duration of, and insure the success of, the Colorado pikeminnow augmentation effort.

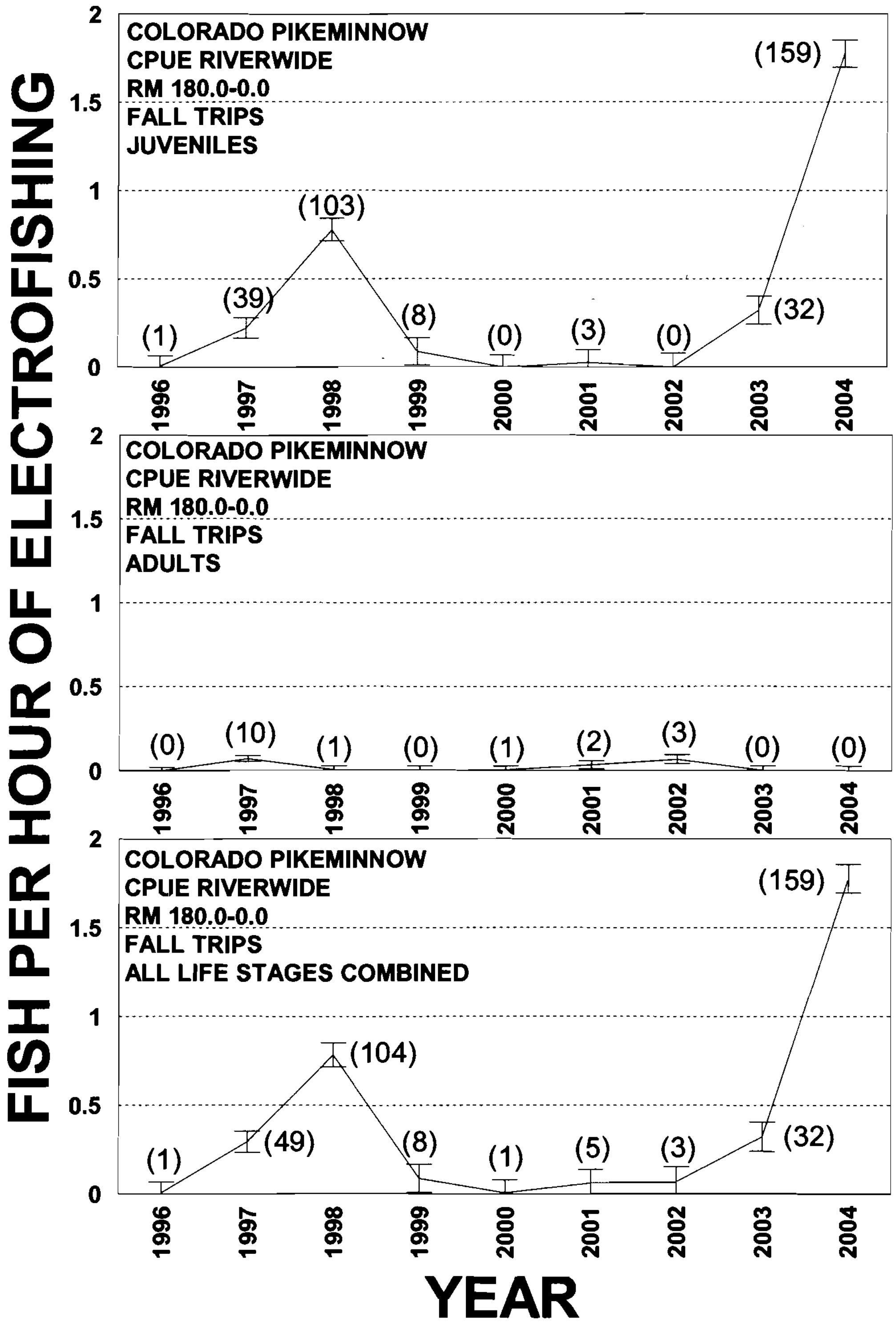

Figure 2. Colorado pikeminnow catch per unit effort (CPUE) riverwide (RM 180.0-0.0) on fall Adult Monitoring trips, for juvenile fish (< 450 mm TL; top), adult fish (≥ 450 mm TL; middle), and for all life stages combined (juveniles + adults; bottom). Error bars represent one standard error. Parenthetic numbers above or beside the error bars indicate the sample size.

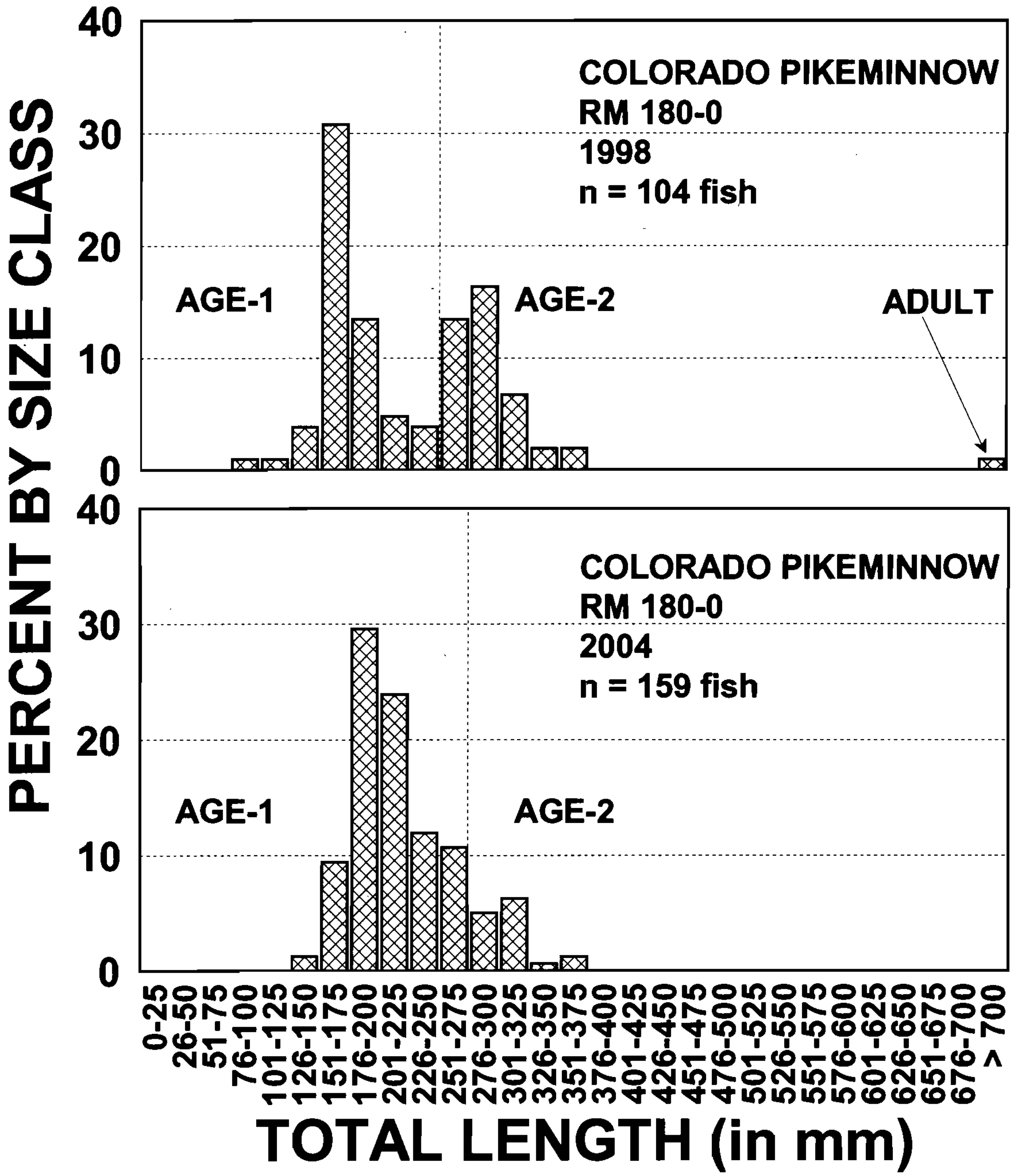

Figure 3. Length-frequency histograms for Colorado pikeminnow recaptured during the fall 1998 and fall 2004 Adult Monitoring trips. Large numbers of age-0 Colorado pikeminnow had been stocked in the fall for two consecutive years prior to each of these Adult Monitoring trips (i.e., 1996 and 1997 versus 2002 and 2003). These are the only two Adult Monitoring trips (Adult Monitoring trips began in 1991) during which > 100 Colorado pikeminnow were recaptured.

Razorback Sucker

Fish Stocked As Part Of An Augmentation Effort

Between March 1994 and August 2004, a total of 10,852 razorback sucker were stocked into the San Juan River (Table 6). All of the 10,852 fish were individually-implanted with PIT tags before being released into the wild. That total includes 2,989 razorback that were stocked into the San Juan during four separate stocking efforts in 2004. This was the largest number of razorback sucker stocked in any single year since augmentation efforts began for this species in 1994.

The first of these four stockings occurred between 12 and 16 April 2004 (Table 6), when a total of 969 razorback sucker were harvested from the 6-Pack ponds and stocked into the river just downstream of Hogback Diversion (RM 158.6). The mean TL of these fish was 326 mm (range = 280-480 mm TL).

The second stocking consisted of 311 fish stocked on 26 April 2004 (Table 6). These 311 fish had been reared by UDWR in the golf course ponds at Page, AZ. These fish were also stocked into the San Juan at RM 158.6, immediately downstream of the Hogback Diversion. The mean TL of these 311 fish was 366 mm (range = 225-559 mm TL).

The third stocking of razorback sucker occurred on 12-16 July 2004 (Table 6). On that date, 983 razorback sucker were harvested from the East Avocet Pond and stocked into the river just downstream of Hogback Diversion (RM 158.6). The mean TL of these fish was 379 mm (range = 295-540 mm TL).

The last stocking of razorback sucker occurred between 23 and 27 August 2004. During that week, 726 razorback sucker were harvested from East Avocet Pond and were stocked at RM 158.6, immediately downstream of the Hogback Diversion (Table 6). The mean TL of these 726 fish was 350 mm (range = 235-510 mm TL).

2004 Collections

Several juvenile razorback sucker, suspected to be wild-spawned progeny of stocked razorback sucker, were collected in 2004 (e.g., Brandenburg et al. 2005, Golden and Holden 2005, Jackson 2005). However, none of these suspected wild juveniles were collected during the fall 2004 Adult Monitoring trip. This is the second year during which wild-produced, post-larval razorback sucker were collected in the San Juan River. In addition, wild-produced, larval razorback sucker were collected for the seventh consecutive year (1998-2004) in 2004 (e.g., Brandenburg et al. 2005).

A total of 117 razorback sucker were collected on the fall 2004 Adult Monitoring trip (Table 7). This was a six-fold increase over the 19 fish collected on the fall 2003 Adult Monitoring trip. These 117 collections ranged from RM 160.0-2.9. Of the 117 recaptures with stocked razorback sucker, original stocking dates could be determined for 107. Of those 107 fish, one was originally stocked in 1994, three were stocked in 2000, nine were stocked in 2001, three were stocked in 2002, one was stocked in 2003, and the remaining 90 (84.11%) were stocked in 2004. Among the other ten fish, two had no detectable PIT tag at the time of recapture, two were accidentally dropped back into the river before the fish could be scanned for a PIT tag, and the original stocking information could not be located for the remaining six fish. Among the 117 razorback sucker captures on the fall 2004 Adult Monitoring trip, 16 were known males, 1 was a known female, and 100 were of indeterminate sex (Table 7).

Table 6. All known stockings (intentional or otherwise) of razorback sucker into either the San Juan River or the San Juan River arm of Lake Powell, 1994-2004.

Date(s) Stocked	River Miles Fish Were Stocked At	Number Of Fish Stocked	Mean Total Length (Range Of TL's)
Experimental Stocking Study, 1994-1996 (n = 940 Fish Stocked):			
29-30 March 1994	136.6-79.6	15	277 (251-316)
27 October 1994	136.6-79.6	16	403 (384-435)
16-17 November 1994	158.6-79.6	478	190 (100-374)
18 November 1994	158.6-79.6	178	400 (330-446)
27 September 1995	158.6	16	424 (397-482)
3 October 1996	158.6	237	335 (204-434)
Five-Year Augmentation Effort, 1997-2001 (n = 5,896 Fish Stocked):			
3 September 1997	158.6	1,027	193 (193-240)
17 September 1997	158.6	227	229
19 September 1997	158.6	1,631	185 (104-412)
22 April 1998	158.6	57	420 (380-460)
28 May 1998	158.6	67	417 (341-470)
14-15 October 1998	158.6	1,155	232 (185-315)
3 August 1999	170.8	Unknown[a]	Unknown[a]
17-20 October 2000	158.6	1,044	214 (111-523)
30 October to 1 November 2001	158.6	688	409 (288-560)
Interim Period Between "Official" Augmentation Efforts[b] In The San Juan River (n = 4,016 Fish Stocked):			
11 April 2002	178.2	13	137 (110-170)
22 April 2002	158.6	102	335 (240-470)
5-6 November 2002	158.6	25	351 (295-456)
14 April 2003	158.6	121	413 (341-491)
14-18 April 2003	158.6	70	380 (255-495)
19 May 2003	178.2	11	124 (100-150)
27-31 October 2003	158.6	685	309 (253-396)
12-16 April 2004	158.6	969	326 (280-480)
26 April 2004	158.6	311	366 (225-559)
12-16 July 2004	158.6	983	379 (295-540)
23 -27 August 2004	158.6	726	350 (235-510)
Known Stockings Of Razorback Sucker By Other Agencies Into The San Juan River Arm Of Lake Powell, 1995 (n = 164 Fish Stocked):			
8 August 1995	Piute Farms	65	405 (348-428)
15 August 1995	Piute Farms	65	409 (369-437)
1 November 1995	Lake Powell	34	446 (419-495)

a This was an unintentional stocking that occurred when unseasonably heavy rains caused the dike at Ojo Pond to wash out. The entire pond drained into Ojo Wash, with some fish eventually reaching the San Juan River, several miles downstream.

b "Official" augmentation efforts are those that are guided by approved razorback sucker augmentation plans. The first of these took place from 1997-2001. The second (scheduled to be eight years in duration) will likely begin in 2006 or 2007.

Table 7. Razorback sucker collected from the San Juan River on the fall 2004 Adult Monitoring trip (n = 117).

Date Of Recapture	PIT Tag Number	Total Length (in mm)	Weight (in g)	Sex[a]	Capture River Mile	Days In The River Since Stocking
09/20/2004	447A6E2E43	410	660	I	158.0	69
09/20/2004	4504173C1D	373	450	I	158.0	69
09/20/2004	436573293C	391	550	I	158.0	27
09/20/2004	4415201250	385	520	I	158.0	147
09/20/2004	4366047606	390	545	I	158.0	28
09/20/2004	4508730B41	415	715	I	158.0	68
09/20/2004	433F782651	370	605	I	158.0	28
09/20/2004	4368491D22	418	650	I	158.0	25
09/20/2004	43684A2D2C	415	620	I	158.0	28
09/20/2004	4472013B50	415	720	I	157.0	68
09/20/2004	436738737B	295	260	I	157.0	25
09/20/2004	43657B5410	410	550	I	157.0	28
09/20/2004	45036C7744	390	550	I	157.0	68
09/20/2004	4364414D24	402	540	I	157.0	28
09/20/2004	447F350C65	390	565	I	157.0	UNKNOWN[b]
09/20/2004	4504661F07	340	350	I	157.0	68
09/20/2004	4368432975	365	360	I	157.0	28
09/20/2004	43656F0760	391	570	I	157.0	28
09/20/2004	4369053E68	410	690	M	157.0	26
09/20/2004	434F2E5306	412	600	M	157.0	28
09/20/2004	450B16225A	405	600	I	157.0	68
09/20/2004	447E133939	400	610	I	157.0	69
09/20/2004	450745611C	392	620	I	157.0	68
09/20/2004	44741B7F44	375	550	I	157.0	68
09/20/2004	450406611D	429	750	I	155.0	68
09/20/2004	45033A0E43	365	410	I	155.0	69
09/20/2004	447153191E	344	320	I	155.0	69
09/20/2004	4471604779	365	440	I	155.0	69
09/20/2004	441B235455	407	580	I	155.0	147
09/20/2004	44747D4C33	368	400	I	155.0	69
09/20/2004	4365727573	426	670	I	155.0	25
09/20/2004	43672C1B27	388	505	I	155.0	27
09/20/2004	447416574E	352	375	I	155.0	68
09/20/2004	43644B0226	443	575	I	155.0	27
09/20/2004	4364480E09	439	660	I	155.0	28
09/20/2004	447D6C0234	417	700	I	155.0	69
09/20/2004	436865163F & 5326435E29[c]	434	730	M	155.0	28

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

b The original stocking data could not be found for this fish.

c This fish was accidentally implanted with a second PIT tag at the time of recapture.

Table 7. Continued.

Date Of Recapture	PIT Tag Number	Total Length (in mm)	Weight (in g)	Sex[a]	Capture River Mile	Days In The River Since Stocking
09/20/2004	43647F1635	408	570	I	155.0	28
09/20/2004	4369247460	294	235	I	155.0	26
09/20/2004	447B570911	386	550	I	155.0	68
09/20/2004	4479725706	410	710	I	154.0	68
09/20/2004	4503334132	425	770	M	154.0	68
09/20/2004	424015340B	501	1340	I	154.0	1058
09/20/2004	4369332E06	368	500	I	154.0	27
09/20/2004	4368732A19	405	540	I	154.0	28
09/20/2004	43687F750E	310	290	I	154.0	28
09/20/2004	423C62610A[b]	425	740	I	154.0	UNKNOWN
09/20/2004	43693F0C6A	436	860	M	152.6	28
09/20/2004	53256B3646	441	850	M	152.6	1433
09/20/2004	4508711B58	420	685	I	152.6	69
09/20/2004	423E7F7419	452	920	M	152.6	1055
09/20/2004	UNKNOWN[c]	410	580	I	152.0	UNKNOWN
09/20/2004	52283F3118	465	860	I	151.0	147
09/20/2004	43687D6C72	410	620	I	151.0	27
09/20/2004	4369192570	450	800	I	151.0	27
09/20/2004	4507633A36	540	1750	I	151.0	69
09/20/2004	4360211E1E	295	200	I	151.0	27
09/20/2004	43654A630F	455	950	I	151.0	28
09/20/2004	4366036029	375	485	I	151.0	28
09/20/2004	4504733615	415	620	I	151.0	68
09/20/2004	4503436F43	335	350	I	151.0	68
09/20/2004	436902115F	360	560	I	151.0	UNKNOWN[d]
09/20/2004	4474002C1C	405	590	I	151.0	69
09/20/2004	450C7B2A6A	441	755	I	151.0	68
09/20/2004	450B20441E	380	452	I	149.0	68
09/20/2004	450305670F	361	400	I	149.0	69
09/20/2004	441D402372	395	660	I	148.3	147
09/20/2004	5326004514	427	890	I	148.3	1431
09/20/2004	436550166E	397	550	I	148.3	26
09/21/2004	UNKNOWN[e]	UNKNOWN	UNKNOWN	I	146.0	UNKNOWN

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

b This fish did not have a detectable PIT tag at the time of recapture. It was implanted with a new PIT tag (listed here) before it was returned alive to the river.

c This fish was dropped back into the river before it could be scanned for a PIT tag.

d The original stocking data could not be found for this fish.

e This fish was dropped back into the river before it could be weighed, measured or scanned for a PIT tag.

Table 7. Continued.

Date Of Recapture	PIT Tag Number	Total Length (in mm)	Weight (in g)	Sex[a]	Capture River Mile	Days In The River Since Stocking
09/21/2004	423F1A4C28	461	920	I	143.0	1057
09/21/2004	4242373135	450	960	M	142.0	1056
09/21/2004	436858581A	367	455	I	139.0	27
09/21/2004	52283C6F04	386	605	I	136.0	146
09/21/2004	423F757F1C	455	880	I	133.3	1057
09/21/2004	45091E2E26	460	755	M	133.3	70
09/21/2004	4364454A25	408	640	I	133.3	UNKNOWN[b]
09/21/2004	423E7B2626	483	1210	M	133.3	1057
09/22/2004	52282D0F06	404	665	I	131.0	145
09/22/2004	5239356E26	462	950	I	128.0	527
09/22/2004	434F2C412B	385	520	I	127.0	29
09/22/2004	43650C3B44	379	505	I	124.0	29
09/22/2004	525B723609	394	695	I	119.2	UNKNOWN[b]
09/24/2004	42421B2941	499	1395	M	160.0	1058
09/24/2004	4420784343	396	710	I	160.0	151
09/24/2004	423F5D406A	474	915	I	160.0	1058
10/04/2004	451103420F	342	420	I	113.0	83
10/04/2004	441D566522	332	360	I	109.0	161
10/05/2004	426A1F5176	377	455	I	106.0	174
10/05/2004	43693E6A2A	399	635	I	104.0	43
10/05/2004	43654F6C5C	435	880	I	104.0	40
10/05/2004	44152A6D2F	401	560	I	103.0	172
10/05/2004	522A190457	425	760	I	103.0	897
10/05/2004	5228304134	442	960	M	103.0	897
10/05/2004	4269496E35	352	375	I	103.0	175
10/05/2004	447F29584F	438	850	M	101.0	84
10/05/2004	43654E4300	385	520	I	101.0	42
10/05/2004	4365554348	369	450	I	101.0	UNKNOWN[b]
10/05/2004	1F4143510C	520	1480	F	101.0	3609
10/05/2004	434F20702E	457	850	I	100.0	UNKNOWN[b]
10/05/2004	5325740172	569	1130	M	98.0	1446
10/06/2004	441D47D403	381	670	I	94.0	163
10/06/2004	44210A180C	382	640	M	92.0	163
10/06/2004	447C366023	439	825	I	86.0	84
10/06/2004	447C421205	379	535	I	85.0	84
10/06/2004	44792F1204	342	370	I	83.0	85
10/06/2004	45127B722C	433	830	I	82.2	84
10/07/2004	4269011E07	374	430	I	80.0	177
10/08/2004	423F713022	458	1050	M	72.0	1072
10/09/2004	4366014F06	395	545	I	57.0	45
10/09/2004	44172E621F	398	580	I	51.0	172

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

b The original stocking data could not be found for this fish.

Table 7. Continued.

Date Of Recapture	PIT Tag Number	Total Length (in mm)	Weight (in g)	Sex[a]	Capture River Mile	Days In The River Since Stocking
10/10/2004	4365692B54[b]	322	225	I	43.0	47
10/12/2004	426A2C705E	475	1150	I	16.0	707
10/13/2004	52291A1936	390	550	I	9.0	UNKNOWN[c]
10/13/2004	4368616D66	379	500	I	7.0	50
10/13/2004	442075401B	395	600	I	5.6	170
10/13/2004	45081F4C18	401	1000	I	2.9	92

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

b This fish had large semi-circular bite marks across the dorsal keel area and around its head. It had been bitten at least twice by an adult channel catfish and was in very poor health when it was recaptured. There was a good possibility this fish would become a delayed mortality.

c This fish did not have a detectable PIT tag at the time of recapture. It was implanted with a new PIT tag (listed here) before it was returned alive to the river.

Population Trends

In contrast to the marked increases in total CPUE observed for stocked Colorado pikeminnow in 1997 and 1998 (Figure 2), total CPUE for stocked razorback sucker remained fairly low, but steady between 1996 and 2000 (Figure 4). Then, between 2000 and 2002, razorback sucker total CPUE increased slightly on fall Adult Monitoring trips. Then between the fall 2002 fall 2003 Adult Monitoring trips, razorback sucker CPUE showed a slight decline (Figure 4). This decline may be linked to the large volume, storm-induced flow spike that occurred in September 2003, just prior to the fall 2003 Adult Monitoring trip.

On the fall 2004 Adult Monitoring trip, total CPUE for razorback sucker (1.44 fish/hr of electrofishing) was considerably higher than it had been in any previous year (Figure 4). Total CPUE for razorback sucker on the fall 2004 Adult Monitoring trip was 1.44 fish/hr of electrofishing from RM 180.0-2.9. This value was over five times higher than any previously observed value on an Adult Monitoring trip. This upswing in CPUE was almost equally split between collections of juvenile and adult fish (Figure 4).

Between the fall 2004 Adult Monitoring trip (n = 107; Table 7) and the April 26-30, 2004 razorback sucker monitoring trip (n = 56; Ryden 2005b), a total of 163 razorback sucker with known stocking dates were recaptured. The 56 razorback sucker with known stocking dates recaptured on the April 26-30 2004 razorback sucker monitoring trip had been in the river from 0-736 days post-stocking (Ryden 2005b). The 107 razorback sucker with known stocking dates recaptured on the fall 2004 Adult Monitoring trip had been in the river from 25-3,609 days post-stocking. By far the large majority of razorback sucker (133 {81.6%} out of these 163 fish with known stocking dates) recaptured on either of these monitoring trips were fish that had been stocked within the last 200 days prior to sampling (Table 7, Figure 5; Ryden 2005b).

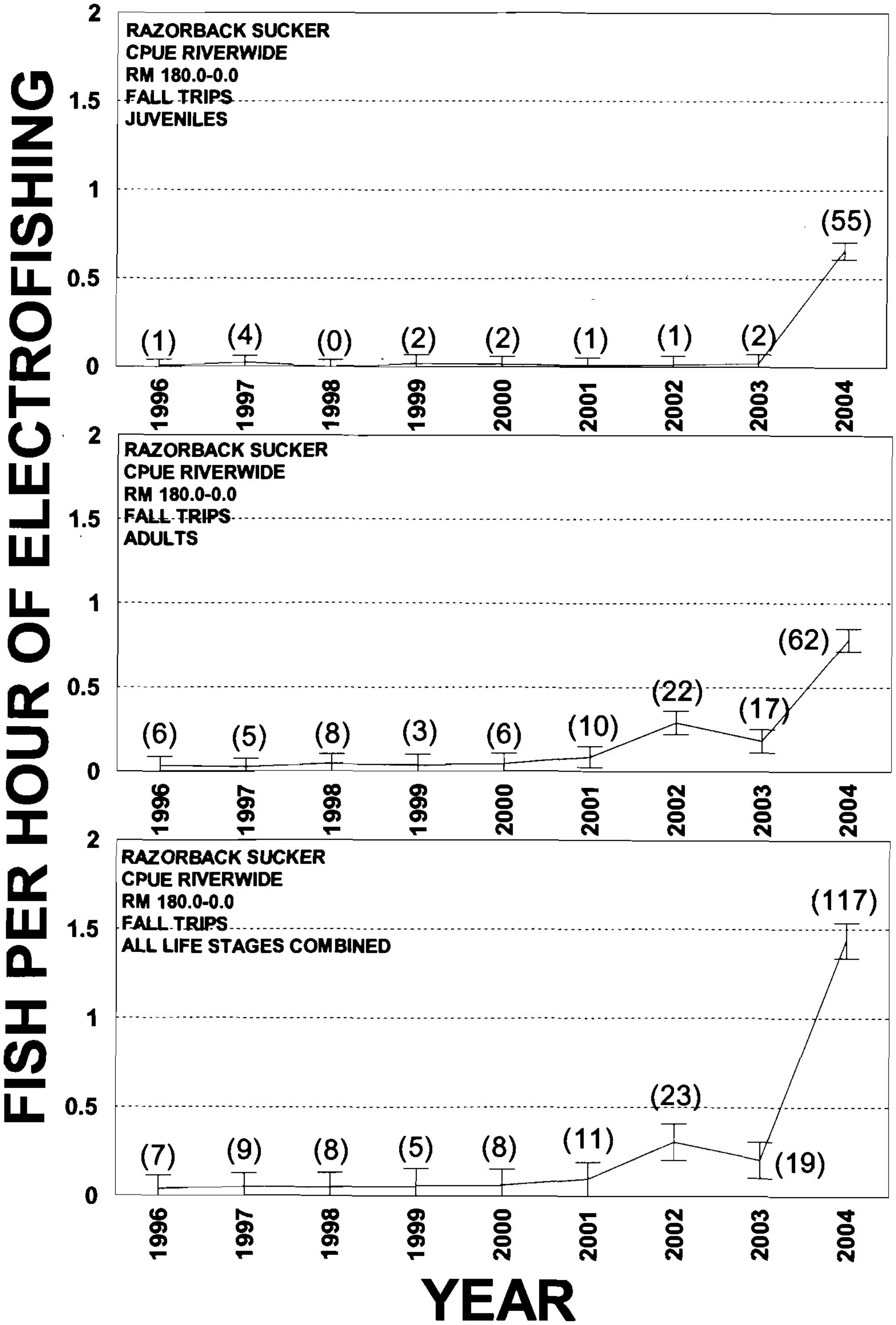

Figure 4. Razorback sucker catch per unit effort (CPUE) riverwide (RM 180.0-0.0) on fall Adult Monitoring trips, for juvenile fish (< 400 mm TL; top), adult fish (≥ 400 mm TL; middle), and for all life stages combined (juveniles + adults; bottom). Error bars represent one standard error. Parenthetic numbers above or beside the error bars indicate the sample size.

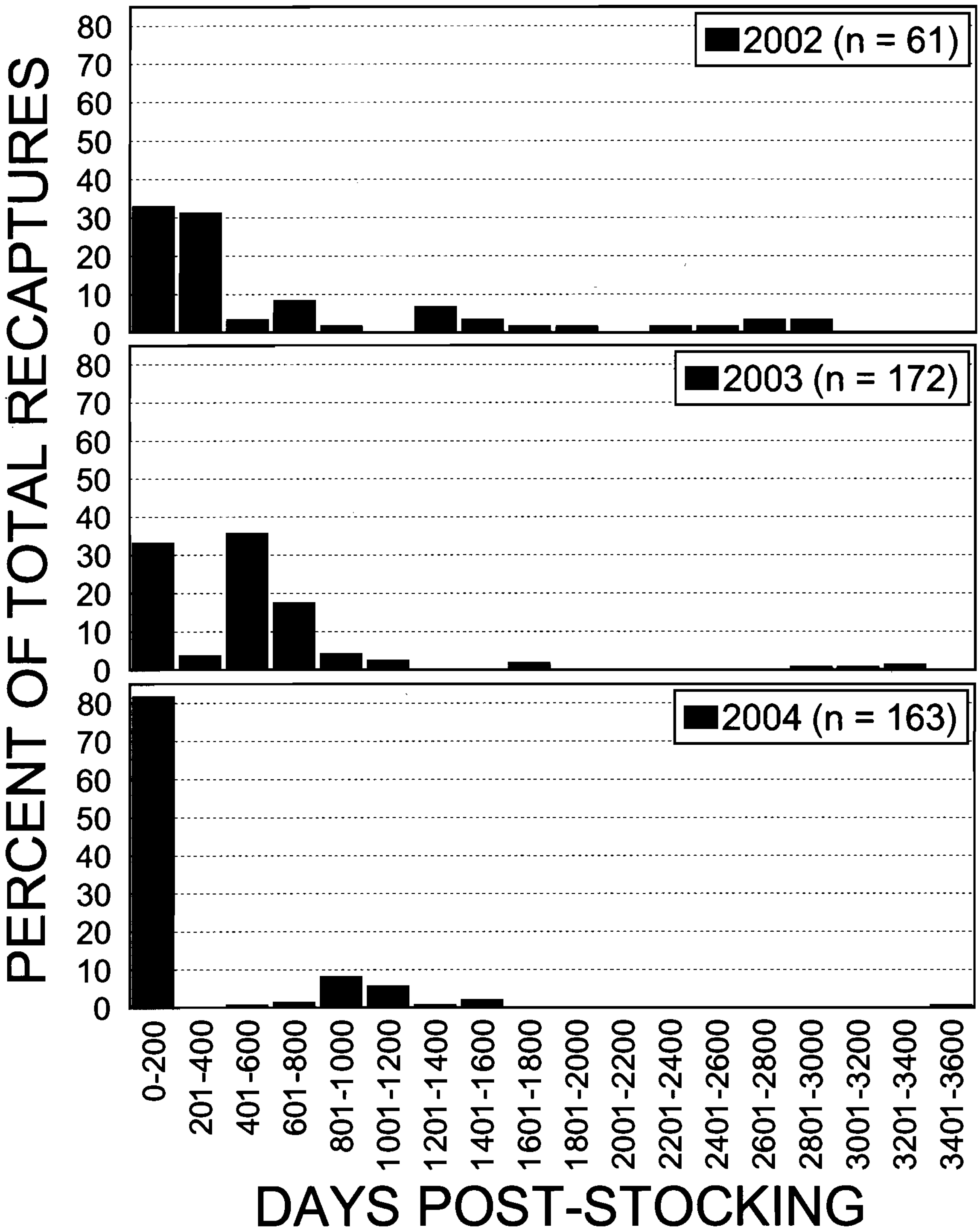

Figure 5. A measure of longevity among stocked fish in the San Juan River razorback sucker population, expressed as the number of days in the river since stocking versus the percent of total recaptures represented by recaptured fish, in 2002 (top), 2003 (middle), and 2004 (bottom). Some recaptures could not be used in this analysis due to lack of a detectable PIT tag at the time of recapture.

As was the case in 2002 and 2003, the majority of razorback sucker recaptured in 2004 were fish that had been stocked in the relatively recent past (Figure 5; Ryden 2005b). However, unlike 2002, there were very few individual razorback sucker collected in 2003 and 2004 that had been resident in the San Juan River for > 1200 days post-stocking (n = 5 fish in 2004; Figure 5). While fish from several different stocking events were collected during both the April 26-30 2004 razorback sucker monitoring trip and the fall 2004 Adult Monitoring trip, all but one of the 163 fish with known stocking dates had been stocked within the last four calendar years. This trend away from the apparent long-term recapture/retention of older stocked razorback sucker (i.e., those that have been in the river > 1200 days post-stocking) is somewhat disconcerting.

In light of this information, it appears that the recent increases in razorback sucker CPUE (Figure 4) are based almost completely on recently-stocked fish (Figure 5). It now appears that stocked razorback sucker may not be surviving/retaining in the San Juan River in any appreciable numbers past about four years post-stocking. It also appears as if the large majority of the older fish (i.e., those stocked in the 1990's) may now absent from the San Juan River razorback sucker population.

Spawning Aggregations

Although it was not documented during the fall 2004 Adult Monitoring trip, a single suspected spawning aggregation of razorback sucker was identified in the San Juan River during 2004 (Ryden 2005b). On 26 April 2004 two ripe adult razorback sucker were collected at RM 154.27 on river left (Table 3). One was a female (497 mm TL, 1390 g) and the other was a male (455 mm TL, 950 g). Both fish were freely expressing gametes (i.e., ripe) at the time of collection. The collection of an adult female razorback sucker that is freely expressing gametes is very rare in the San Juan River and is usually indicative that spawning is taking place at the time and site of collection, thus the labeling of this site as a suspected spawning location. These two fish were collected less than ten feet apart from one another in the midst of numerous ripe, presumably-spawning flannelmouth sucker over a shallow cobble bar (< 2 feet deep) at the upstream mouth of a long secondary channel. The water temperature was 17^{o}C at the site at the time of collection (i.e., ~5:30 PM). Substrate at the site ranged from small cobbles to pea-sized gravel.

These two fish had been stocked on two different stocking dates, the female having been stocked on 18 October 2000 at RM 158.6, and the male having been stocked on 31 October 2001 at RM 158.6. The female had been in the river for 1286 days post-stocking, while the male had been in the river for 908 days post-stocking. As has been observed in past years, fish from temporally-separated stockings appear to have located one another and suitable habitat for spawning (Ryden 2005b).

In contrast to past years, the 2004 spawning aggregation did not take place on the ascending limb of the 2004 spring hydrograph. Rather, it occurred at almost the bottom of a trough between two distinct peaks of a relatively low-volume spring hydrograph. The first peak occurred on 5 April 2004 when flows in the river reached 4,760 CFS (as measured at the Shiprock USGS gage, # 09368000). Flows then dipped to a low trough of 949 CFS on 27 April 2004 (the spawning aggregation was documented the day before this low flow). Then flows rose again to 3,560 CFS on 11 May 2004. With one exception (i.e., the spring 2002 razorback sucker spawning aggregation at Slickhorn Rapid, which occurred at a base flow; Ryden 2004) razorback sucker spawning aggregations that were documented in past years (i.e., 1997, 1999, 2001) have occurred on a distinctly ascending limb of the spring hydrograph.

Roundtail Chub

2004 Collections

No roundtail chub were collected during the fall 2004 Adult Monitoring trip.

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 in the San Juan River. Collections of roundtail chub in the San Juan River, when they do occur, tend to be concentrated mostly in areas downstream of the LaPlata and Mancos river confluences (Ryden 2004). These two small rivers, along with the Animas River, are the only three tributaries of the San Juan River that are known to have resident populations of roundtail chub (Miller and Rees 2000). The large majority of the roundtail chub collections between 1987 and 2003 consisted of subadult fish (Ryden 2004).

Between 1991 and 2003, a total of 25 roundtail chub (TL range = 116-414 mm) were implanted with PIT tags (SJRIP Integrated Database). Of these 25, only three individuals were recaptured a second time after their initial capture and release (Ryden 2004).

The dearth of adult roundtail chub in the San Juan River, combined with a lack of recaptures among PIT-tagged fish over time, and the fact that most roundtail chub captures in the mainstem San Juan River occur downstream of major tributaries known to have resident populations of roundtail chub, would seem to suggest that the roundtail chub being collected in the mainstem San Juan are only transient members of the mainstem river's fish community. It seems very 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

Flannelmouth Sucker

Catch Per Unit Effort (CPUE)

Flannelmouth sucker continue to be the most common large-bodied fish collected riverwide during Adult Monitoring trips (Table 3, Figure 6; Ryden 2000, 2001, 2003a, 2004). While numbers of this fish have fluctuated both riverwide and in individual geomorphic reaches over the years, flannelmouth sucker have remained numerically dominant in both overall numbers of specimens collected and in frequency of occurrence in electrofishing samples (Table 3, Figure 6; Ryden 2000, 2001, 2003a, 2004).

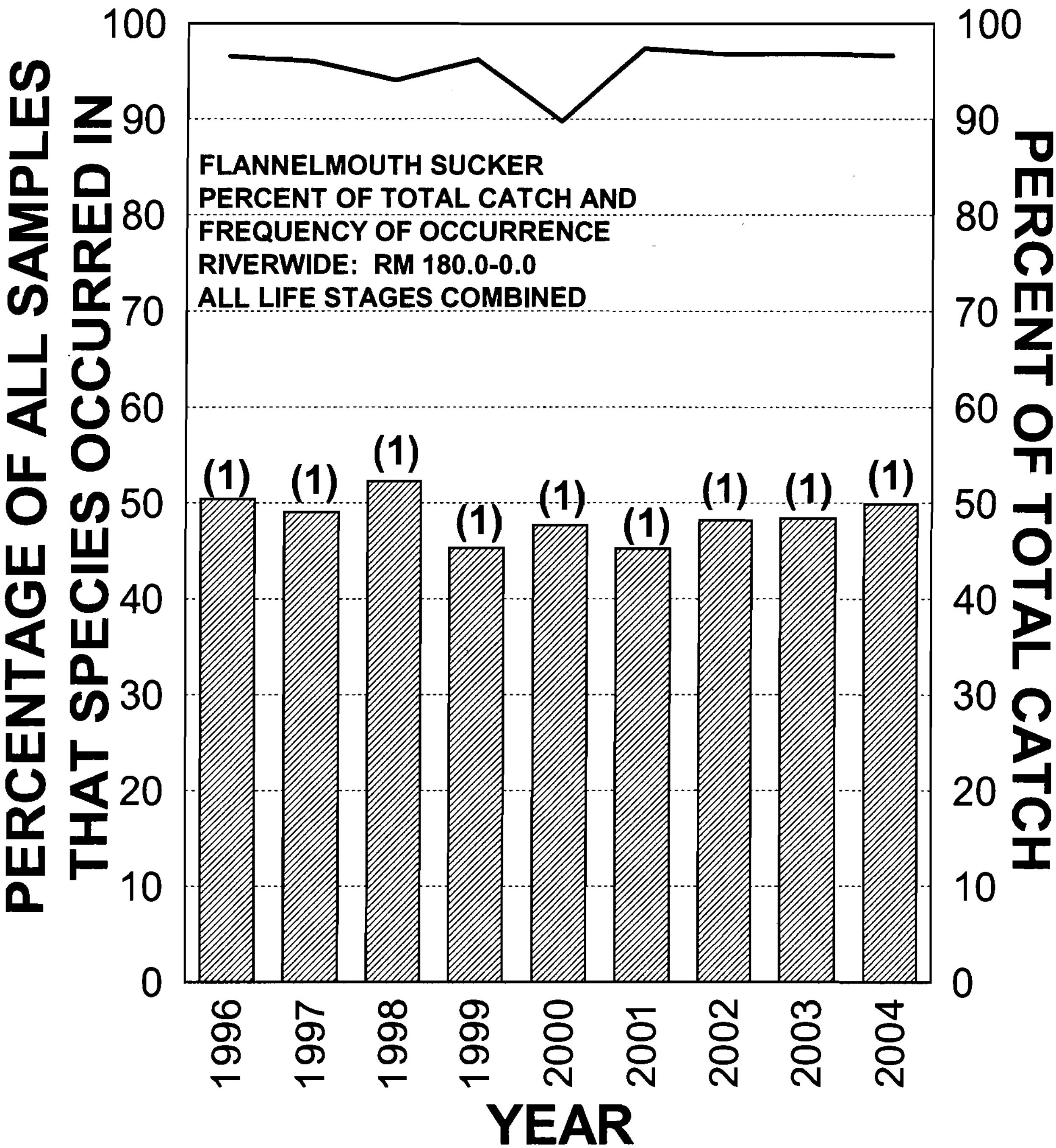

Figure 6. A summary of flannelmouth sucker relative abundance in riverwide Adult Monitoring collections, 1996-2004. The solid black line represents the percentage of all electrofishing samples on a given Adult Monitoring trip in which this species occurred (i.e., frequency of occurrence). The shaded bars represent the percent of the total catch that this species composed in a given year. The parenthetic numbers indicate the numeric rank for this species in a given year relative to all other fish species collected.

Riverwide (RM 180.0-0.0) CPUE for juvenile flannelmouth sucker almost doubled between 2003 and 2004 (Figure 7). Riverwide CPUE for juvenile flannelmouth sucker was 41.08 fish/hr. This was the second highest observed riverwide CPUE among juvenile flannelmouth sucker (juvenile CPUE riverwide in 2000 was 41.90 fish/hr) in the last nine years (Figure 7). However, the long-term trend line for juvenile flannelmouth sucker riverwide CPUE over the last nine years remained almost completely flat, indicating that despite year-to-year fluctuations, this portion of the flannelmouth sucker population has remained relatively stable over that nine-year period. Likewise, riverwide CPUE for adult flannelmouth sucker also was higher in 2004 than in 2003, although it was lower in 2004 than in several previous years (Figure 7). As was the case among juvenile fish, the long-term trend line for riverwide CPUE among adult flannelmouth sucker remained essentially flat over the last nine years (Figure 7). Likewise, despite a marked increase between 2003 and 2004 (from 43.10 fish/hr to 67.49 fish/hr), the long-term trend line for flannelmouth sucker total CPUE riverwide is also essentially flat over the last nine-year period (Figure 7).

Flannelmouth sucker total CPUE was up in all six Reaches in 2004, compared to 2003 (Figures 8-10), but with the exception of Reach 6, none of these increases was statistically significant. Discerning meaningful trends in CPUE among flannelmouth sucker becomes more difficult when data are partitioned at the geomorphic reach level. However, two general pieces of information are evident. First, flannelmouth sucker are most abundant in Reach 6 and CPUE values generally drop in each subsequent downstream reach (although CPUE values in Reaches 5-3 are very similar to one another) until, in Reach 1 adjacent to Lake Powell, very few flannelmouth sucker are collected (Figures 8-10). Second, flannelmouth sucker CPUE values from reaches that were sampled in their entirety from 1991-2004 (i.e., Reaches 5, 4, and 3) would seem to indicate that riverwide CPUE values for this species were likely higher in the early 1990's (i.e., 1991-1993) than they have been over the last 11-year period (1994-2004; Figures 8-10). The lack of early 1990's data in Reaches 6, 2, and 1 likely is giving us a somewhat skewed interpretation of the longer-term (1991-2004) trends among the San Juan River flannelmouth sucker population. While it is evident that overall numbers of fish in the San Juan River flannelmouth sucker population have been relatively stable riverwide since 1996 (Figure 7), it also appears that this population is stable at a lower overall population size than what was present in the early 1990's (1991-1993; Figures 8-10).

<u>Length Frequency And Mean Total Length</u>

Riverwide length-frequency histograms show that two distinct year-classes of young flannelmouth sucker were present in fall 2004 Adult Monitoring collections. One group (age-0 fish) was centered around 76-100 mm TL (Figure 12). The second group (likely age-1 fish) was centered around 126-175 mm TL (Figure 12). In addition, the group of large sub-adult flannelmouth sucker that were centered around 376-400 mm TL in 2003 appear to have entered the adult population (Figure 12). In 1999, the San Juan River flannelmouth sucker population was heavily dominated by adult fish with a relatively low percentage of young fish (< 350 mm TL) being collected (Figure 11). However, since 1999, there have been three observable pulses of young fish into the San Juan River flannelmouth sucker population (in 2000, 2003, and 2004; Figures 11 and 12).

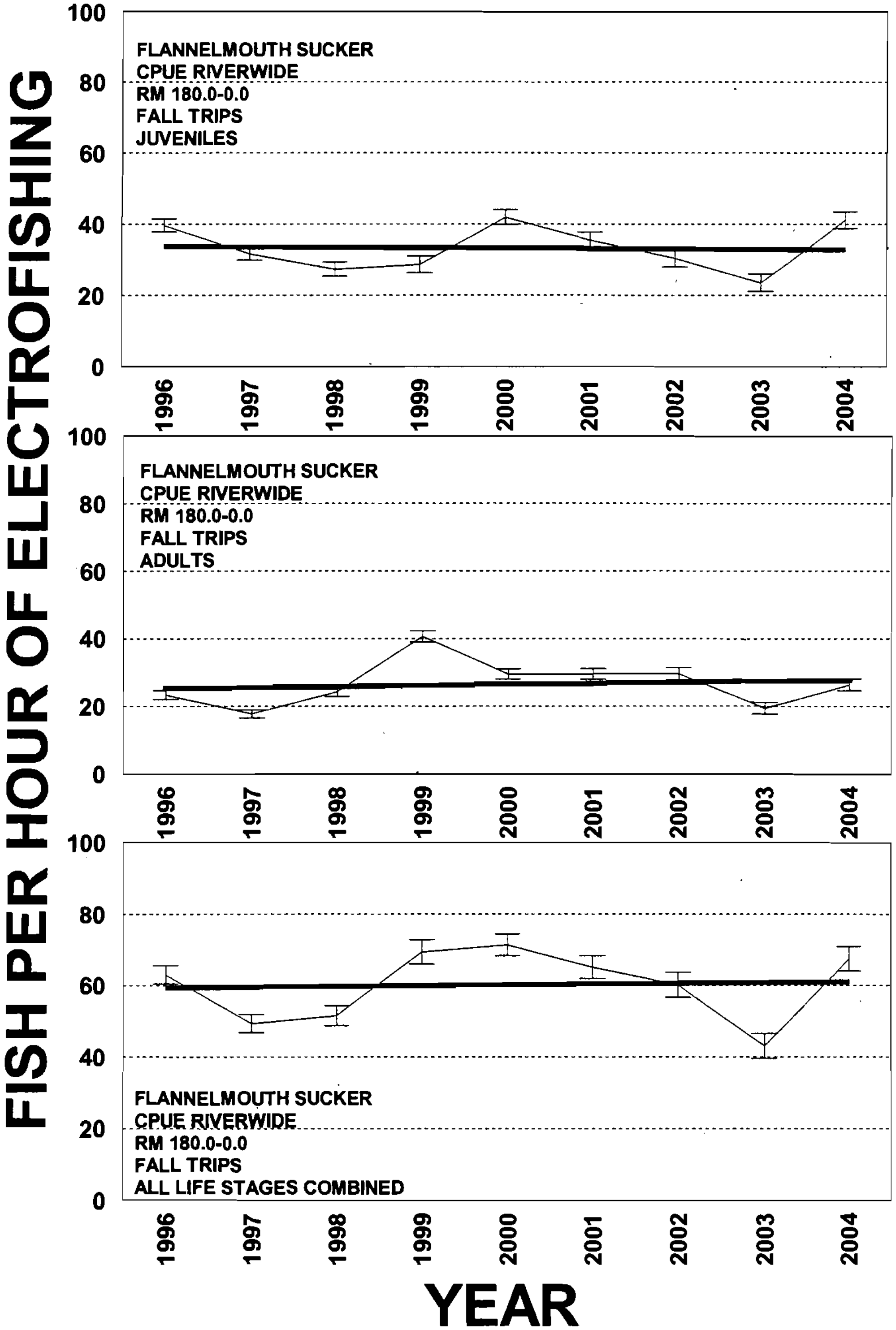

Figure 7. Flannelmouth sucker catch per unit effort (CPUE) riverwide (RM 180.0-0.0) on fall Adult Monitoring trips, for juvenile fish (< 410 mm TL; top), adult fish ($\geq$ 410 mm TL; middle), and for all life stages combined (juveniles + adults; bottom). Error bars represent one standard error. Sloping horizontal lines represent the long-term trend in CPUE.

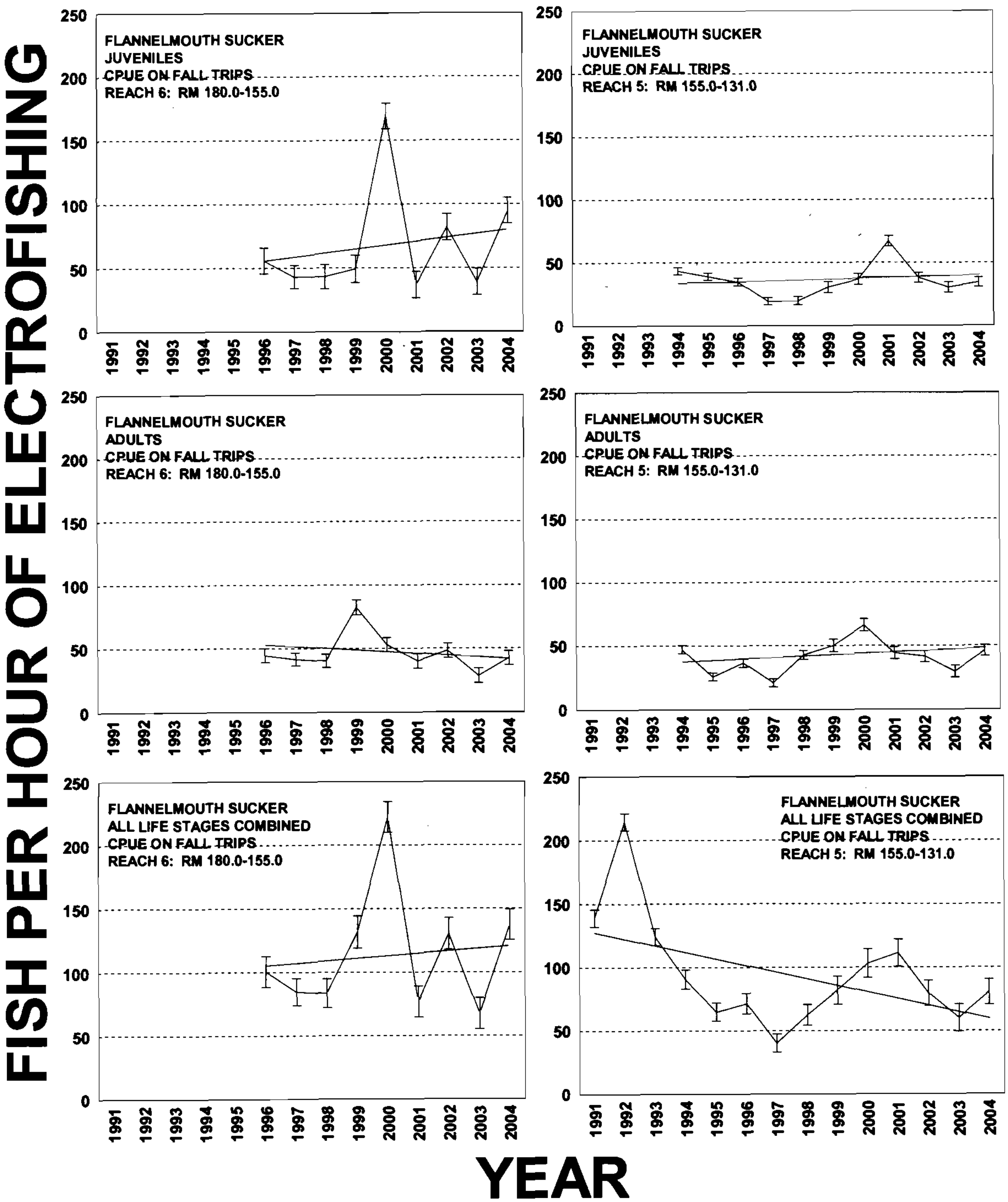

Figure 8. Flannelmouth sucker catch per unit effort (CPUE) in Reach 6 and Reach 5 on fall Adult Monitoring trips for juvenile fish (< 410 mm TL; top), adult fish (≥ 410 mm TL; middle), and for all life stages combined (juveniles + adults; bottom). Error bars represent one standard error. Sloping horizontal lines represent the long-term trend in CPUE.

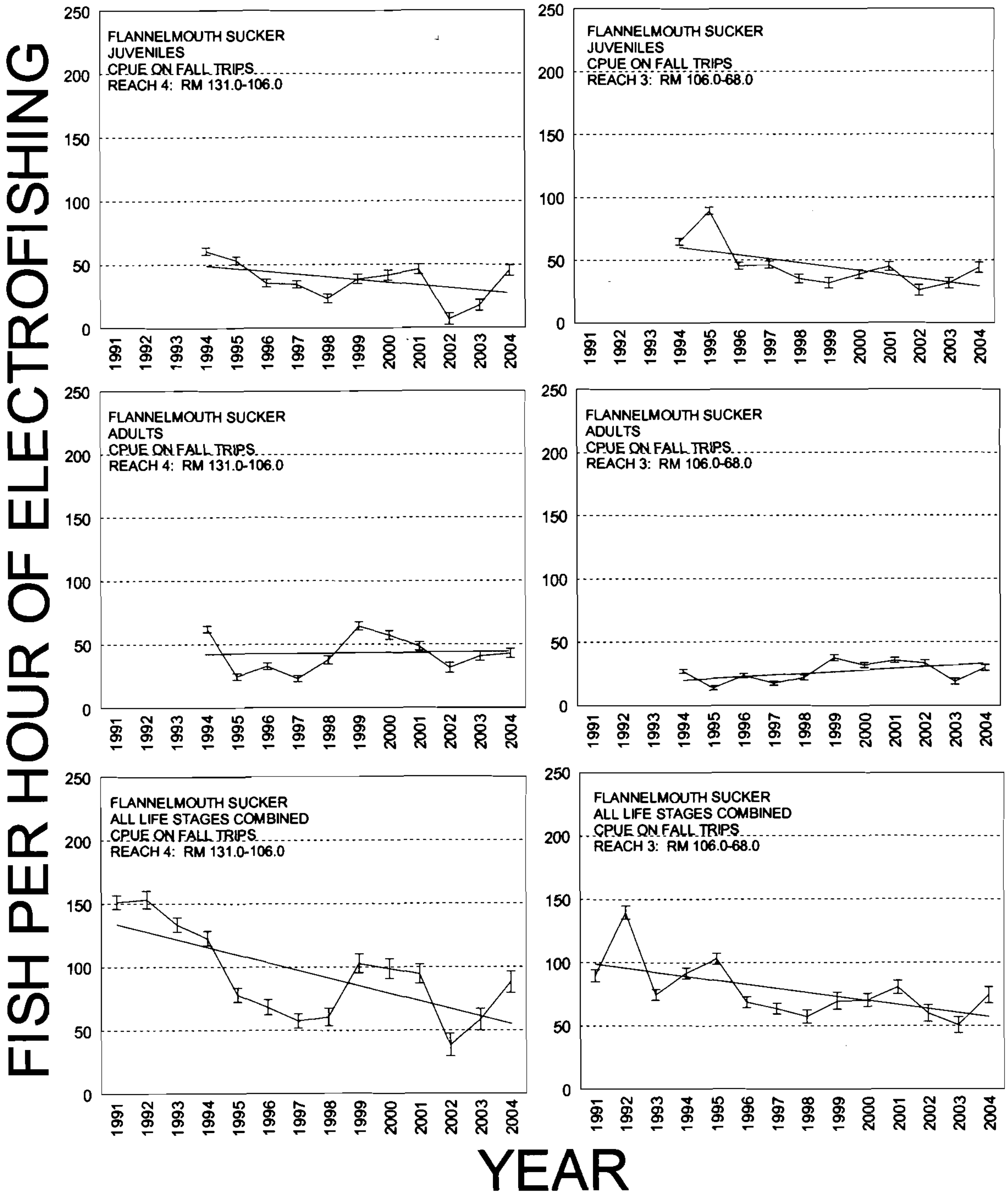

Figure 9. Flannelmouth sucker catch per unit effort (CPUE) in Reach 4 and Reach 3 on fall Adult Monitoring trips for juvenile fish (< 410 mm TL; top), adult fish (≥ 410 mm TL; middle), and for all life stages combined (juveniles + adults; bottom). Error bars represent one standard error. Sloping horizontal lines represent the long-term trend in CPUE.

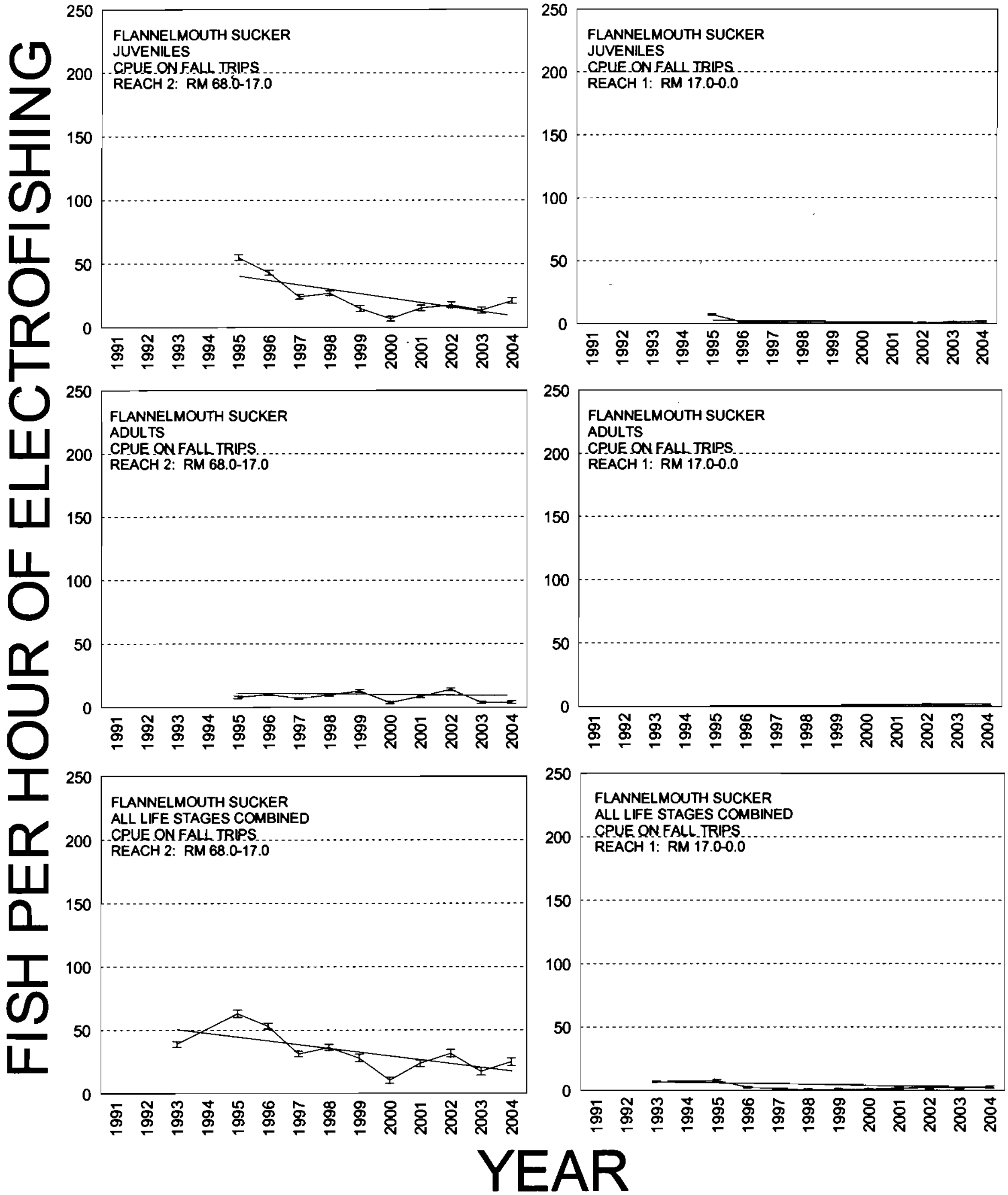

Figure 10. Flannelmouth sucker catch per unit effort (CPUE) in Reach 2 and Reach 1 on fall Adult Monitoring trips for juvenile fish (< 410 mm TL; top), adult fish (≥ 410 mm TL; middle), and for all life stages combined (juveniles + adults; bottom). Error bars represent one standard error. Sloping horizontal lines represent the long-term trend in CPUE.

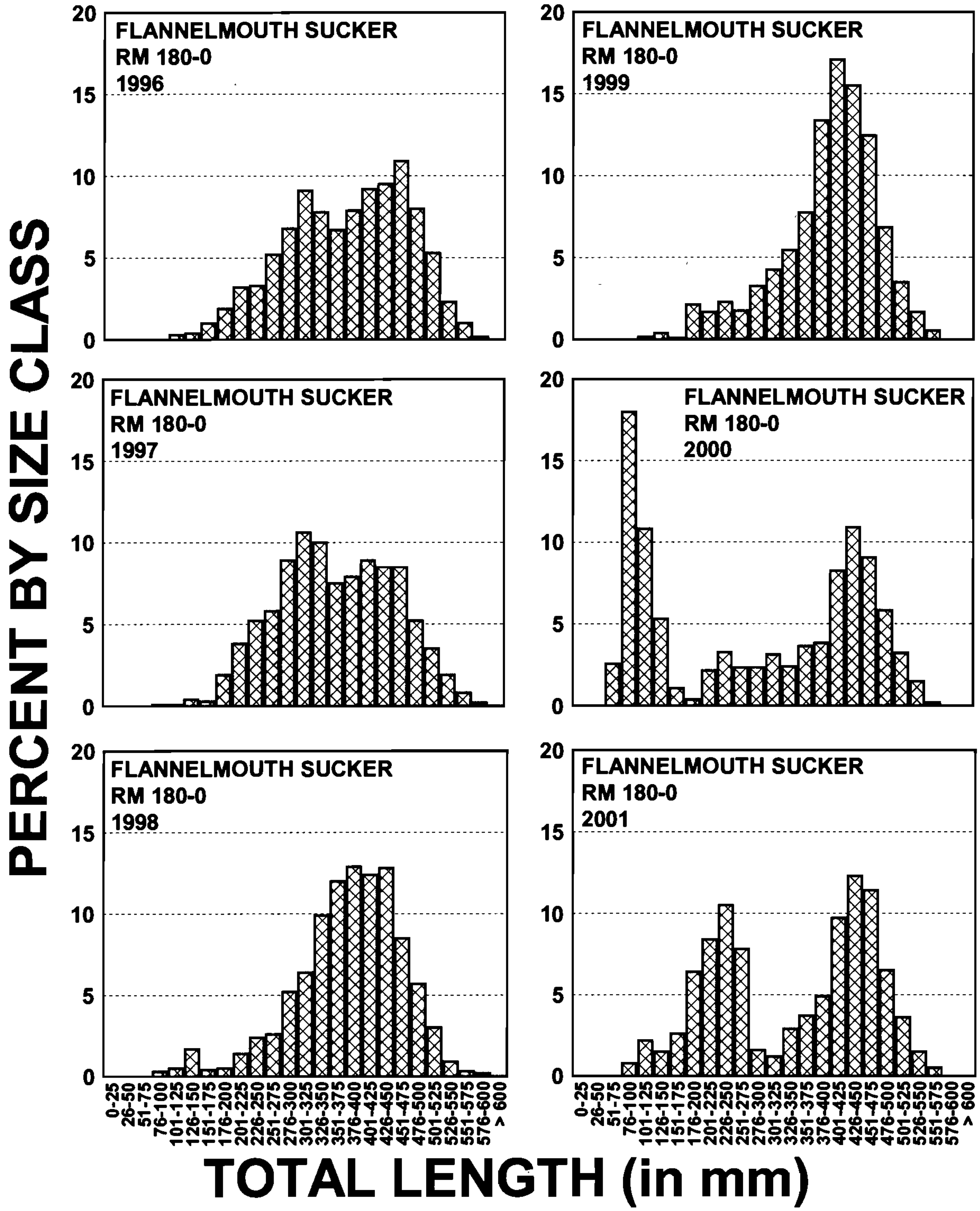

Figure 11. Length-frequency histograms showing the riverwide (RM 180.0-0.0) size-class distribution of flannelmouth sucker on fall Adult Monitoring trips in the San Juan River, 1996-2001.

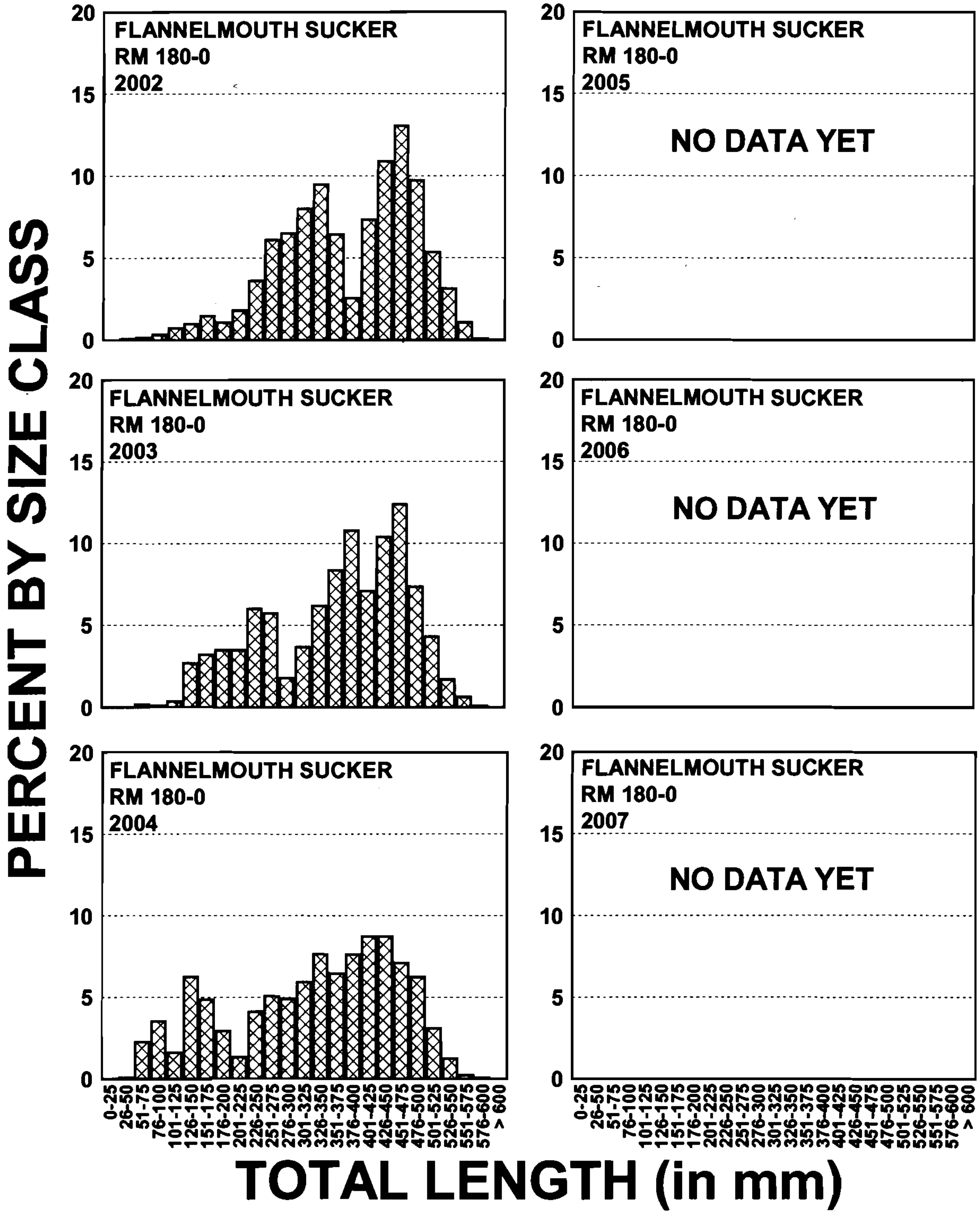

Figure 12. Length-frequency histograms showing the riverwide (RM 180.0-0.0) size-class distribution of flannelmouth sucker on fall Adult Monitoring trips in the San Juan River, 2002-2004.

As was evidenced by the length-frequency histograms, flannelmouth sucker mean TL values riverwide (for all life stages combined) increased markedly between 1996 and 1999 (Figure 10). Mean TL for flannelmouth sucker then dropped markedly riverwide in 2000 due to the large influx of age-0 juveniles (Figure 13). The increase in mean TL of flannelmouth sucker riverwide between 2000 and 2002 (Figure 13), tracks right along with the 2000 year-class attaining larger sizes and beginning to recruit (Figures 11 and 12). Then, in 2003 and again in 2004, mean TL of flannelmouth sucker riverwide dropped markedly again new cohorts of young fish entered the population (Figures 12 and 13).

Biomass

Flannelmouth sucker mean biomass (weight in grams) riverwide tracks almost identically with riverwide mean total length (Figures 13 and 14). In years when influxes of smaller size-class flannelmouth sucker cause a decline in the mean riverwide total length (e.g., in 2000, 2003, and 2004), the mean biomass also declines (Figure 14). However, while the long-term trend in flannelmouth sucker mean total length over the last nine years shows a marked declining trend, the long-term trend in flannelmouth sucker mean biomass is slightly increasing over that same time period.

Total biomass of flannelmouth sucker collected on the fall 2004 Adult Monitoring trip was 29.79 kg per hour of electrofishing (Figure 14). This is a very intermediate value, compared to other recent years. Total biomass of flannelmouth sucker collected has normally been in the range of 20.00-40.00 kg per hour of electrofishing on fall Adult Monitoring trips over the last nine years (Figure 14).

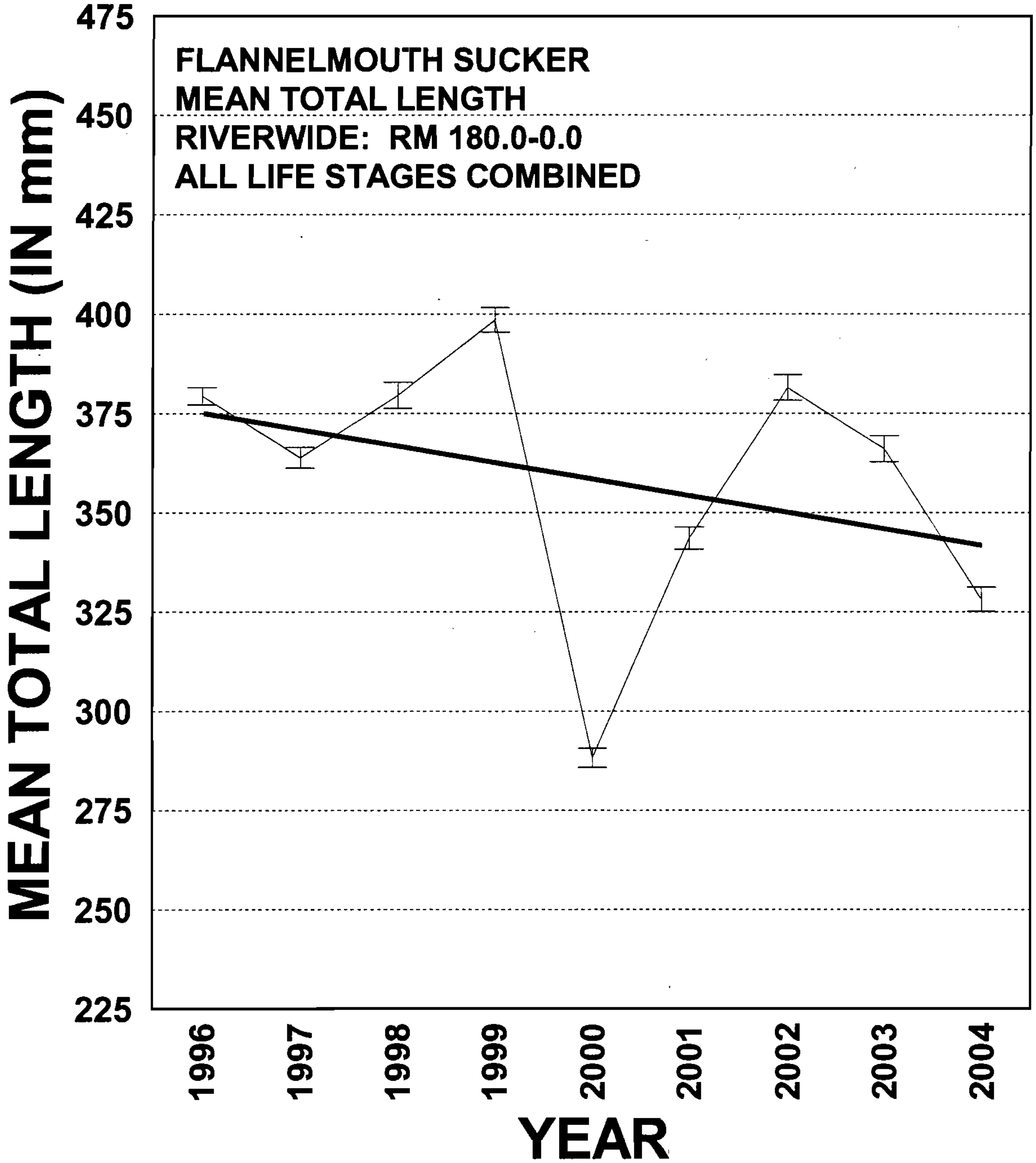

Figure 13. Mean total length (in mm) of flannelmouth sucker riverwide (RM 180.0-0.0) on fall Adult Monitoring trips in the San Juan River. Error bars represent one standard error. The sloping horizontal line represents the long-term trend in mean total length.

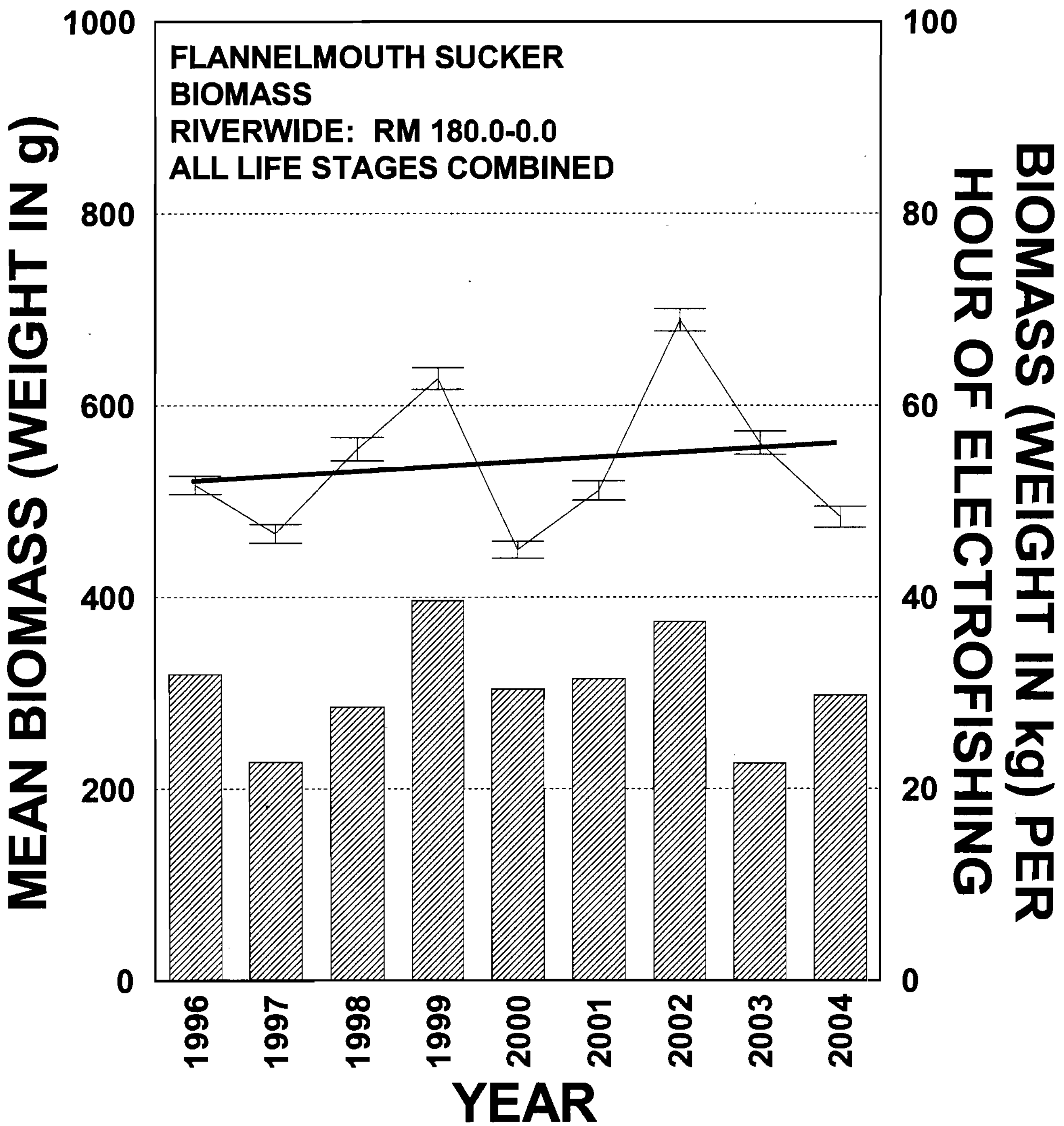

Figure 14. Mean biomass (weight in g; line connecting error bars) and total biomass (weight in kg; cross-hatched vertical bars) per hour of electrofishing of flannelmouth sucker riverwide (RM 180.0-0.0) on fall Adult Monitoring trips in the San Juan River. Error bars represent one standard error. The sloping horizontal line represents the long-term trend in mean biomass.

Bluehead Sucker

Catch Per Unit Effort (CPUE)

Since 1997, bluehead sucker have been among the four most commonly-collected large-bodied fish species during the Adult Monitoring collections (Table 3, Figure 15). In the last three years (2002-2004) bluehead sucker have been the second most commonly-collected fish species overall during fall Adult Monitoring collections (Table 3, Figure 15). While bluehead sucker have rarely accounted for more than 20% of the total catch on Adult Monitoring trips over the last nine years (1996-2004), they have become more widely distributed throughout the San Juan River since 2002 (Figure 15). In fact, on the fall 2004 Adult Monitoring trip, bluehead sucker occurred in 96.61% of all electrofishing sample riverwide (Figure 15).

Long-term trends in juvenile, adult, and total CPUE values for bluehead sucker riverwide all showed increasing trends between 1996 and 2004 (Figure 16). However, the only statistically significant changes between 1996 and 2004 bluehead sucker riverwide CPUE values occurred among juvenile and total CPUE ($p = 0.044$ and 0.046, respectively; Figure 16). The increasing long-term trend in juvenile and total CPUE among bluehead sucker that has been observed over the last nine years (1996-2004) is mainly being driven by increasing CPUE trends among juvenile bluehead sucker in Reaches 6 and 2 (Figures 16, 17, and 19).

The San Juan River bluehead sucker population, within our study area, is largely centered in Reach 6 (Figure 17-19). In Reach 6, bluehead sucker are very often the most common large-bodied fish species collected. Total CPUE for bluehead sucker in Reach 6 is very unpredictable, demonstrating large up- and downswings between years in both juvenile and adult CPUE. It is very possible that numbers of bluehead sucker in Reach 6 are heavily affected on an annual basis by either immigration of fish from or emigration of fish to upstream river reaches and/or the Animas River. Collections of bluehead sucker are over twice as common (and in some years much higher than that) in Reach 6 as in adjacent Reach 5 downstream and the differential increases dramatically versus river reaches even further downstream (Figures 17-19). Even more so than flannelmouth sucker, bluehead sucker CPUE declines noticeably in each contiguous downstream river reach (Figures 17-19).

In 2005, total CPUE for bluehead sucker increased slightly in Reaches 6, 4, 3, and 2 over 2003 CPUE values (Figures 17-19). Also in 2004, bluehead sucker were collected in Reach 1 adjacent to Lake Powell for the second straight year ($n = 1$ adult fish and 1 juvenile fish in 2003; $n = 2$ juvenile fish in 2004). Prior to 2003, bluehead sucker had never been collected in Reach 1 on an Adult Monitoring trip.

Length Frequency And Mean Total Length

The 2004 riverwide length-frequency histogram for bluehead sucker showed two distinct cohorts of young juveniles (Figure 21). The first group, centered around 176-200 mm TL, were age-1 fish spawned in 2003 (Figure 21). The second group, centered around 76-100 mm TL, were age-0 fish spawned in 2004 (Figure 21). Length-frequency histograms show that over the last five years, there have been regular influxes of young fish into the San Juan River bluehead sucker population. These influxes occurred in 2000, 2002 (as evidenced by the age-1 fish collected in 2003), 2003 and 2004 (Figures 20 and

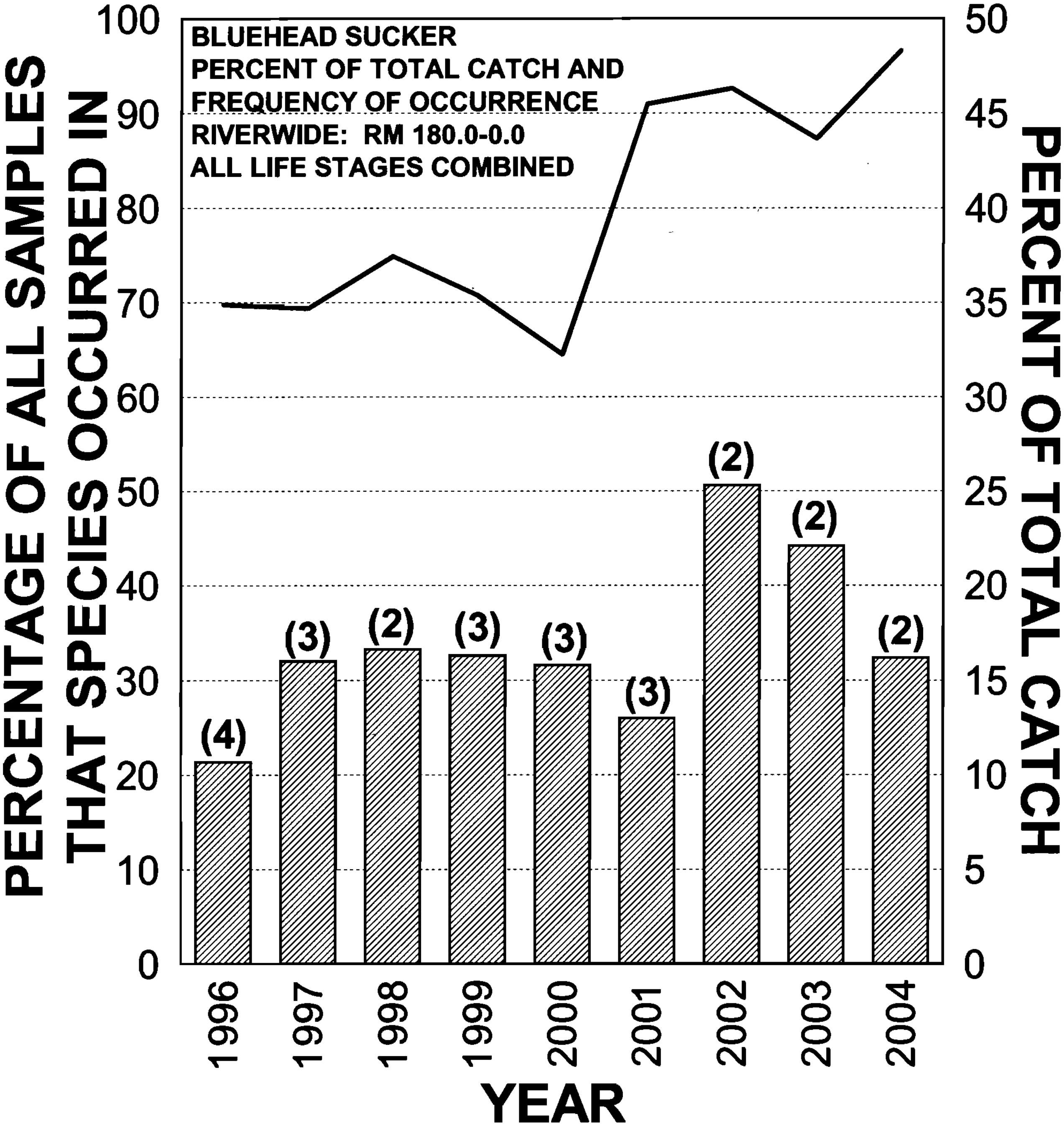

Figure 15. A summary of bluehead sucker relative abundance in riverwide Adult Monitoring collections, 1996-2004. The solid black line represents the percentage of all electrofishing samples on a given Adult Monitoring trip in which this species occurred (i.e., frequency of occurrence). The shaded bars represent the percent of the total catch that this species composed in a given year. The parenthetic numbers indicate the numeric rank for this species in a given year relative to all other fish species collected.

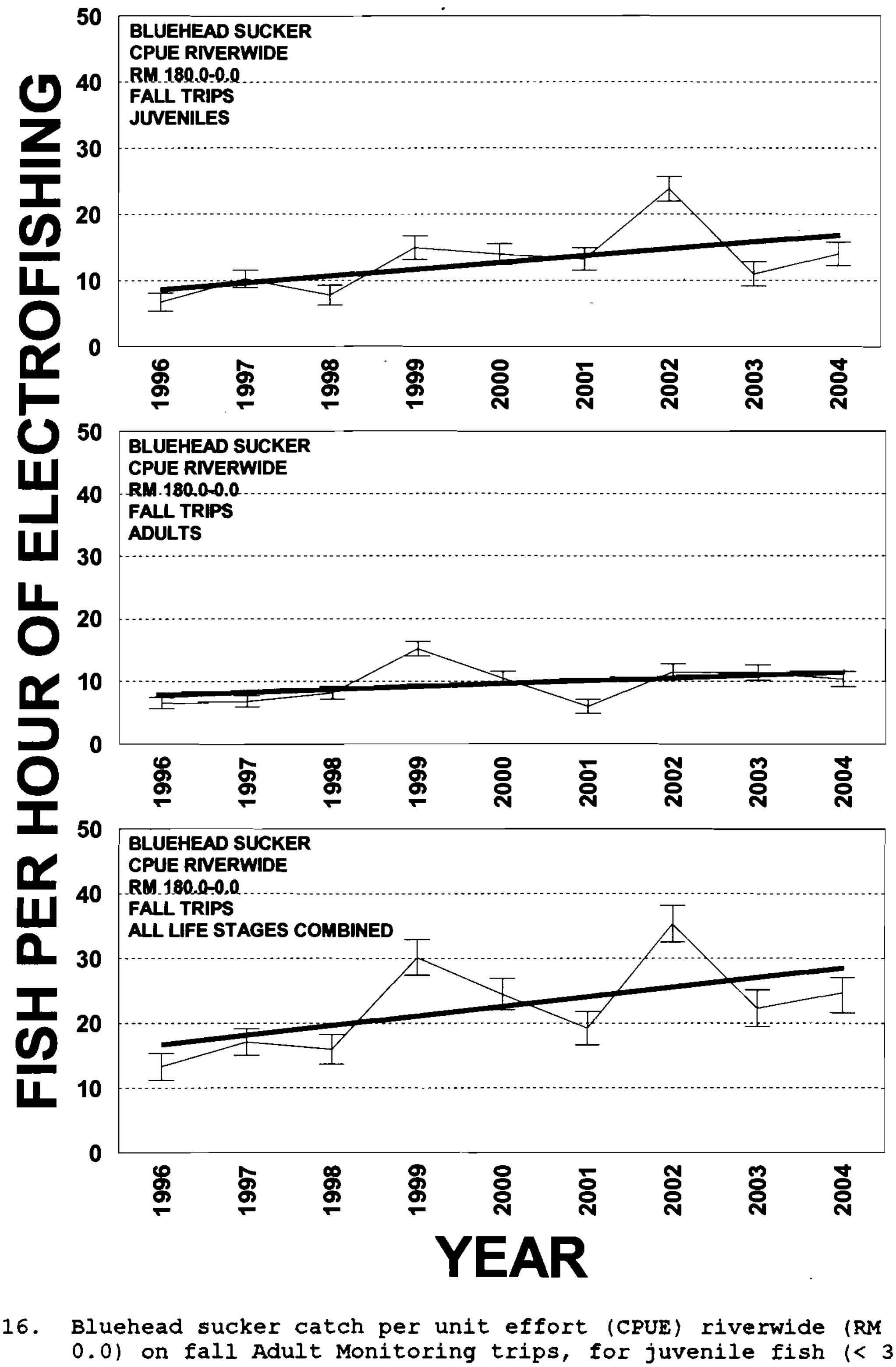

Figure 16. Bluehead sucker catch per unit effort (CPUE) riverwide (RM 180.0-0.0) on fall Adult Monitoring trips, for juvenile fish (< 300 mm TL; top), adult fish (≥ 300 mm TL; middle), and for all life stages combined (juveniles + adults; bottom). Error bars represent one standard error. Sloping horizontal lines represent the long-term trend in CPUE.

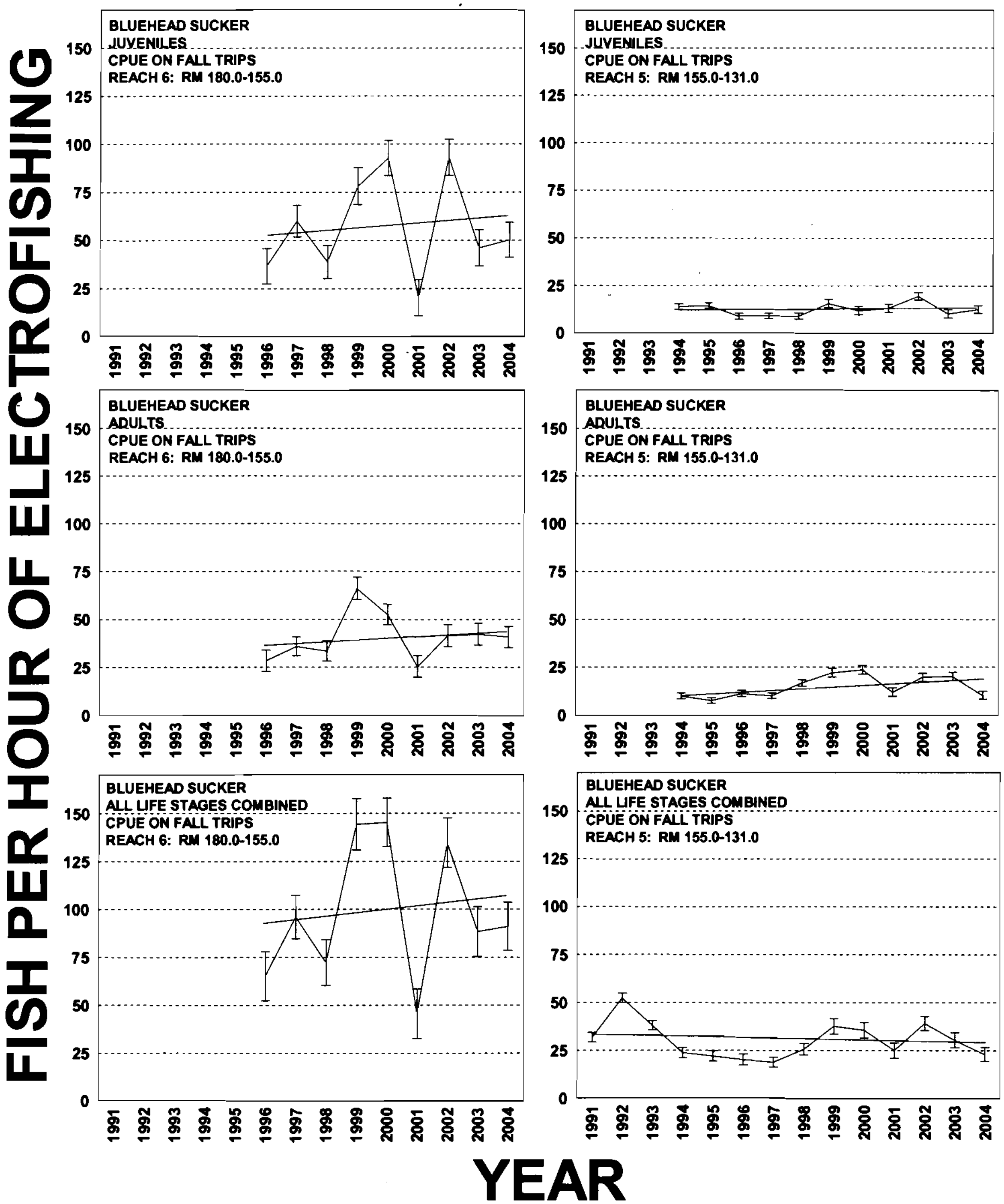

Figure 17. Bluehead sucker catch per unit effort (CPUE) in Reach 6 and Reach 5 on fall Adult Monitoring trips for juvenile fish (< 300 mm TL; top), adult fish ($\geq$ 300 mm TL; middle), and for all life stages combined (juveniles + adults; bottom). Error bars represent one standard error. Sloping horizontal lines represent the long-term trend in CPUE.

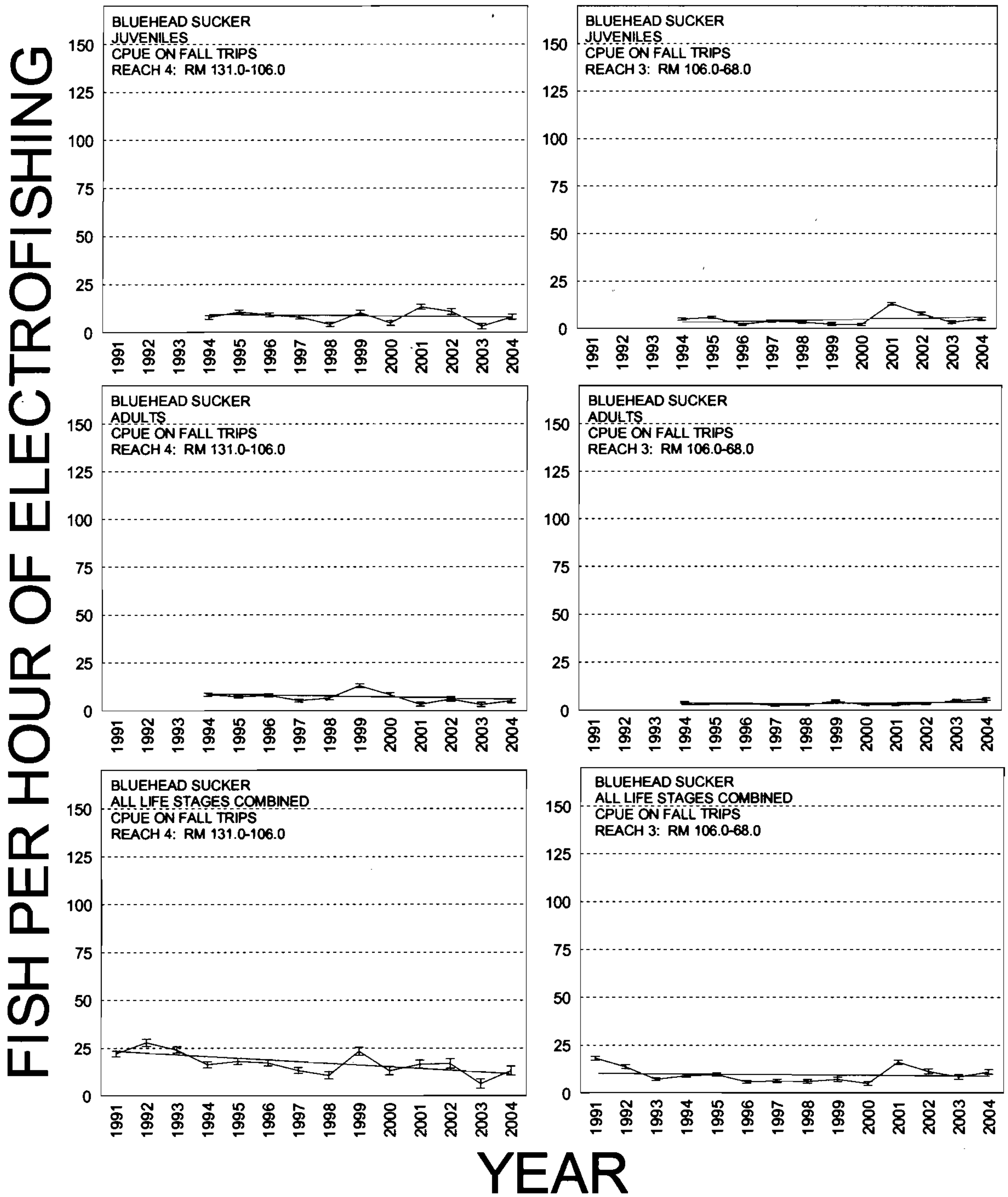

Figure 18. Bluehead sucker catch per unit effort (CPUE) in Reach 4 and Reach 3 on fall Adult Monitoring trips for juvenile fish (< 300 mm TL; top), adult fish (≥ 300 mm TL; middle), and for all life stages combined (juveniles + adults; bottom). Error bars represent one standard error. Sloping horizontal lines represent the long-term trend in CPUE.

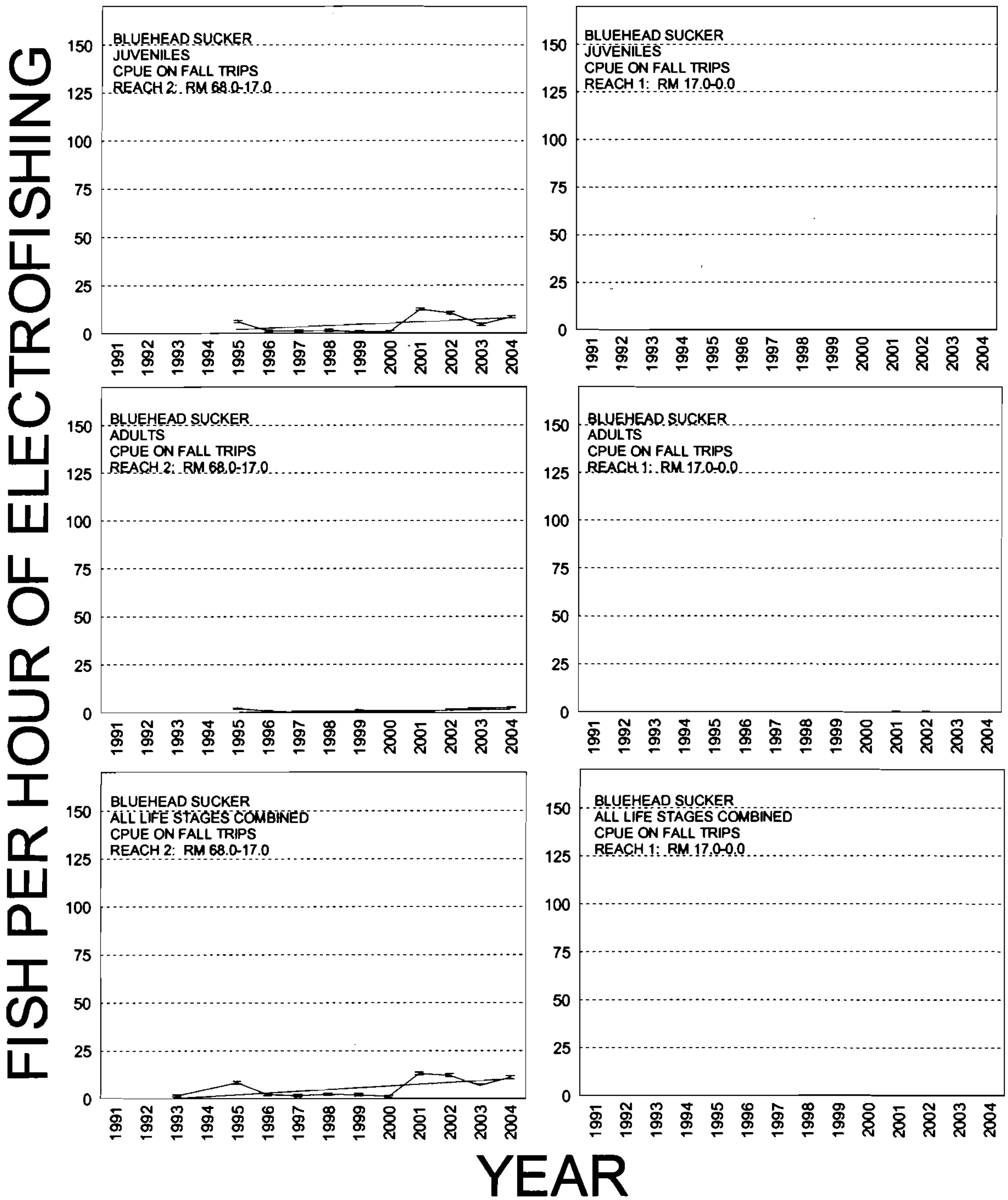

Figure 19. Bluehead sucker catch per unit effort (CPUE) in Reach 2 and Reach 1 on fall Adult Monitoring trips for juvenile fish (< 300 mm TL; top), adult fish (≥ 300 mm TL; middle), and for all life stages combined (juveniles + adults; bottom). Error bars represent one standard error. Sloping horizontal lines represent the long-term trend in CPUE.

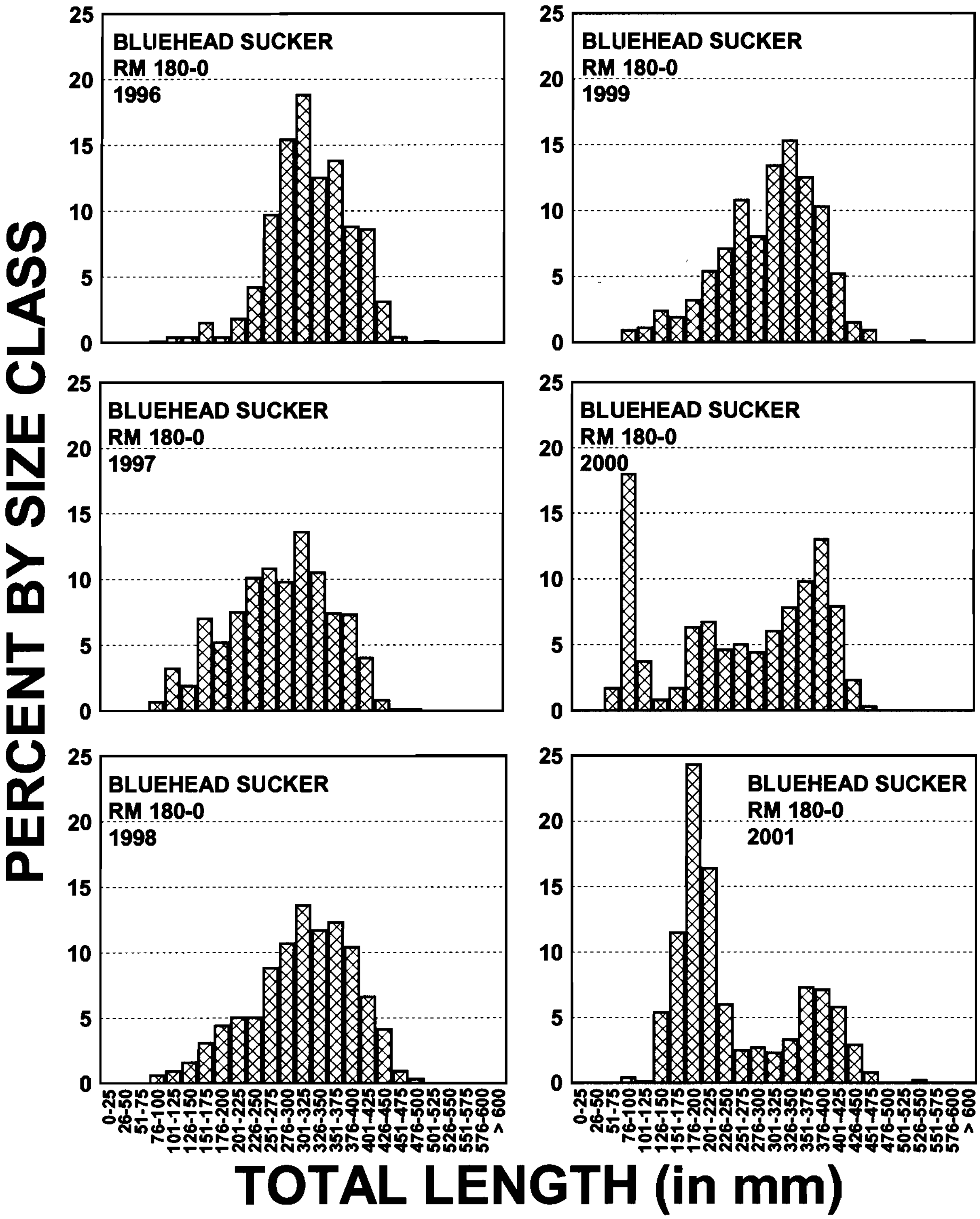

Figure 20. Length-frequency histograms showing the riverwide (RM 180.0-0.0) size-class distribution of bluehead sucker on fall Adult Monitoring trips in the San Juan River, 1996-2001.

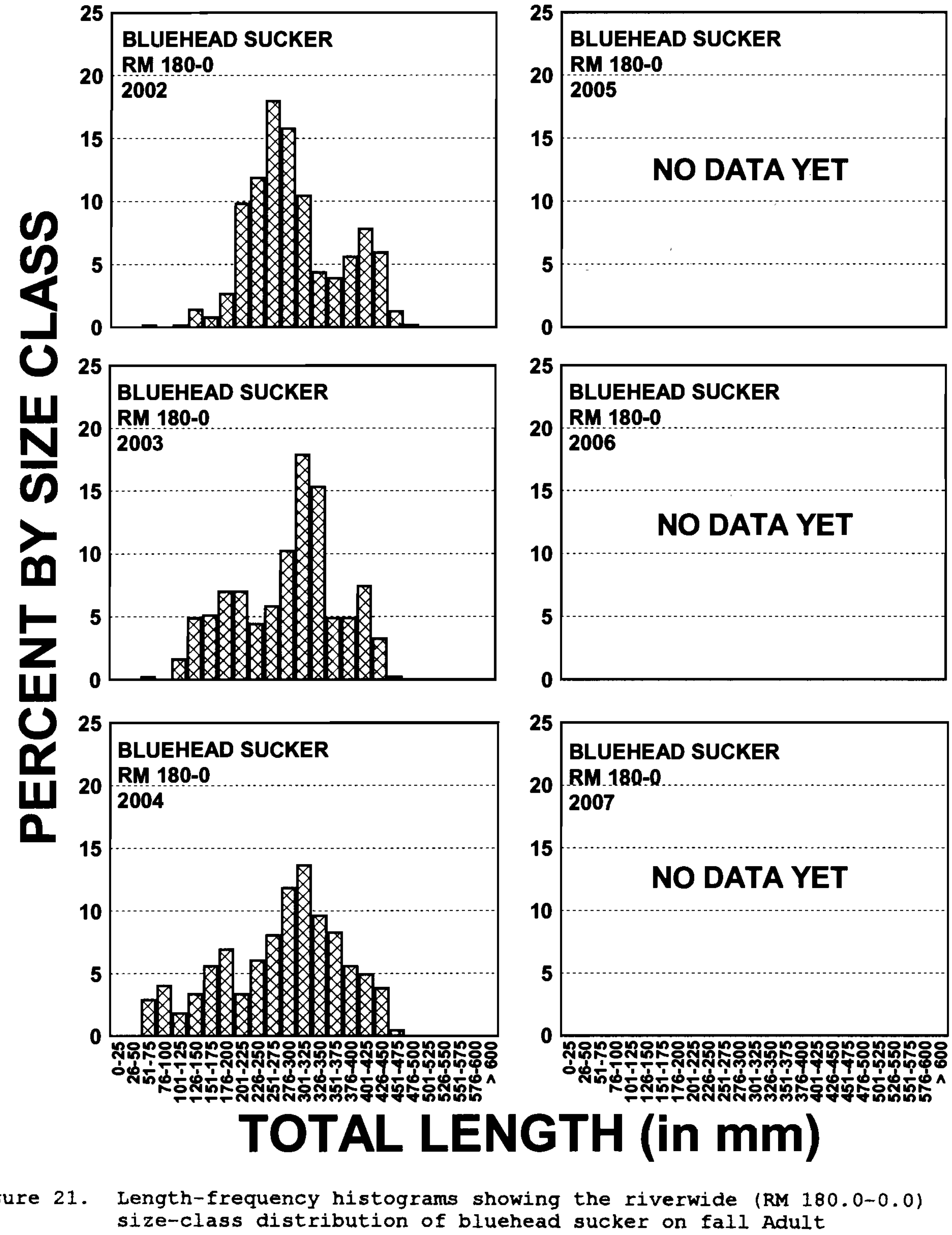

Figure 21. Length-frequency histograms showing the riverwide (RM 180.0-0.0) size-class distribution of bluehead sucker on fall Adult Monitoring trips in the San Juan River, 2002-2004.

21). It also appears as if there were smaller cohorts of young fish spawned in 1996 and 1997 (based on the smaller size-class fish evident in the 1997 length-frequency histogram (Figure 20).

With the large influxes of young fish, bluehead sucker mean TL values (for all life stages combined) dropped markedly riverwide between 1999 and 2000 and again between 2000 and 2001 (Figure 22). Riverwide, bluehead sucker mean TL values in 2001 were lower than in any of the five preceding or following years (i.e., 1996-2000 and 2002-2004; Figure 22). Then, as young fish from the 2000 cohort grew larger and became large sub-adults in 2002, the riverwide mean TL value increased (Figure 22). In 2003, the riverwide mean TL for bluehead sucker dropped again. This is due to the influx of age-1 (2002 year-class) fish that were observed as age-1 fish in the 2003 length-frequency histogram (Figures 21). Likewise, in 2004, bluehead sucker mean TL values dropped again (Figure 22) as two more year-classes (the 2003 and 2004 year-classes) of young bluehead sucker were observed in the 2004 length-frequency histogram (Figure 21).

The long-term trend in bluehead sucker mean TL riverwide shows a marked drop in mean TL over the last nine years. Bluehead sucker mean TL in 2004 was significantly lower (one-way ANOVA; $p < 0.000$) than it was in 1996.

Biomass

While the long-term trend for mean TL among bluehead sucker riverwide has declined markedly over the last nine years, the long-term trend for mean biomass (weight in g) has remained almost flat over that same time period. There was no significant difference (one-way ANOVA) between the 1996 and 2004 riverwide mean biomass values for bluehead sucker. This means that while bluehead sucker are getting generally smaller riverwide, their mean weight is staying roughly the same. This would result in generally increasing condition factors among bluehead sucker in the San Juan River over the nine-year period 1996-2004.

Bluehead sucker total biomass (weight in kg) per hour of electrofishing was 5.71 kg/hr in 2004. This was a median value, with half of the preceding eight years having been less than this and half more.

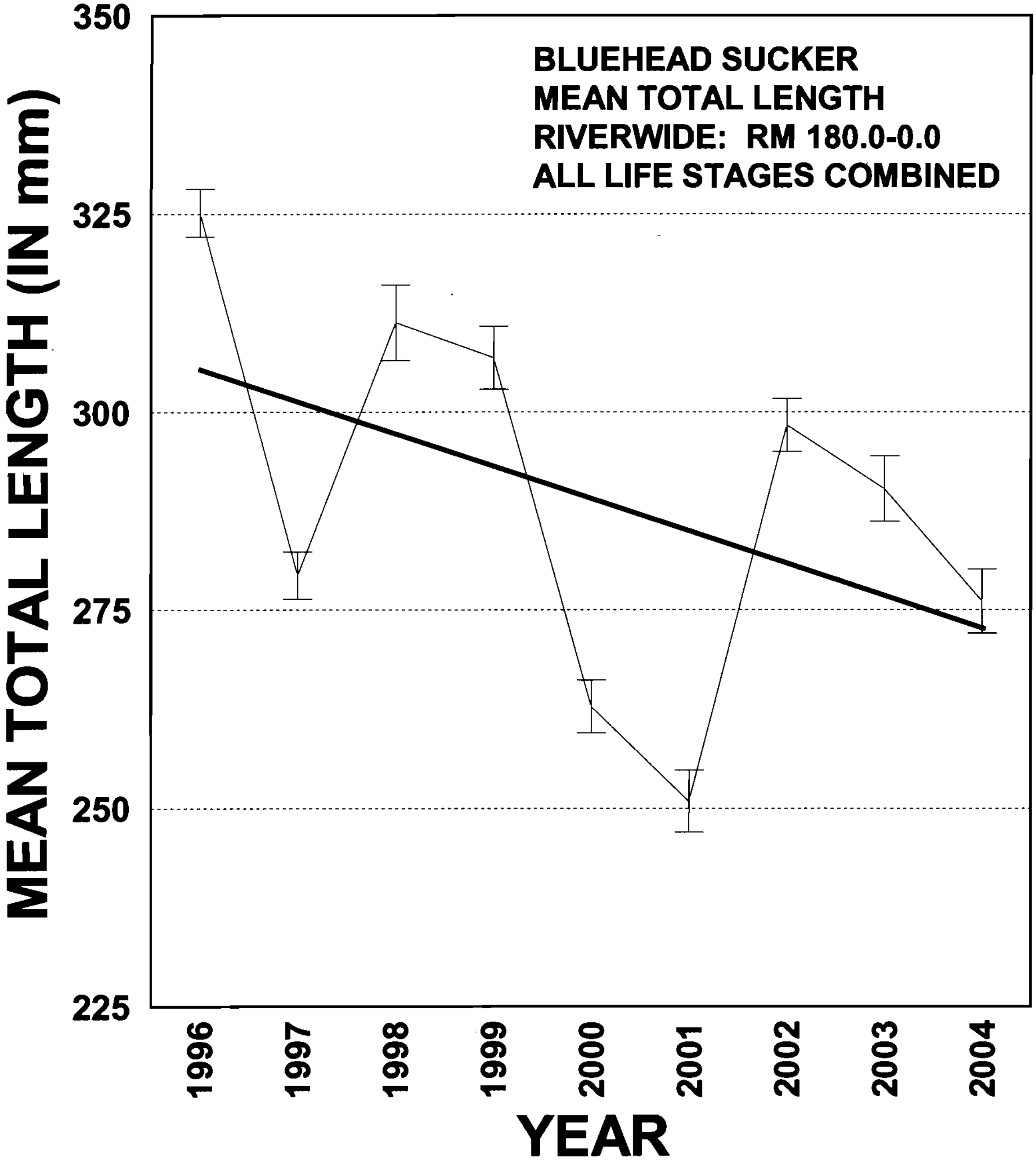

Figure 22. Mean total length (in mm) of bluehead sucker riverwide (RM 180.0-0.0) on fall Adult Monitoring trips in the San Juan River. Error bars represent one standard error. The sloping horizontal line represents the long-term trend in mean total length.

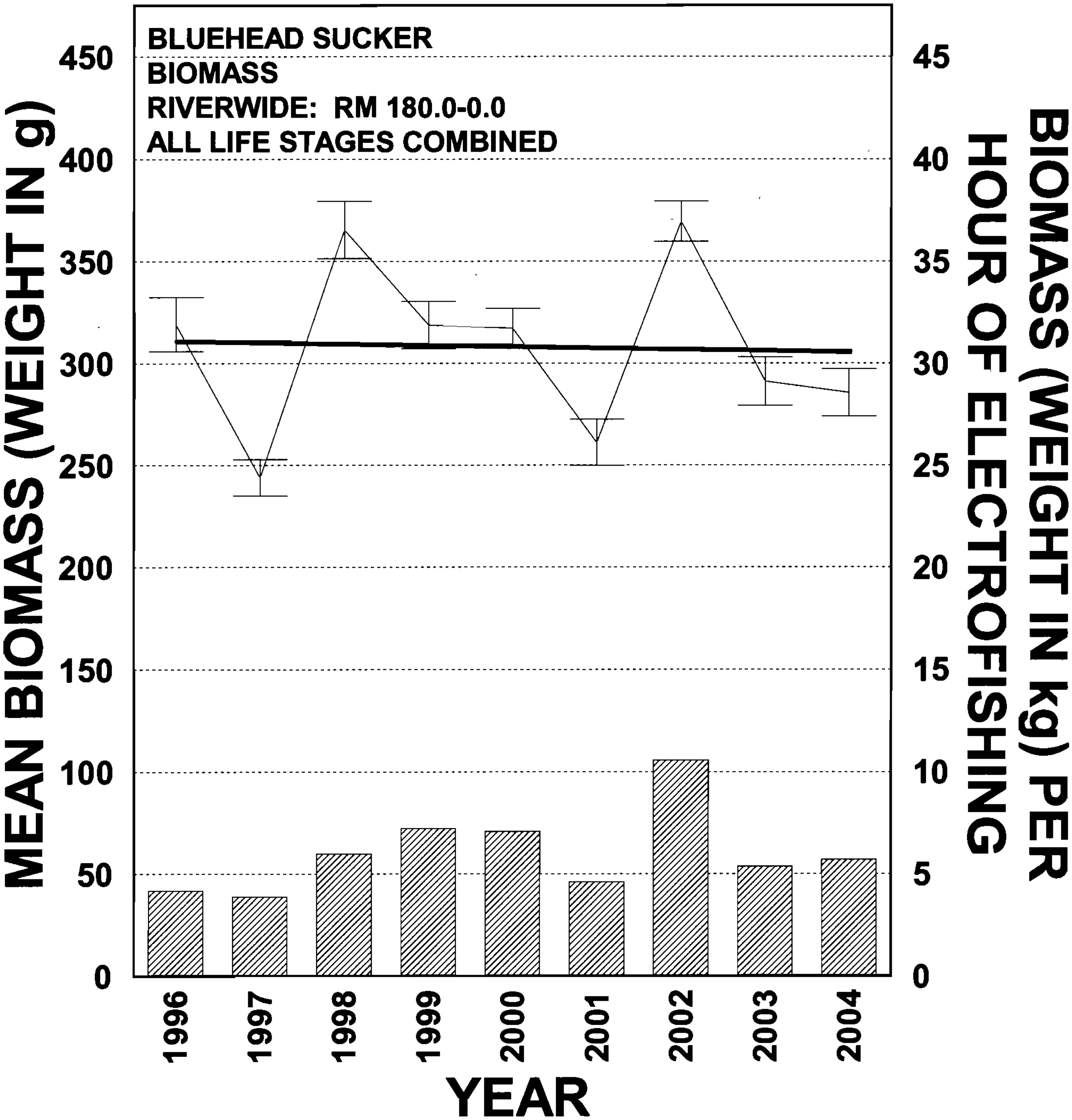

Figure 23. Mean biomass (weight in g; line connecting error bars) and total biomass (weight in kg; cross-hatched vertical bars) per hour of electrofishing of bluehead sucker riverwide (RM 180.0-0.0) on fall Adult Monitoring trips in the San Juan River. Error bars represent one standard error. The sloping horizontal line represents the long-term trend in mean biomass.

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) and have remained among the top three most commonly-collected fish species on fall Adult Monitoring in each of the last nine years (Figure 24). Channel catfish are ubiquitous, being collected in a myriad of habitat types (pers. obs.) and occasionally (as was the case in 2000) being collected in more individual electrofishing samples than even flannelmouth sucker (Figures 6 and 24; Ryden 2003a). However, over the last three years (2002-2004) the percent of the total catch has remained right around 15%, dropping to 14.36% of the total catch in 2004, the lowest riverwide value ever observed during a riverwide Adult Monitoring trip. In 2001 channel catfish were collected in 94.38% of all electrofishing samples riverwide, the highest observed value observed in the last nine years (Figure 24). However, for the last three years (2002-2004), the frequency of occurrence of channel catfish in Adult Monitoring collections has steadily declined, until in 2004, channel catfish were only collected in 75.42% of electrofishing collections riverwide (Figure 24). While this number is still relatively high, it is indicating that over the last three years channel catfish have become less widely distributed in the San Juan River than they were in 2001 (Figure 24).

Riverwide, total CPUE for channel catfish rose markedly between 1998 and 2001, then stayed relatively high for the next two years (2000-2001; Figure 25). That increase was predominantly caused by an increase in juvenile fish riverwide, although adult channel catfish CPUE riverwide also increased slightly every year between 1997 and 2001 (Figure 25). Then between 2001 and 2004, channel catfish total CPUE dropped markedly (Figure 25). Again, this was mostly caused by a large decline in numbers of juvenile fish between 2001 and 2004 (Figure 25). However, more encouraging than the decline in juvenile and total channel catfish CPUE over that time period is the three-year decreasing trend in riverwide adult CPUE between 2001 and 2004 (Figure 25). Channel catfish adult CPUE riverwide dropped to an all-time low of 2.98 fish/hr of electrofishing in 2004, a value significantly lower than six of the eight (1997 and 2003 being the exceptions) preceding years (p-values ranging from 0.003 to < 0.000). This decrease in channel catfish adult CPUE riverwide has almost certainly decreased the reproductive potential of the San Juan River channel catfish population.

Since 1991, trends in channel catfish CPUE over time among individual reaches have been hard to discern, at best. This is mostly due to very pronounced fluctuations in juvenile channel catfish CPUE, although adult CPUE can fluctuate markedly as well. However, some clear trends can be determined. In reach 6, channel catfish adult CPUE (and juvenile CPUE to a lesser degree) has demonstrated a long-term declining trend over the last nine years (Figure 26). In Reach 5, both juvenile and adult channel catfish CPUE were steadily increasing between 1994 and 2000 (for juveniles) or 2001 (for juveniles). However, since that time, CPUE for channel catfish has greatly declined in Reach 5, with adult channel catfish reaching an all-time low of 2.42 fish/hr of electrofishing in 2004 and juvenile channel catfish reaching its second lowest observed value riverwide since 1996 (n = 3.16 fish/hr in 2004; Figure 26). In addition, channel catfish total CPUE in Reach 5 in 2004 was also at

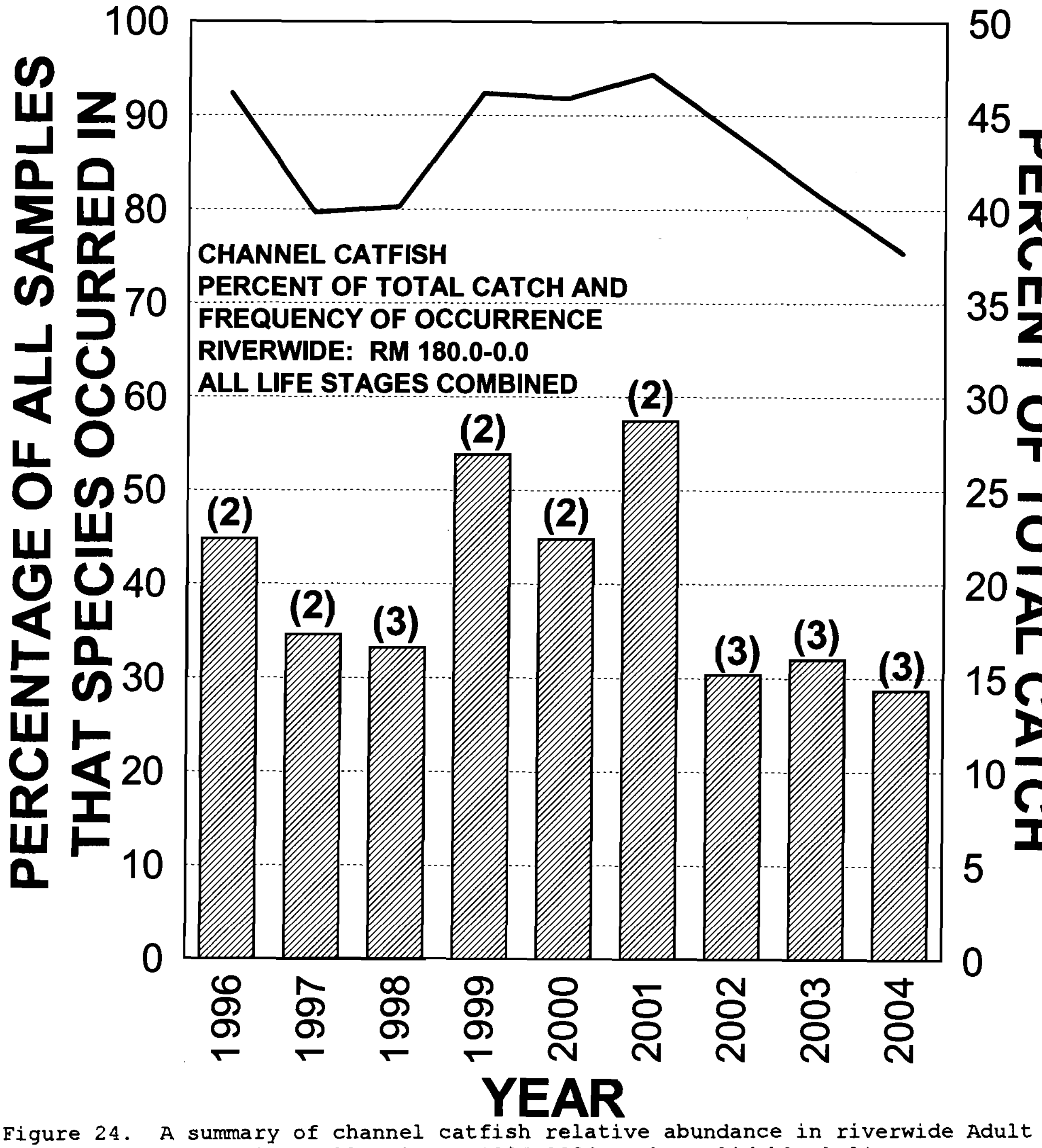

Figure 24. A summary of channel catfish relative abundance in riverwide Adult Monitoring collections, 1996-2004. The solid black line represents the percentage of all electrofishing samples on a given Adult Monitoring trip in which this species occurred (i.e., frequency of occurrence). The shaded bars represent the percent of the total catch that this species composed in a given year. The parenthetic numbers indicate the numeric rank for this species in a given year relative to all other fish species collected.

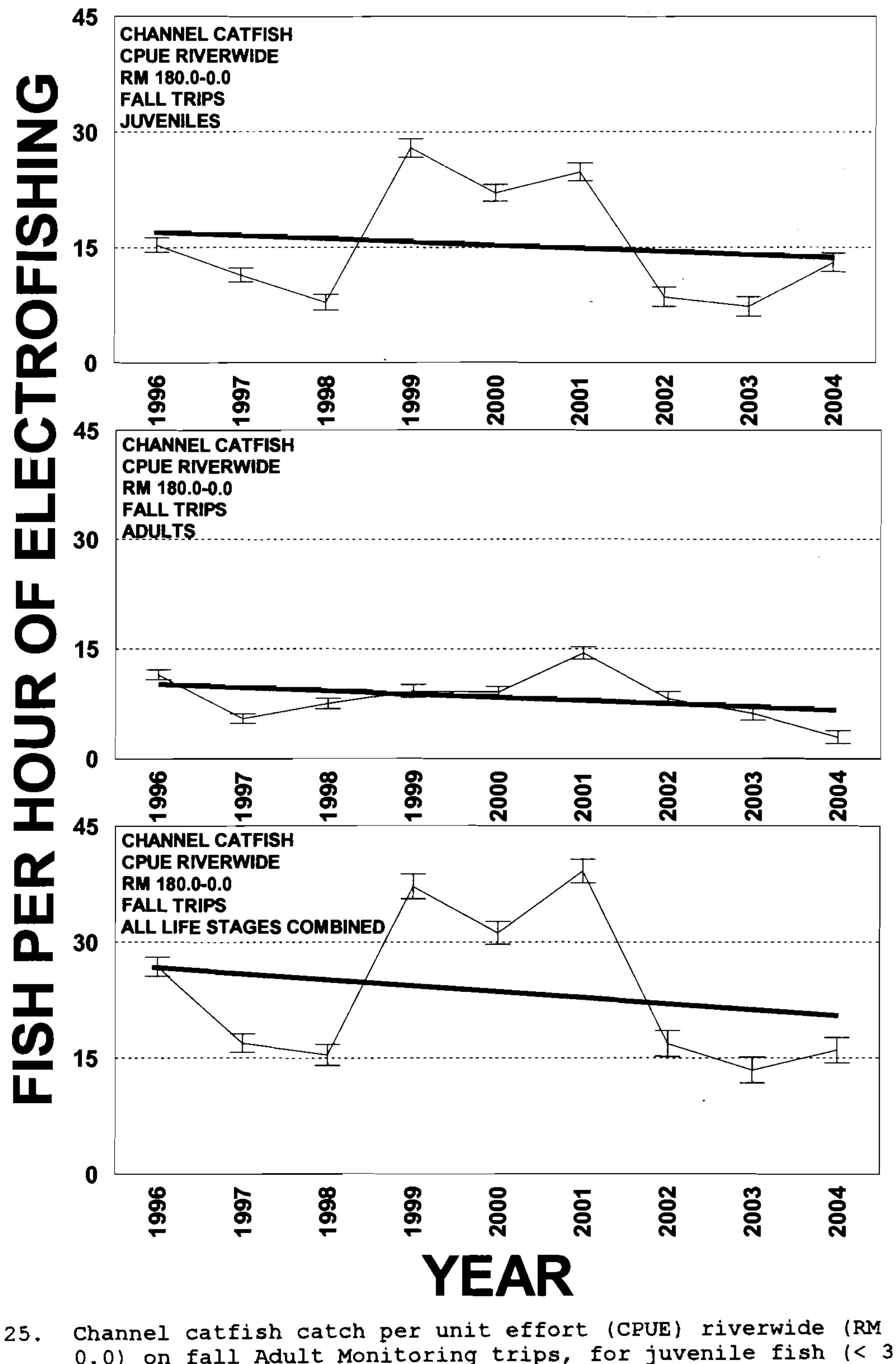

Figure 25. Channel catfish catch per unit effort (CPUE) riverwide (RM 180.0-0.0) on fall Adult Monitoring trips, for juvenile fish (< 300 mm TL; top), adult fish (≥ 300 mm TL; middle), and for all life stages combined (juveniles + adults; bottom). Error bars represent one standard error. Sloping horizontal lines represent the long-term trend in CPUE.

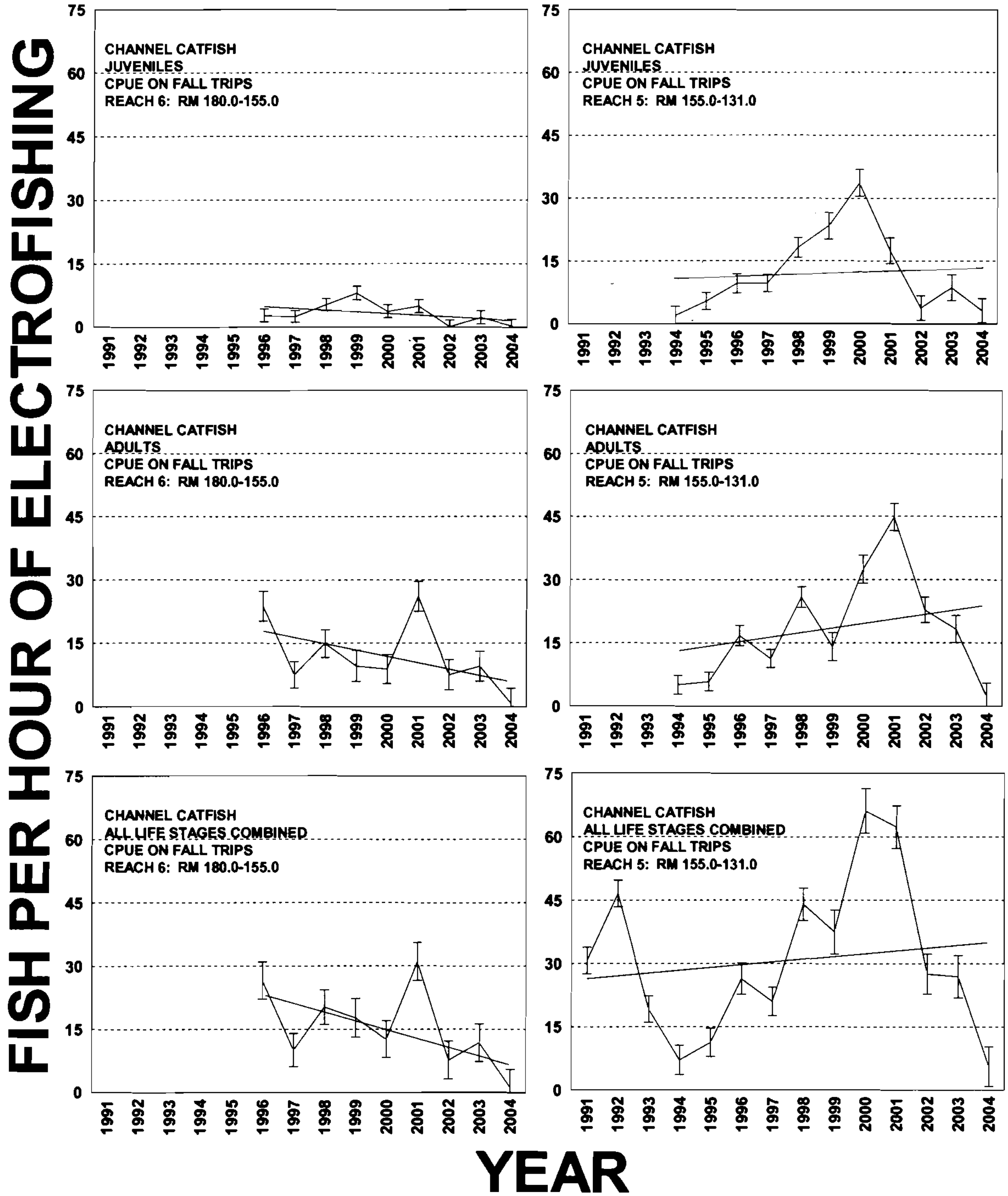

Figure 26. Channel catfish catch per unit effort (CPUE) in Reach 6 and Reach 5 on fall Adult Monitoring trips for juvenile fish (< 300 mm TL; top), adult fish (≥ 300 mm TL; middle), and for all life stages combined (juveniles + adults; bottom). Error bars represent one standard error. Sloping horizontal lines represent the long-term trend in CPUE.

the lowest observed value (5.58 fish/hr) since Adult Monitoring began in 1991 (Figure 26). Channel catfish total CPUE declined markedly (from an all-time high value in Reach 5 of 66.15 fish/hr in 2000) in each of the last four years in this river reach (Figure 26).

Channel catfish CPUE trends, especially juvenile and total CPUE, are harder to discern in Reaches 4-1 (Figures 27 and 28). Adult channel catfish CPUE has either been stable (as in Reach 4) or declined (Reaches 3-1) over the last 9-10 years in these river reaches (Figures 27 and 28). However, juvenile channel catfish CPUE has been highly variable in Reaches 4-2, while generally declining in Reach 1. It appears as if Reaches 4-2 are now harboring the majority of the juvenile channel catfish in the San Juan River population. With numbers of adult channel catfish either declining or remaining stable in most river reaches, perhaps it would be wise to expand intensive, repetitive nonnative fish removal efforts to a riverwide approach, so that these large numbers of young channel catfish in Reaches 4-2 can be diminished. Channel catfish CPUE has remained relatively low in Reach 1 since intensive nonnative fish removal began in this Reach in 2001 (Figure 28).

Length Frequency And Mean Total Length

On the fall 2004 Adult Monitoring trip, the two most commonly collected size-class groupings of channel catfish were age-0 fish (centered around 51-75 mm TL) and age-1 fish (centered around 126-150 mm TL; Figure 30). Over the last nine years (i.e., since removal of nonnative fishes began in 1996), there has been a general trend towards the San Juan River channel catfish population becoming increasingly dominated by smaller size-class fish, as larger, older fish are mechanically removed (Figures 29-31). The relatively large influxes of juvenile fish observed from 1999-2001 (Figure 25) were likely the result of compensatory reproductive efforts, associated with a drop in numbers of adult fish riverwide, caused by mechanical removal efforts. The relative percentage of juvenile fish in the San Juan River channel catfish population, riverwide reached an all-time high in 2004 at 78.34% (Figure 31). Over that same nine-year period (1996-2004), the relative size-class of the largest mode observed in channel catfish length-frequency histograms (Figures 29 and 30) has been becoming increasingly smaller (Figure 31), until the most dominant size-class of channel catfish being collected and measured in three of the last four years were fish centered around 126-150 mm TL (Figures 29-31). As might be expected, with the increasing dominance of juvenile channel catfish in collections over the last nine years, channel catfish mean TL riverwide has shown a long-term declining trend (Figure 32). This particular metric did increase steadily for four straight years, between 1999 and 2003, as fish spawned in the mid- to late 1990's (e.g., 1996-1998) began recruiting into the adult size-classes (i.e., > 400 mm TL; Figures 29 and 30). However, the shift towards smaller size-class fish in the 2004 length-frequency histogram (Figure 30) and the marked decline in riverwide mean TL among channel catfish between 2003 and 2004 (Figure 32) would seem to indicate that either these fish were effectively cropped out of the channel catfish population by mechanical removal efforts or they moved out of the San Juan River between 2003 and 2004.

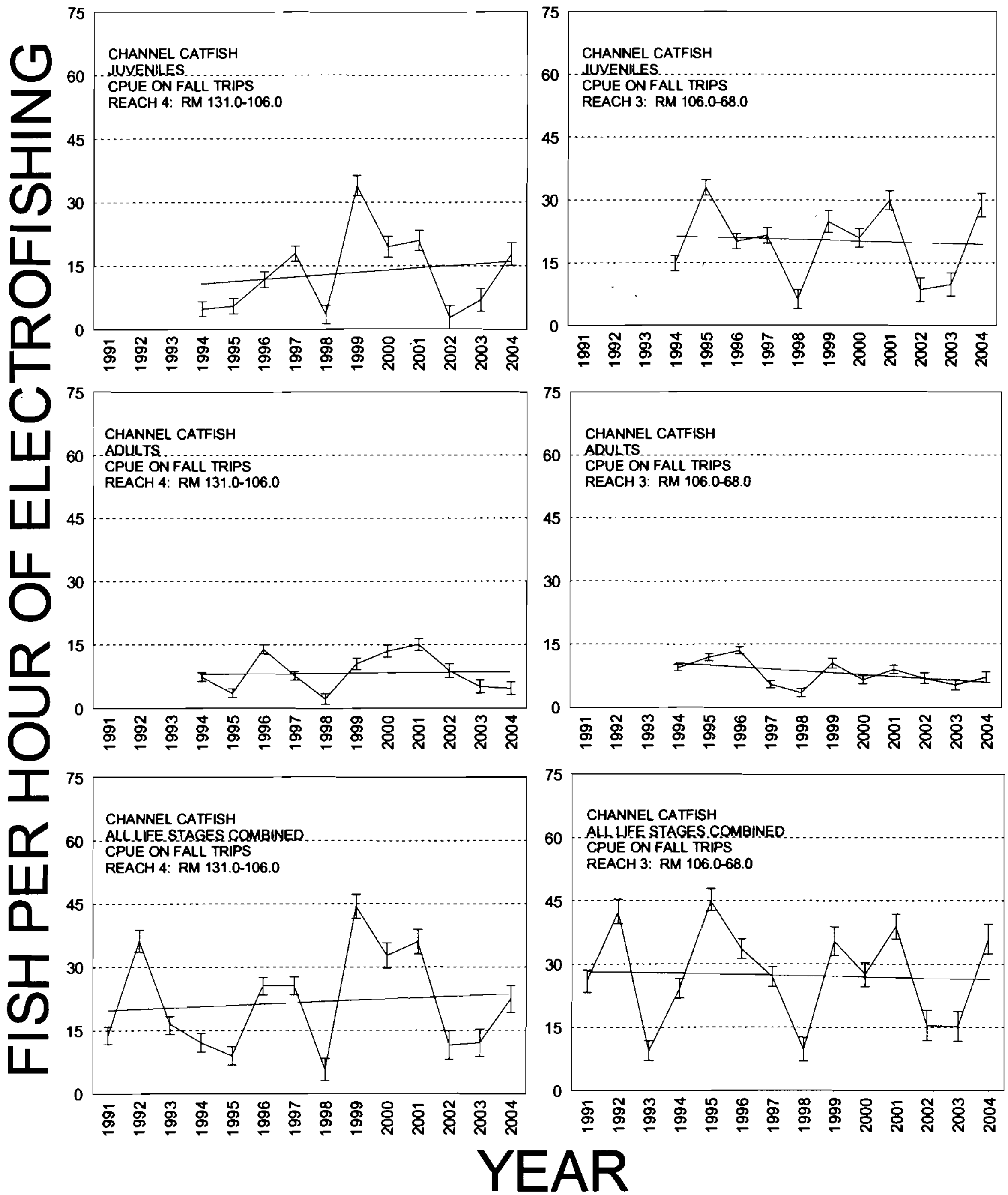

Figure 27. Channel catfish catch per unit effort (CPUE) in Reach 4 and Reach 3 on fall Adult Monitoring trips for juvenile fish (< 300 mm TL; top), adult fish ($\geq$ 300 mm TL; middle), and for all life stages combined (juveniles + adults; bottom). Error bars represent one standard error. Sloping horizontal lines represent the long-term trend in CPUE.

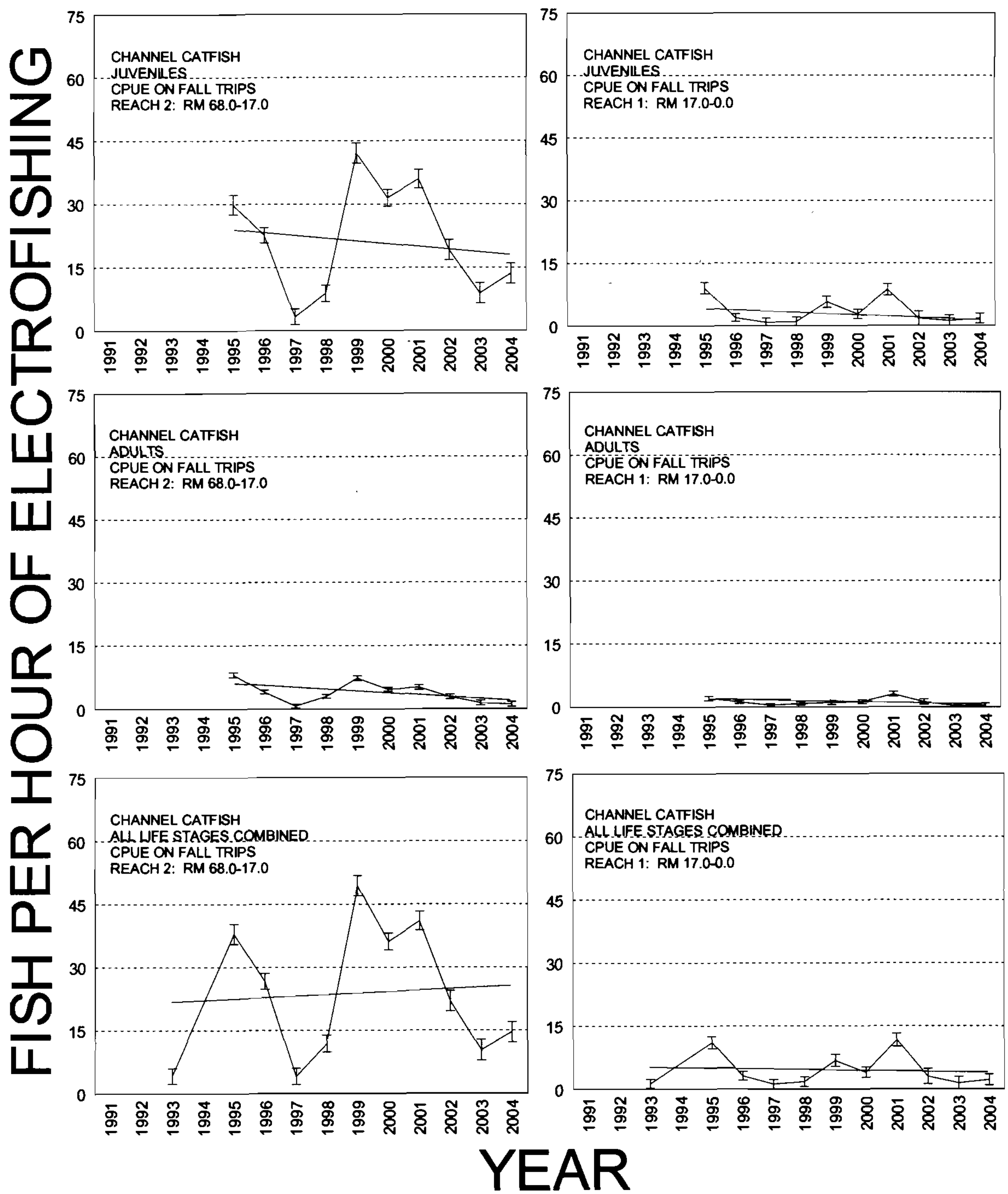

Figure 28. Channel catfish catch per unit effort (CPUE) in Reach 2 and Reach 1 on fall Adult Monitoring trips for juvenile fish (< 300 mm TL; top), adult fish (≥ 300 mm TL; middle), and for all life stages combined (juveniles + adults; bottom). Error bars represent one standard error. Sloping horizontal lines represent the long-term trend in CPUE.

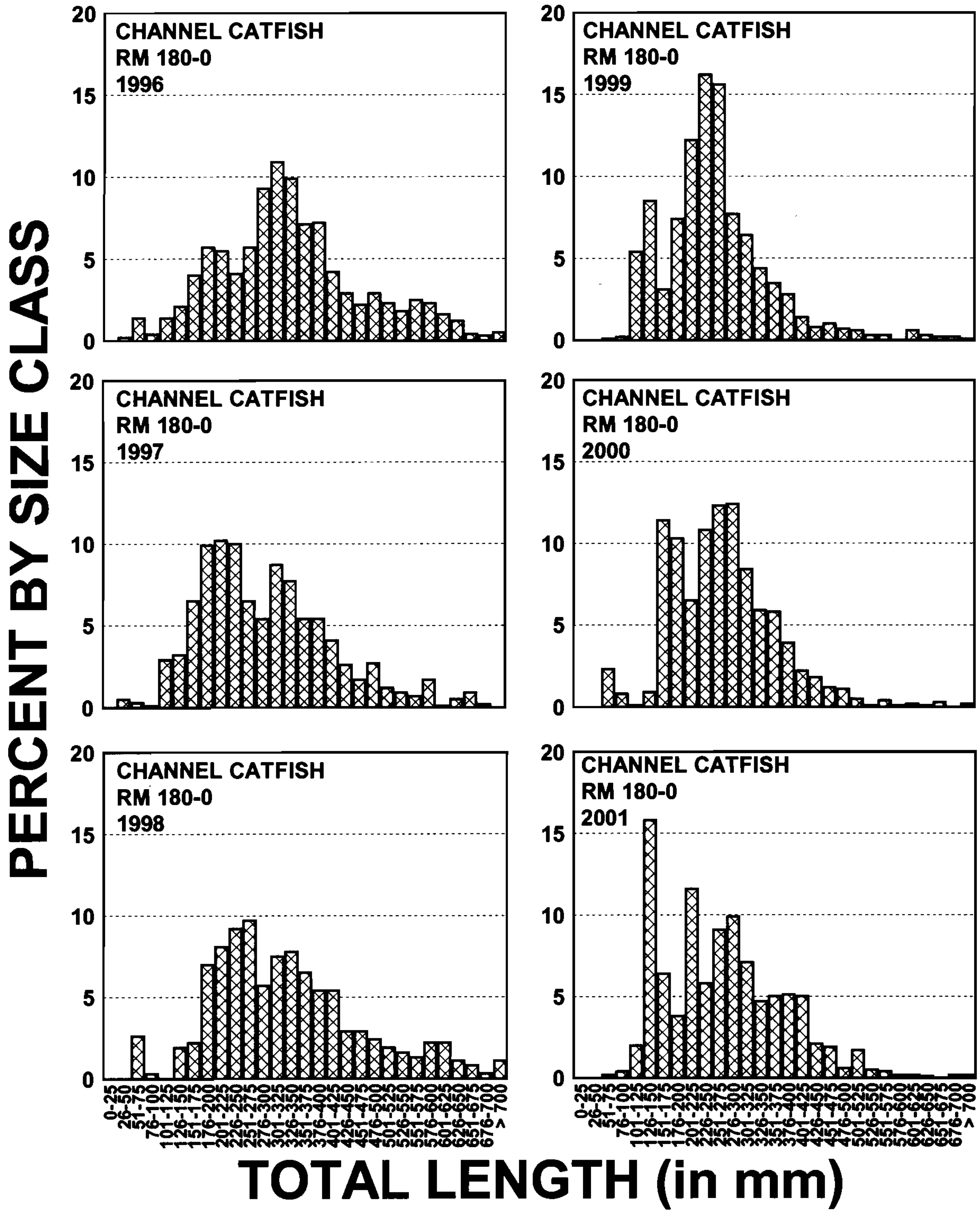

Figure 29. Length-frequency histograms showing the riverwide (RM 180.0-0.0) size-class distribution of channel catfish on fall Adult Monitoring trips in the San Juan River, 1996-2001.

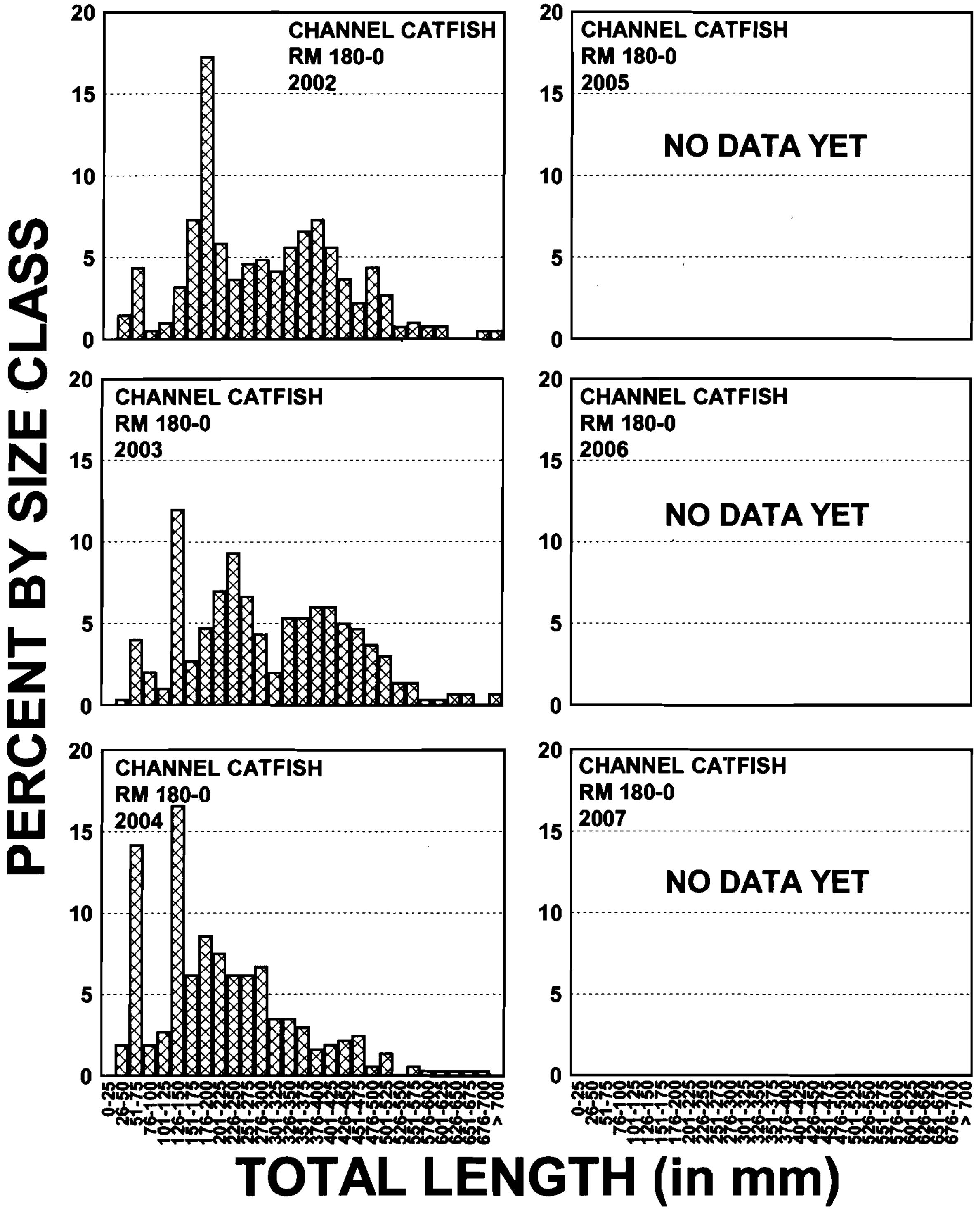

Figure 30. Length-frequency histograms showing the riverwide (RM 180.0-0.0) size-class distribution of channel catfish on fall Adult Monitoring trips in the San Juan River, 2002-2004.

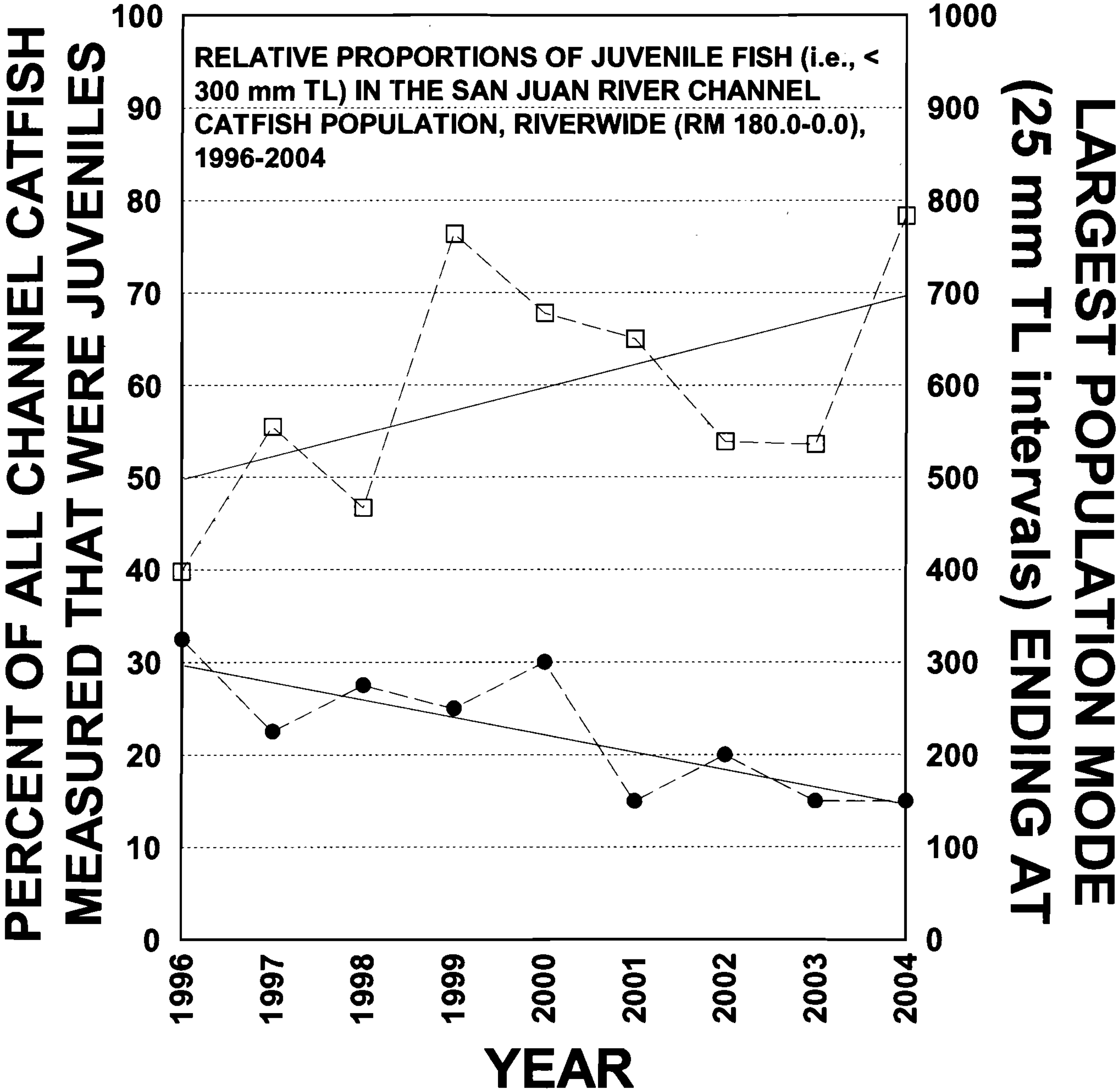

Figure 31. The relative proportion of juvenile fish (< 300 mm TL) observed among channel catfish collected and measured from the San Juan River, 1996-2004. The top dashed line (with open squares) represents the percent of all measured channel catfish in a given year's samples that were juveniles. The bottom dashed line (with solid circles) represents the TL at which the largest population mode (from Figures 29 and 30), ended at. Therefore, the 2004 value represents 126-150 mm TL, the 2002 value represents 176-200 mm TL, and so on. The solid sloping lines (top and bottom) represent the long-term trends for these two metrics.

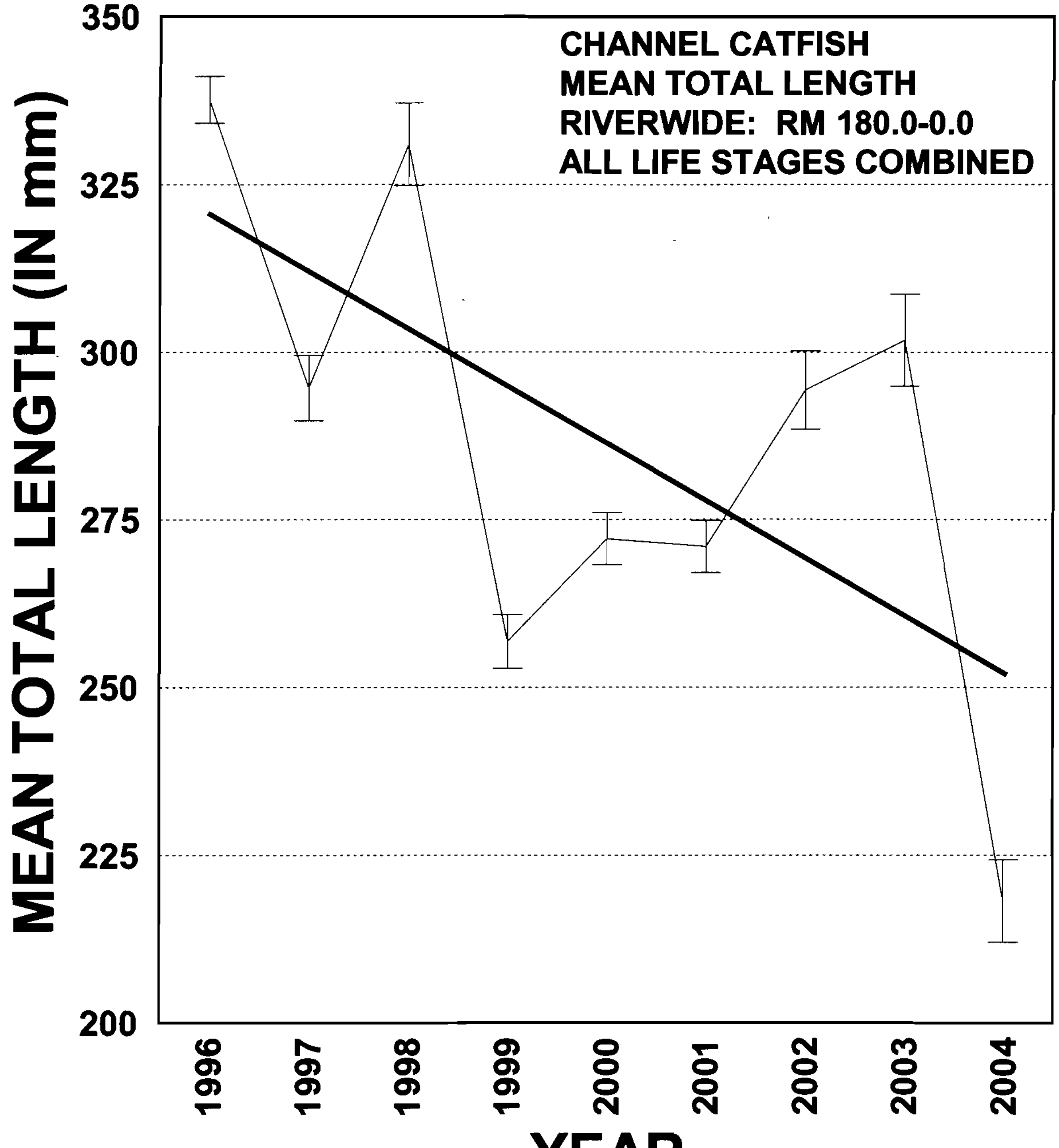

Figure 32. Mean total length (in mm) of channel catfish riverwide (RM 180.0-0.0) on fall Adult Monitoring trips in the San Juan River. Error bars represent one standard error. The sloping horizontal line represents the long-term trend in mean total length.

Biomass

As was seen with mean TL riverwide among channel catfish (Figure 32), mean biomass (weight in g) riverwide increased steadily between 1999 and 2003 (Figure 33), as fish spawned in the mid- to late 1990's (e.g., 1996-1998) began recruiting into the adult size-classes (i.e., > 400 mm TL; Figures 29 and 30). However, just like channel catfish mean TL riverwide (Figure 32), mean biomass riverwide decreased markedly between 2003 and 2004 (Figure 33). Also like mean channel catfish TL riverwide (Figure 32), mean biomass riverwide has shown a long-term downward trend over the last nine years (Figure 33).

Total biomass (weight in kg) per hour of electrofishing riverwide has also shown a long-term declining trend over the last nine years (1996-2004; Figure 33). However, this downward trend in total biomass per hour of electrofishing has been even more marked over the last four years (2001-2004; Figure 33). In 2004, total biomass per hour of electrofishing among channel catfish riverwide was at its lowest ever observed value (4.21 kg/hr), about a third of what it was in 1996 (Figure 33).

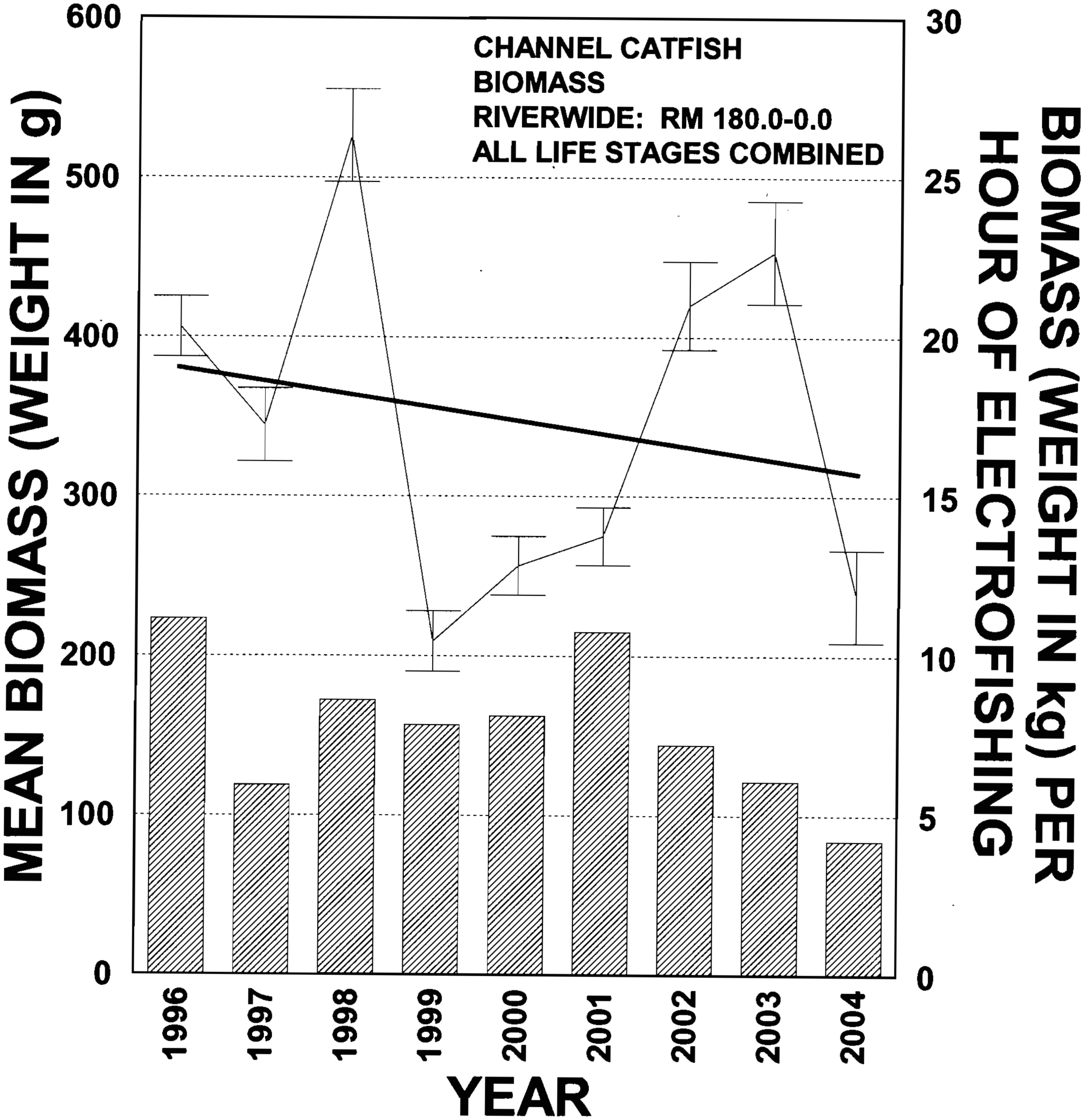

Figure 33. Mean biomass (weight in g; line connecting error bars) and total biomass (weight in kg; cross-hatched vertical bars) per hour of electrofishing of channel catfish riverwide (RM 180.0-0.0) on fall Adult Monitoring trips in the San Juan River. Error bars represent one standard error. The sloping horizontal line represents the long-term trend in mean biomass.

Common Carp

Catch Per Unit Effort (CPUE)

Common carp dropped to being the fifth most commonly-collected fish (behind flannelmouth sucker, bluehead sucker, channel catfish, and speckled dace) on the fall 2004 Adult Monitoring trip (Table 3, Figure 34). This marks the first time, since Adult Monitoring studies began in 1991, that common carp have not been among the four most commonly-collected fish on a fall Adult Monitoring trip (Figure 34; Ryden 2000). A total of only 547 common carp were collected riverwide during the fall 2004 Adult Monitoring trip (Table 3). Common carp have composed less of the total catch in each consecutive year since 1997, dropping to a low of 4.73% of the total catch in 2004 (Figure 34). Common carp were collected in 69.07% of all electrofishing collections in 2004, compared to being collected in 82.99%-89.14% of all electrofishing collections riverwide between 1996 and 2002 (Figure 34).

The decline of common carp riverwide is reflected in a marked and significant (one-way ANOVA; $p < 0.000$) drop in CPUE among adult common carp between 1996 and 2004 (from 14.67 fish/hr to 3.62 fish/hr; Figure 35). During this same period, CPUE among juvenile common carp riverwide underwent an almost five-fold significant increase (from 0.57 fish/hr to 2.41 fish/hr, $p < 0.000$; Figure 35). However, even with this increase in juvenile CPUE riverwide, adult common carp still outnumbered juveniles by a ratio of 1.5:1 (Figure 35). The declining trend in adult common carp CPUE over the last nine years has, by far, been the most marked in Reach 6, although the long-term trend in CPUE for adult common carp has declined in all six river reaches over the last nine years (Figures 36-38). The increase in CPUE among juvenile common carp is mostly occurring in Reaches 6-4 (Figures 36-38). Juvenile common carp CPUE actually declined slightly in Reaches 2 and 1 between 2003 and 2004 (Figure 38).

Length Frequency And Mean Total Length

From 1996-1999, riverwide length-frequency histograms of common carp showed a population whose main channel component was based almost completely around large, adult fish (> 375 mm TL; Figure 39). However, in three of the last five years (i.e., in 2000, 2002, and 2004) there have been relatively large influxes of juvenile fish into the San Juan River common carp population (Figures 39 and 40). These relatively large influxes of juvenile fish may be the result of compensatory reproductive efforts, associated with a drop in numbers of adult fish riverwide, caused by mechanical removal efforts. However, unlike in the channel catfish population (where this same type of phenomenon seems to have occurred from 1999-2001), where juvenile fish now compose fully 81.5% of the population riverwide and accounted for 13.07 fish/hr of electrofishing in 2004 (Figure 25), juvenile common carp are still much more rare, composing only 39.9% of the population and accounting for only 2.41 fish/hr of electrofishing in 2004 (Figure 35). The reason that the influx of juvenile common carp is so noticeable in the 2004 riverwide length-frequency histogram (Figure 40) is because the number of adult fish has dropped to such a comparatively low level (3.62 fish/hr; Figure 35).

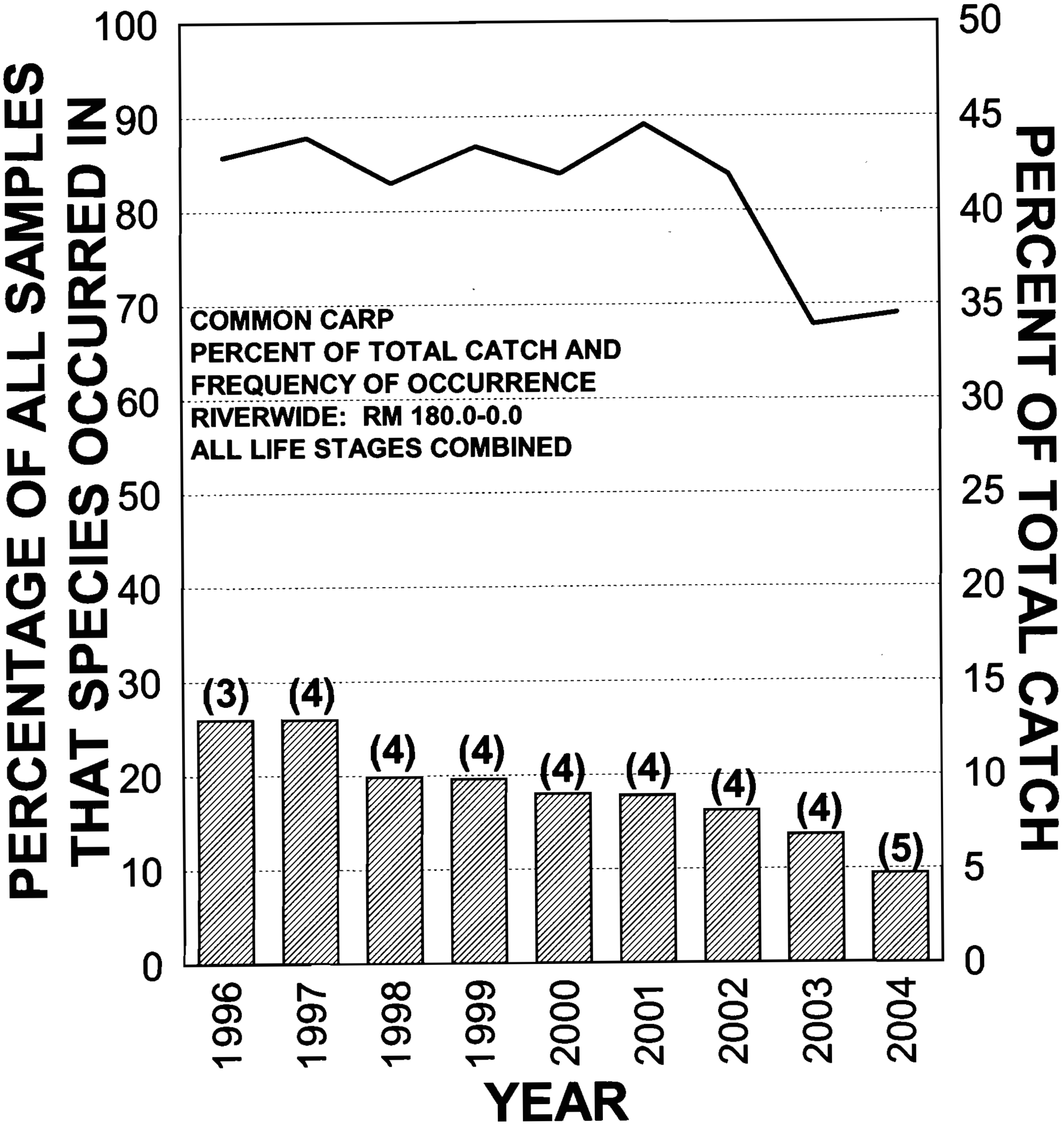

Figure 34. A summary of common carp relative abundance in riverwide Adult Monitoring collections, 1996-2004. The solid black line represents the percentage of all electrofishing samples on a given Adult Monitoring trip in which this species occurred (i.e., frequency of occurrence). The shaded bars represent the percent of the total catch that this species composed in a given year. The parenthetic numbers indicate the numeric rank for this species in a given year relative to all other fish species collected.

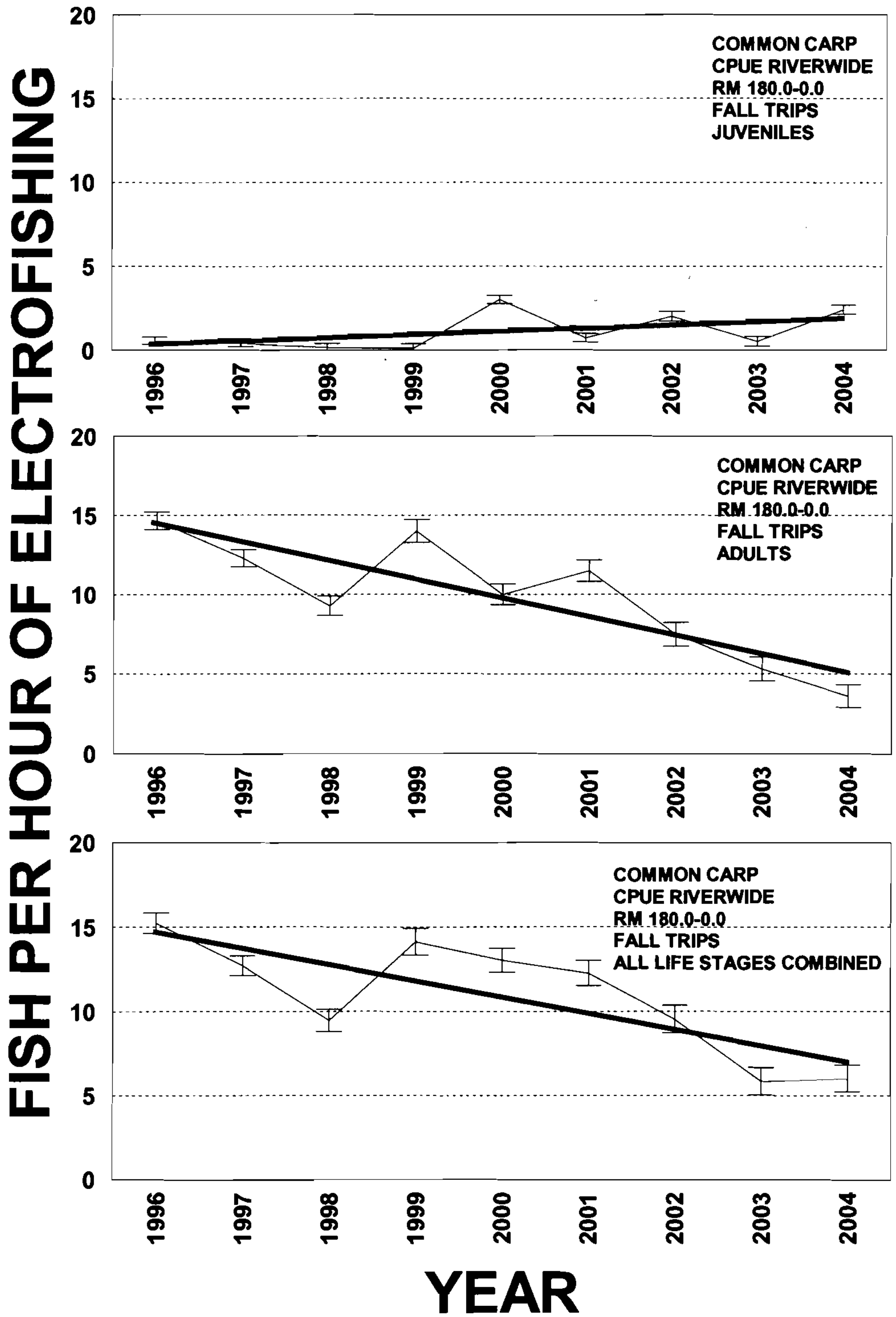

Figure 35. Common carp catch per unit effort (CPUE) riverwide (RM 180.0-0.0) on fall Adult Monitoring trips, for juvenile fish (< 250 mm TL; top), adult fish (≥ 250 mm TL; middle), and for all life stages combined (juveniles + adults; bottom). Error bars represent one standard error. Sloping horizontal lines represent the long-term trend in CPUE.

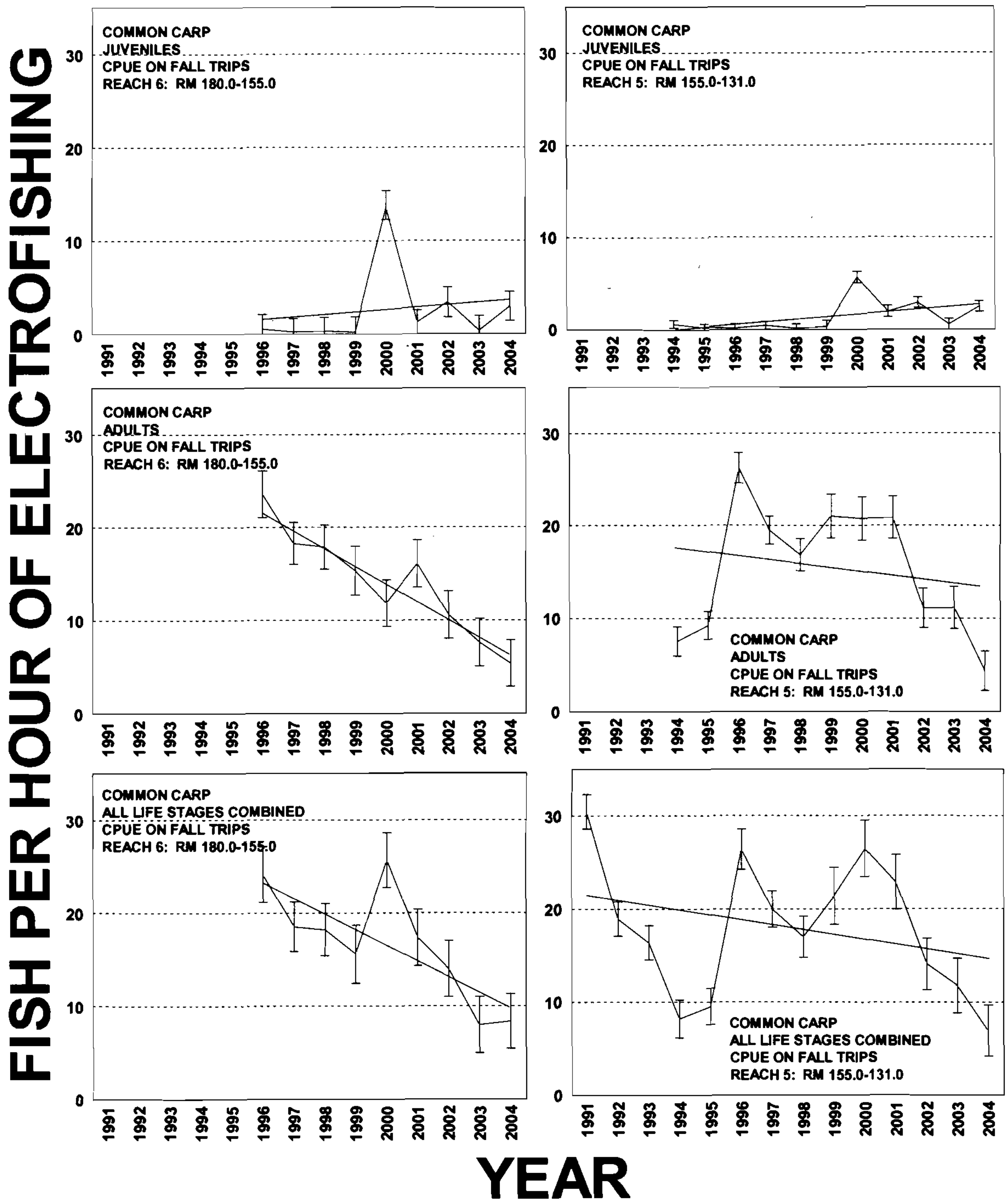

Figure 36. Common carp catch per unit effort (CPUE) in Reach 6 and Reach 5 on fall Adult Monitoring trips for juvenile fish (< 250 mm TL; top), adult fish (≥ 250 mm TL; middle), and for all life stages combined (juveniles + adults; bottom). Error bars represent one standard error. Sloping horizontal lines represent the long-term trend in CPUE.

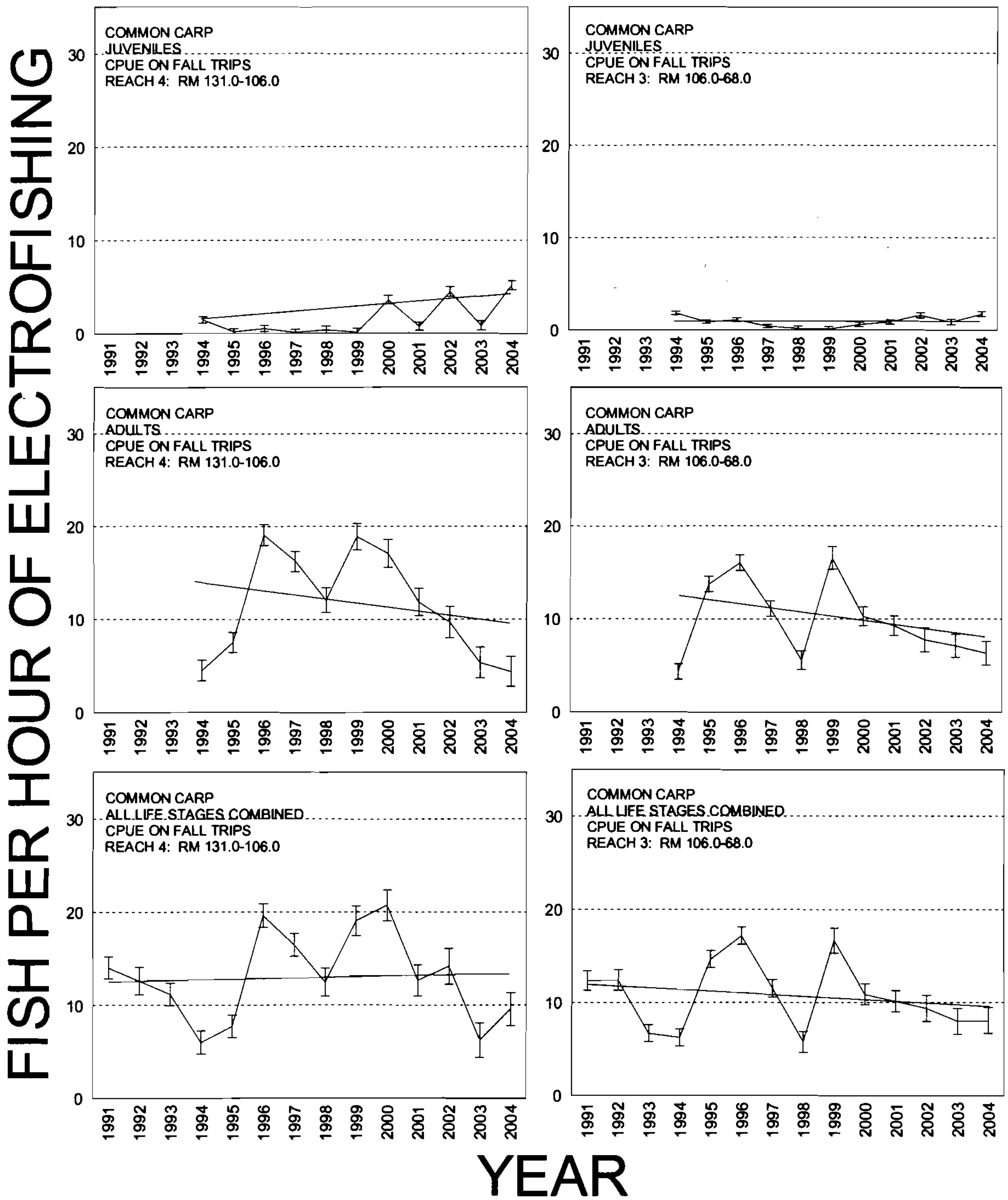

Figure 37. Common carp catch per unit effort (CPUE) in Reach 4 and Reach 3 on fall Adult Monitoring trips for juvenile fish (< 250 mm TL; top), adult fish (≥ 250 mm TL; middle), and for all life stages combined (juveniles + adults; bottom). Error bars represent one standard error. Sloping horizontal lines represent the long-term trend in CPUE.

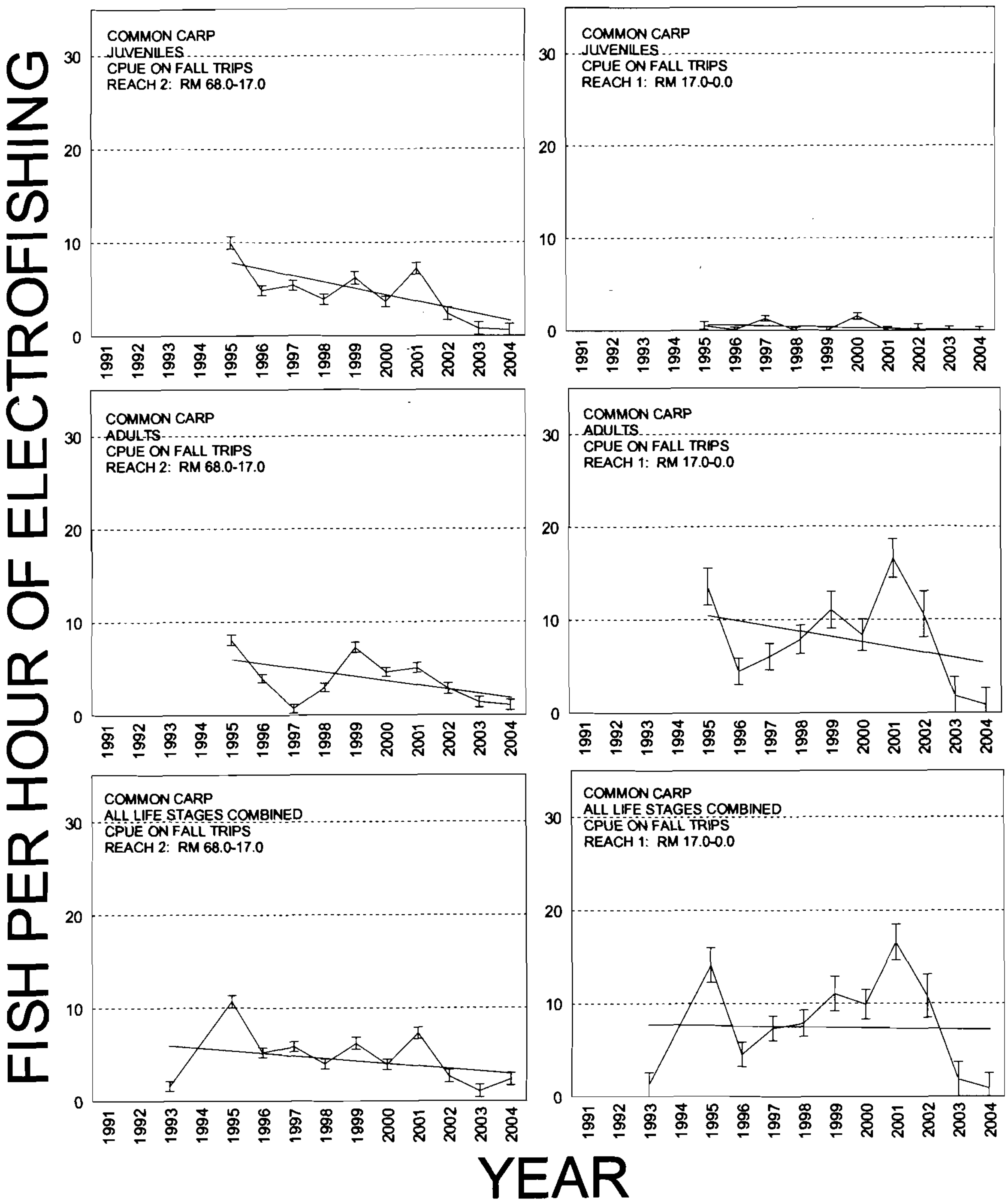

Figure 38. Common carp catch per unit effort (CPUE) in Reach 2 and Reach 1 on fall Adult Monitoring trips for juvenile fish (< 250 mm TL; top), adult fish (≥ 250 mm TL; middle), and for all life stages combined (juveniles + adults; bottom). Error bars represent one standard error. Sloping horizontal lines represent the long-term trend in CPUE.

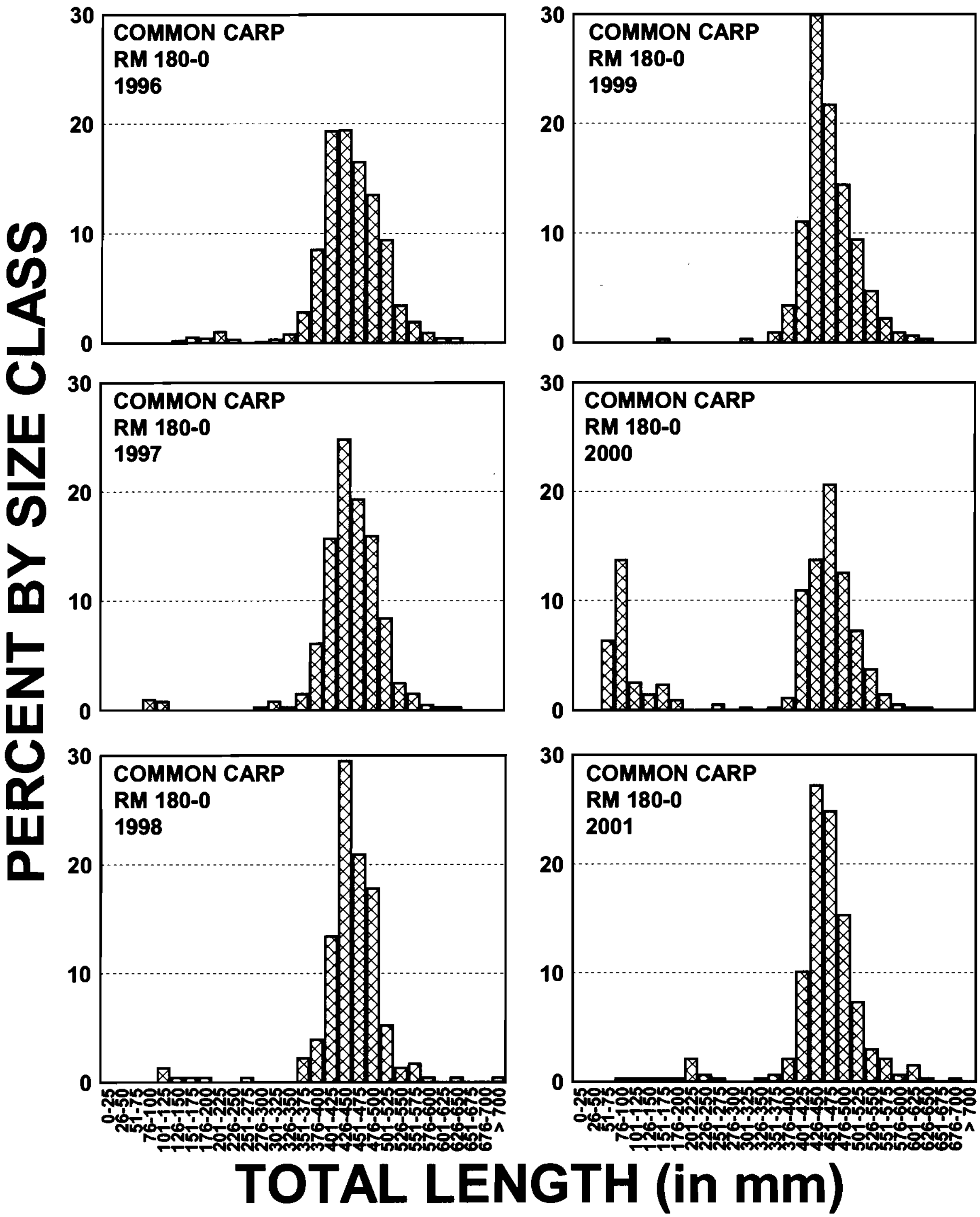

Figure 39. Length-frequency histograms showing the riverwide (RM 180.0-0.0) size-class distribution of common carp on fall Adult Monitoring trips in the San Juan River, 1996-2001.

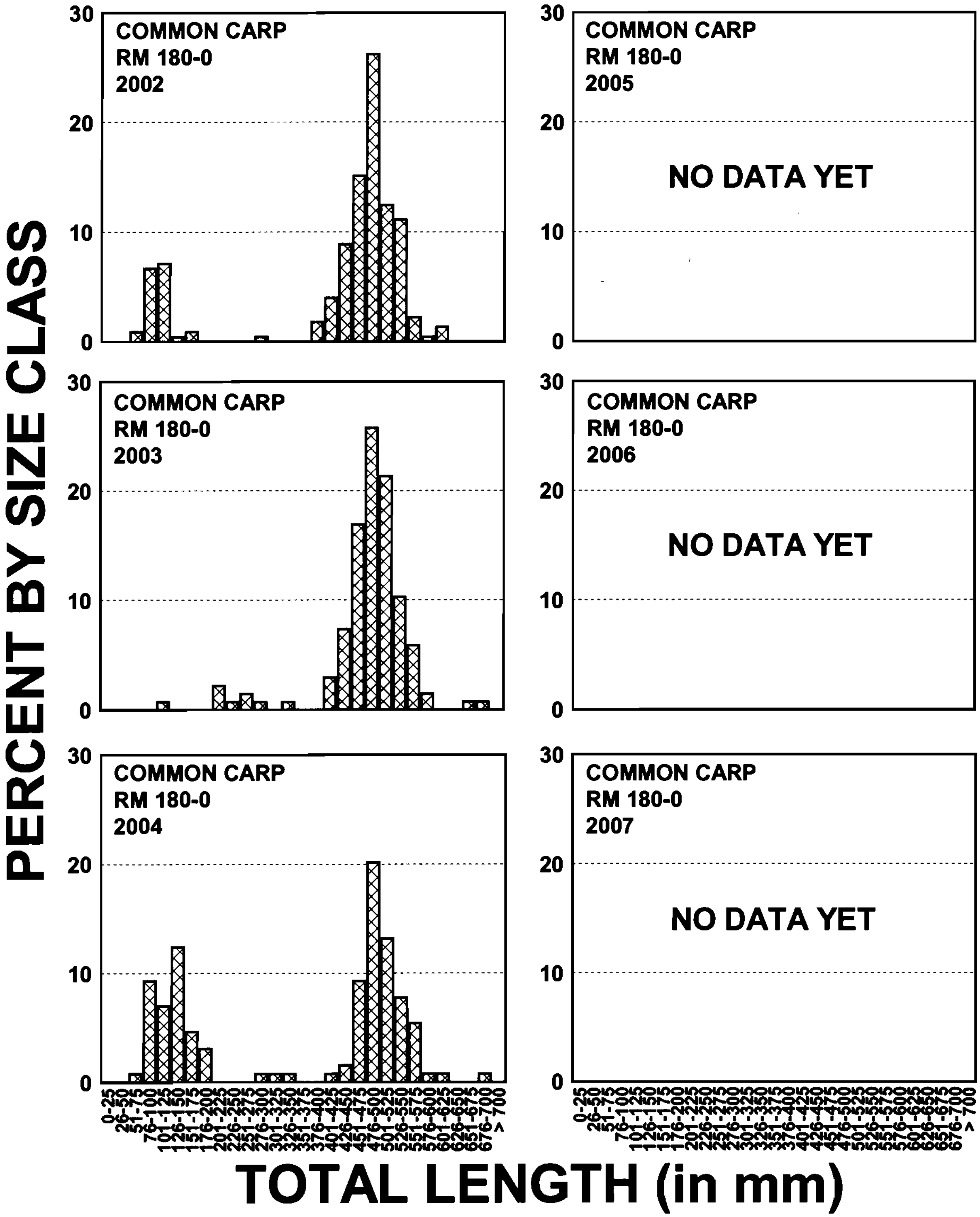

Figure 40. Length-frequency histograms showing the riverwide (RM 180.0-0.0) size-class distribution of common carp on fall Adult Monitoring trips in the San Juan River, 2002-2004.

Despite the increasing percentage of juvenile fish within the San Juan River common carp population over the last nine years, large, adult common carp (> 425 mm TL) still continue to be the most commonly-collected size-class (Figures 39, 40, and 41). In fact, as the relative numbers of adult fish decline, the adult fish that are remaining in the river appear to be getting larger. The most frequently-collected size-class of common carp from 2002-2004 were fish that were 476-500 mm TL (Figure 41). This is an increase over the period 1996-2001, when the most commonly-collected size-class (with the exception of 2000) were fish that were 426-450 mm TL (Figure 41). The relatively large influxes of juvenile fish in 2000, 2002, and 2004 are clearly associated with declines in mean TL among common carp riverwide in those same years (Figure 42).

Biomass

Like mean TL, common carp mean biomass (weight in g) riverwide saw drops in 2000 and 2004, associated with the influxes of juvenile fish (Figure 43). With the exception of those two years, there has been a generally increasing trend in common carp mean TL riverwide between 1996 and 2003 (Figure 43). This is because adult common carp are so much larger and heavier than their juvenile counterparts that even in years when there are relatively large numbers of juvenile fish present (i.e., 2000, 2002, 2004) the mean biomass of these larger adult fish masks the smaller fish and tends to drive the trends seen in the mean biomass profile riverwide. The increasing trend in mean biomass riverwide (Figure 43) over the last nine years also attests to the fact that the adult common carp that remain in the San Juan River are not only getting larger, but heavier as well.

Unlike mean biomass, total biomass (weight in kg) per hour of electrofishing riverwide has been steadily declining over the last three years and reached an all-time observed low in 2004 of 8.75 kg/hr of electrofishing Figure 43). This is directly associated with the overall decline in adult common carp CPUE riverwide (Figure 35).

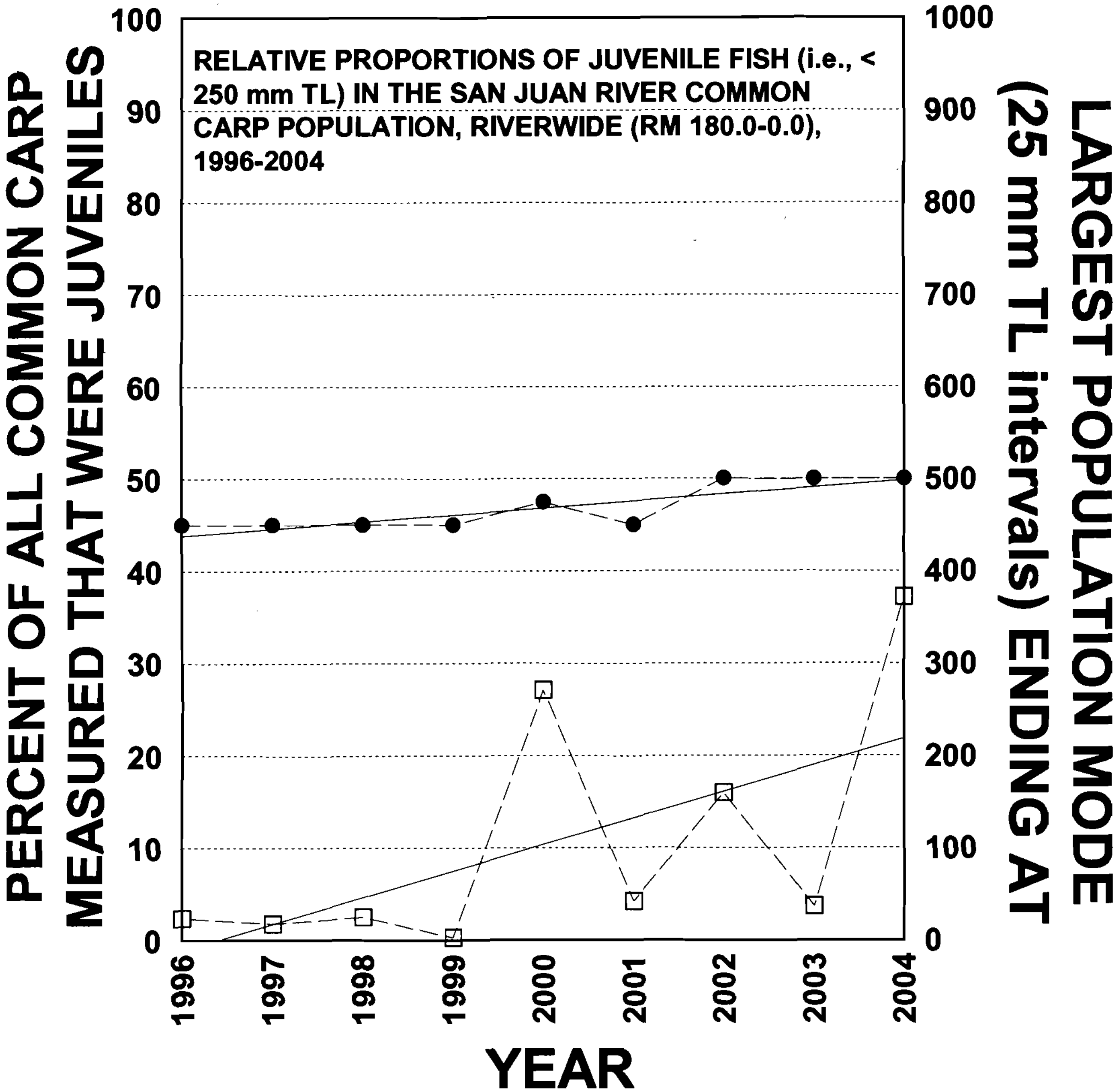

Figure 41. The relative proportion of juvenile fish (< 250 mm TL) observed among common carp collected and measured from the San Juan River, 1996-2004. The bottom dashed line (with open squares) represents the percent of all measured common carp in a given year's samples that were juveniles. The top dashed line (with solid circles) represents the TL at which the largest population mode (from Figures 39 and 40), ended at. Therefore, the 2002-2004 values represent 476-500 mm TL, the 1996-1998 values represent 426-450 mm TL, and so on. The solid sloping lines (top and bottom) represent the long-term trends for these two metrics.

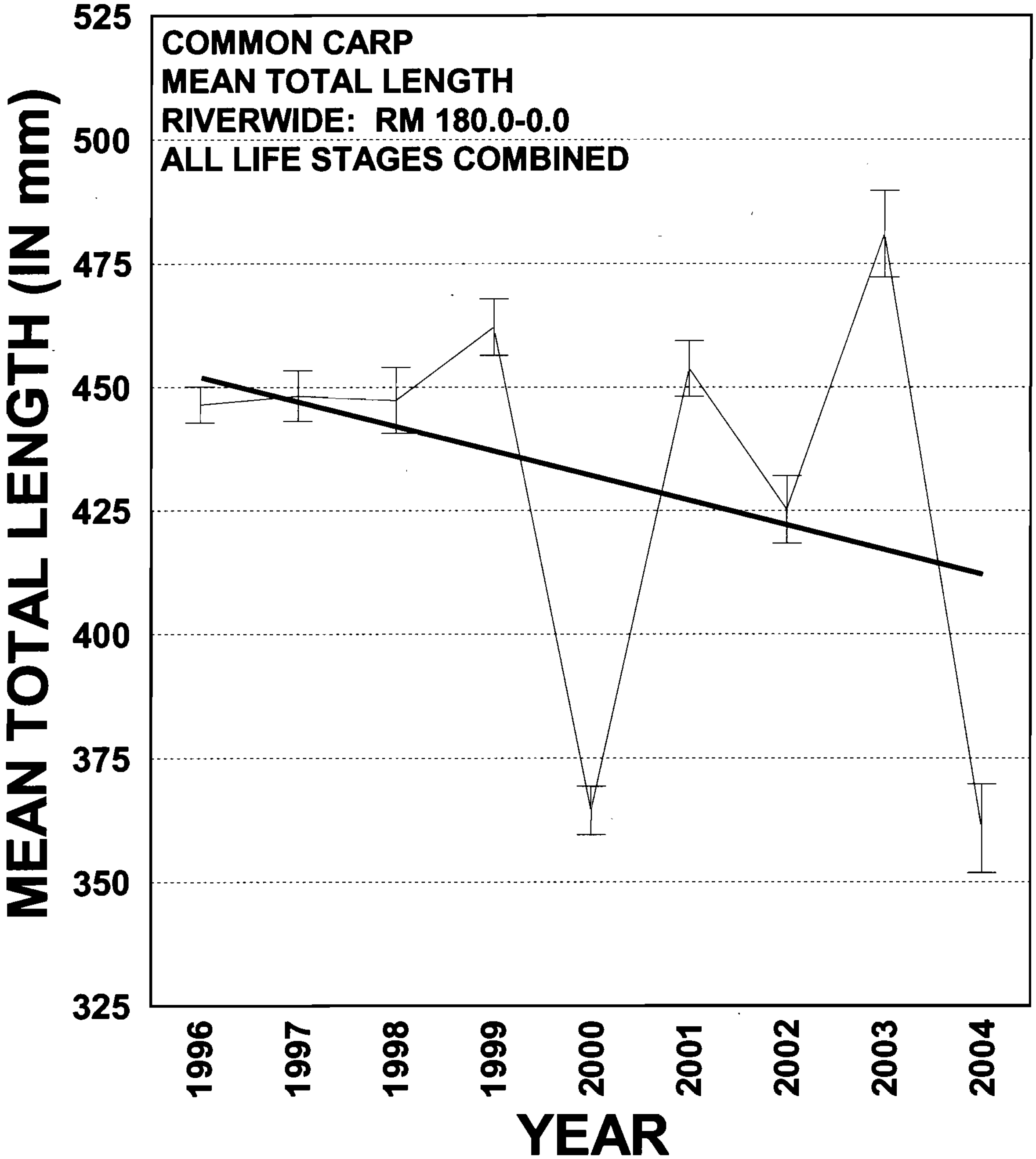

Figure 42. Mean total length (in mm) of common carp riverwide (RM 180.0-0.0) on fall Adult Monitoring trips in the San Juan River. Error bars represent one standard error. The sloping horizontal line represents the long-term trend in mean total length.

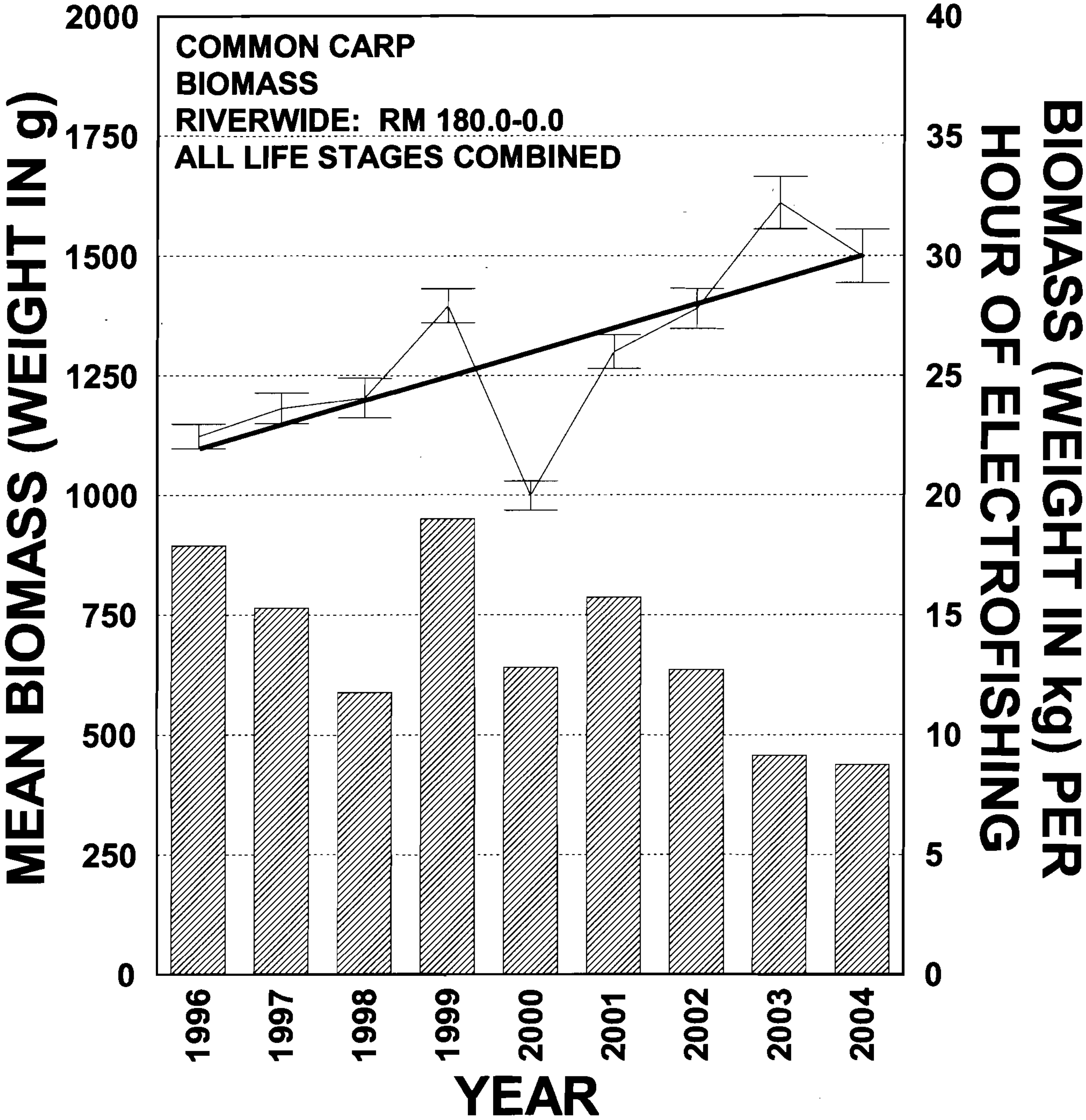

Figure 43. Mean biomass (weight in g; line connecting error bars) and total biomass (weight in kg; cross-hatched vertical bars) per hour of electrofishing of common carp riverwide (RM 180.0-0.0) on fall Adult Monitoring trips in the San Juan River. Error bars represent one standard error. The sloping horizontal line represents the long-term trend in mean biomass.

Other Nonnative Fishes

Largemouth Bass, Striped Bass, and Walleye

A total of 59 largemouth bass (all juveniles) were collected during 2004 Adult Monitoring collections (Table 8). Collections of largemouth bass ranged from RM 176.0—7.0 and fish ranged in size from 51-285 mm TL. This was the second highest number of largemouth bass collected during the last nine years of riverwide Adult Monitoring trips (Table 8). Of the 59 juvenile largemouth bass collected, 36 were collected in Reach 6, 12 were collected in Reach 5, 7 were collected in Reach 4, 1 was collected in Reach 3, 2 were collected in Reach 2, and 1 one collected in Reach 1. The large majority, 45 (76.3%) of 59, were collected upstream of the highway bridge in Shiprock, NM (i.e., > RM 147.9). Nonnative fish removal crews also reported collecting large numbers of juvenile largemouth bass in the river from RM 166.6-147.9 during the spring and early summer of 2004 (J. Davis pers. comm.).

As in years past, it would seem that the point of origin of these fish is upstream of Shiprock, NM. The complete lack of adult largemouth bass in electrofishing collections would seem to suggest that these fish are coming from an off-channel source, and not being spawned in the river itself. The lack of appreciable numbers of largemouth bass from year to year (Table 8) and the apparent lack of recruitment would also seem to indicate that these fish are not surviving for long periods of time in the mainstem San Juan River (i.e., they are transient members of the mainstem river's fish community).

For the second straight year, no striped bass or walleye were collected during Adult Monitoring collections in 2004 (Table 8). The formation of a waterfall downstream of Clay Hills boat landing (Clay Hills = RM 2.9) in 2003 seems to have effectively isolated the lower San Juan River from Lake Powell, thereby preventing predatory fish from Lake Powell from invading the San Juan River.

Table 8. 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, 1996-2004.

Year	Number Of Hours Of Electrofishing	Total Numbers Collected, Life Stages[a], And (CPUE) By Species		
		Largemouth Bass	Striped Bass	Walleye
1996	165.41	Total = 16 J=16 (0.10/hr)	Total = 14 A=14 (0.08/hr)	Total = 21 A=21 (0.13/hr)
1997	166.01	Total = 2 A=2 (0.01/hr)	Total = 0 (0.00/hr)	Total = 9 J=5/A=4 (0.05/hr)
1998	137.15	Total = 5 J=5 (0.04/hr)	Total = 17 J=6/A=11 (0.12/hr)	Total = 6 J=1/A=5 (0.04/hr)
1999	88.36	Total = 0 (0.00/hr)	Total = 0 (0.00/hr)	Total = 9 A=9 (0/10/hr)
2000	116.89	Total = 111 J=109/A=2 (0.95/hr)	Total = 109 J=1/A=108 (0.93/hr)	Total = 7 A=7 (0.06/hr)
2001	109.61	Total = 2 J=2 (0.02/hr)	Total = 2 A=2 (0.02/hr)	Total = 1 A=1 (0.01/hr)
2002	92.17	Total = 7 Y=1/J=2/A=4 (0.08/hr)	Total = 0 (0.00/hr)	Total = 0 (0.00/hr)
2003	94.42	Total = 2 J=2 (0.02/hr)	Total = 0 (0.00/hr)	Total = 0 (0.00/hr)
2004	93.75	Total = 59 J=59 (0.63/hr)	Total = 0 (0.00/hr)	Total = 0 (0.00/hr)

a Y= Young-Of-The-Year; J= Juvenile; A= Adult

DISCUSSION

Rare Native Fishes

Colorado Pikeminnow

No wild adult Colorado pikeminnow were collected during any 2004 sampling trip or study. However, two wild-produced larval Colorado pikeminnow were collected in 2004. The first was collected on 22 July 2004 at RM 46.3 (14.2 mm TL) and the other was collected on 24 July 2004 at RM 17.0 (18.1 mm TL; Brandenburg et al. 2005). These two larvae, collected by crews from UNM, were the first larval Colorado pikeminnow collected from the San Juan River since 2001 (Brandenburg et al. 2005). The collection of these two larval fish proves that adult Colorado pikeminnow are still successfully spawning at some location in the San Juan River.

A total of 159 individual juvenile Colorado pikeminnow were recaptured during the fall 2004 Adult Monitoring trip. This marks only the second time that > 100 Colorado pikeminnow were collected on an Adult Monitoring trip (n = 104 in 1998). The large majority of these recaptured fish were either age-1 fish that were stocked on 6 November 2003 (n = 130) or age-2 fish that were stocked on 9 June of 2004 (n = 12). Very few age-2 fish from the 24 October 2002 stockings were collected, indicating that survival among this group of fish was not as high as had originally been anticipated. Several hundred collections of juvenile Colorado pikeminnow from these same stockings occurred on sampling trips for other studies throughout 2004 (e.g. Brandenburg et al. 2005, Golden and Holden 2005, Jackson 2005). Notable among these were the collection of numerous recently-stocked juvenile Colorado in the Hogback Canal (L. Renfro pers. comm.) and the collection of a juvenile Colorado pikeminnow (212 mm TL) that had been consumed by an adult (416 mm TL) channel catfish after being in the river for less than 12 days post-stocking (Jackson 2005). In addition, five age-2 Colorado pikeminnow that were stocked just downstream of the Animas River confluence on 9 June 2004 were collected in the lower Animas River during the first two weeks of July 2004 (Zimmerman 2005).

Recaptures of Colorado pikeminnow (1991 year-class) that were stocked as adults in April of 2001 continue, although the numbers of contacts with these fish are quickly dwindling. None of these fish were collected during the fall 2004 Adult Monitoring trip. However, three individuals were recaptured during other studies in 2004. Two individuals were collected during nonnative fish removal operations (one of these fish was recaptured three different times; Davis 2005) and two individuals were recaptured in the PNM Fish Ladder (one of these was the same fish that was recaptured multiple times during nonnative fish removal; Lapahie 2004).

The last group of Colorado pikeminnow that were encountered in the San Juan River in 2004 were fish that had originally been stocked as age-0 fish in either 1996 or 1997 by the UDWR. Over the past couple of years, several of these fish that had recruited into adulthood have been collected in the lower San Juan River (i.e., downstream of Mexican Hat, UT) by nonnative fish removal crews (e.g., Jackson 2004). In 2004 however, only one of these recruited adults (a 1997 year-class fish) was collected in the lower San Juan River (on 25 March 2004 at RM 16.4; Jackson 2005).

So at present, there are Colorado pikeminnow from several different year-classes and stockings residing in the San Juan River. In addition, the distribution of these fish is widespread (i.e., from the Animas River downstream to just above Lake Powell). However, even though CPUE of Colorado pikeminnow during the fall 2004 Adult Monitoring trip was at an all-time high and numerous different year-classes of fish (including spawning adults) were present in the river in 2004, there is still a need for caution when interpreting these results.

First, very few adult fish are being collected annually. Likewise collections of wild-produced larvae remain low or absent in most years. In addition, stocked fish (whether originally stocked as adults or as age-0, age-1, or age-2 fish) seem to not be remaining in the river in great numbers for multiple years post-stocking. Survival into the first year or two post-stocking seems to be relatively good, but then numbers of fish surviving from any given stocking seem to dwindle rapidly.

Several sources of post-stocking loss among stocked Colorado pikeminnow have been identified over the last several years. First, the loss of large numbers of stocked fish within the first 36-72 hours post-stocking due to either stocking stress or differences in water quality between the hatchery and the river appears to have been an issue in the fall of 2003 (Golden and Holden 2005). It has also been documented that stocked Colorado pikeminnow are prone to adverse interactions with ictalurid fishes in the San Juan River, whether they be the victim of predation by channel catfish (Jackson 2005) or they choke on either channel catfish (Ryden and Smith 2002) or black bullhead (Lapahie 2003) while trying to consume them. Likewise, the documented loss of stocked fish due to instream water diversion structures such as Hogback Canal (L. Renfro pers. comm.) and the now-defunct Cudei Canal (Arcer et al. 2000) is also a concern.

It appears as if the San Juan River's wild Colorado pikeminnow population is now essentially gone. At best, a few older, adult fish may remain. Therefore, the artificial augmentation of this population using hatchery-produced fish (following Ryden 2003b) has become critically necessary. The documented, large-scale losses of stocked fish, to various sources, within the first couple of years post-stocking is likely not anything unusual. Even among healthy populations of wild fish, very high mortality rates between spawning and recruitment into adulthood are the norm. Therefore, when employing hatchery-reared fish (which have even higher mortality rates than wild-produced fish) to augment the San Juan River Colorado pikeminnow population, it becomes very much a numbers game. Hopefully, if we stock Colorado pikeminnow in large enough numbers for enough consecutive years (while still working to remove impediments to their survival and long-term retention), the few survivors from several different years-classes, along with their wild-produced offspring, will combine to form a healthy, multi-year-class population.

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 (e.g., Ryden 2005b). This was the case again in 2004, when only 2,989 razorback sucker were stocked into the San Juan River (Ryden 2005b). However, despite falling well short of the annual stocking goal of 11,400 razorback sucker $\geq$ 300 mm TL (as specified in Ryden 2003c), more razorback sucker were stocked in 2004 than in any previous year.

Despite the comparative paucity of razorback sucker that have been stocked into the San Juan River, these fish continue to persist and grow. These fish have successfully spawned for seven consecutive years. Larval razorback sucker were collected in every year from 1998-2004 (e.g., Brandenburg et al. 2005). A spawning aggregations of adult razorback sucker was also identified in the San Juan River in 2004. This aggregation, consisting of one ripe male (455 mm TL) and one ripe female (497 mm TL) was documented at RM 154.27 on 26 April 2004 (Ryden 2005b).

Despite the relatively small numbers of fish that have been stocked since 1994, trends in CPUE among stocked razorback sucker have been encouraging. CPUE among razorback sucker in fall 2004 was the highest ever recorded for an Adult Monitoring trip at 1.44 fish/hr of electrofishing. This CPUE value was over four times as high as during any previous year's fall Adult Monitoring trip. In fact, 2004 was the first year that > 100 (n = 117) individual razorback sucker were collected on a fall Adult Monitoring trip. Numerous stocked razorback sucker also continue to be collected throughout the San Juan River during sampling trips for other studies (e.g., Davis 2005, Jackson 2005). In addition, there is evidence that razorback sucker spawned in the wild are beginning to recruit, albeit in small numbers. Wild-produced, juvenile razorback sucker were collected during both seining and electrofishing efforts for other studies in 2004 (e.g., Golden and Holden 2005, Jackson 2005). Stocked razorback sucker and their offspring are now found, longitudinally, throughout the San Juan River, as well as in the San Juan River arm of Lake Powell (S. Vatland and G. Mueller pers. comm.). Razorback sucker now inhabit the San Juan River from the PNM Weir (e.g., Lapahie 2004) to Lake Powell.

However, like stocked Colorado pikeminnow, the majority of stocked razorback sucker appear to inhabit the San Juan River for only a few years post-stocking. Examination of the numbers of days in the river post-stocking among recaptured razorback sucker from 2002-2004, revealed that most recaptured razorback sucker have been in the river for < 4 years post-stocking (Figure 5; Ryden 2005b). Again, this may simply be a numbers game. As was the case with hatchery-reared Colorado pikeminnow, pond-reared razorback sucker ($\geq$ 300 mm TL) likely survive in lesser numbers post-stocking than would corresponding wild fish of the same age- and size-classes. And, to date, the number of stocked razorback sucker in the river in any given calendar year has been relatively low. Since it appears that survival and/or retention among stocked razorback sucker drops off markedly at about four years post-stocking, then the continued annual stocking of large numbers of razorback sucker (up to 11,400 annually; Ryden 2003c) becomes critically important to the future health of this fish population in the San Juan River.

Roundtail Chub

Roundtail chub collections continue to be very rare during Adult Monitoring collections in the San Juan River. No roundtail chub were collected in the San Juan River during 2004 Adult Monitoring collections.

Common Native Fishes

Flannelmouth Sucker

Flannelmouth sucker are still the most abundantly-collected large-bodied fish species in the San Juan River. This species is consistently collected in > 90% of all electrofishing riverwide each year. Flannelmouth sucker are found throughout all six river reaches in the Adult Monitoring study area and are ubiquitous, occupying a multitude of habitat types. In addition, flannelmouth sucker of all life stages continue to be collected with regularity, showing that reproduction and recruitment are still occurring. Long-term trend lines show that despite year-to-year fluctuations observed in riverwide CPUE, the flannelmouth sucker population has remained relatively stable over the last nine years. However, CPUE data from Reaches 5-3 collected from 1991-1995 seem to indicate that while the San Juan River flannelmouth sucker population appears to be relatively stable over the last nine years (1996-2004), its overall abundance is less than what it likely was, riverwide, in the early 1990's.

Noticeable influxes of age-0 and age-1 fish were apparent in the 2004 flannelmouth sucker length-frequency histogram. This indicates that sizeable cohorts of flannelmouth sucker are in the process of recruiting into the adult population.

Bluehead Sucker

Since the early 1990's, bluehead sucker in the San Juan River have been heavily concentrated in upstream reaches of the river, specifically in Reach 6 of the Adult Monitoring study area. In most years, bluehead sucker total CPUE in Reach 6 is twice as high (sometimes as much as three times as high as in adjacent Reach 5, where they are next most abundant. In reaches downstream of Reach 5, bluehead sucker CPUE drops off very rapidly, with bluehead sucker usually becoming completely absent from Adult Monitoring collections by Reach 1. Therefore, "riverwide" trends in bluehead sucker CPUE are really driven by what occurs in Reach 6 and to a lesser extent in Reach 5. Given their heavy concentration in the most upstream reach of our study area, it seems likely that the dramatic fluctuations in bluehead sucker CPUE observed in Reach 6 over the last nine years are, at least in part, an artifact of the population in this reach being heavily influenced (e.g., via immigration and emigration) by bluehead sucker from adjacent upstream river sections (i.e., the Animas River and/or Reach 7).

Over the last four years, bluehead sucker have become more widely distributed throughout the San Juan River. This species was the second most commonly-collected fish species during fall Adult Monitoring collections in each of the last three years. In 2004, bluehead sucker occurred in 96.6% of all electrofishing collections riverwide. In addition, 2004 marked the second consecutive year in which bluehead sucker were collected from Reach 1, adjacent to Lake Powell. Prior to 2003, no bluehead sucker were ever collected from Reach 1 during Adult Monitoring studies. Unlike the other three common large-bodied fish species, the long-term trend line for riverwide CPUE for this species has shown a noticeable increase over the last nine-year period.

The reason for the increased distribution of bluehead sucker in the San Juan River over the last years is unknown. The last four years corresponds nicely to the time when intensive nonnative fish removal efforts really began in earnest in both the upper (RM 166.6-147.9) and lower (RM 52.9-2.9) San Juan River. Nonnative fish removal efforts actually began in 1996, but between 1996 and 1999, they were fairly limited both in numbers of sampling trips and in the amount of river being repeatedly sampled. In 2000, nonnative fish removal efforts began intensively (ten trips/year with three passes/trip) in the upper portion of the San Juan River between PNM Weir and Buck Wheeler's property (RM 166.6-159.4), just upstream of the Hogback Diversion. Later, these efforts were expanded to include the section of river from Hogback Diversion downstream to Shiprock, NM (RM 158.6-147.9). In 2001, a similar intensive nonnative fish removal effort (ten trips/year with one pass/trip) began in the lower river downstream of Mexican Hat, UT (RM 52.9-2.9). However, whether the increased distribution and number of bluehead sucker riverwide is actually tied to nonnative fish removal efforts, or whether these two things are purely coincidental is unknown.

As was the case with flannelmouth sucker, the 2004 bluehead sucker length-frequency histogram showed noticeable cohorts of both age-0 and age-1 fish. This indicates that there are healthy and abundant year-classes of young fish currently recruiting in the San Juan River bluehead sucker population.

Common Nonnative Fishes

Channel Catfish

For the third year in a row, channel catfish were the third most commonly-collected species during fall Adult Monitoring collections. While still abundant and widespread, it appears as if the San Juan River channel catfish population is beginning to be noticeably impacted by nonnative fish removal efforts. First, channel catfish were only collected in 75.4% of all 2004 electrofishing collections. While this is still fully ¾ of all collections, this is the least widespread channel catfish have been during riverwide Adult Monitoring collections over the last nine years. Second, the San Juan River channel catfish population is becoming increasingly dominated by juvenile fish. During fall 2004 Adult Monitoring collections, 78.3% of all channel catfish collected were juvenile fish. While this phenomenon could be the result of a very large influx of juvenile fish masking the presence of adult fish, such was not the case in 2004. In 2004, the riverwide CPUE for adult channel catfish dropped to the lowest value ever observed, while juvenile CPUE rose only slightly. In fact, riverwide CPUE among adult channel catfish has declined consistently and markedly over the last four years. Again, this corresponds nicely to the time frame when intensive nonnative removal efforts really began in both the upper (RM 166.6-147.9) and lower (RM 52.9-2.9) portions of the San Juan River. This decline in adult CPUE riverwide, combined with a reduction in distribution is almost certainly beginning to effect the reproductive potential as a whole. While juvenile channel catfish CPUE rose slightly between 2003 and 2004, the long-term trend for riverwide CPUE among both juvenile and adult channel catfish is declining over the last nine years (1996-2004). At present, the largest proportion of the San Juan River channel catfish population is residing in Reaches 5-2, directly in between the two areas where intensive nonnative fish removal efforts are occurring.

Channel catfish have been documented to have adverse effects on the San Juan River's native fish community. They are documented predators of flannelmouth sucker, bluehead sucker, speckled dace, Colorado pikeminnow (Jackson 2005), and razorback sucker (Jackson 2005). They present a choking hazard when ingested by Colorado pikeminnow (Ryden and Smith 2002). They have also been implicated in attacking adult native suckers. Circular or crescent-shaped "bite marks" found on all three native sucker species are thought to be from channel catfish (Appendix A).

If the SJRIP is truly serious about nonnative fish removal, multi-pass removal efforts appear to be the way to go. On the fall 2004 Adult Monitoring trip, a total of 1,662 channel catfish were removed in a single pass from RM 180.0-2.9. Comparatively, USFWS-NMFRO nonnative fish removal crews removed 6,925 channel catfish from RM 166.6-147.9 in ten trips (three passes per trip) and UDWR-Moab nonnative fish removal crews removed 7,781 channel catfish from

RM 52.9-2.9 in ten trips (one pass per trip) in much shorter river sections. The number of nonnative fish removed by supporting studies like Adult Monitoring or razorback sucker monitoring, while not inconsequential, is much lower than the numbers of fish that can be removed on multiple trips that specifically target nonnative fish species. If multi-pass nonnative fish removal efforts were initiated riverwide, then it would likely be possible to keep the large number of juvenile channel catfish (specifically those in Reaches 5-2) cropped back, so they do not become reproductively-active adults, while at the same time further reducing the number of mature adult fish that are currently remaining in the river. Even if nonnative fish removal efforts are not expanded, it is my recommendation that they not be terminated or scaled back. It is also my recommendation that opportunistic removal of all nonnative fishes encountered continues on all SJRIP studies.

Common Carp

In 2004, common carp no longer were one of the top four most commonly-collected fishes on Adult Monitoring trips for the first time since these studies were initiated in 1991. Common carp accounted for only 4.73% of the total catch in 2004 and were collected in only 69.1% of all electrofishing samples riverwide in 2004. The San Juan River common carp population (at least the portion we collect on fall Adult Monitoring trips) has always been dominated by large adult fish. However, numbers of adult common carp have declined in every single river reach for at least three straight years and longer than that in Reach 6. The result is that the riverwide CPUE for adult common was at the lowest value ever observed in 2004. Between 1999 and 2004, juvenile common carp CPUE riverwide has increased twenty-fold, but even with this increase, juvenile common carp still only reached 2.41 fish/hr of electrofishing on the fall 2004 Adult Monitoring trip.

The exact causes of the large-scale decline in adult common carp CPUE riverwide through 2004 are unknown. While nonnative fish removal efforts may not have been the single driving factor in the decline in common carp CPUE's observed through 2004, they were almost certainly a heavily contributing factor. These nonnative fish removal efforts 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 or possibly even expanded (see Channel Catfish above).

Other Nonnative Fishes

No striped bass or walleye were collected during 2004 Adult Monitoring collections. Upstream access into the lower San Juan River for these two species has been blocked by the very low water levels in Lake Powell and the formation of new waterfall in the summer of 2003 just downstream of Clay Hills boat landing (Clay Hills = RM 2.9).

A total of 59 juvenile largemouth bass were collected during the fall 2004 adult Monitoring trip. However, no adult largemouth bass were collected on that trip. The collection locations and sizes of these 59 fish seemed to indicate that they were originating from an upstream source (likely off-channel ponds), possibly near Farmington, NM. The lack of adult largemouth bass collections, combined with very few largemouth bass collections of any life stage in most years seems to indicate that the largemouth bass that are being collected are transient members of the San Juan River fish community. There does not appear to be a healthy, reproductively-active largemouth bass population in the mainstem San Juan River.

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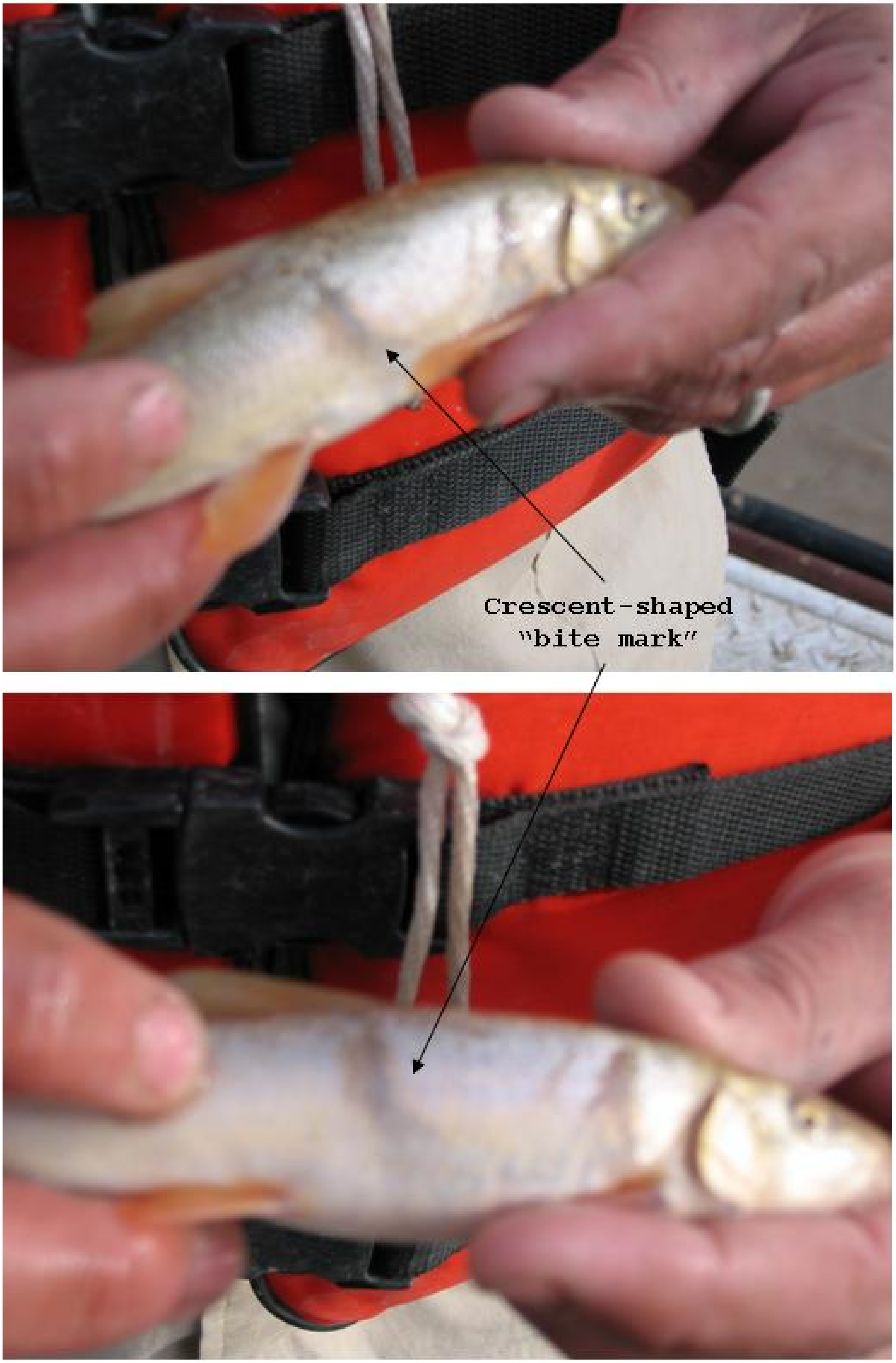
APPENDIX A

Photographs of suspected channel catfish bite marks that have been observed on native suckers in the San Juan River.

A 322 mm TL razorback sucker

A 472 mm TL razorback sucker

A 497 mm TL razorback sucker



An out-of-focus picture of a juvenile flannelmouth sucker with a "bite mark"

A 484 mm TL
flannelmouth sucker

A 504 mm TL flannelmouth sucker

A 337 mm TL
bluehead sucker