

**Note: This project has been redirected toward smallmouth bass management in the Colorado River, beginning in FY 04. Catfish management may resume if/when more effective management techniques are identified. This report serves as the final report for the FY 03 effort in the Colorado River.**

I. Project Title: **Development of a channel catfish removal and control program in the Upper Colorado River of western Colorado.**

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III. Project Summary:

The purpose of this study is to 1) determine if a removal program is feasible for controlling adult channel catfish abundance in the Upper Colorado River in western Colorado near Grand Junction, and 2) if removal is feasible, should this approach be incorporated into a long-term plan for managing catfish. The ultimate goal is to enable endangered and other native fishes to coexist and thrive. Field activities commenced in 2003 and almost all tasks were completed. Five complete passes were accomplished using boat and raft-based electrofishing within the 39-mile study area from the Colorado/Gunnison River confluence to the Utah/Colorado stateline. The study area was partitioned into two reaches, each with two control and two treatment segments. Channel catfish collected in the control segments (n=1,356) were marked and returned to the river alive; channel catfish collected in the treatment segments were removed and stocked alive into Highline Lake in western Colorado. This accounted for 1,236 catfish totaling approximately 640.431 kg (1,412 pounds).

Using catch/effort indices (fish/hour and fish/mile), there did not appear to be an obvious reduction in channel catfish density or abundance between control and treatment segments over the five passes during 2003. Biomass estimates were even less definitive in detecting a change in the channel catfish population during 2003.

There was no essentially no significant difference ( $\alpha=.05$ ) in the mean total length of channel catfish captured between the control and treatment segments over the five passes with electrofishing. This was the case in both the Upper and Lower reaches.

Channel catfish capture rate was only 1.4%. Sixty-three percent (10 of 16) of recaptured

fish had moved outside the control segment in which they were marked and released. Between release and recapture points, upstream movement (mean=12.5 miles) was about 2.8 times greater than downstream movement (mean=4.5 miles). Initial mortality related to capture, handling, and transporting was estimated at about 0.99%.

Trap nets selected for young channel catfish (mean=131 mm total length). Numbers of smallmouth bass, a by-catch species of this study, appear to be on the increase in the Colorado River. Smallmouth bass relative abundance steadily increased throughout the first year of this study. Smallmouth bass were about 2.8 times more numerous than largemouth bass, and relative abundance estimates (fish/hour) for smallmouth bass were over 3 times greater.

IV. Study Schedule:

- a. initial year: 2003
- b. final year: 2003 (Redirected toward smallmouth bass beginning in 2004).

V. Relationship to RIPRAP:

Colorado River Action Plan: Mainstem

- III. Reduce negative impacts of nonnative fishes and sportfish management activities.
  - III.A. Develop and implement control programs in reaches of the Colorado River occupied by endangered fishes.
    - III.A.5. Develop and implement program to identify required level of channel catfish control.

VI. Accomplishment of FY 2003 Tasks and Deliverables, Discussion of Initial Findings and Shortcomings:

A. FY-2003 Tasks and Deliverables: Tasks 1, 2, and 3.

Task 1. Coordinate I & E efforts with personnel from the Recovery Program and Public Service and aquatic staffs from the Colorado Division of Wildlife for implementing a public awareness program for removing channel catfish from the Colorado River in the Grand Valley. This task was recommended by the Biology Committee at the August 27-28 meeting in Salt Lake City. The task was added to the scope-of-work as recommended, but no money was added to the project budget. CRFP-Grand Junction did not know what the extent of their involvement would be and, therefore, any estimated costs could not be justified.

Task Completed.

Task 2. Sample channel catfish with electrofishing and trap/hoop nets. Mark and release alive (control segments) and hold, transport, and stock live channel catfish (treatment segments) in approved Colorado waters to provide a channel catfish sport fishery. Radiotag up to 10 adult channel catfish.

Task partially completed. Five passes of the upper and lower reaches were

completed with aluminum and raft-based electrofishing. Channel catfish, smallmouth bass and largemouth bass captured in treatment segments were transferred alive and stocked into Highline Lake. Trap nets were set in backwaters in two control segments of the upper reach. An administrative decision was made to defer implanting adult channel catfish with radio transmitters to 2004. Instead, the effort necessary to implant channel catfish with radio transmitters was used to make as many passes as possible to maximize catches of channel catfish in the Upper and Lower reaches of the Colorado River.

Task 3. a) analyze data; b) prepare annual RIP reports.

Task completed. Preparation of the annual report also sufficed for the December 2003 nonnative fish workshop.

## B. Findings (2003 Highlights)

### General

The study area encompassed a 39-mile section of the Colorado River in western Colorado from the Gunnison and Colorado River confluence to the Utah/Colorado stateline. This section was divided into a Upper Reach and Lower Reach (Table 1). The Upper Reach was 18 miles long that extended from the Gunnison and Colorado River confluence to the Loma Boat Landing. The Lower Reach was about 20.5 miles long and extended from the Loma Boat Landing to the Utah/Colorado stateline. The two reaches are characterized by different hydro-geomorphic features. The Upper Reach flows through a wide alluvial section of the lower Grand Valley; the Lower Reach flows through a canyon-bound section. The Lower Reach is considered a quasi-alluvial section. Two control and two treatments segments were delineated for each of the two respective reaches (Table1). A complete description of length and river miles for each of these segments is provided in Table 1. In the control segments, channel catfish were marked with a colored and numbered floy tag, weighed, measured (total length, mm), and returned alive to the river. In the treatment reaches, channel catfish were weighed, measured, and fin-clipped. Catfish in the treatment segments were transported in 0.5% salt solution (by weight). Compressed oxygen was provided to the fish in the holding tanks. These fish were then stocked into Highline Lake north of Loma, Colorado. Nonnative sportfish such as smallmouth and largemouth bass collected in treatment areas were also transported alive and stocked into Highline Lake. When sufficient numbers of bass species were collected within control segments, and it was feasible, Colorado Division of Wildlife assisted Fish and Wildlife Service personnel by transporting bass to Highline Lake.

Five passes were made in the Upper and Lower reaches using boat and raft-based electrofishing to collect channel catfish from 30 June to 31 October in 2003. Every attempt was made to use two electrofishing craft per pass. However, on occasion, only one craft was used because the other craft was unavailable due to equipment breakdowns. When time permitted, the segment was electrofished a second time so that all segments received an equal amount of effort. Baited trap nets were set in four different backwaters

in two control segments of the Upper Reach from 24 July to 22 August to determine the efficacy of trap nets in collecting channel catfish. Trap nets were baited with a mixture of blood, whey, and corn meal.

### Electrofishing

*Raw Numbers.* Summary statistics for channel catfish collected with boat and raft-based electrofishing during each of the five passes were tallied by individual control and treatment segments for the Upper and Lower reaches (Tables 2–6). Additionally, control segments for the Upper and Lower reaches were combined because sample sizes were small during some passes. For the same reason, treatment reaches were combined as well (Tables 2–6). For the control segments, 470 channel catfish were captured in the Upper Reach during all five passes as compared to 886 for the Lower Reach. In the treatment segments, 524 channel catfish were collected in the Upper Reach, compared to 749 in the Lower Reach. This included all channel catfish captured, including young-of-the-year, juvenile, and adults.

*Catch/Effort.* Catch/effort was computed as fish/hour and fish/mile. Fish/hour was greatest for the two treatment segments in the Lower Reach (26.34 fish/hour). Fish/hour for the five passes combined was similar for the two control segments and two treatment segments in the Upper Reach (15.28 and 16.21, respectively). Fish/hour for the five passes combined for the two control segments in the Lower Reach (12.66 fish/hour) was similar to the two control segments in the Upper Reach.

Fish/hour and channel catfish collected per mile were plotted for the combined control segments and combined treatment segments for the Upper (Figure 1) and Lower (Figure 2) reaches over the five passes. For the Upper Reach, fish/hour in the control segments increased slightly from pass 1 to pass 5. In the treatment segments of the Upper Reach, the fish/hour and fish/mile indices steadily increased from pass 1 to pass 5. In the Lower Reach, the trend for these same two indices were more erratic. In the two control segments, fish/hour steadily increased from pass 1 through pass 4, but declined during pass 5. The same general trend held for the two treatment segments; pass three had the highest fish/hour and channel catfish caught per mile.

*Biomass.* Total biomass of channel catfish collected per pass for the Upper (Figure 3) and Lower (Figure 4) reaches was also plotted to determine the effectiveness of the removal program. Again, because sample sizes were small during some passes, control segments were combined and treatment segments were combined. Among passes, this parameter was variable in both control and treatment segments for both reaches. It is probably still too early in the study to determine if changes in biomass in discrete study segments can be used as a reliable index to detect a response to mechanical removal efforts.

*Size Distribution–Length Frequency.* Length frequency distribution of all sizes of channel catfish collected with electrofishing were plotted for each pass by control and treatment segments and by Upper (Figures 5 and 6) and Lower (Figures 7 and 8) reaches.

Because sample sizes were small during some passes, control segments were combined and treatment segments were combined. Mean total length of all channel catfish collected in 2003 were similar between the Upper (mean=348 mm; n=981) and Lower (mean=333 mm; n=1,626) reach.

Changes in size (i.e., length) have been used to detect changes in age composition of a fish population over time. In this instance, we are looking for a index that could reliably be used to detect changes in the overall size [age] structure of channel catfish in the designated study reaches and discrete control and treatment segments over time. Size structure changes over time then could be used to evaluate whether mechanical removal is reducing the numbers of a particular size [length] group, and therefore, if this technique could be recommended as an effective management tool for removal.

The mean total length and confidence intervals were calculated for control and treatment segments for the Upper (Figure 9) and Lower (Figure 10) reaches. Channel catfish 250 mm and larger were used to analyze if there had been any change (increase or decrease) in the length structure of the channel catfish captured over the five passes during 2003. There was no essentially no significant difference ( $\alpha=.05$ ) in the mean total length of channel catfish captured between the control and treatment segments over the five passes with electrofishing. This occurred in both the Upper and Lower reaches.

*Recaptures.* A total of 1,164 channel catfish were marked with floy tags in the control segments of the Upper and Lower reach. Only 16 of these marked fish were later recaptured (1.4% return rate)(Table 7). Two channel catfish were recaptured by CDOW personnel in the 15-mile reach. Two channel catfish returns were reported by local anglers. Ten of these fifteen catfish were recaptured outside of the control segment where they were originally captured. Seven marked catfish moved into other treatment segments; only one marked catfish moved into another control segment. Between original capture and recapture, nine marked catfish were located upstream; seven others were located downstream. The mean upstream movement was 12.5 miles; the mean downstream movement was 4.5 miles. The days at large between marking and recapture ranged from 2–61 days with a mean of 25.5 days (Table 8). The value of these data from 2003 is that if a considerable number of catfish are recaptured in future years, and this general movement trend continues, this will help assist researchers and bio-statisticians determine the type of population model to use to estimate channel catfish population size.

## Trap Netting

*Raw Numbers and Catch/Effort.* Eight hundred and twenty channel catfish, averaging 131 mm total length, were collected in trap net sets. Trap net hours totaled 1,223.2. Catch/effort was computed as catfish/net day and catfish caught per 24-hr period. Catfish/24-hr was slightly greater (17.45) for the two backwaters netted at river miles 159.2 and 158.2 in the lower control segment (C-2) than the two backwaters in the control segment upstream (C-1: 13.02)(Table 9).

*Size Distribution–Length Frequency.* Trap nets selected mostly young, juvenile size fish (Figure 11). The mean total length for both sites was similar (129 mm vs. 134 mm)(Table 7).

*Recaptures.* No channel catfish were recaptured in trap net sets.

## Mortality

Immediate mortality due to sampling and handling appeared to be low for channel catfish. Only twenty-six channel catfish were reported as immediate deaths which computed to a 0.99% rate. All channel catfish that were captured and held were provided salt (0.5% by weight). In addition to the salt treatment, all channel catfish held and transported via boats and vehicles that were later stocked into Highline Lake were provided compressed oxygen. However, less information is known regarding delayed mortality from sampling, handling, and transporting. For channel catfish, smallmouth bass, and largemouth bass stocked at Highline Lake, Colorado State Division of Parks personnel at the lake did not observe any dead fish during the 4 months fish were stocked there (personal communication, Chris Foreman).

## Stocking Channel Catfish

All channel catfish captured in treatment segments were stocked into Highline Lake. One-thousand, twelve hundred and thirty-six catfish totaling approximately 640.431 kg (1,412 pounds) were stocked (Table 10). On two different dates, researchers encountered anglers on the river. A total of 34 adult-size channel catfish (25.620 kg) were distributed to these anglers (Table 11).

## Largemouth Bass and Smallmouth Bass

*Electrofishing.* The numbers and lengths of these two centrarchid species collected were also documented. The number of both of these two fishes collected with electrofishing in the main channel was considerable. The number of smallmouth bass collected as compared to those collected during previous investigations now leads researchers to believe that this species is becoming more abundant in the Colorado River of the Grand Valley and Ruby and Horsethief canyons. Fish and Wildlife researchers sampling the Colorado River in the spring of 2003 also observed increased catches of smallmouth bass.

Catch/effort (fish/hour and fish/mile) were computed for largemouth bass and smallmouth bass collected in main channel habitats for each of the five passes (Table 12). Fish/hr and fish/mile computations revealed that both bass species increased from pass 1 to pass 5. However, numbers of smallmouth bass were about 2.8 times more numerous than largemouth bass, and relative abundance estimates (fish/hour) were over 3 times greater for smallmouth bass. Estimating the relative abundance of these two bass species in the Colorado River may not be directly comparable. The reason for this is that during this study, electrofishing was conducted primarily in main channel habitats but very little in backwaters. Therefore, these estimates did not include backwater habitats where largemouth bass may be more numerous because of their preference for lentic habitats. Smallmouth bass appear to prefer lotic habitats. Nonetheless, it is important to note that the length frequency of smallmouth bass included young-of-the-year fish (68 mm), juveniles, and adults (Figure 12).

*Trap Nets.* A insignificant number of smallmouth bass (n=1) and largemouth bass were collected in trap nets (n=7).

### I & E Involvement

Grand Junction CRFP staff participated in the evening public meeting held on 28 April 2003 at the City of Grand Junction Auditorium. Dave Buchanan, sports writer for the Grand Junction Daily Sentinel, accompanied fish research biologists on one of their sampling trips in Horsethief Canyon on 31 July 2003. Mr. Buchanan subsequently wrote a full, one page article in the Sentinel on the efforts by the Recovery Program to remove nonnative fish in different river reaches of the Upper Colorado River Basin.

## VII. Recommendations:

1. Suspend all electrofishing operations when it is determined that Colorado pikeminnow show signs of preparing to spawn, e.g., mid- to late-June. Electrofishing will be suspended during this period to eliminate the likelihood of harassment, interference, and injury to spawning Colorado pikeminnow. Trap netting would be substituted for electrofishing during this period. Trap netting should be conducted for at least 4 weeks starting in mid- to late-June in 2004. Plans are to extend trap netting to include low-velocity habitats parallel to the shoreline. Trap nets will again be baited, but soy cake meal will be used.
2. Electrofishing should commence following cessation of spawning of Colorado pikeminnow which should be sometime in mid- to late-July.
3. Increase the number of electrofishing passes in both the Upper and Lower reaches, if possible, in 2004.

4. Adult channel catfish will be implanted with radio transmitters during the sampling period that coincides with the Colorado pikeminnow population estimate study. Preliminary plans are to implant transmitters in adult catfish in the Upper and Lower reaches when sampling teams are in these river reaches. Target implantation dates will be from mid-April to late-May.

VIII. Project Status:

- A. "On track and ongoing".
- B. Study direction and sampling design for 2004 may be adjusted pending the outcome from the nonnative fish workshop in early-December 2003.

IX. FY 2003 Budget Status

- A. Funds Provided: \$ 83,000
- B. Funds Expended: \$ 83,000
- C. Difference: \$ -0-
- D. Percent of the FY 2003 work completed, and projected costs to complete: 100%.
- E. Recovery Program funds spent for publication charges: \$ -0-

- X. Status of Data Submission (Where applicable): All endangered fish collected during this evaluation were checked for a PIT tag in the field. Those wild Colorado pikeminnow that did not have a PIT tag were implanted with one. All data associated with the capture and release of endangered fish were computerized. These data were electronically transmitted to the UCRB database coordinator in Grand Junction in late-October 2003.

- XI. Signed: Bob B. Burdick 14 November 2003  
Principal Investigator Date

APPENDIX:

- A. More comprehensive/final project reports. If distributed previously, simply reference the document or report. None.
- B. Appendix: 11 tables attached  
12 figures attached.

Prepared and compiled by: Bob D. Burdick, 11/14/2003

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## APPENDIX

Table 1. Description of the control and treatment segments in the Colorado River for the channel catfish removal evaluation, 2003.

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Gunnison and Colorado River confluence → Loma Boat Landing [18-Mile Reach] (River miles 171.0–152.6)

1 <sup>st</sup>	4.6 miles:	Control (RETURN FISH SEGMENT)	C-1	171.0–166.4	Gunn/Colo River confluence → Redlands Parkway Bridge
2 <sup>nd</sup>	4.6 miles:	Treatment (REMOVAL FISH SEGMENT)	T-1	166.4–161.8	Redlands Parkway Bridge → Upstream End of Dupont Island
3 <sup>rd</sup>	4.6 miles:	Control (RETURN FISH SEGMENT)	C-2	161.8–157.2	Upstream End of Dupont Island → Fruita State Park Boat Landing
4 <sup>th</sup>	4.6 miles:	Treatment (REMOVAL FISH SEGMENT)	T-2	157.2–152.6	Fruita State Park Boat Ramp → Loma Boat Landing

Loma Boat Landing → Utah/Colorado Stateline [Horsethief/Ruby Canyons] (River miles 152.6–132.0)

1 <sup>st</sup>	5.1 miles:	Treatment (REMOVAL FISH SEGMENT)	T-3	152.6–147.5	Loma Boat Landing → 1 mile Upstream from Crow Bottom
2 <sup>nd</sup>	5.1 miles:	Control (RETURN FISH SEGMENT)	C-3	147.5–142.4	1 mile Upstream from Crow Bottom → 1.8 miles Downstream from Salt Creek /Colorado River confluence
3 <sup>rd</sup>	5.1 miles:	Treatment (REMOVAL FISH SEGMENT)	T-4	142.4–137.3	1.8 miles Downstream from Salt Creek/ Colorado River confluence → 0.6 mile Upstream from the Upper End of Black Rocks
4 <sup>th</sup>	5.3 miles:	Control (RETURN FISH SEGMENT)	C-4	137.3–132.0	0.6 mile Upstream from the Upper End of Black Rocks → Utah /Colorado State line

Walter Walker State Wildlife Area (river miles 165–162.7) is within a Treatment (removal) segment.

Snooks Bottom (river miles 157.3–156.0) is within a Treatment (removal) segment.

Horsethief State Wildlife Area and Skippers Island (river miles 155.6–154.0) are both within Treatment (removal) segments.

Crow Bottom (river miles 146.3–143.9) is within a Control (return) segment.

Table 2. Summary statistics for channel catfish collected during pass number 1 with electrofishing (EL) from control and treatment segments of two reaches of the Upper Colorado River near Grand Junction, Colorado, 30 June to 7 July 2003. Note the Upper Reach extended 18 river miles from the Colorado/Gunnison River confluence to the Loma Boat Landing (river miles 171.0–152.6). The Lower Reach extended 20.6 miles from the Loma Boat Landing to the Colorado/Utah stateline (river miles 152.6–132.0).

Pass No. 1–Upper Reach (EL)

	Segments				Segments Combined	
	<u>C-1</u>	<u>T-1</u>	<u>C-2</u>	<u>T-2</u>	<u>C-1+C-2</u>	<u>T-1+T-2</u>
No. caught	30	20	38	18	68	38
Recaptures	--	0	0	0	0	0
Mortalities	0	0	0	0	0	0
Biomass (kg)	19.419	11.535	24.924	15.380	44.343	26.915
River Mile						
Length	4.6	4.6	4.6	4.6	9.2	9.2
No. of miles sampled	9.2	9.2	9.2	9.2	18.4	18.4
No. of boats	2	2	2	2	4	4
Effort (hr)	4.06	3.54	3.25	3.33	7.31	6.87
C/E (fish/hr)	7.39	5.65	11.69	5.41	9.30	5.53
Fish/mile	3.26	2.17	4.13	1.96	3.70	2.07
Mean weight of fish (grams)	647	577	656	854	652	708

Pass No. 1–Lower Reach (EL)

	Segments				Segments Combined	
	<u>T-3</u>	<u>C-3</u>	<u>T-4</u>	<u>C-4</u>	<u>T-3+T-4</u>	<u>C-3+C-4</u>
No. caught	12	74	45	7	57	81
Recaptures	0	0	0	0	0	0
Mortalities	0	0	0	0	0	0
Biomass (kg)	9.575	48.001 (n=72)	29.335	5.105	38.910	53.106 (n=79)
River Mile						
Length	5.1	5.1	5.1	5.3	10.2	10.4
No. of miles sampled	10.2	10.2	5.1	10.6	15.3	20.8
No. of boats	2	2	1	2	3	4
Effort (hr)	4.27	4.19	2.30	4.21	6.57	8.40
C/E (fish/hr)	2.81	17.66	5.10	1.66	8.68	9.64
Fish/mile	1.18	7.25	8.82	0.66	3.73	3.90
Mean weight of fish (grams)	798	667 (n=72)	652	729	683	672 (n=79)

Table 3. Summary statistics for channel catfish collected during pass number 2 with electrofishing (EL) from control and treatment segments of two reaches of the Upper Colorado River near Grand Junction, Colorado, 8 July to 17 July 2003. Note the Upper Reach extended 18 river miles from the Colorado/Gunnison River confluence to the Loma Boat Landing (river miles 171.0–152.6). The Lower Reach extended 20.6 miles from the Loma Boat Landing to the Colorado/Utah stateline (river miles 152.6–132.0).

Pass No. 2–Upper Reach (EL)						
	Segments				Segments Combined	
	<u>C-1</u>	<u>T-1</u>	<u>C-2</u>	<u>T-2</u>	<u>C-1+C-2</u>	<u>T-1+T-2</u>
No. caught	7	77	81	38	88	115
Recaptures	0	0	0	0	0	0
Mortalities	0	0	0	0	0	0
Biomass (kg)	6.230	51.988	50.255 (n=62)	34.198	56.485 (n=69)	86.186
River Mile						
Length	4.6	4.6	4.6	4.6	9.2	9.2
No. of miles sampled	9.2	9.2	9.2	9.2	18.4	18.4
No. of boats	2	2	2	2	4	4
Effort (hr)	2.22	4.50	3.49	4.19	5.71	8.69
C/E (fish/hr)	3.15	17.11	23.21	9.06	15.41	13.23
Fish/mile	0.76	8.37	8.80	4.13	4.79	6.25
Mean weight of fish (grams)	890	675	811 (n=62)	900	819 (n=69)	749
Pass No. 2–Lower Reach (EL)						
	Segments				Segments Combined	
	<u>T-3</u>	<u>C-3</u>	<u>T-4</u>	<u>C-4</u>	<u>T-3+T-4</u>	<u>C-3+C-4</u>
No. caught	78	115	123	71	201	186
Recaptures	0	2	3	0	3	2
Mortalities	0	9	0	0	0	9
Biomass (kg)	43.930	46.695 (n=112)	57.210 (n=111)	37.870	101.140 (n=189)	84.565 (n=183)
River Mile						
Length	5.1	5.1	5.1	5.3	10.2	10.4
No. of miles sampled	10.2	7.2	10.2	10.6	20.4	17.8
No. of boats	2	1.5	2	2	4	3.5
Effort (hr)	4.54	3.03	4.68	4.62	9.22	7.65
C/E (fish/hr)	17.18	37.95	26.28	15.37	21.80	24.31
Fish/mile	7.65	15.97	12.06	6.70	9.85	10.45
Mean weight of fish (grams)	563	417 (n=112)	515 (n=111)	533	535 (n=189)	463 (n=183)

Table 4. Summary statistics for channel catfish collected during pass number 3 with electrofishing (EL) from control and treatment segments of two reaches of the Upper Colorado River near Grand Junction, Colorado, 18 July to 31 July 2003. Note the Upper Reach extended 18 river miles from the Colorado/Gunnison River confluence to the Loma Boat Landing (river miles 171.0–152.6). The Lower Reach extended 20.6 miles from the Loma Boat Landing to the Colorado/Utah stateline (river miles 152.6–132.0).

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Pass No. 3–Upper Reach (EL)

	Segments				Segments Combined	
	<u>C-1</u>	<u>T-1</u>	<u>C-2</u>	<u>T-2</u>	<u>C-1+C-2</u>	<u>T-1+T-2</u>
No. caught	17	21	25	20	42	41
Recaptures	0	1	0	0	0	1
Mortalities	0	0	0	0	0	0
Biomass (kg)	17.450	10.540	20.400	17.680	37.850	28.220
River Mile						
Length	4.6	4.6	4.6	4.6	9.2	9.2
No. of miles sampled	9.2	4.6	4.6	4.6	13.8	9.2
No. of boats	2	1	1	1	3	2
Effort (hr)	3.11	2.07	2.07	1.28	5.18	3.35
C/E (fish/hr)	5.47	10.14	12.08	15.63	8.11	12.24
Fish/mile	1.85	4.57	5.43	4.35	3.04	4.46
Mean weight of fish (grams)	1,026	502	816	884	901	688

Pass No. 3–Lower Reach (EL)

	Segments				Segments Combined	
	<u>T-3</u>	<u>C-3</u>	<u>T-4</u>	<u>C-4</u>	<u>T-3+T-4</u>	<u>C-3+C-4</u>
No. caught	189	82	100	23	289	105
Recaptures	0	1	0	0	0	1
Mortalities	1	0	0	0	1	0
Biomass (kg)	43.022 (n=112)	41.998	62.447	12.220	105.469 (n=212)	54.218
River Mile						
Length	5.1	5.1	5.1	5.3	10.2	10.4
No. of miles sampled	5.1	5.1	5.1	5.3	10.2	10.4
No. of boats	1	1	1	1	1	1
Effort (hr)	2.24	2.47	2.35	1.46	4.59	3.93
C/E (fish/hr)	84.38	34.41	42.55	15.75	62.96	26.72
Fish/mile	37.06	16.08	19.61	4.34	28.33	10.10
Mean weight of fish (grams)	384 (n=112)	512	624	531	497 (n=212)	516

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Table 5. Summary statistics for channel catfish collected during pass number 4 with electrofishing (EL) from control and treatment segments of two reaches of the Upper Colorado River near Grand Junction, Colorado, 1 August to 25 August 2003. Note the Upper Reach extended 18 river miles from the Colorado/Gunnison River confluence to the Loma Boat Landing (river miles 171.0–152.6). The Lower Reach extended 20.6 miles from the Loma Boat Landing to the Colorado/Utah stateline (river miles 152.6–132.0).

Pass No. 4–Upper Reach (EL)

	Segments				Segments Combined	
	<u>C-1</u>	<u>T-1</u>	<u>C-2</u>	<u>T-2</u>	<u>C-1+C-2</u>	<u>T-1+T-2</u>
No. caught	50	71	140	113	190	184
Recaptures	1	1	1	0	2	1
Mortalities	0	1	0	0	0	1
Biomass (kg)	28.955	38.792 (n=60)	81.123	31.470 (n=49)	110.118	70.496 (n=109)
River Mile						
Length	4.6	4.6	4.6	4.6	9.2	9.2
No. of miles sampled	4.6	9.2	9.2	4.6	13.8	13.8
No. of boats	1	2	2	1	3	3
Effort (hr)	3.39	5.52	4.56	2.31	7.95	7.83
C/E (fish/hr)	14.75	12.86	30.70	48.92	23.90	23.50
Fish/mile	10.87	7.72	15.22	24.57	13.77	13.33
Mean weight of fish (grams)	579	647 (n=60)	579	642 (n=49)	579	647 (n=109)

Pass No. 4–Lower Reach (EL)

	Segments				Segments Combined	
	<u>T-3</u>	<u>C-3</u>	<u>T-4</u>	<u>C-4</u>	<u>T-3+T-4</u>	<u>C-3+C-4</u>
No. caught	50	259	47	52	97	311
Recaptures	0	1	0	0	0	1
Mortalities	1	14	0	0	1	14
Biomass (kg)	22.767 (n=45)	103.019 (n=164)	27.134 (n=39)	23.240 (n=49)	49.901 (n=84)	126.259 (n=213)
River Mile						
Length	5.1	5.1	5.1	5.3	10.2	10.4
No. of miles sampled	5.1	10.2	5.1	10.6	10.2	20.8
No. of boats	1	2	1	2	2	4
Effort (hr)	1.98	6.01	1.88	3.01	3.86	9.02
C/E (fish/hr)	25.25	43.09	25.00	17.28	25.13	34.48
Fish/mile	9.80	25.39	9.22	4.91	9.51	29.90
Mean weight of fish (grams)	506 (n=45)	628 (n=164)	696 (n=39)	447 (n=49)	594 (n=84)	593 (n=213)

Table 6. Summary statistics for channel catfish collected during pass number 5 with electrofishing (EL) from control and treatment segments of two reaches of the Upper Colorado River near Grand Junction, Colorado, 26 August to 8 September 2003 (C-1, C-2, T-1, T-2, T-4); and 21 October to 23 October 2003 (C-3, C-4, T-3). Note the Upper Reach extended 18 river miles from the Colorado/Gunnison River confluence to the Loma Boat Landing (river miles 171.0–152.6). The Lower Reach extended 20.6 miles from the Loma Boat Landing to the Colorado/Utah stateline (river miles 152.6–132.0).

Pass No. 5–Upper Reach (EL)						
	Segments				Segments Combined	
	C-1	T-1	C-2	T-2	C-1+C-2	T-1+T-2
No. caught	29	38	53	108	82	146
Recaptures	0	0	1	0	1	0
Mortalities	0	0	0	1	0	1
Biomass (kg)	7.580	45.631	33.050	45.316	40.630	90.947
	(n=10)	(n=36)	(n=49)	(n=91)	(n=59)	(n=127)
River Mile						
Length	4.6	4.6	4.6	4.6	9.2	9.2
No. of miles sampled	4.6	4.6	4.6	4.6	9.2	9.2
No. of boats	1	1	1	1	2	2
Effort (hr)	1.93	2.92	2.68	2.66	4.61	5.58
C/E (fish/hr)	15.03	13.01	19.78	4.06	17.79	26.16
Fish/mile	6.30	8.26	11.52	23.48	8.91	15.87
Mean weight of fish (grams)	758	1,268	674	498	687	716
	(n=10)	(n=36)	(n=49)	(n=91)	(n=59)	(n=127)
Pass No. 5-Lower Reach (EL)						
	Segments				Segments Combined	
	T-3	C-3	T-4	C-4	T-3+T-4	C-3+C-4
No. caught	60	100	45	103	105	203
Recaptures	0	0	1	1	1	1
Mortalities	0	0	0	0	0	0
Biomass (kg)	43.720	77.197	24.147	58.150	67.867	135.347
	(n= 61)	(n=98)	(n=38)	(n=87)	(n=99)	(n=185)
River Mile						
Length	5.1	5.1	5.1	5.3	10.2	10.4
No. of miles sampled	5.1	5.1	5.1	9.2	10.2	14.3
No. of boats	1	1	1	1	2	2
Effort (hr)	2.14	2.67	2.06	9.72	4.20	12.39
C/E (fish/hr)	28.04	37.45	21.84	10.60	25.00	16.38
Fish/mile	11.76	19.61	8.82	11.20	10.29	14.20
Mean weight of fish (grams)	717	788	635	668	685	732
	(n=61)	(n=98)	(n=38)	(n=87)	(n=99)	(n=185)

Table 7. Number of channel catfish marked with floy tags in the control segments in the Upper and Lower reaches of the Upper Colorado River from 30 June to 31 October 2003, and the total number of channel catfish recaptured with electrofishing and from anglers from within both control and treatment segments, and from outside control and treatment segments.

	Total Number of Channel Catfish <u>Marked</u>	Total Number of Channel Catfish Recaptured in Control & Treatment <u>Segments</u>	Total Number of Channel Catfish Recaptured Outside Control & Treatment <u>Segments</u>
Pass 1			
Upper Reach			
Control	68	0	0
Treatment	--	0	0
Lower Reach			
Control	80	0	0
Treatment	--	0	0
Pass 2			
Upper Reach			
Control	68	0	0
Treatment	--	0	0
Lower Reach			
Control	119	1	0
Treatment	--	4	0
Pass 3			
Upper Reach			
Control	40	0	0
Treatment	--	1	0
Lower Reach			
Control	98	1	0
Treatment	--	0	0
Pass 4			
Upper Reach			
Control	175	2	0
Treatment	--	1	0
Lower Reach			
Control	243	1	0
Treatment	--	0	0

Table 7. (cont'd).

	Total Number of Channel Catfish <u>Marked</u>	Total Number of Channel Catfish Recaptured in Control & Treatment <u>Segments</u>	Total Number of Channel Catfish Recaptured Outside Control & Treatment <u>Segments</u>
Pass 5			
Upper Reach			
Control	59	1	0
Treatment	--	0	0
Lower Reach			
Control	214	1	0
Treatment	--	1	0
15-mile reach	--	--	2
-----			
Totals	1,164	14	2 <sup>a</sup>
Percent Recaptured (16/1,164)			1.4 %

<sup>a</sup> two marked channel catfish recaptured by Rick Anderson, Colorado Division of Wildlife, in early-September 2003.



Table 8. Original and recapture data for 16 channel catfish marked with floy tags after being collected with electrofishing (EL) and angling in the Upper and Lower reaches of the Upper Colorado River from the Colorado/Gunnison River confluence to the Colorado/Utah stateline, and 15-mile reach, 30 June to 31 October 2003.

Fish No.	Floy-Tag No.	Original Capture				Recapture				Distance Moved Between Capture & Recapture (miles)		Days at Large	Return Type Angler/ EL	
		Date	RM	Pass No.	Segment	Date	RM	Pass No.	Segment	Up (+)	Dn (-)			
<sup>a</sup> 1	32702	07/19/03	149.2	2	C-3	07/24/03	164.7	3	T-1	20.5	--	10	Angler	
2	32487	07/14/03	142.4	2	C-3	07/28/03	144.5	3	C-3	0.5	--	14	EL	
3	32597	07/09/03	157.3	2	C-2	08/04/03	157.4	4	C-2	0.1	--	25	EL	
4	32282	08/01/03	171.0	4	C-1	08/04/03	169.9	4	C-1	--	0.1	3	Angler	
<sup>a</sup> 5	32164	07/15/03	133.1	2	C-4	08/13/03	163.0	4	T-1	29.9	--	29	EL	
<sup>a</sup> 6	32587	08/06/03	161.7	4	C-2	08/11/03	143.8	4	C-3	--	17.9	5	EL	
7	32611	07/15/03	136.6	2	C-4	07/17/03	138.1	2	C-4	1.5	--	2	EL	
<sup>a</sup> 8	32620	07/15/03	133.1	2	C-4	07/17/03	139.2	2	T-4	6.1	--	2	EL	
<sup>a</sup> 9	32469	07/15/03	134.6	2	C-4	07/17/03	138.0	2	T-4	3.4	--	2	EL	
<sup>a</sup> 10	32211	07/02/03	145.1	1	C-3	07/14/03	142.4	2	T-4	--	2.7	12	EL	
<sup>a</sup> 11	32765	07/02/03	144.2	1	C-3	07/14/03	142.4	2	T-4	--	1.8	12	EL	
12	32264	08/14/03	161.6	4	C-2	08/28/03	161.3	5	C-2	--	0.3	24	EL	
<sup>a</sup> 13	32705	07/14/03	144.4	2	C-3	09/09/03	138.2	5	T-4	--	6.2	56	EL	
14	32271	08/01/03	169.8	4	C-1	09/04/03	177.5	- <sup>b</sup>	--	7.7	--	61	EL	
15	32158	07/15/03	136.7	2	C-4	09/09/03	179.8	- <sup>b</sup>	--	43.1	--	51	EL	
16	32602	07/15/03	134.4	2	C-4	10/23/03	132.1	5	C-4	--	2.3	100	EL	
										Maximum	43.1 mi	17.9 mi	61	
										Minimum	1.5 mi	0.1 mi	2	
										Mean	12.5 mi	4.5 mi	25.5	
											n=9	n=7	n=16	

<sup>a</sup> catfish that were recaptured outside of the control segment where they were originally captured. Ten of 16 (63%) channel catfish originally marked in a control segment were later recaptured in another control segment, treatment segment, or upstream in the 15-mile reach.

<sup>b</sup> channel catfish captured by Rick Anderson, Colorado Division of Wildlife, in the 15-mile reach.

Table 9. Number, catch effort (fish/net day and fish/24 hrs), and other summary statistics for channel catfish, largemouth bass, and smallmouth bass collected in trap nets from four backwaters in two control segments of the Upper Reach from the Upper Colorado River in July and August 2003.

	TRAP NETS	
	Control Segment (RM 168.2)	Control Segment (RM 159.2 & 158.2)
No. of channel catfish collected	437	383
Mean TL (mm)	129	134
Range TL (mm)	47-452	35-500
Std Dev.	54.8	59.6
Recaptures (catfish)	0	0
No. of largemouth bass collected	5	2
No. of smallmouth bass collected	1	0
Effort (hrs)	805.5	526.7
Net Days	31	18
Mean Number of traps set/day	3	2
Catch Effort (catfish/net day)	14.10	20.89
(catfish/24 hrs)	13.02	17.45
Dates sampled	7/24-8/1 & 8/18-8/22	8/5-8/13

Table 10. Number and biomass of channel catfish translocated alive from the Colorado River to Highline Lake between 30 June and 22 October 2003.

<u>Pass No.</u>	<u>Number of Fish</u>	<u>Biomass (kg)</u>
1	95	65.825
2	316	187.326
3	329	133.689
4	279	120.397
5	251	158.814
Totals	1,270	666.051
less fish given to anglers	34	25.620
Net total stocked into Highline Lake	1,236	640.431 (1,412 pounds)

Table 11. Number and biomass of adult channel catfish donated to anglers on the Colorado River during the 2003 channel catfish removal evaluation.

<u>Date</u>	<u>Number of Fish</u>	<u>Biomass (kg)</u>
7/31/03	8	7.600
9/03/03	26	18.020
Totals	34	25.620

Table 12. Number, catch effort (fish/hr and fish/mile) for largemouth bass and smallmouth bass collected from main channel habitats in the Upper Colorado River with electrofishing from river mile 171.0 to 132.0 (Colorado/Gunnison River confluence to the Utah/Colorado stateline), 30 June to 31 October 2003. Note: data for the Upper Reach (Colorado/Gunnison River confluence to the Loma Boat Landing) and Lower Reach (Loma Boat Landing to the Colorado/Utah stateline) were combined. Total effort (hrs) = 26.78; total miles sampled = 42.9.

	<u>Largemouth Bass</u>			<u>Smallmouth Bass</u>		
	<u>No.</u>	<u>Fish/hr</u>	<u>Fish/Mile</u>	<u>No.</u>	<u>Fish/hr</u>	<u>Fish/Mile</u>
Pass 1	8	0.27	0.11	39	1.34	0.53
Pass 2	13	0.42	0.17	41	1.31	0.54
Pass 3	6	0.06	0.14	33	1.94	0.76
Pass 4	41	1.43	0.70	96	3.35	1.63
Pass 5	46	1.72	1.07	109	4.07	2.54

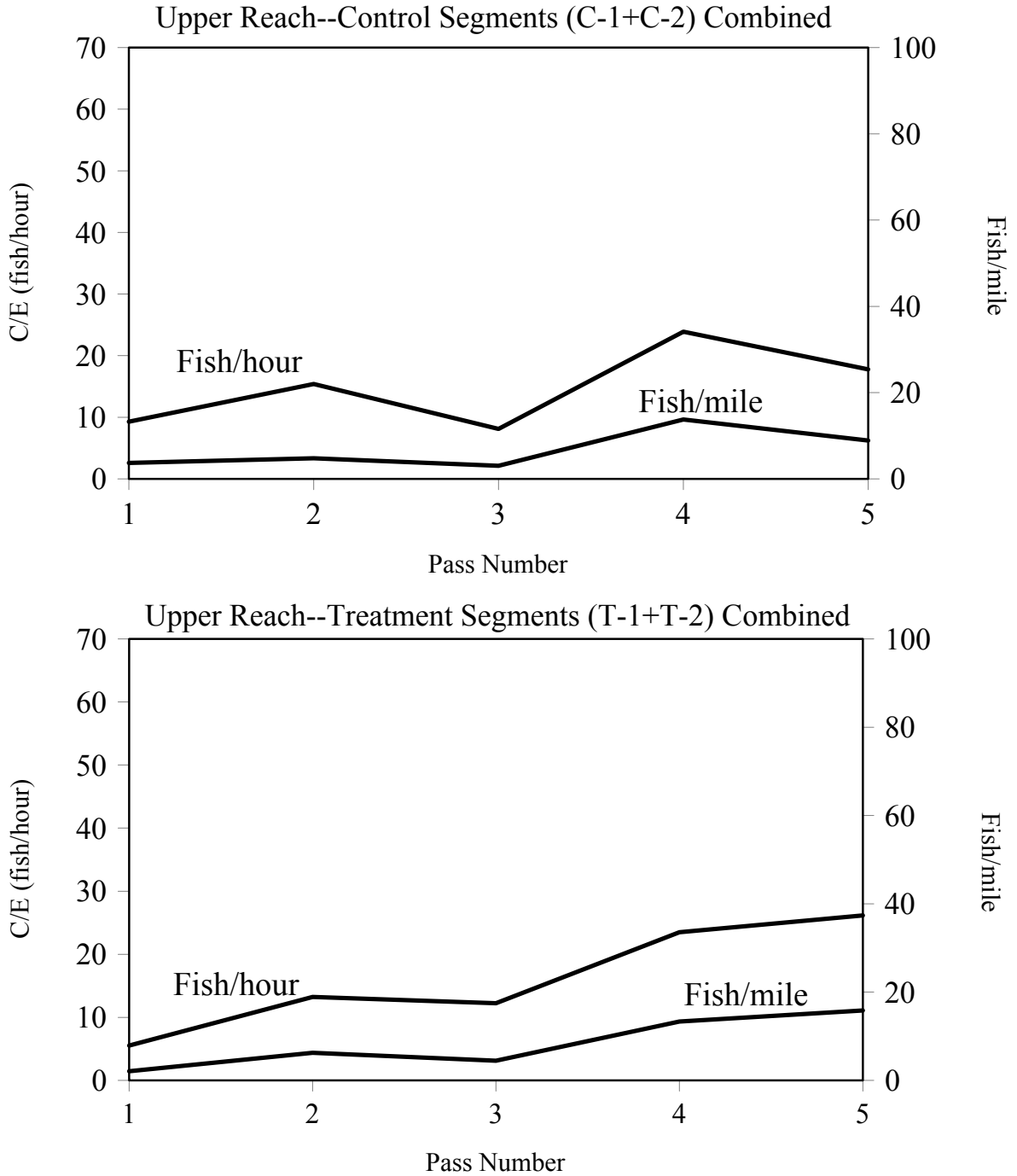


Figure 1. Catch/effort (fish/hour and fish/mile) estimates for channel catfish captured with electrofishing during five passes within control (upper) and treatment (lower) segments of the Upper Reach (river mile 171.0–152.6) of the Colorado River, late-June to mid-October 2003. Note: control segments combined; treatment segments combined.

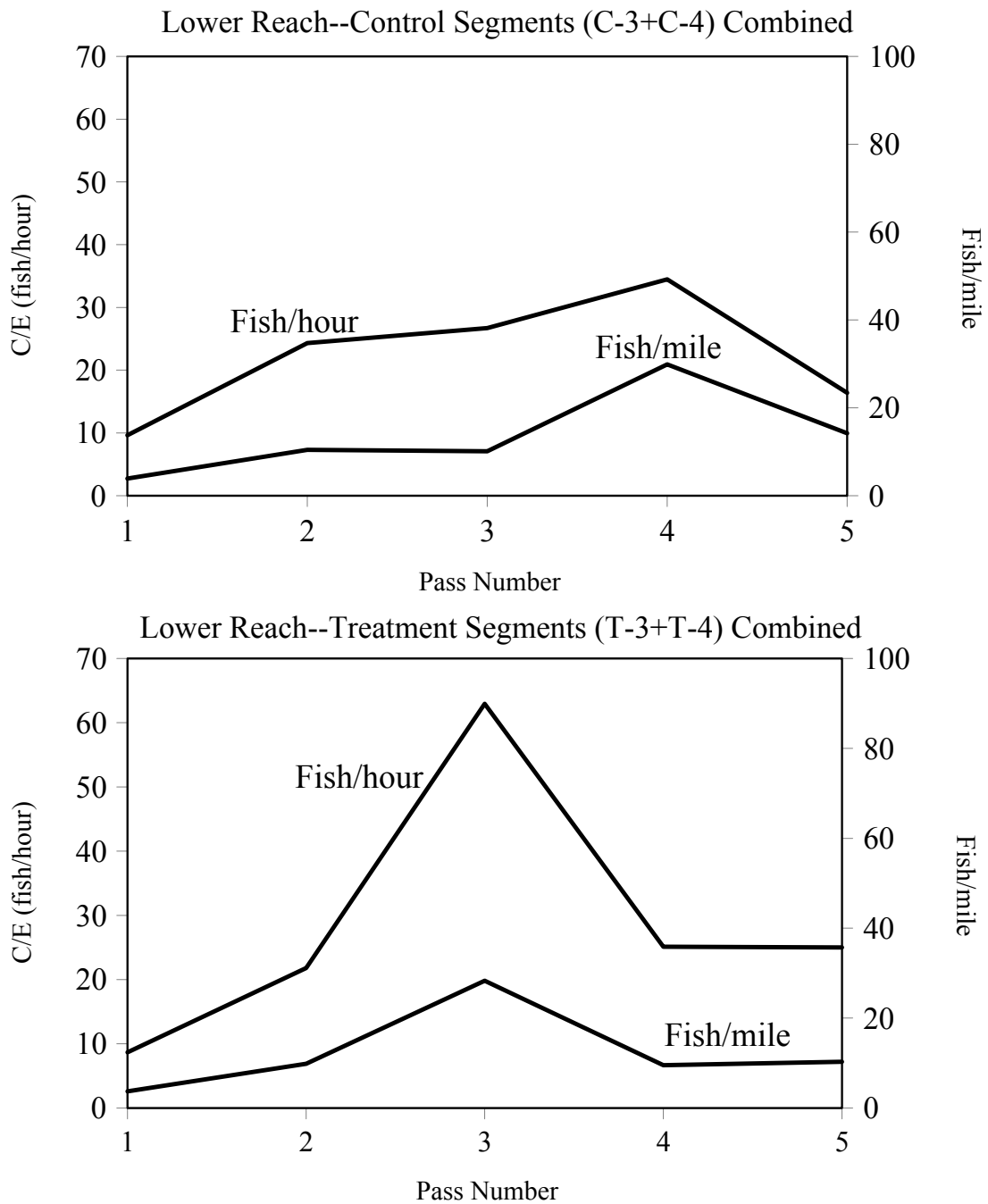


Figure 2. Catch/effort (fish/hour and fish/mile) estimates for channel catfish captured with electrofishing during five passes within control (upper) and treatment (lower) segments of the Lower Reach (river mile 152.6–132.0) of the Colorado River, late-June to mid-October 2003. Note: control segments combined; treatment segments combined.

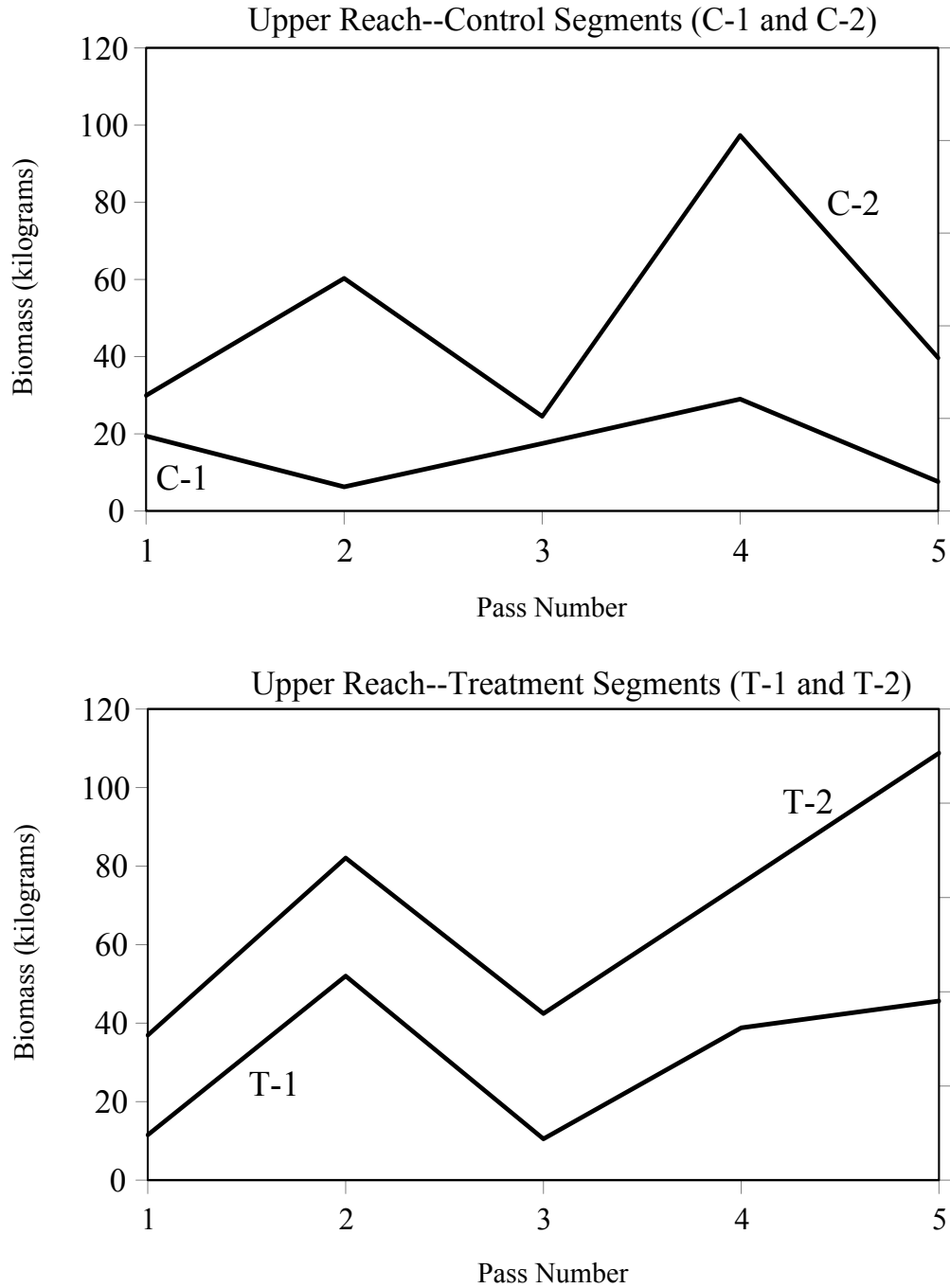


Figure 3. Total biomass of all channel catfish captured with electrofishing during five passes within control (upper) and treatment (lower) segments of the Upper Reach (river mile 171.0–152.6) of the Colorado River, late-June to mid-October 2003. (see Tables 2-6 for summary statistics of biomass and mean size of fish).

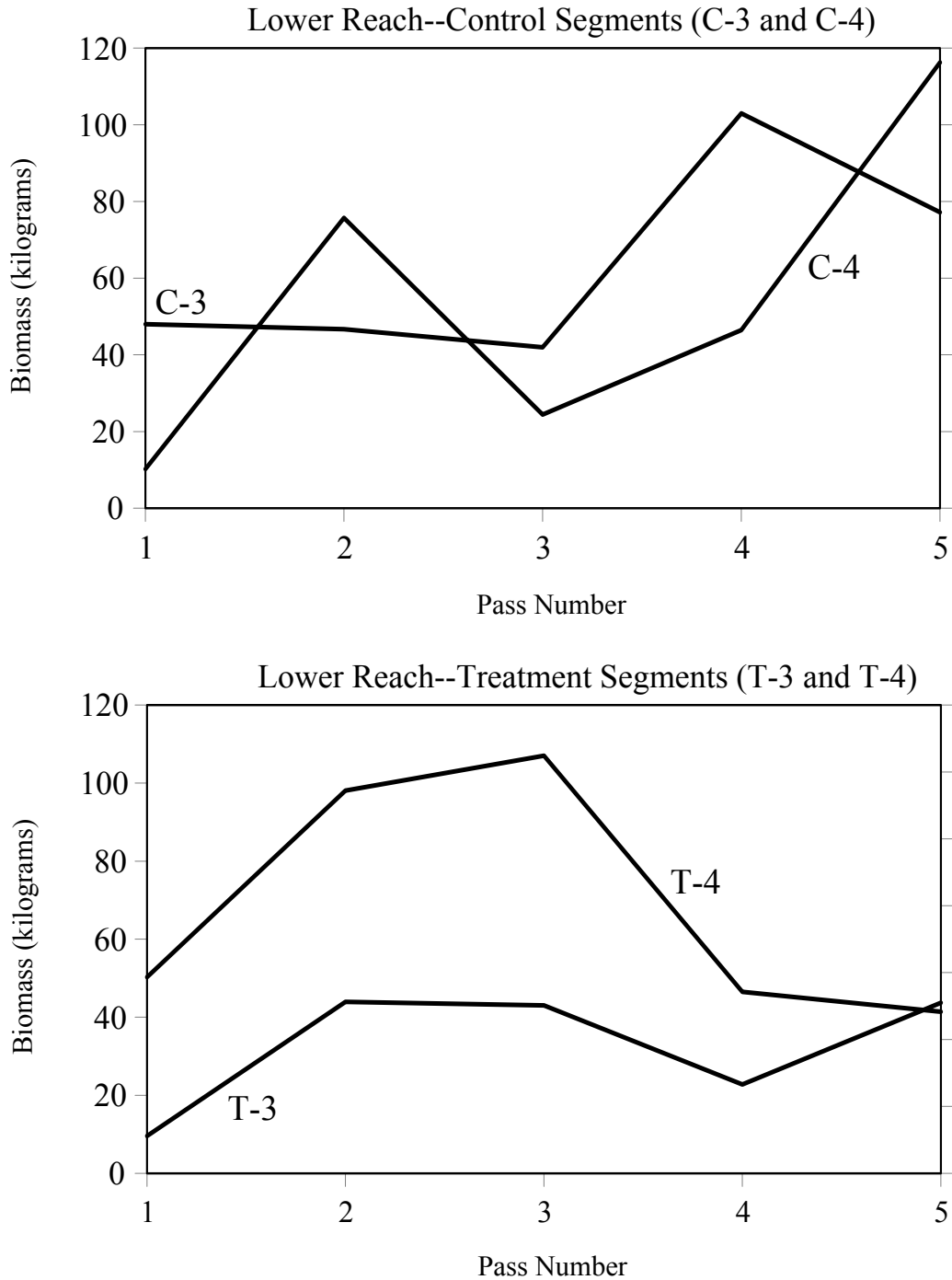


Figure 4. Total biomass of all channel catfish captured with electrofishing during five passes within control (upper) and treatment (lower) segments of the Lower Reach (river mile 152.6–132.0) of the Colorado River, late-June to late-October 2003. (see Tables 2-6 for summary statistics of biomass and mean size of fish).



**Colorado River--UPPER REACH--2003--EL  
Control Segments (C-1+C-2) Combined**

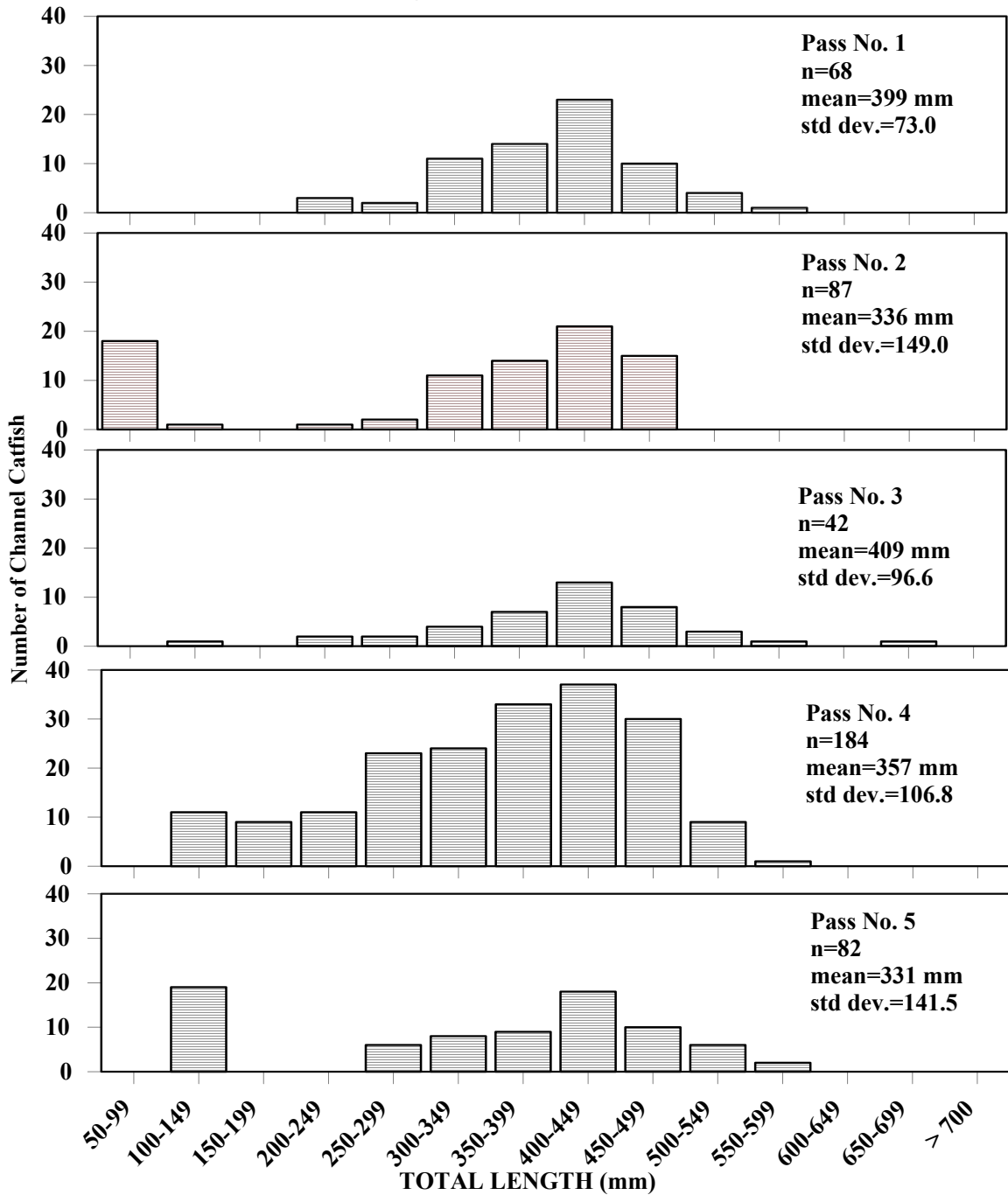


Figure 5. Total length frequency of all channel catfish collected with electrofishing during five passes from the two control segments from the Upper Reach (river mile 171.0–152.6) of the Colorado River, late-June to mid-October 2003.

**Colorado River--UPPER REACH--2003--EL  
Treatment Segments (T-1+T-2) Combined**

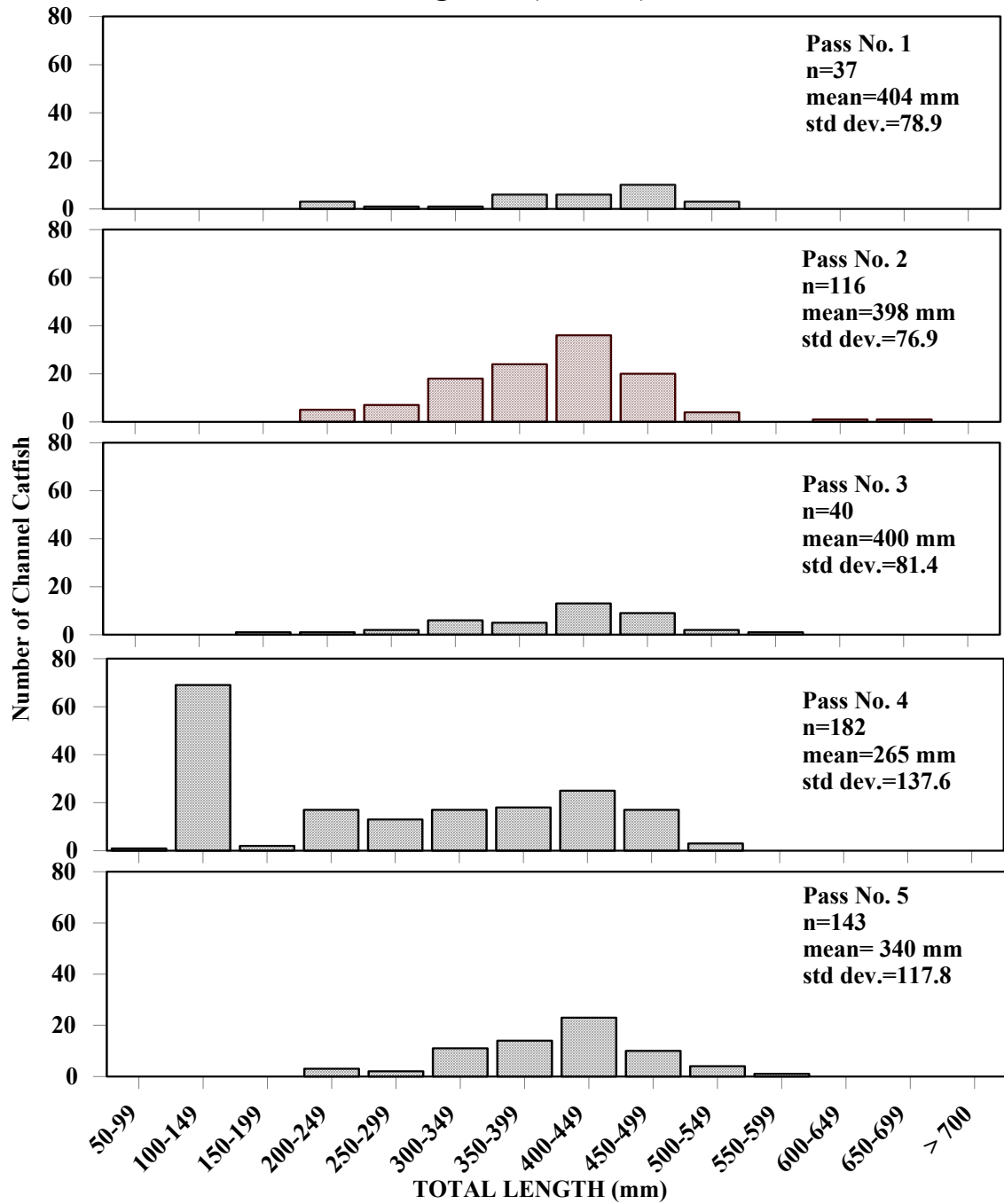


Figure 6. Total length frequency of all channel catfish collected with electrofishing during five passes from the two treatment segments from the Upper Reach (river mile 171.0–152.6) of the Colorado River, late-June to mid-October 2003.

**Colorado River--LOWER REACH--2003--EL  
Control Segments (C-3+C-4) Combined**

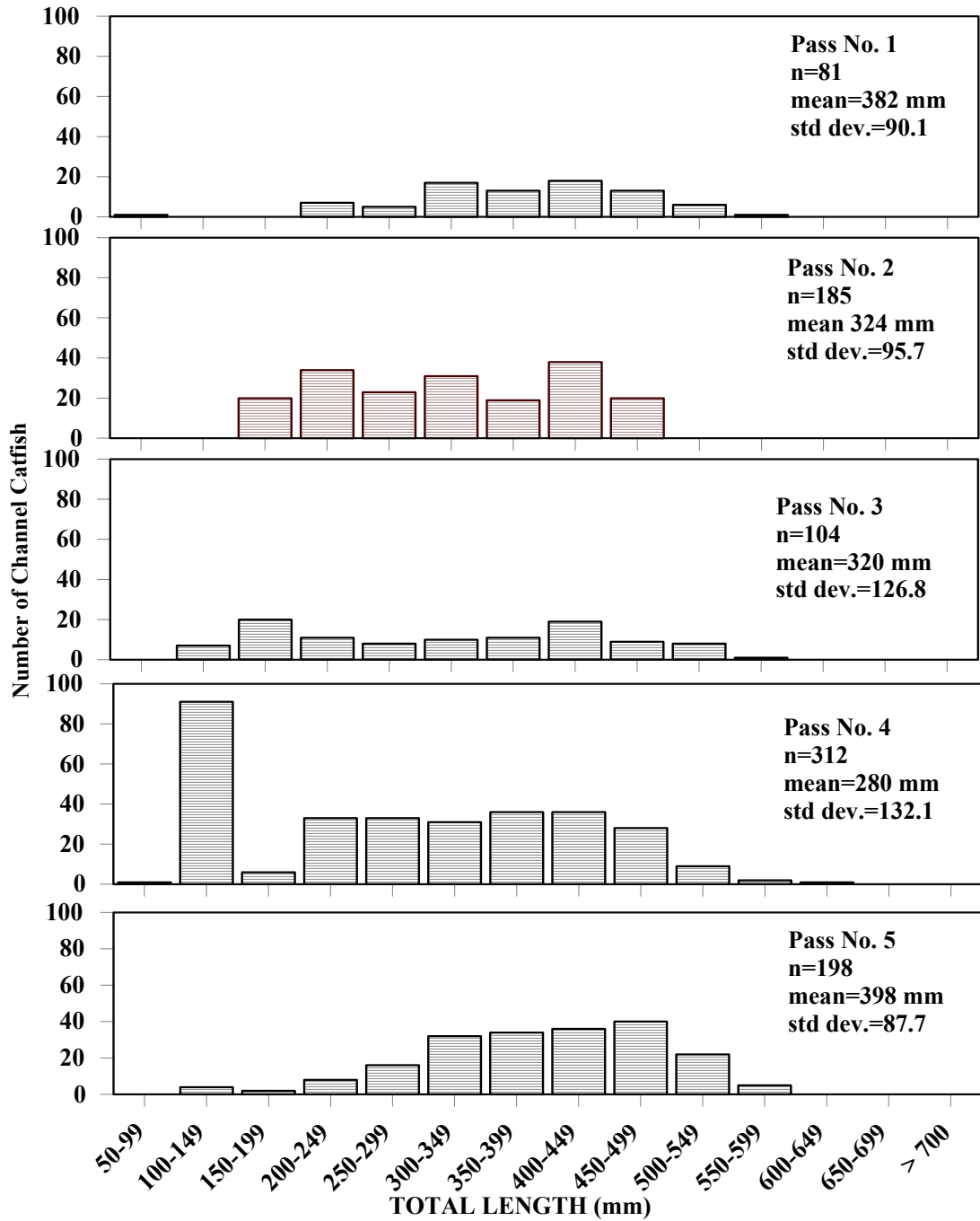


Figure 7. Total length frequency of all channel catfish collected with electrofishing during five passes from the two control segments from the Lower Reach (river mile 152.6–132.0) of the Colorado River, late-June to late-October 2003.

**Colorado River--LOWER REACH--2003--EL  
Treatment Segments (T-3+T-4) Combined**

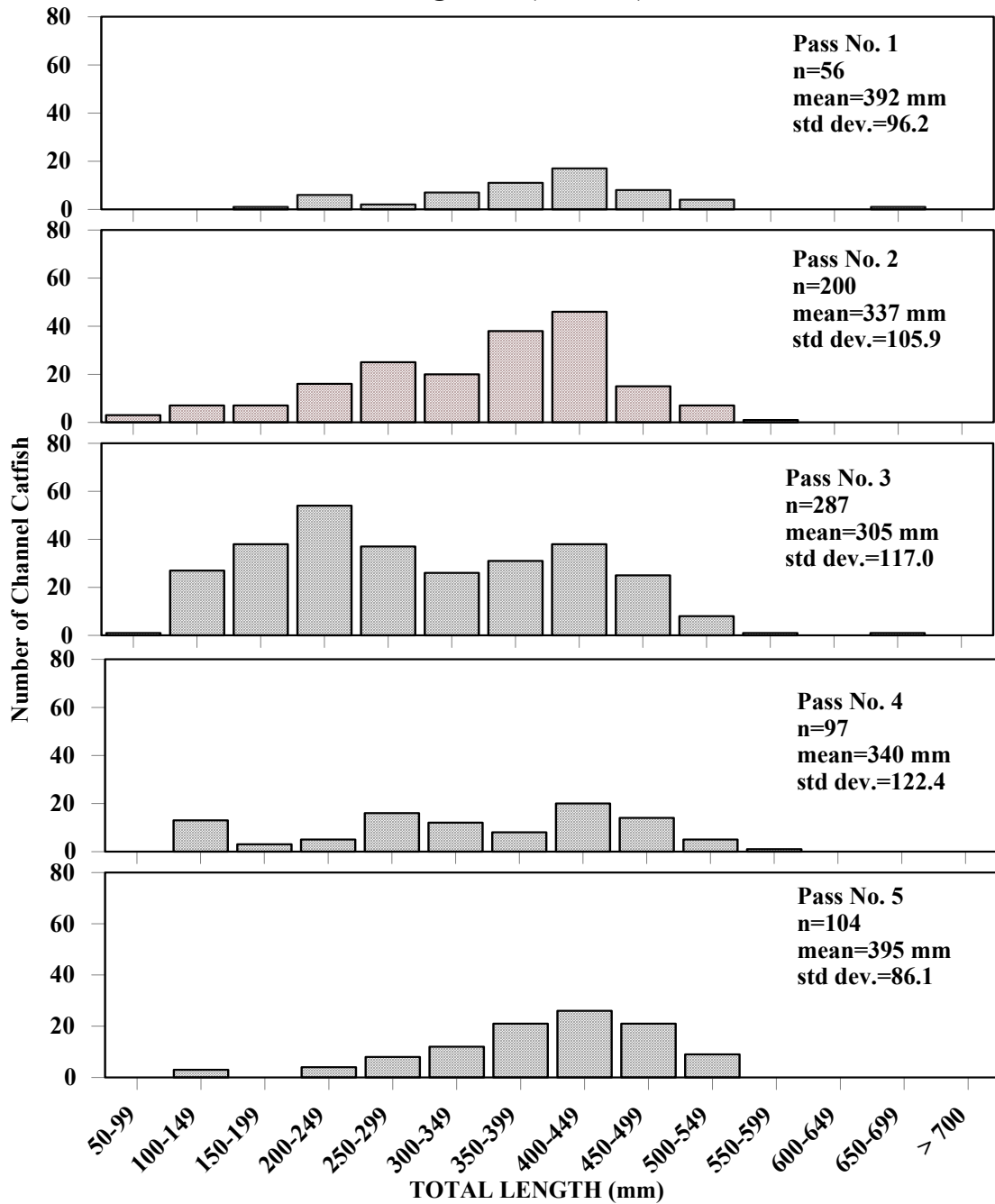


Figure 8. Total length frequency of all channel catfish collected with electrofishing during five passes from the two treatment segments from the Lower Reach (river mile 152.6–132.0) of the Colorado River, late-June to late-October 2003.

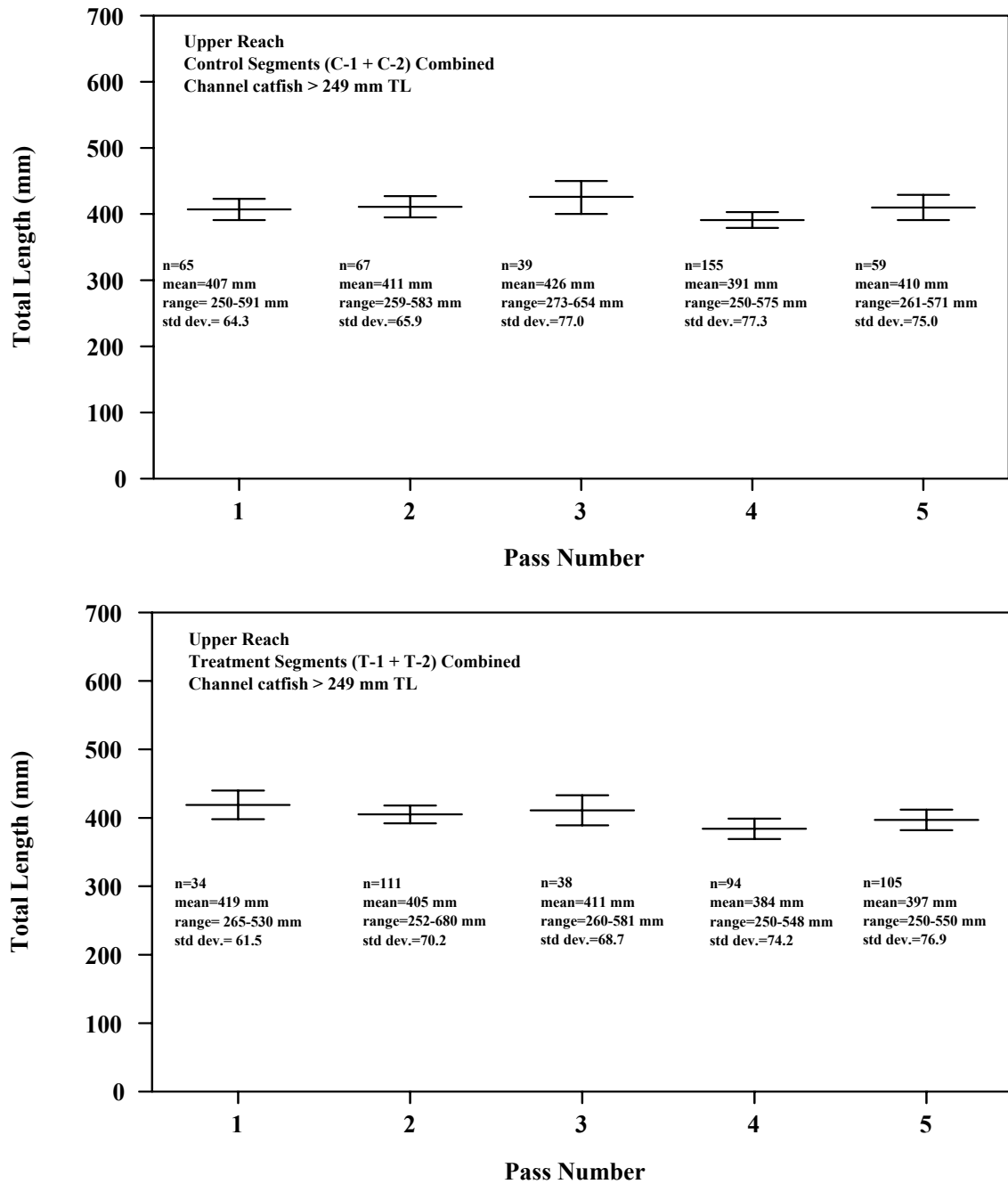


Figure 9. Mean total length and 95% confidence interval for channel catfish 250 mm total length and larger that were collected with electrofishing during five passes from control (upper) and treatment (lower) segments from the Upper Reach (river mile 171.0–152.6) of the Colorado River, late-June to mid-October 2003. Note: the two control segments were combined; the two treatment segments were combined. The mean is the middle horizontal line; the 95% confidence intervals are represented by the error bars ( $\tau \perp$ ).

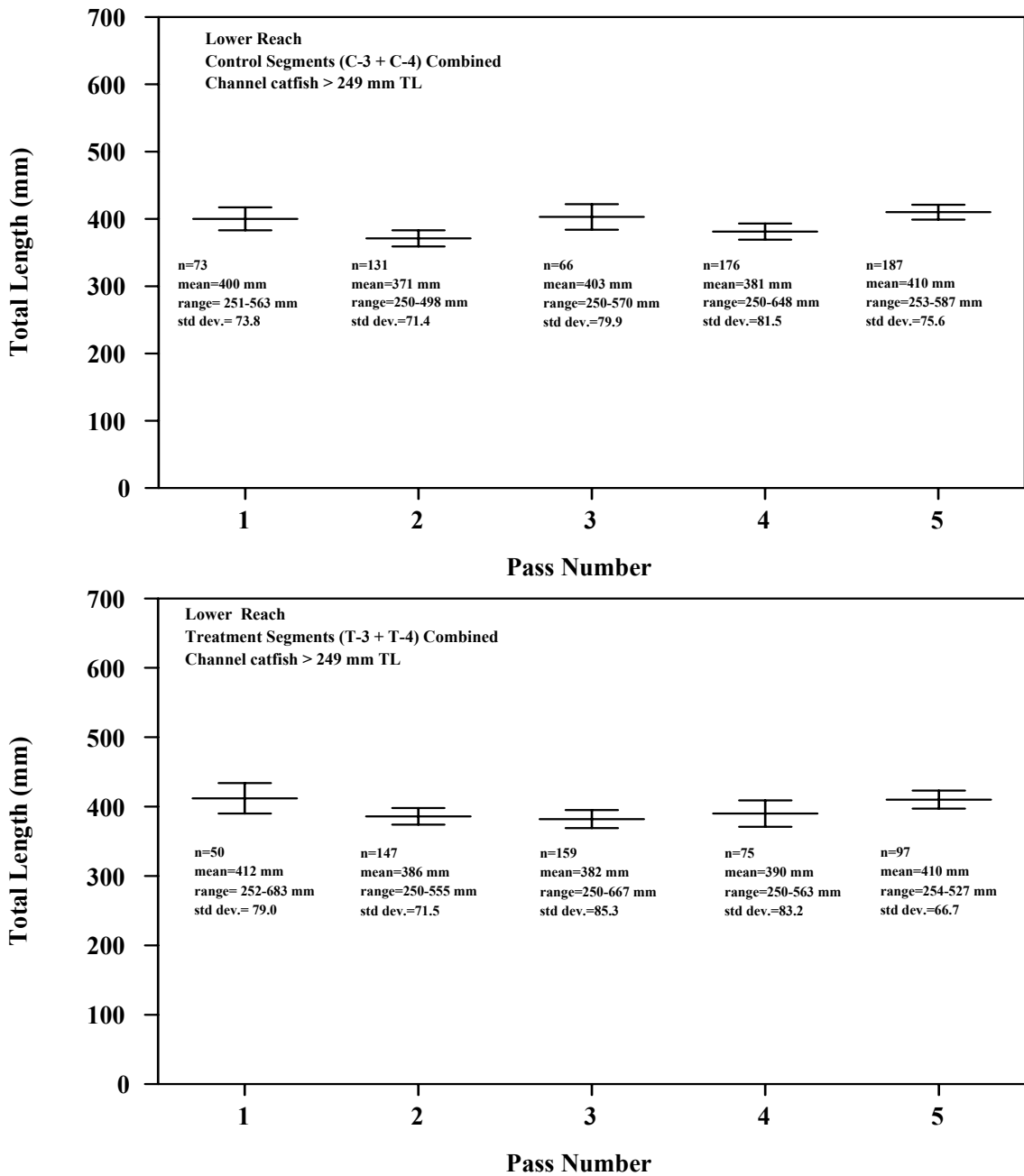


Figure 10. Mean total length and 95% confidence interval for channel catfish 250 mm total length and larger that were collected with electrofishing during five passes from control (upper) and treatment (lower) segments from the Lower Reach (river mile 152.6–132.0) of the Colorado River, late-June to late-October 2003. Note: the two control segments were combined; the two treatment segments were combined. The mean is the middle horizontal line; the 95% confidence intervals are represented by the error bars ( $\bar{x} \pm$ ).

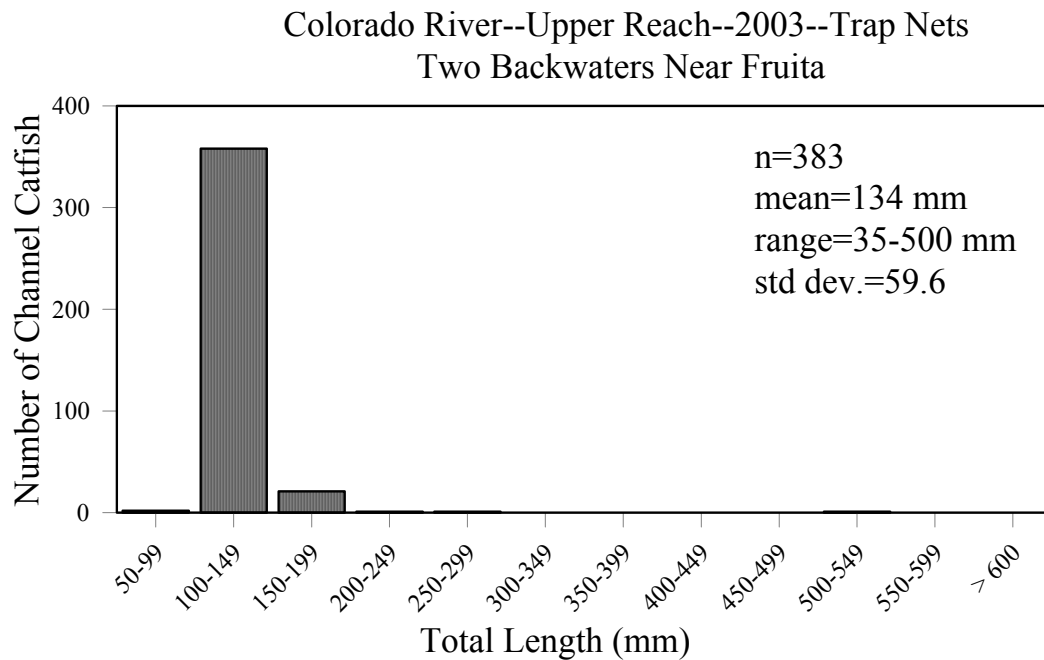
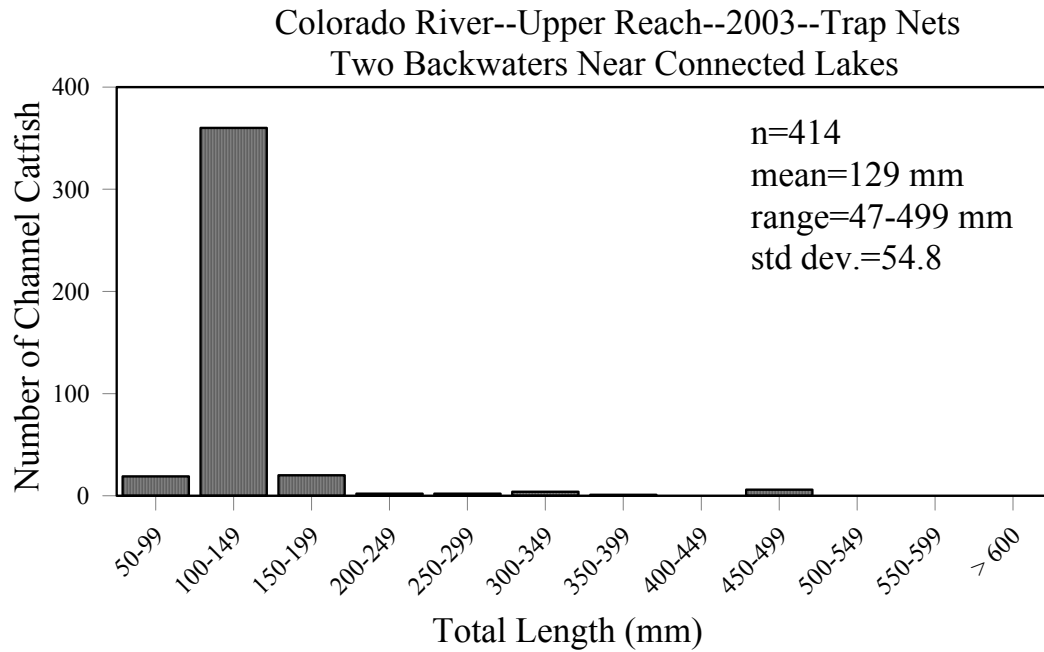
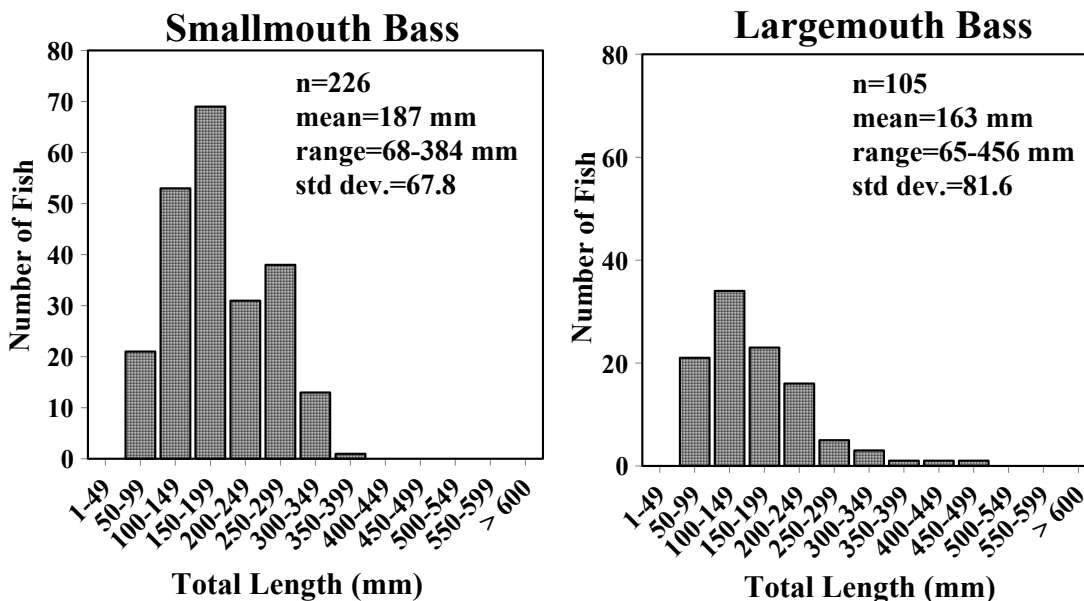


Figure 11. Total length frequency of channel catfish collected in multiple trap net sets from four different backwaters within two control segments of the Upper Reach of the Colorado River between 24 July and 22 August 2003. (see Table 9 for summary statistics).

## Colorado River--Upper Reach--2003



## Colorado River--Lower Reach--2003

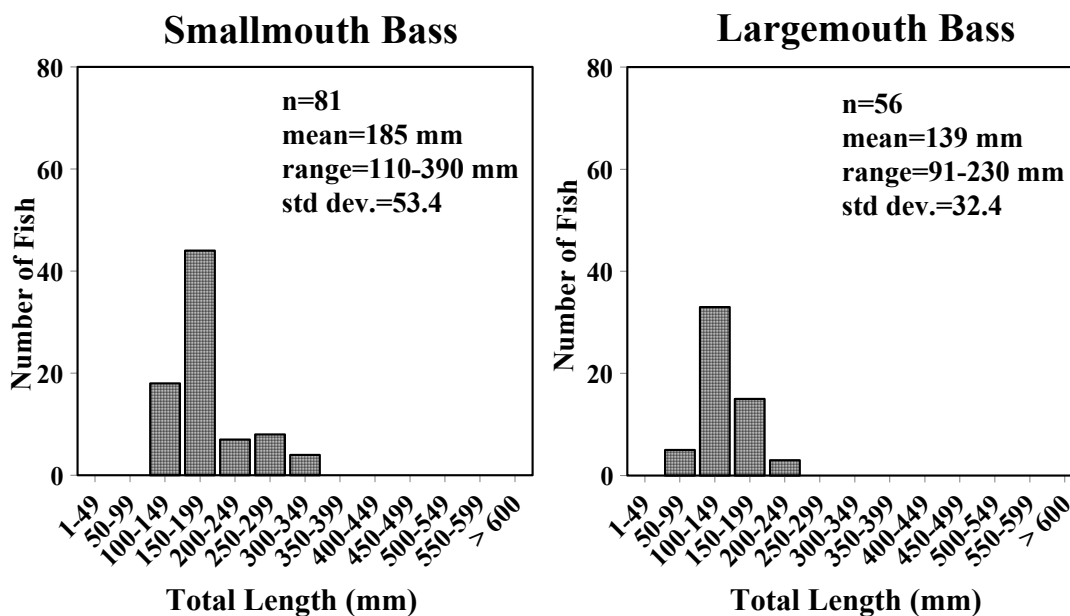


Figure 12. Total length frequency of smallmouth bass and largemouth bass collected with electrofishing during the channel catfish removal evaluation from the Upper and Lower reaches of the Colorado River, 30 June to 31 October 2003. (See Table 12 for catch/effort data).