

I. Project Title: Smallmouth Bass Control in the Green River

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III. Project Summary:

The Upper Colorado River Endangered Fish Recovery Program has determined that control of nonnative fish in the upper Colorado River basin is essential to the recovery of the four endangered fish species: Colorado pikeminnow, razorback sucker, humpback chub, and bonytail. Smallmouth bass abundance dramatically increased in the Green River around 2000. As a result, the 2003 Nonnative Fish Control Workshop (Grand Junction, Colorado) recommended that agencies attempt to reduce this species in the Green River. Five years of removal and Nonnative Fish Control Workshops have added insight to the effort required to successfully remove smallmouth bass from the Green River. During the December 2006 workshop, participants discussed the importance of increasing removal and reallocating effort to concentration areas, resulting in this scope of work for the Echo Park to Split Mountain reach of the Green River in Utah. This year was the third field season of increased effort in the study reach (16 passes rather than 4). For 2009, catfish removal was added as a pilot project due to decreased catch rates of smallmouth bass. This component was added to determine if increased removal passes might influence catfish abundance in the study reach.

IV. Study Schedule: To be continued as needed

V. Relationship to RIPRAP:

GENERAL RECOVERY PROGRAM SUPPORT ACTION PLAN

III. Reduce negative impacts of nonnative fishes and sportfish management activities (nonnative and sportfish management).

III.A. Reduce negative interactions between nonnative and endangered fishes.

III.A.2. Identify and implement viable active control measures.

GREEN RIVER ACTION PLAN: MAINSTEM

III. Reduce impacts of nonnative fishes and sportfish management activities (nonnative and sportfish management).

III.A. Reduce negative impacts to endangered fishes from sportfish management activities.

III.A.4. Develop and implement control programs for nonnative fishes in river reaches occupied by the endangered fishes to identify required levels of control.

VI. Accomplishment of FY 2009 Tasks and Deliverables, Discussion of Initial Findings and Shortcomings:

All scheduled sampling was completed (16 passes) according to the scope of work for the 2009 fiscal year. We accomplished the objectives of conducting a population estimate for adult and sub-adult bass and channel catfish in the study reach and removing bass and catfish from Echo Park to Split Mountain boat ramp. We did not achieve the target of 65% exploitation of bass >150mm total length (TL).

SMALLMOUTH BASS

Abundance Estimates, Exploitation, and Population Size Structure

The adult (≥ 200 mm TL) and sub-adult (100-199 mm TL) abundance point estimates were 488 (20 bass/mile) and 2,538 (103 bass/mile) individuals, respectively, in the study reach (Table 1). Two hundred seventy-six adults and 827 sub-adults were removed from the population during the study period. Because the study occurred over a period of three months, within-year growth based on tag returns was considered when grouping fish into age classes. The lengths at which age classes were separated were adjusted to reflect typical growth of fish without having marked fish change from one age class to another. Sub-adult fish marked in the first two passes grew into the 200mm+ category by pass 8, with at least one fish marked as a sub-adult growing to 237mm by the end of the sampling period. Fish smaller than 100mm TL were grouped together because there was no clear separation later in the sampling between young of year and age-1 fish. Based on the point estimates, 57% of adults and 30% of sub-adults were removed (Table 2). The rate for adults was higher this year than in 2008 (29%), but lower for sub-adults (69%). The exploitation rates for 2009 were lower for both age classes than in 2007. Exploitation rates derived from the abundance estimates differ from those derived from tag returns for adults (Table 2), but the exploitation estimates for sub-adults were similar. When comparing exploitation rates based on tag returns from 2007-2009, the results are more similar across years, especially for sub-adults, perhaps reflecting the precision of population estimates from year to year. Modeling by Haines and Modde (2007) suggested an exploitation rate of greater than 65% would be necessary for bass >150mm in order to cause a population crash. After adjusting the population estimate for this new size category and adjusting for growth through the study period, the exploitation rate for bass >150mm was estimated at 37.5%, with 29% of tags recaptured. These estimates are similar to those generated by classifying sub-adults at lengths between 100-199mm at the time of tagging. These data suggest a decline in the adult bass population, at least when comparing 2009 to 2004. The overlapping confidence intervals, however, make it

difficult to conclude that there has been a significant decline in the last few years (Figure 1). Also, over this time period, it appears the sub-adult component of the population has remained fairly stable.

The length frequencies of bass captured for the June-July period and August-September period are shown in Figures 2a-b. There was a large cohort of sub-adult fish between 100-200mm at the beginning of the season, with some of those fish growing into the 200-225mm category. The large group of 150-175mm fish from the early season appears to correspond to a cohort that centered around 126-150mm in 2008 and that was probably spawned in 2007. Figure 3 shows length frequencies for all fish captured in 2008 and 2009. Because nearly half the number of fish was caught this year compared to last, the figure shows the percent of total catch in each size class. This year larger fish made up a larger proportion of bass captured, and fish in the small sub-adult categories made up less of the catch. Age-0 bass were captured later in the season, peaking in mid-September (Figure 4). The total number of age-0 bass was slightly higher than 2008, but still much lower and later in the season than 2007, when a large cohort was produced.

Catch Rates

Catch rates for smallmouth bass declined over the season (Table 3; Figure 5). This was true whether analyzing adults, sub-adults, or adults and sub-adults combined. An increase in catch rate was observed during pass 15, when heavy rains increased turbidity. In particular, catch rates for adults increased more dramatically during these conditions. This pattern has been consistent in 2008 and 2009, indicating adult fish may be moving into deeper water as turbidity decreases through the season and spawning activity subsides. Adults in deeper water would be more difficult to catch and target using raft electrofishing. The catch rate this year for adults and sub-adults combined decreased by nearly half compared to previous years (Figure 6). The catch rate data suggest there has been a detectable decline in the bass density in this reach over the last few years, as well as during this season. This is probably due to a combination of environmental conditions that have reduced bass reproductive success in the last two years, and intensive removal of adults and sub-adults. The continued presence of a strong cohort from 2007 has made reducing the total population difficult.

Movement

Eighty tagged bass (18 adults, 62 sub-adults) from this study were recaptured, allowing an analysis of movement. Nine adults (50%) were recaptured in the same area where they were tagged, six (33%) were encountered upstream of their original capture, and three (17%) were recovered downstream. Of the 62 sub-adults recaptured, 42 (68%) were caught in the same area, four (7%) were captured upstream, and 16 (26%) were found downstream. Three of the sub-adults recaptured were found in the study reach below this one. These data suggest adult bass may be more likely to move upstream than sub-adults. No bass tagged in this study reach were caught upstream in Yampa Canyon. There were also two adult bass and four sub-adult bass with red tags not included in these numbers from the Utah Division of Wildlife Resources study reach below Split Mountain. One bass tagged in Yampa Canyon in 2008 was caught in this study reach.

Ancillary Fish Captures

In addition to the smallmouth bass in the reach, numerous other nonnative and native species were captured (Table 4). Two adult gizzard shad were caught in Split Mountain Gorge this year. Gizzard shad were reported for the first time in Whirlpool Canyon in 2007, but were not seen in 2008. Many small age-1 chubs (*Gila spp.*) were also observed in this reach, particularly in Island Park. This represents an increase in these fish over recent years. Finally, one northern pike was captured in the study reach with a blue tag, indicating it was marked in a previous year upstream in the Yampa study reaches sampled by Colorado Department of Wildlife and Colorado State University Larval Fish Laboratory.

CHANNEL CATFISH

Channel catfish were Floy tagged with yellow tags starting pass 7 in order to conduct a population estimate. Seventy-two adult (TL \geq 300mm) catfish and 216 sub-adults (TL 50-299mm) were Floy tagged and released. During pass 8, 44 adults and 241 sub-adults were caught, with no recaptures. For pass 9, 97 adults and 419 sub-adults had their dorsal fins clipped, and pass 10 was used as a recapture pass for population estimation. On pass 10, 975 fish of both age classes were caught, with only six total recaptures. Using these numbers, the total population of channel catfish was estimated at 72,224 individuals (\pm 50,887 95% C.I.). This translates to 2,936 catfish per river mile in the study reach. Generating population estimates separately for adults and sub-adults produced even less precise estimates and a larger overall population. After the estimate, 2,749 catfish (3.8%) of all sizes were removed in seven passes, with 2.6% of all marked fish recaptured. The size structure for the catfish caught in this study was comprised mostly of sub-adult fish <300mm (Figure 7). With the exception of passes 9 and 10, the catch rate for each pass remained relatively similar (Figure 8) and showed no detectable decline. Of the tagged fish that were recaptured, three remained in the same reach, and one moved upstream one reach. Two of 355 fish that were tagged in 2005 were also recaptured. These fish had grown 34mm and 18mm in four years (mean=6.5mm/year). Crews noted during angling that catfish were present in high numbers in deeper water, but these fish were not available to capture using electrofishing. This was consistent with the low number of recaptures and suggests a large portion of the catfish population inhabits areas inaccessible to electrofishing methods.

Literature Cited

Haines, G.B. and T. Modde. 2007. A review of smallmouth bass removal in Yampa Canyon, with notes on the simulated effort needed to reduce smallmouth bass in the Green River subbasin. Draft Report Upper Colorado River Basin Recovery Implementation Program, U.S. Fish and Wildlife Service.

VII. Recommendations:

-Continue with smallmouth bass removal as scheduled and adjust the Haines and Modde model by incorporating these data. This year showed a decline in catch rates through the

season, as well as compared to the last five years. It is worthwhile to continue removal efforts to see if they will continue to produce declining population point estimates and catch rates. In addition to personal observations, the data reflect a general absence of bass compared to previous years. This study reach represents the best opportunity to determine if mechanical removal is possible given an increased level of effort, and continued removal is necessary to estimate the extent to which this population can be reduced, especially given the possibility of future years with increased reproduction.

-Strongly consider discontinuing catfish removal given the negligible effect on this population, the absence of removal in adjacent reaches, the potential for negative public reaction, and the potential for this removal to overwhelm bass control efforts.

VIII. Project Status: On track and ongoing

IX. FY 2009 Budget Status

- A. Funds Provided: **\$185,049**
- B. Funds Expended: **\$185,049**
- C. Difference: -0-
- D. Percent of the FY 2009 work completed, and projected costs to complete: 100%
- E. Recovery Program funds spent for publication charges: -0-

X. Status of Data Submission (Where applicable):
Submission pending completion of reporting, expected no later than 12/31/09.

XI. Signed: *P. Badame & M.T. Jones* 11/6/2009
Principal Investigators Date
Submitted electronically

Table 1. Lincoln-Petersen estimates of smallmouth bass in study reach, 2009.

Size class	Abundance	95% CI	SE	CV (%)
Sub-adult (100-199mm TL)	2,347	1,315-3,378	516	22
Adult (>200mm TL)	488	184-792	152	31

Table 2. Exploitation of smallmouth bass in the study reach as determined by population estimates and tag returns. TL = total length.

ADULTS (≥ 200 mm TL)		
Population Estimate	Number Removed	Exploitation (%)
488	276	57
Tags Released (pass 1-2)	Number Recovered (passes 3-16)	Exploitation (%)
62	20	32
SUB-ADULTS (100-199 mm TL)		
Population Estimate	Number Removed	Exploitation (%)
2,347	708	30
Tags Released (pass 1-2)	Number Recovered (passes 3-16)	Exploitation (%)
191	58	30

Table 3. Total fish caught by pass and size class, 2009. Bass sub-adults and adults were tagged and released in passes 1 and 2. Removal occurred for all other passes. Catfish were marked and released in passes 7 and 9.

Pass	Smallmouth bass				Channel catfish		
	<100mm	Sub-adults	Adults	Total	Sub-adults	Adults	Total
1	8	80	31	119			
2	10	114	31	155			
3	22	121	34	177			
4	17	98	27	142			
5	9	45	26	80			
6	2	55	24	81			
7	5	48	19	72	219	72	291
8	0	20	16	36	241	44	285
9	0	42	14	56	419	98	517
10	0	93	18	111	783	192	975
11	0	48	10	58	252	58	310
12	39	40	12	91	356	70	426
13	50	29	13	96	275	62	337
14	33	14	12	59	226	58	284
15	264	70	36	370	157	44	201
16	64	26	14	104	151	62	213
Total	488	943	337	1768	3079	760	3839

Table 4. Ancillary fish captures in the study reach.

Species	Number Captured
Black bullhead (<i>Ameiurus melas</i>)	7
Black crappie (<i>Pomoxis nigromaculatus</i>)	3
Bluegill (<i>Lepomis macrochirus</i>)	38
Gizzard shad (<i>Dorosoma cepedianum</i>)	2
Green sunfish (<i>Lepomis cyanellus</i>)	128
White sucker and hybrids (<i>Catostomus commersonii</i> , spp.)	496
Northern pike (<i>Esox lucius</i>)	15
Walleye (<i>Sander vitreus</i>)	16
Colorado pikeminnow (<i>Ptychocheilus lucius</i>)	34
Razorback sucker (<i>Xyrauchen texanus</i>)	2
Humpback chub (<i>Gila cypha</i>)	1
Roundtail chub (<i>Gila robusta</i>)	16
<i>Gila</i> spp. (usually TL <100mm)	51

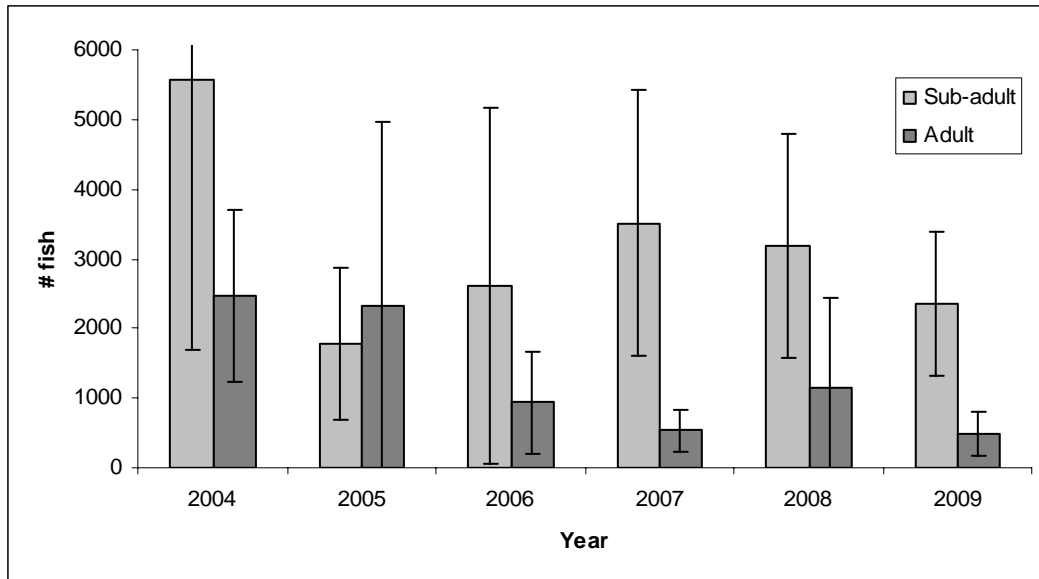


Figure 1. Population estimates with 95% C.I. for smallmouth bass in Whirlpool Canyon/Split Mtn., 2004-2009.

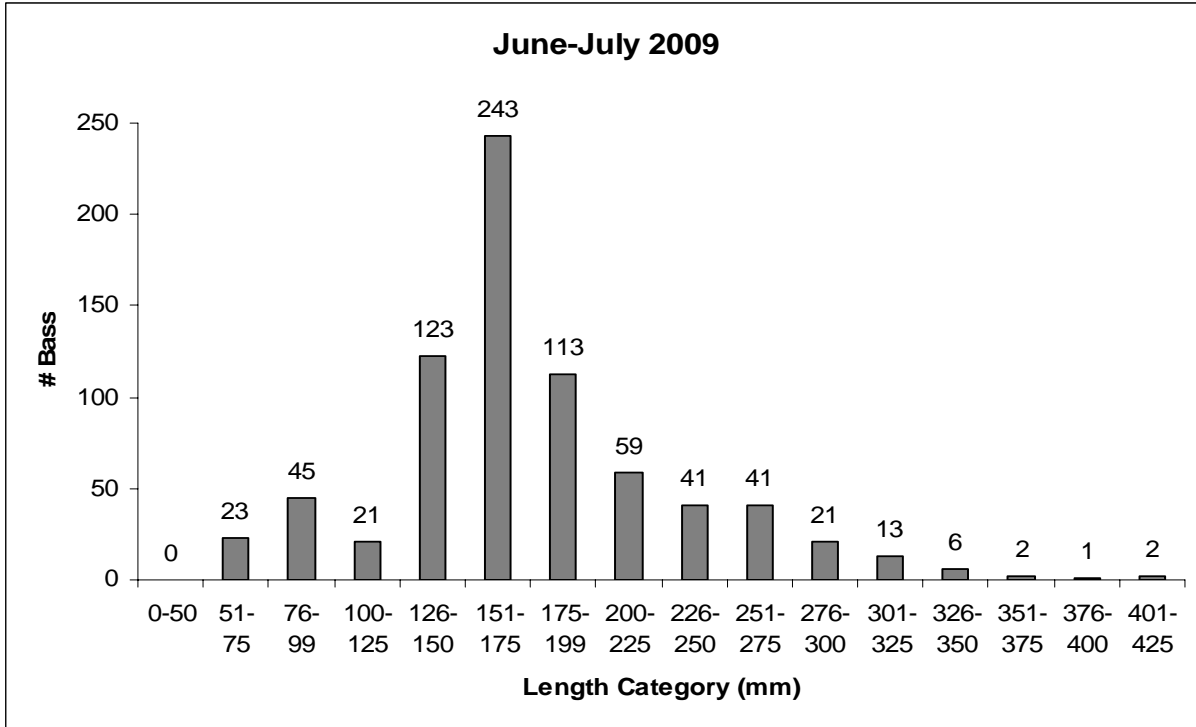


Figure 2a. Length frequency of smallmouth bass caught in June-July 2009.

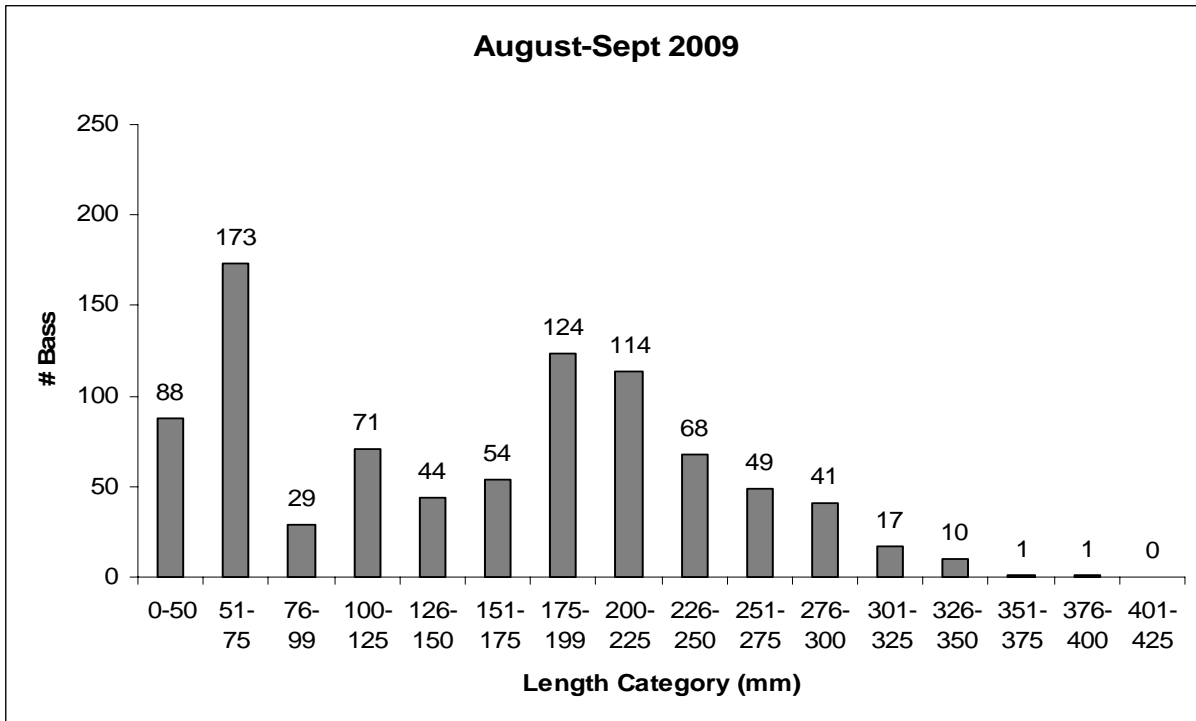


Figure 2b. Length frequency of smallmouth bass captured in the study reach at end of study (Aug.-Sept.).

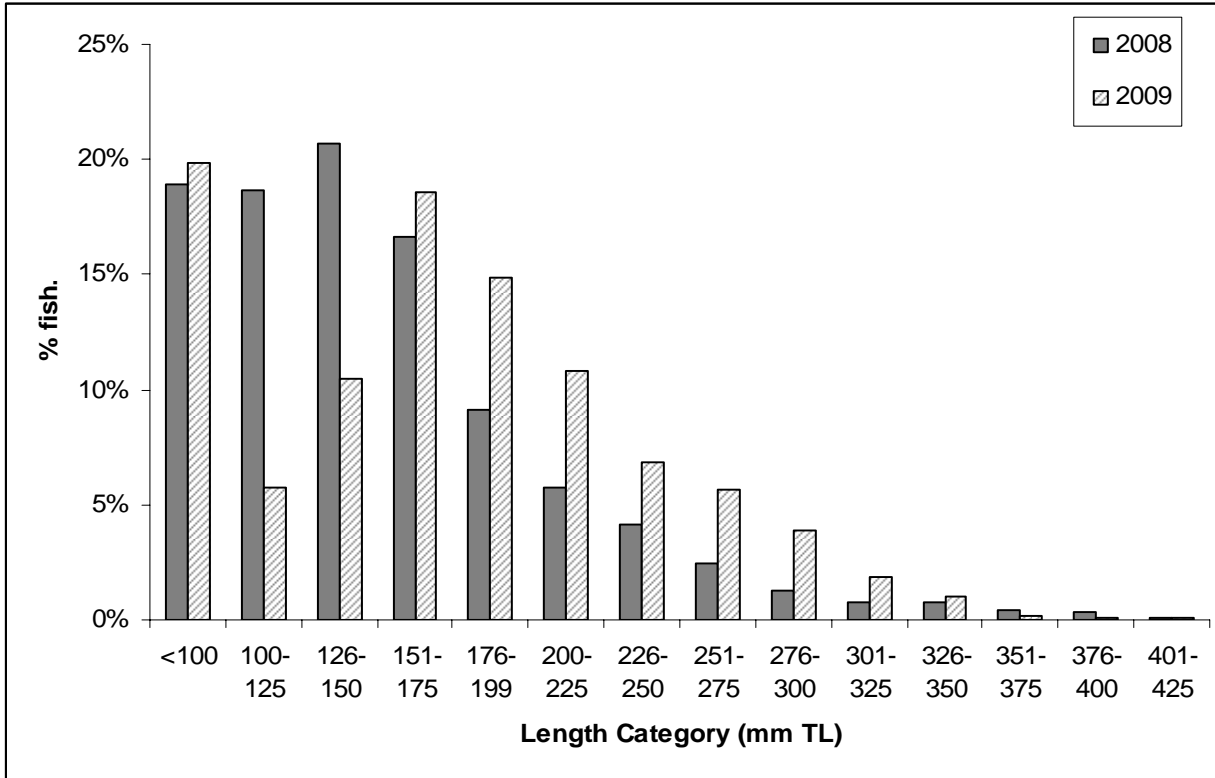


Figure 3. Length frequency of all smallmouth bass captured 2008-2009.

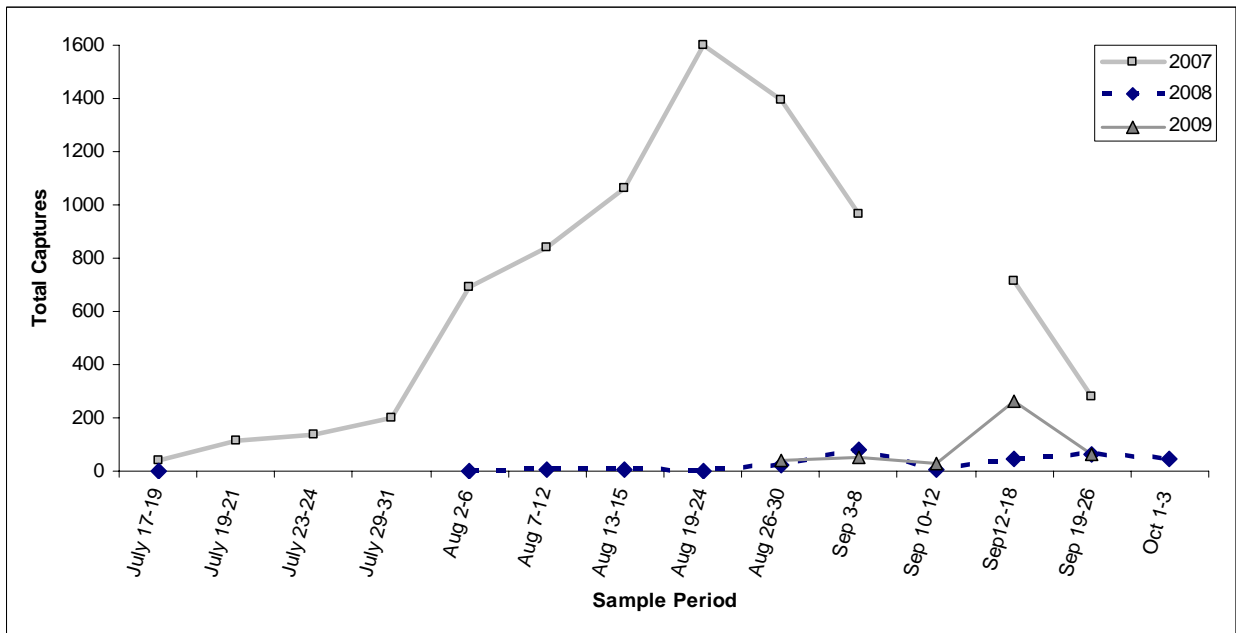


Figure 4. Total catch of age-0 bass over sampling period, 2007-2009.

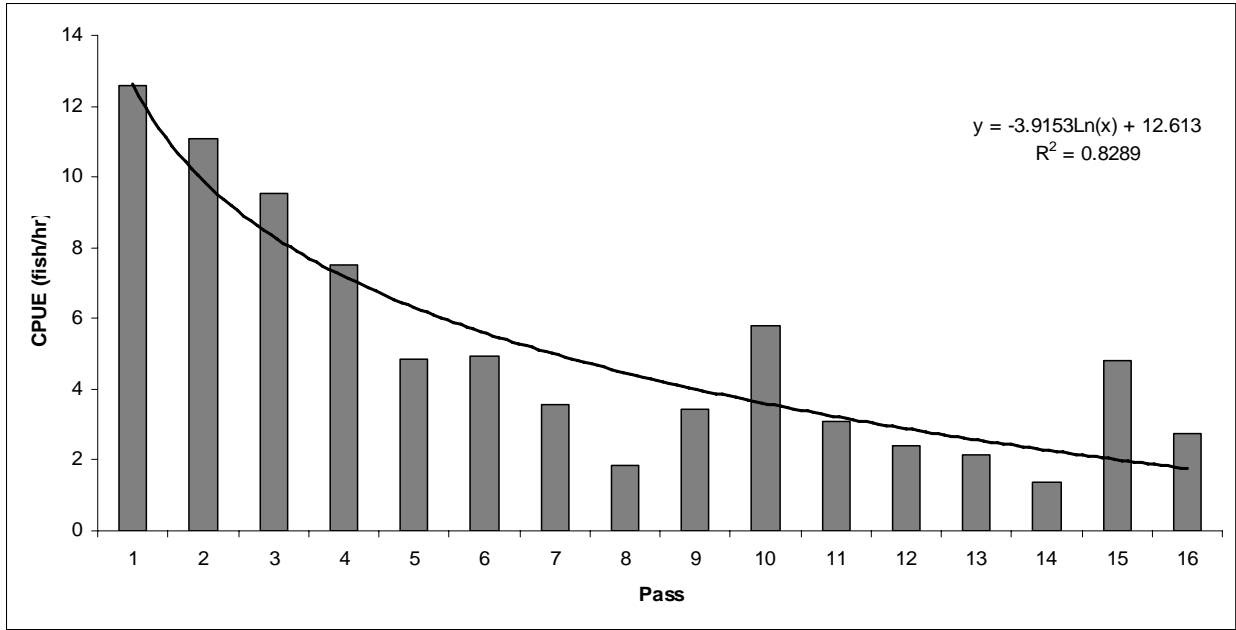


Figure 5. Smallmouth bass (sub-adult and adult) catch rate by pass, 2009.

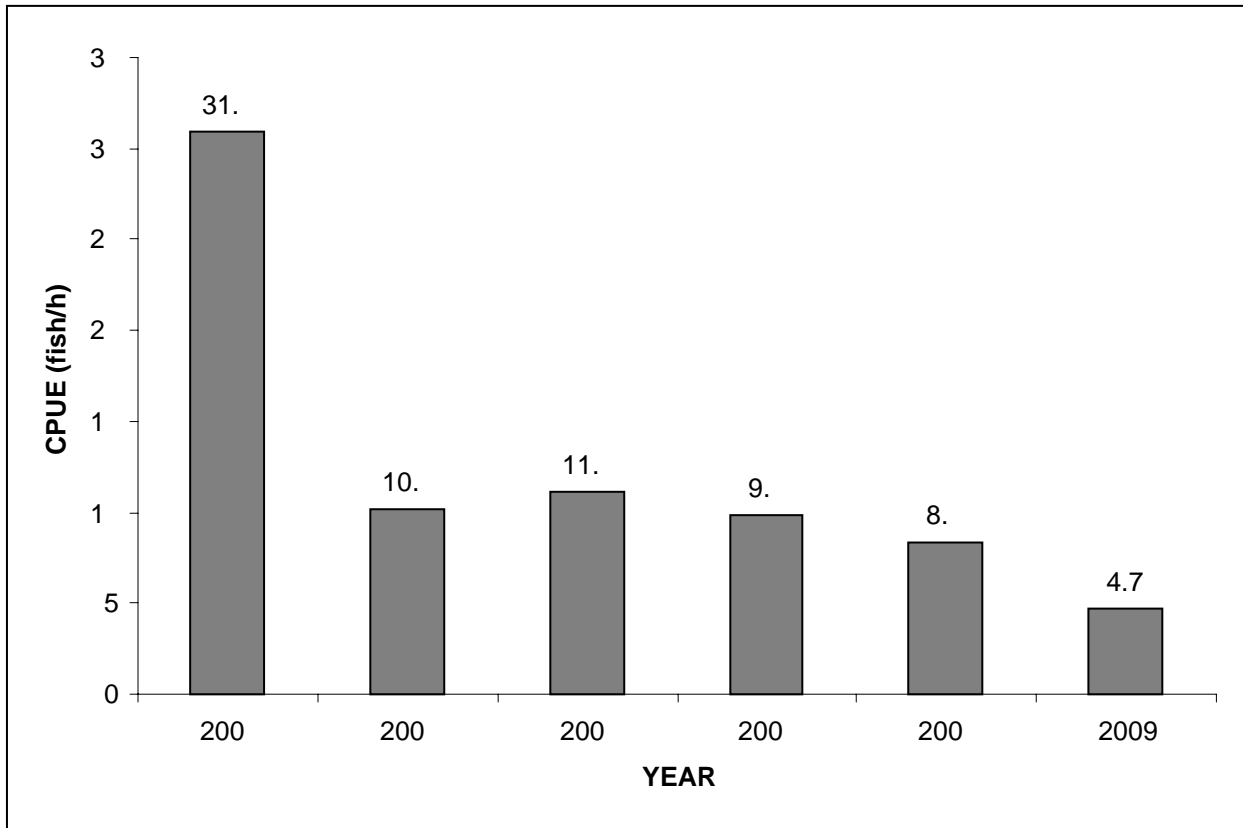


Figure 6. Smallmouth bass catch rates (sub-adult and adult) in the reach for 2004-2009.

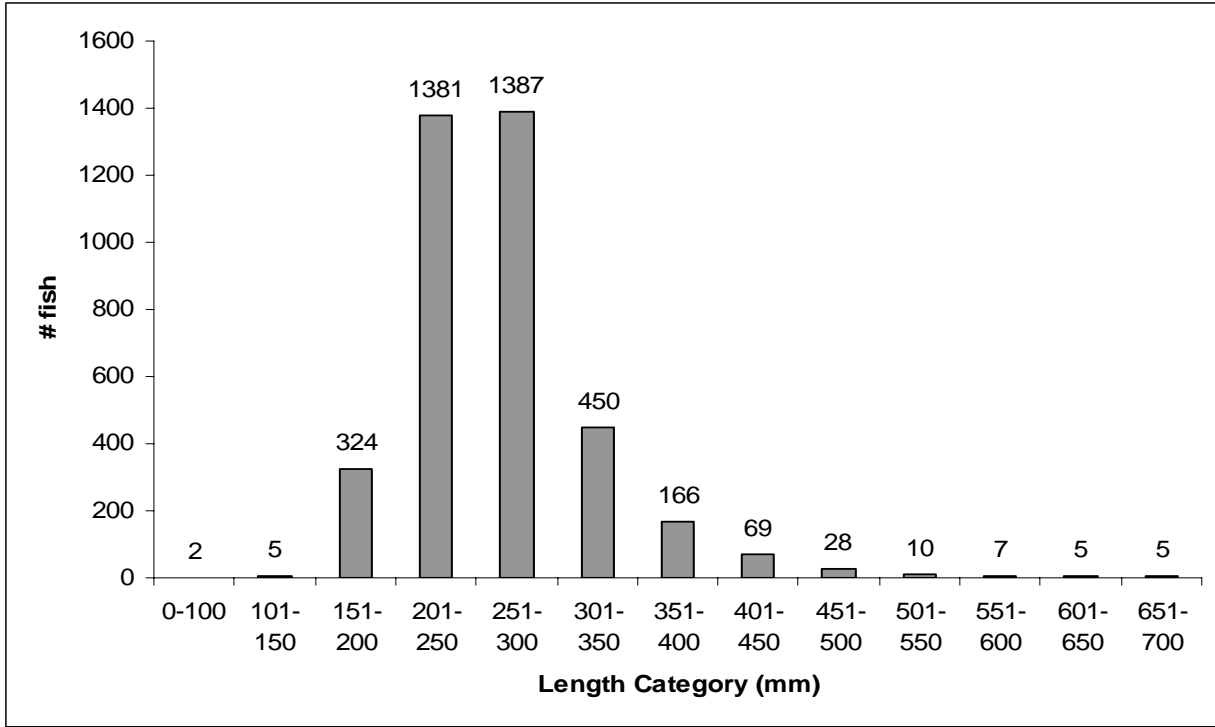


Figure 7. Length frequency of channel catfish caught in 2009.

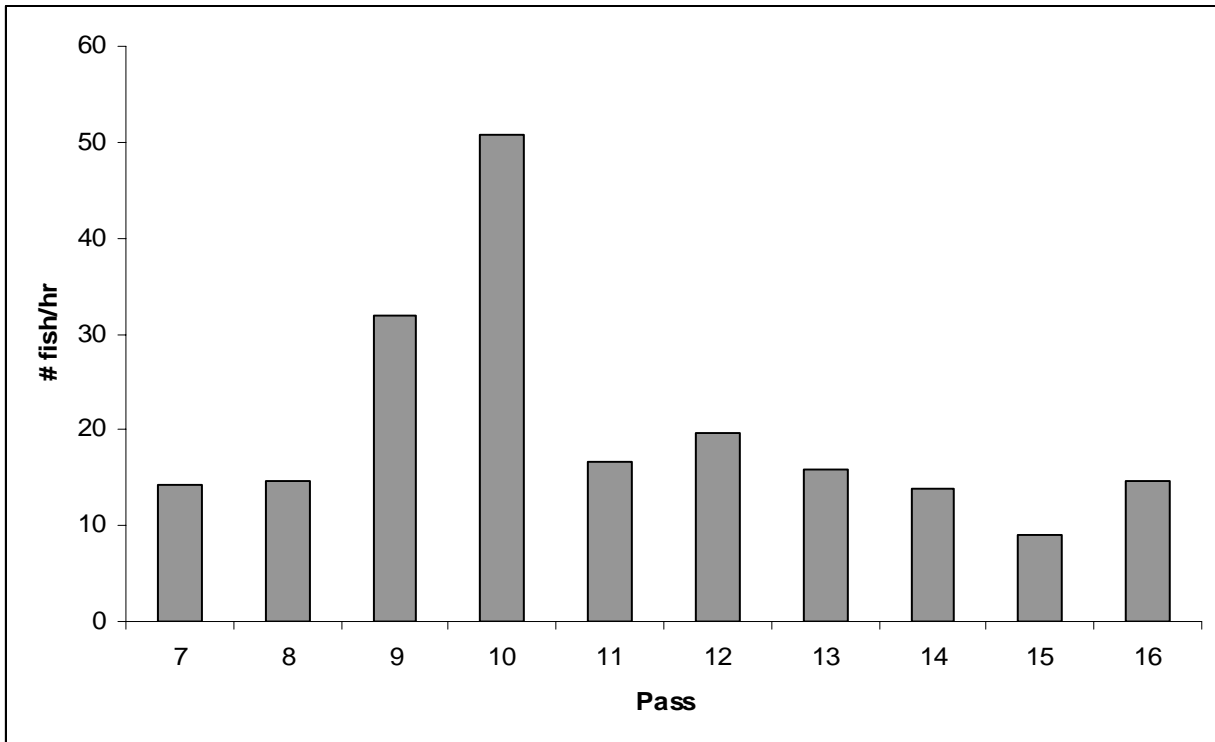


Figure 8. Catch rates by pass for channel catfish, 2009.