

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. Six 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 fourth field season of increased effort in the study reach (15 passes rather than 4).

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 2010 Tasks and Deliverables, Discussion of Initial Findings and Shortcomings:

Fifteen sampling passes were completed. We accomplished the objectives of conducting a population estimate for adult and sub-adult bass in the study reach and removing bass from Echo Park to Split Mountain boat ramp. Population estimates based on depletion estimates and mark-recapture estimates suggest we were able to achieve >65% exploitation of adult bass. This year was the fourth year where a decrease in the point estimates and catch rates was observed.

SMALLMOUTH BASS

Abundance Estimates, Exploitation, and Population Size Structure

Smallmouth bass were marked with green Floy® tags on the fifth pass. This approach was taken in order to maximize the removal of spawning adults during the early passes. The adult (≥ 200 mm TL) and sub-adult (100-199 mm TL) abundance point estimates (after 4 passes of removal) were 264 (11 bass/mile) and 218 (9 bass/mile) individuals, respectively, in the study reach (Table 1). In order to estimate the initial population before removals began, Leslie depletion estimates were also calculated using all 14 removal passes (Table 1). This method yielded initial estimates of 442 adults (18 fish/mi) and 636 subadults (25 fish/mi). Three hundred seventy-two adults and 372 sub-adults were removed from the population during the study period. This includes smallmouth bass removed during two additional passes conducted collaboratively with CSU. These fish are reported here for the purpose of estimating exploitation since nonnative fish removal is not the main goal of that study. Other fish captures from the CSU Lodore passes are reported under the Project 115 report. 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 during the fifth pass grew into the 200mm+ category by the subsequent pass, with at least one fish marked as a sub-adult growing to 233mm 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 from the Leslie estimates, 84% of adults and 58% of sub-adults were removed (Table 2). Exploitation rates derived from the abundance estimates were higher than those estimated from tag returns (Table 2). When comparing exploitation rates based on tag returns from 2007-2010, the results are more similar across years, especially for sub-adults, perhaps reflecting the imprecision of population estimates from year to year.

The population estimates suggest a significant decline in the sub-adult bass population this year. This trend can be explained by sub-adult bass from 2009 recruiting to adult

size coming into 2010 and reproduction in 2008-2009 being insufficient to replace those fish. When looking at length frequency histograms from 2008 to present, a large cohort of fish produced in 2007 has been slowly growing to maturity. This is supported by 2009 tag returns which showed that fish 150-200mm total length in 2009 had grown well into adult size (>200mm) by the beginning of the 2010 sampling. Despite this recruitment, the adult population appeared to remain fairly stable, and the total number of adults caught was lower than 2009.

The length frequencies of bass captured for the June-July period and August-September period are shown in Figures 2a-b. Figure 3 shows length frequencies as percent of catch for all fish captured in 2008 through 2010. Adult fish made up a larger proportion of bass captured, although the total number caught was lower for nearly every size class. Age-0 bass were captured starting in late July, and peaked in early September. The total number of age-0 bass was low compared to previous years.

Catch Rates

Catch rates for smallmouth bass declined over the season (Table 3; Figure 4). This was true whether analyzing adults, sub-adults, or adults and sub-adults combined. Adult catch rates declined more dramatically following pass 6, and remained low for the duration of the study. This is likely due to adult movement from spawning habitat, which is easily sampled via electrofishing, into deeper water. The overall catch rate for this reach decreased again compared to previous years (Figure 5). The trend in catch rates, as well as the population estimates and total captures, suggests there has been a decline in the number of smallmouth bass in this reach.

Movement

Thirty-one tagged bass (13 adults, 18 sub-adults) from this study were recaptured, allowing an analysis of movement. Ten adults (77%) were recaptured in the same area where they were tagged, and three (23%) were recovered downstream. No upstream movement of tagged adults was observed. Of the eighteen sub-adults recaptured, 13 (72%) were caught in the same area, one (6%) was captured upstream, and four (22%) were found downstream. No bass tagged in this study reach were caught upstream in Yampa Canyon or downstream in the Uinta Basin. There were seven adult bass with red tags not included in these numbers from the Utah Division of Wildlife Resources study reach in the Uinta Basin. These fish moved upstream into the Split Mountain and Island Park reaches.

This year, several fish from 2008 and 2009 were also recaptured, including 14 adults and six sub-adults. Four of the adults were recaptured in the same reach where they were originally tagged, and ten were captured downstream. The majority of downstream movement was observed from reach 1 (Echo Park to the CO/UT state line) to reach 4 (Split Mountain Canyon). One adult fish tagged in 2009 as a sub-adult was also recaptured upstream in the lowest reach of Yampa Canyon, and an adult fish tagged in 2009 was recaptured in the Uinta Basin. Sub-adult recaptures were evenly split between downstream movement or remaining within their original reach. It is interesting to note

that no fish tagged in reaches 3 or 4 in 2008-2009 were recaptured after more than a year at large.

Tag data also allowed for the estimation of growth rates during the study period. Adults grew an average of 0.89mm/day, and sub-adults grew 1.03mm/day. Fish that were tagged in 2009 as sub-adults grew an average of 61mm over the year they were at large. Adults tagged in 2009 grew an average of 38mm during the 2009-2010 period.

Ancillary Fish Captures

In addition to the smallmouth bass in the reach, numerous other nonnative and native species were captured (Table 4). Of particular concern was the capture of a single adult burbot in this reach, representing the first time this species has been seen downstream of the Flaming Gorge dam. Walleye captures increased to 30 fish this year, up from 16 fish in 2009 and 26 fish in 2008. Walleye averaged 498mm total length (396-703mm), and most of the walleye (57%) were caught in Split Mountain Canyon.

VII. Recommendations:

- Continue this project to evaluate the ongoing removal of fish in the long term, as recommended by the Modde and Haines model. This season represented the fourth year of decreasing point estimates and catch rates, in addition to a decrease in the overall number of bass caught. The removal of fish by this project, in addition to decreased reproduction from unfavorable flows and water temperatures, appears to have reduced the population as a whole. Although a large cohort of sub-adult fish from 2009 were able to recruit to adult size, the adult population estimate did not show a corresponding increase.
- Continue to remove adult fish during the spawning season. By targeting the beginning of spawning for removal, more adults were removed early in the study when catch rates were higher. The number of adults declined dramatically after the initial passes, making their removal less likely. This approach will make estimating the population more difficult, but increases the chances of removing fish before they are able to reproduce. If catch rates decline through the season, as they have for the last two years, it may be possible to use depletion estimates of abundance rather than mark-recapture estimates.
- Monitor burbot and walleye captures more closely. The presence of burbot in the study reach is alarming, since the dam's configuration makes escapement unlikely for adult fish. Also, the increase in the number of walleye raises concern, especially given the close proximity of a population in Red Fleet Reservoir. Both species should be collected for otolith microchemistry analyses in the future. This will allow us to determine their origin and what year they reached the river, presumably after escaping from nearby reservoirs. In addition, the risk of escapement from Flaming Gorge dam should be re-evaluated for burbot.

VIII. Project Status: On track and ongoing

IX. FY 2010 Budget Status

- A. Funds Provided: **\$186,989**
- B. Funds Expended: **\$186,989**
- C. Difference: -0-
- D. Percent of the FY 2010 work completed, and projected costs to complete: 95%
- 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 12/31/10.

XI. Signed: M.T. Jones & K. Breidinger 11/15/2010

Principal Investigators Date
(Submitted electronically)

Table 1. Population estimates of smallmouth bass in study reach, 2010. Lincoln-Petersen estimates are for the population size at pass 5, after 4 removal passes. Leslie depletion estimates are for the initial population before any removals.

Size class	Method	Abundance	95% CI	SE	CV (%)
Sub-adult (100-199 mm)	Lincoln-Petersen	218	57-380	81	37
	Leslie depletion	636	308-964	152	
Adult (>200mm TL)	Lincoln-Petersen	264	105-424	80	30
	Leslie depletion	442	351-533	42	

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 (%)
442	372	84
Tags Released (pass 5)	Number Recovered (passes 6-15)	Exploitation (%)
46	13	28

SUB-ADULTS (100-199 mm TL)

Population Estimate	Number Removed	Exploitation (%)
636	372	58
Tags Released (pass 5)	Number Recovered (passes 6-15)	Exploitation (%)
38	15	39

Table 3. Total fish caught by pass and size class, 2010. Bass sub-adults and adults were tagged and released in pass 5. Removal occurred for all other passes.

Pass	<100mm	Sub-adults	Adults	Total
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1	7	26	40	73
2	8	29	37	74
3	20	40	56	116
4	12	45	62	119
5	15	39	46	100
6	19	27	44	90
7	3	34	23	60
8	8	24	16	48
9	3	37	17	57
10	2	25	12	39
11	14	37	9	60
12	29	16	7	52
13	12	6	14	32
14	7	5	7	19
15	33	6	10	49
CSU	1	15	18	34
Totals	193	411	418	1022

Table 4. Ancillary fish captures in the study reach.

Species	Number Captured
Black bullhead (<i>Ameiurus melas</i>)	2
Black crappie (<i>Pomoxis nigromaculatus</i>)	1
Bluegill (<i>Lepomis macrochirus</i>)	3
Burbot (<i>Lota lota</i>)	1
Gizzard shad (<i>Dorosoma cepedianum</i>)	1
Green sunfish (<i>Lepomis cyanellus</i>)	131
White sucker and hybrids (<i>Catostomus commersonii</i> , spp.)	509
Northern pike (<i>Esox lucius</i>)	20
Walleye (<i>Sander vitreus</i>)	30
Colorado pikeminnow (<i>Ptychocheilus lucius</i>)	43
Razorback sucker (<i>Xyrauchen texanus</i>)	2
Humpback chub (<i>Gila cypha</i>)	2
Roundtail chub (<i>Gila robusta</i>)	36
<i>Gila</i> spp. (usually TL <100mm)	97

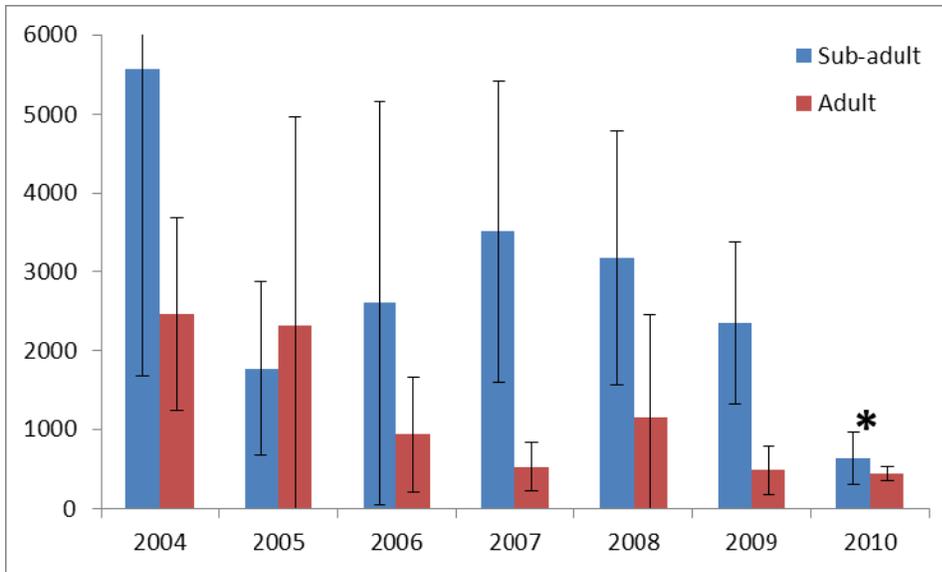


Figure 1. Population estimates with 95% C.I. for smallmouth bass in Whirlpool Canyon/Split Mtn., 2004-2010. Note: *estimates for 2010 were calculated using a different method.

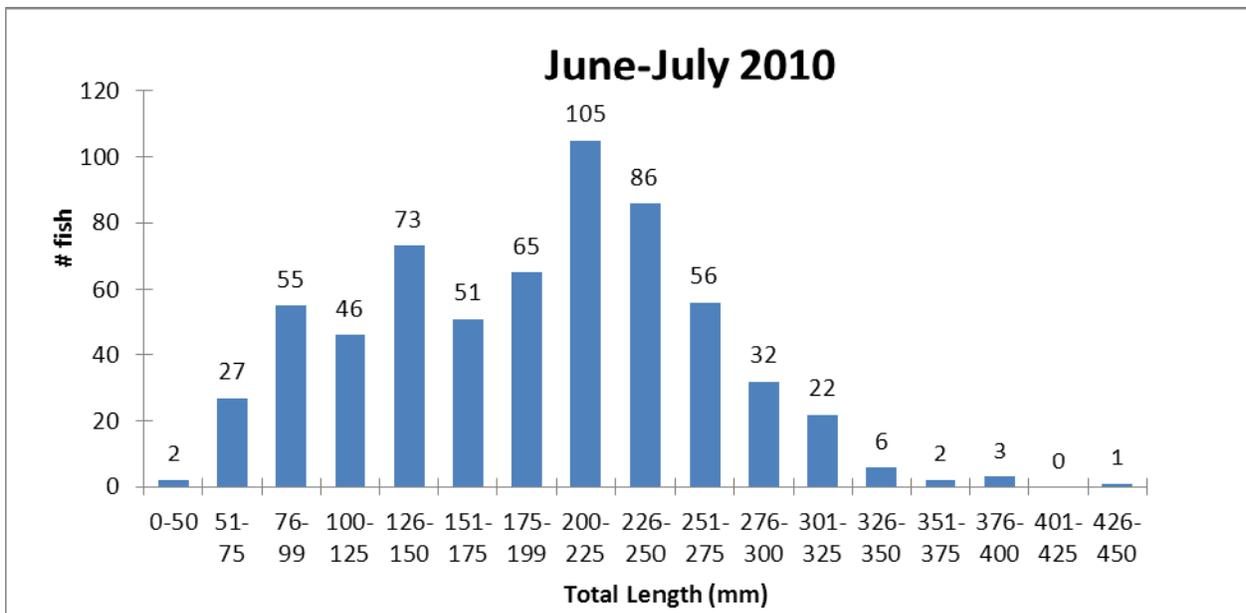


Figure 2a. Length frequency of smallmouth bass caught in June-July 2010.

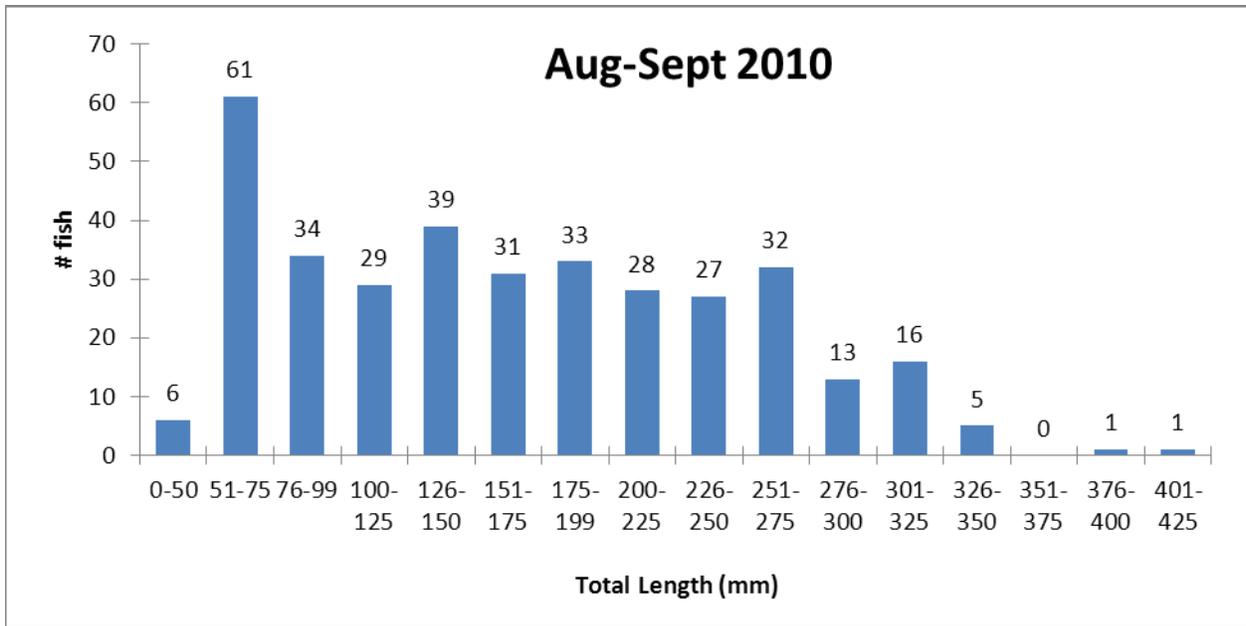


Figure 2b. Length frequency of smallmouth bass captured in the study reach at end of study (Aug.-Sept.).

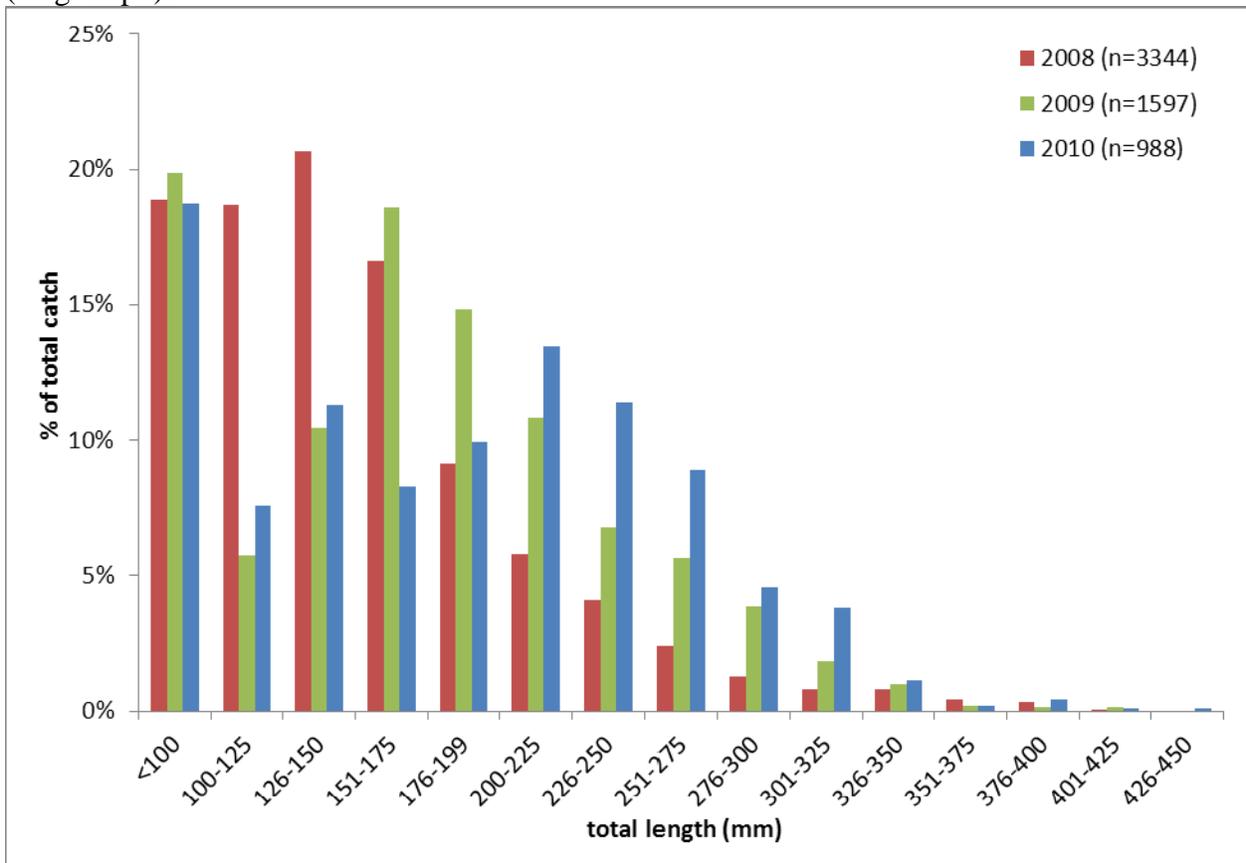


Figure 3. Length frequency of all smallmouth bass captured 2008-2010.

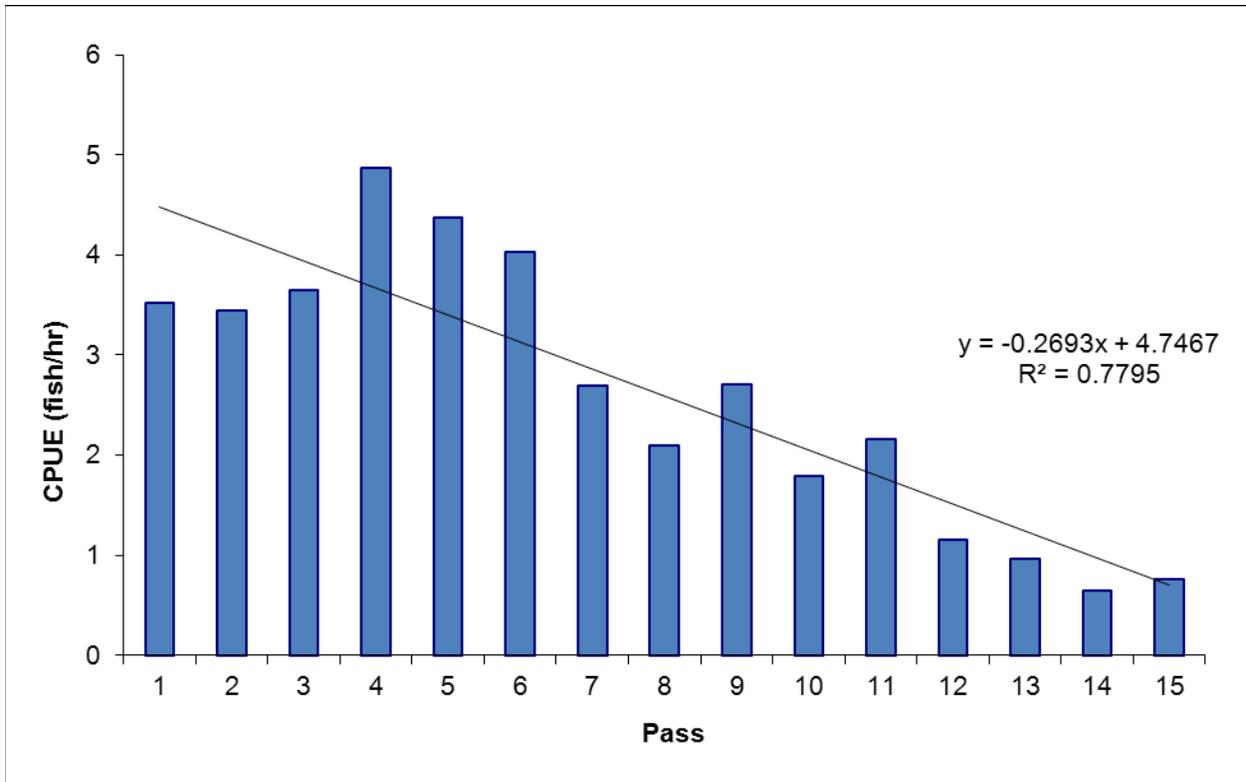


Figure 4. Smallmouth bass (sub-adult and adult) catch rate by pass, 2010.

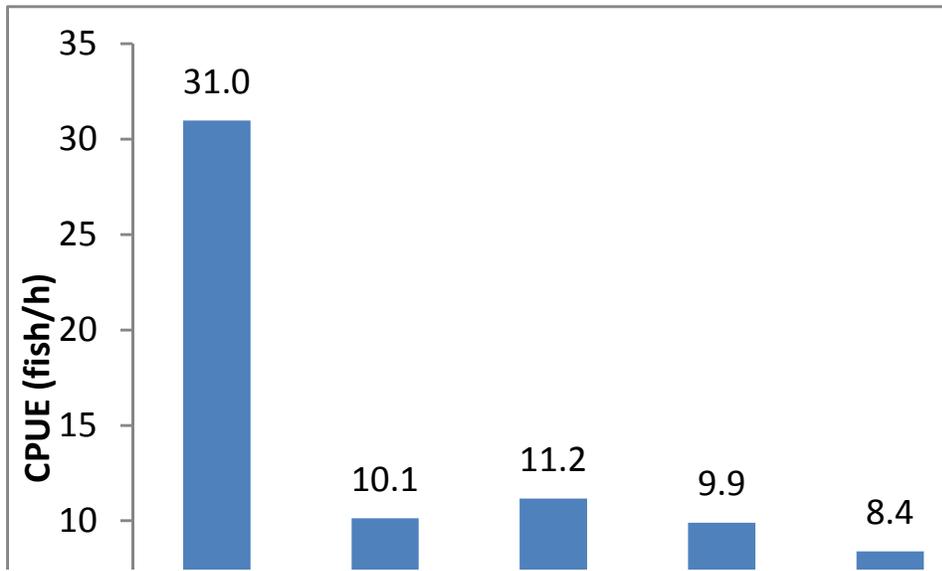


Figure 5. Smallmouth bass catch rates (sub-adult and adult) in the reach for 2004-2010.