

I. Project Title: **Evaluation of smallmouth bass and northern pike management in the middle Yampa River.**

II. Principal Investigator(s):

John Hawkins *John.Hawkins@ColoState.EDU*  
Larval Fish Laboratory (970) 491-2777  
Dept. Fishery and Wildlife Biology (970) 491-5091 fax  
1474 Campus Mail  
Colorado State University  
Ft Collins, CO 80523  
Coauthors: Walford, C. (CSU), Wright, B. (CDOW)

Field crews: CSU: Tate Wilcox, Tuttle, Donald, Corey Heim, Glen Brenner, Andy Kellner, Bill Kohler, Jon Wardell, Andre Breton, Angela Hill; DOW: Jeff Behncke, Andrea Sponseller, Jay Guerrin, Charlie Cunningham; FWS: Aaron Webber, Bob Burdick, Ben Schleicher, Brendan Crowley, Ann Sugiura, Greg Fraser, Karie Hiam; BOR: Dave Speas

III. Project Summary:

This study was an evaluation of whether smallmouth bass *Micropterus dolomieu* numbers can be controlled through active removal from critical habitat for Colorado pikeminnow *Ptychocheilus lucius* in the Yampa River. The study area included 87 miles of the middle Yampa River from South Beach boat launch (river mile; RM 134.2) downstream of Craig, Colorado to just upstream of Dinosaur National Monument (RM 47) and was divided into seven reaches. Fish sampling occurred on four to twelve occasions (passes) from April through July using two electrofishing boats sampling both shorelines. Smallmouth bass  $\geq 100$  mm were marked and released on several occasions in each reach with a Floy tag to estimate their abundance and monitor movement and growth. Smallmouth bass were removed from the river on all other passes. To evaluate removal success we estimated the number of sub-adult (100–199-mm) and adult ( $\geq 200$ -mm) smallmouth bass at each study site using capture-recapture methods. On removal passes, smallmouth bass  $\geq 250$  mm were transported and released in Elkhead Reservoir for their angling potential. From July through October, we removed small, primarily Age-0 smallmouth bass from the lower 12-mile portion of Little Yampa Canyon and from Lily Park using an electric seine. Starting in 2009, we started removing two other nonnative species, white sucker and common carp from those same two sites. We also removed northern pike and transported them to State Parks Headquarter's pond near Hayden. Data for northern pike that we caught were provided to Colorado Division of Wildlife (CDOW) biologists and those results are reported in Project # 98a.

IV. Study Schedule: Initial Year: 2003  
Final Year: ongoing

V. Relationship to RIPRAP : : April 2009 version @ <http://www.r6.fws.gov/crrip/rip.htm>

Green River Action Plan: Yampa and Little Snake rivers

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

III.B. Implement CDOW Yampa Basin aquatic wildlife management plan and the Recovery Program's YampaRiver Nonnative Fish Control Strategy.

III.B.1. Prevent nonnative fish introduction; reduce invasion and recruitment.

III.B.1.(d)(2) Smallmouth bass

III.B.2. Control nonnative fishes via mechanical removal.

III.B.2.a. Estimate nonnative abundance, status, trends & distribution (YS I-3)

III.B.2.e. Remove and translocate smallmouth bass. (YS J-1)

VI. Accomplishment of FY 2010 Tasks and Deliverables, Discussion of Initial Findings and Shortcomings:

Preliminary results for 2010 are provided below and are subject to change. For comparison with previous results see the 2008 and 2009 annual reports, Hawkins 2009, Wright 2009 and the 2003-2007 bass synthesis report, Hawkins et al. 2009.

#### *Smallmouth bass*

The goal is to reduce the number of smallmouth bass from two study sites in the Yampa River in order to benefit native fishes and assist in the recovery of endangered fishes.

Objectives:

1. Obtain an estimate of the number of smallmouth bass in Little Yampa Canyon, Lily Park, and if possible river-wide using a mark-recapture abundance estimator. Coordinate mark-recapture sampling with CDOW and USFWS to obtain a river-wide estimate of smallmouth bass, upstream of Yampa Canyon.
2. Conduct one marking pass and eight removal passes in Little Yampa Canyon and Lily Park study reaches.
3. Calculate the proportion of juvenile and adult smallmouth bass removed from each study area based on initial population size and compare capture rates on each sample pass over time.
4. Remove large numbers of age-0 and age-1 smallmouth bass from a 12-mile treatment reach (RM100-112) in Little Yampa Canyon and Lily Park to supplement Recovery Program Project 140 (Native fish response evaluation).

#### *Northern pike*

The goal is to reduce the number of northern pike from two study sites in the Yampa River in order to benefit native fishes and assist in the recovery of endangered fishes. Coordinate mark-recapture sampling with CDOW and USFWS to obtain a river-wide estimate of northern pike upstream of Yampa Canyon (Primarily accomplished by CDOW Project 98a and supplemented by this Project (#125).

Objective:

Conduct one marking pass and eight removal passes for northern pike from the Little Yampa Canyon and Lily Park study reaches to support Project 98a.

*Other species*

The goal is to reduce the number of other nonnative species from two study sites in the Yampa River in order to benefit native fishes and assist in the recovery of endangered fishes.

Objectives:

1. Remove centrarchids, black bullhead, and stickleback on all sample occasions in all areas of the two study sites on the Yampa River.
2. Remove white sucker, white sucker hybrids, and common carp in Lily Park and the lower 12-miles of Little Yampa Canyon to develop baseline data on the effort required to reduce their numbers.
3. Evaluate whether there is a change in relative abundance of common carp, white sucker and white sucker hybrids over time and between control and treatment reaches by comparing CPUE of the two species from 1-mile fish-community samples in treatment and control reaches.

VII. Recommendations:

- Focus removal in production areas and continue the Surge campaign targeting nest disruption and removal of adult smallmouth bass during spawning.
- Extend the Surge campaign into the baseflow period.
- Increase removal efforts in the Craig reach.
- Determine the timing and level of escapement of smallmouth bass from Elkhead Reservoir via telemetry, a PIT tag station, or a weir below the spillway

VIII. Project Status: On going and on track

IX. FY 2010 Budget Status

- A. Funds Provided: \$264,413
- B. Funds Expended: \$264,413
- C. Difference: 0
- D. Percent of the FY 2010 work completed, and projected costs to complete: 100%
- E. Recovery Program funds spent for publication charges: \$0

- X. Status of Data Submission (Where applicable): Endangered fish capture data will be submitted by year's end and all other data is currently being formatted for consistency and submission to the database administrator.

Reports Submitted for Program peer review:

Hawkins, J., C. Walford, and A. Hill. 2009. Smallmouth bass control in the middle Yampa River, 2003–2007. Contribution 154 of the Larval Fish Laboratory, Colorado State University. Final Report for the Upper Colorado River Endangered Fish Recovery Program, U. S. Fish and Wildlife Service.

XI. Signed: John Hawkins 11/30/10  
Principal Investigator Date  
*Submitted electronically.*

## **Preliminary Results of smallmouth bass removal in the middle Yampa River,2010**

### *Methods*

The study area included an 87 mile-long section of the middle Yampa River, between Craig, Colorado (river mile; RM 134.2) and Dinosaur National Monument (DNM, RM 47.5) and consisted of five reaches totaling 79.6 miles of sampled waters. Two reaches were sampled by CSU (Lily Park and Little Yampa Canyon) and the three other reaches were sampled by CDOW.

### Study reaches in the middle Yama River

Lily Park	RM 47.5–55.5	8 miles
Sunbeam	RM 60.6–71.0	10.4 miles
lower Maybell	RM 71.0–79.2	8.2 miles
upper Maybell	RM 79.2–88.7	9.5 miles
lower Juniper	RM 91-100	9 miles
Little Yampa Canyon	RM 124-100	24 miles
South Beach	RM 124--134.5	10.5 miles

Fish sampling occurred on four to twelve occasions (passes) from mid-April through mid-July using two electrofishing boats sampling both shorelines. Smallmouth bass were removed on all occasions except on the marking passes when we marked and released smallmouth bass  $\geq 100$ -mm (all lengths are reported in total length) with a numbered Floy tag to identify individual fish to estimate their abundance and monitor movement and growth. In 2010, we delayed marking fish until late April and early May in order to synchronize the marking pass with other agencies sampling in adjacent reaches. In several key reaches we marked so few bass on the first mark pass, that we continued to mark on a second occasion in all reaches and a third occasion in Little Yampa Canyon and Upper Maybell. In Lily Park, we were unable to access the river on at least two occasions.

On passes when smallmouth bass were not marked they were removed from the river and either euthanized if under 250 mm or tagged, given a left-pelvic fin clip, and translocated to Elkhead Reservoir. A few bass larger than 250 mm were also euthanized for research purposes, such as aging, stomach analysis, and otolith microchemistry research to identify their source. Smallmouth bass were grouped into life stages based on length which included juvenile ( $< 100$  mm), sub-adult (100–199-mm), and adult ( $\geq 200$ -mm). We also tagged and removed northern pike in a similar manner and those data are reported by CDOW though Project # 98a. Pike were transported to State Parks Headquarter's pond near Hayden, except for young-of-year (YOY) pike that were euthanized and frozen for aging and stomach analysis.

In Little Yampa Canyon and all of Lily Park we collected data on all species to examine the fish community. In addition, we targeted two large areas for removal of white sucker, white sucker hybrids, and common carp. Those removal areas included the lower 12 miles of Little Yampa Canyon and all of Lily Park (Treatment areas) and in the upper 12 miles of Little Yampa Canyon (Control area) all white suckers and common carp were measured and returned to the river alive. During baseflow from July through October,

using electric seine we removed the same target species from Treatment areas but focused on removing small, primarily age-0, smallmouth bass. About twice a month during baseflow we removed adult bass by angling in Little Yampa Canyon and Juniper Canyon.

### *The Surge intensive removal campaign*

In 2010, an intensive removal program (The Surge) was started to increase the range and intensity of smallmouth bass removal from spawning areas. The goal was to disrupt 2010 production. This was especially important because a strong year class of 2007 cohorts was entering the spawning population as 3 year olds and had the potential to produce another strong cohort in 2010. Additional removal passes were added in June at South Beach, Lower Juniper, Upper Maybell, and Craig reaches, areas not typically sampled at this time of year. The Surge effectively disrupted nest building, spawning, and nest guarding between June 22 and July 10 focusing on the upper reaches of South Beach, Little Yampa Canyon, and Lower Juniper. This was accomplished by assembling field crews and equipment from CSU, DOW, FWS (Vernal and Grand Junction field stations) to assist with removal during spawning. The additional resources allowed us to remove bass from three reaches each day and increase rate of resampling so that fish were removed from target reaches every 3-5 days at the peak of spawning. To assess the success of The Surge, we sampled the river for YOY smallmouth bass from South Beach to Dinosaur National Monument (RM 134--46) in August and September. These samples are still being processed.

### *Smallmouth bass abundance and exploitation*

In 2010, we estimated abundance of smallmouth bass for each reach when data were adequate. Unfortunately, in several reaches only one tagged fish, and in some cases no tagged fish were recaptured and we were unable to calculate a reliable estimate for those reaches with standard techniques. For the same reason, we did not combine data from all reaches for a river wide estimate of abundance.

The two reaches with the best capture probabilities were Little Yampa Canyon and Lily Park. At Little Yampa Canyon, the number of adult smallmouth bass increased from 2009 to 2010. We estimated there were 1,379 adult smallmouth bass in Little Yampa Canyon in 2010 compared to 1045 in 2009 (Table 1). Density of adult smallmouth bass in Little Yampa Canyon increased from 44 fish/mile in 2009 to 57 fish/mile in 2010. Sub-adult smallmouth bass numbered 2,228 fish in 2010, but there was no comparable estimate for 2009.

At Lily Park, both sub-adult and adult numbers were similar in 2009 and 2010. We estimated there were 796 adult smallmouth bass living there in 2010 compared to 812 in 2009 (Table 1) and 3,929 sub-adult smallmouth bass in 2010 compared to 4,281 in 2009. Adult density was 100 fish/mile and sub-adult density was 491 fish/mile, higher than of any other reach. A large portion of the smallmouth bass in the river was the strong 2007 year class.

Capture probability was lower for sub-adults than adults in all reaches resulting in less reliable abundance estimates of sub-adult smallmouth bass. Abundance was not estimated in three reaches (Lower Juniper, Lower Maybell, and Sunbeam because few fish were marked and there were no recaptures (Table 2). Abundance estimates for South Beach and Upper Maybell were estimated but are likely imprecise because capture probability of fish in those reaches was very low and recaptures were few at three or less (Table 2). There was no comparable abundance data from previous years for these two reaches.

While the number of adult smallmouth bass living in Little Yampa Canyon have been stable for the last two years, their current number is about half of the number that lived there historically from 2004-2007 (Figure 1). Historical trends in abundance at Lily Park show that the number of adult smallmouth bass has remained constant since 2004 (Figure 1). Further analysis may reveal changes in the size structure or growth rate of both populations.

### *Exploitation Rates*

Based on point estimates for adult bass, we removed 67% (n=919) of the adults from Little Yampa Canyon and 26% (n=208) from Lily Park in 2010 (Table 1). Lily Park removal rates were lower than in 2009 because we were unable to sample this reach on several occasions due to limited access to the site. At South Beach we removed 28% (n=231) and at upper Maybell 8% (n=219) of the adult smallmouth bass, but these percentages were based on possibly unreliable point estimates of abundance. Based on point estimates of abundance for sub-adults, we removed 26% (n=1,029) at Lily Park, 46% (n=1,026) at Little Yampa Canyon, and 10% (n=469) at upper Maybell in 2010.

### *Fish removal*

We sampled a total of 669 hours with boat electrofishing, 134 hours with fyke nets, 143 man hours angling, and 67 hours with electric seine (Tables 3 and 5). Electrofishing effort was consistent for each pass and each reach (Table 3). The number of passes at South Beach, Lower Juniper, and Upper Maybell were increased in 2010 compared to 2009 with the addition of passes in those reaches by the DOW and the Surge campaign (Table 3). Our objective to complete eight removal passes at the reaches with highest density was achieved only at South Beach, because we marked fish on one or two additional passes. Fish were marked and released on more than one pass because of extended cold water temperatures and low flows that reduced catch rates and the low number of fish marked on the first attempt.

We also captured bass by angling on several occasions during baseflow in Little Yampa Canyon (104 hrs) and on one occasion in Juniper Canyon (39 hrs).

### *Fish captured with boat electrofishing and angling-including the Surge.*

Using boat electrofishing and angling we removed 6,348 smallmouth bass from all reaches of the middle Yampa River, including 685 adults that were moved to Elkhead

Reservoir (Table 4). No bass were captured by fyke nets. The total number of smallmouth bass removed was almost half the number removed in 2009 (n=11,208). We marked and released 15% (n=1,112) of all smallmouth bass handled for research into abundance, movement, and growth. A large portion of smallmouth bass fish was removed during the Surge campaign. Approximately 50% of all smallmouth bass removed from South Beach, Little Yampa Canyon and Lower Juniper, were removed during the Surge (Table 4). At the Craig reach, we removed 58 smallmouth bass on one day of exploratory sampling during the Surge. At Upper Maybell, we removed 330 smallmouth bass during one day of exploratory sampling during the Surge. This was 37% of all bass removed from that reach.

We removed 511 smallmouth bass by angling during the autumn in Little Yampa Canyon and Juniper Canyon. Juniper Canyon is an area un-sampled with electrofishing boats and we removed 337 smallmouth bass from there in one afternoon with five anglers.

### *Catch Rates*

Catch rates (# fish/hr) in each of the seven reaches in 2010 were nearly identical to those in 2009 except at Lily Park, where catch rate declined to more than half the value in 2009 (Figure 2). Lower catch rates at Lily Park may reflect a decline in the number of smallmouth bass living in that reach, but could also be due to low catch rates associated with sampling earlier in 2010 than in 2009 (Table 3).

Our ability to catch smallmouth bass as reflected in catch rate with boat electrofishing was poor early in the year, but improved in late May and early June as flows neared their peak. The river peaked at 11,500 cfs at the Maybell gage on June 9. However, catch was not directly related to flow, because catch rates remained high through June and into July even as flows declined (Table 3). This trend was consistent among all life stages and across all reaches. The river became un-navigable by our electrofishing boats after July 10 when flows declined below 1,000 cfs although smallmouth bass were still spawning at that time. We need to identify and implement techniques other than boat electrofishing that allow us to extend our sampling into the low-flow periods in mid-July while catch rates are high.

Of the 7,460 smallmouth bass handled this year, 51% were sub-adults between 100 and 200 mm (Table 3). A majority of these sub-adults were the 2007 cohort that was 150--200 mm (Figure 3). Therefore, an extremely large portion of the smallmouth bass in the Yampa River was produced in 2007 and this large cohort has been tracked since 2008 (Figure 4).

### *Smallmouth bass production and distribution in the middle Yampa River*

Smallmouth bass live in all reaches of the middle Yampa River, but were most abundant in reaches with appropriate habitat. Few smallmouth bass occupy the alluvial floodplain reaches in Sunbeam and Lower Maybell (RM 60—79) where habitat contains minimal diversity, structure, or cover (Figure 5). Reproduction occurred in the upper canyon

reaches of Upper Maybell, Little Yampa Canyon, and South Beach (RM 79—134) based on high catch rates of YOY and yearling (i.e. juvenile) bass in those reaches (Tables 3 and 5). While some of these young fish remain in those upper reaches, a large portion of them move downstream to Lily Park as sub-adults (Table 3; Figure 5). Spawning habitat for smallmouth bass appears lacking at Lily Park as it produces few YOY and yearlings; however, Lily Park contains ample habitat and serves as a sink for older, sub-adult and adult smallmouth bass which are abundant there (Tables 3 and 5; Figure 5).

### *Spawning observations*

Spawning occurred in late June and early July based on capture of ripe males and female between June 24 and July 11. On July 11, we collected 12-mm YOY smallmouth bass that had recently moved off the nest at RM 103 located just downstream of the Morgan Gulch boat ramp.

### *Young of Year (YOY) sampling with electric seine*

We removed 12,188, mostly YOY, smallmouth bass from the lower 12-miles of Little Yampa Canyon in 2010 with an electric seine, compared to 7,883 that were removed in 2009. We removed 659, mostly YOY, smallmouth bass from Lily Park with an electric seine in 2010 compared to 208 in 2009 (Table 5). These increases suggest that smallmouth bass may have produced a strong year class in 2010. Removal occurred from August 4 through Oct 18 during baseflow. Other species removed included northern pike, black bullhead, white sucker, common carp, creek chub, brook stickleback, and several centrarchid species (Table 6). Effort in 2010 included 59 hours at Little Yampa Canyon and 8 hours at Lily Park.

### *Movement*

We marked and released 1,105 unique fish and 809 of those fish were not seen again in 2010. Of the 296 that were recaptured, 256 were recaptured within the same reach in which they were tagged and forty moved to another reach. Maximum distance traveled for a fish tagged in 2010 was a 297 mm smallmouth bass that traveled 42 miles upstream from Sunbeam to Little Yampa Canyon. This and two other smallmouth bass tagged at Sunbeam in April were recaptured in Little Yampa Canyon in late June and early July during spawning. One of those fish was a ripe female. Additional analysis of movement data will occur after 2010 data is incorporated with the tag histories from previous years and may be presented at the 2011 Researcher's Meeting.

### *Elkhead escapees*

In 2010, we captured 17 smallmouth bass that had escaped from Elkhead Reservoir after translocation. Two were stocked in the reservoir in 2007, eight in 2008, and six in 2009. We recaptured two smallmouth bass that were placed in the Justice Center pond in 2007 and 2008. Because the Justice Center pond is landlocked and at least a mile from the river they could not escape without assistance. Those fish were either caught by anglers and returned to the river or they were removed during a salvage operation in late 2009

that moved bass from the pond to Elkhead Reservoir. We plan to present additional information about escapees at the 2010 Nonnative Fish Workshop.

### *Fish Community Sampling*

Nonnative fish comprised 96% of the fish community in Little Yampa Canyon and relative abundance trends of each fish species were very similar to those observed in 2009. Smallmouth bass and white suckers were the most abundant fishes collected (Table 7). Bluehead sucker, flannelmouth sucker, and roundtail chub still occur in Little Yampa Canyon, but in low numbers. At Lily Park, the fish community changed from that observed in 2009. Native fish abundance increased from 27% in 2009 to 63% in Lily Park. Most of the natives collected in 2010 were flannelmouth sucker (48%), bluehead sucker (12%), and roundtail chub (2%). The dominant nonnative fishes were smallmouth bass (20%), channel catfish (8%), and white sucker and their hybrids (6%).

In addition to the 1-mile fish community sampling we collected and measured all species on most sampling occasions in Little Yampa Canyon and Lily Park. At Little Yampa Canyon we captured 16 nonnative species, including two nonnative sucker hybrids, and seven native species (Table 8). Of significance was the capture of an 808 mm grass carp *Ctenopharyngodon idella* on April 16 at RM 10-4.5. A similar-sized specimen was collected in 2009. At Lily Park, we handled 12 nonnative species, including two nonnative sucker hybrids, and five native species (Table 8).

### *Conclusions*

- The strong 2007 year class contributed to the number of smallmouth bass in the Yampa River.
- Most reproduction is occurring in upstream reaches of Upper Maybell, Lower Juniper, Little Yampa Canyon, and South Beach.
- Lily Park does not appear to support reproduction of smallmouth bass but does serve as a sink for sub-adult and adult, especially sub-adult sized smallmouth bass.
- Catch rates were influenced by environmental conditions and were highest after mid-May.
- Abundance estimates were not possible in several reaches due to low catch rates.
- Smallmouth bass move both up and downstream through all reaches of the middle Yampa River.
- Smallmouth bass translocated from the river to Elkhead Reservoir are escaping back to the river.
- 

### *References*

Hawkins, J., C. Walford, and B. Wright. 2009. Evaluation of smallmouth bass and northern pike management in the middle Yampa River. Project 125. 2008 Annual Report to the Colorado River Recovery Program.

Hawkins, J. 2008. Evaluation of smallmouth bass and northern pike management in the middle Yampa River. Project 125. 2008 Annual Report to the Colorado River Recovery Program.

Hawkins, J. C. Walford, and A. Hill. 2009. Smallmouth bass control in the middle Yampa River. Contribution 154 of the Larval Fish Laboratory, Colorado State University. Final Report for the Upper Colorado River Endangered Fish Recovery Program, U. S. Fish and Wildlife Service..

Hawkins, J., C. Walford, B. Wright., J. Logan, and A. Hill. 2009 Evaluation of smallmouth bass and northern pike management in the middle Yampa River. Project 125. 2009 Annual Report to the Colorado River Recovery Program.

Wright, B. 2009. Middle Yampa River northern pike removal and evaluation: smallmouth bass evaluation and limited removal. Project 98a. 2008 Annual Report to the Colorado River Recovery Program.

Table 1--- Abundance estimates for sub-adult (100-199 mm) and adult ( $\geq 200$  mm) smallmouth bass at four representative reaches in the middle Yampa River, 2010. Abundance was estimated using a Huggins estimator. SE = Standard Error. CV= Coefficient of Variation. Exploitation rate is the number of smallmouth bass removed after the marking passes were completed and does not include fish removed prior to the marking passes.

Life Stage	Abundance	lower – upper 95% CI	SE	CV	Capture probability	Density (#fish/mile)	Exploitation rate	
							# of fish removed	% of population removed
South Beach (10 miles)								
Sub-adult	NA							
Adult	816	206--4079	782.3	96%	2%	82	231	28
Little Yampa Canyon (24 miles)								
Sub-adult	2228	1313--3981	652.9	29%	10%	93	1026*	46
Adult	1379	1055--1862	202.5	15%	18%	57	919**	67
Upper Maybell (10 miles)								
Sub-adult	4527	1698--12820	2545	56%	3%	453	469	10
Adult	2701	858--9306	1857.9	69%	3%	270	219	8
Lily Park (8 miles)								
Sub-adult	3929	2974--5289	583.1	15%	9%	491	1029	26
Adult	796	559--1201	159.4	20%	14%	100	208	26

\* Little Yampa Canyon sub-adults removed includes 123 captured by angling.

\*\* Little Yampa Canyon adults removed includes 51 captured by angling.

Table 2 --- Number of smallmouth bass handled during mark and recapture occasions in the middle Yampa River, 2010.

---

	Life Stage	# of mark passes	# of fish marked	# of fish handled at recapture	# of fish recaptured
South Beach (10 miles)	Sub-adult	2	26	8	0
	Adult	2	51	16	1
Little Yampa Canyon (24 miles)	Sub-adult	3	99	225	10
	Adult	3	188	242	33
Lower Juniper (10 miles)	Sub-adult	2	0	15	0
	Adult	2	8	17	0
Upper Maybell (10 miles)	Sub-adult	3	97	140	3
	Adult	3	73	74	2
Lower Maybell (10 miles)	Sub-adult	2	1	1	0
	Adult	2	4	8	0
Sunbeam (10 miles)	Sub-adult	2	1	8	0
	Adult	2	12	3	0
Lily Park (8 miles)	Sub-adult	2	395	368	37
	Adult	2	128	112	18

---

Table 3— CPUE (catch per unit effort) for smallmouth bass captured by electrofishing in the middle Yampa River, 2010. Life stages were based on length: juvenile (<100 mm), sub-adult (100-199 mm), adult ( $\geq$ 200 mm). Passes when fish were marked and released are highlighted in grey. Fish were removed on all passes except the Mark pass.

Craig				Number captured				CPUE (#fish/ hour electrofishing)			
Pass	Dates sampled	Fish Disposition	Effort (hrs)	juvenile	sub-adult	adult	All sizes	juvenile	sub-adult	adult	All sizes
1	June 24	Removal-SURGE	9.1	5	29	24	58	0.5	3.1	2.6	6.4
South Beach				Number captured				CPUE (#fish/ hour electrofishing)			
Pass	Dates sampled	Fish Disposition	Effort (hrs)	juvenile	sub-adult	adult	All sizes	juvenile	sub-adult	adult	All sizes
1	April 16	Removal	9.0	1	2	13	16	0.1	0.2	1.4	1.8
2	April 22	Removal	8.9	1	8	43	52	0.1	0.9	4.8	5.9
3	April 29	Mark/Release	9.0		1	8	9	0.0	0.1	0.9	1.0
4	May 12, 18	Mark/release	13.5	2	27	44	73	0.1	2.0	3.3	5.4
5	May 25	Recapture	8.7	1	8	16	25	0.1	0.9	1.8	2.9
6	June 8	Removal	9.6		36	33	69	0.0	3.8	3.5	7.2
7	June 11	Removal	2.4	1	26	18	45	0.4	10.7	7.4	18.6
8	June 16	Removal	3.5	4	30	10	44	1.1	8.6	2.9	12.6
9	June 22	Removal-SURGE	13.0	13	51	41	105	1.0	3.9	3.1	8.1
10	June 25	Removal-SURGE	8.2	1	4	24	29	0.1	0.5	2.9	3.5
11	June 28	Removal-SURGE	8.0	4	19	44	67	0.5	2.4	5.5	8.4
12	June 30- July 1	Removal-SURGE	11.2	7	34	45	86	0.6	3.0	4.0	7.7
all passes			105.0	35	246	339	620	0.3	2.3	3.2	5.9

Table 3----cont.

Little Yampa Canyon				Number captured				CPUE (#fish/ hour electrofishing)			
Pass	Dates sampled	Fish Disposition	Effort (hrs)	juvenile	sub-adult	adult	All sizes	juvenile	sub-adult	adult	All sizes
1	April 15-18	Removal	29.1	49	41	62	152	1.7	1.4	2.1	5.2
2	April 29-May2	Mark/Release	22.5	17	2	10	29	0.8	0.1	0.4	1.3
3	May 11-14	Mark/Release	30.3	57	34	51	142	1.9	1.1	1.7	4.7
4	May 15-18	Mark/Release	29.8	60	63	133	256	2.0	2.1	4.5	8.6
5	May 27-31	Recapture	37.0	39	226	241	506	1.1	6.1	6.5	13.7
6	June 10-13	Removal	32.6	39	227	153	419	1.2	7.0	4.7	12.8
7	June 22-25	Removal-SURGE	36.1	105	107	73	285	2.9	3.0	2.0	7.9
8	June 28-30	Removal-SURGE	28.7	109	93	162	364	3.8	3.2	5.6	12.7
9	July 1	Removal-SURGE	9.1	28	27	32	87	3.1	3.0	3.5	9.5
10	July 7-10	Removal-SURGE	30.5	167	223	207	597	5.5	7.3	6.8	19.6
all passes combined			285.9	670	1043	1124	2837	2.3	3.6	3.9	9.9

Lower Juniper				Number captured				CPUE (#fish/ hour electrofishing)			
Pass	Dates sampled	Fish Disposition	Effort (hrs)	juvenile	sub-adult	adult	All sizes	juvenile	sub-adult	adult	All sizes
1	April 14	Removal	7.7			2	2	0.0	0.0	0.3	0.3
2	April 27	Mark/Release	8.3	2	1	3	6	0.2	0.1	0.4	0.7
3	May 14, 16	Mark/Release	9.3	1		5	6	0.1	0.0	0.5	0.6
4	June 3	Recapture	9.2		15	17	32	0.0	1.6	1.8	3.5
5	June 17	Removal	5.3	38	56	15	109	7.1	10.5	2.8	20.4
6	June 24	Removal-SURGE	10.7	70	23	24	117	6.5	2.1	2.2	10.9
7	June 29-30	Removal-SURGE	6.0	12	15	38	65	2.0	2.5	6.4	10.9
8	July 9	Removal-SURGE	0.9		3	10	13	0.0	3.4	11.3	14.6
all passes combined			57.5	123	113	114	350	2.1	2.0	2.0	6.1

Table 3---cont.

Upper Maybell			Effort (hrs)	Number captured				CPUE (#fish/ hour electrofishing)			
Dates sampled	Fish Disposition	juvenile		sub- adult	adult	All sizes	juvenile	sub- adult	adult	All sizes	
1	April 15	Removal	9.3	1	2	3	6	0.1	0.2	0.3	0.6
2	April 21	Removal	9.2	1	3	24	28	0.1	0.3	2.6	3.0
3	April 28	Mark/Release	7.4	2	4	12	18	0.3	0.5	1.6	2.4
4	May 11	Mark/Release	8.9		10	14	24	0.0	1.1	1.6	2.7
5	May 19	Mark/Release	3.5	2	87	50	139	0.0	24.9	14.3	39.7
6	May 27	Recapture	9.8	9	140	74	223	0.9	14.3	7.6	22.8
7	June 2	Removal	9.1	8	77	56	141	0.9	8.5	6.2	15.5
8	June 10	Removal	7.9	9	101	55	165	1.1	12.8	7.0	20.9
9	June 25	Removal-SURGE	7.2	145	151	34	330	20.1	21.0	4.7	45.8
all passes combined			72.3	177	575	322	1074	2.4	8.0	4.5	14.9

Lower Maybell			Effort (hrs)	Number captured				CPUE (#fish/ hour electrofishing)			
Dates sampled	Fish Disposition	juvenile		sub- adult	adult	All sizes	juvenile	sub- adult	adult	All sizes	
1	April 13	Removal	7.3		1	1	2	0.0	0.1	0.1	0.3
2	April 20	Removal	6.9	2	7	4	13	0.3	1.0	0.6	1.9
3	April 30	Mark/Release	6.4			2	2	0.0	0.0	0.3	0.3
4	May 13	Mark/Release	8.3	1	2	2	5	0.1	0.2	0.2	0.6
5	May 24	Recapture	6.9		1	8	9	0.0	0.1	1.2	1.3
all passes combined			35.8	3	11	17	31	0.1	0.3	0.5	0.9

Table 3—cont.

Sunbeam		Fish Disposition	Effort (hrs)	Number captured				CPUE (#fish/ hour electrofishing)			
Dates sampled	juvenile			sub-adult	adult	All sizes	juvenile	sub-adult	adult	All sizes	
1	April 26	Mark/Release	7.7	3	2	8	13	0.4	0.3	1.0	1.7
2	May 10	Mark/Release	7.6			4	4	0.0	0.0	0.5	0.5
3	May 26	Recapture	8.3	1	8	3	12	0.1	1.0	0.4	1.4
4	June 9	Removal	8.7	1	7	4	12	0.1	0.8	0.5	1.4
all passes combined			32.2	5	17	19	41	0.2	0.5	0.6	1.3

Lily Park		Fish Disposition	Effort (hrs)	Number captured				CPUE (#fish/ hour electrofishing)			
Pass	Dates sampled			juvenile	sub-adult	adult	All sizes	juvenile	sub-adult	adult	All sizes
1	April 13-14	Removal	6.4	4		4	8	0.6	0.0	0.6	1.3
2	April 19-20	Removal	9.1	3	6	11	20	0.3	0.7	1.2	2.2
3	April 27-28	Removal	7.2	4	19	19	42	0.6	2.7	2.7	5.9
4	May 4	Mark/Release	5.4	2	6	11	19	0.4	1.1	2.0	3.5
5	May 25-26	Mark/Release	13.1	8	395	121	524	0.6	30.2	9.2	40.0
6	June 1, 8-9	Recapture	15.0	10	367	113	490	0.7	24.5	7.5	32.7
7	June 14-15	Removal	7.2	10	322	49	381	1.4	45.0	6.8	53.2
8	June 27	Removal	8.1	68	340	46	454	8.4	42.2	5.7	56.3
all passes combined			71.3	109	1455	374	1938	1.5	20.4	5.2	27.2

Table 4— Number of smallmouth bass either released or removed in the middle Yampa River, 2010. Marked fish were tagged and returned to the river for research. Surge percentage indicates the proportion of fish removed during the intensive removal of the Surge campaign. Removed fish include 685 adult smallmouth bass moved to Elkhead Reservoir.

---

Reach	Total # of fish handled	# of fish marked & released	# of fish removed	% of all fish removed during SURGE
Craig	58		58	100%
South Beach	620	80	540	53%
LYC	3011	294	2717	49%
Lower Juniper	350	8	342	57%
Juniper Canyon	337		337	--
Upper Maybell	1074	174	900	37%
Lower Maybell	31	5	26	--
Sunbeam	41	17	24	--
Lily Park	1938	534	1404	--
Grand Total	7460	1112	6348	--

---

Table 5— Sample dates, seine electrofishing effort, number, and CPUE of YOY and yearling smallmouth bass captured in two reaches of the Yampa River, 2010.

<i>Little Yampa Canyon, 12-mile Treatment site</i>						
	Sample	Number	Effort	# SMB	Biomass	CPUE
Trip	Dates	of sites	(hrs)	removed	(kg)	(#fish/hr)
1	Aug 4-8	16	5.9	682	2.4	116
2	Aug 17-21	19	7.0	1,664	7.0	238
3	Sep-2-7	17	8.3	1,715	4.4	207
4	Sep 14-21	26	15.3	3,840	14.2	251
5	Sep 28-Oct 5	25	14.8	3,219	10.8	218
6	Oct 12-19	18	7.8	1,068	3.6	137
	Total	121	59.1	12,188	42.3	206
<i>Lily Park</i>						
	Sample	Number	Effort	# SMB	Biomass	CPUE
Trip	Dates	of sites	(hrs)	removed	(kg)	(#fish/hr)
1	Aug 23-24	11	2.1	255	2.8	121
2	Aug 31-Sep1	10	2.7	160	5.9	59
3	Oct 17-18	11	2.9	244	1.0	84
	Total	32	7.6	659	9.7	87

Table 6— Number and biomass (kg) of each fish species removed with electric seine from two reaches in the Yampa River, 2010. Smallmouth bass, common carp, and white sucker were not removed from the 12-mile control sub-reach in Little Yampa Canyon.

	Little Yampa Canyon		Lily Park
	upper 12-miles	lower 12-miles	
	Control	Treatment	
smallmouth bass	-	12188 (42.3)	659 (9.7)
northern pike	17 (2.7)	11 (1.3)	-
black bullhead	4468 (3.5)	2151 (1.3)	-
black crappie	1 (0.002)	-	1 (0.2)
green sunfish	5 (0.05)	6 (0.05)	1
bluegill	12 (0.1)	6 (0.03)	-
brook stickleback	117 (0.1)	122 (0.1)	8 (0.01)
creek chub	134 (0.3)	501 (1.9)	-
common carp	-	46 (0.3)	18 (10.2)
white sucker	-	1660 (13.6)	66 (1.3)
white sucker hybrids	-	12 (0.03)	2
<b>Total</b>	<b>4734 (6.8)</b>	<b>16698 (60.9)</b>	<b>750 (21.4)</b>

Table 7---Relative abundance of fish collected with boat electrofishing in the 1-mile fish community sample sites of the Yampa River, 2010. Little Yampa Canyon contained four 1-mile sites and Lily Park contained one site.

	Little Yampa Canyon	Lily Park
<i>nonnative species</i>		
smallmouth bass	48.1	19.9
northern pike	4.0	0.3
white sucker	33.4	5.1
white x flannelmouth sucker	2.5	0.3
creek chub	3.7	-
black bullhead	0.5	-
rainbow trout	0.4	0.1
common carp	0.4	2.5
white x bluehead sucker	1.0	0.1
fathead minnow	0.1	-
black crappie	-	0.1
green sunfish	0.2	0.1
brown trout	0.1	-
channel catfish	0.3	8.0
brook stickleback	0.4	-
sand shiner	0.2	-
red shiner	-	0.3
iowa darter	0.1	-
redside shiner	-	0.2
<i>native species</i>		
flannelmouth sucker	1.0	48.8
roundtail chub	0.7	2.4
bluehead sucker	1.6	11.6
mountain whitefish	0.4	-
speckled dace	0.2	-
Colorado pikeminnow	0.3	0.1
mottled sculpin	0.4	0.1
Total number of fish	1113	945
% nonnative fish	95.5	37.0
% native fish	4.5	63.0

Table 8--- Number of fish captured by boat electrofishing in Lily Park in the Yampa River, 2010.

	Removed	Released	Total
<i>nonnative species</i>			
smallmouth bass	1404	534	1938
northern pike	27	2	29
channel catfish		438	438
white sucker	259	2	261
common carp	138	1	139
bluegill	2		2
rainbow trout		2	2
white x flannelmouth sucker	11		11
sand shiner		1	1
red shiner		10	10
black crappie	1		1
white x bluehead sucker	9		9
black bullhead	2		2
brown trout		1	1
green sunfish	1		1
creek chub	2		2
<i>native species</i>			
flannelmouth sucker		2710	2710
bluehead sucker		375	375
roundtail chub		164	164
Colorado pikeminnow		9	9
mountain whitefish		1	1
mottled sculpin		4	4

Table 9---Number of fish captured by boat electrofishing in Little Yampa Canyon in the Yampa River, 2010.

	Removed	Released	Total
<b><i>nonnative species</i></b>			
smallmouth bass	2580	294	2874
northern pike	226	28	254
white sucker	895	1529	2424
white x flannelmouth sucker	98	183	281
bluegill	2		2
creek chub		328	328
black bullhead	29		29
rainbow trout		37	37
common carp	10	21	31
white x bluehead sucker	16	30	46
fathead minnow		9	9
black crappie	1		1
green sunfish	9		9
brown trout		17	17
channel catfish		13	13
brook stickleback	22		22
sand shiner		2	2
white x flannelmouth x bluehead sucker	4	1	5
rainbow x cutthroat trout		1	1
lowa darter		2	2
grass carp	1		1
redside shiner		3	3
<b><i>native species</i></b>			
flannelmouth sucker	1	65	66
roundtail chub		59	59
bluehead sucker		94	94
mountain whitefish		29	29
speckled dace		33	33
Colorado pikeminnow		10	10
flannelmouth x bluehead sucker		1	1
mottled sculpin		26	26

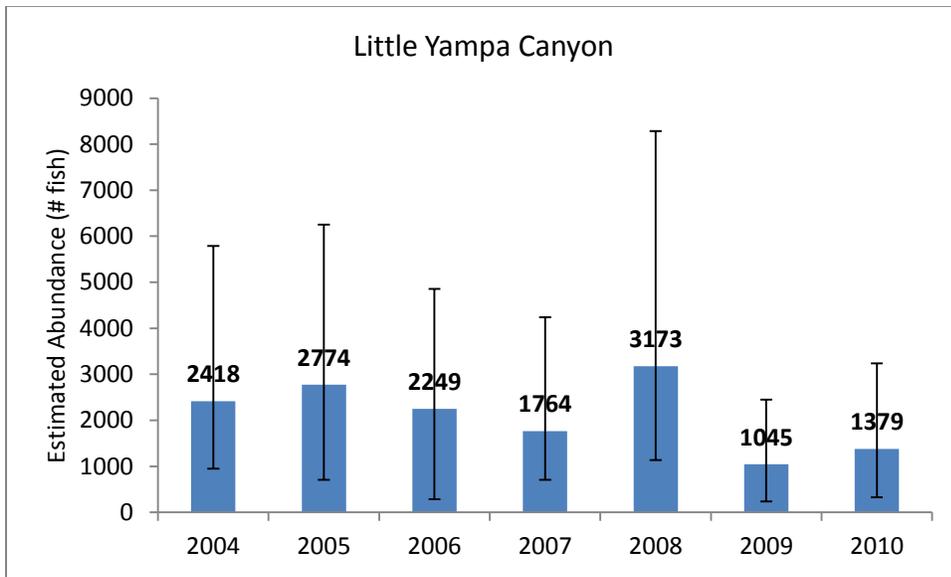
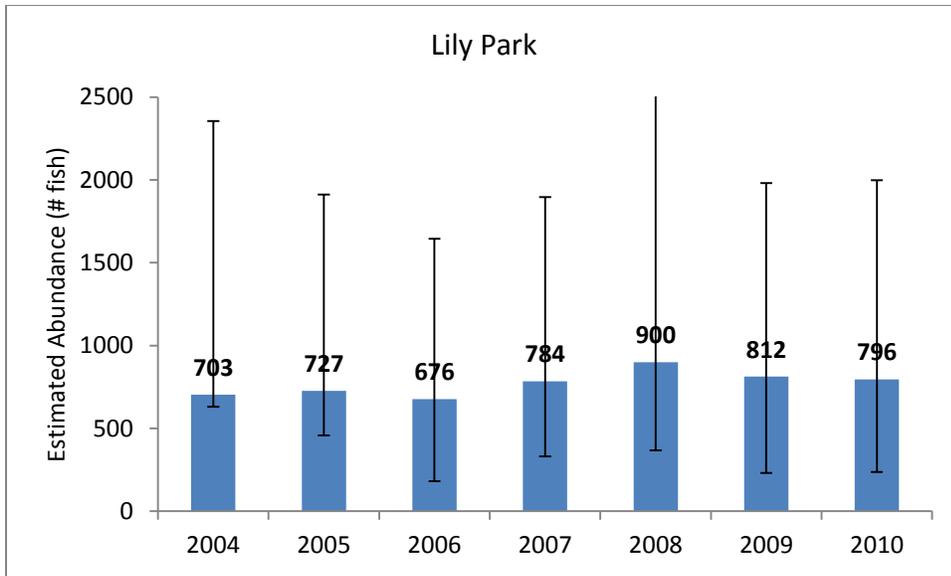


Figure 1---Estimated abundance of adult smallmouth bass( $\geq 200$  mm) in two reaches of the Yampa River, 2004--2010.

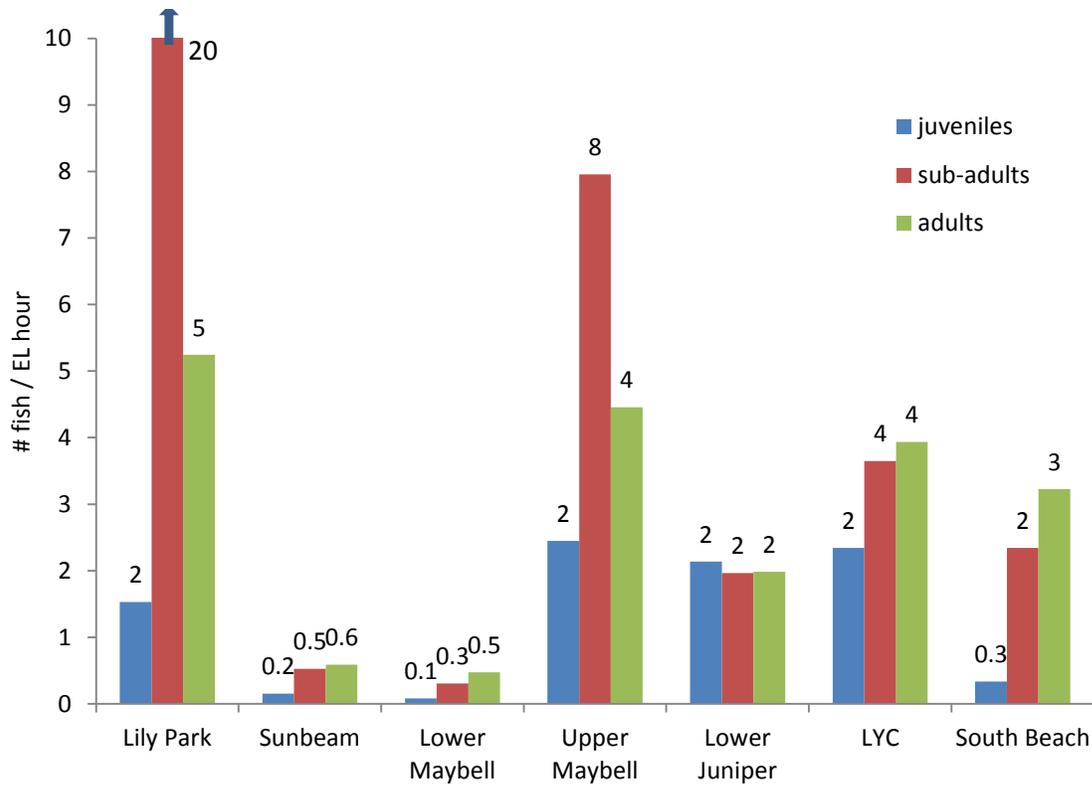


Figure 2—Catch per unit effort at each reach along a longitudinal gradient of the middle Yampa River, 2010. Note that the value for sub-adult in Lily Park is twice the size of the y-axis scale.

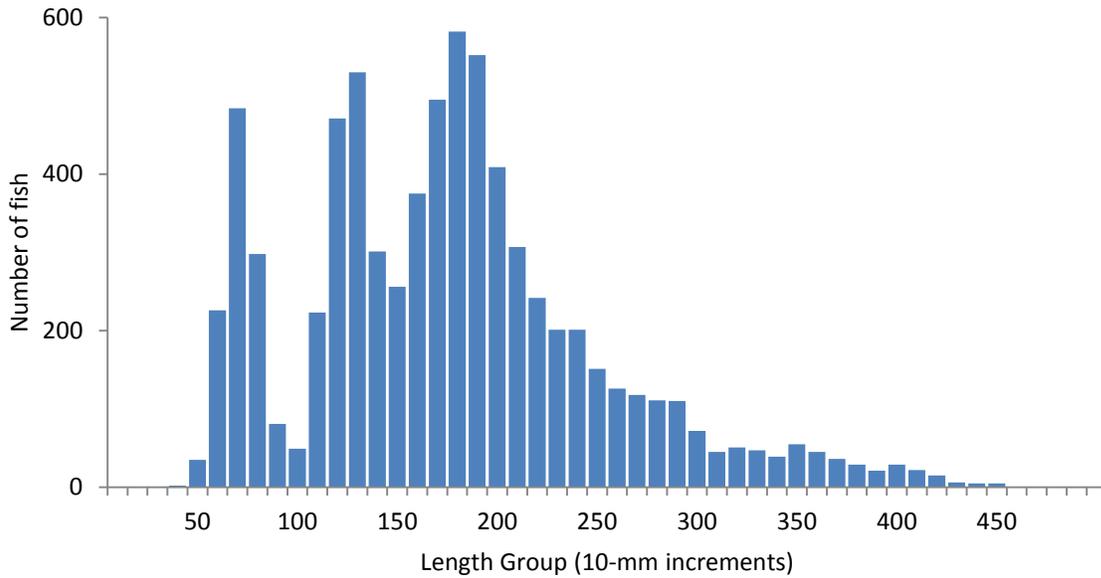


Figure 3---Length frequency of smallmouth bass captured in all reaches of the middle Yampa River, 2010.

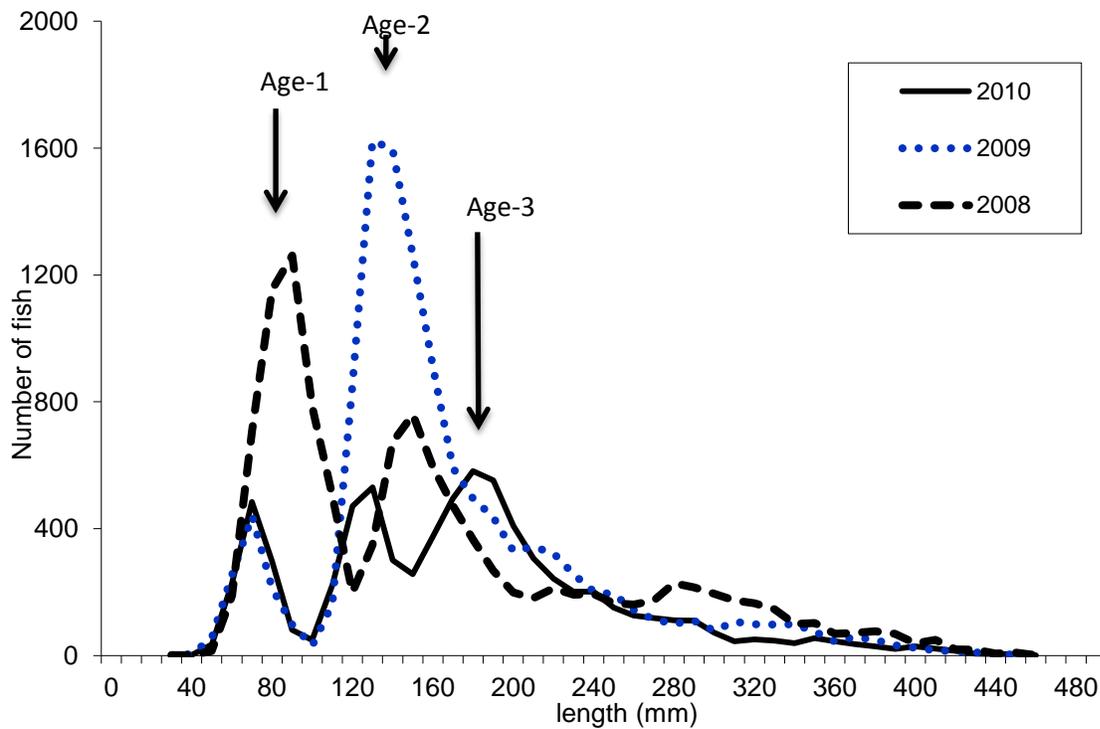


Figure 4--- Length-frequency of smallmouth bass collected by boat electrofishing in the middle Yampa River, 2010. Ages track the 2007 cohort over time.

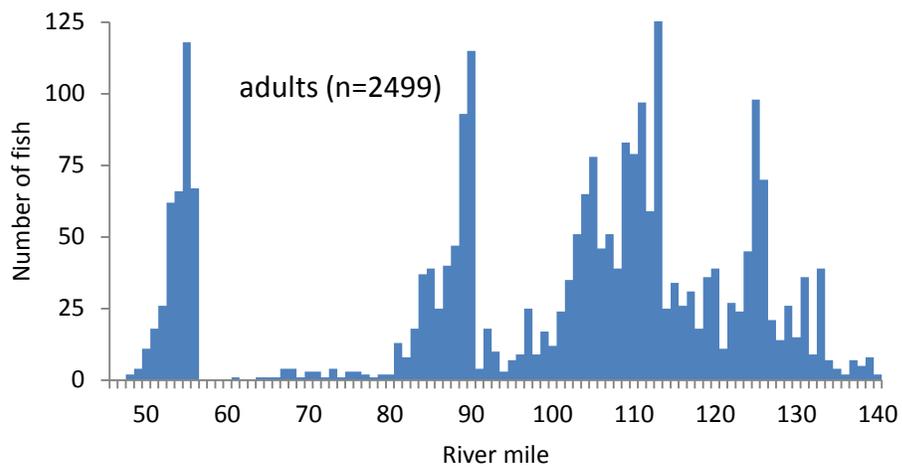
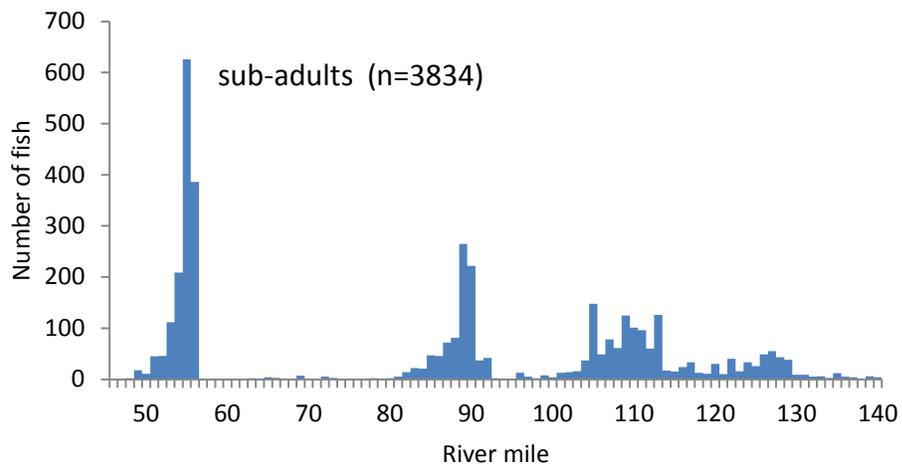
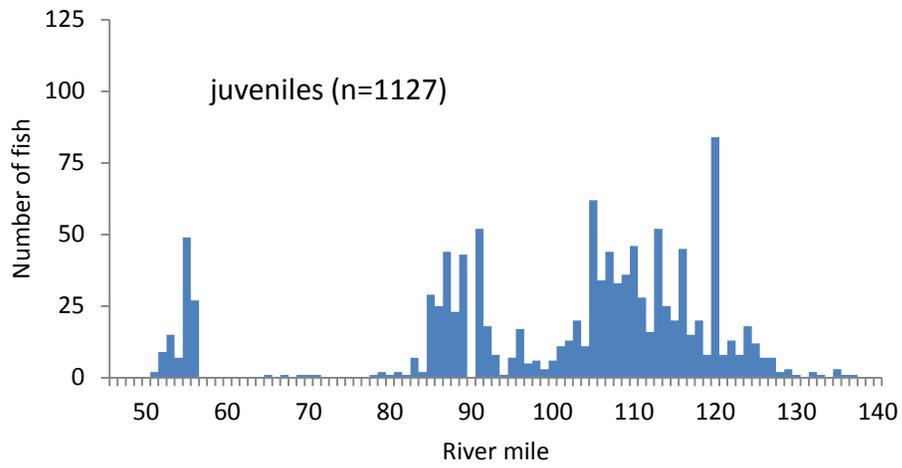


Figure 5---Number of smallmouth bass captured per mile in the middle Yampa River, 2010.