

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

II. Principal Investigator(s):

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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) near Craig, Colorado to just upstream of Dinosaur National Monument (RM 47) and was divided into seven reaches. Fish sampling occurred on four to 14 occasions (passes) from April through August using two electrofishing boats sampling both shorelines. Smallmouth bass ≥ 100 mm were marked and released on one occasion in each reach 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 (≥ 200 -mm) smallmouth bass at each study site using capture-recapture methods. From August 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. All smallmouth bass removed from the river were euthanized. We also removed northern pike and transported those ≥ 500 mm to State Parks Headquarter's pond near Hayden. Data for northern pike that we caught were provided to Colorado Division of Wildlife (CPW) 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 CPW 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 2011 Tasks and Deliverables, Discussion of Initial Findings and Shortcomings:

Preliminary results for 2011 are provided in the attached report and are subject to change as data are further analyzed. For comparison with previous results see Hawkins et al. 2008, Hawkins et al. 2009a, Hawkins et al. 2009b, Hawkins et al. 2010, and Wright 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 CPW 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 CPW and USFWS to obtain a river-wide estimate of northern pike upstream of Yampa Canyon (Primarily accomplished by CPW 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:

- Continue adult smallmouth bass removal during runoff.
- Continue smallmouth bass nest disruption focusing on major production areas.
- Continue to explore techniques to extend the intensity and range of smallmouth bass removal and spawning disruption during the baseflow period.
- Determine the abundance and range of smallmouth bass in the Craig reach.
- Reduce or prevent escapement of resident smallmouth bass from Elkhead Reservoir.

VIII. Project Status: On going and on track

IX. FY 2011 Budget Status

- A. Funds Provided: \$307,819
 - a. \$287,053 to CSU,
 - b. \$20,766 to FWS
- B. Funds Expended: \$307,819
- C. Difference: 0
- D. Percent of the FY 2011 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 11/14/11
Principal Investigator Date
Submitted electronically.
Date submitted: 11-14-11

Preliminary Results of smallmouth bass removal in the middle Yampa River,2011

Overview: This report provides a preliminary summary of data that was collected this year and therefore contains minimal analysis and discussion.

Methods

The study area included an 87 mile-long section of the middle Yampa River, between the South Beach boat ramp near Craig, Colorado (river mile; RM 134.2) and Dinosaur National Monument (RM 47.5) and consisted of seven reaches totaling 79.6 miles of sampled waters. These reaches were sampled by Colorado Parks and Wildlife (CPW) and Colorado State University-Larval Fish Laboratory (CSU).

Study reaches in the middle Yama River

<u>Reach</u>	<u>Agency</u>	<u>River miles</u>	<u>Length (miles)</u>
Lily Park	CSU	47.5 -- 55.5	8.0
Sunbeam	CPW	60.6 -- 71.0	10.4
Lower Maybell	CPW	71.0 -- 79.2	8.2
Upper Maybell	CPW	79.2 – 88.7	9.5
Lower Juniper	CPW	91.0 – 100.0	9.0
Little Yampa Canyon	CSU	100.0 – 124.0	24.0
South Beach	CPW	124.0 – 134.2	10.5

Fish sampling occurred on four to fourteen occasions (passes) at each reach from April through August using two electrofishing boats sampling both shorelines concurrently. Smallmouth bass ≥ 100 -mm total length (TL) were marked with a numbered Floy tag and released on one sample occasion to estimate abundance and monitor movement and growth. The marking pass was coordinated among agencies to occur between May 9 and May 13. The recapture pass occurred between May 16 and May 20 in all reaches except Lower Juniper which was delayed due to high flows until July 8.

Smallmouth bass were removed from the river on all other sample occasions and euthanized. In previous years, smallmouth bass 250 mm and larger were translocated to Elkhead Reservoir but translocation was stopped in 2011 due to excessive escapement of some of those fish from the reservoir. A large number of smallmouth bass were preserved for aging and diet studies.

Smallmouth bass were grouped into life stages based on their total length. Life stages included juvenile (< 100 mm), sub-adult (100–199-mm), and adult (≥ 200 -mm). We also tagged and removed northern pike in a similar manner and those data are reported primarily by CPW though Project # 98a. Pike ≥ 500 mm were transported to State Parks Headquarters pond near Hayden and some young-of-year (YOY) pike were euthanized and frozen for aging and diet studies.

In Little Yampa Canyon and Lily Park we captured and measured all species on most sample occasions to examine the fish community structure and composition. In addition, we targeted these two areas for removal of white sucker, white sucker hybrids, and common carp. Those species were removed from the lower 12 miles of Little Yampa Canyon and Lily Park (Treatment areas) and they were released in the upper 12 miles of

Little Yampa Canyon (Control area).

When flows declined too low for safe power boat navigation, we shifted to canoes and removed smallmouth bass YOY with an electric seine in the lower 12-miles of Little Yampa Canyon and at Lily Park. In August and September, we sampled every 5-miles from South Beach to Dinosaur National Monument (RM 134--46) with seine and backpack electrofisher to determine where smallmouth bass spawning occurred. These samples are still being processed.

The Surge intensive removal campaign

In 2011, we completed the second year of an intensive removal program (The Surge) that increased the range and intensity of smallmouth bass removal during spawning with the goal of disrupting 2011 production. Surge removal started on July 19 soon after water temperatures reached 16°C on July 14. Spawning temperatures of 16°C occurred almost one month later in 2011 than in 2010 because temperatures remained lower than normal for an extended period due to a large overwinter snow pack which sustained a high, long duration runoff.

The Surge effectively disrupted nest building, spawning, and nest guarding between July 19 and August 22 in South Beach, Little Yampa Canyon, and Lower Juniper. It was accomplished by assembling field crews and equipment from CSU, CPW, and FWS (Vernal and Grand Junction field stations) to assist with the removal. The additional resources allowed us to remove bass from three locations instead of one location each day and to increase the rate of resampling at each location so that fish were removed from nests in target reaches every 2-5 days at the peak of spawning.

Smallmouth bass abundance and exploitation

In 2011, we estimated abundance of smallmouth bass for each reach using a Lincoln-Petersen model when data were adequate. Data were adequate for South Beach, Little Yampa Canyon, Upper Maybell, and Lily Park. Unfortunately, in all other reaches an insufficient number of fish were marked or recaptured and a reliable estimate of abundance was not possible for those reaches. For the same reason, we did not calculate 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 and sub-adult smallmouth bass in 2011 was 50% less than in 2010. In 2010, there were 57 adults/mile and in 2011 there were 36 adults /mile. Sub-adult density was 93 fish/mile in 2010 and 55 fish/mile in 2011 (Table 1). Abundance of smallmouth bass at Lily Park also declined from 2010 to 2011. Density of adults declined from 100/mile in 2010 to 73/mile in 2011. Density of sub-adults declined drastically from 491/mile in 2010 to 59/mile in 2011 (Table 1).

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

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. 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).

Exploitation Rates

Based on point estimates for adult bass, we removed 91% (n=793) of the adults from Little Yampa Canyon and 99% (n=577) of the adults from Lily Park in 2011 (Table 1). Removal numbers are based on the number of fish removed after the marking pass. Our estimates were derived from a Lincoln Petersen estimator and potentially underestimate the number of animals because that estimator treats all fish and all sample occasions equally and does not account for the effects of fish length, sample occasion, or reach. Exploitation may also be high due to capture of non-resident fish immigrating into reaches during removal passes. At South Beach we removed 49% (n=204) and at upper Maybell we removed 32% (n=136) of the adult smallmouth bass.

In 2011, we marked and released 368 smallmouth bass in the middle Yampa River and recaptured 129 of those fish through the year. Tag returns for marked smallmouth bass in 2011 were 35% (129/368). This number is lower than the exploitation rate based on point estimates and indicates that a large number of tagged fish either lost their tags or were less susceptible to capture possibly by moving out of the sampled reaches.

Fish removal effort

We sampled a total of 765 hours boat electrofishing, 35 man-hours angling, and 36 hours with electric seine (Table 3). Effort in 2011 was similar to that in 2010 at all reaches except Little Yampa Canyon where we increased the number of hours of boat electrofishing by 43% for a total of 409 hours. High discharge during runoff pushed the river over its banks and we suspended sampling for 22 days between May 31 and June 21 while flows were over 12,000 cfs (i.e. bankfull flow; Figure 5). This resulted in fewer removal passes in several reaches due to extremely high flows that made sampling difficult and dangerous. During that time high flows made navigation under many bridges impossible, specifically at Lower Juniper, Maybell, and Lily Park. Fortunately high flows also allowed us to continue sampling for a longer period into the summer when flows are typically too low (i.e. <1000 cfs) to navigate safely with standard electrofishing boats. In 2010, we ended electrofishing boat sampling on July 10 after flows declined below 1000 cfs and in 2011, we continued fish removal about one month longer than in 2010 because flows remained over 1000 cfs until August 10 (Figure 5). In addition, we also obtained a flow-release from Elkhead Reservoir between August 19 and August 22 that allowed us to extend smallmouth bass removal and spawning disruption for 3 days during the Surge. Approximately 300 cfs was released from Elkhead Reservoir during that time.

In previous years, we typically stopped smallmouth bass removal at the peak of spawning, resulting in only disrupting the first half of the spawning period. Due to high, late-season flows that occurred when smallmouth bass were spawning and with the

additional flow provided by Elkhead Reservoir releases, we were able to remove smallmouth bass from nesting areas during their entire spawning period (July 19-August 22) in 2011. It is important that spawning disruption occurs during the entire spawning period and this will require innovative techniques. In 2011, we took advantage of high natural flows and supplemental flows from Elkhead Reservoir; but, in future years other techniques or sampling gear may be required to adequately sample for an extended period during lower flows.

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

Using boat electrofishing and angling we removed 6,061 smallmouth bass from all reaches of the middle Yampa River using boat electrofishing (Table 4) and 41 fish by angling. We marked and released 6% (n=368) of all smallmouth bass handled. Those fish were marked to obtain information about abundance, movement, and growth.

The Surge increased our effort significantly within a short period of time in targeted reaches of known spawning areas (South Beach, Little Yampa Canyon, and Lower Juniper). Surge effort accounted for less than 55% of the total electrofishing effort in South Beach, Little Yampa Canyon, and Lower Juniper respectively but resulted in catching 80%, 62%, and 68% of all smallmouth bass captured in each of those reaches respectively. Sixty-six percent of the bass removed from those three reaches were removed during the Surge.

Effort and number of smallmouth bass captured during the Surge compared to all other sampling.

	Electrofishing Hours			# fish captured		
	All passes	Surge passes	Surge proportion	All passes	Surge passes	Surge Proportion
South Beach	94.4	52.1	55%	600	479	80%
Little Yampa Canyon	409.2	188.8	46%	2514	1569	62%
Lower Juniper	53.2	12.2	23%	172	117	68%
Total all Surge reaches	556.8	253.1	45%	3286	2165	66%

Catch Rates

Smallmouth bass live in all reaches of the middle Yampa River, but were most abundant in reaches with appropriate habitat. Few smallmouth bass occupied the alluvial floodplain reaches in Sunbeam and Lower Maybell (RM 60—79) where habitat contained minimal diversity, structure, or cover (Figure 3). Catch rates for adult smallmouth bass were highest in Lily Park, followed by Upper Maybell. Catch rates were high and similar at Little Yampa Canyon, South Beach, and Craig. However, catch rates for adult smallmouth bass were generally lower in 2011 than in 2010 for all reaches except Lily Park. CPUE of adult smallmouth bass has declined since 2004 for the two reaches with a long-term record. Little Yampa Canyon has declined from just under 10 adults/hour to 2 fish/hour and Lily Park from 25 adults/hour to just under 10 adults/hour (Figure 2).

Spawning observations

Spawning occurred in mid-July through mid-August based on adequate water temperatures, capture of ripe males building nests, and ripe females. Reproduction was delayed approximately one month later than normal in 2011, because high runoff flows maintained cooler water temperatures. Bass spawning is believed to start at 16°C and this temperature was not reached until July 14 compared to 2010, when this temperature occurred on June 22.

Young of Year (YOY) sampling with electric seine

In the lower 12-mile Treatment area of Little Yampa Canyon, electric seine CPUE declined by 70% from 206 fish/hour in 2010 to 62 fish/hour in 2011 (Table 3). Similar declines were observed at Lily Park where electric-seine CPUE declined from 87 fish/hour in 2010 to 16 fish/hour in 2011. These decreases suggest that production of YOY smallmouth bass in 2011 was harmed by negative environmental conditions and Surge removals.

Movement

Of 368 smallmouth bass marked and released, there were 135 recapture records including 129 individual fish and 6 fish captured more than once. Forty-one fish were recaptured during the recapture pass that was used to estimate abundance. None of those fish moved outside of the reach in which they were tagged providing evidence of closure during abundance estimation.

Seventy percent of all smallmouth bass recaptured in 2011 were recaptured within 5 miles of their release site and 33% were recaptured within one mile of their release. Smallmouth bass that were recaptured in 2011 moved distances that ranged from 40 miles downstream to 60 miles upstream of their release (Figure 7). Maximum distance traveled for a fish tagged in 2011 was a 456-mm smallmouth bass that traveled 60 miles upstream from Lower Maybell to Craig during the spawning period.

Elkhead escapees

In 2011, we captured 47 smallmouth bass that had escaped from Elkhead Reservoir after translocation. One was translocated to the reservoir in 2007, two in 2008, 26 in 2009, and 18 in 2010. We also caught one smallmouth bass that might have escaped from Elkhead Reservoir this year. It had a right pelvic fin clip which was the backup mark given to resident smallmouth bass Floy tagged in Elkhead Reservoir by CPW earlier this spring. We also captured four, age-1, largemouth bass that most likely came from Elkhead Reservoir, the only known source for this species in the Yampa basin.

Fish Community Sampling

Nonnative fish comprised 93% of the fish community in Little Yampa Canyon. Smallmouth bass and white suckers were the most abundant fishes collected (Table 5). There was an increase in the abundance of nonnative creek chub, rainbow trout, and channel catfish and the addition of two species (black crappie and bluegill). Native roundtail chub and mountain whitefish numbers increased from 2010. Otherwise relative abundance trends for other fish species were very similar to those observed in 2010. At Lily Park, nonnative fish comprised only 45% of the fish community. The most abundant species was native flannelmouth sucker followed by smallmouth bass.

In addition to the 1-mile fish community sampling we collected and measured all fish species on most sampling occasions in Little Yampa Canyon and Lily Park. At Little Yampa Canyon we captured eight native species and 20 nonnative species and at Lily Park, we handled five native species and 15 nonnative species (Table 6).

Conclusions

- Smallmouth bass production was limited in South Beach, Little Yampa Canyon, and Lower Juniper in 2011 due to the combination of negative environmental conditions and management actions (Surge).
- Declining abundance and CPUE provided evidence of declining populations of adult smallmouth bass in Little Yampa Canyon and Lily Park.
- Escapement of translocated and possibly resident smallmouth bass from Elkhead Reservoir was documented in 2011.
- Smallmouth bass moved both up and downstream among all reaches of the Yampa River.
- Intensive removal during spawning was an efficient technique to remove large numbers of smallmouth bass and disrupt spawning.
- Elkhead Reservoir flows can be used to extend the sampling period to increase removal and spawning disruption of smallmouth bass.
- CPUE of smallmouth bass in the Craig reach was similar to that observed in other high-concentration areas such as South Beach and Little Yampa Canyon.

References

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 Endangered Fish Recovery Program, U. S. Fish and Wildlife Service.

Hawkins, J. C. Walford, and A. Hill. 2009a. 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.

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

Hawkins, J., C. Walford, and B. Wright. 2010. Evaluation of smallmouth bass and northern pike management in the middle Yampa River. Project 125. 2010 Annual Report to the Colorado River Endangered Fish Recovery Program, U. S. Fish and Wildlife Service.

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 Endangered Fish Recovery Program, U. S. Fish and Wildlife Service.

Table 1--- Abundance estimates for sub-adult (100-199 mm) and adult (≥ 200 mm) smallmouth bass at four representative reaches in the middle Yampa River, 2011. Abundance was estimated using a Lincoln-Petersen estimator. SE = Standard Error. CV= Coefficient of Variation. NA = Mark-recapture data not sufficient for an estimate. Exploitation rate is based on the number of smallmouth bass removed after the marking passes were completed and does not include fish removed prior to the marking passes (see Table 3).

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	418	110--2091	397	95%	5%	41	204	49%	
Little Yampa Canyon (24 miles)									
Sub-adult	1325	525--3722	728.5	55%	5%	55	1130*	85%	
Adult	871	577--1401	203.2	25%	14%	36	793**	91%	
Upper Maybell (10 miles)									
Sub-adult	NA								
Adult	428	159--1444	279.5	65%	11%	43	136	32%	
Lily Park (8 miles)									
Sub-adult	469	257—971	169.5	36%	14%	59	1117	238%	
Adult	585	395--932	132.1	23%	15%	73	577	99%	

* Little Yampa Canyon sub-adults removed includes 21 captured by angling.

** Little Yampa Canyon adults removed includes 17 captured by angling.

Table 2 --- Number of smallmouth bass handled during mark and recapture occasions in the middle Yampa River, 2011.

	Life Stage	# of mark passes	# of fish marked	# of fish handled at recapture	# of fish recaptured
South Beach (10 miles)	Sub-adult	1	1	4	0
	Adult	1	19	22	1
Little Yampa Canyon (24 miles)	Sub-adult	1	56	71	3
	Adult	1	100	122	14
Lower Juniper (10 miles)	Sub-adult	1	0	4	0
	Adult	1	3	5	0
Upper Maybell (10 miles)	Sub-adult	1	14	53	0
	Adult	1	19	43	2
Lower Maybell (10 miles)	Sub-adult	1	0	10	0
	Adult	1	2	8	0
Sunbeam (10 miles)	Sub-adult	1	1	5	0
	Adult	1	11	15	1
Lily Park (8 miles)	Sub-adult	1	44	63	5
	Adult	1	92	89	14
Totals all reaches			362	512	41

Table 3— CPUE (catch per unit effort) for smallmouth bass captured by boat and electric seine electrofishing in the middle Yampa River, 2011. Life stages were based on length: juvenile (<100 mm), sub-adult (100-199 mm), adult (≥200 mm). Passes when fish were marked and released are highlighted in grey. Fish were removed from the river on all passes except the Mark pass. Removal-YOY were fish removed by electric seine during baseflow.

Craig Reach				<u>Number captured</u>				<u>CPUE (#fish/ hour electrofishing)</u>			
Pass	Dates sampled	Fish Disposition	Effort (hrs)	juvenile	sub-adult	adult	All sizes	juvenile	sub-adult	adult	All sizes
1	July 19	Removal-Surge	1.5			5	5			3.3	3.3
2	July 21	Removal-Surge	8.2	11	9	12	32	1.3	1.1	1.5	3.9
3	Aug 2	Removal-Surge	2.0	17	8	6	31	8.6	4.0	3.0	15.6
4	Aug 4	Removal-Surge	2.0	3	5	3	11	1.5	2.5	1.5	5.5
Total			13.7	31	22	26	79	2.3	1.6	1.9	5.8
South Beach Reach				<u>Number captured</u>				<u>CPUE (#fish/ hour electrofishing)</u>			
Pass	Dates sampled	Fish Disposition	Effort (hrs)	juvenile	sub-adult	adult	All sizes	juvenile	sub-adult	adult	All sizes
1	April 11	Removal	9.9			19	19			1.9	1.9
2	May 3	Removal	9.6	1	2	26	29	0.1	0.2	2.7	3.0
3	May 9	Mark	9.0		1	19	20		0.1	2.1	2.2
4	May 16	Recapture-Removal	9.9	1	4	22	27	0.1	0.4	2.2	2.7
5	July 7	Removal	3.9		9	17	26		2.3	4.4	6.7
6	July 19-20	Removal-Surge	14.4	20	72	47	139	1.4	5.0	3.3	9.6
7	July 21-22	Removal-Surge	12.4	11	54	30	95	0.9	4.4	2.4	7.7
8	Aug 2-3	Removal-Surge	13.1	42	59	48	149	3.2	4.5	3.7	11.4
9	Aug 4-5	Removal-Surge	11.4	15	33	37	85	1.3	2.9	3.2	7.5
10	Aug 22	Removal-Surge	0.9	3	5	3	11	3.4	5.7	3.4	12.5
Total			94.4	93	239	268	600	1.0	2.5	2.8	6.4
1	Oct 4	Removal-YOY	2.7	71	11	0	82	26.3	4.1	0.0	30.4
Total			2.7	71	11	0	82	26.3	4.1	0.0	30.4

Table 3----cont.

Little Yampa Canyon Reach				<u>Number captured</u>				<u>CPUE (#fish/ hour electrofishing)</u>			
Pass	Dates sampled	Fish Disposition	Effort (hrs)	juvenile	sub-adult	adult	All sizes	juvenile	sub-adult	adult	All sizes
1	April 26-29	Removal	29.6	7	18	43	68	0.2	0.6	1.5	2.3
2	April 30-May 3	Removal	26.5	4	4	21	29	0.2	0.2	0.8	1.1
3	May 12-14	Mark	30.4	7	57	104	168	0.2	1.9	3.4	5.5
4	May 16-18	Recapture-Removal	30.9	2	71	122	195	0.1	2.3	3.9	6.3
5	May 28-31	Removal	34.8	7	70	102	179	0.2	2.0	2.9	5.1
6	June 23-26	Removal	34.6	10	48	78	136	0.3	1.4	2.3	3.9
7	July 6-9	Removal	33.5	25	77	68	170	0.7	2.3	2.0	5.1
8	July 19-21	Removal-Surge	25.9	29	117	63	209	1.1	4.5	2.4	8.1
9	July 21-23	Removal-Surge	26.5	44	90	23	157	1.7	3.4	0.9	5.9
10	July 25-26	Removal-Surge	28.3	66	86	58	210	2.3	3.0	2.0	7.4
11	Aug 2-3	Removal-Surge	25.7	47	115	74	236	1.8	4.5	2.9	9.2
12	Aug 4-5	Removal-Surge	26.5	50	121	77	248	1.9	4.6	2.9	9.3
13	Aug 8-9	Removal-Surge	28.6	60	146	58	264	2.1	5.1	2.0	9.2
14	Aug 20-21	Removal-Surge	27.3	24	172	49	245	0.9	6.3	1.8	9.0
Total			409.2	382	1192	940	2514	0.9	2.9	2.3	6.1
1	Aug 17-19	Removal-YOY	1.6	4	12	1	17	2.5	7.5	0.6	10.6
2	Sep 6-8	Removal-YOY	2.9	170	4	0	176	58.6	1.4	0.0	60.7
3	Sep 14-21	Removal-YOY	9.1	1188	16	1	1205	130.5	1.8	0.1	132.4
4	Sept 29-30	Removal-YOY	3.9	23	4	0	27	5.9	1.0	0.0	6.9
5	Oct 12-19	Removal-YOY	9.7	374	12	1	386	38.6	1.2	0.1	39.8
6	Oct 25-27	Removal-YOY	2.2	0	0	0	0	0.0	0.0	0.0	0.0
Total			29	1759	48	3	1811	59.8	1.6	0.1	61.6

Table 3----cont.

Lower Juniper Reach				<u>Number captured</u>				<u>CPUE (#fish/ hour electrofishing)</u>			
Pass	Dates sampled	Fish Disposition	Effort (hrs)	juvenile	sub- adult	adult	All sizes	juvenile	sub- adult	adult	All sizes
1	April 27	Removal	8.5	1		4	5	0.1		0.5	0.6
2	May 4	Removal	9.9			1	1			0.1	0.1
3	May 12	Mark	8.6			3	3			0.3	0.3
4	July 8	Recapture- Removal	5.5	3	4	5	12	0.5	0.7	0.9	2.2
5	July 14-15	Removal	8.3	10	10	14	34	1.2	1.2	1.7	4.1
6	July 24	Removal-Surge	8.1	16	15	19	50	2.0	1.9	2.4	6.2
7	Aug 22	Removal-Surge	4.3	5	36	26	67	1.2	8.3	6.0	15.4
Total			53.2	35	65	72	172	0.7	1.2	1.4	3.2
1	Oct 3	Removal-YOY	1.7	101	5	0	106	59.4	2.9	0.0	62.4
Total			1.7	101	5	0	106	59.4	2.9	0.0	62.4
Upper Maybell Reach				<u>Number captured</u>				<u>CPUE (#fish/ hour electrofishing)</u>			
	Dates sampled	Fish Disposition	Effort (hrs)	juvenile	sub- adult	adult	All sizes	juvenile	sub- adult	adult	All sizes
1	April 28	Removal	9.1	3	4	20	27	0.3	0.4	2.2	3.0
2	May 5	Removal	8.8	5	17	10	32	0.6	1.9	1.1	3.6
3	May 10	Mark	8.6		14	19	33		1.6	2.2	3.8
4	May 17	Recapture- Removal	10.1	7	53	43	103	0.7	5.2	4.3	10.2
5	June 27	Removal	9.8	11	68	37	116	1.1	6.9	3.8	11.8
6	June 30	Removal	7.9	20	111	56	187	2.5	14.1	7.1	23.7
Total			54.3	46	267	185	498	0.8	4.9	3.4	9.2

Table 3---cont.

Lower Maybell Reach				<u>Number captured</u>				<u>CPUE (#fish/ hour electrofishing)</u>			
	Dates sampled	Fish Disposition	Effort (hrs)	juvenile	sub- adult	adult	All sizes	juvenile	sub- adult	adult	All sizes
1	April 29	Removal	5.9		1	3	4		0.2	0.5	0.7
2	May 11	Mark	7.4	2		2	4	0.3		0.3	0.5
3	May 19	Recapture- Removal	8.8	2	10	8	20	0.2	1.1	0.9	2.3
4	June 29	Removal	8.1	8	19	8	35	1.0	2.3	1.0	4.3
Total			30.2	12	30	21	63	0.4	1.0	0.7	2.1

Sunbeam Reach				<u>Number captured</u>				<u>CPUE (#fish/ hour electrofishing)</u>			
	Dates sampled	Fish Disposition	Effort (hrs)	juvenile	sub- adult	adult	All sizes	juvenile	sub- adult	adult	All sizes
1	May 2	Removal	8.8			3	3			0.3	0.3
2	May 13	Mark	9.4	2	1	11	14	0.2	0.1	1.2	1.5
3	May 20	Recapture- Removal	10.8	3	5	15	23	0.3	0.5	1.4	2.1
4	June 28	Removal	9.8	1	10	4	15	0.1	1.0	0.4	1.5
Total			38.9	6	16	33	55	0.2	0.4	0.8	1.4

Table 3—cont.

Lily Park Reach			Effort (hrs)	<u>Number captured</u>				<u>CPUE (#fish/ hour electrofishing)</u>			
Pass	Dates sampled	Fish Disposition		juvenile	sub- adult	adult	All sizes	juvenile	sub- adult	adult	All sizes
1	May 10-11	Mark	12.4	5	44	93	142	0.4	3.6	7.5	11.5
2	May 15	Recapture- Removal	10.0	4	64	89	157	0.4	6.4	8.9	15.7
3	May 26-27	Removal	11.9	2	96	89	187	0.2	8.0	7.5	15.7
4	June 27-28	Removal	12.7	11	229	123	363	0.9	18.1	9.7	28.7
5	July 10-11	Removal	12.5	46	298	160	504	3.7	23.8	12.8	40.3
6	July 12	Removal	4.9	90	237	46	373	18.4	48.4	9.4	76.1
7	Aug 7	Removal	7.1	91	193	70	354	12.9	27.4	9.9	50.2
Total			71.4	249	1161	670	2080	3.5	16.3	9.4	29.1
1	Sept 28	Removal-YOY	1.6	22	12	0	34	13.8	7.5	0.0	21.3
2	Oct 14	Removal-YOY	0.7	1	1	0	2	1.4	1.4	0.0	2.9
Total			2.3	23.0	13.0	0.0	36.0	10.0	5.7	0.0	15.7

Table 4— Disposition of smallmouth bass handled during boat electrofishing in the middle Yampa River, 2011. Marked fish were tagged and released in the river for research into abundance, movement, and growth.

Reach	Total # of fish handled	# of fish marked & released	# of fish removed
Craig	79		79
South Beach	600	20	580
LYC	2514	161	2353
Lower Juniper	172	3	169
Upper Maybell	498	33	465
Lower Maybell	63	2	61
Sunbeam	55	12	43
Lily Park	2080	137	1943
Grand Total	6061	368	5693

Table 5---Relative abundance of fish collected with boat electrofishing in the 1-mile fish community sample sites of the Yampa River, 2011. 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	34.1	29.7
northern pike	5.5	0.7
white sucker	37.7	4.6
white x flannelmouth sucker	3.0	0.1
creek chub	8.1	-
black bullhead	0.3	-
rainbow trout	1.3	0.1
common carp	-	3.5
white x bluehead sucker	0.5	0.1
bluegill	0.3	0.1
black crappie	0.5	0.3
green sunfish	0.1	-
brown trout	0.3	-
channel catfish	1.1	5.6
brook stickleback	0.1	-
rainbow x cutthroat trout	-	0.1
<i>native species</i>		
flannelmouth sucker	1.5	44.0
roundtail chub	2.3	5.1
bluehead sucker	1.2	5.6
mountain whitefish	1.3	-
speckled dace	0.4	-
Colorado pikeminnow	0.1	0.3
mottled sculpin	0.3	-
Total number of fish	743	720
% nonnative fish	92.9	44.9
% native fish	7.1	55.0

Table 6---Number of fish captured by boat electrofishing in Lily Park in the Yampa River, 2011.

	Removed	Released	Total
<i>nonnative species</i>			
smallmouth bass	1943	137	2080
northern pike	18	9	27
white sucker	201	1	202
white x flannelmouth sucker	4		4
bluegill	1		1
creek chub	1		1
channel catfish		228	228
rainbow trout		2	2
common carp	103		103
white x bluehead sucker	3		3
black crappie	4		4
brown trout		2	2
red shiner		6	6
rainbow x cutthroat trout		1	1
reidside shiner		5	5
<i>native species</i>			
flannelmouth sucker		1999	1999
roundtail chub		149	149
bluehead sucker		317	317
mountain whitefish		2	2
speckled dace		1	1
Colorado pikeminnow		13	13
mottled sculpin		3	3
Total all species	2278	2713	4991

Table 7---Number of fish captured by boat electrofishing in Little Yampa Canyon in the Yampa River, 2011.

	Removed	Released	Total
<i>nonnative species</i>			
smallmouth bass	2353	161	2514
northern pike	409	42	451
white sucker	541	1151	1692
white x flannelmouth sucker	42	72	114
bluegill	26		26
creek chub	264	2	266
black bullhead	17		17
rainbow trout	1	57	58
common carp	76	6	82
white x bluehead sucker	7	12	19
fathead minnow		14	14
black crappie	20		20
green sunfish	11		11
brown trout		38	38
channel catfish		21	21
brook stickleback	11		11
sand shiner		2	2
largemouth bass	2		2
cutthroat trout		1	1
reidside shiner	1		1
<i>native species</i>			
flannelmouth sucker	1	60	61
roundtail chub		76	76
bluehead sucker		49	49
mountain whitefish		51	51
speckled dace		19	19
Colorado pikeminnow		7	7
flannelmouth x bluehead sucker		1	1
mottled sculpin		9	9
Total all species	3782	1767	5549

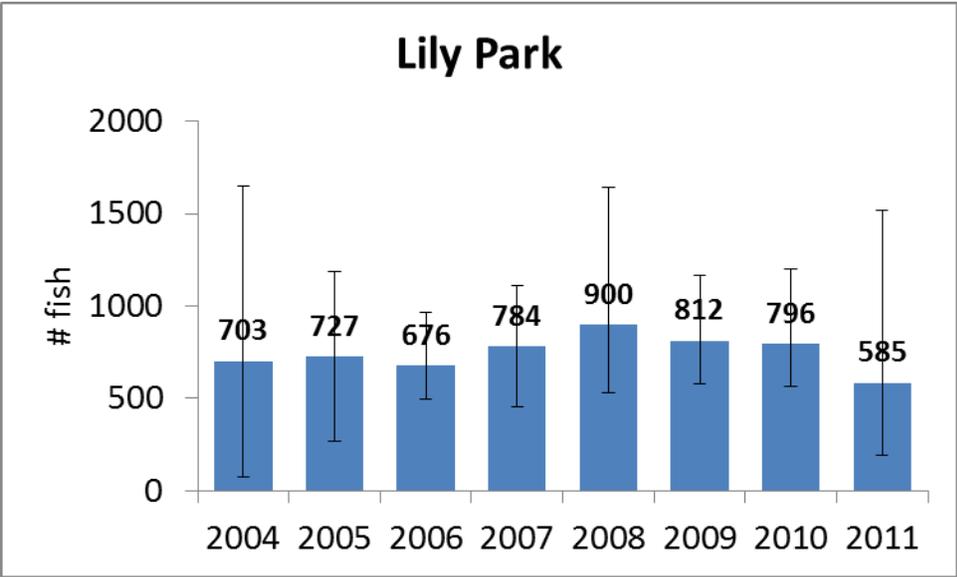
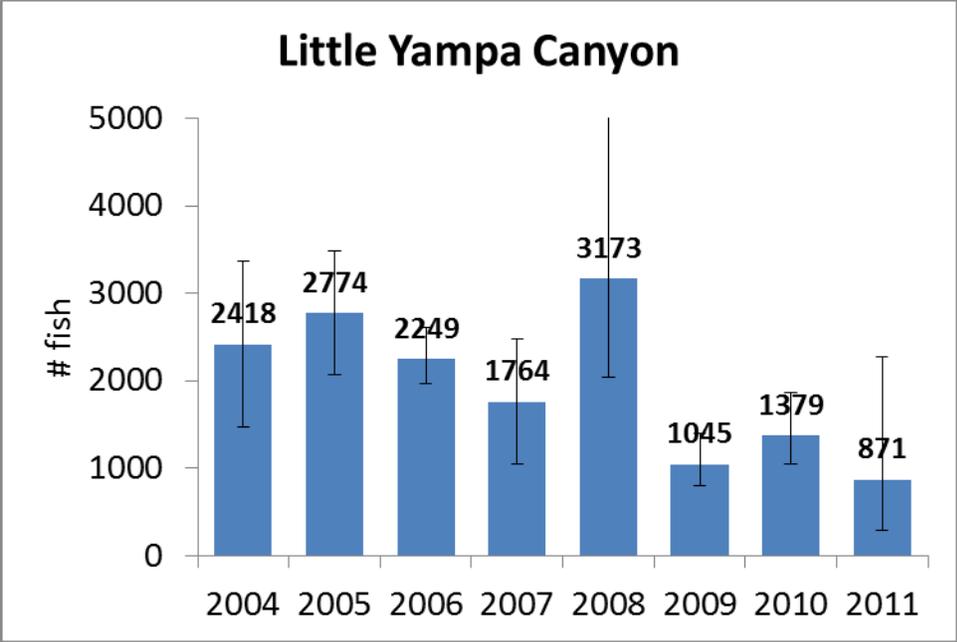


Figure 1---Estimated abundance of adult smallmouth bass(≥ 200 mm) in two reaches of the Yampa River, 2004--2011.

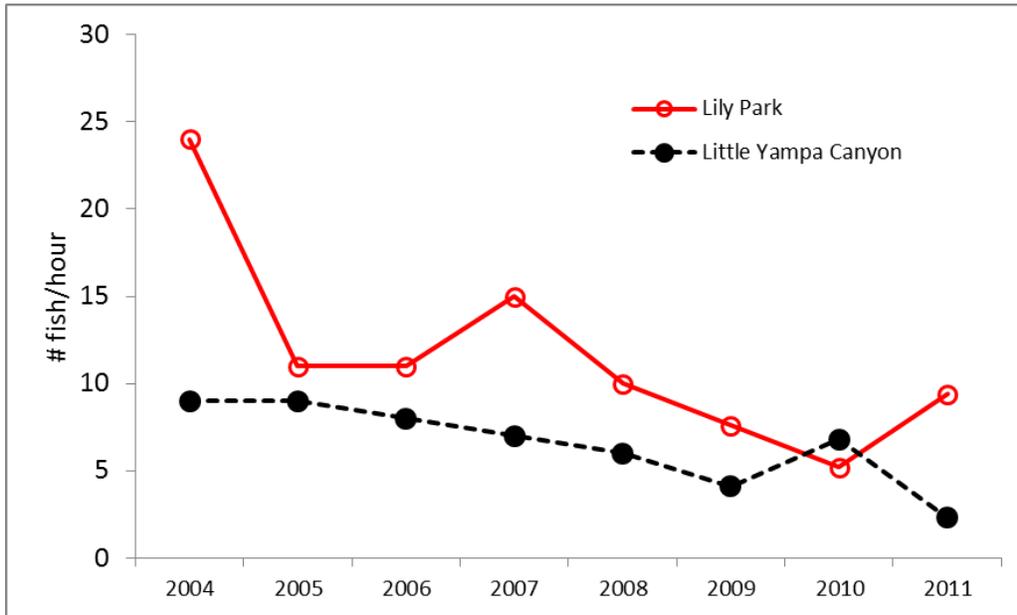


Figure 2—Number of adult (≥ 200 mm) smallmouth bass captured per hour of boat electrofishing in two reaches of the Yampa River, 2004-2011.

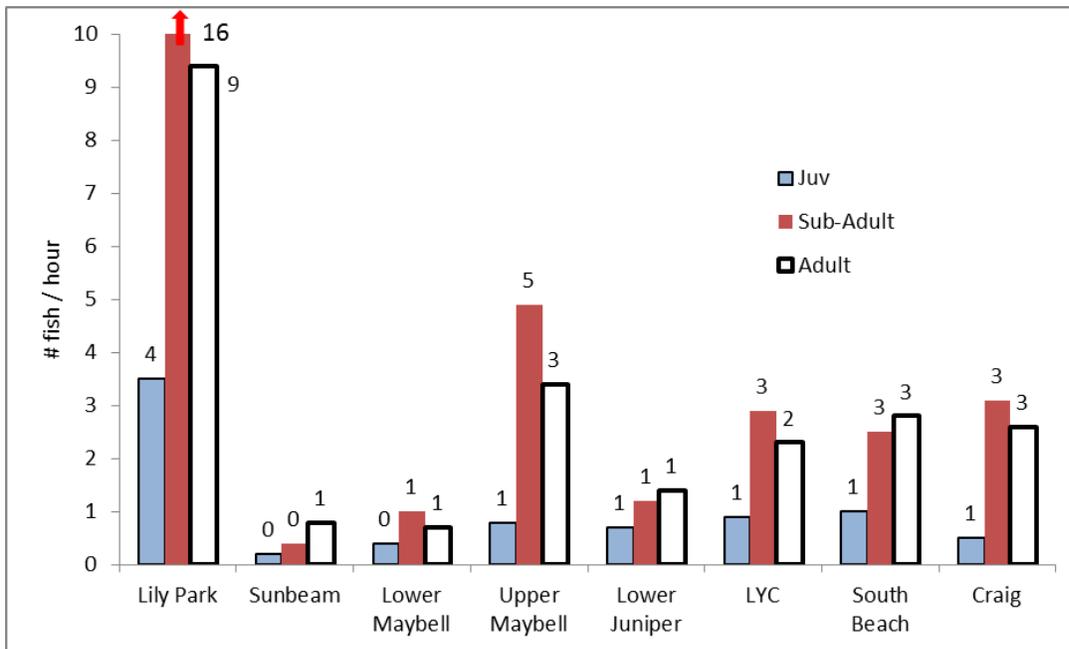


Figure 3—Catch per unit effort along a longitudinal gradient of the middle Yampa River, 2011. Note that the value for sub-adult in Lily Park (16fish/hr) is higher than the maximum of the y-axis scale (10 fish/hr).

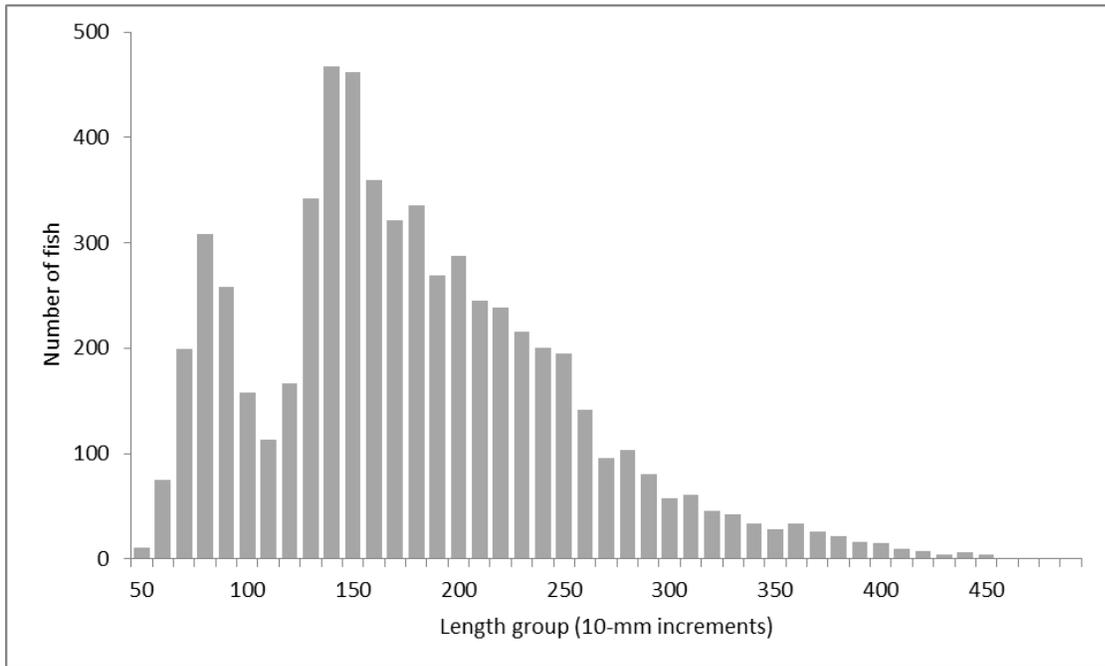


Figure 4---Length frequency of smallmouth bass captured in all reaches of the middle Yampa River, 2011.

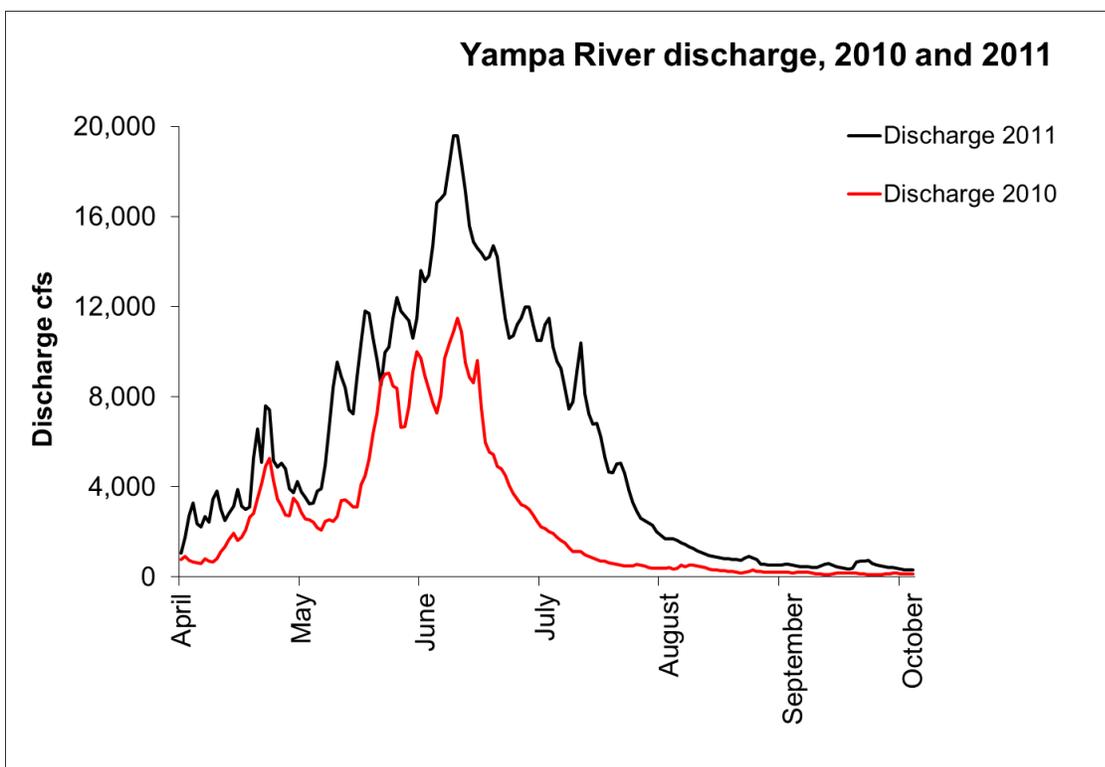


Figure 5-- Comparison of 2011 to 2010 discharge at the Maybell USGS gage on the Yampa River.

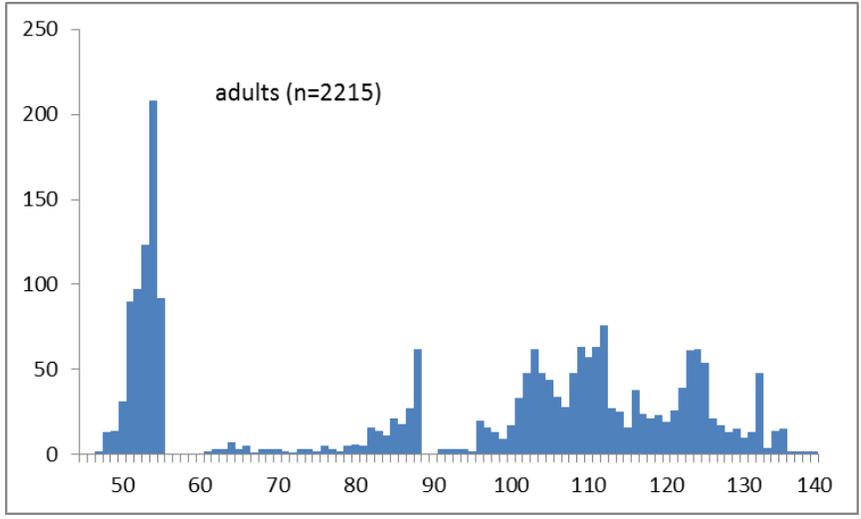
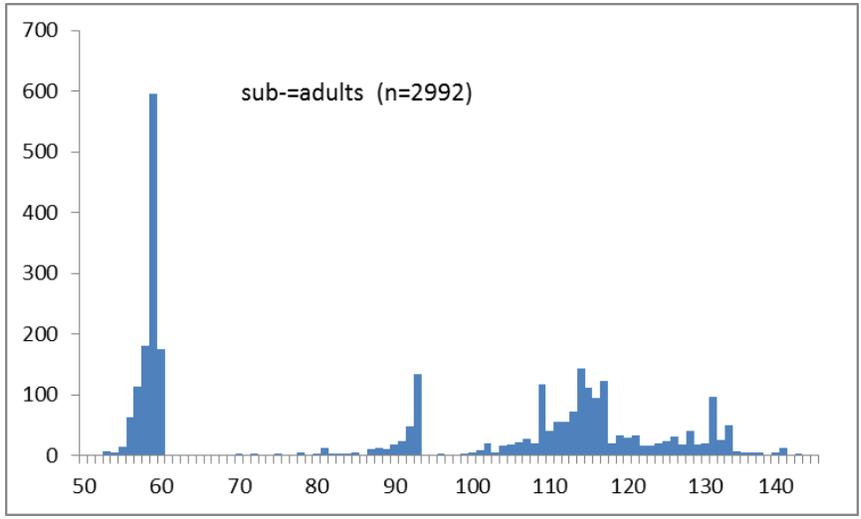
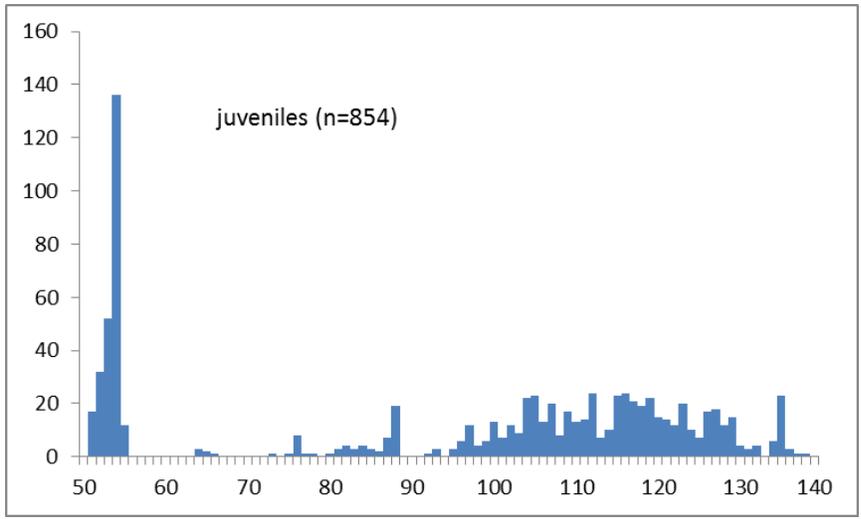


Figure 6—Number of smallmouth bass captured per mile in the middle Yampa River, 2011.

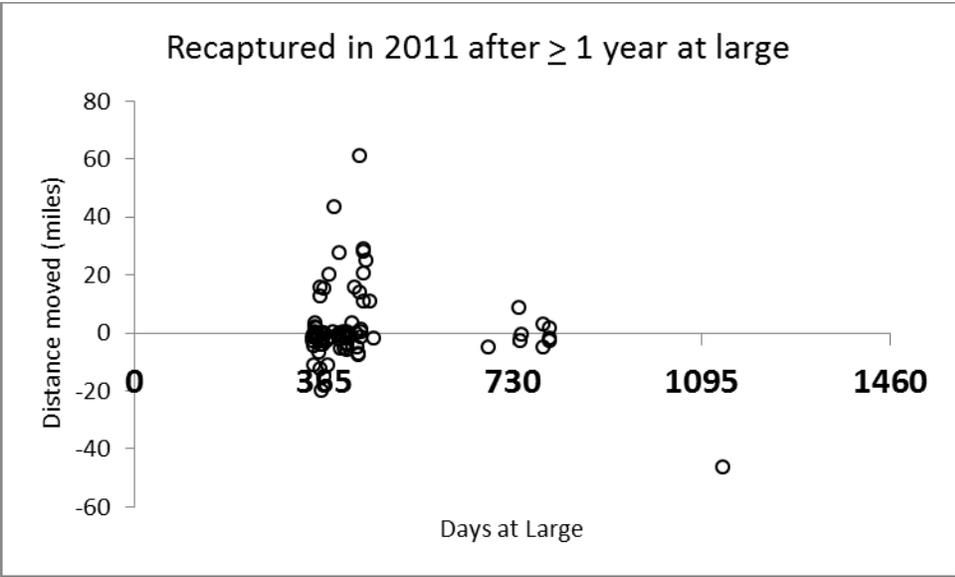
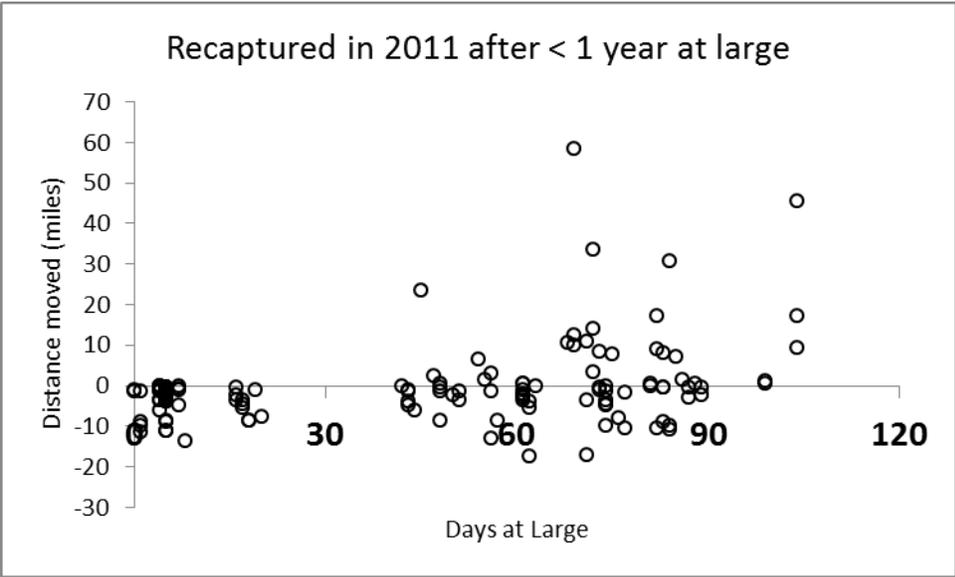


Figure 7—Movement of smallmouth bass recaptured in 2011 that were at large for either less than 1 year (i.e. tagged and recaptured within 2011) or more than one year.