

COLORADO RIVER RECOVERY PROGRAM
FY 2009 ANNUAL PROJECT REPORT

RECOVERY PROGRAM
PROJECT NUMBER: 125

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

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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 Launch (river mile; RM 134) downstream of Craig, Colorado to Dinosaur National Monument (RM 47) and was divided into seven reaches. Fish sampling occurred on five to eleven occasions (passes) from April through July using two electrofishing boats sampling both shorelines. On one of the sample passes we marked and released smallmouth bass ≥ 100 -mm 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 (≥ 200 -mm) smallmouth bass at each study site using capture-recapture methods. During removal passes, bass larger than 250-mm TL were transported to either the Justice Center pond in Craig or Elkhead Reservoir for the angling public. From July through October, we removed small, primarily Age-0 smallmouth bass from the lower 12-mile portion of the Little Yampa Canyon reach and at Lily Park using an electric seine. Starting in 2009, we started removing white sucker and common carp from selected sites. We also removed northern pike and transported them to Loudy Simpson Ponds in Craig or 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 : (March 31, 2008 version)

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 2008 Tasks and Deliverables, Discussion of Initial Findings and Shortcomings:

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

Smallmouth bass

The goal was to remove as many smallmouth bass as possible from the middle Yampa River.

Objectives:

1. Obtain an estimate of the number of smallmouth bass in Little Yampa Canyon and Lily Park using a mark-recapture abundance estimator.
2. Conduct one marking pass and seven removal passes in Little Yampa Canyon and Lily Park.
3. Calculate the proportion of 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 in Little Yampa Canyon [and Lily Park].

All objectives were met in 2009.

VII. Recommendations:

- Generally, we should continue removal efforts riverwide as done in 2009 with increased emphasis on completing at least seven removal passes in all reaches.
- Conduct the marking pass in late April.
- Improve coordination among researchers to determine when to start the marking pass and when to start the recapture pass.
- Mark northern pike earlier than the bass marking pass.
- Determine areas of smallmouth bass production by rapid-assessment sampling of every 10 mile section from Hayden to the Green River confluence to identify areas with the greatest abundance (CPUE) of YOY smallmouth bass.
- 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
- Increase education and enforcement to reduce illegal transport of nonnative species from local impoundments such as Elkhead Reservoir to the river.

VIII. Project Status: On going and on track

IX. FY 2009 Budget Status

- A. Funds Provided: \$241,395
- B. Funds Expended: \$241,395
- C. Difference: 0
- D. Percent of the FY 2008 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 11/26/09
Principal Investigator Date
Submitted electronically.

Version control:

submitted 11/30/09 by JAH

Preliminary Results of 2009

Methods

The study area included an 87 mile-long section of the middle Yampa River, between Craig, Colorado (river mile; RM 134.5) 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 and three were sampled by CDOW. For consistency with previous years, we combined the sub-reaches of upper Maybell, lower Maybell, and Sunbeam to form the Maybell-Sunbeam reach.

Study reaches in the middle Yama River

●	Lily Park	lead agency: CSU	RM 47.5–55.5	8 miles
●	Maybell-Sunbeam	lead agency: DOW	RM 60.6–88.7	28.1 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	lead agency: DOW	RM 91-100	9 miles
●	Little Yampa Canyon	lead agency: CSU	RM 124-100	24 miles
●	South Beach	lead agency: CDOW	RM 134.5–124	10.5 miles

Fish sampling occurred on five to eleven occasions (passes) from April through July using two electrofishing boats sampling both shorelines. On one of the sample passes at each reach we marked and released smallmouth bass ≥ 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. On all other passes, smallmouth bass were removed from the river and either euthanized if under 250 mm or translocated to the Justice Center pond or Elkhead Reservoir. A few bass larger than 250 mm were also euthanized for research purposes, such as otolith microchemistry examination. Smallmouth bass were grouped into life stages based on length which 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 by CDOW though Project # 98a. Pike were transported to Loudy Simpson Ponds in Craig or State Parks Headquarter's pond near Hayden, except for young-of-year (YOY) pike that were euthanized and frozen for age and growth analysis.

In Little Yampa Canyon and all of Lily Park, we also collected data on all species to examine the fish community. In previous years we collected fish community data only at four 1-mile sites in Little Yampa Canyon and one 1-mile site at Lily Park. Starting in 2009 in addition to the 1-mile samples, we sampled the fish community throughout the entire Little Yampa Canyon and Lily Park reaches. 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.

During the low-flow period from July through October, we removed small, primarily age-0, smallmouth bass from the lower 12-miles of Little Yampa Canyon and the entire Lily Park reach using an electric seine and occasionally captured bass by angling.

Changes in 2009 included:

- Smallmouth bass data collected by CDOW in the middle Yampa River were provided to

CSU for analysis and incorporation in this report.

- We attempted to coordinate the marking pass for consistency between agencies with the goal of obtaining a river wide estimate of smallmouth bass abundance.

Changes in 2009 at Little Yampa Canyon and Lily Park included:

- In an attempt to increase the number of passes, we started sampling early at Little Yampa Canyon and completed three removal passes before the marking pass.
- At Lily Park, we increased the reach length to include an additional 2.5 miles of the sand-bed reach between the Little Snake River and DNM. This added an additional day of sampling at Lily Park.
- We expanded the fish community sampling from one-mile samples to the entire area of both Little Yampa Canyon and Lily Park.
- We started removing common carp, white sucker, and white-sucker hybrids. In Little Yampa Canyon they were removed from the lower 12 miles and at LP they were removed from the entire reach..
- We collected data to compare CPUE of the Smith Root GPP 5.0 vs Smith Root VVP-15b (updated Coffelt VVP-15 model) electrofishing units, including recording total numbers of fish captured by each electrofisher and the electrofishing effort for each electrofisher in ½ mile increments.
- Electrofishing output voltage and amperes were measured daily for electrofishing standardization analysis by CDOW.

Smallmouth bass abundance and exploitation

In 2009, we estimated abundance of smallmouth bass for each reach when data were adequate. Unfortunately, in several reaches only one fish, and in some cases no 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 riverwide estimate of abundance. Data were adequate to estimate adult abundance for Little Yampa Canyon, Maybell-Sunbeam, and Lily Park reaches and sub-adult abundance only for Lily Park.

At Little Yampa Canyon, in 2009, we estimated there were 1045 (95% CI = 808-1403, CI, CV=21%) adult smallmouth bass (Table 1). This was much lower than the 3173 (95% CI = 2036–5112, CV=24%) measured for similar sized bass in 2008. Estimates prior to 2007 were for bass ≥ 150 mm and will need to be recalculated using current length groups to be comparable. Density of adult smallmouth bass at Little Yampa Canyon was 44 fish / mile, 67% lower than in 2008.

At the Maybell-Sunbeam reach we estimated there were 884 (95% CI = 364–2467, CV= 54%) adult smallmouth bass (Table 1). This estimate is imprecise and highly suspect because it is based on only three recaptures. There is no comparable abundance data for this reach from past years. Density of adult smallmouth bass was 32 fish / mile, and less than the density in Little Yampa Canyon.

At Lily Park, we estimated there were 812 (95% CI = 581–1196, CV= 19%) adult smallmouth bass and 4,281 (95% CI = 2728–6917, CV= 24%) sub-adult smallmouth bass (Table 1). The

adult population size was unchanged from 2008 ($\hat{N}=900$, 95% CI 532–1643, CV=30%) and there was no comparable data for sub-adults in previous years. Based on the point estimates, density of sub-adult bass was 535 fish / mile and density of adult bass was 102 fish / mile. Adult density was lower compared to 180 fish / mile the previous year; although, some of this difference can be attributed to the marginal habitat in the newly added reach. This section of river contributed few bass to the Lily Park catch in 2009. Still, Lily Park remains the area of highest density for both adult and sub-adult smallmouth bass of all reaches in the middle Yampa River.

South Beach and lower Juniper reaches had low catch rates during the mark and recapture passes, conditions also experienced the previous year. In fact, the numbers of fish marked on the first pass, handled on the recapture pass, and recaptured in each of the CDOW reaches in 2008 closely match those in 2009 (see pages 10–11, Wright 2009).

Low catch rates in all reaches in April contributed to an inadequate number of fish marked. Because of low catch rates, we (CSU) delayed our marking pass from April 20 until the next pass that started on April 30. In hindsight, we would have tagged only 16 adult smallmouth bass on April 20 instead of the 159 that we marked on the next pass on April 30. To obtain adequate samples for estimating abundance in future years will require higher catch rates by delaying the marking pass until around late April.

Exploitation Rates

Based on point estimates for adult bass, we removed 97% (n=1015) of the adults from Little Yampa Canyon, 54% (n=477) from Maybell-Sunbeam, and 77% (n=622) from Lily Park. Based on point estimates for sub-adults at Lily Park, we removed 113% (n=4829) of the sub-adults in 2009. This did not account for fish that may have recruited into each life stage or immigrated into each reach. In comparison, our exploitation rate based on tag returns was much lower than the exploitation based on number of fish removed. We marked and released 659 smallmouth bass in 2009 and recaptured 264 of those fish which equals a recapture rate of 40%.

Fish removal

We sampled a total of 639 hours with boat electrofishing, 362 hours with fyke nets, 143 hours angling, and 54 hours with electric seine (Tables 2 and 5). Effort by pass for each reach is reported in Table 2. Our objective was to complete seven removal passes at the reaches with highest density (South Beach, Little Yampa Canyon, Maybell, and Lily Park) and complete three removal passes at Lower Juniper. We achieved that goal at all reaches except Maybell where only six removal passes were completed. We completed 10 removal passes at Little Yampa Canyon but three of those were in early April when catch rates were extremely low. CSU assisted the DOW by completing a removal pass at South Beach on July 8-9 (Pass 7) and a removal pass at Lower Juniper on July 13 (Pass 5).

Fish captured with boat electrofishing and angling

Using boat electrofishing we removed 11,208 smallmouth bass. This included 157 fish moved to

the Justice Center pond, 933 fish moved to Elkhead Reservoir, and 10,118 fish euthanized. Of all fish handled, we captured 53% in Lily Park, 26% in Little Yampa Canyon, and 15% in Maybell-Sunbeam. An additional 699 were marked and released, including some fish handled more than once. We removed 308 smallmouth bass by angling during the fall low-flow sampling and no bass were captured in fyke nets. Few smallmouth bass were captured during April sampling. Numbers captured per pass and their disposition are provided in Table 3 .

Catch Rates

Catch rates (CPUE) for all bass captured in each reach were almost five times higher at Lily Park (64 fish/hr) than the catch rate at the next highest reach, Maybell-Sunbeam (14 fish/hr); and was followed by Little Yampa Canyon (10 fish/hr), Lower Juniper (6 fish/hr), and South Beach (6 fish/hr). Lily Park CPUE in 2009 was similar to that observed in 2008 (67 fish/hr) and Little Yampa Canyon CPUE (10 fish/hr) declined from that measured in 2008 further supporting a decline in adult smallmouth bass abundance at Little Yampa Canyon (17 fish/hr; Table 4).

Using CPUE as a representative of abundance for each life stage, Lily Park had the highest abundance of all the reaches. Adults were twice as abundant at Lily Park (8 fish/mile) compared to the other reaches where bass catch ranged from 3-4 fish/mile (Figure 1). Sub-adults were almost 10 times more abundant at Lily Park (52 fish /hr) than any other reach except Maybell-Sunbeam where they were moderately abundant (8 fish/hr). The large number of sub-adults at Lily Park represents a large cohort that is recruiting from the juvenile (predominately yearling) cohort observed in 2008 (37 fish/hr; Table 2 in Hawkins 2008). This represents a strong year class produced in 2007. In 2009, juvenile abundance increased in a downstream direction and was greatest in Lily Park.

The strength of the yearling cohort in 2008 can be seen best in the length frequency histogram of smallmouth bass collected from 2007–2009 (Figure 2). A large number of juveniles were collected in 2008 and their length ranged between 70-125 mm. That cohort of yearling fish grew into the large cohort of sub-adults (125–200 mm) in 2009.

Compared to previous years, abundance of adults declined in all reaches except South Beach, which remained similar at 2 and 3 fish/hr in 2008 and 2009, respectively. From 2008 to 2009, adult abundance at Little Yampa Canyon declined from 6 to 4 fish/hr, at Maybell it declined from 6.3 to 3.8 fish / hr, and at Lily Park it declined from 10 to 7.6 fish/hr.

Catch rates varied greatly by pass. Specifically, earlier passes in April were extremely inefficient at catching smallmouth bass; however, starting in late April and early May, catch rates at some reaches increased an order of magnitude. For example, at Little Yampa Canyon, the catch rate for adults increased from 1.2 to 8.5 fish/hr between April 20 and April 30 (Table 4; Figures 3a and 3b). The primary physical change that occurred during that interval was increased flows. Discharge increased from 2760 to 6139 cfs and specific conductance changed from 475 to 271 micro siemens. Temperature remained constant at 11⁰ C and water clarity was the same as measured by secchi depth which remained constant at 10 cm. We believe that fish responded to substantially increased flows by moving from the thalweg to the shore margins where they were susceptible to the sampling gear. Increased flow also reduced conductivity through dilution to a

level more suitable for catching smallmouth bass with boat electrofishing. Later in the season water clarity improved as flows declined. Visibility was marginal in May based on Secchi depth readings of 10-15 cm and improved to optimal in June when secchi depth was 30-40 cm. By July water was extremely clear as measured by 65cm secchi depths. Improved water clarity increased catch rates because it allowed netters to see and net fish that were shocked deep underwater.

Spawning observations

Spawning occurred in late June based on capture of a ripe female on June 26 and other smallmouth bass with anal-fin abrasions from nest cleaning in late June and early July. On June 30 we captured several smallmouth bass over nests in a 1-m deep, gravel-substrate backwater at RM 103.0, located just downstream of the Morgan Gulch boat ramp. Twelve days later we collected several 10-16 mm YOY smallmouth bass in that backwater. During supplemental sampling in the South Beach and lower Juniper reaches in early July, several adult smallmouth bass were captured in still-water habitat apparently over nests. CSU and DOW researchers also conducted supplemental sampling for YOY smallmouth bass on September 11. We captured 48–65 mm YOY at both Sunbeam and in Craig near Loudy Simpson indicating reproduction in reaches where few adult bass were captured.

Fish captured with electric seine

We removed 7,883 smallmouth bass from the lower 12-miles of Little Yampa Canyon and 208 from Lily Park with electric seine in 2009 (Table 6). These numbers were very similar to those observed in 2008. In 2009, removal occurred from August 4 through Oct 18 during low flow. Other species removed included northern pike, black bullhead, white sucker, common carp, creek chub, and several centrarchids (Table 6). Of significance was the number of black bullhead which increased from 2,052 in 2008 to 8,791 in 2009. Effort for each year was similar, 43 hours in 2008 and 47 hours in 2009.

Most bass captured with the electric seine were YOY < 100 mm (Figure 4). Interestingly, Lily Park appears to contribute very little to smallmouth bass production based on extremely low catch rates of age-0 bass captured with the electric seine. In 2009, CPUE was 167 at Little Yampa Canyon and 34 at Lily Park, almost exactly the same as in 2008 when it was 164 at Little Yampa Canyon and 32 at Lily Park. Effective control measures will require identification of the production areas that are producing the yearling cohorts found at Lily Park. Reproduction could be occurring in other reaches such as Maybell-Sunbeam and may not be related to adult abundance.

Movement

We had 333 individual fish in 2009 with previous capture records, including 264 fish that were tagged and recaptured in 2009. Some fish had more than one capture occasion in the past and capture histories included previous captures for the past 5 years back to 2004. The 264 smallmouth bass that were tagged and recaptured in 2009 were a portion of the 659 smallmouth bass that we tagged and released in 2009. These fish were handled on 275 occasions, meaning that some fish were handled more than once within the year.

Recapture histories of the smallmouth bass revealed movement patterns similar to those reported in Hawkins et al. (2009). That is, smallmouth bass moved as far as 36 miles downstream and 48 miles upstream from their release location and longer distance movements were detected after 60 days at large. Still, two fish were found within ½ mile and 2 miles of their release location after 111 days at large; so smallmouth bass have the ability to remain at or relocate to their release location (Figure 5). As time at large increased so did the distance moved. After being at large for at least one year, smallmouth bass moved distances up to 80 miles (Figure 6).

Short term movements can help identify the potential for displacement during sampling and smallmouth bass were found as far as 5 miles downstream when recaptured within the same day as release and as far as 11 miles downstream if recaptured within a week of release (Figure 5). No movements were detected in an upstream direction during short term recaptures, but this may be a function of our sampling which generally moved downstream and therefore had a greater ability to detect downstream movement.

Movement based on size

Although a portion of smallmouth bass released in 2009 remained near their release location, there was a trend for smaller bass (sub-adults) to displace downstream after release. Adult-sized bass were recaptured both up and downstream of their release site but there was a trend for larger adults (>300 mm) to displace upstream (Figure 7).

Movement between Projects

Twenty nine smallmouth bass tagged in the middle Yampa moved into Yampa Canyon and were recaptured by USFWS in 2009. Length averaged 179 mm and ranged 127–257 mm. One was a 181 mm fish that moved 83 miles downstream from Little Yampa Canyon to Yampa Canyon in a year. The other 28 were all tagged in Lily Park in 2009 and moved 5–36 miles over 41–78 days. Three smallmouth bass tagged by USFWS in Yampa Canyon moved upstream into Lily Park in 2009. They ranged from 173–292 mm long and were released in Yampa Canyon in 2008 and 2009.

Elkhead escapees

In 2009, we captured 32 smallmouth bass that had escaped from Elkhead Reservoir after translocation. Three of these fish were repeat offenders that had been moved to Elkhead and escaped twice. We recaptured them in 2009 and again relocated them back to Elkhead reservoir. One escapee had been placed in Elkhead reservoir in 2008, 28 were placed there in 2007, and three were placed there in 2005. We expected and documented some escapement while the reservoir was undergoing maintenance construction to enlarge the dam in 2005 and 2006 and the three fish that were translocated there in 2005 and escaped, could have escaped during dam construction. But the majority of escapees recaptured in 2009 were placed in the reservoir after construction was completed, indicating that the present dam configuration may be encouraging greater escapement than the earlier dam, prior to construction. YOY largemouth bass, a lacustrine species, were also captured in the middle Yampa River in 2009 and most likely escaped from Elkhead Reservoir. Escapees represented 3% (n=7) of the 210 fish tagged and released at Little Yampa Canyon in 2009. If resident bass in ELkhead Reservoir behave like

translocated fish, then there could be a significant influx of bass to our study reaches by reservoir fish. Another remote possibility to explain escapees is that anglers are moving smallmouth bass back to the river in protest of nonnative control actions. If we continue to translocate bass to Elkhead Reservoir, we should determine the timing and level of escapement via telemetry, a PIT tag station, or a weir below the spillway and consider increased enforcement to prevent illegal moving of nonnative species into the river.

Fish Community Sampling

We continued our 1-mile community sampling in 2009 and the species collected and their relative abundance was very similar to that observed in 2008. Nonnative fish dominated both reaches, especially Little Yampa Canyon where they comprised 94% of the community and at Lily Park they comprised 73% of the fish community (Table 7). Smallmouth bass were the dominant species in both reaches followed by nonnative white suckers at Little Yampa Canyon and native flannelmouth suckers at Lily Park. Nonnative creek chub abundance doubled at Little Yampa Canyon, from about 3% in 2008 to 6% in 2009, otherwise other species remained relatively similar to abundance measured in 2008.

All fish captured

At Little Yampa Canyon we captured 20 nonnative species, three nonnative sucker hybrids, and eight native species (Table 8). At Lily Park, we handled 13 nonnative species, two nonnative sucker hybrids, and six native species (Table 9). Of significance was the recapture of a 430-mm razorback sucker on April 28 in Lily Park at RM 52.8. That is about 7 miles upstream from Dinosaur National Monument. Based on the PIT tag number, the fish was hatchery-raised and stocked by the U.S. Fish and Wildlife Service as a juvenile in the Green River at the town of Green River, UT in 2004. Original length was 290 mm and over the five-year period it traveled 280 miles upstream from its original stocking location and grew 140 mm. The fish appeared healthy and normal and was captured in habitat historically occupied by the species. This fish is significant because the last time that an adult razorback sucker was captured in this section of the Yampa River was almost 30 years ago when two adult razorback suckers were collected near this location in 1980. We also captured a large grass carp (960 mm) in Little Yampa Canyon and three YOY largemouth bass that ranged 70–100 mm.

Conclusions

- Abundance of adult smallmouth bass declined 67% at Little Yampa Canyon in 2009 as supported by lower abundance estimates and lower CPUE as compared to 2008.
- Similar declines based on declines in CPUE from 2008 to 2009 were observed in all other reaches except South Beach.
- Abundance at Lily Park remained constant from 2008 to 2009, possibly due to a strong year class from 2007 that was tracked over time and maintained the population at Lily Park.
- Abundance estimates were not possible for many reaches due to low catch rates which were partially related to timing of sampling.
- Lily Park maintains the highest density for all life stages of smallmouth bass compared to

- other reaches.
- Lily Park does not appear to support reproduction of smallmouth bass based on low densities of YOY collected during fall sampling; therefore, the population may be sustained by reproduction from other reaches.
 - Smallmouth bass have the potential to move both up and downstream through all reaches of the Yampa River from Craig to Yampa Canyon.
 - Smallmouth bass translocated from the river to Elkhead Reservoir are escaping at back to the river.

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 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..

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 smallmouth bass at five reaches in the middle Yampa River, 2009. Life stages included: sub-adult (100-199 mm TL) and adult (≥ 200 mm TL). No estimate was calculated for some life stages due to inadequate number of recaptured fish. Abundance was estimated using a Huggins estimator which is similar to model M_t . Number of fish handled on each pass is provided for those wanting to estimate abundance by the Lincoln-Peterson method. Number of fish handled on recapture sample occasion includes recaptures.

Life stage	Abundance	95% CI	SE	CV	capture probability	Density #fish/mile	# fish marked	# fish handled at recapture	# recaps
<i>South Beach reach (10-miles long)</i>									
sub-adult	No estimate	--	--	--	--	--	6	24	0
adult	No estimate	--	--	--	3%?	--	31	24	1
<i>Little Yampa Canyon reach (24-miles long)</i>									
sub-adult	No estimate	--	--	--	2%?	--	51	204	1
adult	1045	808-1403	149	14%	21%	44	159	217	33
<i>Lower Juniper reach (9-miles long)</i>									
Sub-adult	No estimate	--	--	--	--	--	1	2	0
adult	No estimate	--	--	--	--	--	16	24	0
<i>Maybell-Sunbeam reach (28-miles long)</i>									
sub-adult	No estimate	--	--	--	--	--	18	112	0
adult	884	364-2467	478	54%	9%	32	34	78	3
<i>Lily Park reach (8-miles long)</i>									
sub-adult	4281	2728-6917	1039	24%	6%	612	231	278	15
adult	812	581-1196	153	19%	18%	112	112	145	20

Table 2–Sampling effort (hours) by pass for smallmouth bass in five reaches of the Yampa River, 2009. Each pass was a complete sample occasion through a reach.

South Beach reach (RM 124-134)					
Pass	Dates sampled	Fish Disposition	Electrofishing	Fyke	Angling
1	April 17	Removal	8.5		
2	April 22-23	Mark / Release	12.4		
3	April 28	Recapture/Removal	11.1		
4	May 13	Removal	9.5		
5	June 3	Removal	9.0		
6	June 11	Removal	10.5		
7	July 8-9	Removal	6.1		
Total Hours			67.1		

Little Yampa Canyon reach (RM 100-124)					
Pass	Dates sampled	Fish Disposition	Electrofishing	Fyke	Angling
1	April 7-9	Removal	19.2		
2	April 14-18	Removal	24.0		
3	April 18-20	Removal	21.1		
4	April 30-May 3	Mark / Release	19.8		
5	May 12-15	Recapture/ Removal	34.3	105.6	
6	May 15-19	Removal	30.3	126.9	
7	May 28-31	Removal	33.0	54.3	
8	June 11-14	Removal	29.2	75.2	
9	June 24-27	Removal	26.8		
10	June 28-30	Removal	23.2		
11	July 9-13	Removal	30.4		
extra	August 9,22 & Sept 7,19	Removal			143.3
Total Hours			291.5	362.0	143.3

Table 1–cont.

Lower Juniper reach (RM 91-100)

Pass	Dates sampled	Fish Disposition	Electrofishing	Fyke	Angling
1	April 15	Removal	10.6		
2	April 27	Mark / Release	9.1		
3	May 1	Recapture/Removal	10.3		
4	June 12	Removal	9.8		
5	July 13	Removal	9.6		
Total Hours			49.4		

Maybell-Sunbeam reach (RM 60.6-88.7)

Pass	Dates sampled	Fish Disposition	Electrofishing	Fyke	Angling
1	April 14-16	Removal	10.6		
2	April 20-21, 24	Mark / Release	29.4		
3	April 29-May 5	Recapture/Removal	29.2		
4	May 11-12	Removal	18.3		
5	May 14	Removal	10.0		
6	June 2-3	Removal	18.3		
7	June 9-10	Removal	18.0		
Total Hours			133.8		

Lily Park reach (RM 48-55)

Pass	Dates sampled	Fish Disposition	Electrofishing	Fyke	Angling
1	April 28-29	Mark / Release	9.2		
2	May 4-5	Recapture/Removal	13.7		
3	May 26-27	Removal	15.5		
4	June 1-2	Removal	14.6		
5	June 9-10	Removal	15.0		
6	June 15-16	Removal	13.3		
7	June 23	Removal	8.6		
8	July 7	Removal	7.5		
Total Hours			97.3		

	Electrofishing	Fyke	Angling
Grand Total Hours	639.1	362.0	143.3

Table 3— Disposition of smallmouth bass captured by electrofishing boat and angling on each sampling pass in the middle Yampa River, 2009. Fish accidentally released during removal passes are marked with an asterisk.

South Beach						
Pass	Dates sampled	marked & released	Justice Center	Elkhead Reservoir	removed	Total
1	April 17		8		2	10
2	April 22-23	37			1	38
3	April 28				50	50
4	May 13			13	27	40
5	June 3			19	34	53
6	June 11			18	22	40
7	July 8-9			43	105	148
Total		37	8	93	241	379
Little Yampa Canyon						
Pass	Dates sampled	marked & released	Justice Center	Elkhead Reservoir	removed	Total
1	April 7-9	2 *	20		9	30
2	April 14-18		27		13	40
3	April 18-20		14		4	19
4	April 30-May 3	220			7	227
5	May 12-15			146	290	436
6	May 15-19			121	354	475
7	May 28-31			73	289	362
8	June 11-14			39	143	182
9	June 24-27			48	153	201
10	June 28-30			25	195	220
11	July 9-13			81	531	612
Angling	August 9,22 & Sept 7,19			33	275	308
Total		222	61	566	2263	3112

Table 3— cont

Lower Juniper

Pass	Dates sampled	marked & released	Justice Center	Elkhead Reservoir	removed	Total
1	April 15		19		6	25
2	April 27	17			1	18
3	May 1				27	27
4	June 12				56	56
5	July 13			38	153	191
Total		17	19	38	243	317

Maybell-Sunbeam

Pass	Dates sampled	marked & released	Justice Center	Elkhead Reservoir	removed	Total
1	April 14-16		6		6	12
2	April 20-21, 24	61			9	70
3	April 29-May 5		21		194	215
4	May 11-12			58	385	443
5	May 14			37	167	204
6	June 2-3			36	302	338
7	June 9-10				545	545
Total		61	27	131	1608	1827

Lily Park

Pass	Dates sampled	marked & released	Justice Center	Elkhead Reservoir	removed	Total
1	April 28-29	353			6	359
2	May 4-5	1 *	42		383	426
3	May 26-27			36	1016	1052
4	June 1-2			27	1148	1175
5	June 9-10			18	1343	1361
6	June 15-16	8 *		5	880	893
7	June 23			12	479	491
8	July 7			7	508	515
Total		362	42	105	5763	6272

All reaches combined

Grand total	marked & released	Justice Center	Elkhead Reservoir	removed	Total
	699	157	933	10118	11907

Table 4— CPUE (catch per unit effort) for smallmouth bass captured in the middle Yampa River, 2009. 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.

South Beach										
Pass	Dates sampled	Number captured					CPUE (#fish/ hour electrofishing)			
		juvenile	sub-adult	adult	All sizes		juvenile	sub-adult	adult	All sizes
1	April 17	1	1	8	10	1	0.1	0.1	0.9	1.2
2	April 22-23	1	6	31	38	2	0.1	0.5	2.5	3.1
3	April 28	2	24	24	50	3	0.2	2.2	2.2	4.5
4	May 13		23	17	40	4		2.4	1.8	4.2
5	June 3	3	26	24	53	5	0.3	2.9	2.7	5.9
6	June 11	1	17	22	40	6	0.1	1.6	2.1	3.8
7	July 8-9	19	51	78	148	7	3.1	8.4	12.9	24.4
all passes combined		27	148	204	379		0.4	2.2	3.0	5.7

Little Yampa Canyon										
Pass	Dates sampled	Number captured					CPUE (#fish/ hour electrofishing)			
		juvenile	sub-adult	adult	All sizes		juvenile	sub-adult	adult	All sizes
1	April 7-9	4	3	23	30	1	0.2	0.2	1.2	1.6
2	April 14-18	2	8	30	40	2	0.1	0.3	1.2	1.7
3	April 18-20		3	16	19	3	0.0	0.1	0.8	0.9
4	April 30-May 3	7	52	168	227	4	0.4	2.6	8.5	11.4
5	May 12-15	15	204	217	436	5	0.4	5.9	6.3	12.7
6	May 15-19	27	250	198	475	6	0.9	8.3	6.5	15.7
7	May 28-31	41	195	126	362	7	1.2	5.9	3.8	11.0
8	June 11-14	28	86	68	182	8	1.0	2.9	2.3	6.2
9	June 24-27	39	69	93	201	9	1.5	2.6	3.5	7.5
10	June 28-30	75	91	54	220	10	3.2	3.9	2.3	9.5
11	July 9-13	79	343	190	612	11	2.6	11.3	6.2	20.1
all passes combined		317	1304	1183	2804		1.1	4.5	4.1	9.6

Pass	Dates sampled	Number captured					CPUE (#fish/ hour angling)			
		juvenile	sub-adult	adult	All sizes		juvenile	sub-adult	adult	All sizes
Angling August 9,22 & Sept 7,19			201	107	308			1.4	0.7	2.1

Table 4— Cont

Lower Juniper

Pass	Dates sampled	Number captured					CPUE (#fish/ hour electrofishing)			
		juvenile	sub-adult	adult	All sizes		juvenile	sub-adult	adult	All sizes
1	April 15	1	2	22	25	1	0.1	0.2	2.1	2.4
2	April 27	1	1	16	18	2	0.1	0.1	1.8	2.0
3	May 1	1	2	24	27	3	0.1	0.2	2.3	2.6
4	June 12	8	17	31	56	4	0.8	1.7	3.2	5.7
5	July 13	36	84	71	191	5	3.7	8.7	7.4	19.8
all passes combined		47	106	164	317		1.0	2.1	3.3	6.4

Maybell-Sunbeam

	Dates sampled	Number captured					CPUE (#fish/ hour electrofishing)			
		juvenile	sub-adult	adult	All sizes		juvenile	sub-adult	adult	All sizes
1	April 14-16	4	2	6	12	1	0.4	0.2	0.6	1.1
2	April 20-21, 24	18	18	34	70	2	0.6	0.6	1.2	2.4
3	April 29-May 5	25	112	78	215	3	0.9	3.8	2.7	7.4
4	May 11-12	20	275	148	443	4	1.1	15.0	8.1	24.2
5	May 14	9	115	80	204	5	0.9	11.5	8.0	20.4
6	June 2-3	38	219	81	338	6	2.1	12.0	4.4	18.5
7	June 9-10	91	370	84	545	7	5.1	20.6	4.7	30.3
all passes combined		205	1111	511	1827		1.5	8.3	3.8	13.7

Lily Park

Pass	Dates sampled	Number captured					CPUE (#fish/ hour electrofishing)			
		juvenile	sub-adult	adult	All sizes		juvenile	sub-adult	adult	All sizes
1	April 28-29	5	237	117	359	1	0.5	25.9	12.8	39.2
2	May 4-5	3	277	146	426	2	0.2	20.2	10.7	31.1
3	May 26-27	5	901	146	1052	3	0.3	58.3	9.4	68.0
4	June 1-2	35	1017	123	1175	4	2.4	69.5	8.4	80.3
5	June 9-10	94	1178	89	1361	5	6.3	78.6	5.9	90.8
6	June 15-16	99	730	64	893	6	7.5	55.0	4.8	67.3
7	June 23	104	356	31	491	7	12.0	41.2	3.6	56.8
8	July 7	123	369	23	515	8	16.4	49.3	3.1	68.9
all passes combined		468	5065	739	6272		4.8	52.0	7.6	64.4

Table 5— Sample dates, seine electrofishing effort, number, and CPUE of mostly YOY smallmouth bass captured in two reaches of the Yampa River, 2009.

<i>Little Yampa Canyon, 12-mile Treatment site</i>						
Trip	Sample Dates	Number of sites	Effort (hrs)	# SMB removed	Biomass (kg)	CPUE (#fish/hr)
1	Aug 4-8	14	6.1	807	4.2	133
2	Aug 19-24	15	6.0	694	2.4	116
3	Sep 1-8	28	10.2	2,077	7.2	204
4	Sep 15-22	21	11.8	2,584	11.1	219
5	Sep 29-Oct 6	16	5.4	623	2.7	115
6	Oct 14-18	24	7.8	1,098	4.1	141
	Total	118	47.3	7,883	31.8	167

<i>Lily Park</i>						
Trip	Sample Dates	Number of sites	Effort (hrs)	# SMB removed	Biomass (kg)	CPUE (#fish/hr)
1	Aug 10-11	11	2.5	73	2.3	29
2	Aug 18,25	9	2.4	118	2.7	50
3	Oct 13	5	1.3	17	0.4	13
	Total	25	6.2	208	5.4	34

Table 6— Number and biomass (kg) of each fish species removed from two reaches in the Yampa River, 2009. 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 Control	lower 12-miles Treatment	
smallmouth bass	-	7883 (31.8)	208 (5.4)
northern pike	23 (2.8)	18 (2.4)	2 (2.0)
largemouth bass	3 (0.05)	6 (0.1)	-
black bullhead	87 (0.7)	1965 (1.0)	-
black crappie	6 (0.1)	3 (0.1)	-
green sunfish	3 (0.05)	23 (0.4)	-
bluegill	58 (1.0)	88 (1.8)	4 (0.05)
brook stickleback	109 (0.1)	129 (0.1)	5 (0.004)
creek chub	-	901 (2.4)	1 (0.002)
common carp	-	40 (0.1)	8 (8.1)
white sucker	-	1069 (10.8)	190 (1.3)
white sucker hybrids	-	15 (0.02)	-
Total	289 (4.8)	12140 (51.0)	418 (16.9)

Table 7— Relative abundance of fish collected with boat electrofishing in the 1-mile fish community sample sites, Yampa river, 2009. Little Yampa Canyon contained four 1-mile sites and Lily Park contained one site.

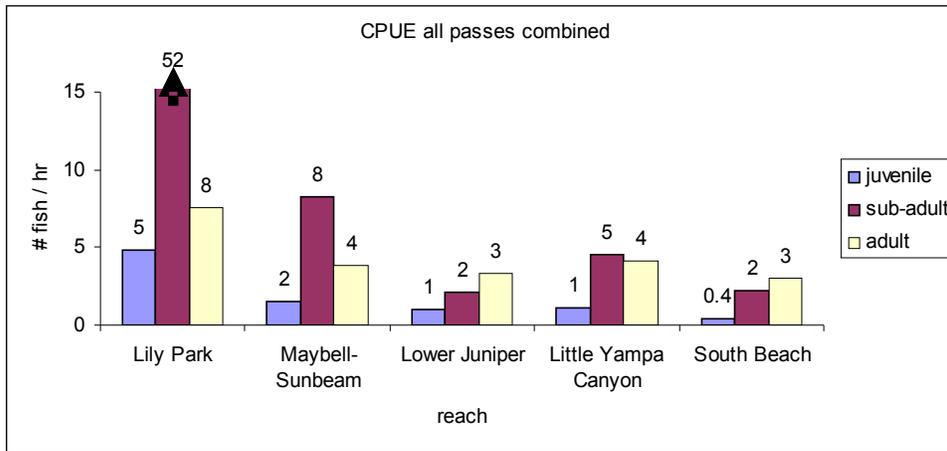
	Little Yampa Canyon	Lily Park
<i>nonnative species</i>		
smallmouth bass	38.5	54.0
northern pike	2.0	0.2
white sucker	37.1	7.2
white x flannelmouth sucker	3.6	0.3
bluegill	1.2	0.6
creek chub	6.0	-
black bullhead	1.1	-
rainbow trout	0.6	0.3
common carp	1.0	1.5
white x bluehead sucker	1.0	0.1
fathead minnow	0.1	-
black crappie	0.3	0.1
green sunfish	0.3	-
brown trout	0.3	0.1
channel catfish	0.1	6.9
brook stickleback	0.2	-
sand shiner	0.3	0.7
red shiner	-	0.6
white x flannelmouth x bluehead sucker	0.1	-
largemouth bass	0.1	-
lowa darter	0.1	-
redside shiner	0.1	-
<i>native species</i>		
flannelmouth sucker	2.3	23.2
roundtail chub	1.7	1.0
bluehead sucker	1.0	3.1
mountain whitefish	0.3	-
speckled dace	0.1	-
Colorado pikeminnow	0.2	0.1
cutthroat trout	0.2	-
mottled sculpin	0.1	-
razorback sucker	-	0.1
Total number of fish	1144	1732
% nonnative fish	94.1	72.6
% native fish	5.9	27.4

Table 8— Number of fish captured in Lily Park, Yampa River, 2009.

	Removed	Released	Total
<i>nonnative species</i>			
smallmouth bass	5,910	362	6,272
northern pike	23	3	26
channel catfish		615	615
white sucker	550	1	551
common carp	203		203
bluegill	93		93
rainbow trout		13	13
white x flannelmouth sucker	12		12
sand shiner		12	12
red shiner		11	11
black crappie	8		8
white x bluehead sucker	4		4
black bullhead	3		3
brown trout		2	2
green sunfish	1		1
<i>native species</i>			
flannelmouth sucker		2,269	2,269
bluehead sucker		212	212
roundtail chub		136	136
Colorado pikeminnow		9	9
mountain whitefish		1	1
razorback sucker		1	1

Table 9— Number of fish captured in Little Yampa Canyon, Yampa River, 2009.

	Removed	Released	Total
<i>nonnative species</i>			
smallmouth bass	2,890	222	3,112
northern pike	218	38	256
white sucker	1,476	925	2,401
white x flannelmouth sucker	99	173	272
bluegill	194		194
creek chub	1	103	104
black bullhead	103		103
rainbow trout		72	72
common carp	38	32	70
white x bluehead sucker	14	25	39
fathead minnow		22	22
black crappie	19		19
green sunfish	17		17
brown trout	2	12	14
channel catfish		10	10
brook stickleback	9		9
sand shiner		4	4
white x flannelmouth x bluehead sucker	3		3
largemouth bass	3		3
Iowa darter		2	2
grass carp	1		1
redside shiner		1	1
<i>native species</i>			
flannelmouth sucker		109	109
roundtail chub	1	104	105
bluehead sucker		80	80
mountain whitefish		31	31
speckled dace		10	10
Colorado pikeminnow		10	10
cutthroat trout		7	7
mottled sculpin		7	7



1Figure 1— CPUE at each reach along a longitudinal gradient in the middle Yampa River, 2009. Note: The number for sub-adult at Lily Park exceeds the maximum y-axis value.

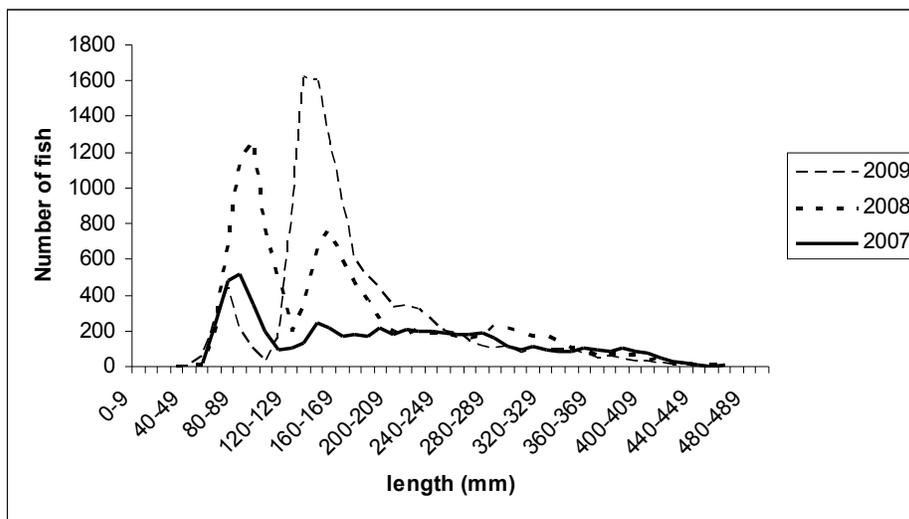


Figure 2 Length-frequency of smallmouth bass collected in the middle Yampa River by boat electrofishing, 2007-2009.

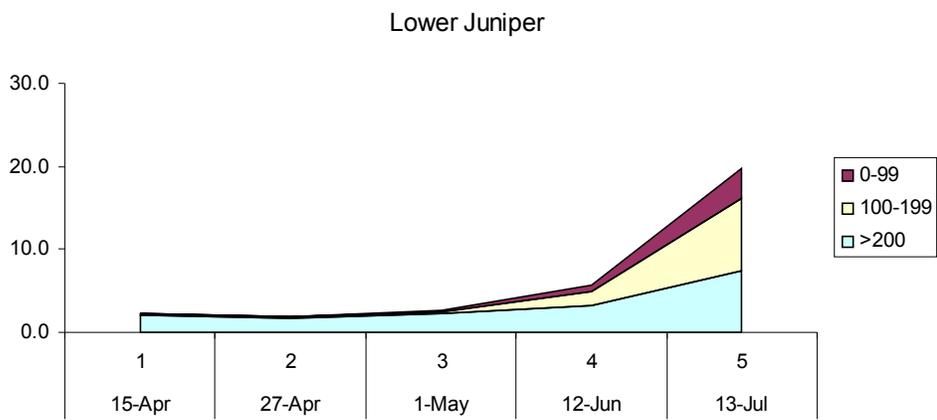
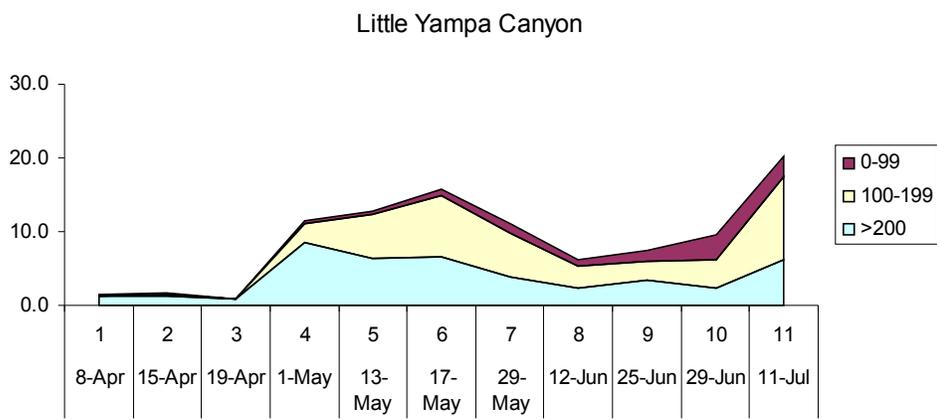
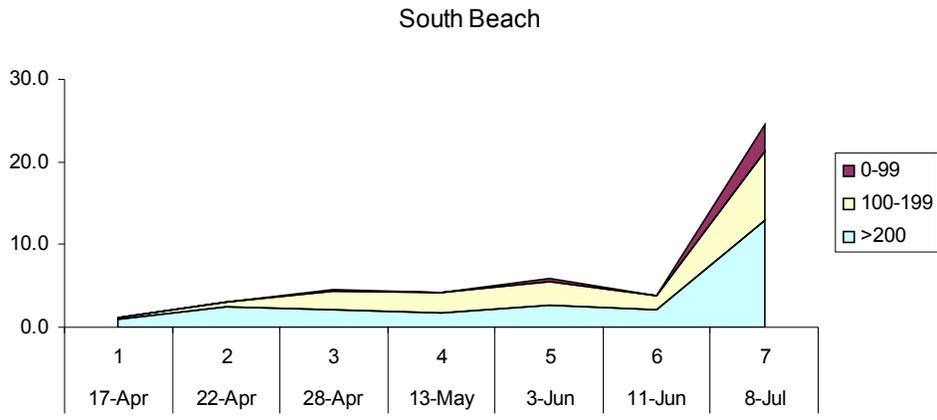


Figure 3a CPUE in each reach of the middle Yampa River, 2009.

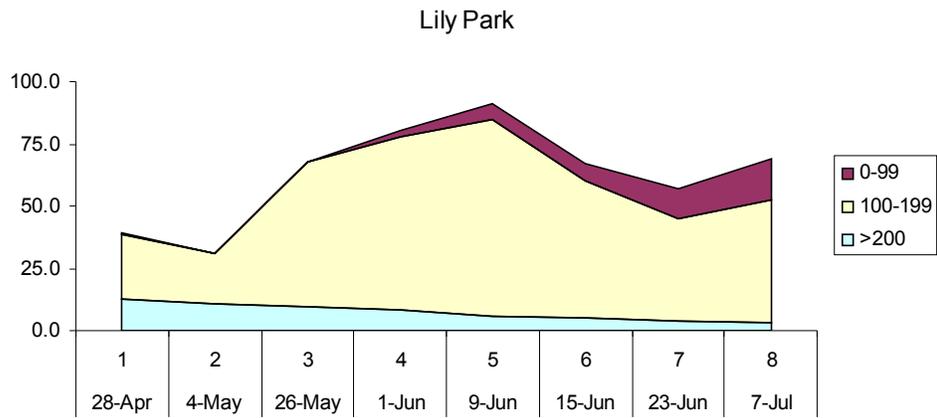
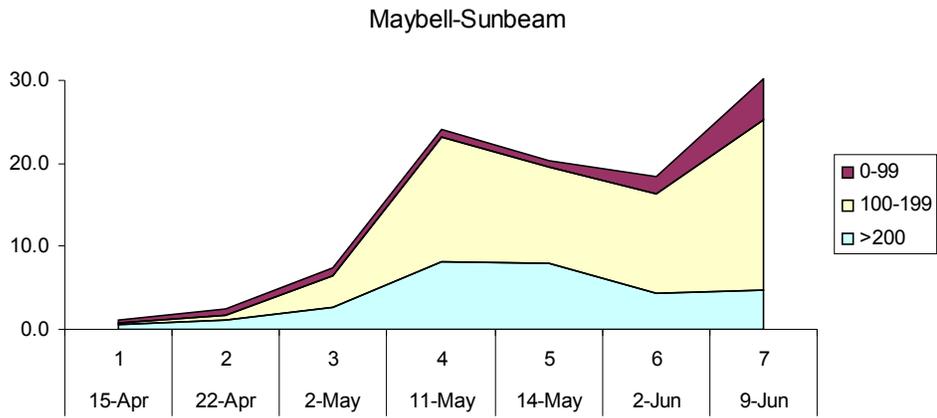


Figure 3b CPUE in each reach of the middle Yampa River, 2009.
 Note that the Lily Park y-axis scale is 3 times larger than the other reaches.

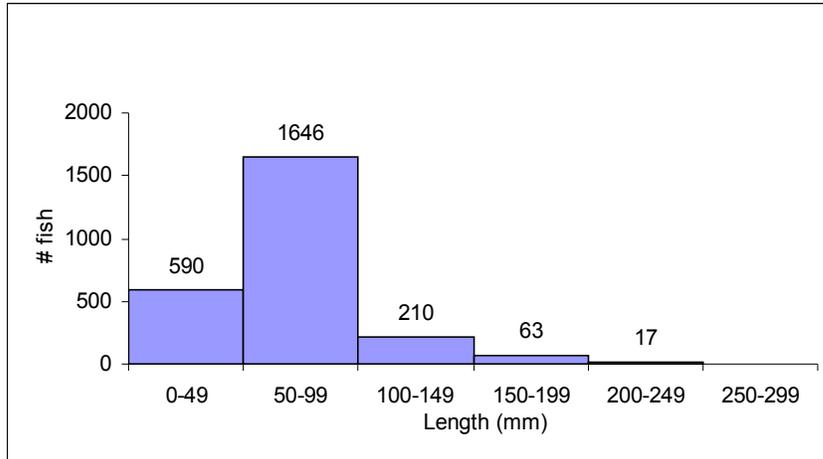


Figure 4 Length frequency of a sub-sample of smallmouth bass removed with an electric seine in the middle Yampa River, 2009.

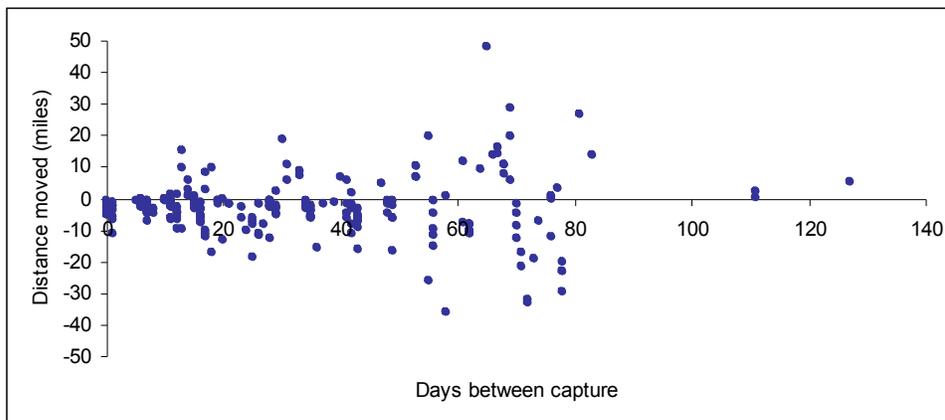


Figure 5 Distance that smallmouth bass moved between initial capture location and recapture location in 2009.

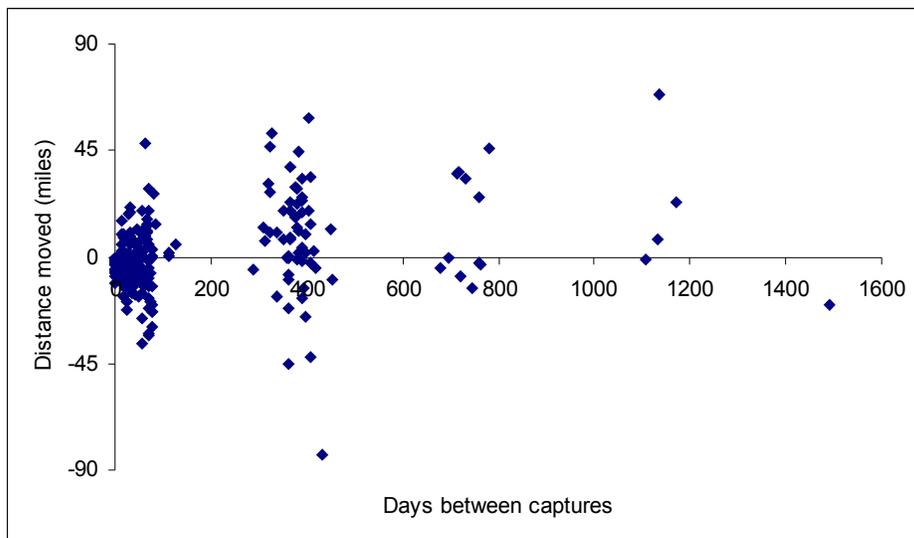


Figure 6 Previous movement history of smallmouth bass at large for 1—5 years between initial capture location and recapture location for fish recaptured in 2009.

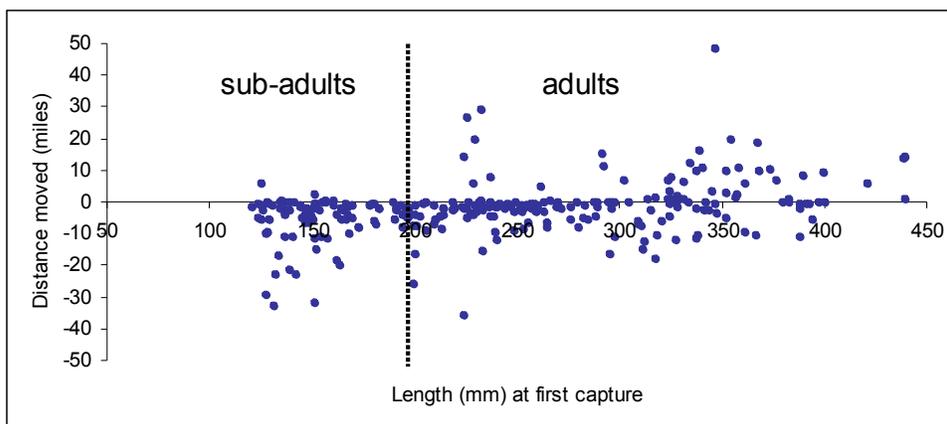


Figure 7 Distance that smallmouth bass moved between initial capture location and recapture location within the 2009 sampling season as a function of their length at first capture.