

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 and northern pike numbers can be controlled through active removal from a two sections of critical habitat for Colorado pikeminnow (*Ptychocheilus lucius*) in the Yampa River. There were two study sites: a 24-mile reach in Little Yampa Canyon downstream of Craig, Colorado and a 5-mile reach at Lily Park between Cross Mountain Canyon and the Little Snake River confluence. We sampled the river using two electrofishing boats sampling both shorelines on up to seven different sampling occasions. We also sampled by angling a portion of the study site on an additional occasion.. To evaluate removal success, we calculated the size of the population using capture-recapture methods. All bass and pike ≥ 150 mm TL were tagged and released on the first and second sample occasions and their recapture on the second and third occasions were used to estimate the population size. After the two marking occasions, all smallmouth bass were removed on subsequent occasions. During removal sampling occasions (3–8) bass larger than 250 mm were transported to either the Justice Center pond in Craig or Elkhead Reservoir and those smaller were euthanized. Northern pike were also removed from each study site and transported to Loudy Simpson Ponds in Craig as in conjunction with study # 98a by Colorado Division of Wildlife (CDOW). Most northern pike results are reported by the CDOW. An additional objective was to remove large numbers of small (young-of-year and yearling) smallmouth bass from the lower 12-mile portion of the Little Yampa Canyon site using an electric seine. Objectives listed below were met.

IV. Study Schedule: Initial Year: 1999
 Final Year: ongoing

V. Relationship to RIPRAP : (April 2004 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 (nonnative and sportfish management).

III.A.1. Implement Yampa Basin aquatic wildlife management plan.

III.A.1.b. Remove and translocate northern pike from the Yampa River.

III.A. 1.d. Remove and translocate smallmouth bass.

VI. Accomplishment of FY 2006 Tasks and Deliverables, Discussion of Initial Findings and Shortcomings:

Smallmouth bass

The goal is to remove as many smallmouth bass as possible from a 24-mile treatment reach and a 5-mile concentration reach and estimate the proportion of the population removed from each reach.

Objectives:

1. Obtain an estimate of the number of smallmouth bass in the 24-mile treatment reach in Little Yampa Canyon and a 5-mile reach in Lily Park using a mark-recapture abundance estimator.
2. Remove a large portion of the estimated population of smallmouth bass from the 24-mile treatment reach in Little Yampa Canyon and the 5-mile concentration area in Lily Park.
3. Calculate the proportion of smallmouth bass removed from each study area based on initial population size.
4. Remove large numbers of age-0 and age-1 smallmouth bass from the 12-mile treatment reach in Little Yampa Canyon. [This is the lower section of the 24-mile study reach and corresponds with the Native Fish Evaluation Study # 140].
5. Understand movement of recaptured smallmouth bass tagged in previous years or during the first (tagging) pass each year.

Northern pike

The goal is to remove as many pike as possible from critical habitat and estimate the fraction of the population removed. (Primarily accomplished by Project 98a and supplemented by this Project (#125).

Objectives:

1. Obtain an estimate of the number of northern pike that reside in the 95-mile study reach in the Yampa River using a mark-recapture abundance estimator. (This will be done by Project 98a).

2. Remove a large portion of the estimated population of northern pike from the smallmouth bass study reaches and from other reaches opportunistically as needed to support Project # 98a.
3. Calculate the proportion of northern pike removed based on initial population size. (We will assist the PI of Project 98a to accomplish this objective).

Objectives were met and preliminary results are shown in the attached tables and figures. We were able to achieve our stated objectives to obtain abundance estimates for each species and study group. We are still analyzing movement data for smallmouth bass, including recaptures of fish tagged in previous years and by other agencies. The new objective to remove young smallmouth bass in the late summer and fall was accomplished with sampling trips from July through October.

Preliminary results for 2006

Intro: Attached are summary tables and figures of some of the data collected from 2006, including some comparisons with 2004 and 2005 results. Study designs changes occurred between 2003 and 2006 (Table 1). Data provided here is preliminary and is subject to change as we continue to proof it for errors and further analyze it in detail. This information has not yet been peer reviewed. A peer-reviewed summary report will be available in early 2007.

Methods: There were two study sites: a 24-mile site in Little Yampa Canyon (LYC) downstream of Craig, Colorado, located between Roundbottom and about 1-mile upstream of Government Bridge near Lay, Colorado (river mile, RM 124–100) and a 5-mile site at Lily Park (LP) between Cross Mountain Canyon and the Little Snake River confluence (RM 55.5–50.5). The LYC site is occasionally referred to in tables or figures here as the Juniper Reach. In the year prior the 24-mile site in LYC had included a Control and Treatment site, each 12-miles long. In 2006, the Control site approach was dropped and the two sites were combined into a single 24-mile Treatment site. This was done to prevent potentially confounding results due to smallmouth bass recaptures in 2005 that showed movements and mixing of bass between the Control and Treatment reaches.

We sampled the river using two electrofishing boats sampling both shorelines. A third boat provided either additional electrofishing capabilities or provided fish handling and transport support. Prior to fish removal we obtained an estimate of the number of smallmouth bass ≥ 150 mm total length (TL) using capture-recapture techniques. Normally the marking pass is the first sampling pass of the entire study reach. During the first marking pass it appeared that most northern pike were smaller than those captured in previous years and we were unsure whether our electrofishing equipment was operating properly. For this reason we did another marking pass with the initial idea of combining the two sample passes into one marking event. We later determined that bass and pike catch rates were normal on the first pass and decided to calculate a 3-pass mark-recapture abundance estimate for smallmouth bass. For northern pike, the two marking passes were combined as one for the abundance estimate reported by Recovery Program Project 98a.. Most northern pike collection data is reported for Project 98a by Colorado Division of Wildlife and are not in this report. The number of removal passes was six at the Little Yampa Canyon site and five at Lily Park. Our goal was for at least eight removal passes, but due to

mechanical problems with two of the three boats we had fewer removal passes. We were able to continue with a reduced fleet by borrowing equipment from CDOW (*thanks LM and SH*) and by re-rigging our chase boat to serve as an electrofishing boat. Our last sampling pass was during very low flow and we used canoes and a raft to sample a portion of the study site by angling. During removal sampling occasions (3–8) bass larger than 250 mm were transported to either the Justice Center pond in Craig or Elkhead Reservoir and those smaller were euthanized. Northern pike were also removed from each study site and transported to Loudy Simpson Ponds in Craig in conjunction with study 98a. After flow became un-navigable with electrofishing boat we continued with to remove small (young-of-year and yearling) smallmouth bass from the lower 12-mile portion of the LYC site using an electric seine. This reach was a Treatment site for the Native Fish Evaluation study # 140.

Numbers of Bass: We captured a total of 2517 smallmouth bass with a biomass of 1899 lbs. at LYC and 1722 bass with a biomass of 325 lbs. at LP (Table 2). Approximately 800 bass (~1000 lbs.) were translocated alive to waters with public access for future fishing opportunities. These locations included a kid's fishing pond near the Craig Justice Center and Elkhead Reservoir. Approximately 2500 bass (~400 lbs) were euthanized because they were either less than 250 mm TL or were needed by other researchers.

Abundance estimate: To estimate abundance we used a Huggins estimator from Program MARK which is very similar to model M(t). Both estimates are provided to show this similarity. Huggins has greater flexibility than model M(t) because it allows examination of covariates such as fish length. We plan to explore some of these potential covariates with future analysis. In 2006, we estimate there were 3084 (2738–3500, 95% CI) smallmouth bass in the entire 24-miles of LYC and 894 (712–1161) in LP at the start of sampling (Table 3). Capture probabilities were 13–14%. Estimates were also calculated for the original 12-mile study sites for comparison with previous years. For 2006, we estimated 1467 (1171–1881, 95% CI) bass in the 12-mile Control and 1347 (1074–1734 95% CI) in the 12-mile Treatment.

Percent Removal: We removed 671 bass or 46% of the initial population from the 12-mile LYC Control site and reach, 642 bass or 48% of the initial population from the 12-mile LYC Treatment site, and 778 bass or 87% of the initial population of the LP site (Figure 1).

TL-Frequency: Length of smallmouth bass in each reach from 2004–2006 was generally similar among years, but the composition of length groups varied by reach. In reaches where smallmouth bass were actively removed (LYC and LP treatment reaches), the population was comprised of mostly smaller bass (<250 mm TL). At LP there were few bass \geq 250 mm. In the LYC control reach where bass were not removed until this year, the population was comprised of mostly larger bass (>250 mm) (Figures 2–4). In 2006, length frequency of smallmouth bass was relatively constant at both study sites during the first three sample passes and changed on subsequent passes with fewer large fish and the addition of smaller fish (Figures 5 and 6).

CPUE: Catch per unit effort (CPUE) provides a potential surrogate to changes in population size over time. There was little change in CPUE of smallmouth bass \geq 250 mm TL on all passes in 2003 before removal started. In subsequent years, CPUE remained high and constant in the LYC control and generally declined in the LYC and LP Treatment reaches after the start of removal

each year (Figure 7). In 2006, although CPUE generally declined for bass ≥ 250 mm, the number of bass captured on each pass varied and even increased on the last few passes. We attribute this increase to smaller fish recruiting to the gear (Table 2 and Figure 8). Even with increased catch, biomass collected on each pass declined at LYC and remained low and constant at LP (Figure 8). The abundance of small bass at LP and large fish at LYC is apparent in the number of fish captured on all passes in each river mile of the two sites. Bass less than 300 mm comprise most of the community and almost all of the biomass at LP while number and biomass of bass of those sizes were much less common in LYC and most of those were in the lower 12-miles (Figure 9).

Elkhead escapees and other agency recaptures: In 2006, bass ≥ 250 mm that were removed from the river were stocked in the Justice Center pond between 9 May and 20 June. We stocked fish there to avoid stocking Elkhead Reservoir during runoff and Elkhead Dam Construction to prevent possible re-invasion of stocked fish. Elkhead was stocked with bass from 6 June through 14 July after runoff. We recaptured 84 bass in 2006 that escaped Elkhead Reservoir. Year of escape is unknown. Of the 84 recaptured, escaped bass, four were stocked into Elkhead in 2003, 36 were stocked in 2004, and 44 were stocked in 2005. None of the bass stocked in 2006 were recaptured in the river in 2006. In 2006, we also recaptured six smallmouth bass originally tagged about 1-mile upstream of our LYC site by CDOW in April 2006. They had moved 2–9 miles downstream into our LYC site when we recaptured them 1-4 weeks after tagging. We plan to further analyze and describe these and other recapture records within and between years for a better understanding of bass home range and movements.

Spawning Observations: To determine spawning period for smallmouth bass we watched closely for sexual condition of bass, worn ventral portions of medial fins (indicating nest clearing), males guarding nests, and nest beds in low-velocity areas. Using these criteria we observed spawning between 19 June and 28 July although most of the evidence was collected between 19 June and July 1. Ripe, spawning females were captured at an island-backwater complex on 19 June, we removed males guarding nests on 30 June, and bass with worn median fins were captured on 3 July. We actively removed young from nests on 30 June, 1 July and 28 July. Locations ranged from throughout the LYC site, RMs 103 to 121. No spawning characteristics, behavior, or nests were observed at LP. Morning temperatures taken around 0900–1000 hrs each day during spawning ranged 16–21^o C. Another approach to determining spawning date is to back-calculate daily growth increments in otoliths of YOY bass. Preliminary results of this technique show promise.

Small bass removal: From mid-July through October, we sampled the lower 12-miles of the LYC site with an electric seine a total of 32.5 hours and removed a total of 7909 small bass. These fish were primarily YOY less than 100 mm TL. CPUE was 243 bass/hour.

Preliminary Conclusions: Based on declining catch rates of large-sized smallmouth bass and different catch rates and lengths over time in control and treatment reaches, there is compelling evidence that large numbers of large smallmouth bass were reduced in the Treatment reaches each year. Unfortunately, removal each year was potentially compromised by conditions that allowed re-invasion and confounded results. In 2004 and 2005, study sites were small and allowed mixing and invasion of the treatment site by bass from the control site and from a bass concentration reach immediately upstream of our study sites. To reduce these confounding

effects the following changes were made to study design in 2006. First, reach size was expanded and the control reach was eliminated to prevent mixing between control and treatment sites and second, removal of bass was expanded into the adjacent upstream reach. However, a screen failure in 2005 and unconstrained outflow in 2006 from Elkhead Reservoir during construction allowed bass to escape over the spillway. These bass were found in the study reach in both 2005 and 2006, further confounding results. Elkhead construction is now complete and most outflow is screened; therefore, we expect few bass escapees and better conditions to evaluate removal in 2007. Prior to the next field season we plan to analyze this re-invasion and movement data to better understand and quantify these confounding effects in previous years.

VII. Recommendations:

1. Continue examining techniques that increase capture probabilities; otherwise, maintain a large number of removal passes based on capture probability and the desired rate of removal.
2. We suggest at least 6 or more removal passes to achieve a measurable reduction in bass numbers.
3. Establish contingency plans and have back-up equipment (boats, trucks, boat motors, electrofishing equipment) available in case of equipment failure.
4. Continue to provide consistent information and public relations messages for agencies and the affected public.

VIII. Project Status:

The project accomplished an intensive removal program within the study sites and assisted with removal of northern pike in a study site of the Colorado Division of Wildlife. This project and several other nonnative fish management projects will be reviewed in a workshop scheduled for Dec 11-13, 2006 and this work will be revised based on those finding and discussions.

IX. FY 2006 Budget Status

- A. Funds Provided: \$265,446
- B. Funds Expended: \$246,852.95
- C. Difference: \$18,593.05
- D. Percent of the FY 2006 work completed, and projected costs to complete: 95% completed, cost to complete 18,593
Most of the remaining money is earmarked for major boat motor maintenance and repair, jet boot purchase to create a back-up motor and equipping new pickups with field accessories (i.e. toppers, racks).
- E. Recovery Program funds spent for publication charges: \$0

X. Status of Data Submission (Where applicable): Data will be submitted with the summary report.

XI. Signed: John Hawkins 12/06/06
Principal Investigator Date

Submitted electronically.

Version control: submitted 12/06/06 by JAH

Table 1— Summary of sample design for smallmouth bass studies in the middle Yampa River, 2003–2006.

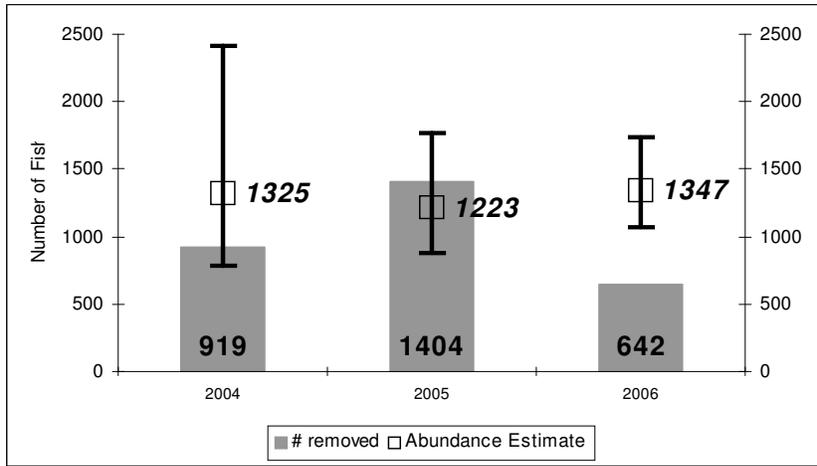
	2003	2004	2005	2006
<u>Study Site locations (river miles):</u> Little Yampa Canyon Control Little Yampa Canyon Treatment: Lily Park Treatment:	105–111 111-117 none	112–124 100–112 50.5–55.5	112–124 100–112 50.5–55.5	none 100–124 50.5–55.5
<u>Study Site lengths (miles):</u> Little Yampa Canyon Control Little Yampa Canyon Treatment: Lily Park Treatment:	6 6 None	12 12 5	12 12 5	none 24 5
Population estimate (mark-recapture) Size of bass used for estimate.	5-pass 150 mm	2-pass 150 mm	2-pass 150 mm	3-pass 150 mm
<u>Number of marking passes in:</u> Little Yampa Canyon Control Little Yampa Canyon Treatment: Lily Park Treatment:	5 5 none	5 1 1	4 2 1	none 2 2
<u>Number of removal passes in</u> Little Yampa Canyon Treatment Lily Park Treatment	1 none	9 5	7 5	6 5
<u>Length of bass (mm) :</u> Moved to reservoirs: Euthanized:	none none	all none	≥ 250 mm < 250 mm	≥ 250 mm < 250 mm
Locations where bass were moved:	Elkhead Reservoir on last pass	Elkhead Reservoir	Elkhead Reservoir	Justice Center pond, Elkhead
Significant Information	Primary purpose was to determine bass pop. size and catch rates, minimal removal on last 2 passes	Removal Starts; sites expand to 12-miles due to bass movement; Lily Park added as study site.	Elkhead construction starts, screen failure, bass escapees documented ; start lethal removal of small bass < 250 mmTL.	Elkhead construction continues, unscreened releases, bass escapees documented

Table 2– Number, biomass, and disposition of smallmouth bass captured at 24-mile Little Yampa Canyon and 5-mile Lily Park study sites in the middle Yampa River, 2006. Euthanized category includes bass less than 150 mm on passes 1 and 2, bass less than 250 mm on remaining removal passes, and bass provided to CDOW for additional research.

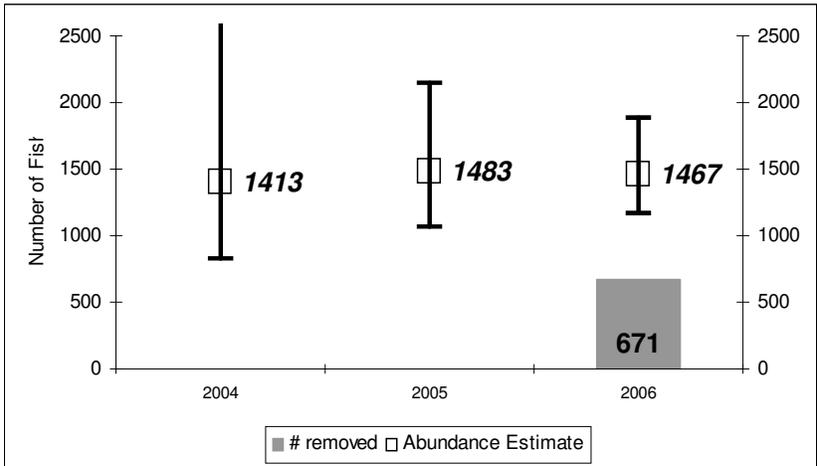
Pass	Date	Marked & Released in River	Moved to ponds or reservoirs	Euthanized	Total fish
<u>24-mile Little Yampa Canyon</u>					
1	Apr 20–24	249 348 lbs	0	40 1 lb	289 349 lbs
2	May 3–8	299 351 lbs	0	40 3 lbs	339 354 lbs
3	May 17–25	2 2 lbs	373 492 lbs	249 51 lbs	624 545 lbs
4	Jun 3–5		89 104 lbs	90 11 lbs	179 115 lbs
5	Jun 16–19		120 173 lbs	112 21 lbs	232 194 lbs
6	Jun 27–30		117 142 lbs	369 77 lbs	486 219 lbs
7	Jul 1–4	4 5 lbs	36 48 lbs	245 28 lbs	285 82 lbs
8	Jul 12–14		18 25 lbs	65 18 lbs	83 43 lbs
Totals		554 707 lbs	753 983 lbs	1210 209 lbs	2517 1899 lbs
<u>5-mile Lily Park</u>					
1	Apr 25	151 46 lbs	0	35 2 lbs	186 48 lbs
2	May 4	169 49 lbs	0	46 3 lbs	215 52 lbs
3	May 9		28 20 lbs	199 33 lbs	227 53 lbs
4	Jun 6		12 9 lbs	387 58 lbs	399 67 lbs
5	Jun 15		16 15 lbs	425 53 lbs	441 68 lbs
6	Jun 20		11 9 lbs	243 27 lbs	254 36 lbs
Totals		320 94 lbs	67 52 lbs	1335 177 lbs	1722 324 lbs

Table 3—Abundance estimates for smallmouth bass ≥ 250 mm TL in each study site of the middle Yampa River, 2004–2006. Years 2004 and 2005 estimates were based on 2-pass mark-recapture and 2006 was based on 3-pass mark-recapture. CPUE (# fish/hr) calculated for bass of all sizes captured.

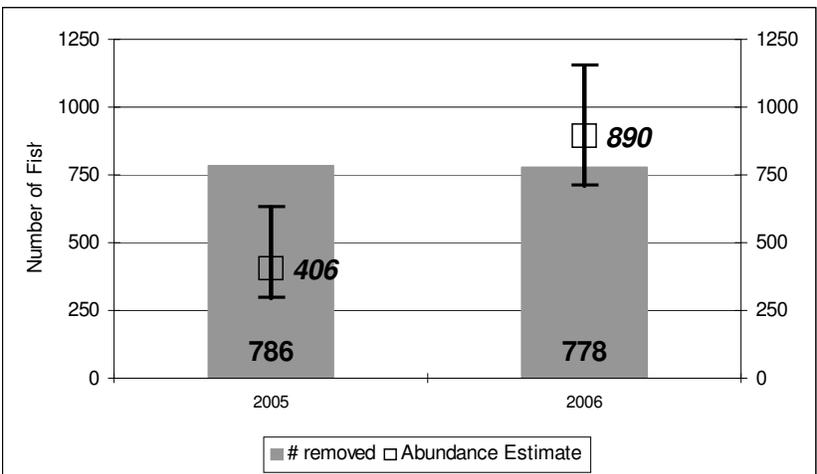
Year	Abundance	95% CI	SE	CV	Model	Capture probability	Marked # fish on 1st pass	# fish on 2nd pass	# of recaps	EL Effort Hours	# all bass	CPUE #fish/hr
Little Yampa Canyon-12-mile Control (RM 124--112)												
2004	1413	825--2591	430.1	30%	M(t) Chao	12%	73	171	8	65	574	9
2005	1483	1065--2145	269.8	18%	M(t) Chao	15%	148	228	22	57	926	16
2006	1467	1171--1881	179.2	12%	M(t)	11%	--	--	--	--		
Little Yampa Canyon-12-mile Treatment (RM 112-100)												
2004	1325	788--2414	395.1	30%	M (t) Chao	17%	53	220	8	157	1600	10
2005	1223	884--1765	220	18%	M (t) Chao	12%	183	152	22	143	2508	18
2006	1347	1074--1734	166.7	12%	M(t)	11%	--	--	--	--		
Little Yampa Canyon 24-miles, combined Control & Treatment (RM 124--100)												
2006	3079	2737--3496	193.2	6%	M(t)	14%	246	295	35	195	2517	13
2006	3084	2738--3500	193.6	6%	Huggins	14%	--	--	--	--		
Lily Park 5-mile Treatment (RM 55.5--50.5)												
2004	703	244--2398	470.9	67%	M(t) Chao	6%	31	43	1	26	1346	52
2005	406	293--628	81.8	20%	M(t) Chao	9%	153	35	13	35	2115	60
2006	890	710--1153	111.6	13%	M(t)	13%	148	162	14	37	1722	47
2006	894	712--1161	112.9	13%	Huggins	13%	--	--	--	--		



Little Yampa Canyon
Treatment
12-miles



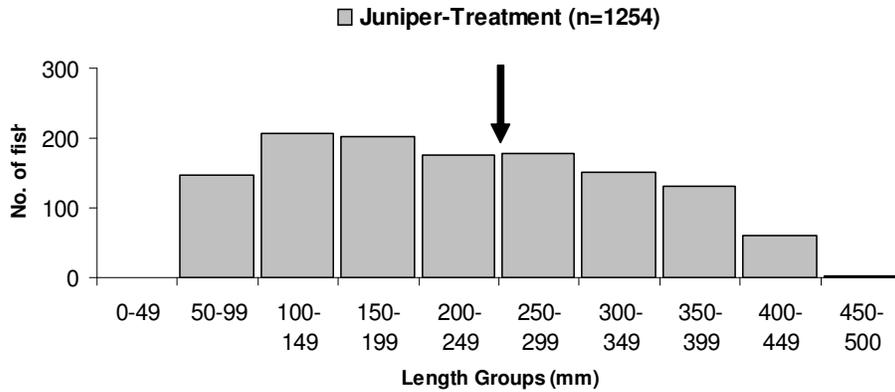
Little Yampa Canyon
Control
12-miles



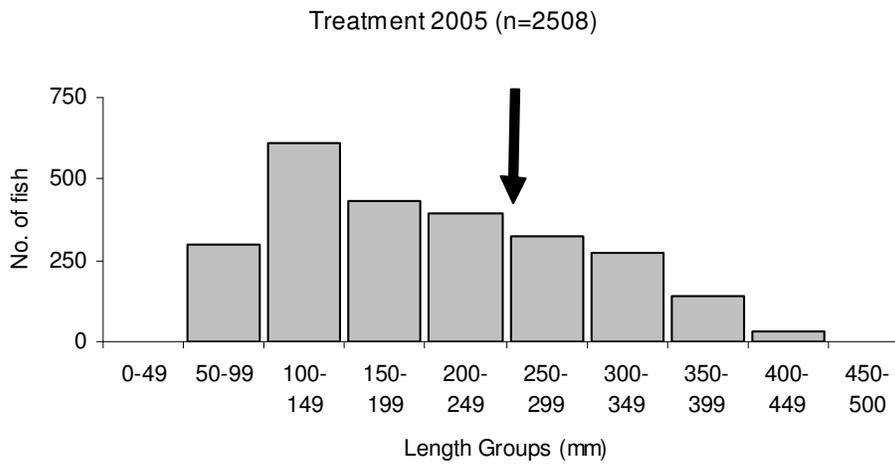
Lily Park
Treatment
5-miles

Figure 1—Abundance estimates, 95% CI, and number of smallmouth bass ≥ 150 mm TL removed from study sites in middle Yampa River, 2004--2006.

2006



2005



2004

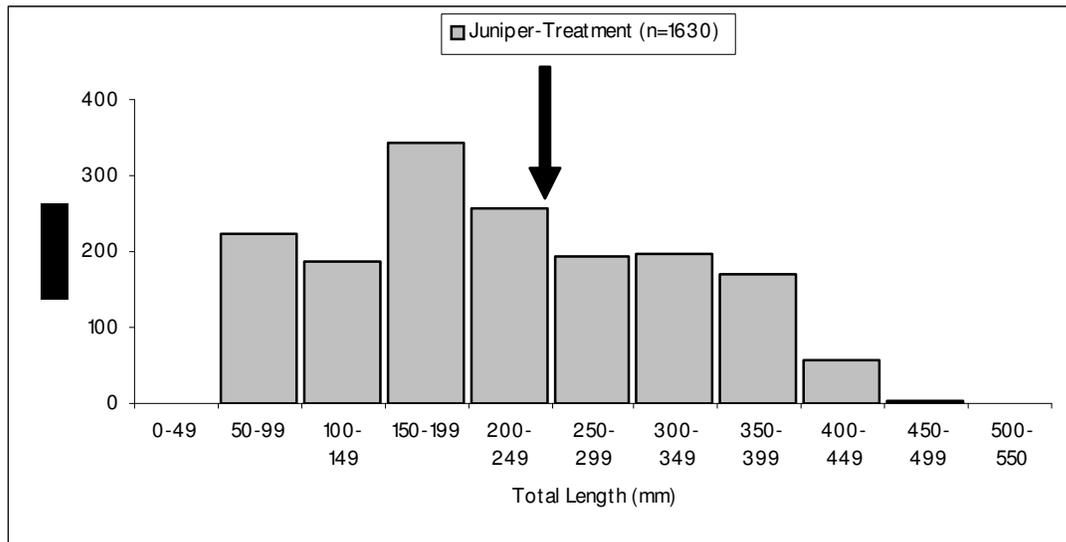


Figure 2—Length frequency of smallmouth bass captured in Little Yampa Canyon Treatment reach, Yampa River, 2004–2006. Smallmouth bass ≥ 250 mm (10 inches; arrow) TL were moved to local ponds or reservoirs.

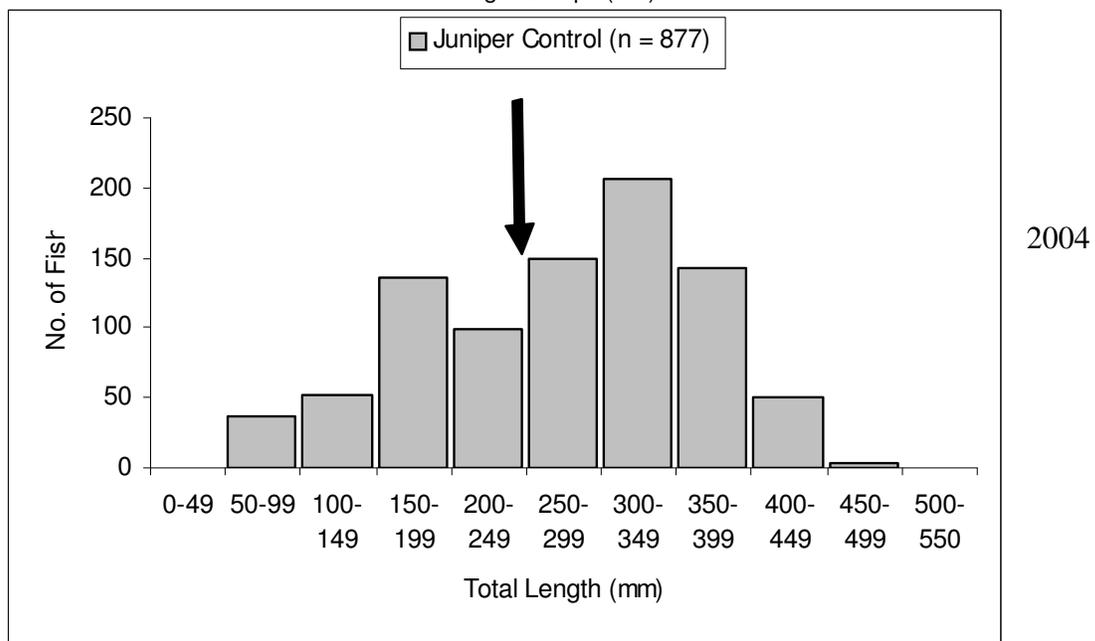
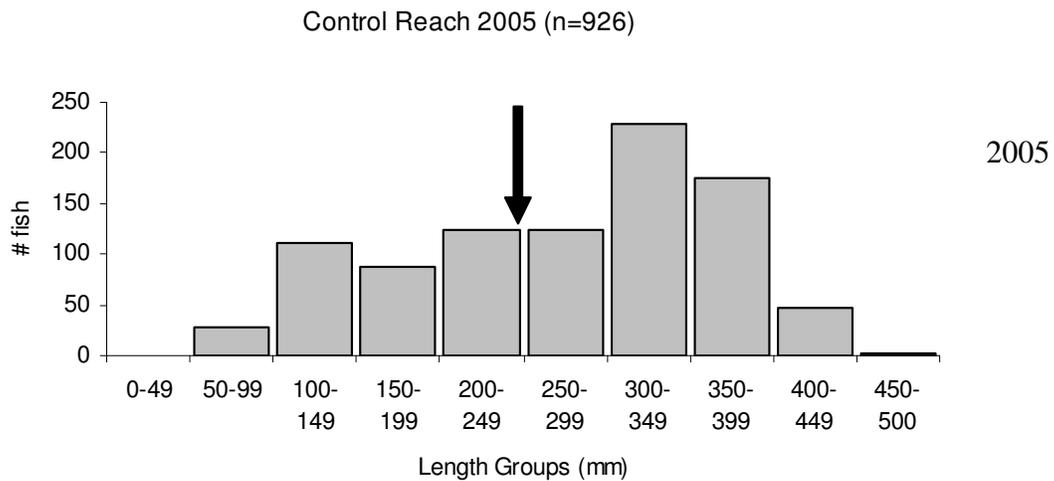
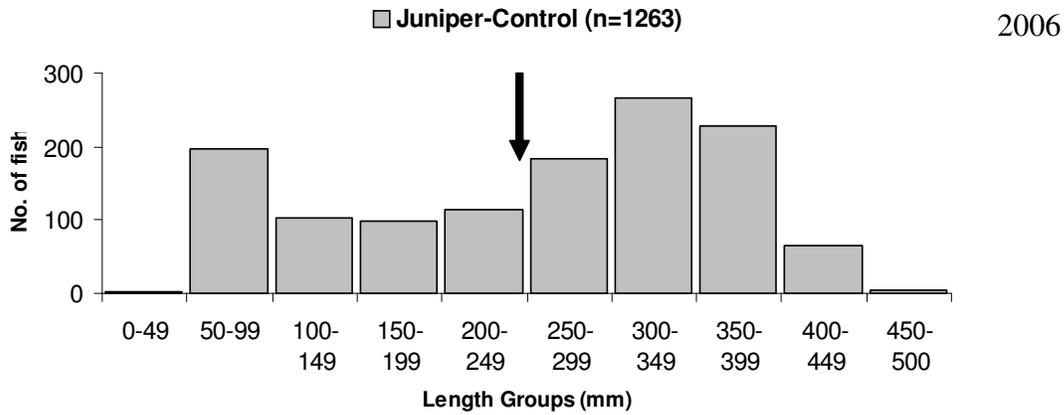
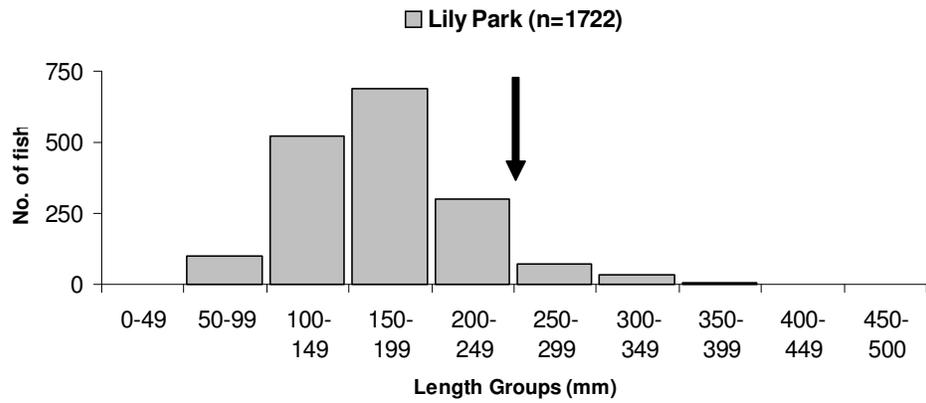
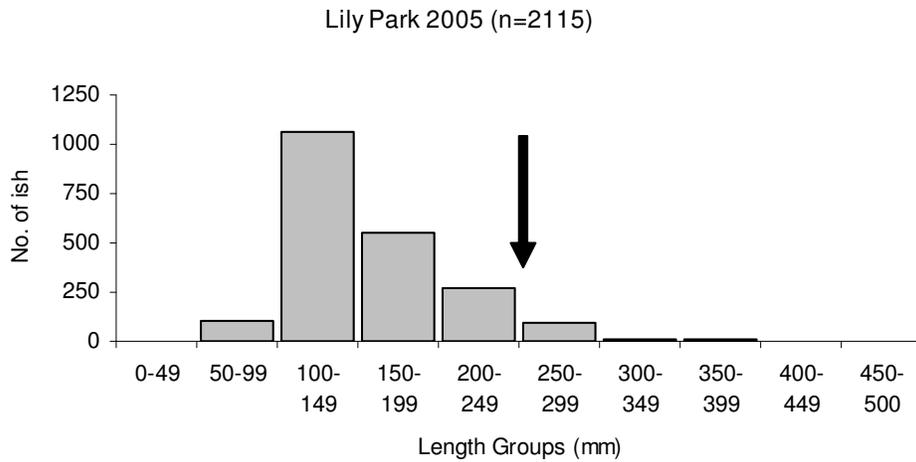


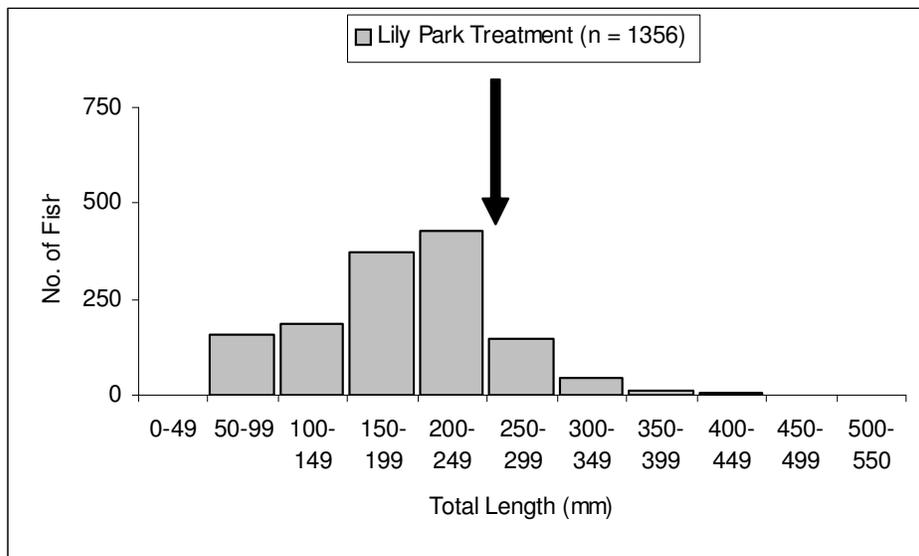
Figure 3—Length frequency of smallmouth bass captured in Little Yampa Canyon Control reach, Yampa River, 2004–2006. Smallmouth bass ≥ 250 mm (10 inches; arrow) TL were moved to local ponds or reservoirs.



2006



2005



2004

Figure 4—Length frequency of smallmouth bass captured in Lily Park treatment reach, Yampa River, 2004–2006. Smallmouth bass ≥ 250 mm (10 inches; arrow) TL were moved to local ponds or reservoirs.

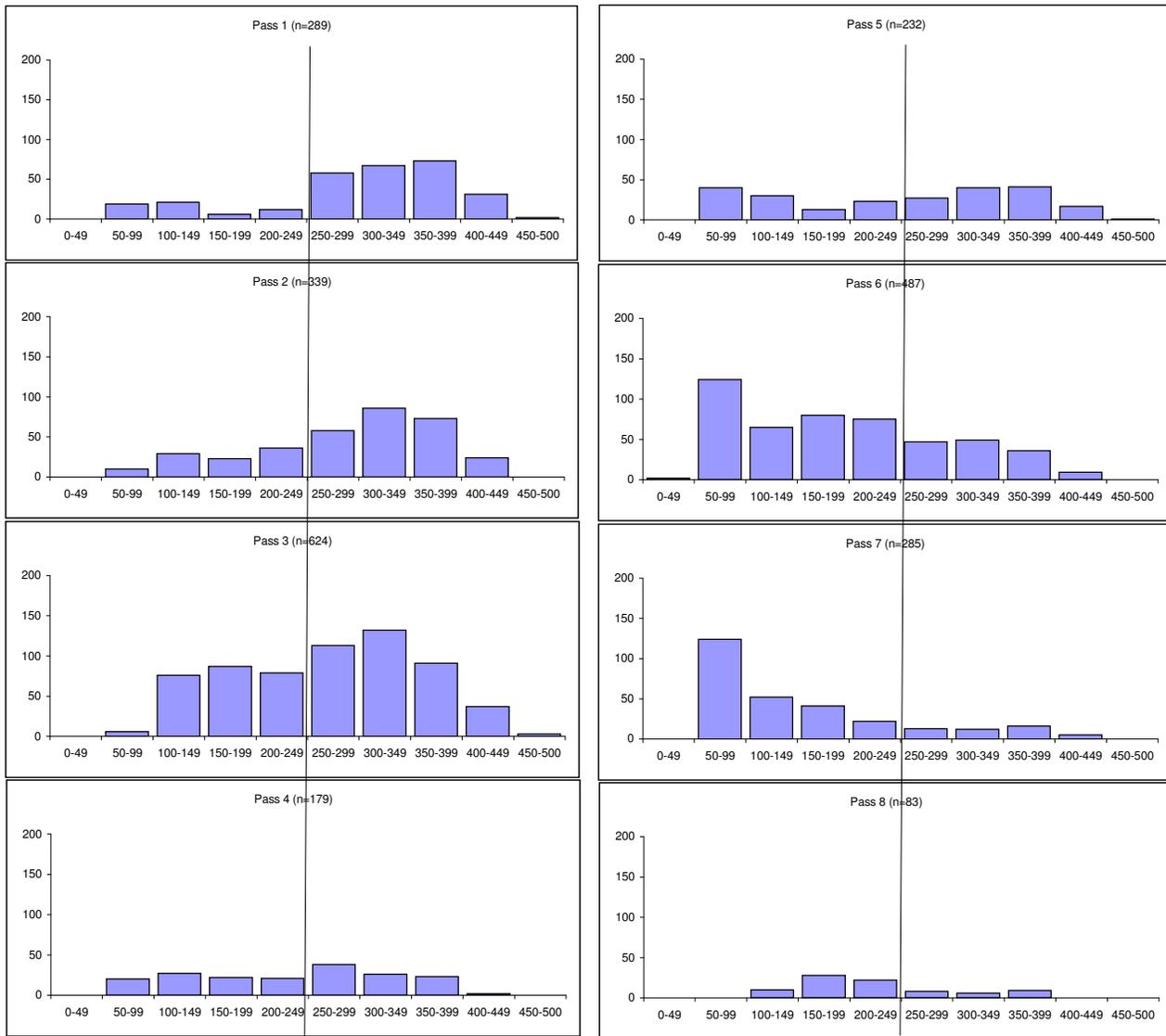


Figure 5-- Length-frequency of smallmouth bass captured on each pass in the 24-mile Treatment reach of Little Yampa Canyon, Yampa River, 2006. Bass \geq 250 mm TL were moved to local ponds or reservoirs.

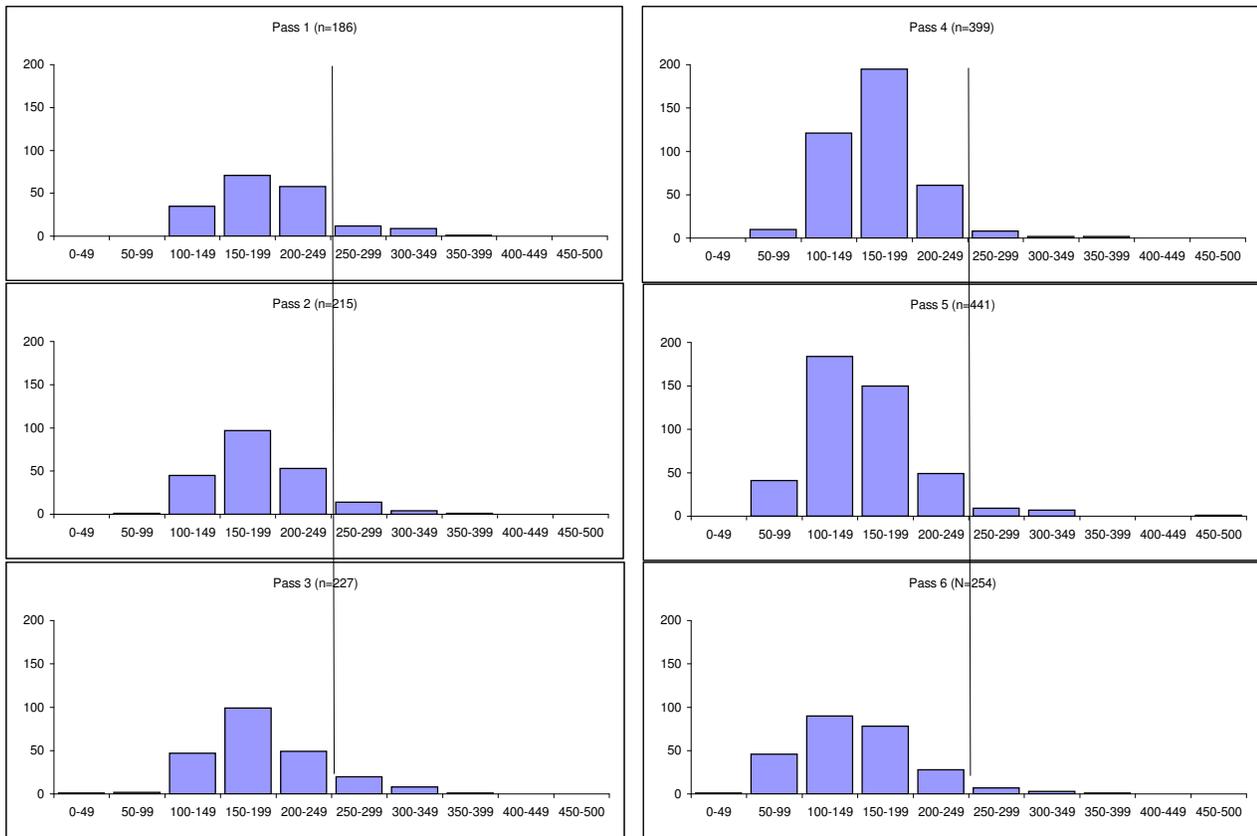


Figure 6-- Length-frequency of smallmouth bass captured on each pass in 5-mile Treatment reach of Lily Park, Yampa River, 2006. Bass ≥ 250 mm TL were moved to local ponds or reservoirs.

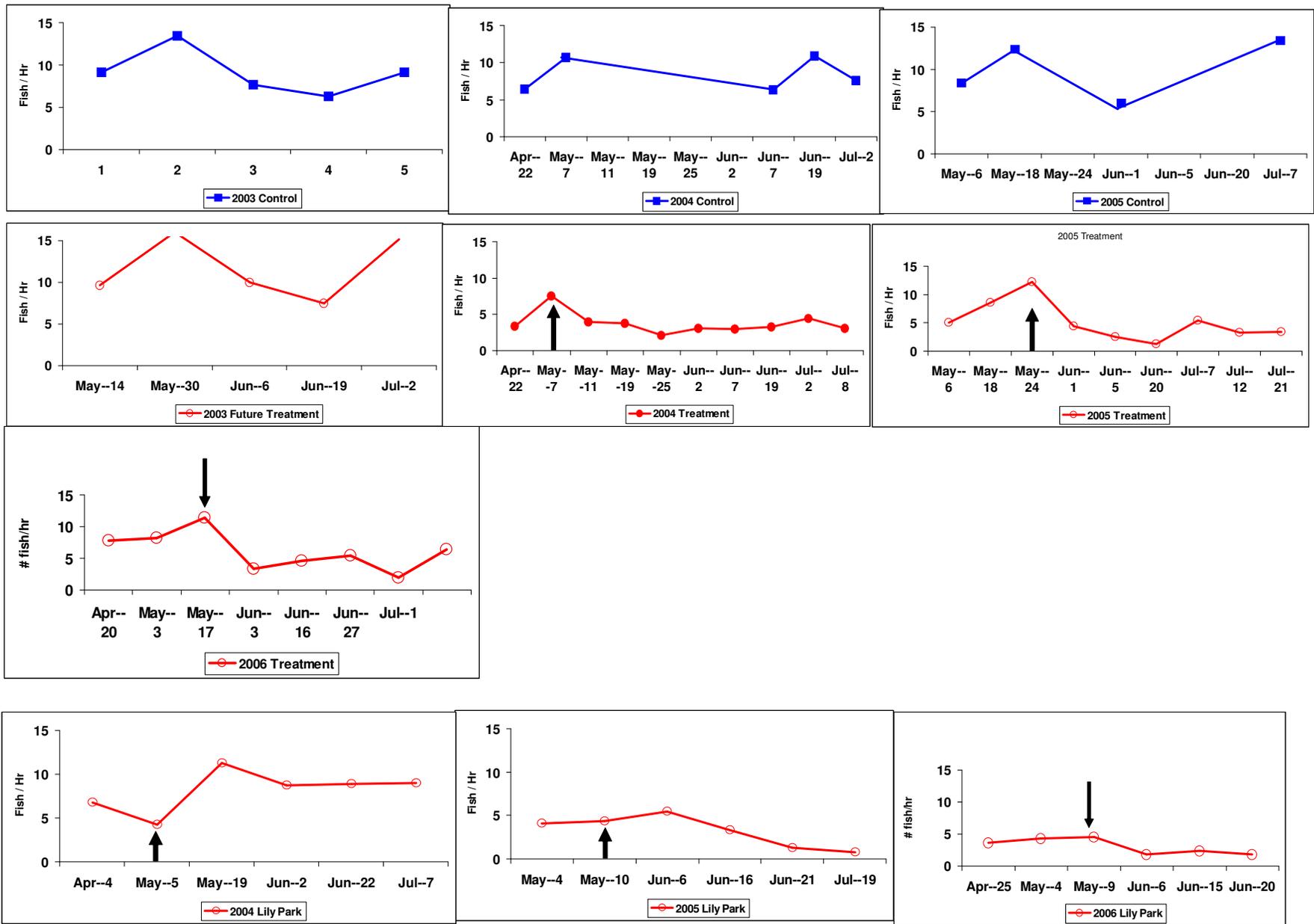


Figure 7—Catch per unit effort (CPUE) for smallmouth bass ≥ 250 mm in Little Yampa Canyon and Lily Park sites in the middle Yampa River, 2003–2006. Arrows denote when removal started in each Treatment reach for each year. No removals were done in 2003.

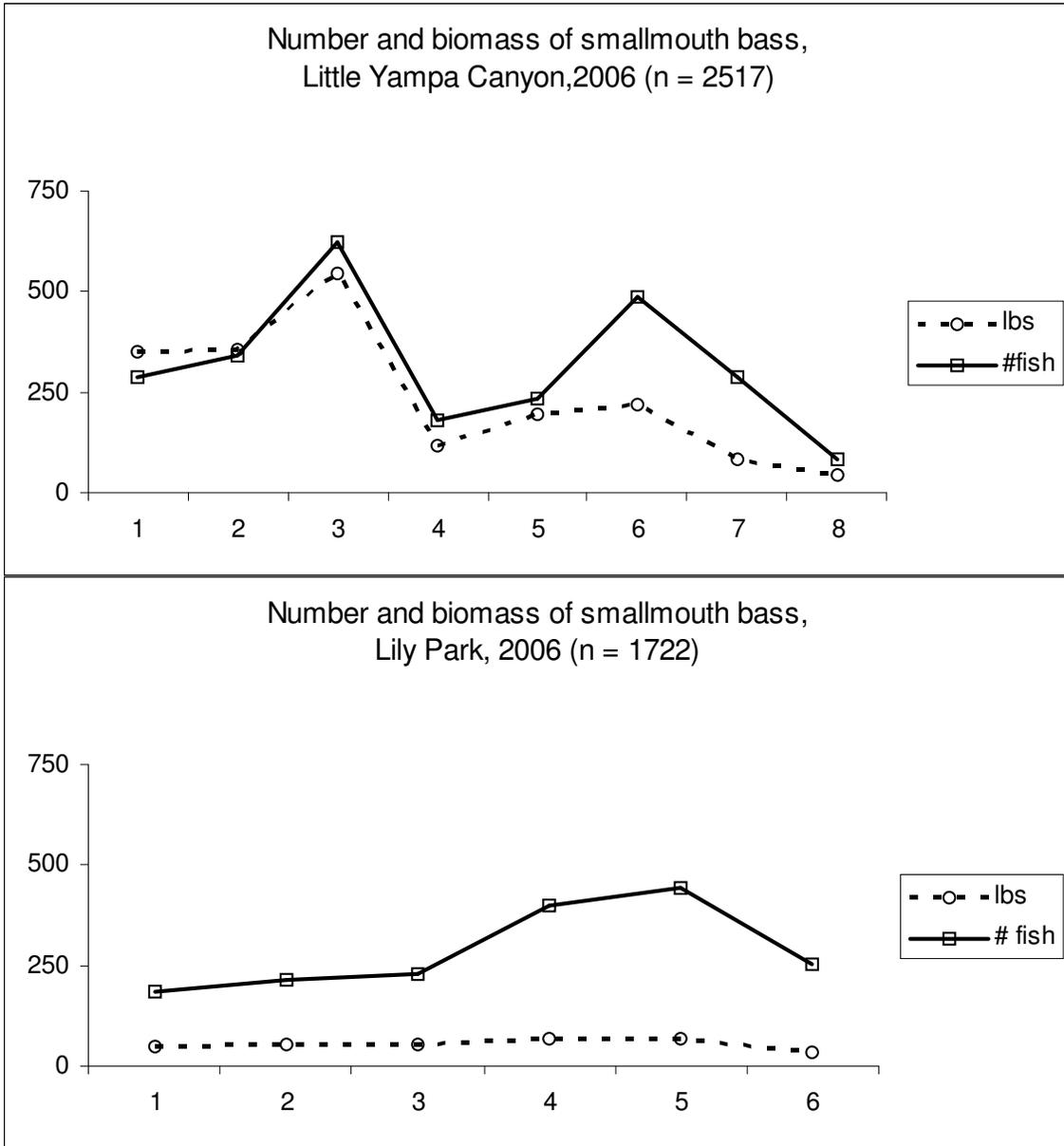
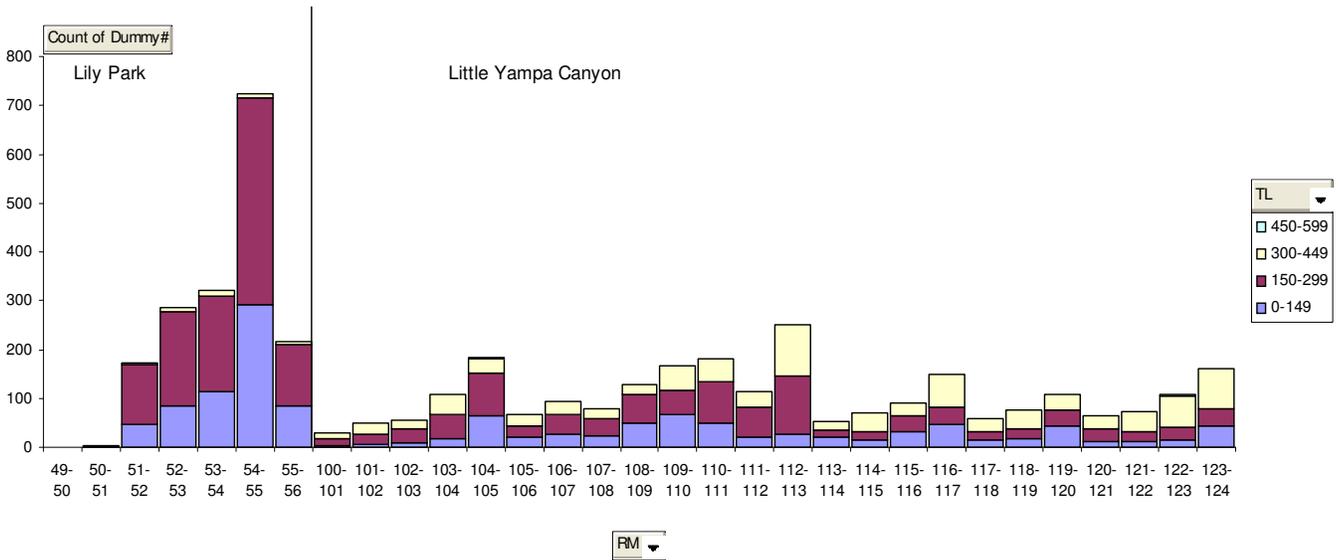


Figure 8—Number and biomass (lbs) of smallmouth bass of all sizes captured each sampling pass in Little Yampa Canyon and Lily Park sites of the middle Yampa River, 2006.

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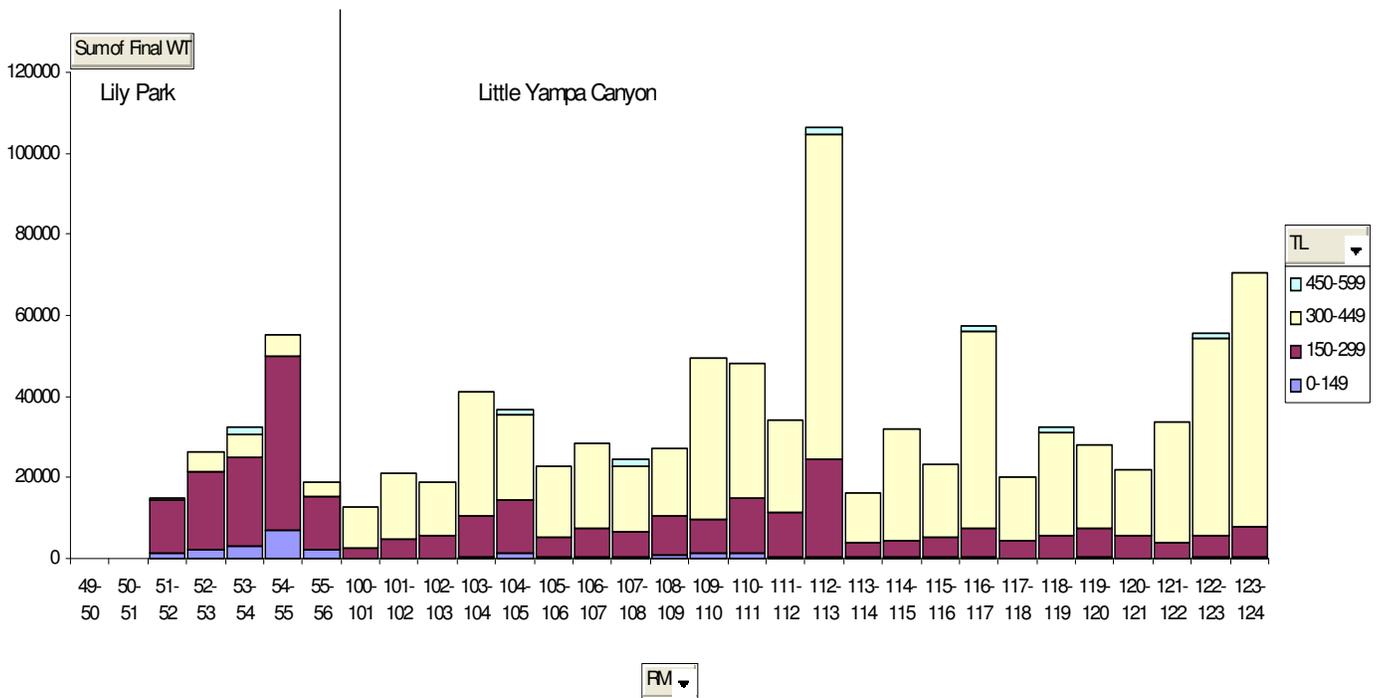


Figure 9—Number (upper) and biomass (lower) of smallmouth bass captured per mile on all sample passes combined in the middle Yampa River, 2006.

