COLORADO RIVER RECOVERY PROGRAM
FY 2011 ANNUAL PROJECT REPORT

RECOVERY PROGRAM
PROJECT NUMBER: 140

I. Project Title: Evaluating effects of non-native predator removal on native fishes in the Yampa River, Colorado

II. Principal Investigator(s): Larval Fish Laboratory
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III. Project Summary: Control actions for several non-native fish predators have been implemented in rivers of the Upper Colorado River Basin but effects of those removals on restoration of native fishes is unknown. Understanding the response of the native fish community to predator removal is needed to understand if removal programs are having the desired effect. The objective of this project is to document fish community changes in response to predaceous fish removals in a reach of the Yampa River, Colorado. Compared to early sampling (2003-2004) conducted in this project native species richness has increased as has frequency in samples and abundance of native fishes, particularly since 2008. Comparison of native fish frequency and abundance in a control and treatment reach suggested that both non-native predator removals, as well as environmental effects due mostly to higher water, are responsible.

IV. Study Schedule: *2003, ongoing*

V. Relationship to RIPRAP:

REDUCE NEGATIVE IMPACTS OF NONNATIVE FISHES AND SPORTFISH MANAGEMENT ACTIVITIES (NONNATIVE AND SPORTFISH MANAGEMENT)

Green River Action Plan: Yampa and Little Snake Rivers

III.A.1. Implement Yampa Basin aquatic wildlife management plan to develop nonnative fish control programs in reaches of the Yampa River occupied by endangered fishes. Each control activity will be evaluated for effectiveness and then continued as needed.

Green River Action Plan: Mainstem

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

III.A.2.c Evaluate the effectiveness (e.g., nonnative and native fish response) and develop and implement an integrated, viable active control program.

VI. Accomplishment of FY 2011 Tasks and Deliverables, Discussion of Initial Findings and

Shortcomings:

In 2011, we sampled control and treatment reaches of Little Yampa Canyon and in Lily Park, with an effort similar to 2010 and the past. In all, 167 different samples were collected to document native fish response. Of those, 73 were collected in the treatment reach of Little Yampa Canyon (where small-bodied smallmouth bass were removed from nearshore habitat) and 46 samples were collected from the control reach (where no small-bodied smallmouth bass were removed). The remainder of samples were scattered throughout South Beach, Juniper, and Lily Park reaches. Total of 22 isolated pool samples were among the total as well. All data are not yet available because we only recently finished sampling in late October and samples remain to be sorted and data analyzed. As usual, a presentation of 2011 data will be given at the non-native fish workshop in early December 2011. Native fishes were even more widespread and abundant in samples in 2011 than in 2008-2010. This is compared to 2003-2007, when few native fishes were found, and those mostly only in isolated pools with few predators (Figure 1). In isolated pools, native fishes were most abundant when abundance of smallmouth bass was lowest (Figure 2).

Number of native fishes in samples collected in main channel samples of the Little Yampa Canyon reach of the Yampa River continued to show a positive response through time in the period 2003-2011 (Fig 1), with the increase in 2011 being the largest on record to nearly 13% of all fishes captured. This is in contrast to 2003 when only a single native fish, speckled dace *Rhinichthys osculus*, was captured (n = 4 individuals). In 2004 the number increased to two species, and from 2005-2007, four were captured. In 2008, six native fishes were collected, in 2009-2010 five, and in 2011 a t toal of seven native fishes were collected, adding mountain whitefish and mountain sucker *Catostomus platyrhynchus* (first detection in the reach).

The % of native fishes in samples has also increased since intensive removal of adult and age-0 bass commenced in 2005 (Figure 3). While the total % native fish remains low relative to samples collected in the early 1980's, the 2008-2011 levels represent a five-fold or more increase over 2007 and before.

Perhaps most importantly, frequency of native fishes in samples has also increased, particularly for roundtail chub *Gila robusta*, and they are present in substantially larger numbers in the treatment reach where Age-0 bass are removed compared to the control reach where no Age-0 bass are removed (Figure 4). We feel that higher frequencies are more important than absolute abundance (e.g., Figure 3) because the abundance can be biased by one or a few very large samples. A higher frequency of native fishes in samples supports the idea of a broader distribution of those taxa. This is especially true in the treatment reach where sampling locations for native fish response are often the same ones as those targeted for bass removal (sites where bass numbers are high), and thus, these data may be conservative for occurrence and abundance. We interpret these collective patterns as a river-wide response of increased native fish abundance in 2008 and after, perhaps because of higher stream flows and reduced water temperatures. Those same conditions promote later smallmouth bass spawning and slower growth (see below), particularly in years such as 2010 and 2011, which may inhibit or reduce predation by that species on native fishes. The larger proportion of native fish in samples in the treatment reach compared to the control is thought a response to removal of large numbers of Age-0 smallmouth bass each year.

An additional aspect of work in FY-2010-2011 was an evaluation of sampling efficiency of our one-pass sampling in specific habitat types. To accomplish that, we sampled in a typical fashion in several locations one or more times. Each time at each site, we sampled with a single pass of electric seine sampling, and then repeated that sampling 1-2 more times to determine removal efficiency of our sampling. That sampling showed that our single pass sampling was effective; more than 60% of young smallmouth bass were removed on the first sampling pass (the typical removal level) relative to the total removed in up to three sampling passes. As is customary, we plan to report results of 2011 sampling at the December Non-native Fish workshop in Grand Junction or at the Researchers Meeting in January 2012.

We continue to make excellent progress on analysis of otoliths of smallmouth bass collected from the Yampa River. The goal is to better understand effects of streamflow and water temperature on timing and duration of smallmouth bass spawning and hatching dates and growth rates. Results of otolith analysis (Figure 5) show that smallmouth bass in the Yampa River study area first hatched well after spring peak flows declined but varied from early June to early July across years 2005-2009. A main controlling factor to smallmouth bass reproduction appears to be water temperature. For example in the lower flow year 2007 when water temperatures warmed earlier, smallmouth bass hatching began as early as 4 June. In contrast, first hatching of smallmouth bass in 2008, a higher flow year where water temperatures remained colder later, occurred as late 2 July. Even though timing of hatching varied across years, a consistent environmental cue to spawning appeared to be the regular onset of water temperatures of 16°C or higher. Peak hatching in the Yampa River occurred about 2-3 weeks after first bass hatched, although in 2009 the peak was only about 10 days after hatching first started. The duration of the spawning season was relatively brief, usually about 4-5 weeks in most years. Results of hatching date distributions related to flow and water temperature regimes was presented at the Non-native Fish Workshop in 2009 as well as at the Upper Colorado River Researchers Meeting (2010), the Colorado-Wyoming Chapter of the American Fisheries Society (2009), and the Larval Fish Conference in Santa Fe, New Mexico (2010), and was well-received.

We have also conducted comprehensive analyses of factors affecting growth rates of Age-0 smallmouth bass in the Yampa River. Specifically, we compared intra-annual and inter-annual patterns of bass growth rates and lengths and related those patterns to thermal and hydrologic characteristics of the Yampa River in the period 2003-2009. Intra-annual cohort growth of smallmouth bass varied from 0.66 mm/day in 2005 to 1.12 mm/day in 2006, both in first cohorts of the year. The shortest length bass were from cohort 3 in 2008 (mean TL = 40 mm) and the largest in cohort 1 in 2007 (102 mm TL). Early cohort growth rates were faster than later ones in all years because they had the benefit of the entire warm summer season to grow. Bass growth ceased when water temperatures declined to about 10°C. General linear model analyses showed that age-0 bass growth rates were highest, and length was greater in September, in years when water temperatures were high and spring runoff flows declined early. Conversely, bass growth rates were lower, and length was shorter in September, in years when water temperatures were cool and runoff was prolonged. Bass from isolated pools usually grew more slowly than those from the mainstem Yampa River. Quantifying factors that affect growth and ecology of age-0 smallmouth bass in the Yampa River will assist with population dynamics investigations of bass relative to optimizing strategies for their removal, and aid recovery efforts for native fishes in the Upper Colorado River Basin. Results of bass growth rate analyses were presented three times in 2010 (all by Angela Hill), at the Upper Colorado River Researchers Meeting, the Colorado-Wyoming Chapter of the American Fisheries Society, and the Larval Fish Conference in Santa Fe, New Mexico, and each was well-received.

We also conducted additional smallmouth bass otolith research in spring 2010. The literature is controversial in regards to the number daily increments and timing of their deposition in otoliths of smallmouth bass at hatching and swimup. Because this information is critical to our understanding of hatching time and interpretation of hatching date distributions, we raised smallmouth bass embryos in constant and fluctuating temperature regimes at 20°C. Embryos were acquired from the Colorado Division of Wildlife Hatchery at Wray, Colorado. Series of bass from each treatment were preserved through ontogeny to resolve the issue of increment deposition timing and clarity. Those analyses are underway and may be presented at the Researchers Meeting.

VII. Recommendations: We will present a more complete summary of data regarding the native fish response evaluation at the 2011 Non-native Fish Workshop, and at the 2012 Researchers Meeting if necessary.

VIII. Project Status: On track and ongoing.

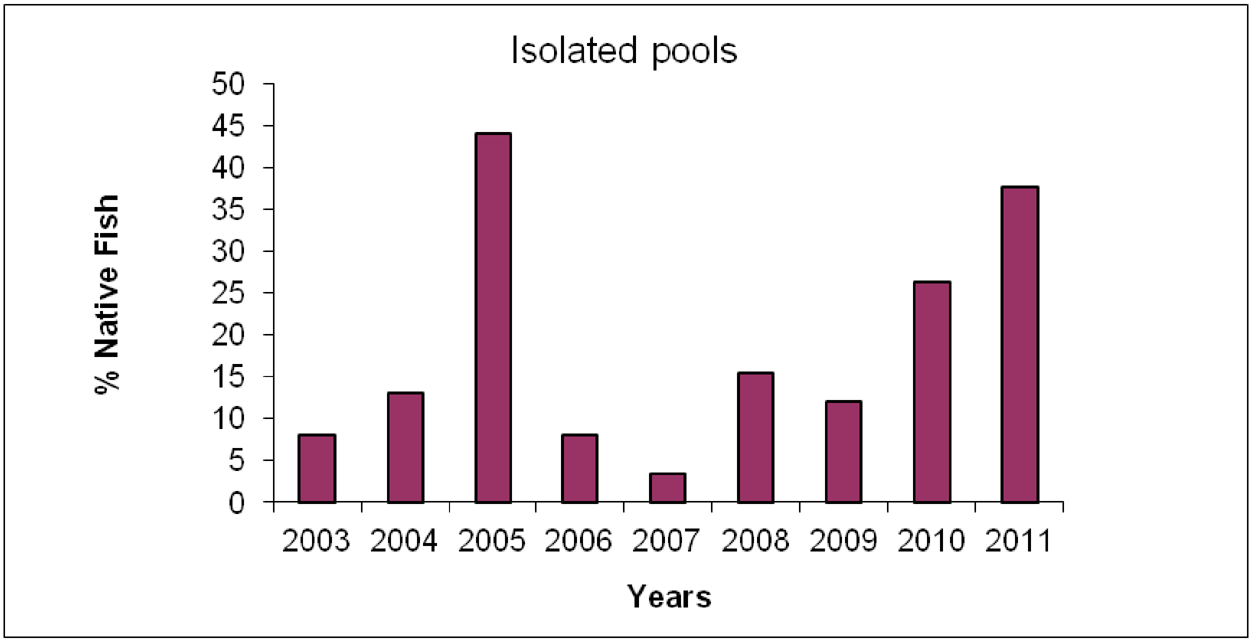
IX. FY 2011 Budget Status

A. Funds Provided: $85,976
B. Funds Expended:$68,781
C. Difference: $ 17,195
D. Percent of the FY 2010 work completed, and projected costs to complete: 80% of FY11 complete.
E. Recovery Program funds spent for publication charges: 0

X. Status of Data Submission (Where applicable): *[Indicate what data have been submitted to the database manager.]Data submitted spring 2010*

XI. Signed: Kevin R. Bestgen 12 November 2011 (revised 1 December 2011)
Principal Investigator Date
(Just put name and date here, since you will be submitting the report electronically)

APPENDIX: *[More comprehensive/final project reports (NOT to be used in place of a complete annual report.). If distributed previously, simply reference the document or report.]*



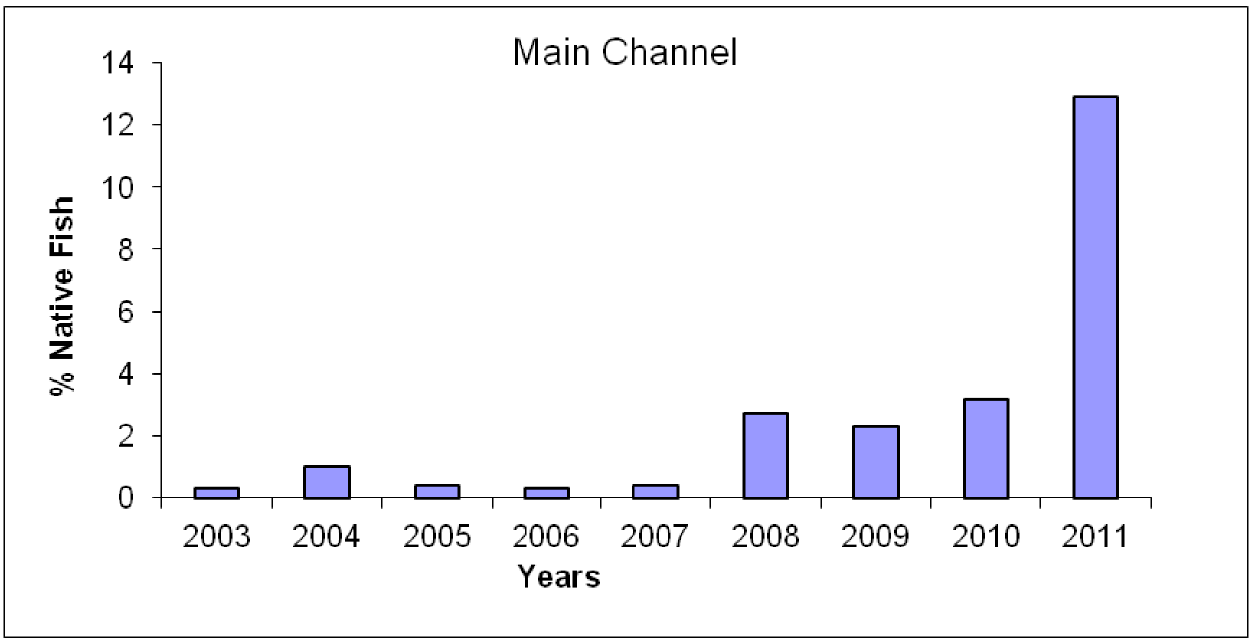


Figure 1. Percent composition of native fishes in the Yampa River, 2003-2011, in samples collected from isolated pools (upper) and the main channel (lower) in Little Yampa Canyon.

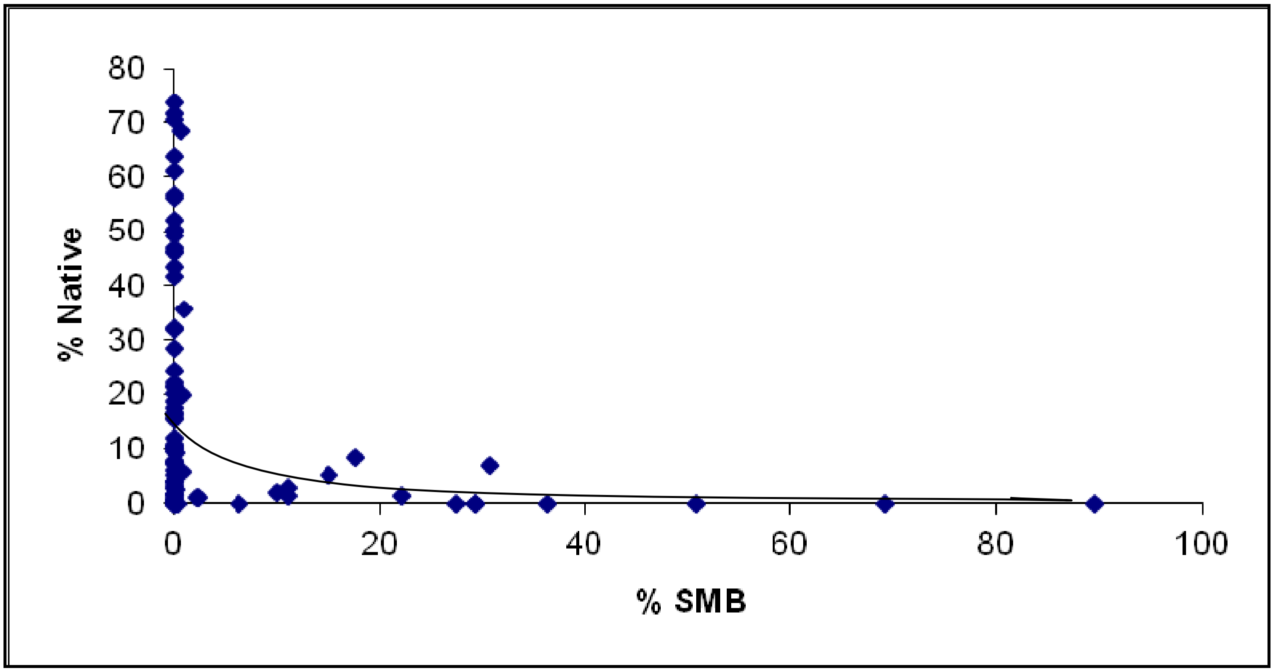


Figure 2. Percent native fishes as a function of percent smallmouth bass in samples collected from isolated pools in the Little Yampa Canyon reach of the Yampa River 2003-2011.

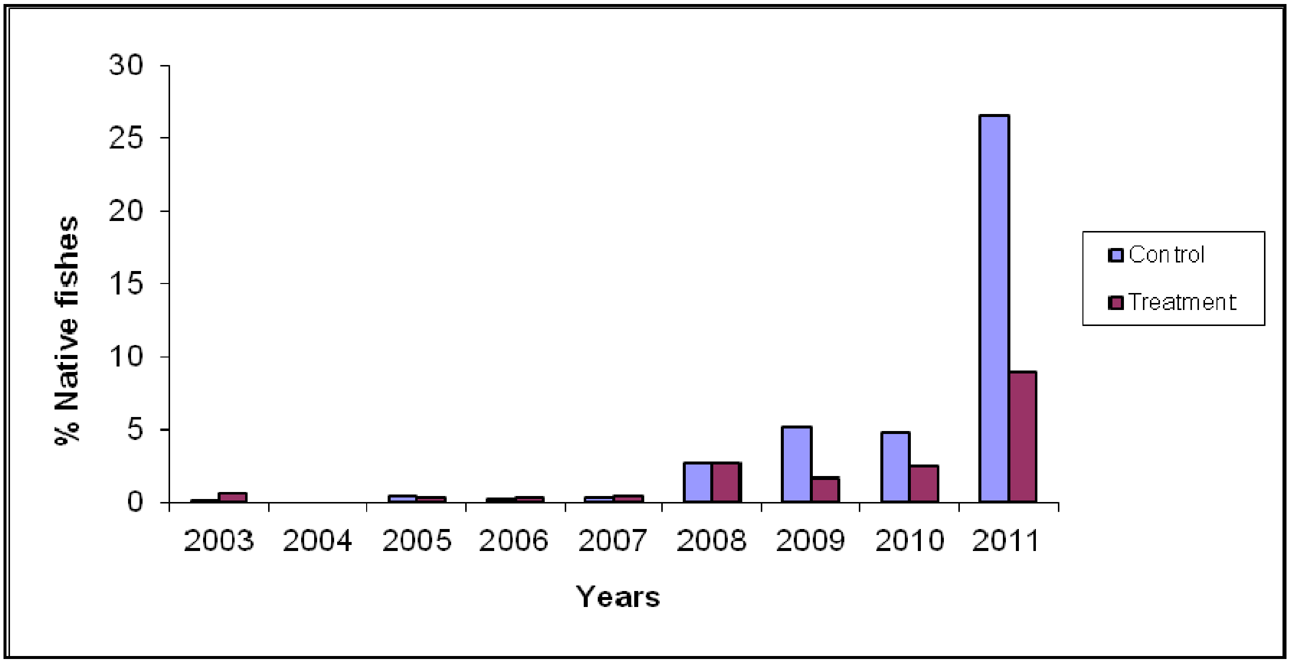
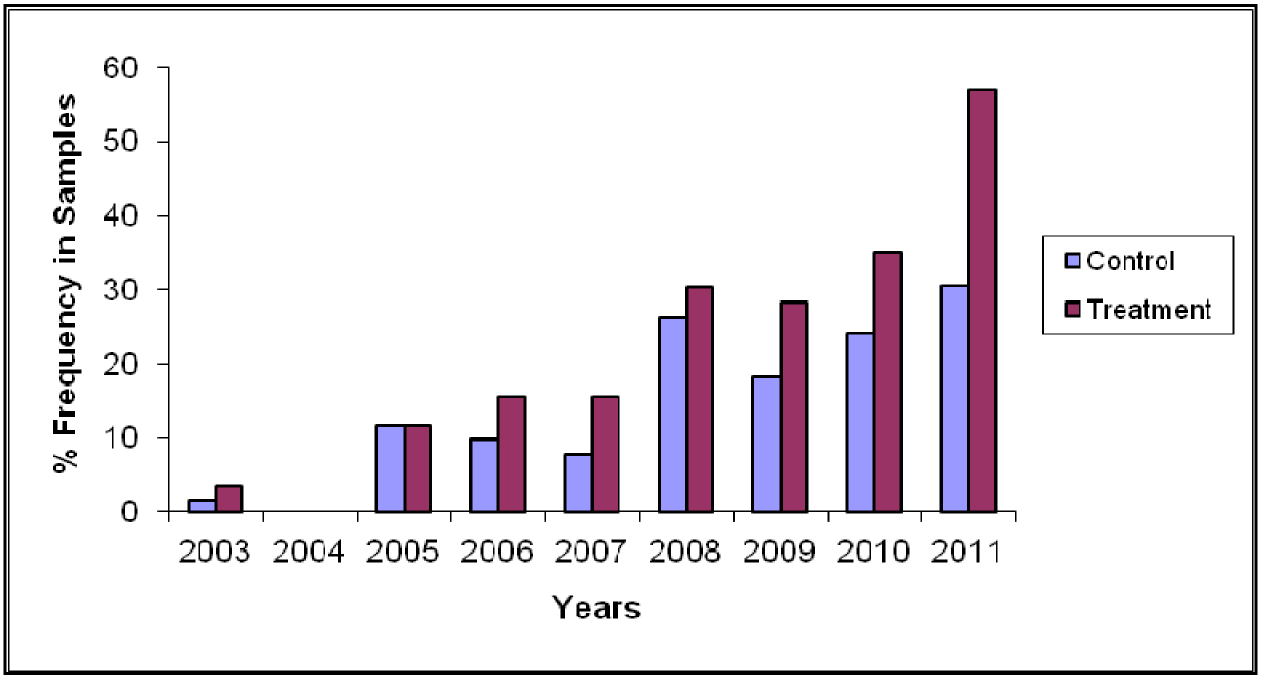


Figure 3. Percent native fishes in samples collected in the main channel Yampa River in the control (no Age-0 smallmouth bass removal) and treatment (intensive Age-0 smallmouth bass removal) reaches in Little Yampa Canyon, 2003-2011.



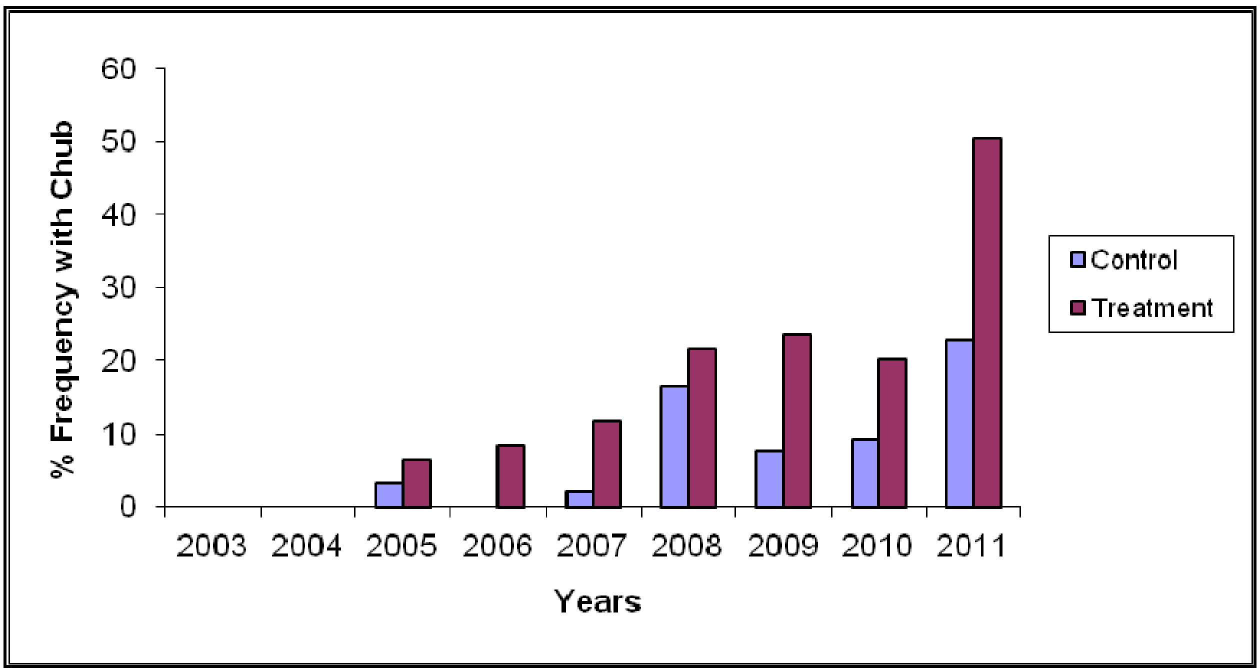
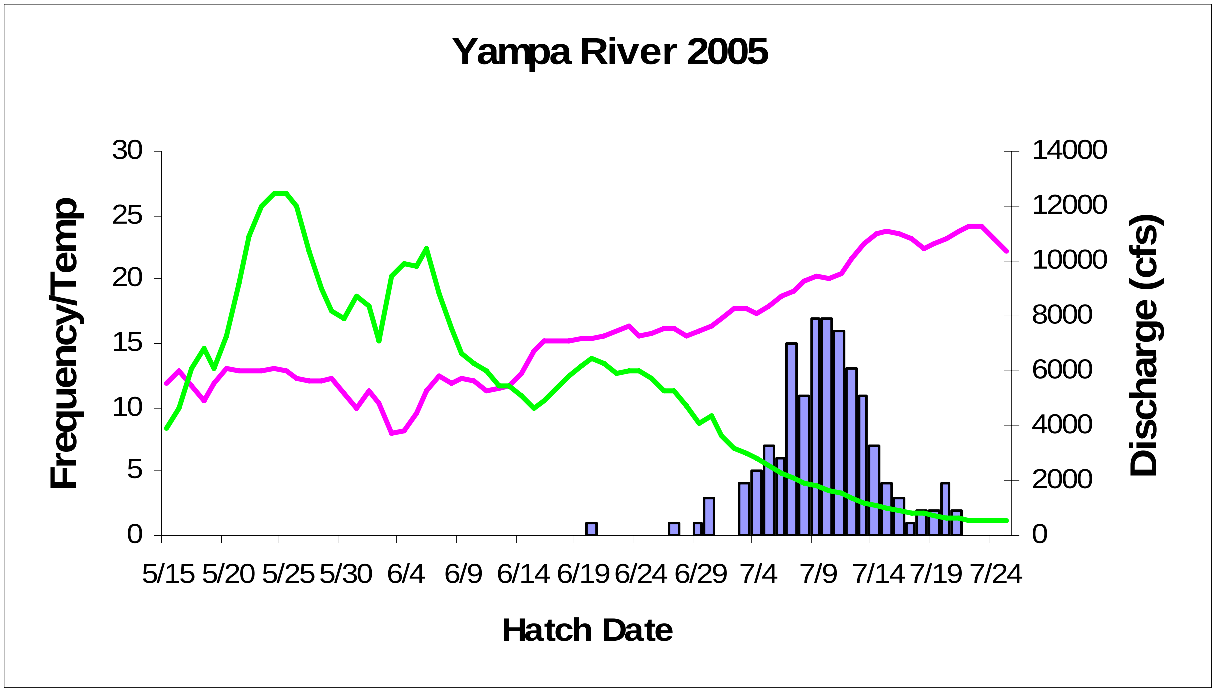


Figure 4. Frequency of native fishes (upper panel) and roundtail chubs (lower panel) in samples collected in the main channel of the Yampa River in control (no Age-0 smallmouth bass removal) and treatment (intensive Age-0 smallmouth bass removal) reaches in Little Yampa Canyon, 2003-2011.



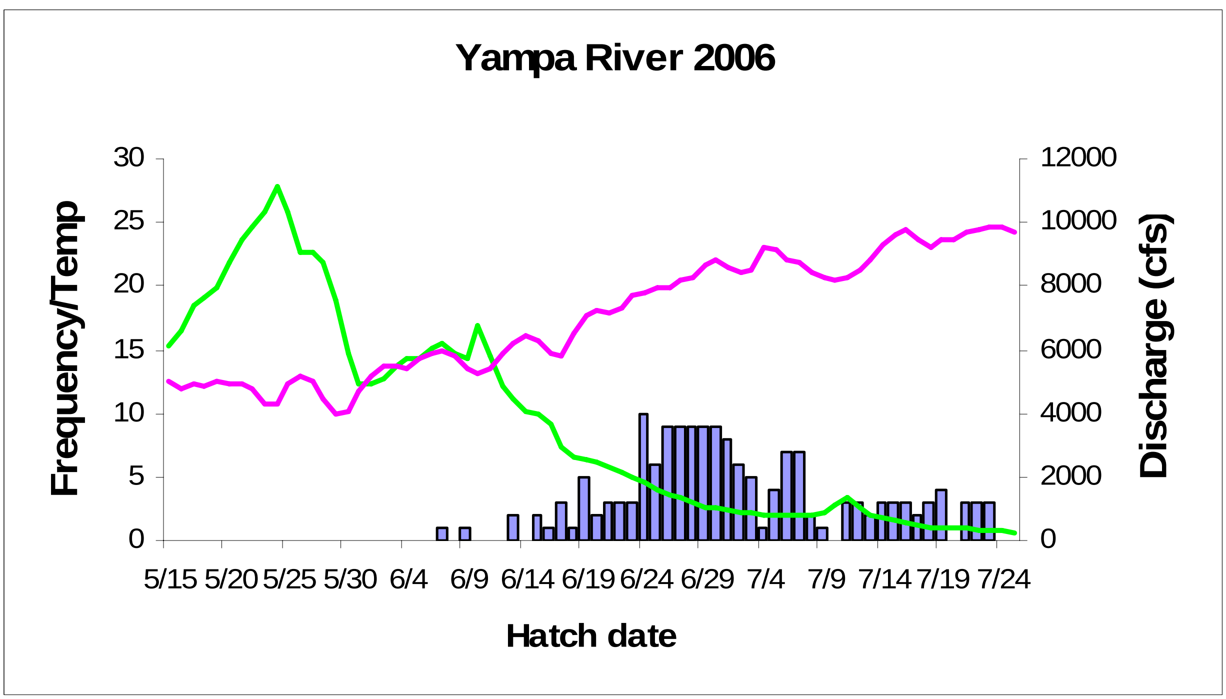
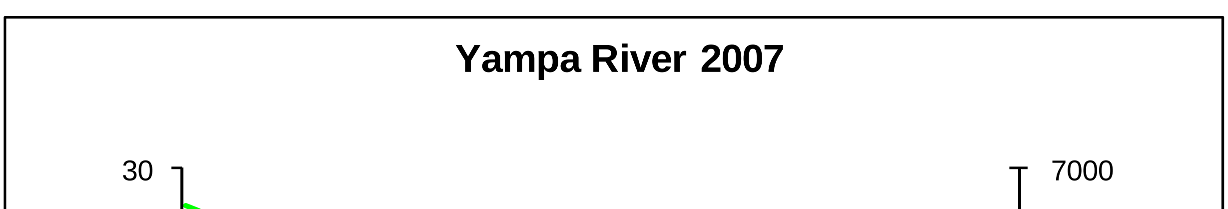
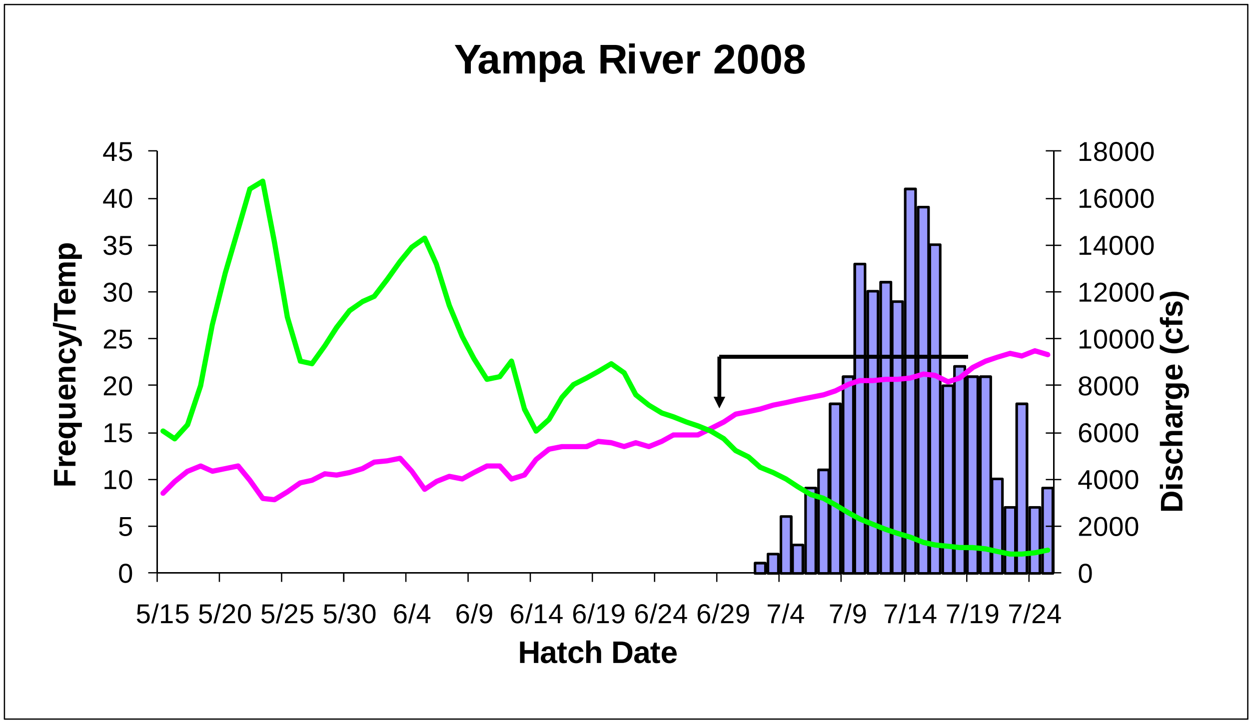


Figure 5 continued below.





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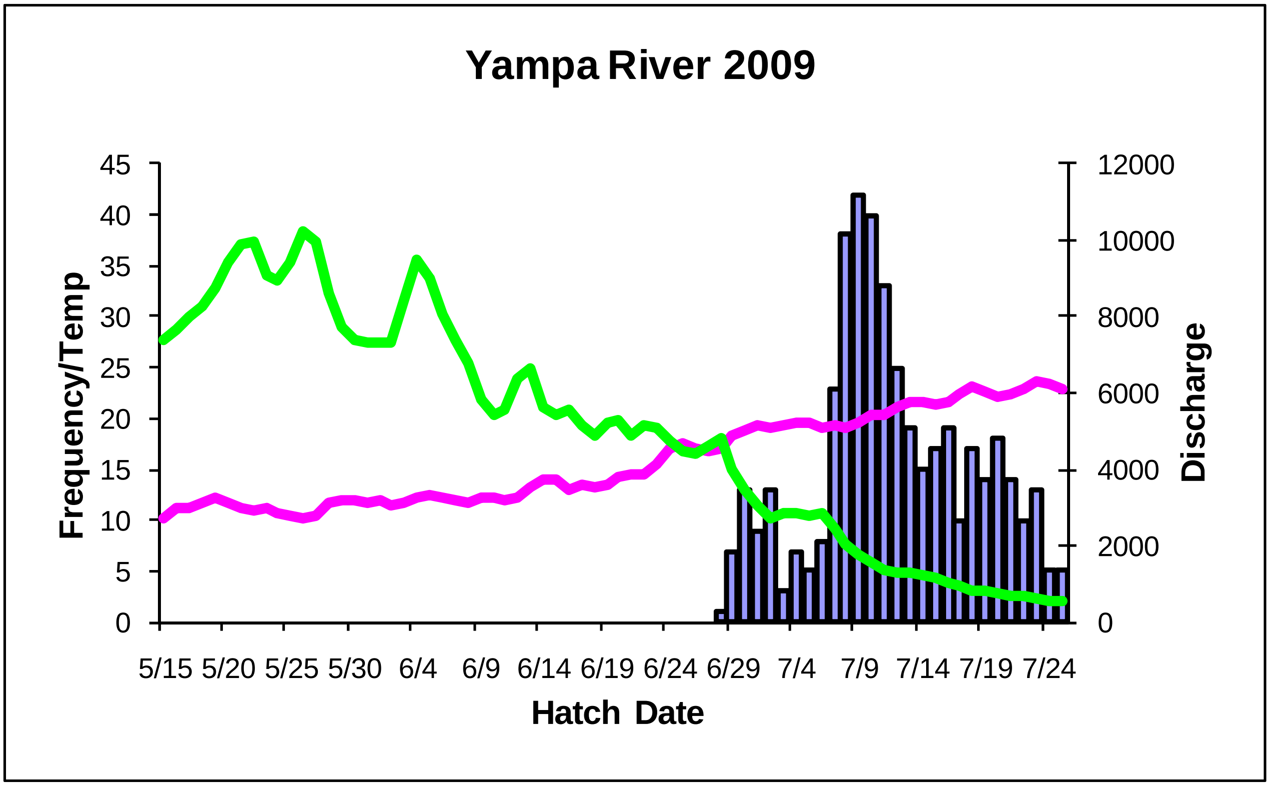

Figure 5. Distributions of hatching dates of smallmouth bass in the Yampa River related to stream flow (green) and water temperature (pink), 2005-2009.