COLORADO RIVER RECOVERY PROGRAM
FY 2014 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. Bureau of Reclamation Agreement Number(s): R14AP00001

Project/Grant Period:
Start date (Mo/Day/Yr): 1 Oct. 2008
End date: (Mo/Day/Yr): 30 Sept. 2014
Reporting period end date: 30 Sept. 2014
Is this the final report? Yes _____ No _X___

III. Principal Investigator(s): Larval Fish Laboratory
Kevin Bestgen, Cameron Walford, Angela Hill, and John Hawkins
Department of Fish, Wildlife, and Conservation Biology
Colorado State University
Ft. Collins, CO 80523
voice: KRB (970) 491-1848, JAH (970) 491-2777
fax: (970) 491-5091
email: *kbestgen@colostate.edu*

IV. Abstract: 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 poorly understood. 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. Native species richness increased during the removal period compared to early sampling (2003-2004) conducted in this project, as has native species sampling frequency and abundance, particularly since 2008 through 2012; native fish abundance was reduced in 2013. The 2014 sampling data has just been acquired so is not available for reporting. Comparison of native fish frequency and abundance in a control and treatment reaches suggested that both non-native predator removals, as well as environmental effects due mostly to higher water, are responsible.

V. Study Schedule: Ongoing as needed, agreement extends through September 2014.

VI. 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.

VII. Accomplishment of FY 2014 Tasks and Deliverables, Discussion of Initial Findings and Shortcomings:

In 2014, we sampled control and treatment reaches of Little Yampa Canyon with an effort similar to 2013 and the past. Samples were collected in each reach to document native fish response. At time of report submission, we are emerging from field sampling and not all data are ready for analysis. As a result, reporting of 2014 results cannot be included in this report. We will however, present a full summary of activities conducted in 2014 at the Non-native fish workshop in early December in Grand Junction, Colorado.

In 2013, 60 samples were collected in the treatment reach of Little Yampa Canyon (where small-bodied smallmouth bass were removed from nearshore habitat) and 40 samples were collected from the control reach (where no small-bodied smallmouth bass were removed). A total of 12 isolated pool samples were among the total as well.

Number of smallmouth bass sampled and removed in 2013 (n=3,143) declined from 2012, reflecting lower abundance, and was lower than most other years (Figure 1). Reduced number collected in 2013 was thought to be caused by high water levels that lasted well into summer compared to 2012, and reduced reproductive success and growth of age-0 smallmouth bass in the study area. The increased number in 2012 was likely due to relatively warm water early in the year, caused by low flow conditions.

Native fish abundance was much reduced in 2013 compared to 2012 and 2011 (Figure 2). The 2013 native fish abundance in the main channel of the Yampa River was lower than for 2003-2007, when few native fishes were found, and those mostly only in isolated pools with few predators. In isolated pools, native fishes were also rare and were typically found only when abundance of smallmouth bass was lowest (Figure 3).

Number of native fish species collected in main channel samples of the Little Yampa Canyon reach of the Yampa River showed a positive response through time in the period 2003-2011, remained relatively abundant in 2012, but declined dramatically in 2013. In 2003 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 species were captured. In 2008, six native fishes were collected and in 2009 five, the same number captured in 2010; seven native fishes were collected in 2011, the most ever, and included bluehead, mountain, and flannelmouth sucker, mottled sculpin, speckled dace, roundtail chub, and mountain whitefish. In 2013, five native fishes were collected including bluehead and flannelmouth suckers, roundtail chub, speckled dace, and mottled sculpin.

The frequency of presence of native fishes in samples has increased since intensive removal of adult and age-0 bass commenced in 2005 (Figure 4). While the total % native fish remains low, the 2008-2010 levels represent a five-fold or more increase over 2007 and before, and the 2011 level has not been realized since sampling began. Presence of native fishes in 2012 samples was also high (comparable to 2008-2010), but slightly less than in 2011, but the 2013 total declined dramatically. Frequency of native fishes in samples has also increased through time, particularly for roundtail chub *Gila robusta*. Roundtail chub were 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 5). We interpret these collective patterns as a river-wide response of increased native fish abundance in 2008 through 2012, perhaps because of higher stream flows and reduced water temperatures. Those same conditions promote later smallmouth bass spawning and slower growth (see below), 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. The 2013 decline in native fishes is likely due to a high abundance of age-0 and age-1 smallmouth bass from large year-classes produced in 2012 and 2013, and a delayed response by native fishes to bass, declining in 2012 and particularly 2013.

An additional aspect of work in FY-2010 to 2014 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. In general, in each of the 2010-2014 sampling years, first pass removal constituted about 55-65% of the smallmouth bass present at each site, a relatively high depletion rate. Repeated visits from late summer into autumn will allow us to understand recolonization dynamics of those habitats through the year. As is customary, we plan to report results of 2014 sampling at the December Non-native Fish workshop in Grand Junction or at the Researchers Meeting in January 2015.

We made good progress on analysis of otoliths of smallmouth bass collected from the Yampa River through 2012, which added to the population dynamics modeling portion of Project 161, the smallmouth bass data synthesis. 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, so strategies to disadvantage reproductive success of that species can be formulated. That information is being summarized in a draft report, along with similar data from the Green River, which will be useful to guide decisions regarding potential modified flows or temperatures from Flaming Gorge Dam. Those modifications would be designed to reduce reproductive success of smallmouth bass in the Green River downstream of Flaming Gorge Dam.

Results of otolith analysis showed that smallmouth bass in the Yampa River study area first hatched well after spring peak flows declined but the specific calendar date varied from early June to early July across years 2005-2012. A main controlling factor to smallmouth bass reproduction appears to be water temperature. For example, when water temperatures warmed earlier in the lower flow year 2007, smallmouth bass hatching began as early as 4 June. In contrast, first hatching of smallmouth bass in the higher flow year 2008, when 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, 2011, 2012, 2013), 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 2003-2011. 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 that support optimizing strategies for bass 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. This information was also incorporated into a population dynamics model for smallmouth bass being developed under Project 161, which allows investigation of year-specific effects on growth and subsequent over-winter survival related to Yampa River flow and water temperature.

We also conducted additional smallmouth bass otolith research in spring 2010-2012. The literature is controversial in regards to the number of daily increments and the 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 have been completed and the Results were published in the North American Journal of Fish Management in 2014 (Hill and Bestgen 2014); the pdf of the reprint was sent to the Program list server in spring 2014 as well.

VIII. Additional noteworthy observations:

IX. Recommendations:

- Present a more complete summary of data regarding the native fish response evaluation at the 2014 Non-native Fish Workshop, and at the 2015 Researchers Meeting (if necessary).
- Continue sampling in 2015 and out years, with similar effort as 2014, to continue to bolster this important data set and understand the relationship of native fish response to predator removal and flow levels in summer in the Yampa River

X. Project Status: Our Cooperative Agreement with the Bureau of Reclamation for this project ended on 30 September 2013. A new agreement was negotiated and was in place in 2014.

XI. FY 2014 Budget Status

A. Funds Provided: $87,846
B. Funds Expended: $64,229
C. Difference: $23,617
D. Percent of the FY 2014 work completed, and projected costs to complete: <25% of FY14 to complete.
E. Recovery Program funds spent for publication charges: 0

XII. Status of Data Submission (Where applicable):

XIII. Signed: Kevin R. Bestgen 16 November 2014
Principal Investigator Date

APPENDIX:

Hill, A. A. and K. R. Bestgen. 2014. Otolith daily increment deposition in age-0 smallmouth bass reared in constant and fluctuating water temperatures. North American Journal of Fisheries Management 34:774-779.

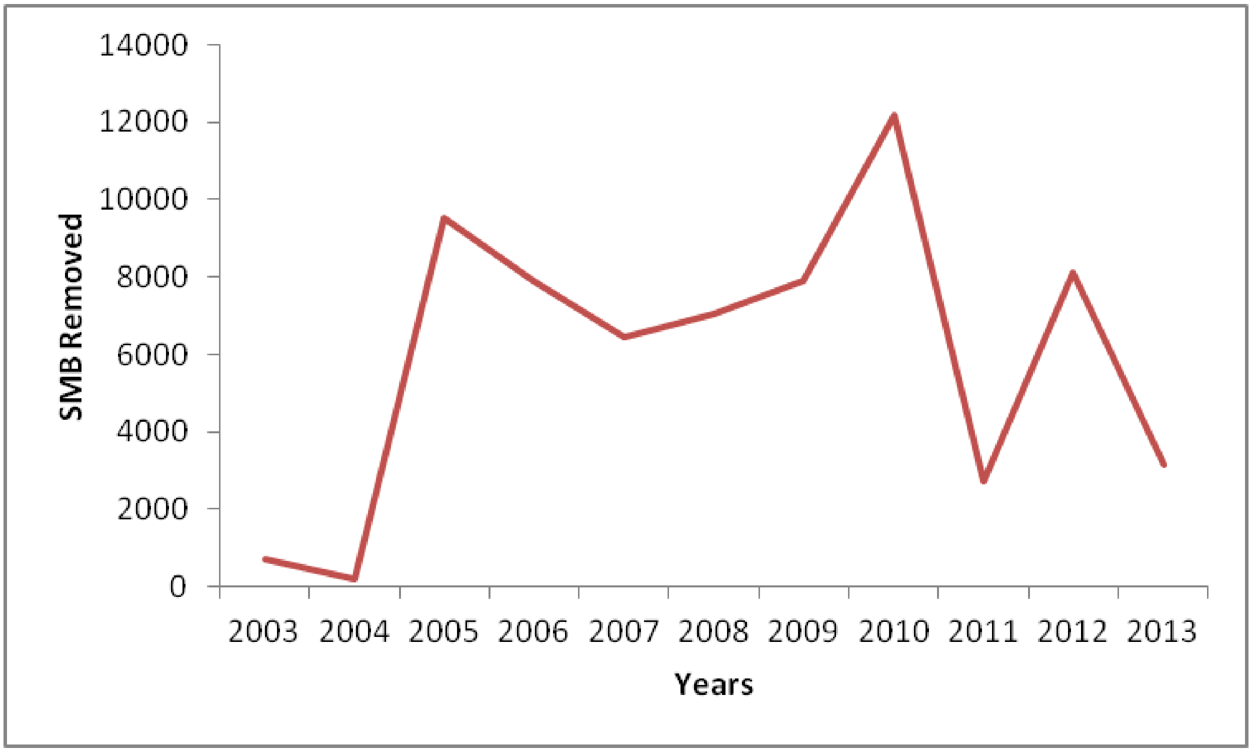

Figure 1. Number of small-bodied (usually < 100 mm total length) smallmouth bass removed from the treatment reach of Little Yampa Canyon, 2003-2013.

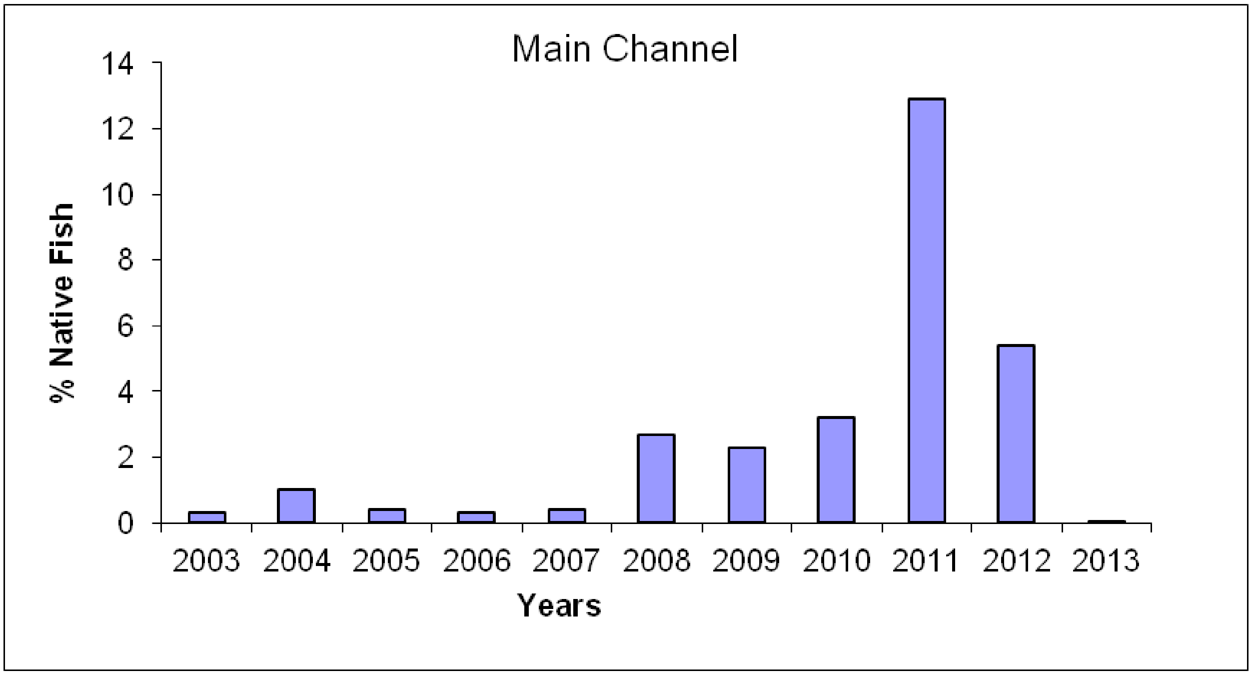

Figure 2. Percent composition of native fishes in the Yampa River, 2003-2012, in samples collected from the main channel in Little Yampa Canyon.

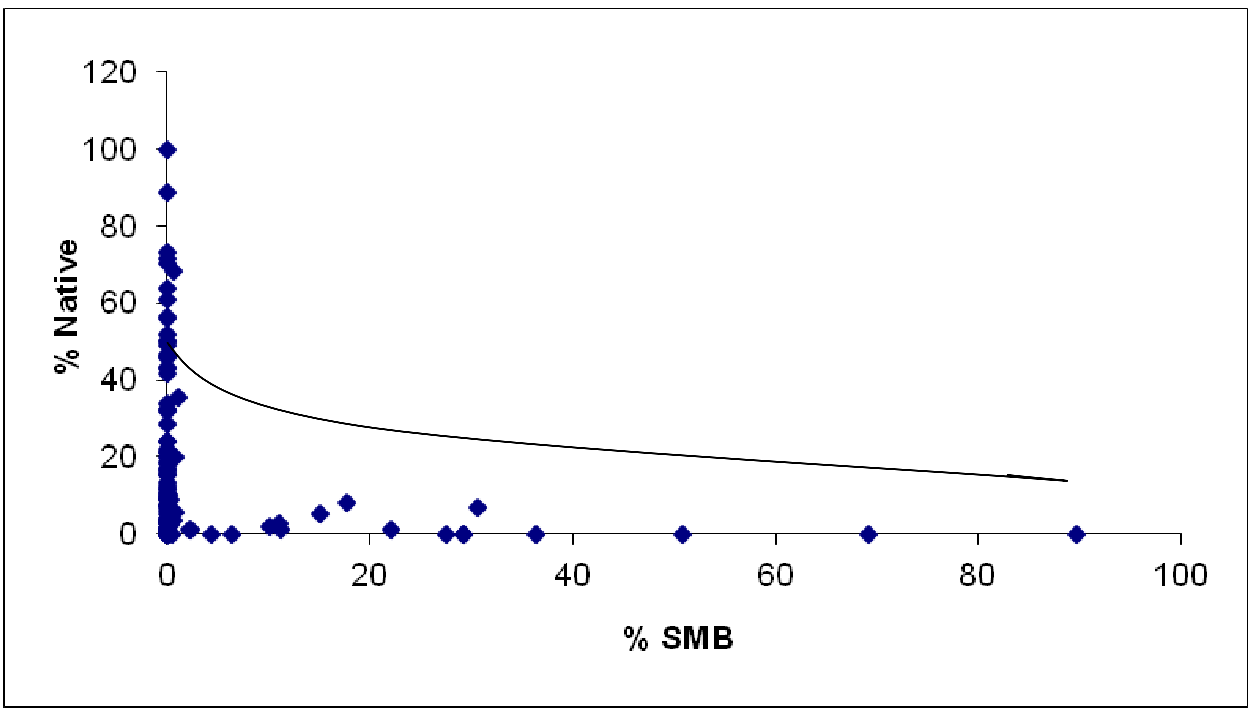

Figure 3. Percent native fishes as a function of percent smallmouth bass in samples collected from isolated pools in the Little Yampa Canyon reach of the Yampa River 2003-2013.

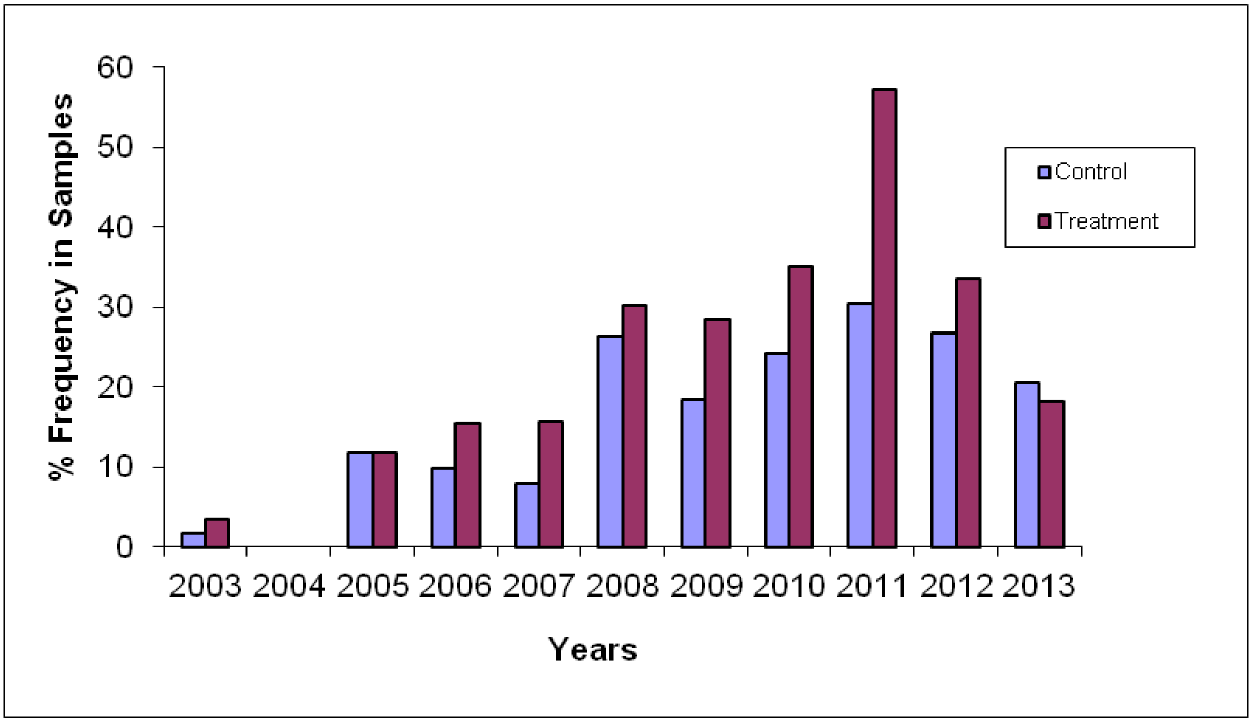

Figure 4. Presence of native fishes (any species) in samples collected in the main channel of the Yampa River in control (no age-0 smallmouth bass removal) and treatment (intensive age-0 smallmouth bass removal) reaches in Little Yampa Canyon, 2003-2013.

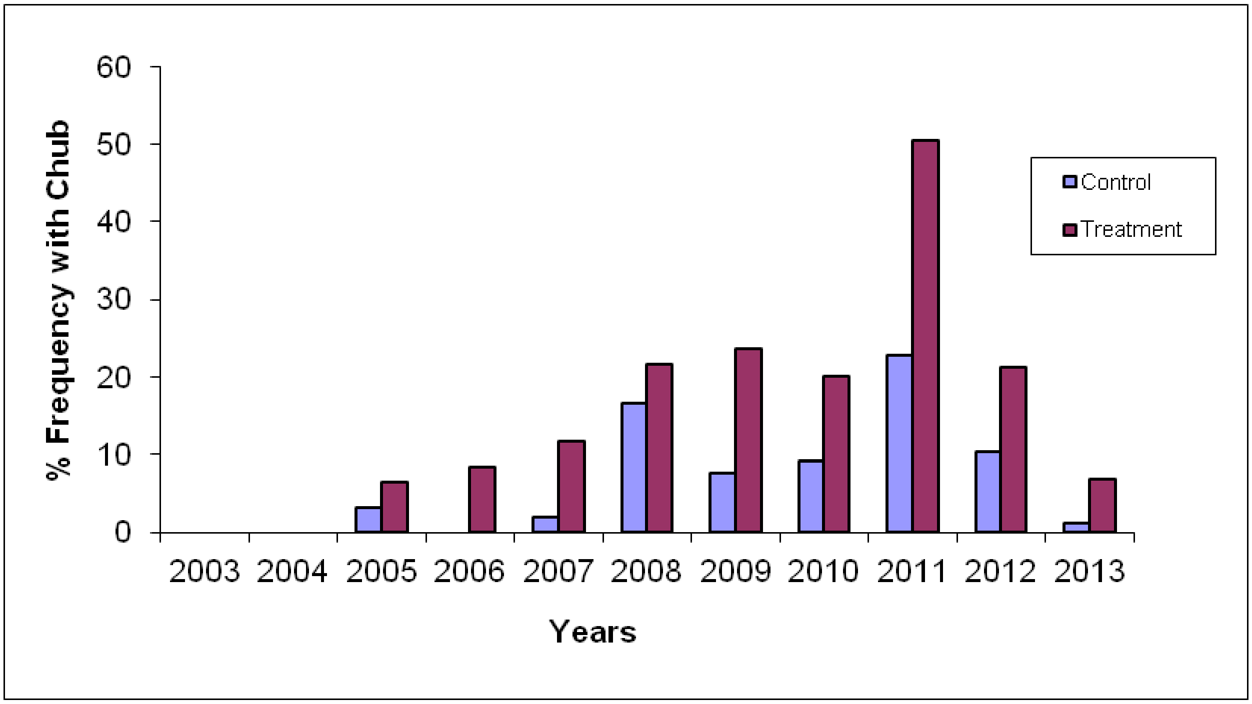

Figure 5. Frequency of roundtail chub in samples collected in the main channel Yampa River in the control (no age-0 smallmouth bass removal) and treatment (intensive age-0 smallmouth bass removal) reaches in Little Yampa Canyon, 2003-2013.