COLORADO RIVER RECOVERY PROGRAM
FY 2012 ANNUAL PROJECT REPORT

RECOVERY PROGRAM
PROJECT NUMBER: FR-115

I. Project Title: Monitoring effects of Flaming Gorge Dam releases on the Lodore and Whirlpool Canyon fish communities

II. Bureau of Reclamation Agreement Number(s): R09AP40873 / 09-FG-40-2873

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. 2012
Is this the final report? Yes _____ No _X__

III. Principal Investigator(s): Lead Agency: Larval Fish Laboratory, Department of Fish, Wildlife, and Conservation Biology, Colorado State University; Bureau of Reclamation; U.S. Fish and Wildlife Service

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IV. Abstract: The primary purpose of this study is to determine the cumulative effect that flow and temperature regimes have had on the fish community of the Green River in Lodore and Whirlpool canyons and recommend how to monitor effects into the future. A secondary purpose is to determine the distribution of the humpback chub population in Whirlpool Canyon to serve as the basis for future monitoring efforts. Future monitoring (i.e. population estimation), if deemed necessary, will be needed to evaluate the contribution of the Whirlpool Canyon population of humpback chub to the overall recovery of the species. A third purpose is to remove non-native fishes present in the study reach. A portion of that work is devoted to better understanding the reproductive ecology of smallmouth bass in the Green River study area. This will be accomplished by collection of young-of-year smallmouth bass, and analysis of otolith microstructure. This will allow determination of hatching dates of bass relative to streamflow and water

temperature patterns, information that may be useful to understand if flow releases from Flaming Gorge Dam may be useful to disadvantage smallmouth bass in the study area. Information gathered will be used to evaluate whether flow and temperature regimes from Flaming Gorge Dam are benefitting endangered fishes in the Green River without causing adverse changes in abundance of non-native fishes.

V. Study Schedule: Initial Year: 2002; Final Year: Not determined

VI. Relationship to RIPRAP:

Green River Action Plan: Mainstem.

II.D. Evaluate and revise as needed, flow regimes to benefit endangered fish populations.

VII. Accomplishment of FY 2012 Tasks and Deliverables, Discussion of Initial Findings and Shortcomings:

Task 1: Thermographs

Thermograph data will be provided by Carrie Cordova, U.S. Fish and Wildlife Service, Lakewood, and by Utah State University, at up to 10 other localities in the Green River. We assisted with data collection by removing thermographs from the river in September, resetting new ones in their place, and establishing new locations in both lower Lodore Canyon near the existing site, and in lower Mitten Park on river right. That Mitten Park location is across the river from the long-term site. The Green River upstream of the Yampa River experienced a relatively cool thermal regime in 2008-2011, when water temperatures exceeded 20°C for just a few days each summer (Figure 1). This is comparison to the warmer 2007 and slightly warmer 2012, when mean daily minima in summer often approached 20°C, and daytime highs reached 25°C on several occasions.

Task 2: Sample main channel fish community (large-bodied fishes).

We completed two electrofishing trips through the study area in 2012, as prescribed in the study proposal. We reported on data collected through 2006 in a summary report, data entry and verification is complete for 2007-2011; 2012 data is being error checked and is preliminary so is not included in this report. We will update the report when it is available.

A total of 11 native species, 19 nonnative species, and several hybrids have been collected in the study area by all sampling gears in the period 2002-2010 (Table 1). The most species are captured by electrofishing, followed by seining, and trammel netting.

Abundance patterns of native fish in the entire study area that were captured in electrofishing samples beginning in 1994-1996 reflected a variably dynamic community for both non-native as well as native fishes (Figures 2 and 3). For example, non-native

brown trout, with the exception of 2008, was consistently abundant in Lodore Canyon but increased in that year in Whirlpool Canyon; that was due to high abundance near Jones Creek. Trout abundance in Lodore and Whirlpool canyons was very high in 2012, based on preliminary data, especially for rainbow trout in Whirlpool Canyon. Channel catfish reached a peak in abundance in both Lodore and Whirlpool canyons in the 2005-2008 period but have declined slightly since; note the relatively low 1994-1996 abundance as the lowest in the period of record although 2011 approaches that level. Common carp abundance appears to be declining in both reaches over time at a slow rate. Northern pike abundance is low overall but highest in Lodore Canyon and variable. Pike have low abundance in Whirlpool Canyon; Browns Park pike removal efforts in 2011and 2012 are discussed more extensively below.

Smallmouth bass abundance in Lodore and Whirlpool canyons show slightly different patterns. Abundance peaked in 2007 in Whirlpool Canyon and has declined since which may reflect substantially increased removal effort beginning in 2007 and lack of recent high recruitment. In Lodore Canyon, bass abundance increased though 2009 but then declined through 2011, preliminary observations based on 2012 data show that bass abundance remains at a relatively low level. White sucker abundance increased in Lodore Canyon through 2009 but then declined by 2011, although 2012 data indicated increased abundance. With the exception of 2008, white suckers in Whirlpool Canyon are relatively uncommon through 2011 (and 2012).

Bluehead sucker abundance is higher in Whirlpool than Lodore Canyon and although abundance declined through about 2009, recent information indicates populations have stabilized or increased slightly. Colorado pikeminnow abundance has been variable and relatively low over the study period, but increased in 2010 in each reach. Pikeminnow abundance was high in each reach in 2012. The finding of pikeminnow in upstream Vermillion Creek in 2011 and 2012 is discussed below. Flannelmouth sucker abundance, the most common large-bodied native fish in the study area, has been relatively stable over time in Lodore Canyon but has declined in Whirlpool Canyon from high levels in 2008. Mountain whitefish has increase rather dramatically in the study area since about 2008, but more so in Lodore Canyon, likely in response to cooler thermal regimes present in recent years. Abundance declined in 2011, but preliminary data showed much increased abundance in 2012 in Lodore and Whirlpool canyons. Increased salmonid abundance in both reaches in 2012 may be a response to cooler water temperatures.

Abundance of all chub species declined rather dramatically, especially since 2002-2004, patterns also reflected by trammel net sampling. In 2011, we captured 10 chubs by Trammel netting in Whirlpool Canyon, and six were previously tagged (one in 2006 and thought to be a humpback chub). One chub captured and tagged in 2003 was also recaptured upstream in Yampa Canyon in summer 2011. In 2012, similar numbers of chubs were captured by trammel netting, in spite of relatively good production of young in the last few years.

In 2011 and 2012, we have increased sampling for northern pike in the Browns Park reach of the Green River. Typically only smaller pike are captured in seine samples taken in backwaters in July and September at Swinging Bridge near the Colorado-Utah state line. Their continued presence motivated additional floodplain sampling during high flows in May and June and many large pike, some exceeding three feet in length (n=22, 11-39 inches, 271-984 mm) were captured in 2011 and removed; all were from a relatively restricted area about 1 mile long. During that sampling, two adult Colorado pikeminnow *Ptychocheilus lucius* were captured, one by angling and another in a trap net. This was unusual because pikeminnow are rare in the 56 mile reach between Flaming Gorge Dam and the upstream end of Lodore Canyon which includes the Swinging Bridge area. In 2012, we captured additional northern pike in the Browns Park reach during a relatively brief period of high flows. Interestingly, only three young-of-year were captured in summer and autumn, which was perhaps a function of the brief period of floodplain inundation. More details on pike abundance and spawning patterns will be presented at the non-native fish workshop in December.

Finding Colorado pikeminnow motivated additional Green River sampling in Browns Park National Wildlife Refuge on the 21-22 June 2011 via boat electrofishing. Two crews sampled from Swinging Bridge downstream 14 miles to Vermillion Creek, a tributary to the Green River a short distance upstream of the boundary of Dinosaur National Monument. One adult pikeminnow was captured near Crook Campground. High Green River flows also allowed access to the lower end of Vermillion Creek, where an additional 8 adult pikeminnow (23-27 inches, 595-692 mm total length,) were captured; at least three more were observed but not captured. In all, only five pikeminnow had been previously tagged and two of those were tags with number series that have not been used for many years, which may indicate that those fish reside in that section of the Green River for substantial periods of the year. Vermillion Creek, a relatively small, turbid, and low flow system, was relatively warm at 72°F (22°C) compared to the Green River (48°F, 9°C); several individual pikeminnow were tuberculate (nearing reproductive readiness) likely because of the warm water. Very high densities of suckers, both native flannelmouth sucker *Catostomus latipinnis*, non-native white sucker *Catostomus commersonii*, and their hybrids, were also captured. High reproductive condition for pikeminnow was not expected because of high, late, and cold flows and because pikeminnow in the downstream Yampa River did not spawn until late July in 2011. High flows benefitted sampling efforts because of increased access to important habitats. Findings also supported the importance of floodplain wetlands and flooded tributary mouths for enhancing condition of endangered fishes like Colorado pikeminnow. In spring 2012, we captured three additional pikeminnow at or in the mouth of Vermillion Creek, in spite of relatively low effort. Consecutive years of capture at that location suggest that the mouth of Vermillion Creek may be a concentration area for pikeminnow in spring.

Table 1.—Tentative list of fishes captured in the Green River, from Browns Park downstream to Rainbow Park with electrofishing, trammel nets, and seining, 2002-2012. N = native, I = introduced.

Species	Status	Electrofishing	Trammel netting	Seining
Mountain whitefish	N	X		X
Humpback chub	N	X	X	
Bonytail	N	X	X	X[1]
Roundtail chub	N	X	X	X
Colorado pikeminnow	N	X	X	X
Speckled dace	N	X		X
Bluehead sucker	N	X	X	X
Flannelmouth sucker	N	X	X	X
Razorback sucker	N	X		
Mountain sucker	N			X
Mottled sculpin	N	X		X
Cutthroat trout	I	X		
Brook trout	I	X		
Rainbow trout	I	X		X
Brown trout	I	X	X	
Northern pike	I	X		X
Red shiner	I	X		X
Common carp	I	X	X	X
Creek chub	I			X
Fathead minnow	I			X
Sand shiner	I			X
Redside shiner	I	X		X
White sucker	I	X	X	X
WS x FM		X	X	
FM x BH		X		
WS x BH		X		
RZB x FM		X		X
Channel catfish	I	X	X	X
Black bullhead	I	X		X
Bluegill	I	X		X
Green sunfish	I	X		X
Smallmouth bass	I	X	X	X
Walleye	I	X		
Iowa darter	I			X

[1] Stocked fish.

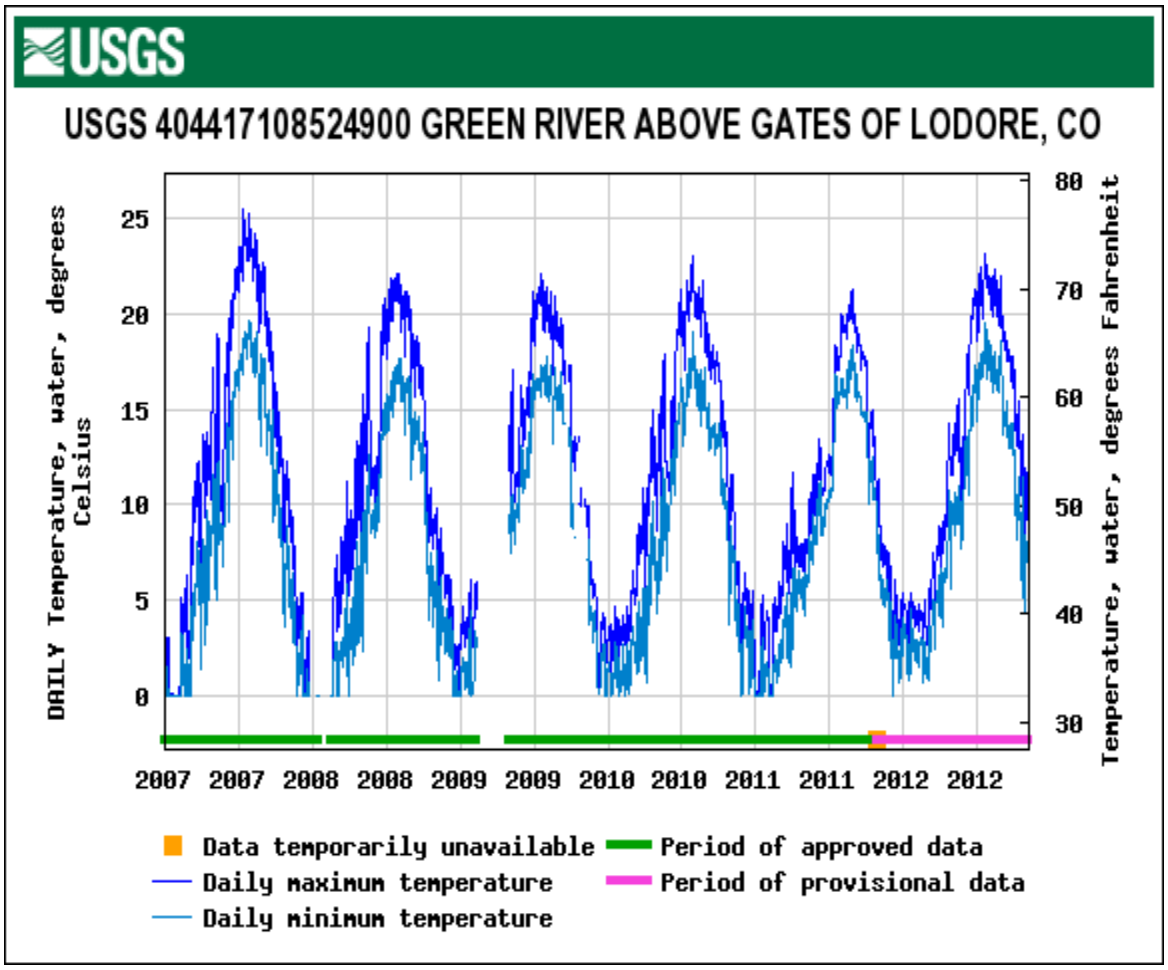


Figure 1. Green River water temperatures at the Gates of Lodore, near the Dinosaur National Monument campground, 2007-2012.

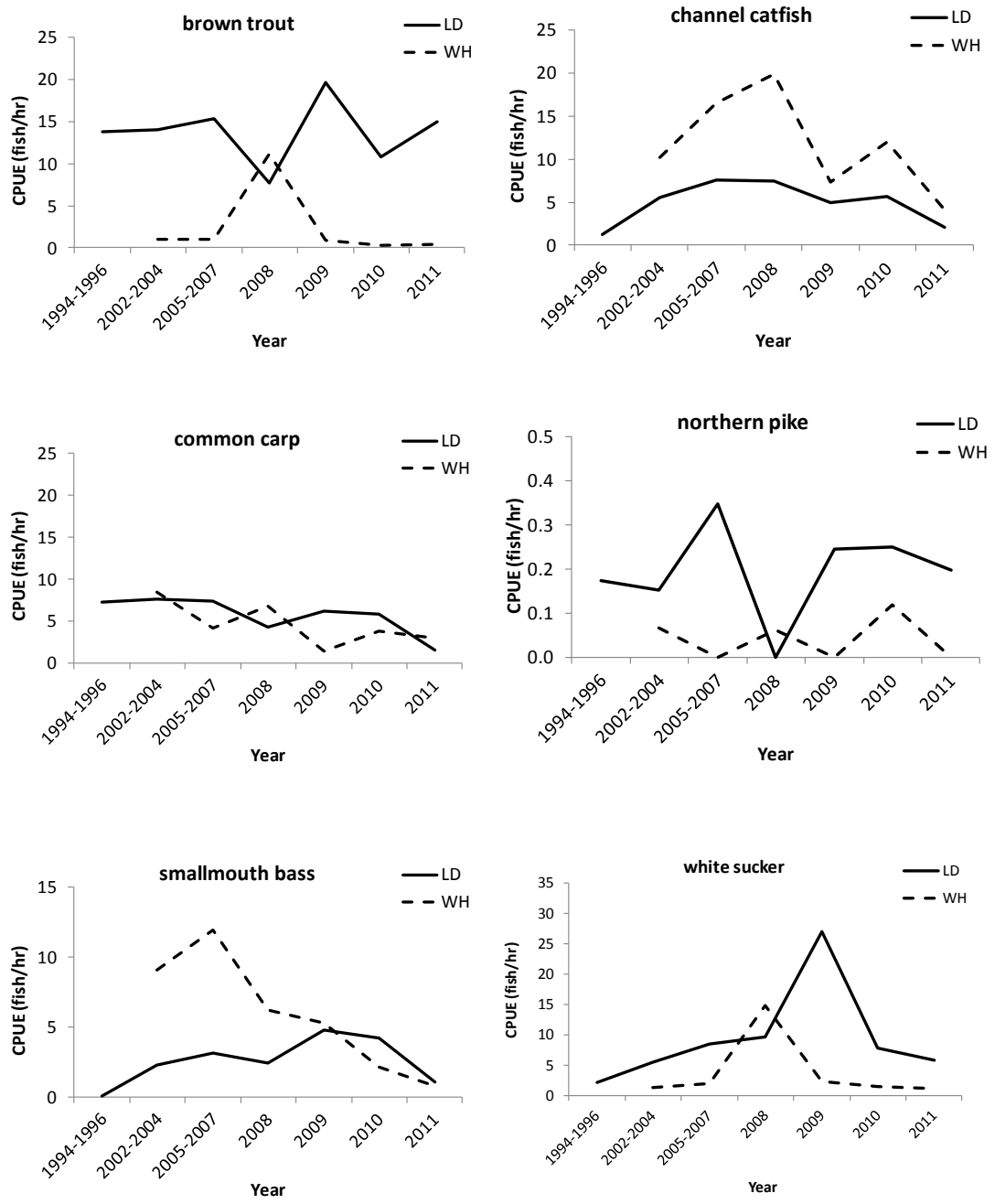


Figure 2.—Number of brown trout, channel catfish, common carp, northern pike, smallmouth bass, and white sucker captured per hour of raft electrofishing effort in four reaches of Lodore Canyon and two reaches of Whirlpool Canyon, Green River, Colorado and Utah, in from 1994-2011. LD is Lodore Canyon and WH is Whirlpool Canyon.

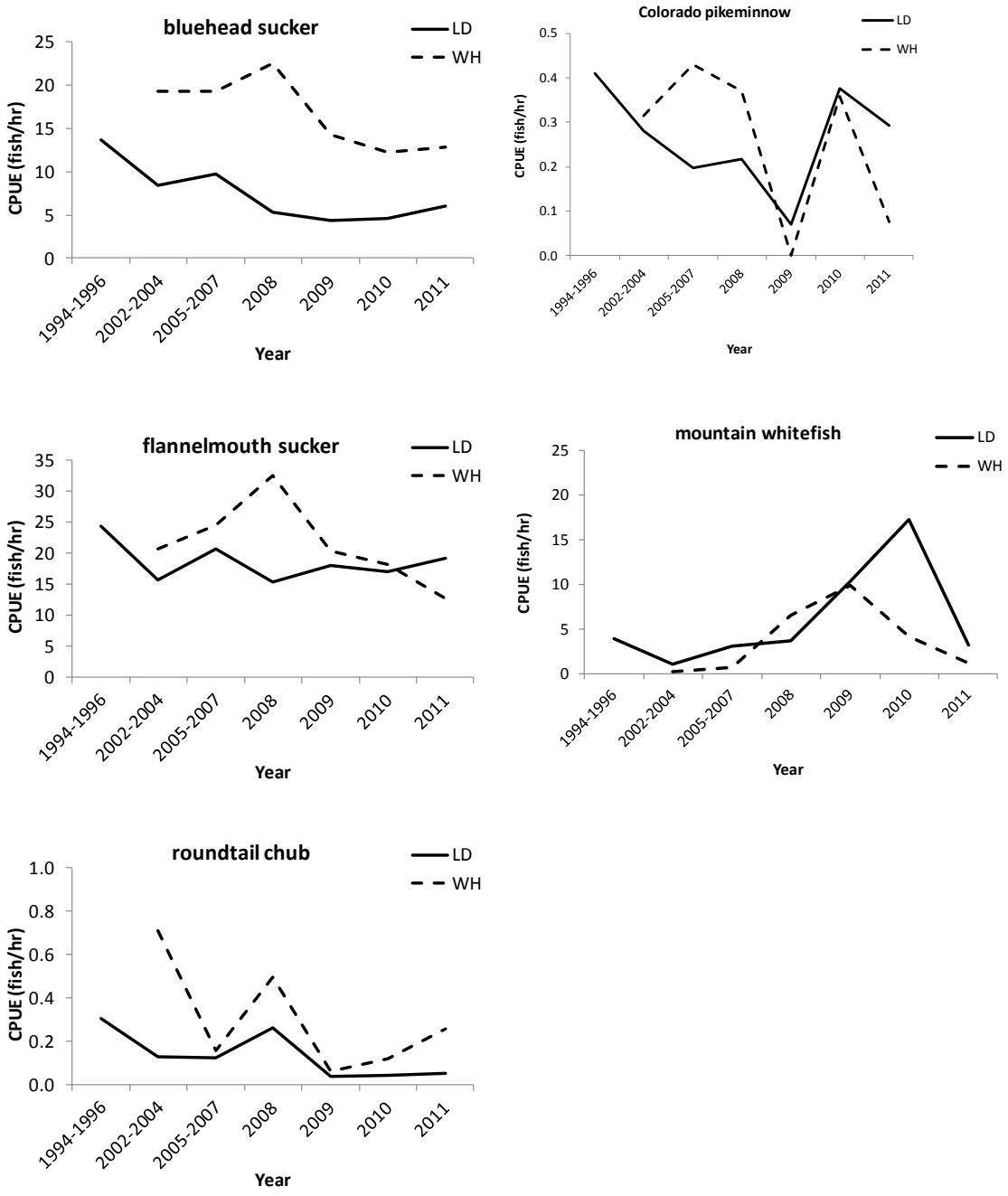


Figure 3.—Number of bluehead sucker, Colorado pikeminnow, flannelmouth sucker, mountain whitefish, and roundtail chub northern captured per hour of raft electrofishing effort in four reaches of Lodore Canyon and two reaches of Whirlpool Canyon, Green River, Colorado and Utah, in from 1994-2011. LD is Lodore Canyon and WH is Whirlpool Canyon.

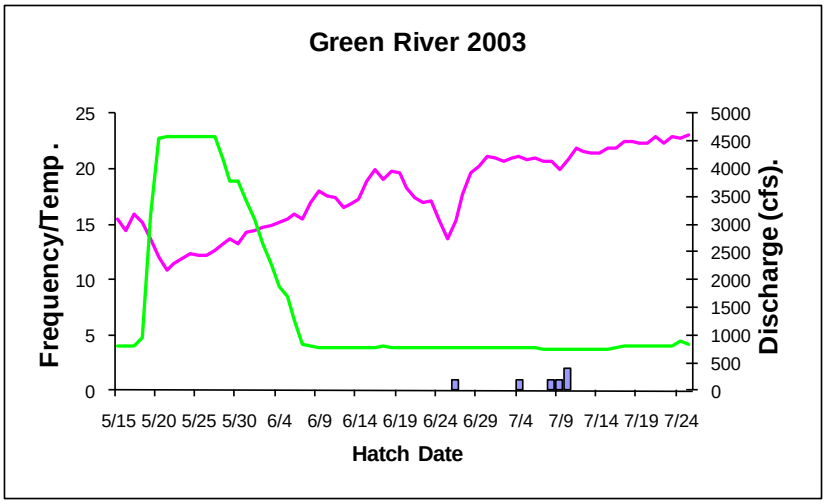
Trammel net sampling was generally conducted only once per year and only in Whirlpool Canyon, including 2012. Overall, humpback chub and roundtail chub abundance was diminished substantially in recent years compared to the period 2002-2004 (Bestgen et al. 2006). This pattern was similar to that reported for electrofishing sampling (e.g., Figure 3). Reduced chub abundance was coincident with invasion and establishment of large populations of smallmouth bass in Lodore and Whirlpool canyons. The 2012 sampling indicated presence but low abundance of roundtail chub; recently stocked bonytail were also detected. Continued low abundance of bonytail recaptures from fish stocked the prior year furthered the notion that they have very low post-stocking survival (Bestgen et al. 2008).

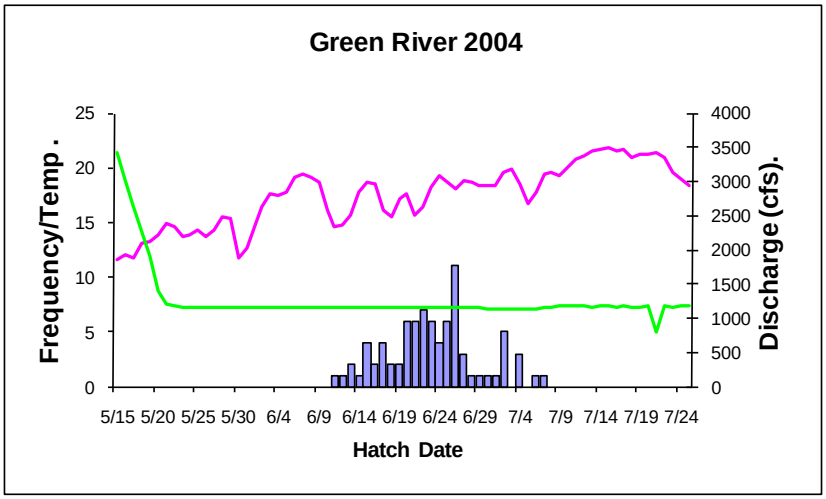
Task 3: Sample small-bodied fish community.

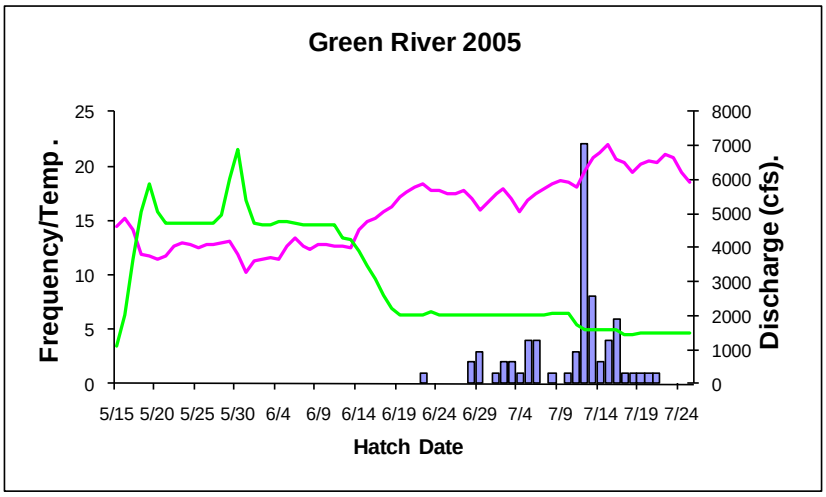
About 100 seine samples were collected in the study area from middle Browns Park downstream to the lower end of Rainbow Park during summer and autumn 2012. We have begun identification of summer and autumn samples. We collected young-of-year northern pike in Browns Park again in spring and summer 2012, indicating successful reproduction by that species in that reach, but relatively low abundance. We will update seine capture data when 2012 samples are identified.

An additional task in this scope of work was to analyze otoliths from age-0 smallmouth bass captured in the Green River study area. This work will assist with understanding smallmouth bass spawning periodicity to assist with disruption of reproduction of that species via flow releases from Flaming Gorge Dam. Studies in other parts of the range of smallmouth bass have shown that weather-related water temperatures reductions or floods reduce their spawning success and number of offspring. Reduced water temperatures often result in abandonment of spawning nests by the guarding male bass, after which developing eggs and just-hatched young are susceptible to predation and other mortality factors. Sampling in the Green River and other areas has shown that higher stream flow, often coupled with increased water turbidity, sweeps weak-swimming young bass away from nests or quiet near-shore habitat, and results in high mortality.

Portions of this work were reported at the January 2010-2012 Researchers Meeting. We found that smallmouth bass in the Green River-Lodore Canyon study area first hatched well after spring peak releases declined and just slightly after (usually within one week) mean daily water temperatures regularly exceeded 16°C in the period 2003-2011 (Figure 4, note axis change for 2011 to accommodate the late spawning initiation); spawning initiation was postulated for 2012 based on water temperature. Hatching date distributions were very similar in 2008 and 2009, reflecting the similar flow and temperature regimes in those years. Hatching date and the extent of the reproductive season was much shorter in 2011 when high flows were relatively cool, and hatching did not begin in 2011 until after bass had *finished* hatching in nearly every other year. The 2012 water temperatures suggest a relatively late initiation of hatching as well, and that is supported by capture of very few and relatively small bass in Lodore Canyon in a late-July sampling trip. We are beginning a synthesis of smallmouth bass hatching date distribution data that is expected to be ready in spring 2013.







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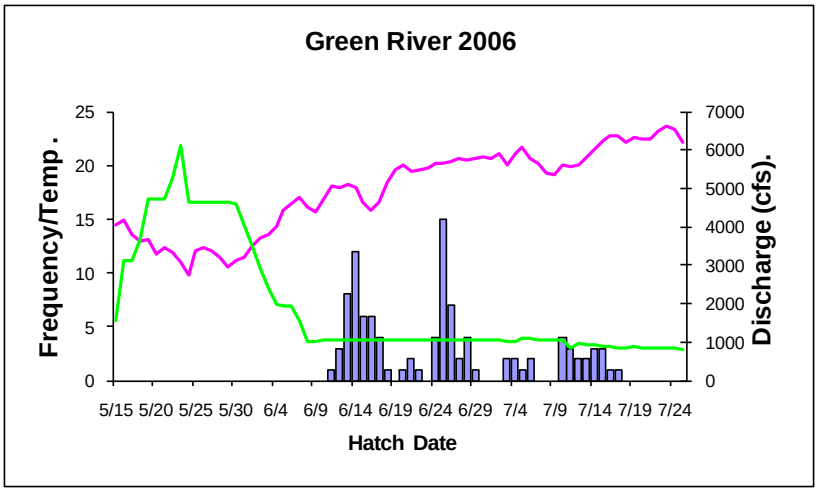

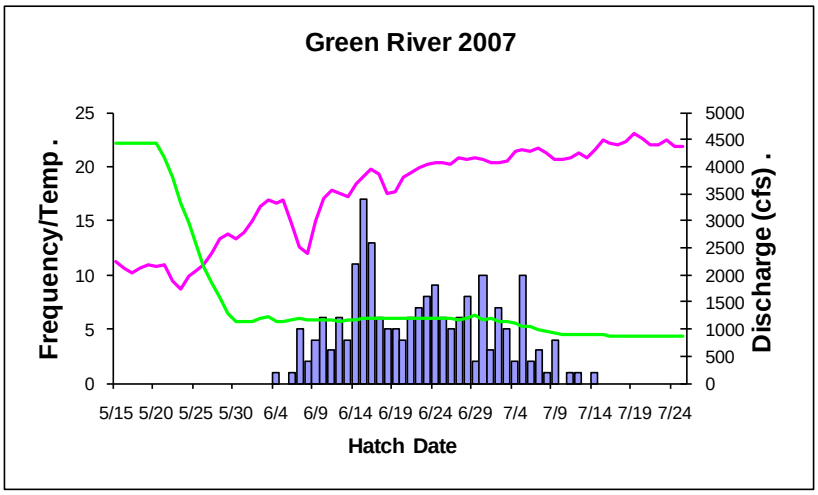

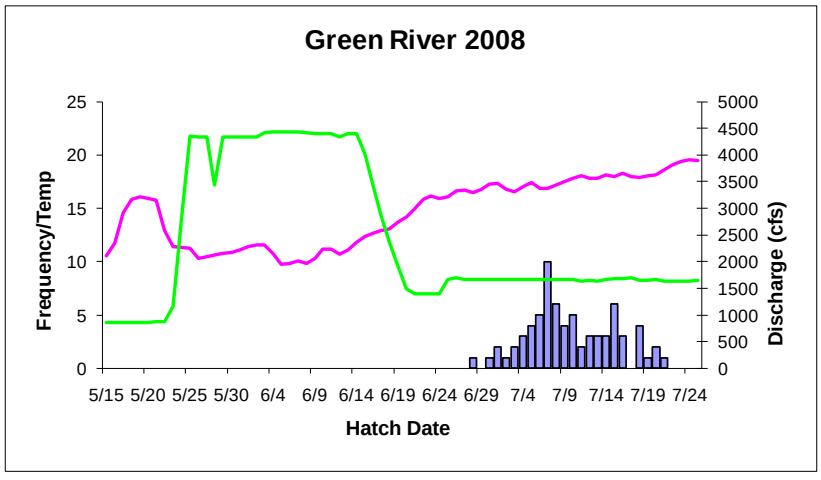

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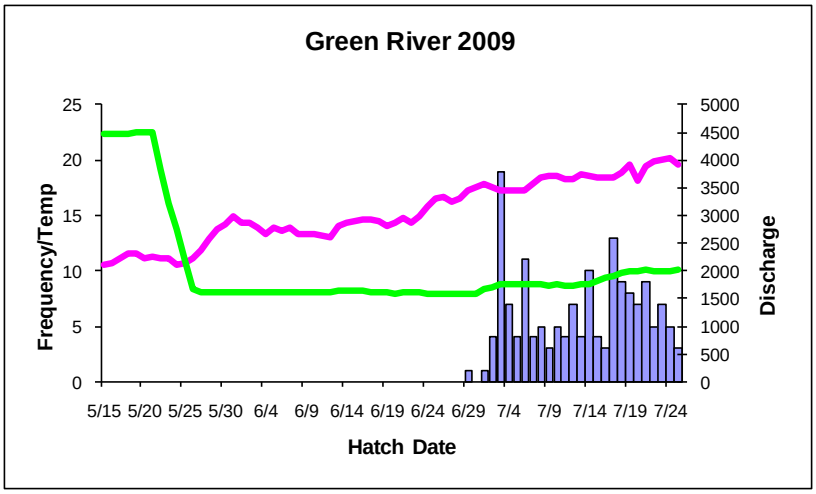

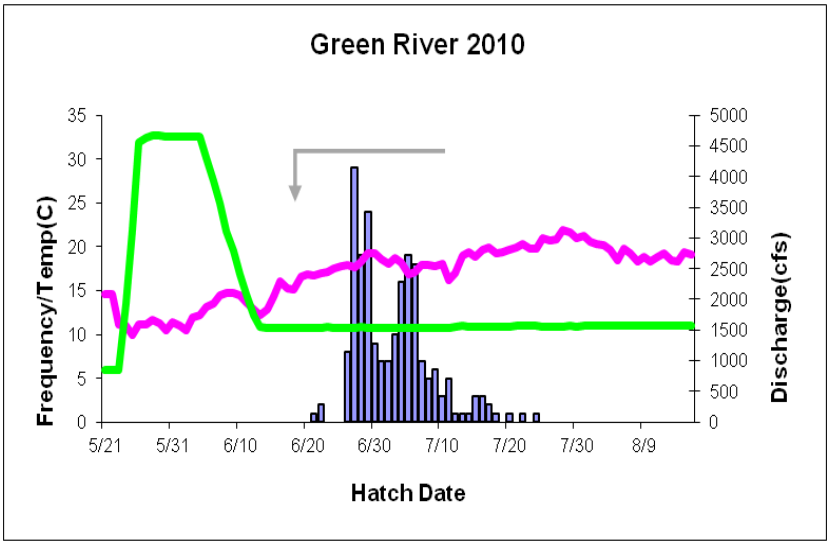

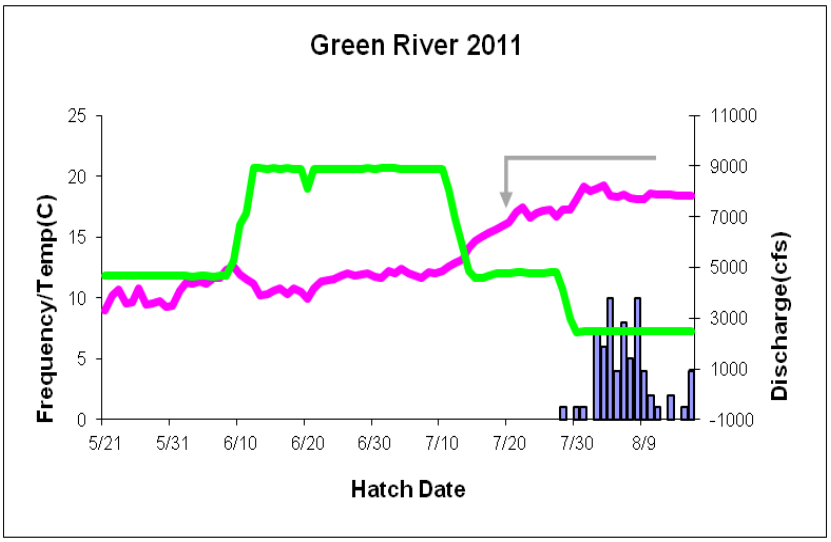

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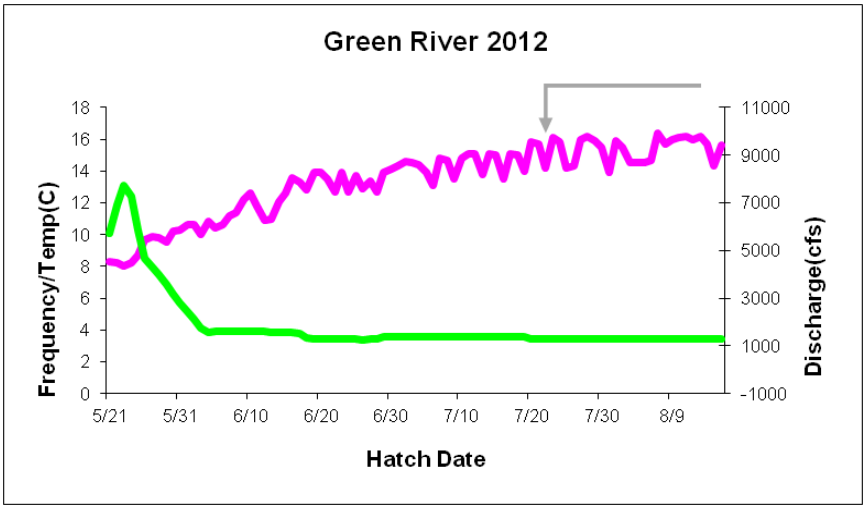

Figure 4.—Distributions of hatching dates of Age-0 smallmouth bass estimated by otolith daily increment analysis, 2003-2009, and first hatching and hatch duration in 2011. Bass were collected from the Green River in Lodore Canyon. Left vertical axis is the frequency of fish in the histograms or water temperature (increasing but variable trace through time, red if in color); right vertical axis is Green River discharge (in cubic feet per second and is depicted by a declining or stable line time, green if in color).

Drift net sampling documented high downstream displacement of small-bodied smallmouth bass during high turbidity and flow events in 2004 and 2007. Such flow and turbidity events may have been responsible for low abundance of smallmouth bass < 100 mm TL in summer 2004, and subsequent low number of Age-1 smallmouth bass in 2005 (data in RIP annual rpts. Badame et al. synthesis report; discussion in Bestgen et al. 2006; 2007). Unfortunately, high flows in 2011 prevented sampling of the Green River because sampling crews were unable to cross the very high Yampa River to reach the Green; drift sampling in 2012 was completed for the entire summer.

Task 4: Sample larval drift and process samples.

Drift samples were collected in the Green River just upstream of the Yampa River during summer 2012. Sampling began on 17 June and extended until 14 August. A total of 177 samples were collected. Sample analysis is not yet complete for 2012 samples.

Task 5: Process preserved samples of small-bodied fish (seine hauls).

We have completed identification of samples and are progressing with 2012 samples.

Task 6: Prepare and submit annual report.

This report.

VIII. Recommendations: Continue with sampling in 2013. Continue preparation of report summarizing the smallmouth bass otolith data and hatching date distributions.

IX. Project Status: On Track and Ongoing.

X. FY 2012 Budget Status

A. Funds Provided: $103,400
B. Funds Expended: $102,338
C. Difference: $1,062
D. Percent of the FY 2012 work completed, and projected costs to complete:
E. Recovery Program funds spent for publication charges:

XI. Status of Data Submission (Where applicable): endangered fish data submitted

XII. Signed: Kevin R. Bestgen 8 November 2012
Principal Investigator Date
(Just put name and date here, since you will be submitting the report electronically)

APPENDIX: *E.g., 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.*

For projects where more than one agency/entity receives funds from the Bureau of Reclamation, append one PPR from each agency/entity. Otherwise, delete.

ANNUAL PERFORMANCE PROGRESS REPORT (PPR)

BUREAU OF RECLAMATION AGREEMENT NUMBER: R09AP40873 / 09-FG-40-2873

UPPER COLORADO RIVER RECOVERY PROGRAM PROJECT NUMBER: FR-115

Project Title: Monitoring effects of Flaming Gorge Dam releases on the Lodore and Whirlpool Canyon fish communities

Principal Investigator: Kevin R. Bestgen, K. Zelasko, C. T. Wilcox, and A. A. Hill.
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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. 2012
Is this the final report? Yes _____ No X

Performance: The Larval Fish Laboratory completed three sampling trips with assistance from the USFWS, Vernal, Utah, on: 9-13 July, 10-13 September, and 24-28 September. Samples were collected and preserved and data on large-bodied fishes was collected. Samples are being identified and data are yet being analyzed, as some information was only recently collected. We also produced an annual report on activities and will prepare presentations based on data at workshops or meetings in December 2012 and January 2013.

ANNUAL PERFORMANCE PROGRESS REPORT (PPR)

BUREAU OF RECLAMATION AGREEMENT NUMBER: R10PG40041

UPPER COLORADO RIVER RECOVERY PROGRAM PROJECT NUMBER: FR-115

Project Title: Monitoring effects of Flaming Gorge Dam releases on the Lodore and Whirlpool Canyon fish communities

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Project/Grant Period: Start date (Mo/Day/Yr): 10/01/2006
End date: (Mo/Day/Yr): 09/30/2012
Reporting period end date (Mo/Day/Yr): 9/30/2012
Is this the final report? Yes __X___ No ____

Performance: USFWS completed assigned portions of tasks 1 and 2. FWS employees provided equipment and assisted with nonnative fish removal and fish community sampling on three trips: 9-13 July, 10-13 September, and 24-28 September.