COLORADO RIVER RECOVERY PROGRAM RECOVERY PROGRAM
FY 2010 ANNUAL PROJECT REPORT PROJECT NUMBER: FR- 115

I. Project Title: Cumulative Effects of Flaming Gorge Dam Releases, since 1996, on the Fish Community in Lodore and Whirlpool canyons, Green River.

II. 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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III. Project Summary: The primary purpose of this study is to determine the cumulative effect that flow and temperature regimes have had on the fish community in Lodore and Whirlpool canyons of the Green River 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.

IV. Study Schedule: 2002-unknown.

V. Relationship to RIPRAP:

Green River Action Plan: Mainstem.

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

VI. Accomplishment of FY 2010 Tasks and Deliverables, Discussion of Initial Findings and Shortcomings:

Task 1: Thermographs

Thermographs 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 on a special trip in November. The Green River upstream of the Yampa River experienced a relatively cool thermal regime in 2008, 2009, and 2010, due to relatively higher flows and cooler weather in late June and July.

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

We completed two electrofishing trips through the study area in 2010, 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 and 2008, 2009; 2010 data is being error checked and is preliminary so is not included in this report.

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 2002-2009 (Tables 1-3). 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 in three periods, 2002-2004, 2005-2006, 2007-2009, reflected a somewhat dynamic community (Table 2). Abundance of all chub species declined rather dramatically since 2002-2004, patterns also reflected by trammel net sampling. Colorado pikeminnow relative abundance remained stable and razorback sucker was very rare. Flannelmouth and bluehead suckers remained abundant, but the latter has apparently declined in abundance over time; flannelmouth sucker has fluctuated somewhat being

more common in 2005-2006 than in other periods. Mountain whitefish, speckled dace, and mottled sculpin have apparently increased in relative abundance, which may be due, in part, to relatively cooler water temperatures, especially in 2008 and 2009.

Abundance patterns of non-native fishes were variable among species over time. Brown trout remained stable from 2002-2009, common carp and channel catfish declined especially in 2008 and 2009, and white sucker and white sucker hybrids increased in abundance, particularly in 2007-2009. Smallmouth bass abundance was lower in 2005-2006, increased in 2007, but declined in 2008 and 2009. Northern pike abundance was lowest in 2002-2004 and 2007-2009, and highest in 2005-2006, but was rare overall.

In 2007-2009, abundance patterns depicted by year showed a general increase in native taxa and a decline in non-native species, but patterns varied in each of Lodore Canyon and Whirlpool Canyon reaches (Table 3, Figure 1). For example, bluehead sucker abundance declined in Lodore Canyon in each year, but was highest in 2008 in Whirlpool Canyon, while abundance of flannelmouth sucker apparently increased over time. Colorado pikeminnow declined in abundance in both reaches over time, especially in 2009. Abundance of roundtail chub was low in all years from 2007-2009, and no bonytail or humpback chub, or razorback or mountain sucker were captured in either reach. Abundance of mountain whitefish, a cool water species, and speckled dace and mottled sculpin increased in 2009 in both reaches.

Non-native brown trout remained relatively abundant in Lodore Canyon in the period 2007-2009 but were uncommon in Whirlpool Canyon, with most captured in the vicinity of relatively cool Jones Creek. Common carp were rare in Whirlpool Canyon relative to Lodore Canyon, and abundance of each declined over the three-year period, while white sucker abundance increased dramatically in Lodore Canyon, perhaps reflecting cooler water temperatures in 2008 and 2009. Channel catfish abundance declined in each reach, especially in 2009. Northern pike abundance remained low in all reaches. Smallmouth bass abundance increased through 2007 since their invasion in 2002, but declined rather dramatically in each reach in 2008 and 2009, compared to 2007, perhaps reflecting, 1) reduced reproductive success when cooler water temperatures prevailed, and 2) increased removal sampling begun in 2007.

These same general patterns over the 2007-2009 period were reflected when viewed across the six main reaches of the study area for the most abundant non-native and potentially predaceous fishes (Fig. 1). Northern pike were most abundant in lower Lodore Canyon and rare elsewhere. Brown trout abundance was highest in upper Lodore Canyon, especially in Reach LD2, which reflected cooler water and abundant riffles and cobble substrate. Smallmouth bass abundance increased in a downstream direction across the six study reaches, but was again much reduced in lower Lodore Canyon and Whirlpool Canyon in 2008-2009 compared to 2007, a warm water year when bass spawned early and small bass were very common. Channel catfish abundance was lowest in upper Lodore Canyon, and in general, was much reduced in 2008 and 2009 in most reaches, compared to 2007.

Table 1.—Tentative list of fishes captured in the Green River, from Browns Park downstream to Rainbow Park with electrofishing, trammel nets, and seining, 2002-2009. 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.

Table 2.—Percent composition of fishes captured in Lodore and Whirlpool canyons, Green River, Colorado and Utah, in three periods, 2002-2004, 2005-2006, and 2007-2009, captured with raft electrofishing gear. Effort is in hours of electrofishing.

	% Relative Abundance		
Species	2002-2004	2005-2006	2007-2009
mountain whitefish	1.0	3.0	6.2
humpback chub	<0.1	0	0
bonytail	0.7	0.1	0
roundtail chub	0.5	0.2	0.2
Colorado pikeminnow	0.3	0.2	0.2
speckled dace	0.2	0.3	0.5
bluehead sucker	18.2	16.6	12.9
flannelmouth sucker	24.9	30.0	21.0
mountain sucker	0	0	0
razorback sucker	0	<0.1	0
mottled sculpin	0.9	0.8	1.3
cutthroat trout	<0.1	0	<0.1
rainbow trout	2.1	1.2	1.3
cutthroat X rainbow trout	<0.1	0	<0.1
brown trout	12.6	11.4	12.0
brook trout	0	<0.1	<0.1
red shiner	0.7	0.6	0.6
common carp	11.3	7.8	5.5
fathead minnow	0	0	0.1
sand shiner	<0.1	<0.1	0.3
redside shiner	<0.1	<0.1	0.4
creek chub	0	0	0
white sucker	5.4	6.6	13.4
bluehead X white sucker	0.4	0.5	0.1
flannelmouth X bluehead sucker	0.9	0.7	0.3
flannelmouth X white sucker	1.9	2.7	2.8
flannelmouth X bluehead X white sucker	0.1	<0.1	0.1
razorback X flannelmouth sucker	<0.1	<0.1	<0.1
black bullhead	<0.1	0	<0.1
channel catfish	10.2	12.3	11.4
northern pike	0.1	0.3	0.1
green sunfish	0.2	0.1	0.2
bluegill	<0.1	0.2	0.1
green sunfish X bluegill	<0.1	0	0
smallmouth bass	7.0	4.1	8.8
black crappie	0.1	<0.1	<0.1
walleye	<0.1	<0.1	<0.1
Total fish	10725	7249	10090
Effort (hours or samples)	151.9	85.2	129.2
# native species	9	9	7
% native species	46.8	51.3	42.3
# non-native species	16	15	18
% non-native species	49.8	44.7	54.3
# hybrid combinations	7	5	6
% hybrid combinations	3.4	4.0	3.4

Table 3.—Percent composition of fishes captured in each of Lodore and Whirlpool canyon reaches, Green River, Colorado and Utah, in 2007-2009, captured with raft electrofishing gear. Effort is in hours of electrofishing.

	% Relative Aundance					
	2007		2008		2009	
Species	Lodore	Whirlpool	Lodore	Whirlpool	Lodore	Whirlpool
mountain whitefish	2.5	0.2	6.1	3.1	9.9	13.7
humpback chub	0	0	0	0	0	0
bonytail	0	0	0	0	0	0
roundtail chub	0.1	0.2	0.4	0.3	<0.1	0.1
Colorado pikeminnow	0.3	0.7	0.4	0.1	0.1	0
speckled dace	0.2	0.1	0.4	0	0.9	1.2
bluehead sucker	12.5	18.6	9.0	34.3	4.1	19.7
flannelmouth sucker	19.4	19.3	25.7	25.0	17.2	28.1
mountain sucker	0	0	0	0	0	0
razorback sucker	0	0	0	0	0	0
mottled sculpin	1.1	0.6	1.3	0.6	1.2	3.2
cutthroat trout	<0.1	0	0	0	0	0
rainbow trout	1.2	2.3	0.1	1.6	0.5	3.6
cutthroat X rainbow trout	0.1	0	0	0	0	0
brown trout	19.1	1.7	13.0	0.3	18.7	1.3
brook trout	0	0	0	0	0.1	0
red shiner	<0.1	0.5	0	0	0.3	3.5
common carp	8.1	4.1	7.2	1.6	5.9	1.9
fathead minnow	0	0	0	0	0.2	0
sand shiner	<0.1	0	0	0	0.3	1.4
redside shiner	0.1	0	0.1	0	1.2	0.5
creek chub	0	0	0	0	0	0
white sucker	10.8	4.0	16.2	2.6	25.8	3.2
bluehead X white sucker	0.3	0	0.1	0	0.1	0.1
flannelmouth X bluehead sucker	0.4	0.3	0.5	0.7	0.2	0.2
flannelmouth X white sucker	4.7	0.4	3.1	2.0	3.5	0.5
flannelmouth X bluehead X white sucker	0.3	0	0	0	<0.1	0
razorback X flannelmouth sucker	0	0.1	0	0	0	0
black bullhead	<0.1	0	0	0	0	0
channel catfish	11.5	19.9	12.5	21.3	4.7	10.1
northern pike	0.2	0	0	0.1	0.2	0
green sunfish	0.3	0.4	0	0	0.1	0.2
bluegill	0	0.1	0	0	0.1	0.2
green sunfish X bluegill	0	0	0	0	0	0
smallmouth bass	6.6	26.6	4.1	6.3	4.5	7.3
black crappie	0	0	0	0	<0.1	0
walleye	<0.1	0.1	0	0.1	0	0.1
Total fish	2286	1535	1371	703	2976	1219
Effort (hours or samples)	26.5	20.3	22.6	14.6	28.1	17.1
# native species	7	7	7	6	7	6
% native species	36.2	39.7	43.2	63.4	33.3	66.0
# non-native species	14	10	7	8	15	12
% non-native species	57.9	59.6	53.1	33.9	62.9	33.3
# hybrid combinations	5	3	3	2	4	3
% hybrid combinations	5.9	0.7	3.7	2.7	3.8	0.7

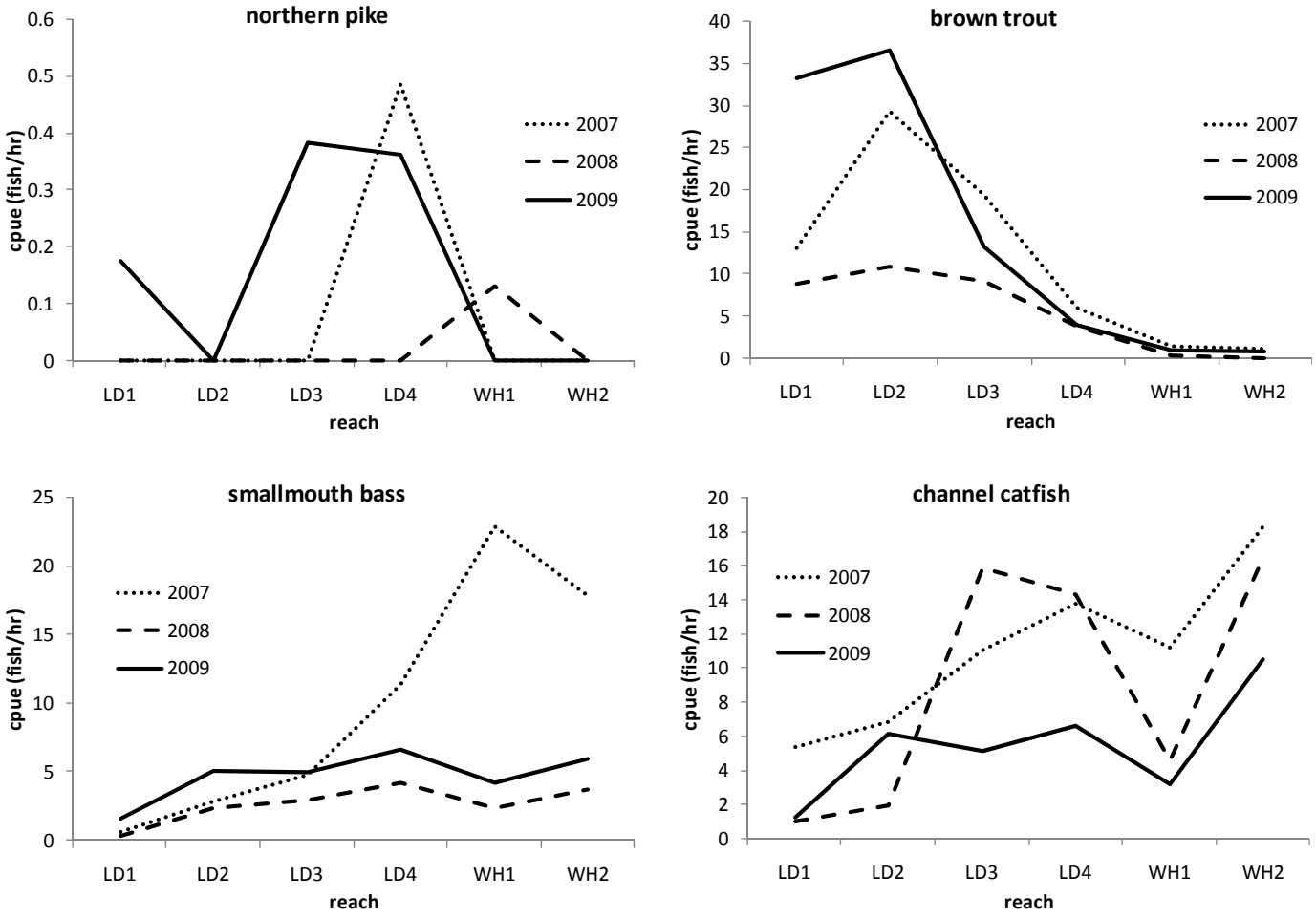


Figure 1.—Number of northern pike, brown trout, smallmouth bass, and channel catfish captured per hour of raft electrofishing effort in four reaches of Lodore Canyon and two reaches of Whirlpool Canyon, Green River, Colorado and Utah, in 2007-2009. Reaches LD1 – LD4 (Lodore Canyon reaches 1-4) and WH (Whirlpool Canyon reaches 1 and 2) are from up to downstream.

Trammel net sampling was generally conducted only once per year and only in Whirlpool Canyon, including in 2009 and 2010. Overall, humpback chub and roundtail chub abundance was diminished substantially in recent years compared to the period 2002-2004 (Bestgen et al. 2006) and 2005 (Table 4). This pattern was similar to that reported for electrofishing sampling. Reduced chub abundance was coincident with invasion and establishment of large populations of smallmouth bass in Lodore and Whirlpool canyons. Recent absence of bonytail in sampling reflected that stocking occurred after our trammel net sampling trips. That no bonytail were recaptured from fish stocked the prior year furthered the notion that they have very low post-stocking survival (Bestgen et al. 2008). Increased chub abundance was detected in 2010 trammel net sampling. However, of the 16 chubs captured (all roundtail chubs) 7 (44%) were recaptures from previous years, indicating that the population remained small.

Table 4.—Number of bonytail, humpback chub, and roundtail chub captured in trammel net sampling in Whirlpool Canyon, Green River, Colorado and Utah, in 2005-2009. Fish of questionable identity are indicated with "?". Most fish were scanned for presence of a PIT tag; "unk" reflects either a recap not noted or fish not scanned for old tags.

	2005		2006			2007		2008			2009		
	recap		recap			recap		recap			recap		
Species	n	y	n	y	unk	n	y	n	y	unk	n	y	total
bonytail	2	35		3			3		3				46
humpback chub		1			1								2
humpback chub?											1		1
roundtail chub	23	5	9	1	3	5		10	2	1	3		62
roundtail chub?											1		1
total	25	41	9	4	4	5	3	10	5	1	5		112

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 2010. All summer samples have been identified and we have begun identification of autumn samples. We collected young-of-year northern pike in Browns Park again in spring and summer 2010, indicating successful reproduction by that species in that reach.

Similar to electrofishing samples, percent composition of small-bodied fishes captured in seine samples was variable over three periods, 2002-2004, 2005-2006, and 2007-2008 in the study area (Tables 5 and 6). The study area included Browns Park, Lodore Canyon, Whirlpool Canyon, and Island-Rainbow Park reaches, from upstream to downstream. Higher relative abundance of mountain whitefish in the 2002-2004 period reflected inclusion of spring samples, during which that species was more abundance. Post-2004 samples do not include spring sampling. Colorado pikeminnow were present but rare in seine samples in all periods, but relative abundance of most other native species, including roundtail chub, speckeld dace, and flannelmouth sucker, increased over time. Bluehead sucker was most abundant in 2005-2006. Abundance of native fishes increased from just over 7% in 2002-2004 to about 20% in the latter two periods.

Similarly, percent composition of non-native fishes declined after 2002-2004. The biggest decline was by red shiner and fathead minnow, while redside shiner and sand shiner remained relatively stable. White sucker abundance in seine samples increased over time, a pattern similar to that observed for white sucker captured with electrofishing. Fewer samples in the two more recent periods reflected fewer years in the sampling period, as well as the fewer number of backwaters to sample in those higher water years compared to 2002-2004.

In 2007-2008, native fish abundance was usually highest in Lodore Canyon and Island-Rainbow Park reaches, followed by Browns Park, and Whirlpool Canyon. Mountain whitefish were more abundant upstream than downstream, and roundtail chub abundance was opposite that pattern. Roundtail chub abundance was especially high in Lodore and Whirlpool canyons in 2008, but mostly in summer samples; chubs were rarer in seine samples collected in autumn. We captured large numbers of roundtail chub young (1000's) in Whirlpool Canyon backwaters in summer 2010 following a rainstorm and subsequent turbidity event. Colorado pikeminnow were rare in seine samples in all reaches, and speckled dace abundance varied over reaches and years. Bluehead sucker abundance increased from up to downstream but were much more abundant in 2007 than 2008. Flannelmouth sucker showed a mostly opposite distributional pattern as they were more abundant upstream than downstream. We collected specimens in most reaches in 2007 that were suspected razorback suckers.

In 2007-2008, non-native fish abundance was usually lowest in Lodore Canyon and Island-Rainbow Park reaches, and higher in Browns Park and Whirlpool Canyon. Red and sand shiners were present in nearly every reach and increased dramatically in abundance from up to downstream, while fathead minnow and redside shiner were more abundant upstream than downstream. White sucker abundance was very high upstream, and particularly so in 2008. Smallmouth bass were not captured in Browns Park in 2007 or 2008, and were variably abundant

in the remaining reaches in those two years. Reproduction by bass was much delayed in 2008 when water temperatures were cooler.

Table 5.—Percent composition of fishes in seine samples collected in the study area, Browns Park, Lodore Canyon, Whirlpool Canyon, and Island-Rainbow Park, Green River, Colorado and Utah, in 2002-2004, 2005-2006, and 2007-2008 sampling periods.

	% Relative Abundance		
Species	2002-2004	2005-2006	2007-2008
mountain whitefish	1.7	<0.1	0.1
humpback chub	0	0	0
bonytail	<0.1	0	0
roundtail chub	0.2	0.9	3.1
Colorado pikeminnow	<0.1	<0.1	<0.1
speckled dace	1.0	4.2	3.5
bluehead sucker	1.3	10.3	5.0
flannelmouth sucker	3.1	7.4	7.6
mountain sucker	0	0.3	0
razorback sucker?	0	0	<0.1
mottled sculpin	0.1	<0.1	0.1
rainbow trout	<0.1	<0.1	0
brown trout	<0.1	<0.1	<0.1
brook trout	0	<0.1	0
red shiner	43.6	28.3	27.2
common carp	0.3	0.2	0.3
fathead minnow	10.4	4.4	4.5
sand shiner	26.2	27.6	23.7
redside shiner	6.7	4.5	6.3
creek chub	<0.1	<0.1	<0.1
unidentified minnow	<0.1	0	<0.1
white sucker	4.4	9.1	14.6
bluehead X white sucker	<0.1	<0.1	<0.1
flannelmouth X bluehead sucker	<0.1	<0.1	<0.1
flannelmouth X white sucker	0.1	0.3	1.0
flannelmouth X bluehead X white sucker	0	<0.1	<0.1
razorback sucker hybrid	<0.1	0	0
Utah sucker?	0	0	<0.1
unidentified sucker	0.1	<0.1	0.1
black bullhead	<0.1	<0.1	<0.1
channel catfish	<0.1	0	<0.1
northern pike	<0.1	<0.1	<0.1
plains killifish	<0.1	<0.1	<0.1
Iowa darter	0	0	<0.1
brook stickleback	<0.1	<0.1	<0.1
green sunfish	0.6	0.1	1.4
bluegill	<0.1	0.2	0.3
green sunfish X bluegill	0	0	<0.1
smallmouth bass	0.2	1.9	1.3
black crappie	<0.1	<0.1	0
Total fish	193264	59301	61276
Effort (samples)	800	365	308
# native species	8	8	8
% native species	7.4	23.2	19.3
# non-native species	18	18	18
% non-native species	92.3	76.4	79.6
% unidentified species	0.1	<0.1	0.1
# hybrid combinations	4	4	5
% hybrid combinations	0.2	0.4	1.0

Table 6.— Percent composition of fishes in seine samples collected in Browns Park, Lodore Canyon, Whirlpool Canyon, and Island-Rainbow Park, Green River, Colorado and Utah, in 2007-2008.

	2007				2008			
Species	BP	LD	WH	IRP	BP	LD	WH	IRP
mountain whitefish	0.1	<0.1	0	0	0.8	0.1	0	0.1
humpback chub	0	0	0	0	0	0	0	0
bonytail	0	0	0	0	0	0	0	0
roundtail chub	0	0.3	2.1	4.6	0	5.0	4.9	1.4
Colorado pikeminnow	0	0	0	<0.1	0	0	0	0
speckled dace	8.0	3.2	0.3	5.1	2.5	6.4	0.9	1.9
bluehead sucker	0.8	3.5	7.7	10.1	0.5	2.7	2.6	6.8
flannelmouth sucker	11.9	18.8	2.2	2.7	8.7	12.1	1.2	5.2
mountain sucker	0	0	0	0	0	0	0	0
razorback sucker?	<0.1	0	<0.1	<0.1	0	0	0	0
mottled sculpin	0.1	0.1	0	0	0	0.2	<0.1	0.1
rainbow trout	0	0	0	0	0	0	0	0
brown trout	0.3	<0.1	0	0	<0.1	0	0	0
brook trout	0	0	0	0	0	0	0	0
red shiner	0.2	26.2	50.5	41.8	0.5	8.3	27.2	28.7
common carp	1.4	0.6	0.1	<0.1	<0.1	0.2	0.5	0.1
fathead minnow	17.7	7.2	0.4	0.6	18.6	5.8	1.9	0.7
sand shiner	0	5.8	31.4	31.2	<0.1	13.2	46.7	43.9
redside shiner	25.5	2.3	0.3	0.1	14.8	13.8	6.9	0.2
creek chub	0	<0.1	0	0	0	<0.1	0	0
unidentified minnow	0.1	0	0	<0.1	0	<0.1	0	0
white sucker	30.6	19.3	3.5	2.3	51.0	26.9	5.1	8.7
bluehead X white sucker	0	<0.1	0	<0.1	0.1	<0.1	<0.1	0
flannelmouth X bluehead sucker	0	<0.1	0	<0.1	0	<0.1	0	0
flannelmouth X white sucker	2.8	3.6	0.2	0.2	0.8	0.8	0.2	0.6
flannelmouth X bluehead X white sucker	0	0	0	0	0	<0.1	0	0
razorback sucker hybrid	0	0	0	0	0	0	0	0
Utah sucker?	0	<0.1	<0.1	0	0	0	0	0
unidentified sucker	0.3	0.1	0	0	0	0.1	0	0.4
black bullhead	0	<0.1	<0.1	0	0	0	<0.1	0
channel catfish	0	<0.1	<0.1	0	0	0	<0.1	0
northern pike	0	0	0	0	0.5	0	<0.1	0
plains killifish	0	0.1	0	<0.1	0	<0.1	0.1	0.1
Iowa darter	0	0	0	0	0	0	<0.1	0
brook stickleback	0	0	0	0	0	0	<0.1	0
green sunfish	0.3	8.0	<0.1	<0.1	1.2	0.7	0.3	0.1
bluegill	0	0	0	0	0	0.8	0.8	0
green sunfish X bluegill	0	0	0	0	0	<0.1	0	0
smallmouth bass	0	0.7	1.3	1.3	0	2.8	0.6	0.9
black crappie	0	0	0	0	0	0	0	0
Total fish	2927	8749	10768	10786	2792	13294	8890	3070
Effort (samples)	18	63	50	29	22	77	33	16
# native species	6	6	5	6	2	6	5	6
% native species	20.9	25.8	12.3	22.4	12.4	26.5	9.7	15.6
# non-native species	7	14	11	9	9	11	15	9
% non-native species	75.9	70.4	87.5	77.3	86.7	72.5	90.1	83.4
% unidentified species	0.4	0.1	0	<0.1	0	0.1	0	0.4
# hybrid combinations	1	3	1	3	2	5	2	1
% hybrid combinations	2.8	3.7	0.2	0.3	0.9	0.9	0.2	0.6

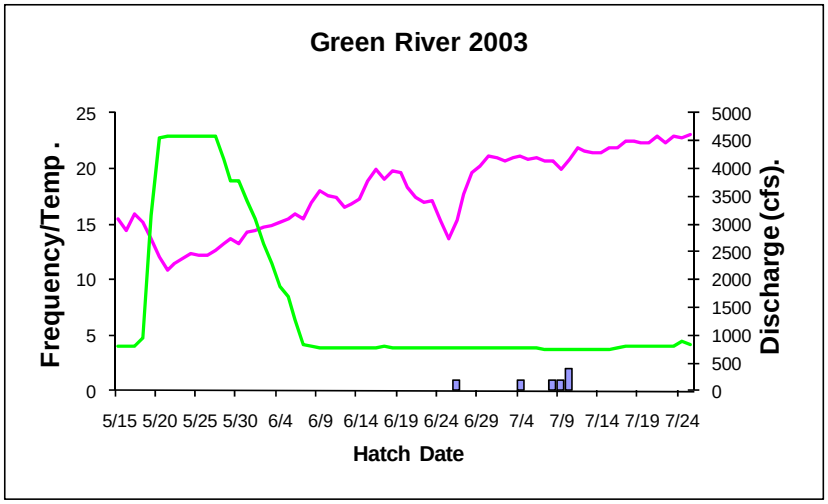
An additional task in this scope of work was to analyze otoliths from age-0 smallmouth bass captured in the Green River study area. This work will assist with understanding smallmouth bass spawning periodicity to assist with disruption of reproduction of that species via flow releases from Flaming Gorge 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.

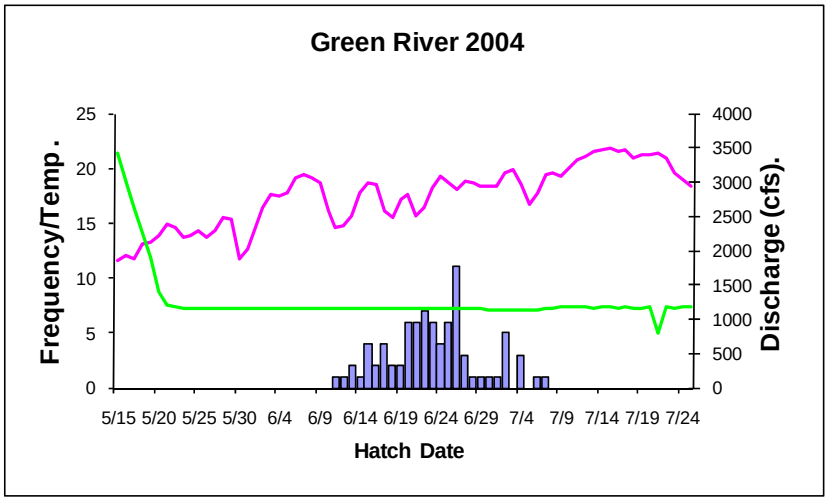
Portions of this work were reported at the January 2010 Researchers Meeting; we have since added data for 2009 samples. These results were also presented at the 2010 Larval Fish Conference in Santa Fe, New Mexico.

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 mean daily water temperatures regularly exceeded 16°C in the period 2003-2009 (Figure 2). Hatching date distributions were very similar in 2008 and 2009, reflecting the similar flow and temperature regimes in those years. In the Yampa River, onset of the smallmouth bass hatching period started just before mean daily water temperatures regularly exceeded 16°C. Peak hatching in the Green River occurred about 2-3 weeks after first bass hatched. The duration of the spawning season was relatively brief, usually about 4 weeks.

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).

We have finished analysis of otoliths of smallmouth bass collected from the Green River for 2009 and plan to begin analyses of bass otoliths captured in 2010 (and Yampa, project 140).





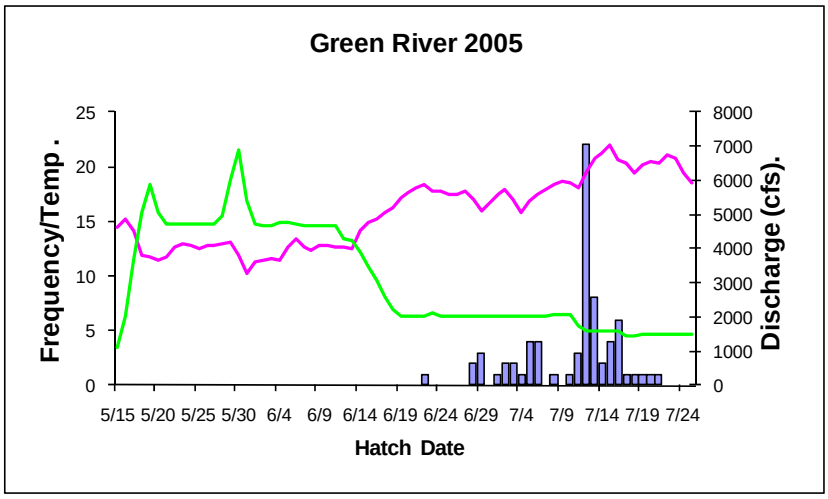
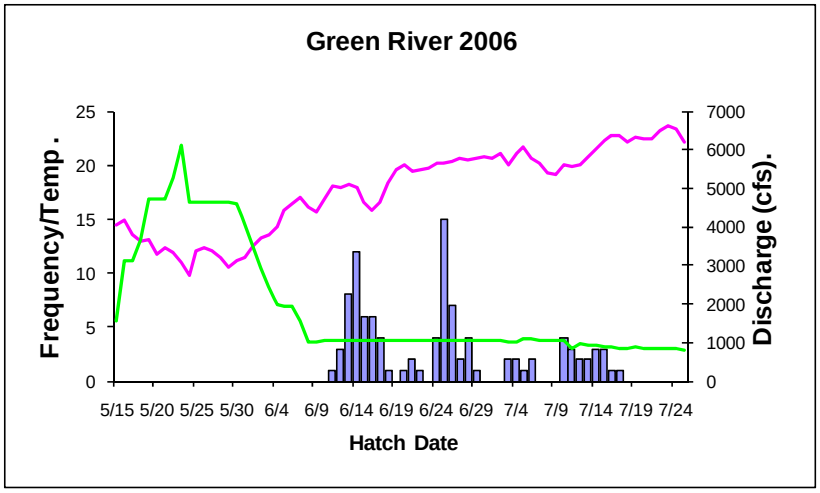
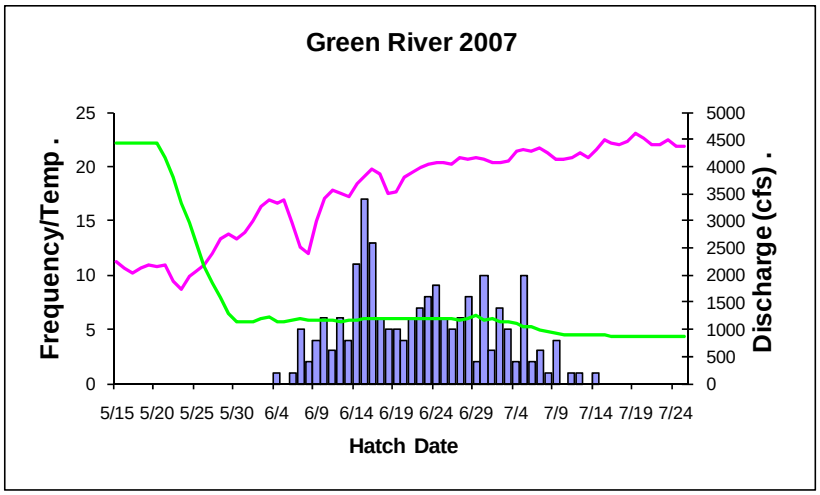


Figure 2 continued below.





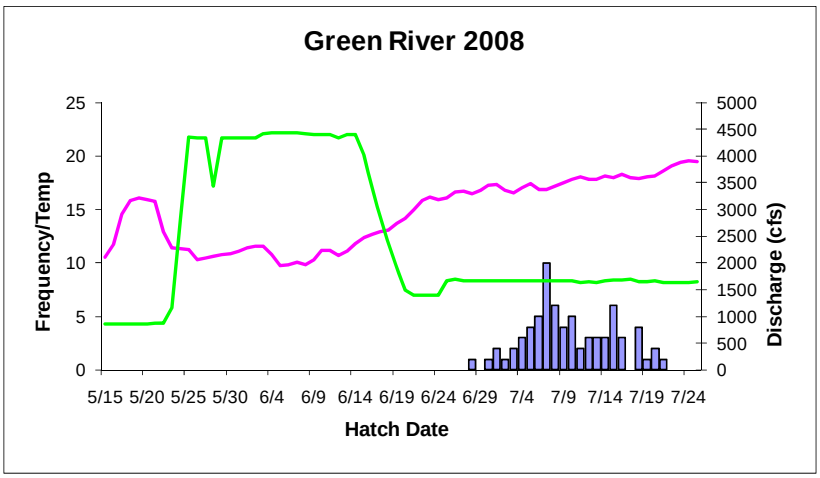


Figure 2 continued below.

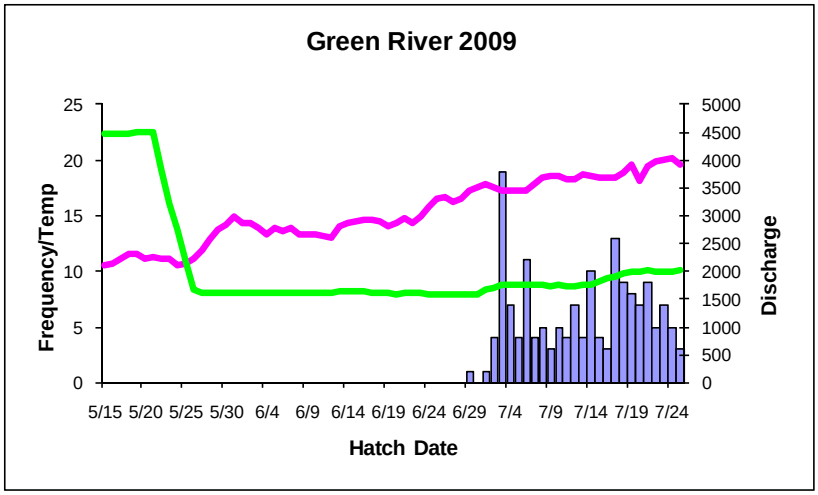


Figure 2.—Distributions of hatching dates of Age-0 smallmouth bass estimated by otolith daily increment analysis, 2003-2009. Bass were collected from the Green River in Lodore Canyon. Left vertical axis is the frequency of fish in the histograms or water temperature (increasing but variable trace through time, green 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).

Task 4: Sample larval drift and process samples.

Drift samples were collected in the Green River just upstream of the Yampa River during summer 2010. Sampling was begun relatively late in July compared to other years because Yampa River flows remained high. No endangered fishes were captured in the Green River, Echo Park, drift net samples in 2010.

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

We have completed identification of 2009 seine samples and are progressing with 2010 samples.

Task 6: Prepare and submit annual report.

This report.

VII. Recommendations: We saw a strong fish community response to drought conditions in the study area in 2002 to 2004, with increased abundance of smallmouth bass and continued upstream dispersal of red shiners into Browns Park. In 2008 and 2009, data show declines in abundance of non-native predaceous fishes, including smallmouth bass, declined perhaps due to reduced reproductive success as well as increased removal of bass in the Whirlpool Canyon reach. Observations based on sampling in 2010 show a continued trend but firm conclusions await final data compilation. Because of ongoing

fish community changes in Lodore and Whirlpool canyons, we will be recommending continued removal of non-native fishes and monitoring of the remainder of the fish community in that reach in 2011 and beyond. Continued drift sampling is also recommended because of captures of early life stages of endangered fishes in 2006, and because that technique documented downstream dispersal of young bass during higher flow and turbidity events.

VIII. Project Status: Ongoing and on track.

IX. FY 2010 Budget Status

A. Funds Provided: $86,720
B. Funds Expended: $78,613
C. Difference: $8,107, these funds are needed to finish identification of samples collected in 2009 and 2010.
D. Percent of the FY 2010 work completed, and projected costs to complete: about 85% completed.
E. Recovery Program funds spent for publication charges:

X. Status of Data Submission (Where applicable): Copy of data will be sent to the database manager in January.

XI. Signed: Kevin R. Bestgen — Principal Investigator; 14 Nov. 2010 — Date

BESTGEN, K. R., K. A. ZELASKO, R. I. COMPTON, AND T. CHART. 2006. Response of the Green River fish community to changes in flow and temperature regimes from Flaming Gorge Dam since 1996 based on sampling conducted from 2002 to 2004. Final report, Upper Colorado River Basin Endangered Fish Recovery Program, Denver, Colorado. Larval Fish Laboratory Contribution 144.

Bestgen, K. R., K. A. Zelasko, and C. T. Wilcox. 2007. Non-native fish removal in the Green River, Lodore and Whirlpool canyons, 2002-2006, and fish community response to altered flow and temperature regimes, and non-native fish expansion. Final report to the Recovery Implementation Program for Endangered Fishes in the Upper Colorado River Basin. U. S. Fish and Wildlife Service, Denver, CO. Larval Fish Laboratory Contribution 149.

Bestgen, K. R., K. A. Zelasko, R. I. Compton, and T. Chart. 2008. Survival, condition, habitat use, and predation on stocked bonytail in the Green River, Colorado and Utah. Southwestern Naturalist 53:488-494.