

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, CSU; Bureau of Reclamation; U.S. Fish and Wildlife Service

Jointly Submitted by: Larval Fish Laboratory, CSU; 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. 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: 2002-2007.

V. Relationship to RIPRAP:

Green River Action Plan: Mainstem.

III.A.1. Determine relationship between Flaming Gorge test flows and the fish community in Lodore Canyon.

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

Task 1: Thermographs

Thermographs data will be provided by George Smith, U.S. Fish and Wildlife Service, Denver, and by Dr. Mark Vinson, Utah State University, at up to 10 other localities in the Green River. The Green River upstream of the Yampa River experienced a warm thermal regime in 2006, due to relatively low flows and warm 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 2006, as prescribed in the study proposal. We captured all endangered fish species during 2006 surveys including Colorado pikeminnow, humpback chub, bonytail and a likely razorback sucker (Table 1, in part). Capture rates from 2005 and 2006 showed a large decline in the number of black crappie in 2006 (Table 2), a species only rarely observed in prior years. Northern pike also declined in abundance in electrofishing captures and most are taken in the Green River just upstream of the confluence with the Yampa River. Those were all adult fish and several were recaptures of fish tagged from the middle Yampa River. Northern pike were also found in upstream Browns Park in each year, 10 in 2005, and 11 in 2006. Browns Park fish were all age-0 (190-280 mm TL, in August 2006) and were found from RM's 375.1 to 381.1, and one was captured near the Lodore Canyon boat ramp, RM 363. In 2006 we also captured smallmouth bass in Browns Park (not in 2005 or before). Those 30 fish were age-0 as well (47-73 mm TL) and were found from RM's 372.5-375.1.

Table 1.-Tentative list of fishes captured in the Green River, from Browns Park downstream to Rainbow Park with electrofishing, trammel nets, and seining, 2002-2006. N = native, I = introduced. Brook trout was a new species 2006.

	Status	Electrofishing	Trammel netting	Seining
Mountain whitefish	N	X		X
Humpback chub	N		X	
Bonytail	N	X	X	X <sup>1</sup>
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		
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
Common carp	I	X	X	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
Green sunfish	I	X		X
Smallmouth bass	I	X	X	X
Walleye	I	X		

Table 2.—Comparison of electrofishing capture rates (fish/hr electrofishing) of various nonnative fishes, including predaceous kinds, and number of fish removed (parenthetically) in the Lodore and Whirlpool Canyon reaches of the Green River, 2005 and 2006. Brown trout were not removed but shown to represent their abundance relative to the other species captured.

	2005	2006
Black crappie	0.79 (62)	0
Bluegill	0.09 (7)	0.04 (4)
Brown trout	5.2 (411)	4.6 (410)
Northern pike	0.20 (16)	0.09 (8)
Common carp	3.7 (288)	2.7 (242)
White sucker	3.4 (269)	1.7 (151)
Channel catfish	4.3 (339)	6.2 (555)
Green sunfish	0.70 (55)	0.02 (2)
Smallmouth bass	1.8 (140)	1.8 (159)
Walleye	0	0.03 (3)

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. We are in the process of identifying those samples. Relatively few fish were collected in samples from Lodore Canyon compared to Whirlpool Canyon. We have finished identification of summer seine samples and are progressing with autumn samples.

Small-bodied smallmouth bass *Micropterus dolomieu* were found in backwaters throughout Whirlpool Canyon and are now present throughout Lodore Canyon in 2006. We captured smallmouth bass in backwater habitat in Lodore as small as 12-20 mm TL in July samples, which suggested reproduction by that species in that reach. We also detected many young smallmouth bass in seine samples in Whirlpool Canyon and in the Rainbow-Island Park reach.

A significant new finding in 2006 was detection of smallmouth bass in seine samples in Browns Park. Samples collected in both summer and autumn detected the species about 10 river miles upstream of Lodore Canyon and about 11 river miles upstream of the previously known most upstream location.

**Northern pike habitat reconnaissance and sampling:** This item was added at the request of the Program Director's office because northern pike reproduction was detected in autumn 2005 in Browns Park. The first facet of this investigation was to assess the habitat available for northern pike in Browns Park (from Little Hole (about 12 RK downstream of Flaming Gorge Dam) downstream to Lodore boat ramp, about 62 RK).

We first scanned aerial maps and interviewed personnel from Browns Park National Wildlife Refuge and the Browns Park Waterfowl Management Area to assess potential river-floodplain connections and areas where pike may have access to spawning areas. We also contacted the State of Utah fishery biologist (R. Schneidervin) for the Flaming Gorge Dam tailwater trout fishery to determine how many northern pike have been detected in their sampling or creel surveys.

Browns Park habitat was observed in spring during high releases from Flaming Gorge Dam, including the 6600 cfs level. Those flows were released to improve flood plain connections to the river to enable studies of razorback sucker larvae entrainment into floodplain wetlands. The findings of this survey and associated fish sampling in August designed to further understand northern pike distribution is attached in an appendix. Briefly, no connections between the river at high flow and flood plain ponds or wetlands were observed during high spring flows. Available floodplain wetlands were at higher elevations than the river or had insurmountable barriers to upstream dispersal that would limit fish movements. Observations also showed that few of the wetlands even supported fish populations. Our conclusion from this is that northern pike spawning in Browns Park must be conducted in flooded vegetation during high flows or more likely, earlier, in rooted aquatic macrophytes in backwaters and channel margins. That sort of habitat is relatively abundant in the Browns Park reach of the Green River.

Sampling in August was conducted at 30 sites with an electric seine in a 10 mile river reach from upstream of Swinging Bridge downstream to the Refuge headquarters boat ramp. Sampling focused on areas likely to support small pike, and included backwaters and low-velocity channel margins that were vegetated. This reach surrounded the sites upstream and downstream of where pike were found in 2005. Sampling revealed continued presence of young of year northern pike in the reach, indicating successful spawning again in 2006 (details above). Pike were not found upstream of the most upstream distribution point in 2005. We also detected smallmouth bass reproduction in the reach (see above). A small pike was also captured downstream near the Gates of Lodore boat ramp, indicating a relatively broad reproduction and distribution of small northern pike.

High flows in spring may be useful to scour rooted aquatic macrophytes in the Green River in Browns Park and disperse small northern pike into unsuitable habitat that may reduce their survival.

Task 4: Sample larval drift and process samples.

Drift samples were collected in the Green River just upstream of the Yampa River from 9 July to 10 August 2006. A total of 99 samples was collected. In general, fish were few in samples compared to drift net samples collected in the nearby Yampa River. Significantly, on July 13, 2006, we collected two Colorado pikeminnow larvae in the Green River in Lodore Canyon, which is upstream of the Yampa River confluence. Colorado pikeminnow spawning has not been documented in the Green River upstream of the Yampa River since before closure of Flaming Gorge Dam in 1962. In those

samples, we captured two Colorado pikeminnow larvae (each about 9 mm TL), one in each of two samples collected on 13 July. Identity of Green River pikeminnow larvae was verified by four of us (D. Snyder, D. Davis, S. Seal myself) and based on specimen characteristics (myomere counts, pigment patterns, size and developmental state), there was no question about the veracity of identifications. The Green River sampling site is located about 0.5 km upstream from the Yampa so there is little possibility that larvae produced in the nearby Yampa River could swim upstream and be subsequently captured in Green River nets. This finding verifies suspicions we have had in the recent past about Colorado pikeminnow spawning in the Lodore Canyon reach, because in at least two years since 2000, ripe or tuberculate male Colorado pikeminnow were found there in summer, but no pikeminnow larvae were found in our drift net samples in each of those years.

Anticipating the possibility that Colorado pikeminnow may spawn in the Green River upstream of the Yampa River, we have always taken care to ensure that Green River samples are not contaminated with nearby Yampa River fish, and vice versa. The pertinent details of our protocol are below, which are closely followed by our trained technicians. Nets and net buckets for daily sampling in each of the Green and Yampa rivers are dedicated to that river for the duration of the sampling season. That practice removes the small chance that a Yampa River fish larva might adhere to the drift net or sample bucket and be mixed with a sample from the Green River. After labeled samples are preserved each morning at the sampling site, Green River nets are stowed on site and samples are picked in camp by technicians. Green River samples are picked first each day, which removes the small chance that fish from Yampa River samples, where pikeminnow larvae are expected, might adhere to sorting trays or equipment and be mistakenly placed into Green River sample containers. Only a single sample is picked at a time by the two technicians ensuring that no fish could be inadvertently placed in the wrong container and each original sample label is placed in the container with the specimens when sample sorting is complete. On 13 July, we also collected pikeminnow larvae (56 total) from each of the three samples collected in the Yampa River, further ensuring that samples were not mislabeled or confused. One of the technicians also recalls picking three larvae (including the two pikeminnows) from the Green River samples and thinking it odd, because fish larvae in Green River samples were comparatively rare in most samples in 2006, and particularly so for fish the size of pikeminnow (most are larger catostomid larvae). Finally, fish from the Green River are usually stained a bit darker than Yampa fish. This is because pigment from the green algae present in Green River samples is washed out by the ethanol preservative and absorbed in the epidermis of the fish, even though samples are usually picked within a few hours of collection. Yampa River larvae captured in drift net samples are not stained because little or no algae is ever present in those samples. The two pikeminnow larvae from the Green River were stained slightly darker than typical pikeminnow larvae from Yampa samples, and could be differentiated easily by an observer who was not privy to the details of the samples. These details outlining our techniques and observations are offered in advance of some of the questions that might arise from this finding. We are now confirming identity of other larvae in samples collected in 2006. We have a potential razorback sucker specimen that we are now confirming the identity of with radiographs of skeletal features including the interneural bones.

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

We have completed identification of 2005 seine samples and are progressing with 2006 samples.

Task 6: Prepare and submit annual report.

This report.

