

FY-2006-2007 PROPOSED SCOPE OF WORK for:

Project #: 115

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

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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Category:

- Ongoing project
- Ongoing-revised project
- Requested new project
- Unsolicited proposal

Expected Funding Source:

- Annual funds
- Capital funds
- Other (explain)

I. Title of Proposal:

Monitoring Effects of Flaming Gorge Dam releases on the Lodore/Whirlpool fish community

II. Relationship to RIPRAP:

Green River Action Plan: Mainstem

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

III. Study Background/Rationale and Hypotheses: In FY01, the Recovery Implementation Program (RIP) revised the RIP Recovery Action Plan to include evaluating and revising, as needed, flow recommendations for the endangered fish throughout the Upper Colorado River Basin. Flaming Gorge Flow and Temperature Recommendations (FGFTR; Muth et

al. 2000) were approved by the RIP in FY01. Long-term implementation of these recommendations is pending; a Record of Decision is expected in 2005.

An expectation of implementation of new flow and temperature recommendations is that native and endangered fishes will benefit via expanded distribution and abundance. It is also possible that new flow and temperature regimes for native endangered fishes may also enhance distribution and abundance of certain nonnative fishes. This is a major concern of managers of the Colorado River in Grand Canyon, where a large population of endangered humpback chub (*Gila cypha*) already exists. There, the decision to enhance the riverine thermal regime to benefit mainstem populations of humpback chub needs to be weighed against potential increases in populations of nonnative fish which may compete with or prey upon native fish, including chubs. Similarly, effects of full implementation of new flow and temperature regimes of the Green River downstream from Flaming Gorge Dam need to be evaluated to determine relative benefits to native and endangered fishes and other non-native elements of the fish community.

The proposed monitoring study is a logical extension of work conducted by Bestgen and Crist (2000) and more recent sampling in 2002 to 2004 (report in preparation). That recent work was conducted to evaluate changes in the fish community that occurred since 1996 in response to partial implementation of new flow recommendations. Aspects of the new flow and temperature recommendations that were realized since 1996 were relatively higher spring peak flows in 1997 and 1999 and low and warm flows in the summer season from 2002 to 2004. A number of changes in the fish community were observed during recent sampling in 2002 to 2004. Those included an expanded population of smallmouth bass *Micropterus dolomieu* in Lodore and Whirlpool canyons, and reproduction by that species in Lodore Canyon in 2004. We also detected upstream expansion of red shiner *Cyprinella lutrensis* in 2002, and upstream expansion of channel catfish *Ictalurus punctatus*.

We also made interesting observations of native fishes during the 2002-2004 sampling. Recent sampling and telemetry work (Kitcheyan and Montagne 2005 draft report) during that same time revealed increased use of Lodore Canyon in summer by Colorado pikeminnow *Ptychocheilus lucius*. Seine sampling in lower Lodore Canyon in summer 2003 captured an early juvenile razorback sucker *Xyrauchen texanus* x white sucker *Catostomus commersoni* hybrid (29 mm TL), which indicated attempted reproduction by razorback suckers there in spring or early summer 2003. We also detected continued presence of humpback chub *Gila cypha* in Whirlpool Canyon in 2002, 2003, and 2004, along with a relatively large population of roundtail chub *Gila robusta*. We also captured (N = 16 scanned for PIT tags) or observed (N = 60) bonytail *Gila elegans* in autumn 2004 in the Green River from the Echo Park boat ramp to downstream about 11 km a short time after their stocking at Echo Park.

An ongoing understanding of shifts in distribution and abundance patterns of native/endangered and nonnative fishes associated with Flaming Gorge operations will provide managers with information necessary to assess effects of full implementation of new flow and temperature recommendations. Of particular interest are continued

assessment of recent changes in distribution and abundance of predaceous species such as smallmouth bass and other native fishes. This adds information to a continued management process (along with other ongoing studies downstream) that addresses uncertainties in flow and temperature recommendations that may affect the fish community (Muth et al. 2000).

IV. Study Goals, Objectives, End Product:

Goal: Remove non-native fishes and determine if changes in Green River flow and thermal regimes are associated with changes in distribution and abundance patterns of native and nonnative fishes in Browns Park, Lodore and Whirlpool canyons, and Island-Rainbow Park.

Objective 1. Remove non-native fishes and determine if shifts in distribution and abundance of large-bodied fishes have occurred in Lodore Canyon and Whirlpool Canyon by comparing the results of shoreline electrofishing and trammel net surveys with the results of previous studies, particularly Bestgen and Crist (2000) and results of the 2002-2004 study.

Objective 2. Remove non-native fishes and determine if shifts in the distribution and abundance of small-bodied fishes have occurred in Brown's Park, Lodore and Whirlpool canyons, and Island-Rainbow Park by comparing results of low-velocity, nearshore seining with the results of previous studies, particularly Bestgen and Crist (2000) and results of the 2002 to 2004 study.

Objective 3. Determine if Colorado pikeminnow spawn in the Green River upstream from the Yampa River confluence by sampling with drift nets in lower Lodore Canyon, and by summer sampling to determine presence of ripe adults. Drift net sampling will be done only occasionally when Green River flows are low and warm (conditions when pikeminnow spawning might be expected) and will be done in conjunction with drift-net sampling in the Yampa River (project 22f).

Objective 4. Analyze hydrological records as recorded by the USGS at their gaging station (09234500) near Greendale, Utah, to compare differences in current and historical operations.

Objective 5. Analyze temperature records of the Green River through Browns Park, Lodore Canyon, and Whirlpool Canyon to compare differences in current and historical operations.

Objective 6. Begin to analyze past otolith samples and those collected in 2007 to understand smallmouth bass spawning periodicity to assist with flow-related management of that species.

Objective 7. Based on results of objectives 1–6, determine physical effects of new operations and subsequent effects on the fish community of the Green River downstream of Flaming Gorge Dam.

End Product: Remove non-native fishes and assessment of effects of non-native fish removal and effects of new flow and temperature regimes based on the fish community response.

V. Study area

In general, the fish community of the Green River will be sampled between the Swinging Bridge in Brown's Park and the lower end of Rainbow Park in Dinosaur National Monument. Additional northern pike sampling in upstream reaches will also be conducted but specific areas dependent on reconnaissance sampling and habitat availability. Specific reaches and gear include:

Seine sampling for small-bodied fishes and northern pike: Beginning upstream near Red Creek in Brown's Park and extending downstream through Island-Rainbow Park.

Raft-based electrofishing and trammel-netting: Lodore Canyon: Entire Canyon, which consists of four contiguous, 5-mile reaches and; Whirlpool Canyon: Entire Canyon, which consists of 2 contiguous, 5-mile reaches.

VI. Study Methods/Approach

Sampling methods will be patterned closely after those used in 2002 to 2004 sampling, and sampling planned for 2005. Data will be collected in a manner that generates catch per unit effort (CPUE) metrics (fish/hour electrofishing, small-bodied fish/m² habitat seined, larval fish/m³ water, fish/hour trammel-netting) with associated variance estimates to enable within-study, and annual comparative statistical analyses. Additional sampling techniques (angling, hoop nets, and minnow traps) will be used on an experimental basis. Flow data collected by USGS and USFWS (G. Smith) at several of its gaging stations on the Green and Yampa rivers will be used to address Objectives 4 and 5.

Three sampling trips will be conducted each year. Sampling will begin in early to mid-summer and ending in autumn. We envision two sampling trips using electrofishing and a third trip using primarily netting gear. Seine sampling will occur on all trips. The two electrofishing trips will be 5-days in length and utilize a 7-person crew; netting trips will have similar requirements.

Large-bodied fishes; Electrofishing: Two electrofishing rafts will simultaneously sample the left and right shoreline. Each two-person crew (one boat operator and one netter) will collect all fish. Each 5-mile reach will be divided into five contiguous 1-mile sections. At the lower end of each section all fish will be enumerated as an adult or sub-adult (based on pre-determined total length ranges per species) and electrofishing effort will be recorded. Rare fish (T&E species) will be weighed, measured, and PIT-tagged. Thus, mean CPUE/trip/reach will be generated from as many as 10 section samples.

In addition to simple enumeration, all fish will be measured and weighed in two sections (both shorelines) of each reach on each trip to characterize size structure and length/weight relationships.

Descriptive statistics will be used to describe CPUE, lengths, and weights of fish and appropriate comparisons with previously collected data will be made.

Large-bodied fishes; Trammel netting: Multi-filament trammel nets (23m x 1.8m; 25-cm outer mesh; 2.5-cm inner mesh) will be set at locations in Lodore and Whirlpool canyons with a main goal of sampling chubs in the genus *Gila*. Trammel nets collect a variety of species, but have been used in other studies as a primary gear type to collect native chubs in canyon-bound reaches of the Green (Chart and Lentsch 1999) and Colorado Rivers (Chart and Lentsch 2000, Valdez and Ryel 1995, McAda 2000). Trammel nets will be fished during crepuscular and nighttime hours at sites in Lodore and Whirlpool canyons. Nets will be set in low velocity habitats and along eddy lines. The number of nets set will be contingent on habitat availability and accessibility. Nets will be checked every 2 hours.

All fish will be measured, weighed, and tagged as necessary. Dorsal and anal fin rays will be enumerated from all chubs collected. Any suspected humpback chub will be photographed, primarily for the purpose of acquainting other researchers with the chubs found in Whirlpool Canyon. Appropriate morphometric measurements (as identified in Douglas et al. 1998) will be collected. Descriptive statistics will be used to describe CPUE, lengths, and weights of fish and appropriate comparisons with data previously collected will be made.

Large-bodied fishes; other gear types: In addition to electrofishing and trammel netting, other sampling techniques such as angling and trap nets may be employed to evaluate their efficiency. Angling will also be used to supplement total numbers of adult Colorado pikeminnow collected and marked for movement and length/weight analyses.

Small-bodied fishes; Seining: The purpose of this sampling will be to track shifts in distribution and abundance of the small-bodied nonnative (red shiner, sand shiner, fathead minnow) and native (speckled dace) cyprinids, and YOY of all other species. We will sample mostly backwaters, eddies, and shorelines; other habitat types (e.g., riffles) will be sampled as needed to detect species of interest. Two or more seine hauls will be taken in each sampled habitat and each seine haul will represent a sample. Physical measurements including area seined and habitat area will be gathered to quantify habitat dimensions and calculate CPUE. Seines used in this study will conform with the ISMP- recommended gear type. Readily identified endangered species will be measured and released alive. Other fish will be preserved in 10% buffered formalin and processed at CSU/LFL.

We will also begin to conduct analyses to understand timing and intensity of smallmouth bass reproduction in the Green River. This will be accomplished by analyzing otolith daily increments of smallmouth bass collected and preserved in ethanol during past years (2002-2006 as available) and in 2007. This will require analysis of several years of samples to understand effects of different flow and temperature regimes on timing and intensity of spawning. This budget increment will initiate this multi-year effort.

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 would 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 would first scan aerial maps and interview 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 would also contact 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. This would help assess the scope of the problem. We would follow this with sampling in backwaters and other low-velocity channel margin areas including connected flood plain wetlands to assess if pike reproduction had occurred in spring 2006. We would accomplish this, in part, by floating the reach in canoes, rafts, or motor boats and sampling where appropriate. Sampling areas would, in part, be dependent on conversations with Browns Park resource managers about habitat connections and the quantity of habitat. We think about a week of intensive sampling would be sufficient to survey most of the available areas. Timing of sampling would also be dependent on the above-referenced information.

VII. Task Description and Schedule

- Task 1: remove non-native fishes and sample main-channel fish community (large-bodied fishes)
- Task 2: remove non-native fishes and sample small-bodied fish community, with added pike sampling and habitat assessment in Browns Park
- Task 3: process preserved samples of small-bodied fish and conduct otolith analyses (fish from seine samples)
- Task 4: prepare and submit annual report

Schedule: FY-2006 (Tasks 1-4)

Task	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
1									X	X	X	X
2									X	X	X	X
3											X	X
4												

Schedule: FY-2007

Task	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
1									X	X	X	X
2									X	X	X	X
3	X										X	X
4	X	X										

- VIII. FY-2007 Work (Tasks 1-4): Sampling, sample processing, and annual reporting.
 – Deliverables/Due Dates: Annual Reports of field activities due to PD’s office November 2006 and November 2007.

– Budget: 2007

Larval Fish Lab and USBR Fish Community Monitoring Trip Costs and Reporting (Tasks 1-4): four trips total, one in each of June/July, August, and September (5-day trip plus two-days of gear and trip preparation per trip) plus the additional pike habitat and sampling assessment in Browns Park, to address: Task 1 (monitor large-bodied fish), Task 2 (monitor small-bodied fish with seines, plus pike sampling and habitat assessment) and Task 3 (process seine samples and conduct otolith analyses). Fringe benefits are 20.8% of the total amount of salaries. LFL overhead rate is 15% under USBR Cooperative Agreement and is charged to all items except equipment in excess of \$5,000. Fringe and overhead are figured into the per day costs for LFL items.

Quantity (d)	Description	Unit cost/d	LFL	BR		Total
Personnel salaries						
21	Biologist (LFL), field sampling (tasks 1-3)	\$425	8925			8925
10	Biologist (LFL), report preparation (task 4)	\$425	4250			4250
112	4 LFL Technicians (4 trips x 7 trip days total x 4, tasks 1- 3)	\$176	19712			19712
14.78	1 LFL Technician, report preparation (task 4)	\$176	2600			2600
5	Biologist, USBR	\$ 400		2000		2000
Subtotal personnel			35,487	0	0	37,487
Trip expenses						
160 pers days	per diem	\$17/day	2,720			2720
LFL miles	900 x 4 trips = 3,600	0.32/mile	1,152			1152
12	vehicle shuttles (3 trips x 4)	\$75/vehicle	900			900
	sampling (Whirlpaks®, preservatives, etc)		350			350
	camp/ sampling gear		600			600
	generator / boat gas/trailer		50			50
Subtotal supplies			5,772	0		5,772
Sample processing						
120	seine hauls (1 sample/haul) plus conduct otolith analysis of specimens from past and 2007 samples	\$75/sample	17,500			17500
Fish Community Monitoring trips			58,759	0		58,759
Equipment						

	Misc equipment (dipnets, measuring boards, electronic balances, etc)	Varies	800			800
3	Trammel nets	\$200	600			600
3	Seines	\$60	180			180
Subtotal equipment			1580			1580
Fish Comm. Monitor. FY07 Totals			60339	2,000	0	62339

USFWS, Vernal Fish Community Monitoring Trip Costs and Reporting (Tasks 1-3) : three trips total, one in each of June/July, August, and September (5-day trip plus two-days of gear and trip preparation per trip), to address: Task 1 (monitor large-bodied fish), Task 2 (monitor small-bodied fish with seines) and Task 3 (process seine samples).

Task Activity	Cost
Task 1-3 Sample Fish Population	
Labor	
GS-11 Biologist (\$36.67/hr x 8 hrs/day x 5 days/trip x 3 trips) + (\$55.00/hr x 2 hrs OT/day x 5 days/trip x 3 trips)	\$6,050
GS-11 Biologist Trip Prep (\$36.67/hr x 8 hrs/day x 3 days)	\$880
GS-8 Fisheries Tech (\$28.29/hr x 8 hrs/day x 5 days/trip x 3 trips) + (\$42.44/hr x 2 hrs OT/day x 5 days/trip x 3 trips)	\$4,668
GS-8 Fisheries Tech Trip Prep (\$28.29/hr x 8 hrs/day x 6 days)	\$1,358
GS-5 Tech (\$20.56/hr x 8 hrs/day x 5 days/trip x 3 trips) + (\$30.84/hr x 2 hrs OT/day x 5 days/trip x 3 trips)	\$3,392
GS-5 Tech Trip Prep (\$20.56/hr x 8 hrs/day x 6 days)	\$987
Subtotal	\$17,335
Travel, Boat gas, Equipment, etc.	
(2 trucks/trip x 173 mi/truck x \$0.405/mi x 3 trips) Vernal to Lodore round trip	\$420
(8 gal gas/boat x 2 boats/trip x \$2.50/gal x 3 trips)	\$120
(2 qts motor boat oil/boat x 2 boats/trip x \$2.75/qt x 3 trips)	\$33
Maintenance and replacement of rafting gear, sampling nets, electrofishing gear, etc.	\$1,693
Subtotal	\$2,266
Task 1-3 Total	\$19,601

FY2007 Budget Summary: condenses tables above

Description	LFL	BR	USFWS	Total
Fish Comm. Monitor. (Tasks 1-3)	53,489	2,000	19,601	75090
Reporting: Task 4	6,850			6850

FY2007 TOTAL	60339	2,000	19601	81940

– Deliverables/Due dates: Annual Report of FY07 field activities due to PD’s office November 2007.

IX. Budget Summary

FY-2006 \$70,777
 FY-2007 \$81,940
 Total: \$152,717

X. Reviewers

Doug Osmundson, U.S. Fish and Wildlife Service, Grand Junction, CO
 Kirk LaGory, Argonne National Laboratory, Argonne, IL
 Rich Valdez, SWCA, Flagstaff, AZ

XI. References

Bestgen, K.R. and L.W. Crist. 2000. Response of the Green River fish community to construction and re-regulation of Flaming Forge Dam, 1962–1996. Final Report of Colorado State University Larval Fish Laboratory to Upper Colorado River Endangered Fish Recovery Program, Denver, Colorado

Bestgen, K.R., R.T. Muth, and M.A. Trammell. 1998. Downstream transport of Colorado squawfish larvae in the Green River drainage: temporal and spatial variation in abundance and relationships with juvenile recruitment. Final Report of Colorado State University Larval Fish Laboratory to Upper Colorado River Endangered Fish Recovery Program, Denver, Colorado.

Carron, J.C. 2000. Simulation and optimization of unsteady flow and water temperature in reservoir regulated rivers. Ph.D. Dissertation. University of Colorado, Boulder, Colorado 147pp.

Chart, T.E. and L.D. Lentsch. 1999. Flow effects on humpback chub (*Gila cypha*) in Westwater Canyon. Final Report of Utah Division of Wildlife Resources to Upper Colorado River Endangered Fish Recovery Program, Denver, Colorado.

Chart, T.E. and L.D. Lentsch. 2000. Reproduction and recruitment of *Gila* spp. and Colorado pikeminnow (*Ptychocheilus lucius*) in the Middle Green River 1992–1996. Report C in Flaming Gorge Studies: reproduction and recruitment of *Gila* spp. and Colorado pikeminnow (*Ptychocheilus lucius*) in the Middle Green River. Final Report of Utah Division of Wildlife Resources to Upper Colorado River Endangered Fish Recovery Program, Denver, Colorado.

Douglas, M.E., R.R. Miller, and W.L. Minckley. 1998. Multivariate discrimination of Colorado plateau *Gila* spp.: “the art of seeing well” revisited. Transactions of the American Fisheries Society 127: 163–173.

- Douglas, M.E., W.L. Minckley, and H.M. Tyus. 1989. Qualitative characters, identification of Colorado River chubs (Cyprinidae: genus *Gila*) and the “art of seeing well.” *Copeia* 1989: 653–662.
- Holden, P.B. and L.W. Crist. 1981. Documentation of changes in the macroinvertebrate and fish populations in the Green River due to inlet modification of Flaming Gorge Dam. Final Report PR-16-5 of BIO/WEST, Inc., Logan, Utah.
- McAda, C.W. 2000. Interagency Standardized Monitoring Program - Population estimate of humpback chub in Black Rocks. FY-00 Annual Report to Colorado River Recovery Program, Project Number: 22-A-3.
- Muth, R.T., L.W. Crist, K.E. LaGory, J.W. Hayse, K.R. Bestgen, T.P. Ryan, J.K. Lyons, R.A. Valdez. 2000. Flow and Temperature Recommendations for Endangered Fishes in the Green River Downstream of Flaming Gorge Dam. Upper Colorado River Endangered Fish Recovery Program, Project FG-53. Final Report
- Tyus, H.M., and C.A. Karp. 1991. Habitat use and streamflow needs of rare and endangered fishes, Green River, Utah. U.S. Fish and Wildlife Service, Vernal, Utah.
- Valdez, R.A. and R.J. Ryel. 1995. Life history and ecology of the humpback chub (*Gila cypha*) in the Colorado River, Grand Canyon, Arizona. Final Report to Bureau of Reclamation, Salt Lake City, Utah. Contract No. 0-CS-40-09110. BIO/WEST Report No TR-250-08.
- Vanicek, C.D., R.H. Kramer, and D.R. Franklin. 1970. Distribution of Green River fishes in Utah and Colorado following closure of Flaming Gorge Dam. *Southwestern Naturalist* 14:297–315.