

**COLORADO RIVER RECOVERY PROGRAM  
FY-2015-2016 PROPOSED SCOPE OF WORK for:**

Project No.: FR-new

An Evaluation of Flow and Temperature Recommendations for Endangered Fish in the Green River Downstream of Flaming Gorge Dam

Lead Agency: Argonne National Laboratory

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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:** An Evaluation of Flow and Temperature Recommendations for Endangered Fish in the Green River Downstream of Flaming Gorge Dam

**II. Relationship to RIPRAP:**

*General I.A.1* - Review instream flow methodologies and assess the technical adequacy of current flow recommendations.

*Green River I.D.1.h* - Integrate and synthesize reports for evaluation and recommended revision of flow and temperature recommendations.

**III. Study Background/Rationale and Hypotheses:** Flow and temperature recommendations for endangered fish in the Green River downstream of Flaming Gorge Dam were established by Muth et al. (2000). Implementation of the flow and temperature recommendations served as the proposed action for an EIS on Flaming Gorge Dam operations (Reclamation 2005). A Biological Assessment of the impacts on endangered species of implementing the recommendations was prepared and a Biological Opinion issued (FWS 2005) that called for development of a study plan to examine the effects of implementation. Projects to address this evaluation were identified in the Green River Study Plan (2007) and have been conducted since then. The purpose of the Study Plan was to identify and recommend to the Recovery Program those monitoring or research projects necessary for implementation and evaluation of the flow and temperature recommendations. Those projects included studies to evaluate the anticipated effects of implementing the recommendations (including potential adverse effects identified in the 2005 Biological Opinion) and studies to examine recognized uncertainties of the

recommendations.

A Flaming Gorge Technical Working Group was established after the flow recommendations were published to evaluate conditions and make recommendations for annual implementation of the flow recommendations.

- IV. Study Goals, Objectives, End Product:** The objectives of this proposed work are to provide an overall evaluation and status assessment of the Green River flow and temperature recommendations based on operational, biological, and physical information collected from 2006 through summer 2014. The end product will be a report that summarizes this review (as outlined below in Section VI) and provides the Recovery Program clear recommended revisions of Muth et al (2000) should this evaluation suggest it is warranted.
- V. Study area:** Green River from Flaming Gorge Dam to the confluence with the Colorado River.
- VI. Study Methods/Approach:** The following describes the proposed structure and content of the report and the materials that will be included in the evaluation. The review will not be limited to these reports and publications.

## **1. Introduction**

This section will include discussion of the following

- Flow and temperature recommendations in Muth et al. (2000)
- Flaming Gorge EIS and record of decision (ROD) (Reclamation 2005 and 2006)
- Biological Opinion (FWS 2005)
- Green River Study Plan (Green River Study Plan Ad Hoc Committee 2007) and related studies that have been conducted
- Uncertainties that have been reduced or resolved since the original recommendations were published
- Remaining, or newly identified uncertainties
- Why the recommendations are being evaluated at this time

## **2. Flow and temperature conditions since implementation of the recommendations**

This section will review flow and temperature conditions in the three reaches since implementation of the flow recommendations began after the ROD. The focus will be on evaluating how well recommendations regarding peak and base flow timing, magnitude, and duration were met in Reaches 1-3. Reclamation's Annual Reports will provide much of this information.

## **3. Status of endangered fish species**

This section will provide an overview of the status of endangered fish in the Green River including trends observed since implementation of the flow and temperature recommendations. Basic biological and ecological characteristics of these species, as presented in the original Muth et al. (2000) document, will not be repeated here. Included will be a presentation of non-native fish population status and trends. The following documents will serve as a basis for the evaluation in this section:

- Colorado pikeminnow: population estimate (Bestgen et al 2010); trends in young-of-the-year (YOY) production (backwater synthesis report); Breen et al. (2011 (Project 138 report)
- Humpback chub: population estimate (Badame 2012)
- Razorback sucker: floodplain synthesis (Bestgen et al 2011), recent annual reports for Projects 22f, 160, 164, and 165; population monitoring plan (Bestgen et al. 2012)
- Bonytail: fate of stocked bonytail (Bestgen et al. 2008)

#### **4. Evaluation of the flow and temperature recommendations**

This section will adopt a structure compatible with Muth et al. (2000), and focus on the three main recommendation topics in that report: spring peak flow, summer to winter base flow, and temperature. Within each topic, biological and physical processes were considered in formulating the recommendations, with fulfilling biological requirements the ultimate requirement. The evaluation will focus on whether recommendations have achieved their desired biological and physical objectives and whether the anticipated effects identified in Muth et al. (2000) have been observed. The following topics will be evaluated for each reach.

##### **a. Peak flows**

##### **i. Floodplain connection and inundation**

##### **1. Physical processes**

- a. Magnitude required to effectively connect floodplains to main channel
- b. Duration and magnitude required to significantly fill floodplains to provide suitable habitat for survival, growth, and rearing

##### **2. Biological processes**

- a. Entrainment of larval razorback sucker and bonytail
- b. Growth, survival, and recruitment of entrained razorback sucker and bonytail
- c. Subsequent return to river

Bestgen et al (2011) will be an important source of information for this evaluation of peak flows. The Larval Trigger Study Plan, and progress towards implementation of this plan, will also be included and discussed. Recent studies and associated annual reports will be evaluated for relevant information, and include Projects 22f, 164, and 165, and Argonne's resurvey of levee breaches. In addition, the team will consider an

evaluation of 2011 aerial photography to determine areas inundated by these high flows.

- ii. Connected backwater nursery habitat formation and maintenance
  - 1. Physical processes
    - a. Magnitude and duration required to rework sandbars and associated backwater nursery habitats
  - 2. Biological processes
    - a. Growth, survival, and recruitment of Colorado pikeminnow

Information from the new backwater synthesis report will be used to evaluate backwater nursery habitat formation and maintenance and the biological response to these processes.

- iii. Prevention of channel narrowing

New information on channel narrowing may not be available since Muth et al. (2000), but evaluation of aerial imagery may be undertaken if feasible.

- iv. Effects of peak flows on nonnative fish

At a minimum, effects of peak flow on walleye, northern pike, and smallmouth bass will be included. The impacts of peak flow magnitude, duration, and timing will be considered as they relate to the life history of nonnative fish. Breton et al (2014) (in draft smallmouth bass synthesis) will be an important source of information for this evaluation. Recent annual reports for Projects 115, 123a, and 123b will be considered. The Larval Fish Laboratory is leading a parallel effort to summarize smallmouth bass early life history as related to environmental correlates. Anecdotal information collected under Projects 128, 138, 158, and 160 could all contribute.

As the reservoir has not spilled since the ROD, an evaluation of spillway entrainment will be limited. The team will consider the recent Burbot Risk Assessment and Johnson et al. 2014 (reservoir escapement risk assessment) in this discussion.

- v. Uncertainties.

This section will describe remaining uncertainties related to peak flow recommendations.

- b. Base flow

- i. Connected backwater habitat conditions
  - 1. Physical processes
    - a. Within-day and seasonal variability in backwater area, volume, and depth
  - 2. Biological processes

- a. Growth, survival, and recruitment of endangered fish (primarily YOY Colorado pikeminnow) as related to backwater conditions

Information from the new backwater synthesis report will be used to evaluate backwater nursery habitat conditions and the biological response to these conditions. Recent annual and final reports from Projects 138 and 158 should also be considered.

- ii. Effects of base flows on nonnative fish

Information from recent studies (including those mentioned above under peak flows) will be evaluated to identify responses of nonnative fish to base flows. Included will be a review of information related to native fish response to nonnative removal (Skorupski et al. 2012)

- iii. Uncertainties

This section will describe remaining uncertainties related to base flow recommendations.

- c. Temperature

- i. Physical processes

- 1. Achieving target temperatures in lower Reach 1 and upper Reach 2

- ii. Biological processes

- 1. Temperature-related life history needs of endangered fish

The section will review achievement rates of meeting target temperatures in Reach 1 and 2, based on a review of annual reports. Temperature conditions will be evaluated to determine how well they conform to requirements for spawning, incubation, and rearing of endangered fishes.

- iii. Effects of temperature on nonnative fish

- iv. Uncertainties

This section will describe remaining uncertainties related to temperature recommendations.

## **5. Flow and temperature recommendations**

This section will parallel that of Muth et al. (2000), and will include a reach-by-reach description of flow and temperature recommendations and their anticipated effects on endangered fishes, compared to observed effects since implementation. Lessons learned from implementation in previous years will be described and considered for possible refinement of

the existing recommendations. Refinements to the existing recommendations will be identified and described if needed.

## **VII. Task Description and Schedule**

We propose an 18 month effort, beginning in FY15. The effort would start with a kickoff meeting of the review team that will provide an overview of project objectives, tasks, schedule, and responsibilities. The team will meet every two months, starting with the in-person kickoff meeting, and then webinars and in-person meetings as determined to be desirable, but sticking to the every other month schedule of meetings. Briefings to the Biology Committee and Water Acquisition Committee of project progress and status will be provided at key points in the schedule (e.g., at 6, 9, and 12 months from project start).

**VIII. FY-2015 - 2016 Work**  
 - Deliverables/Due Dates  
 Argonne National Laboratory (ANL)

Component	FY 2015		FY 2016		Totals	
	Person-Months	Cost (\$1,000)	Person-Months	Cost (\$1,000)	Person-Months	Cost (\$1,000)
Direct Effort						
Scientific Direct	3.2	72.4	1.6	37.4	4.8	110
Scientific – Post-Doc	0	0	0	0	0	0
Secretarial / Clerical Direct	0.3	3	0.2	1.6	0.5	4.6
Student	0	0	0	0	0	
<b>Total Effort</b>	<b>3.5</b>	<b>75.5</b>	<b>1.8</b>	<b>39</b>	<b>5.3</b>	<b>114.6</b>
Other Direct Costs						
Materials & Supplies		0		0		0
Subcontracts		0		0		0
Technical Editing		0		13.7		13.7
Travel		4.8		0		4.8
STA		0		0		0
<b>Total Other Direct Costs</b>		<b>4.8</b>		<b>13.7</b>		<b>18.5</b>
<b>Total Direct Costs</b>		<b>80.3</b>		<b>52.7</b>		<b>133.1</b>
General and Administrative		39		20.8		59.9
LDRD Indirect (included in G&A)		5.9		3		8.9
<b>Total Argonne Cost</b>		<b>119.3</b>		<b>73.6</b>		<b>192.9</b>

\*Totals are off due to rounding.

Larval Fish Laboratory at Colorado State University (LFL)

FY2015

Item	Units(d)	Cost/unit	Total
<b>Salary</b>			
Principal Investigator	66	594	39,204
Senior technician	15	278	4,170
		subtotal	43,374
<b>Travel</b>			
meeting trips	2	600	1,200
		subtotal	1,200
Annual total			\$44,574

FY 2016

Item	Units(d)	Cost/unit	Total
<b>Salary</b>			
Principal Investigator	32	608	19,456
Senior technician	7	284	1,988
		subtotal	21,444
<b>Travel</b>			
meeting trips	1	650	650
		subtotal	650
Annual total			\$22,094

Grand total \$66,668

**IX. Budget Summary**

FY-2015 - \$163,874: ANL (\$119,300) + LFL (\$44,574)

FY-2016 - \$95,694: ANL (\$73,600) + LFL (\$22,094)

Total: \$ 259,568

**X. Reviewers – Biology and Water Acquisition Committee**

**XI. References**

Badame, P. 2012. *Population Estimates for Humpback Chub (Gila cypha) in Desolation and Gray Canyons, Green River, Utah 2006-2007*. Final Report of Utah Division of Wildlife Resources to Upper Colorado River Endangered Fish Recovery Program, Denver, Colorado.

Bestgen, K.R., K. A. Zelasko, R. I. Compton, and T. E. Chart. 2008. Survival, Condition, Habitat Use, and Predation on Stocked Bonytails (*Gila elegans*) in the Green River, Colorado and Utah. *Southwestern Naturalist*, 53(4):488-494.

Bestgen, K.R., J.A. Hawkins, G.C. White, C.D. Walford, P. Badame, and L. Monroe. 2010. *Population Status of Colorado pikeminnow in the Green River Basin, Utah and Colorado, 2006-2008*. Final Report of the Larval Fish Laboratory, Colorado State University to the Upper Colorado River Endangered Fish Recovery Program, Denver, Colorado.

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Breen, M.J., M. Swasey, P. Badame, K. Creighton. 2011. *Upper Colorado River Basin Young-of-Year Colorado Pikeminnow (Ptychocheilus lucius) Monitoring: Summary Report 1986-2009*. Final Report of Utah Division of Wildlife Resources to Upper Colorado River Endangered Fish Recovery Program, Denver, Colorado.

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Johnson, B.M., B. Wolff, and P.J. Martinez. 2014. *Chemically Fingerprinting Nonnative Fishes in Reservoirs*. Final Report of Project C18/19 to the Upper Colorado River Endangered Fish Recovery Program.

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Skorupski, J. A., M. J. Breen, and L. Monroe. 2012. *Native Fish Response to Nonnative Fish Removal from 2005-2008 in the Middle Green River, Utah*. Utah Department of Natural Resources Final Report Project 144 to the Upper Colorado River Endangered Fish Recovery Program.