

**RECOVERY PROGRAM  
FY 2020-2021 SCOPE OF WORK for:**

Recovery Program Project Number: 22f

Light trap and drift net sampling for razorback sucker and Colorado pikeminnow larvae

Reclamation Agreement number: new agreement pending  
Reclamation Agreement term: Oct. 1, 2018 – Sep. 30, 2023

**Lead Agency:** Larval Fish Laboratory

**Submitted:** Kevin R. Bestgen (LEAD)  
**Address:** Larval Fish Laboratory (LFL)  
Department of Fish, Wildlife, and Conservation Biology  
Colorado State University  
Fort Collins, CO 80523

and

Christian Smith, Bruce Haines  
USFWS  
Green River Basin FWCO  
1380 S. 2350 W.  
Vernal, Utah 84078  
Phone: (435) 789-0354; Fax: (435) 789-4805  
E-mail: [christian\\_t\\_smith@fws.gov](mailto:christian_t_smith@fws.gov), [george\\_haines@fws.gov](mailto:george_haines@fws.gov)

**Phone:** KRB: (970) 491-1848/5295; FAX 491-5091  
E-mail [kbestgen@colostate.edu](mailto:kbestgen@colostate.edu)

Category:

- Ongoing project  
 Ongoing-revised project  
 Requested new start  
 Unsolicited

Expected Funding Source:

- Annual funds  
 Capital funds  
 Other (explain)

Revised date:

- I. Title of Proposal: Interagency standardized monitoring assessment of endangered fish reproduction in relation to Flaming Gorge operations in the Middle Green and Lower Yampa rivers.
- II. Relationship to RIPRAP:

Green River Action Plan: Mainstem

- I.A.3.d.1. Conduct real-time larval razorback and Colorado pikeminnow sampling to guide Flaming Gorge operations  
I.D.2.b.(4)(a) Implement LTSP  
I.D.2.d.(1) Conduct annual monitoring of larval razorback suckers and analyze historic monitoring data.  
I.D.2.f.(1) Conduct annual monitoring of larval Colorado pikeminnow.
- V.C.4. Monitor larval Colorado pikeminnow.  
V.D.1. Implement razorback sucker monitoring plan.

Green River Action Plan: Yampa and Little Snake Rivers

V. MONITOR POPULATIONS AND HABITAT AND CONDUCT RESEARCH TO SUPPORT RECOVERY ACTIONS (RESEARCH, MONITORING, AND DATA MANAGEMENT)

III. Study Background/Rationale, and Hypotheses:

The goal of the Flaming Gorge flow and temperature recommendations (Muth et al., 2000) was to improve the status and prospects for recovery of endangered fish populations in the Green River. A major emphasis of those recommendations was to enhance the reproductive and recruitment success of endangered fishes in the middle Green River, in particular razorback sucker and Colorado pikeminnow. The primary means to achieve enhanced populations was to pattern flows after a more natural hydrograph, the timing and duration of which will be based on anticipated annual hydrologic conditions and the biology of the fish. Because of vagaries in timing and runoff patterns within and among various hydrologic scenarios, and uncertainties in anticipated effects of flow and temperature recommendations on endangered fishes, Muth et al. (2000) suggested that real-time data be gathered to guide and fine tune operation of Flaming Gorge Dam each year. This proposal extends past sampling conducted to monitor timing of reproduction and abundance of early life stages of endangered razorback sucker *Xyrauchen texanus* and Colorado pikeminnow *Ptychocheilus lucius*.

**Razorback sucker sampling in spring.**--A key objective of spring flow recommendations is to provide flood plain habitat for early life stages of razorback suckers in the Jensen-Ouray reach of the Green River. Flood plain inundation should provide relatively warm and food-rich habitat for early life stages of fish that may enhance recruitment success of razorback suckers. Originally, Green River flows released from Flaming Gorge Dam were timed to coincide with high spring flows from the Yampa River to ensure maximal habitat availability. However, success of flood plain inundation to enhance recruitment of razorback suckers depends on matching the timing of appearance of larvae in the river with availability of flood plain habitat. Real-time sampling of razorback sucker larvae with light traps during spring and early summer will ensure that flows are released at the correct time and for a sufficient duration to promote recruitment. Presence of catostomid larvae in samples collected from the Green River facilitated decisions regarding timing, level, and duration of flows to inundate flood plain habitat in spring and early summer 1997, 1999, 2005, 2006, and 2011-2018. Continued flow management under the Larval Trigger Study Plan demands the use of razorback sucker larval presence in the middle Green to trigger flow releases from Flaming Gorge Dam (Bestgen et al. 2011; LaGory et al. 2012). Sampling conducted under this program will provide the real-time data to guide flow management each spring.

Additional information from light trap sampling of razorback suckers includes a measure of reproductive success of stocked razorback suckers that are now of sufficient size and age to reproduce. Wild adult razorback suckers in the Green River Basin were very rare by year 2000 and the few remaining fish present at that time may have succumbed (Bestgen et al. 2002). Thus, all reproduction observed is likely by adults that have been stocked. The level of reproduction is an important metric to determine reproductive success of stocked fish in the Green River and their progress toward recovery. For example, the trend over time for captures since about 2000 has been increasing, and high numbers of razorback sucker larvae were captured, especially recent years (e.g., 2007, n = 2133; 2013 n = 7376). This indicated that hatchery fish have been successfully reproducing (Bestgen et al. 2011, final report on flood plain inundation related to razorback sucker reproduction; Bestgen et al. 2012, razorback sucker monitoring program). The timing of presence of larvae in the system also permits evaluation of whether timing of flow releases from Flaming Gorge Dam coincides with the peak number of razorback sucker larvae in the Green River.

Another use of light trap sampling information was to further evaluate results of experimental releases of marked larvae and subsequent entrainment into floodplain wetlands. That work was conducted in 2004, 2005, and 2006. Batches of marked larvae were released at the spawning bar during different levels of flow. Batch marks associated with releases allowed identification of which release and flow level a captured and marked larvae came from. That information was being used to evaluate what flow level and time was most effective to entrain released marked larvae into the floodplain wetlands.

**Colorado pikeminnow sampling in summer.**--An objective of Flaming Gorge Dam base flow recommendations in summer is to provide backwater habitat in the middle and lower Green River for early life stages of Colorado pikeminnow. The time of year that base flows are achieved in summer and the flow level will be generally dependent upon the annual hydrologic condition. However, onset of reproduction of Colorado pikeminnow in the Yampa River is variable from year to year as is the timing of peak production of larvae (Bestgen et al. 1998; Bestgen and Hill 2016). More precise information on timing and extent of reproduction of Colorado pikeminnow could be used to fine tune when the summer base flow period begins and the magnitude of summer base flows from Flaming Gorge Dam. Timing of reproduction of Colorado pikeminnow and abundance of larvae has been used since 1990 to justify decisions regarding onset of summer baseflows from Flaming Gorge Reservoir. In addition, presence and abundance of pikeminnow larvae in the Yampa River was used to make decisions regarding timing, duration, and magnitude of summer flows released from Flaming Gorge Reservoir when inflows dramatically exceeded expectations. If proposed summer base flow enhancements occur in the Green River for Colorado pikeminnow, presence of larvae captured in this study may be used to trigger timing of such flows as well (Bestgen and Hill 2016, Reproduction, abundance, and recruitment dynamics of young Colorado pikeminnow in the Green River Basin, Utah and Colorado, 1979-2012).

Presence of Colorado pikeminnow in the Yampa River is also a means to evaluate if Flaming Gorge flow releases in summer comply with the criterion that Green River temperatures be no more than about 5°C different than the Yampa River. Compliance with the recommendation ensures that the potential for cold shock of Colorado pikeminnow larvae drifting from the warm Yampa River into the cooler Green River is reduced.

Additional information provided by drift-net sampling of Colorado pikeminnow larvae is an index of annual reproduction by the adult population that congregates in the lower Yampa River each year. This area represents one of two main spawning areas for Colorado pikeminnow in the Green River Basin, and sampling of early life stages may provide an index of adult abundance and spawning success. We are also using an index of annual reproductive success to relate to annual recruitment success of young-of-year Colorado pikeminnow in downstream backwaters of the Green River in the Jensen-Ouray reach. Collectively, that information will be useful to investigate hypotheses regarding the apparent decline of recruitment of young Colorado pikeminnow in backwaters of the Green River, and the effects it may be having on the adult population in the Green River Basin (Bestgen 2015; Bestgen and Hill 2016).

### **Other associated research being enabled with this work.**

1). Additional razorback sucker sampling.--The presence of razorback sucker larvae at several key locations will provide the bulk of the information used to regulate timing and level of flows from Flaming Gorge Dam in spring. Such areas presently include Cliff Creek, Stewart Lake drain, Walker Hollow, Baser Wash, and Old Charley outlet and beginning in 2011, the White River (Webber et al. 2013). Although these areas support the most consistent capture locations for larvae, even those locations vary substantially from year to year depending on flow and other conditions. Additional sampling areas that are known to support early life stages of razorback suckers within the middle Green River would give managers better estimates of the timing and duration of the spawning season. Drift-net sampling in spring 2004 associated with a release of marked hatchery-produced razorback sucker larvae and beads also revealed substantial downstream transport of wild razorback sucker larvae.

2). Flow regulation of annual recruitment of Colorado pikeminnow.--A key difference between flow recommendations made in the 1992 opinion and new recommendations is that summer base flow level will be dictated by the prevailing hydrologic condition rather than being fixed at a single level of 51 m<sup>3</sup>/sec. Thus, in wetter years base flows will be higher and in drier years base flows will be lower. The expected biological response by Colorado pikeminnow to this action is unknown. Thus, it is important to evaluate the response of these fish to new summer base flow conditions. One possible response is altered recruitment levels, which may be detectable from autumn ISMP sampling designed to estimate

young-of-year (YOY) pikeminnow abundance in backwaters. Because this measure of fish abundance, which is presumably correlated with habitat suitability, could be confounded with variable levels of reproduction, drift sampling that continues throughout the summer reproductive season is needed to correctly interpret those data. For example, near absence of age-0 Colorado pikeminnow in the middle Green River in 1994 would have been difficult to interpret given that habitat conditions, including relatively low flow levels and warm water temperatures, seemed suitable for recruitment. Drift data from the Yampa River at Echo Park demonstrated that recruitment failure in the middle Green River in low flow summers like 1994, 2007, and 2012 was likely due to very low levels of drift of larvae measured in the Yampa River downstream of the spawning area.

The complexity of recruitment processes for Colorado pikeminnow needs to be more clearly defined so that effects of re-regulation of Flaming Gorge Dam can be ascertained. Minimally this would involve more certain estimates of YOY recruitment, perhaps through abundance estimation. Better resolution of the link between recruitment of age-0 pikeminnow and older age-classes may also better define what other conditions are needed for successful recruitment to older life stages. For example, an analysis of existing ISMP data for Colorado pikeminnow (Muth et al. 2000) suggested that successful recruitment to age-1 may be associated with successive low water years. Such information would be useful to link flow recommendations across years, and presumably, benefit pikeminnow recruitment. Such an analysis of backwater habitat and relationships to pikeminnow abundance was completed in 2016 (Bestgen and Hill 2016).

3). Intra-annual recruitment patterns of Colorado pikeminnow.--Another means that altered patterns of recruitment could be manifest is through changes in within season recruitment patterns. For example, if flow induced backwater conditions are not suitable for survival of Colorado pikeminnow larvae early in the season, one should expect few such larvae to recruit to fall. Alternatively, poor conditions in backwaters later in the season may similarly limit recruitment of late-hatching larvae. A means to examine such recruitment patterns would be through comparative analysis of distributions of hatching dates derived from otoliths of larvae and juveniles captured later in fall. An expectation of such an analysis would be that distributions of hatching dates for each life stage would be similar, with large cohorts of larvae responsible for relatively large portions of the juveniles produced. Absence of juveniles hatched during times when relatively large numbers of larvae were produced may signal recruitment loss during those periods. Examination of the environmental conditions (flow level, water temperatures) present during such periods would assist in determining reasons for recruitment variation and whether such conditions were attributable to operation of Flaming Gorge Dam. Such a technique has successfully used in the past to understand recruitment patterns of pikeminnow in the Green River (Bestgen et al. 2006; Bestgen and Hill 2016).

#### **IV. Study Goals, Objectives, and End Product:**

##### Goal

The goal of this project is to detect timing of reproduction by razorback sucker and Colorado pikeminnow, and determine patterns of presence of larvae and their relative abundance downstream of potential spawning sites in the middle Green River system. A second goal is to aid with monitoring effects of temperature regimes of the Green and Yampa rivers in order to comply with Flaming Gorge flow recommendations, because this task requires understanding the reproductive and drift periods for Colorado pikeminnow.

##### Objectives

- 1). To determine timing and duration of spawning by razorback suckers and presence and abundance of larvae in the Green and White rivers as measured by capture of larvae in light traps or seines.
- 2). To determine timing and duration of spawning by Colorado pikeminnow and presence and abundance of larvae in the system as measured by capture of larvae downstream of spawning

areas in the lower Yampa River.

- 3). Determine presence and abundance of larvae and early juveniles of razorback sucker in floodplain wetlands in the summer post-connection period to determine their presence. This sampling will support research to evaluate the use of a larval trigger to determine timing of flow spring releases from Flaming Gorge Reservoir.

#### End Products

A summary data report will be submitted at the end of each fiscal year to the monitoring program coordinator and the database coordinator. Data will also be provided as needed to provide for real-time management of flows from Flaming Gorge Dam. A summary analysis of razorback sucker data collected since 1992 has been prepared and was approved in summer 2011 (Bestgen et al. 2011), and an analysis of the pikeminnow data was completed in 2016 (Bestgen and Hill 2016). Data gathered will be useful to update such analyses in the future to ensure we are meeting goals of flow and temperature management activities via operation of Flaming Gorge Dam.

#### **V. Study Area:**

**Razorback sucker.**--The study area for razorback sucker sampling is the middle Green River from the Escalante reach spawning area to near Sand Wash, and the White River, Utah. Several specific sampling sites are located within the reach and were chosen because of documented presence of larval razorback sucker in the past. Most of these sites are associated with off-channel habitats such as tributary streams, washes, backwaters, or flooded bottomlands and are in the vicinity of the Escalante spawning bar (RM 301.7 - 319.4), Jensen (RM 276.9 - 301.7), and Ouray (RM 248.1 - 276.9). Additional sampling may be conducted in other locations within the middle Green River of the White River if suitable habitat is found and if the budget allows. Additional sampling will be conducted in middle Green River wetlands in summer just post-connection with the Green River to determine presence of entrained larvae. Field crews have flexibility to change sites or sample additional sites based on discharge, accessibility, and habitat conditions at each site.

**Colorado pikeminnow sampling.**--A single site, the lower Yampa River, will be sampled in FY-2020-2024. This locality was sampled as part of the Flaming Gorge studies program because it is downstream of a known spawning area for Colorado pikeminnow. Data obtained from samples will provide information on timing and relative abundance of Colorado pikeminnow larvae being transported from spawning areas and into potential nursery habitats and will also provide real-time data with which to manage flows from Flaming Gorge Dam. Another site is being considered in the lower Green River, similar to the site and methods used to monitor early life stages of Colorado pikeminnow from 1992-1996, and 1999 (Bestgen and Hill 2016).

#### **VI. Study Methods/Approach:**

**Razorback sucker.**--Approaches for sampling razorback sucker larvae in the Green River system were outlined in recommendations by Muth (1995, Bestgen et al. 2012, monitoring plan), which were based on comprehensive literature and data reviews. Sites with documented high captures of larval razorback sucker will be targeted for sampling, although additional sampling will be conducted to explore other areas for larvae, including the White River. An additional task will be to sample wetlands in the middle Green River just after spring flow connections with the Green River ceases, with a goal of detecting presence of entrained larvae. Light-trap sampling at night in low-velocity nursery habitats will be the primary technique for monitoring. Additionally, fine-mesh seines (1.6-mm or 3.2-mm mesh) will be used on a limited basis during daylight (also possibly at night) to document relative abundance of sympatric species not captured by light traps. Sampling will be conducted at each site twice weekly during at least early/mid May-mid June, and wetland sampling may extend into late July depending on the duration of high flows. The sampling period will be adjusted based on timing and duration of spring flows, onset of main channel water temperatures of 14°C, and temporal occurrence of larvae. Each habitat on each sampling occasion will be sampled with at least three light traps; seine sampling is sometimes used to supplement light trap sampling. If possible, light traps will be set in or near emergent

vegetation at dusk and retrieved before sunrise. Larger fish identifiable in the field will be counted and measured on site and released alive. Other fish will be euthanized with an overdose of tricaine methanesulfonate (MS-222), preserved in 100% ethanol, and returned to the Larval Fish Laboratory for processing. Unit of effort will be hours each light trap is set during darkness and area sampled by each seine haul. These approaches and considerations were revised based on comments from the Biology Committee and other researchers, and discussions with Monitoring Program Coordinators. Monitoring was always coordinated with other sampling in the past such as ISMP, evaluations of levee-removal strategies (Lentsch et al. 1995), investigations at Old Charley Wash, and evaluations of experimental stockings such as for floodplain entrainment investigations. The Larval Fish Laboratory (LFL) will be responsible for larval fish identification and processing, coordinating monitoring activities, integrating results/reports of sampling efforts, and preparing overall annual reports.

**Colorado pikeminnow.**--Passive drift-net sampling is an effective and proven method for capturing Colorado pikeminnow larvae. Sampling can provide a reasonable estimate of annual reproductive output from spawning areas. Colorado pikeminnow in the Colorado River Basin spawn on the descending limb of the hydrograph when water temperature is increasing (Nesler et al. 1988; Tyus and Karp 1989, Bestgen et al. 1998, Anderson 1999, Trammel and Chart 1999; Bestgen and Hill 2016). Sampling for Colorado pikeminnow larvae will be initiated based on those data and stream-flow conditions prior to sampling (probable start date in most years is mid-late June). Duration of the sampling period will depend on number of larvae collected in late-season samples, past data, and stream-flow conditions (probable end date is early-mid August).

Colorado pikeminnow larvae are most consistently captured in drift-net samples at dawn, and nearshore and midstream nets capture roughly equivalent numbers of fish/unit volume of water sampled (Haynes et al. 1984; Nesler 1986, Bestgen 1997, Bestgen and Hill 2016). Therefore, at each station three plankton nets will be set near the shore, daily at dawn for 1-2 h, from end of June through early August. Some diel sampling should also be conducted at each site. This should include samples collected at dawn, noon, dusk and midnight and should be collected on 5-6 d spread throughout the sampling season. Nets will be attached to rectangular steel frames (0.15 m<sup>2</sup>) and staked into the stream substrate adjacent to the shore in water 0.5-1.0 m deep. A removable collection bucket for trapping filtered material and fishes will be attached to the cod end of each net. Flow meters for measuring velocity will be suspended inside the mouth of each net, and net sets will be timed to determine volume of water sampled. Duration of each set will be 1-2 h depending on debris load. Samples will be fixed and preserved in 95-100% ethanol (for subsequent otolith-ageing work if needed). Fishes will be picked from debris in the field, returned to the LFL, identified, measured to the nearest 0.1 mm total length, and enumerated.

## **VII. Task Description/Schedule (FY 2020 and 2021)**

- I). Collect light trap and seine samples for razorback suckers in the Green and White rivers and in Green River floodplain wetlands. The USFWS office in Vernal will be responsible for this task.
- II). Collect drift net samples for Colorado pikeminnow. The Larval Fish Laboratory will be responsible for this task.
- III). Preliminary identification of light trap and drift net samples. Preliminary identifications will be conducted by the responsible sampling entity, with assistance from the LFL, as samples are collected to provide real-time data. Final specimen identification and curation will be conducted by the LFL under Project 15.
- IV). Continue otolith analyses of razorback suckers to understand timing of spawning and hatching and to document growth rate differences of larvae each year.
- V). Summarize specimen data collection in an annual report.

## **VIII. FY-2020-2021 Work: Summarize data and incorporate into report.**

**-Description of Work: Tasks I-VI.**

See above

## **-Deliverables**

A key feature of data collected is to be able to provide information to managers who need to make decisions about stream flows in real-time. A report will also be submitted by end of the fiscal year that summarizes data collected to date.

Travel: Travel costs for field work based on estimated per diem rates for Colorado State University for the area we are working in. Mileage is based on the standard rate for Motor Pool vehicles, which varies depending on age and size of the vehicle. We will use \$ 0.50 per mile for 2020. Meeting costs include three nights of hotel, per diem, and mileage to travel to meetings. These include costs for two people.

Personnel: Salaries include 28.2% fringe rate, an estimate for 2019, plus overhead. Overhead is calculated on all items (including salary plus fringe rate) at 17.5%, per our agreement with BOR.

Supplies: Supplies are used in the conduct of field sampling and lab analysis of specimens and otoliths. Containers and preservatives are to hold field specimens and to curate specimens in the laboratory; preservatives are formalin and ethanol for preservation of samples. Camping gear includes tents, kitchen supplies for field camping, and coolers. Nets include seines and disposable goods that need replacements due to attrition. Estimated costs based on current prices procured from various online sources (local vendors for camping supplies, NRS rafting supplies, Christiansen Inc, for net supplies, Fischer Scientific for preservatives, sample jars, slides, slide folders, other lab supplies).

Budget notes: LFL reduced costs for Project 22F in 2018-2019 by \$11,526. This was accomplished by reducing time for Principal Investigator on Task 3. Increases in other years will be needed to support mandated raises for personnel and if additional funds are available, increased sample costs should be added.

## **FY-2020--2024 Budget**

### **IX. Budget Summary:**

FY2020-2024  
budget

Year	LFL	USFWS	Total
FY2020	\$133,070	\$50,272	\$183,342
FY2021	\$130,889	\$47,068	\$177,957
FY2022	\$133,331	\$47,989	\$181,320
FY2023	\$135,822	\$48,929	\$184,751
FY2024	\$138,475	\$54,333	\$192,808
totals	\$671,587	\$248,591	\$920,178

### **X. Reviewers**

### **XI. References**

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