

COLORADO RIVER RECOVERY PROGRAM
FY 2016 ANNUAL PROJECT REPORT

RECOVERY PROGRAM
PROJECT NUMBER: 22f

I. Project Title: INTERAGENCY STANDARDIZED MONITORING PROGRAM (ISMP) ASSESSMENT OF ENDANGERED FISH REPRODUCTION IN RELATION TO FLAMING GORGE OPERATIONS IN THE MIDDLE GREEN AND LOWER YAMPA RIVERS-Yampa and middle Green River assessment of Colorado pikeminnow and razorback sucker larvae

II. Bureau of Reclamation Agreement Number(s): R14AP00001

Project/Grant Period: Start date (Mo/Day/Yr): 1 Oct. 2014
End date: (Mo/Day/Yr): 30 Sept. 2018
Reporting period end date: 30 Sept. 2016
Is this the final report? Yes No X

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IV. Abstract: The goal of Flaming Gorge flow and temperature recommendations (Muth et al., 2000) that were implemented in 2006 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. Larvae of razorback sucker *Xyrauchen texanus* and Colorado pikeminnow *Ptychocheilus lucius* were captured in the Green River basin in spring and summer 2016. Razorback sucker sampling was conducted with light traps primarily in the Green River between Jensen and Ouray and Colorado pikeminnow sampling was with drift nets in the lower Yampa River. Sampling was designed to provide a measure of timing of reproduction and a measure of annual reproductive success of each species. Diel variation in abundance of Colorado pikeminnow larvae in the drift was also assessed. This data will be used to assess effects of flow and temperature regimes on reproduction by razorback suckers and Colorado pikeminnow and to correlate abundance of larvae to abundance of juveniles in autumn.

V. Study Schedule: Ongoing in a new agreement began in 2014, similar sampling has been conducted since 1990, in most years. Anticipate continued annual sampling.

VI. Relationship to RIPRAP: Relationship to specific RIPRAP items:

Green River Action Plan: Mainstem

- I. Provide and protect instream flows--habitat management.
- I.A. Green River above Duchesne River.
- I.A.1. Initially identify year-round flows needed for recovery while providing experimental flows.
- I.A.2.a. Summer/fall flow recommendations.
- I.A.3. Deliver identified flows.
- I.A.3.a. Operate Flaming Gorge pursuant to the Biological Opinion to provide summer and fall flows.
- I.A.3.d. Operate Flaming Gorge Dam to provide winter and spring flows and revised summer/fall flows, if necessary.
- I.B. Green River below the Duchesne River.
- I.B.1. Initially identify year-round flows needed for recovery while providing experimental flows.
- I.B.2. State acceptance of initial flow recommendations.
- I.B.2.a. Review scientific basis.
- II. Restore habitat--habitat development and maintenance.
- II.A. Restore and manage flooded bottomland habitat.
- II.A.1. Conduct site restoration.
- II.A.1.a. Old Charlie Wash.
- II.A.1.a.(3) Monitor and evaluate success.
- II.C. Enhance water temperatures to benefit endangered fishes.
- II.C.1. Identify options to release warmer water from Flaming Gorge Reservoir to restore native fish habitat in the Green River.
- V. Monitor populations and habitat and conduct research to support recovery actions--research, monitoring, and data management.
- V.A. Conduct research to acquire life history information and enhance scientific techniques required to complete recovery actions.

Green River Action Plan: Yampa and Little Snake Rivers

- I. Provide and protect instream flows--habitat management.
- I.D. Yampa River below Little Snake River.
- I.D.1. Initially identify year-round flows needed for recovery.
- I.D.2. Evaluate need for instream flow water rights.
- I.D.2.a. Review scientific basis.

Green River Action Plan: Yampa and Little Snake Rivers

- V.A.1. Conduct standardized monitoring.
- V.B.2. Conduct appropriate studies to provide needed life history information.

VII. Accomplishment of FY 2016 Tasks and Deliverables, Discussion of Initial Findings and Shortcomings: Project Objectives

- 1). Determine timing and duration of spawning by razorback suckers and presence and abundance of larvae in the system as measured by capture of larvae in light traps. Additional sampling was also conducted in flood plain wetlands in early summer and autumn under this project.
- 2). 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.

Task Description (FY 2016)

- I). Collect light trap samples for razorback suckers. The CRFP office in Vernal was be responsible for this task.
- II). Collect drift net samples for Colorado pikeminnow. The Larval Fish Laboratory was responsible for this task.
- III). Identify 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.
- IV). Summarize specimen data collection in an annual report.

Accomplishments by Task.

- I). Collect light trap samples for razorback suckers. Light trap samples were collected during May and June, 2016 by the Vernal CRFP. Additional sampling near Green River flood plain wetlands was also conducted in summer 2016.
- II). Collect drift net samples for Colorado pikeminnow. Drift net samples were collected during June to August 2016 by the Larval Fish Laboratory.
- III). Identify light trap and drift net samples.

Middle Green River light trap samples, 2015. The identification of 2015 samples was nearly complete by reporting time in 2015 but we present the final portions of those results now. The duration of the sampling season was 5 May until 12 June, 2015. First razorback sucker larvae of the season were captured on 7 May at Cliff Creek, the earliest date ever recorded since this sampling program began in 1992. That date of first appearance was in contrast to 2014, where first larvae appearance was 28 May, a relatively average date of first appearance, and to 2011 when the first larvae were detected late on 24 June. Flows in 2011 were extremely high and cold, which delayed reproduction by razorback suckers; flows were moderately high in 2014, and in 2015, were low in early May and warm, but frequent and heavy rains increased river levels through May and into June. Dates of first appearance of razorback sucker larvae have

been successfully used to make decisions regarding Flaming Gorge Dam water management in spring for several years. Larvae captured in 2015 light trap samples ranged from 10-19 mm total length. The relatively large specimens captured on the last few sampling days (10.8-16 mm TL) indicated that spawning may finished some time before the last sampling date.

Abundance of razorback sucker larvae in 2015 was different than typical, as most larvae were captured prior to onset of high releases from Flaming Gorge Dam and increased Green River, Jensen, Utah, flows (Figure 2). One goal of those increased releases is to connect middle Green River floodplain wetlands with the river when razorback sucker larvae are produced, to aid in their growth and recruitment. Presence of larvae triggers higher releases from Flaming Gorge Dam in spring to support flows from the Yampa River, but typically higher numbers of larvae are present when flow releases peak. The relatively low production of juvenile razorback suckers in Stewart Lake wetland in 2015 could be associated with the lower abundance of larvae produced after flow levels increased.

We also prepared samples of razorback suckers captured for selenium analysis in 2014 and 2015 in conjunction with Recovery Program staff (McAbee).

Middle Green River light trap samples, 2016. The identification of 2016 samples is nearly complete now so we report those results. The duration of the sampling season was mid-May until late June. First razorback sucker larvae of the season were captured on 28 May at Cliff Creek, 21 days after first larvae were collected in 2015 (7 May), and on the same date as larvae were first collected in 2014; May 28 is an average date of first collection. In contrast, first appearance of larvae in 2011 when flows were high and cold very late, was 24 June. Larvae captured in 2016 light trap samples ranged from 8-17 mm total length. Dates of first appearance of razorback sucker larvae have been successfully used to make decisions regarding Flaming Gorge Dam water management in spring since 2012.

Number of razorback sucker larvae collected was down again in 2016 from earlier peaks, although slightly higher than in 2015 and 2014 (Figure 1). Accessibility to sampling sites and likely, lower fish abundance may have been factors associated with those lower numbers. The lower numbers are in contrast to the high numbers of juvenile fish produced in Stewart Lake in 2016.

Abundance of razorback sucker larvae in 2016 was well-timed with increased Green River, Jensen, Utah, flows (Figure 2). Presence of larvae triggers higher releases from Flaming Gorge Dam in spring to support flows from the Yampa River. One goal of those releases is to connect middle Green River floodplain wetlands with the river when razorback sucker larvae are produced, to aid in their growth and recruitment. The higher abundance of larvae later in the season associated with higher flows is positively related to the relatively large number of juvenile razorback suckers (>2,000) produced in Stewart Lake in 2016.

Lower Yampa River drift net sampling, 2015. Samples were collected in the Yampa River about 0.2 to 0.8 km upstream from the Green River (n = 246 total samples collected in 2015), the same site that samples were collected from in 1990 to 1996 (Bestgen et al. 1998) and in 1998 to 2014. Sampling commenced on 17 June and extended through 16 August. The first Colorado pikeminnow larva was collected on 27 June, a relatively average date for first capture of larvae and not unexpected given the warm (but high levels) water temperatures early in summer.

Abundance of Colorado pikeminnow larvae was about average in 2015, similar to that in 2016, but less than that for 2013 and 2014 (Figure 3). Yampa River flows were moderate to low early in the reproductive season. We plotted capture dates of larvae as a function of time and overlaid that with Green River flow. Green River flows at Jensen, Utah, were relatively low in early July and near the level (about 3000 cfs) when habitat conditions are suitable for good survival (Bestgen and Hill 2016). Presence of early lower flows may have increased survival of those larvae. A flow spike in the Yampa River on 10 July may have reduced survival of pikeminnow larvae, similar to that for smallmouth bass upstream (Annual report, Project 140), because few larvae were captured from about 10-22 July. However, a bimodal peak of reproduction is not uncommon (see 2016 data) so low abundance of larvae could also be due to lack of reproduction in the preceding days. About 50% or more of Green River, Jensen flows in July were produced in the Green River, and the remainder was from the Yampa River, the exception being the 10 July flow spike.

Abundance of YOY Colorado pikeminnow in 2015 in the middle Green River, Utah, ISMP samples collected in autumn was very high, especially when compared to recent years (M. Breen personal communication, Project 138 annual report). Above average abundance of larvae does not appear to be one of the reasons that YOY were so abundant, as similar levels of larvae were produced in 2016 and few YOY resulted (see below). One possible reason for increased YOY production in 2015 is that July flows were moderate to low throughout the summer when Colorado pikeminnow larvae were present, unlike 2016 when early July flows were high (see below). Backwaters were also present and abundant at that time, and lower flow levels likely allowed for colonization by the invertebrate food base that Colorado pikeminnow require, which likely also assisted with production of a large YOY pikeminnow year class. This situation is contrasted with 2016 below, a year with similar levels of larvae production but higher flows in early July.

Lower Yampa River drift net sampling, 2016. Samples were collected in the Yampa River about 0.2 to 0.8 km upstream from the Green River (n = 233 total samples collected in 2016), the same site that samples were collected from in 1990 to 1996 (Bestgen et al. 1998) and in 1998 to 2015. Sampling commenced on 23 June and extended through 16 August. The first Colorado pikeminnow larva was collected on 30 June, a relatively average date for first capture of larvae and not unexpected given the warm (but high levels) water temperatures early in summer.

Abundance of Colorado pikeminnow larvae was about average in 2016, similar to that in

2015, but less than that for 2013 and 2014 (Figure 3). High Yampa River flows were present early in the reproductive season. We plotted capture dates of larvae as a function of time and overlaid that with Green River flow. Green River flows at Jensen, Utah, were high in early July and well above the flows when abundant backwater habitat is available. Even though flows were lower in the later portion of July, reduced or absent backwater habitat in early July likely reduced survival of those early larvae. About 50% of those early July flows were produced in the Yampa River, and the other half derived from releases from Flaming Gorge Dam.

Abundance of YOY Colorado pikeminnow in 2016 in the middle Green River, Utah, ISMP samples collected in autumn was very low (M. Breen personal communication, Project 138 annual report). Abundance of larvae does not appear to be one of the reasons as larvae were at average or higher than average abundances in 2016. One possible reason for reduced YOY production is that early July flows were high, during a period when about 50% of Colorado pikeminnow larvae were produced. Thus, backwaters may not have been available during that time. Further, newly formed backwater habitat is likely food-poor because invertebrates have not colonized those areas and established populations. Thus, suitable backwater habitat may not have been available until later in July in 2016. Flow pattern as well as magnitude may be very important for production of good year classes of YOY pikeminnow.

Reasons for lack of YOY Colorado pikeminnow produced from larvae available in the later portion of 2016 are not known. Sampling in autumn 2016 indicated backwaters were arrayed in a different geomorphic pattern than they normally are, and some that were historically present were gone (Matt Breen, personal communication, Project 138 annual report). Habitat shifts may thus, be an additional reason for poor production of YOY Colorado pikeminnow in 2016.

Most sampling data collected in this program (1990-2012, none in 1997) were recently incorporated into a report entitled "Reproduction, abundance, and recruitment dynamics of young Colorado pikeminnow in the Green River Basin, Utah and Colorado, 1979-2012. That report (Bestgen and Hill 2016) has been reviewed by the Biology Committee of the Upper Colorado River Endangered Fish Recovery program, comments incorporated into a final report, which was approved and finalized.

- VIII. Additional noteworthy observations: A total of 4 razorback sucker larvae (8-18 mm TL) were captured in drift nets at the Yampa River drift net sampling site in 2016. Capture dates ranged from 30 June to 12 July. Numerous chub larvae, presumably roundtail chub *Gila robusta* were also noted in samples in 2016.
- IX. Recommendations: Continue sampling as planned in 2017. Continue to integrate this work into recruitment patterns noted for juveniles.
- X. Project Status: Ongoing and on-track.

XI. FY 2016 Budget Status

- A. Funds Provided: \$ 172,330
- B. Funds Expended: \$ 131,435
- C. Difference: \$ 40,895 remaining funds for sample analysis that remains.
- D. Percent of the FY 2016 work completed, and projected costs to complete: About 75% complete.
- E. Recovery Program funds spent for publication charges: None.

XII. Status of Data Submission (Where applicable): Data were made available to investigators.

XIII. Signed: Kevin R. Bestgen 13 November 2016 (updated 9 Dec. 2016)
Principal Investigator Date

APPENDIX: Major recent products based on these data include:

Bestgen, K. R., and A. A. Hill. 2016. Reproduction, abundance, and recruitment dynamics of young Colorado pikeminnow in the Green River Basin, Utah and Colorado, 1979-2012. Final report to the Upper Colorado River Endangered Fish Recovery Program, Project FW BW-Synth, Denver, CO. Department of Fish, Wildlife, and Conservation Biology, Colorado State University, Fort Collins. Larval Fish Laboratory Contribution 183.

Bestgen, K. R. 2015. Aspects of the Yampa River flow regime essential for maintenance of native fishes. Final Report submitted to the National Park Service, Fort Collins, CO, The Nature Conservancy, Boulder, CO, and Western Resource Advocates, Boulder, CO. Department of Fish, Wildlife, and Conservation Biology, Colorado State University, Fort Collins. Larval Fish Laboratory Contribution 181.

Bestgen, K. R., K. A. Zelasko, and G. C. White. 2012. Monitoring reproduction, recruitment, and population status of razorback suckers in the Upper Colorado River Basin. Final Report to the Upper Colorado River Endangered Fish Recovery Program, U. S. Fish and Wildlife Service, Denver. Larval Fish Laboratory Contribution 170.

Bestgen, K. R., G. B. Haines, and A. A. Hill. 2011. Synthesis of flood plain wetland information: Timing of razorback sucker reproduction in the Green River, Utah, related to stream flow, water temperature, and flood plain wetland availability. 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 163.

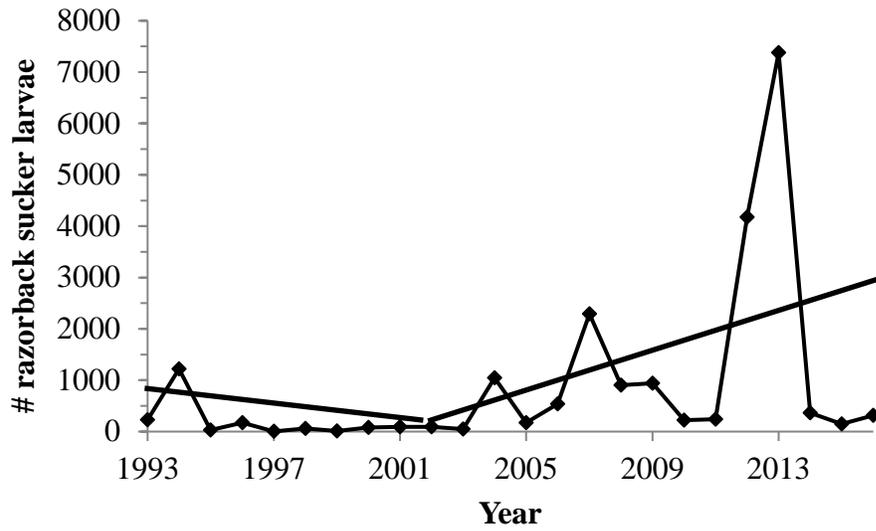
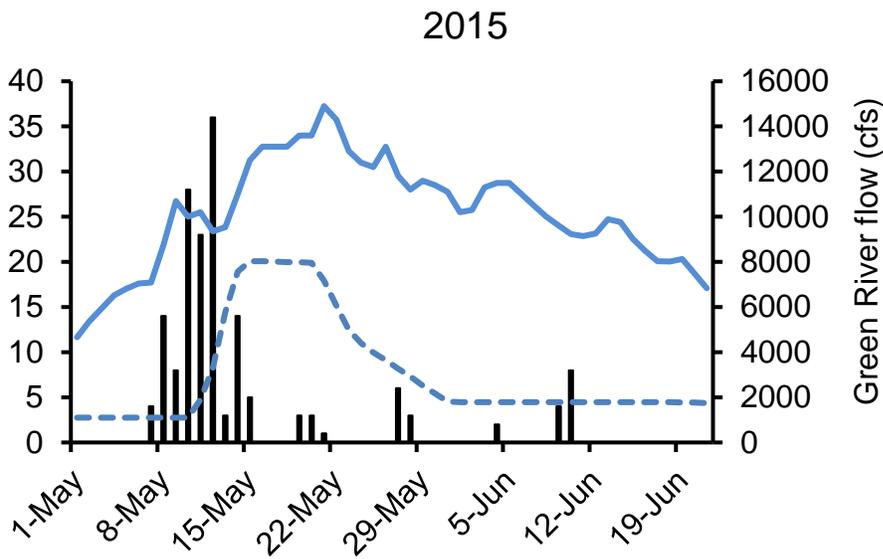


Figure 1. Number of razorback sucker larvae captured from 1993 to 2016 in the middle Green River, Utah, in light traps (all fish including those of questionable taxonomic identity included; 2016 sample identification is mostly complete and results are included here).

a.



b.

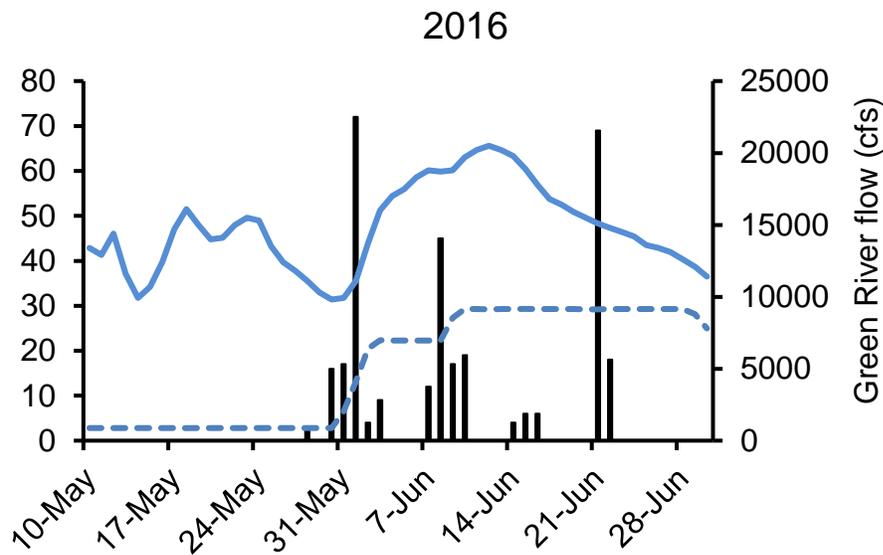


Figure 2. Seasonal distribution of razorback sucker larvae captured in 2015 (upper panel, a) and 2016 (lower panel, b) in middle Green River, Utah, in light trap samples (all fish including those identified as “razorback sucker?” were included). All samples from all locations were combined for each day. Gaps in captures after the first capture of razorback sucker larvae may indicate lack of sampling rather than absence of the species. Green River flows at Jensen, Utah (solid line) are plotted, as are releases from Flaming Gorge Dam (Greendale, Utah gauge, dashed line), with the difference in the two lines being flows of the Yampa River.

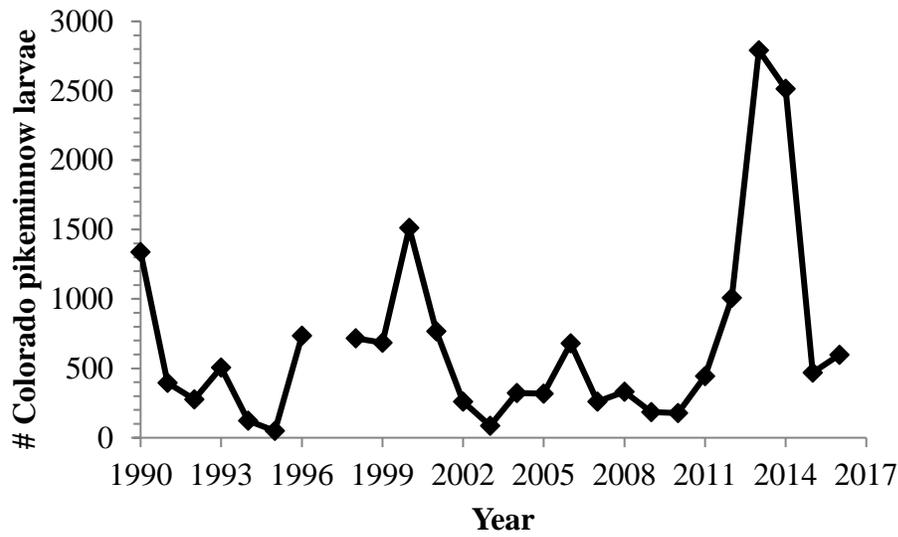
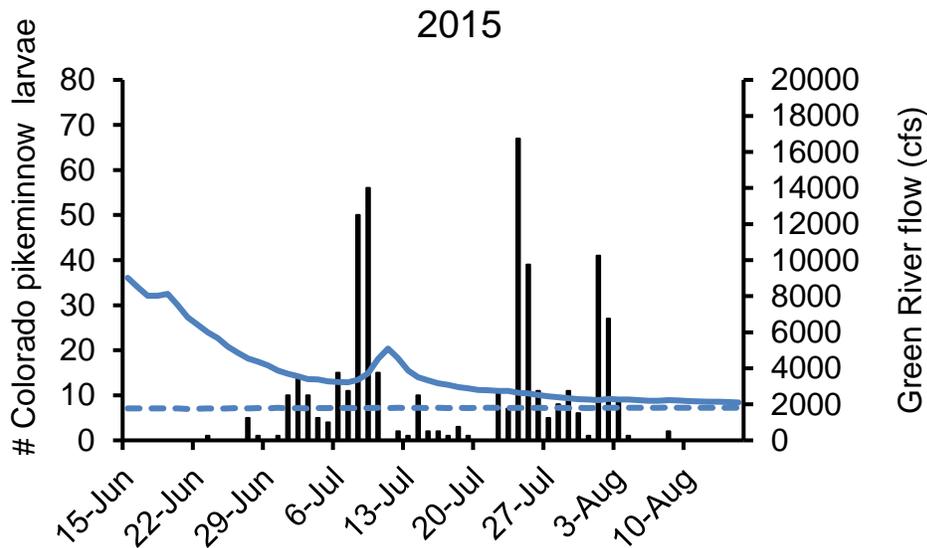


Figure 3. Number of Colorado pikeminnow larvae captured from 1990 to 2016 (no sampling in 1997, includes specimens from all diel samples, 2016 sample identification is complete) in the lower Yampa River, Colorado, during summer in drift nets.

a.



b.

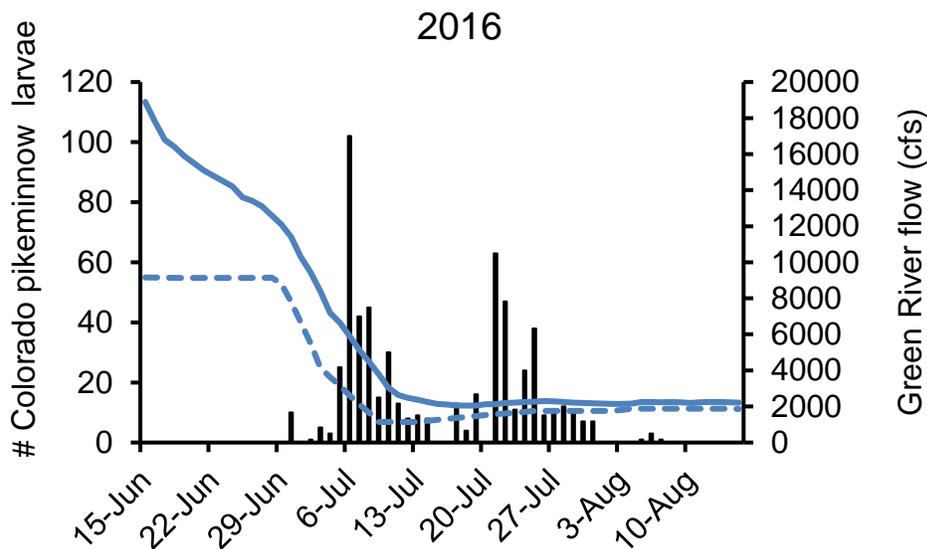


Figure 4. Seasonal distribution of Colorado pikeminnow larvae captured in 2015 (panel a) 2016 (panel b) drift net samples from the lower Yampa River, Colorado. Sampling for 2015 began on 17 June and ended 16 August. Sampling for 2016 (this reporting year) began on 23 June and ended 16 August. Several of the largest capture dates were diel sampling occasions (12 samples total each day). Flows of the Green River at Jensen (solid line) and Greendale (dashed line) are also depicted, with the difference in the two flows being the contribution of the Yampa River.

For projects where more than one agency/entity receives funds from the Bureau of Reclamation, append one PPR from each agency/entity. Otherwise, delete.

ANNUAL PERFORMANCE PROGRESS REPORT (PPR)

BUREAU OF RECLAMATION AGREEMENT NUMBER: R14AP00001

UPPER COLORADO RIVER RECOVERY PROGRAM PROJECT NUMBER: 22f

Project Title: INTERAGENCY STANDARDIZED MONITORING PROGRAM (ISMP)
ASSESSMENT OF ENDANGERED FISH REPRODUCTION IN RELATION
TO FLAMING GORGE OPERATIONS IN THE MIDDLE GREEN AND
LOWER YAMPA RIVERS.

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Project/Grant Period: Start date (Mo/Day/Yr): 1 Oct. 2014
End date: (Mo/Day/Yr): 30 Sept. 2018
Reporting period end date: 30 Sept. 2016
Is this the final report? Yes _____ No X

Performance: The goal of this project is to document timing and intensity of reproduction by razorback suckers and Colorado pikeminnow in the lower Yampa and middle green rivers. In 2016, we collected 246 drift net samples and additional seine samples in the lower Yampa River. In addition, we identified samples collected by the U. S. Fish and Wildlife Service in 2015 and began sample identification for 2016 samples. Another objective of this project is to summarize data collections. This was done in the attached report.

ANNUAL PERFORMANCE PROGRESS REPORT (PPR)

BUREAU OF RECLAMATION AGREEMENT NUMBER: R15PG00083

UPPER COLORADO RIVER RECOVERY PROGRAM PROJECT NUMBER: 22-F

Project Title: INTERAGENCY STANDARDIZED MONITORING PROGRAM (ISMP) ASSESSMENT OF ENDANGERED FISH REPRODUCTION IN RELATION TO FLAMING GORGE OPERATIONS IN THE MIDDLE GREEN AND LOWER YAMPA RIVERS.

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Project/Grant Period: Start date (Mo/Day/Yr): 10/01/2014
 End date: (Mo/Day/Yr): 9/30/2019
 Reporting period end date (Mo/Day/Yr): 09/30/2016
 Is this the final report? Yes _____ No X

Performance: USFWS completed tasks 1 and 3, collecting larval fish samples from 9 sites in the middle Green River from 10 May 2016 to 22 June 2016. Preliminary identification led to the successful initiation of flood flows from Flaming Gorge and the entrainment of larval razorback sucker into key wetland habitats. Fish samples were delivered to the CSU Larval Fish Laboratory for identification as outlined in the scope of work.