

UPPER COLORADO RIVER ENDANGERED FISH RECOVERY PROGRAM

FY 2020 ANNUAL REPORT

PROJECT: 85f

Project Title

Green River Suspended Sediment Monitoring

Bureau of Reclamation Agreement Number:

R17PG0047

Project/Grant Period:

Start date: 10/1/2016

End date: 9/30/2021

Reporting period end date: 9/30/2021

Is this the final report? Yes No

Principal Investigator:

David J. Topping

Research Hydrologist

USGS Grand Canyon Monitoring & Research Center (GCMRC)

2255 North Gemini Drive

Flagstaff, AZ 86001

Phone: (928) 556-7396

Fax: (928) 556-7100

Email: dtopping@usgs.gov

Abstract:

The purpose of this project is to collect and analyze suspended-sediment data to help the Program better understand geomorphic processes that form and maintain habitats important to Colorado pikeminnow and razorback suckers in the Green River, including connected backwaters, side channels, and flooded bottomlands. The Recovery Program is interested in: (1) quantifying changes in sediment storage in the Jensen-Ouray segment of the Green River as a function of the magnitude and timing of inputs of sediment and water; and (2) quantifying the streamflows required to export the sediment delivered to this segment to maintain/improve habitat. For this purpose, this project collects high- temporal-resolution suspended-sediment data using multi-frequency acoustics, calibrated pump samples, and conventional equal-width-increment (EWI) measurements near the USGS gages on the Green River near Jensen and at Ouray, UT, and uses these data to construct mass-balance silt-and-clay and sand budgets.

Study Schedule:

Collection of sediment-transport data for this project began at both Green River sites (above Jensen and above Ouray stations) in FY 2017. These sites will continue to be visited by field staff multiple times each year through FY 2021 for equipment maintenance, collection of suspended-sediment samples for the calibration and verification of acoustical sediment-transport data, and for tracking bedform migration to estimate the bedload component of total sediment transport.

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Relationship to RIPRAP:

General Recovery Program Support Action Plan I. Provide and Protect Instream Flows

Accomplishment of FY 2020 Tasks and Deliverables, Discussion of Initial Findings and Shortcomings:

During FY 2020, 15-minute, two-frequency acoustical suspended-sediment measurements were made at the Green River above Jensen, UT, station (located just downstream from the Split Mountain Campground in Dinosaur National Monument) and the Green River above Ouray, UT, station (located at the fish observation deck in the Ouray National Wildlife Refuge). These stations are located upstream from the USGS gages near Jensen, UT (#09261000) and at Ouray, UT (#09272400), respectively. In addition to the acoustical measurements, 44 calibrated-pump suspended-sediment samples were collected at the above Jensen station and 96 calibrated-pump suspended-sediment samples were collected at the above Ouray station, and 4 EWI measurements (measurements made using depth-integrating samplers deployed across the entire cross section) were made at the above Jensen station and 7 EWI measurements were made at the above Ouray station. Most of pump and EWI physical suspended-sediment samples have been processed through the GCMRC sediment laboratory for concentration and grain size; the remainder will be processed through the laboratory before the end of December 2020.

Both sites were visited multiple times FY 2020 for operation and maintenance purposes, including visits to collect suspended-sediment samples used for calibration and verification of the acoustical and pump-sampler data. The above Jensen station was visited 4 times and the above Ouray station was visited 6 times. EWI and bed-sediment measurements were made during each of these visits. Each of these stations was visited again, with additional EWI and bed-sediment measurements made during October 2020 (exhausting funds carried over from FY 2020). Previously, during FY 2019, we finalized the relations used to estimate sand bedload at the Ouray station on the basis of the suspended-sand load and discharge. These relations were developed from paired EWI and bedform-tracking measurements made during 6 site visits in FY 2017-2018 and have been programmed into our website to provide continuous estimations of sand bedload. In addition, 27 historical cross sections were resurveyed in October 2020 to document long-term topographic changes in the Jensen to Ouray segment.

Based on analyses of the data we collected during FY 2017-2020, net deposition or erosion of sand in the Jensen to Ouray segment during annual floods appears to be controlled by systematic inter-annual changes in the upstream sand supply and not directly by the discharge of water. The upstream sand supply in this segment (at the above Jensen station), in turn, appears to be controlled by the interaction of Flaming Gorge dam releases with Yampa River streamflow. This modulation of the upstream sand supply depends on the duration of higher discharges within the Flaming Gorge dam releases and not on the peak discharge of these releases. Net deposition of sand in the Jensen to Ouray segment occurred during one annual flood (2019). During the 2019 flood, the duration of higher discharges within the Flaming Gorge dam releases was short and the duration of higher discharge within the annual flood of the Yampa River was long (Figure 1). Consequently, the upstream sand supply was enriched during this flood, as evidenced by the much higher concentrations of suspended sand at Jensen than at Ouray (Figure 2a). Conversely, the greatest net erosion of sand from this segment occurred during the 2017 annual flood, when the duration of higher discharges within the Flaming Gorge dam releases was

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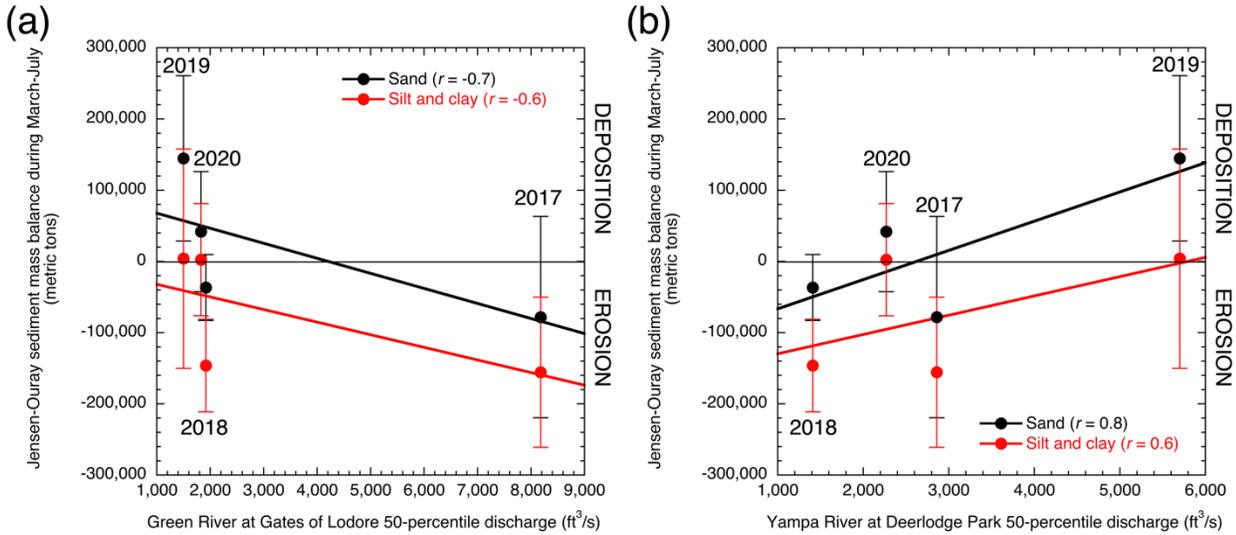


Figure 1. Mass balance of sand and of silt & clay in the Jensen to Ouray segment during March-July of each year plotted as a function of the March-July 50%-percentile discharge in (a) the Green River at the Gates of Lodore and (b) the Yampa River at Deerlodge Park. Least-squares linear regressions with correlation coefficients (r) shown. Positive values of the sediment mass balance indicate net deposition during the March-July period of the annual flood; negative values of the sediment mass balance indicate net erosion during the March-July period of the annual flood. The median (50%) discharge during March-July is used as a proxy for the duration of higher discharges during the annual flood.

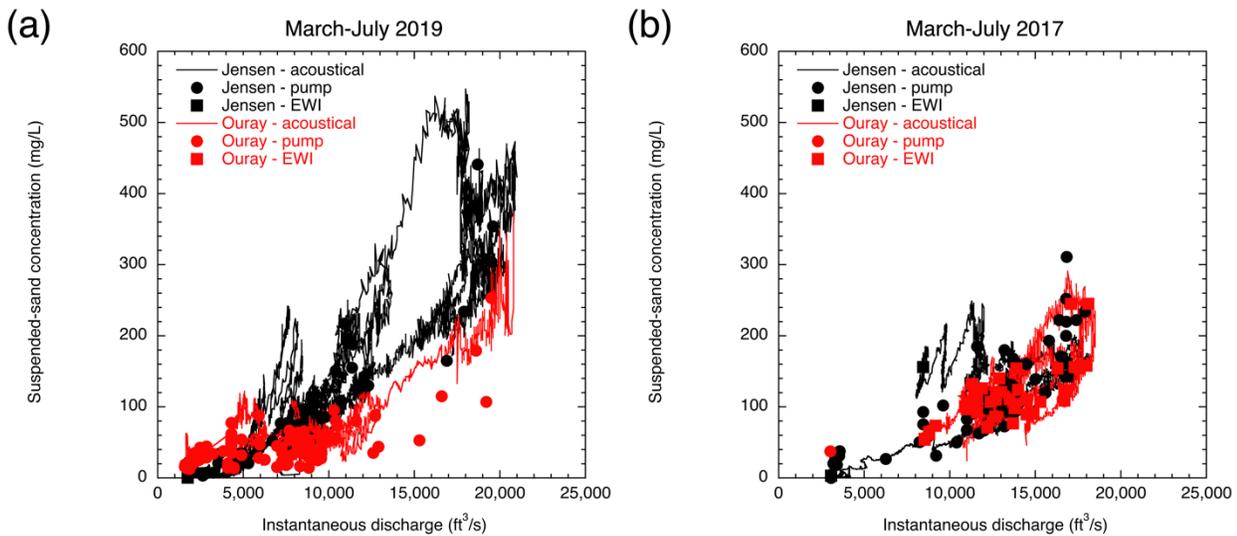


Figure 2. Suspended-sand concentration plotted as a function of the instantaneous discharge of water during (a) March-July 2017 and (b) March-July 2019 at Green River above Jensen, UT, and the Green River above Ouray, UT, stations. Different measurement types indicated.

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long and the duration of higher discharge within the annual flood of the Yampa River was relatively short (Figure 1). Consequently, the upstream sand supply was depleted during this flood, as evidenced by the comparatively low concentrations of suspended sand at Jensen over most of March-July (Figure 2b). The change in sand mass in the Jensen to Ouray segment was smaller during the annual floods in 2018 and 2020, which had intermediate durations of higher discharge from the dam and the Yampa River. Although a similar dependence of the silt-and-clay mass balance in this segment on the relative durations of higher discharge within the Flaming Gorge dam releases and the annual flood of the Yampa River was observed, this relation is less certain than that for sand.

We hypothesize that net erosion of sediment from the Jensen to Ouray segment during annual floods corresponds to an increase in channel complexity that, in turn, corresponds to increased backwater and side-channel habitat for native fish. Conversely, we hypothesize that net deposition of sediment in the Jensen to Ouray segment during annual floods corresponds to a decrease in channel complexity that, in turn, corresponds to decreased backwater and side-channel availability to native fish. In 2021, we will be testing this hypothesis through analysis of the 27 repeat cross sections combined with hydrologic analysis of streamflow in the Jensen to Ouray segment over the last 30 years. We will then know the likelihood of whether the 2017 annual flood resulted in improved native-fish habitat in the Jensen to Ouray segment whereas the 2019 annual flood resulted in degraded native-fish habitat in this segment.

In summary, the mass balance of sediment in the Jensen to Ouray segment is not controlled by the peak discharge of the annual flood in this segment nor by the peak discharge of Flaming Gorge Dam releases. The peak discharge of the 2017 annual flood near Jensen, 18,300 ft³/s, was actually slightly smaller than the 20,900 ft³/s peak discharge of the 2019 flood. Similarly, the peak discharge of the 2017 dam release measured at Gates of Lodore, 8,720 ft³/s, was also slightly smaller than the 8,910 ft³/s peak discharge of the 2019 dam release. Net sediment erosion occurred during the smaller 2017 flood, whereas net sediment deposition occurred during the larger 2019 flood. Thus, depending on the degree to which changes in fish habitat are related to the mass balance of sediment in this segment, the amount and quality of fish habitat may be unrelated to peak flood discharge. Instead, changes in fish habitat may be controlled by the changes in the upstream sediment supply that are driven by the interaction of Flaming Gorge dam releases with Yampa River streamflow.

Recommendations:

We recommend that our study be continued for a sufficient number of years so that we can collect data during enough years with differing hydrologic and sediment conditions to see if the results described in the previous section are universal. Of the four completed years of our 5-year study, we have only three years in which we detected changes in the sediment mass balance in the Jensen to Ouray segment (2020 was indeterminate with respect to changes in the mass of sand and changes in the mass of silt and clay). Although the hydrologic-sediment relations during the four years of our study strongly suggest that the relative durations of higher flows within Flaming Gorge dam releases and within the Yampa River annual flood are the key to managing for improved fish habitat in the Jensen to Ouray reach, we only have a sample size of 3. In addition, we recommend that the cross sections that we resurveyed in October 2020 (previously surveyed in the 1980s-1990s) be resurveyed again before the termination of our study, and that our study continue long enough to make this resurvey meaningful for comparing against our flux-based sediment budgets (i.e., this second survey occurs some number of years after 2020).

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Project Status:

Ongoing

FY 2020 Budget Status

Funds Provided: \$39,736

Funds Expended: \$39,736 (\$1,400 of these funds were spent in October 2020 as described above)

Difference: -0-

Percent of the FY 2020 work completed, and projected costs to complete: 100%

Recovery Program funds spent for publication charges: -0-

Status of Data Submission

All data have been posted to our website, where data can be plotted and downloaded, and mass-balance sediment budgets can be constructed and viewed. This website can be accessed at:

https://www.gcmrc.gov/discharge_qw_sediment/ or

https://cida.usgs.gov/gcmrc/discharge_qw_sediment/.

Signed:

David J. Topping

Principal Investigator

Date: November 25, 2020