Project Title
San Juan River Annual Habitat Monitoring

Bureau of Reclamation Agreement Number:
N/A

Reclamation Agreement Term
N/A

Note: Recovery Program FY23 scopes of work are drafted in May 2022. They often are revised before final Program approval and may subsequently be revised again in response to changing Program needs. Program participants also recognize the need and allow for some flexibility in scopes of work to accommodate new information and changing hydrological conditions.

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United States Fish and Wildlife Service

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Category:
X Ongoing project
__ Ongoing-revised project
__ Requested new project
__ Unsolicited proposal

Expected Funding Source:
__ Annual funds
__ Capital funds
__ Other *[explain]*

Relationship to LRP:
The SJRIP has, as one of its two primary goals, the conservation of populations of Colorado pikeminnow and razorback sucker in the San Juan River basin. To aid in the evaluation of achievement of these program goals, the following monitoring plan goals were developed (San Juan River Basin Recovery Implementation Program. 2012. Monitoring Plan and Protocols. San Juan River Basin Recovery Implementation Program, U.S. Fish and Wildlife Service, Albuquerque, NM. 53 pp.):

1) Track the status and trends of endangered and other fish populations in the San Juan River;
2) Track changes in abiotic parameters, including water quality, channel morphology, and habitat, important to the fish community in particular and the aquatic community in general;

3) Utilize data collected under Goals 1 and 2 to help assess progress towards recovery of endangered fish species; and,
4) Assess effectiveness of management actions, implemented flows, and intra- and inter-annual variability in flows on recovery of Colorado pikeminnow, razorback sucker and population status of other fish species.

Relative to this scope of work, SJRIP goal (2) and (4) above will be met in part. Specifically, achievement of this goal will occur through the tracking of species important low velocity habitats (numbers and areas), as well as channel complexity necessary for all life stages of the two rare fish in the San Juan River. Updating the existing database and comparing the current information will provide a status and trends.

Study Background/Rationale and Hypotheses:
In 1998, flow recommendations were developed by the SJRIP for the San Juan River below the confluence with the Animas River (River Mile 180). The details of the flow recommendations were heavily based upon river channel and habitat response to flows determined from a 7-year research study of channel morphology and habitat. In 1999, long-term monitoring was established to monitor channel and habitat response to flows. The protocols were continuations of those established during the 7-year research period and continued through 2004. From 1992 to 2007, ERI staff did the river-wide habitat mapping.

During the data integration process of 2004–2005, it became evident that backwater habitat types during base flow periods (800-1500 cfs) had been reduced in number and surface area beginning in September, 1995. Backwater surface areas between River miles 2 to 180 had decreased from 140,000 m^2 in September 1995 to less than 20,000 m^2, river wide by October 2003. From 2005 to 2015, backwater surface areas have stabilized at approximately 30,000 to 40,000 m^2. However, during 2016, the area of backwaters increased to over 90,000 m^2. It was hypothesized that the characteristics of the 2016 San Juan River spring runoff (magnitude, duration, etc.) were instrumental in the increase in low velocity habitats. These habitats persisted in 2017 with another high spring flow. However, in 2018, there was no spring release from Navajo Reservoir and the San Juan River experienced significant periods with summer baseflows less than 500 cfs. These resultant low flows reduced backwater surface areas to levels near their lows in 2004. In 2019, two monitoring data points were collected because of additional available water from Navajo Reservoir. The first was at an elevated baseflow of 1,500 cfs and the second at a lower baseflow of 690 cfs. The antecedent conditions prior to data collections, were considered high spring runoff conditions. All high flow metrics were met by the spring runoff. The resultant low velocity habitat surface areas were the largest since the 1995 high measurements

The 2022-23 habitat monitoring will document the impacts of the 2022 hydrograph, which is anticipated to be a lower than average flow year (USBR 2022 anticipated spring flows). We are hypothesizing that the high densities of backwater habitat areas created in 2020 will be further reduced.

One of the following hypothesizes will be addressed for the 2022 data depending upon the hydrologic conditions prior to mapping.

H_{O1} : If the spring runoff is greater than the average runoff, TWA, Island Count and Backwater Type area will be equal to or greater than the areas from the 2021 habitat characteristics (density and area)

H_{O2} : If the spring runoff is equal to the average runoff, TWA, Island Count and Backwater Type area will remain the same compared to the 2021 habitat characteristics (density and area)

H_{O3} : If the spring runoff is less than the average runoff, TWA, Island Count and Backwater Type area will be less than the 2021 habitat characteristics (density and area)

As part of the habitat post processing analysis, backwater and embayments will be divided into several types. These types of backwaters include those associated with main channel point bars and point bars on islands. In addition, backwaters associated with dry secondary channels and dry-island split channels will be defined and quantified by river mile (count and area). Recent analysis has resulted in all historical backwater data being reclassified into these categories.

Study Goals, Objectives, End Product(s):

Goal: The overall Goal of this project is to quantify the amount of low velocity habitat (LVH) in the San Juan River during late summer base-flow conditions.

Objectives: The specific objectives of this work-plan correspond to the overall objectives of the monitoring protocols (2012). Specifically the direct linkage of objectives between this study and protocol objectives (by number) that are in common include:

Objective 1) Annually, following spring runoff, document abundance and distribution of key habitats and geomorphic features (backwaters, embayments, islands and total wetted area) that indicate the response of the river channel and habitat to antecedent runoff conditions and specific management actions… (*Specifically, determine the impact of the 2022 water hydrograph conditions on habitat planform).*

Objective 8) Develop relationships between habitat availability and antecedent flow conditions. Use key habitats for this analysis. (*For example, the hydrograph for 2019 produced more days above 10,000, 8,000 and 5,000 cfs since the high flows of 2008 and produced the most backwater area since 1995.Conversely, flows in 2018 were well below those in 2019 and backwater habitat was reduced to the second lowest level since 2004). The project will evaluate if the existing relationships developed in 2020 between habitat densities and antecedent conditions are still valid for the habitat densities that will be found after the 2022 spring runoff).*

Objective 9) Track long-term trends of habitat availability under base-flow conditions

End Product: A final report will examine the relationships between hydrology (especially recent antecedent hydrology conditions prior to image capture and mapping) and habitat conditions (density and area) throughout the river. Trend analysis will be performed on all habitat types mapped to assess trend with time and flow at mapping. Trends with time will be analyzed with raw data (habitat count and area by river-mile with time) and with data normalized for flow at mapping where flow is a covariate. Antecedent conditions will be calculated and relationships to habitat abundance compared to previously developed relationships.

Study Area:
The area of investigation will cover the Rm 0 to Rm 180. There will be some portion of the river below the waterfall in Lake Powell that will be also photographed

Study Methods/Approach:
Aerial imagery of the San Juan River will be obtained using a TU-206 Cessna fixed wing aircraft that will maintained an altitude above 3,800 feet in order to achieve a 10 centimeter digital 4 band resolution. Images will be captured using a Vexcel UltraCam UCFp Digital Sensor high resolution camera. Keystone Aerial Surveys (Geomni) will capture photographs of the San Juan River during late summer base flow at flows less than 1,000 cfs. This will involve 55 flight lines and 988 Images (Figure 1)

Using ESRI Arcmap 10.0, digital images will be imported and post-processed in the laboratory, and subsequently overlaid on 2011 geo-referenced National Agriculture Imagery Program (NAIP) county mosaics for the full extent of the river floodplain boundaries. Individual images will be geo-referenced and rectified by the contractor (BSC). The end product will be a collection of geo-referenced, high-resolution (10 cm) images of the San Juan River from the confluence of the Animas River to the Lake Powell waterfall at river mile 0 (Figure 1). This initial process of preparing the mapping photos will be similar to the methods employed by Block (2014) on the Little Colorado River.

Task Description, Deliverables and Schedule:

Task Descriptions:

Task 1. Develop high-resolution Digital Imagery for Rm -10 to Rm 180.

The San Juan River will be flown and digital images captured at a resolution of 10 centimeters. Images will be printed with a 20% overlap between images and placed in plastic overlays.

Task 2 Field Habitat Mapping

If necessary, field-verify selected problematic marginally flowing secondary channels during the summer base-flow period (2022) captured in the aerial images. This will be dependent upon flow at image capture. All secondary channels, main channel splits, island splits and cobble/sand bar splits will be noted on base-maps and compared to the newest images.

Task 3) Post-process the planform geometry into ARC GIS and determine density and area for each habitat type.

Once the digital frames have been registered, ArcGIS will be used to digitize the boundaries of the wetted secondary channels. In addition backwaters, embayments islands and in-stream sand/cobble bars will be mapped. The data will be processed and summarized by river-mile to match existing datasets.

Task 4) Prepare a final report describing the effects of the 2022 spring flow hydrograph on the habitats and secondary channel types compared to 2016 to 2021 habitat data

Deliverables:

1) Aerial images of the San Juan channel at base flows (500 to 1000 cfs).
2) Polygon area, perimeter and geo-referenced location of backwaters, embayments, islands, and channel margins for each flight

3) Flow at mapping (flight date) for each USGS gage. Distribution and abundance (area and density) of backwaters, embayments and total wetted area in response to antecedent runoff condition and other management actions. Channel complexity (e.g. island count and total wetted area per river mile)
4) Date of mapping
5) Antecedent runoff hydrograph conditions
6) Data summarized by river mile, geomorphic reach and the full range of mapping
    - An annual draft report prepared and submitted by March 31, 2023
    - A final report submitted by June 1, 2023
    - Attendance at the annual report meeting (2023) and present the results of the project

Schedule:
Base photography will be acquired in September, 2022 (flow permitting). Frame capture, rectification, and photo-interpretation will be completed by December 2022. Field mapping (verification) will occur as soon as possible following image capture and be completed by the end of September 2022. ARC GIS data transfer will be completed by December 31, 2022. The draft annual report will be completed by March 31, 2023 with the final report due June 1, 2023.

Budget Summary:

FY Year	*[Office 1]*	*[Office 2]*
2023	$139,912	
2024	$144,109	
2025	$148,433	
2026	$152,885	
2027	$157,473	
Total	$742812	

Reviewers: