

Habitat and Water Temperature Monitoring 2016

1.0 INTRODUCTION

In 2011 the San Juan Recovery and Implementation Program (SJRIP) developed water temperature and habitat monitoring protocols. During the period of time that habitat and temperatures have been collected in the San Juan River, the river has experienced a wide variety of flows. Habitat monitoring started in the San Juan River in 1991 and 1992 with work being conducted by the BOR. That mapping, which only looked at total wetted area and backwaters, was taken directly from videography without any field inspections. In the fall of 1992, Ecosystems Research Institute (ERI) started mapping the San Juan River using the current river wide mapping methodologies and habitat types. Between 1992 and 2007, base flow river wide habitat has been mapped by ERI 22 times. In the last four years, habitat in the San Juan Rive has been mapped using the protocols described in this 2016 work plan.

Habitat Monitoring

In 1998, flow recommendations were developed by the SJRIP for the San Juan River below the confluence with the Animas River (River Mile 180). Flow recommendation details 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.

During the data integration process of 2004–2005, it became evident that backwater habitat types during base flow periods (800-1200 cfs) had reduced in number and surface area since September 1995. Backwater surface areas between RM 180 to 2 decreased from 140,000 m² in September 1995 to less than 20,000 m² by October 2003. From 2005 to 2007, backwater surface areas stabilized at approximately 40,000 m². In the last four years backwater habitat has increased to over 53,600 m².

The data integration analysis in 2005 also indicated that complex channel reaches (those with high habitat diversity, islands, multi-threaded channels and complex channel margins) correlate to native fish abundance. Furthermore, capture of young-of-year (YOY) endangered fish also tends to be correlated with channel complexity. Finally, backwater and low velocity habitats are more likely to occur in reaches with high complexity. As a result, two detailed reaches were identified for long-term monitoring in the San Juan River during the summer of 2006 through 2010. The goal of this study was to better understand the mechanism or process for creation and maintenance of these complex reaches and to understand the processes resulting in the loss or creation of backwater habitat important for the rare and native fishes in the San Juan River.

To the extent possible, habitat monitoring is closely coordinated and integrated with fish community monitoring to allow assessment of changing habitat availability and fish use in response to management actions and population recovery. Standardized habitat monitoring for the San Juan River was included in the 2000 monitoring plan and was reviewed and revised for the 2011 version. The plan is designed to monitor and evaluate habitat changes through time. The data and information from habitat monitoring will be integrated with different monitoring activities to assess the effectiveness of management actions, such as flow management, fish population estimates, and nonnative fish population abundances. A focused habitat monitoring workshop was conducted in 2011 which evaluated, refined, and refocused the habitat monitoring program on the San Juan River to insure the program implements methodologies that are conducive to answering outstanding questions and provide the data necessary to evaluate and revise the SJRIP's flow recommendations. This work plan incorporates several of the workshop recommendations

Water Temperature Monitoring

Water temperatures have been recorded in the San Juan River at 15 different locations for various periods of record. Using the 1999-2003 integration studies, the Biology Committee (BC) decided to collect temperatures at eight locations to be used for long-term monitoring. The BC decided that temperatures should be recorded every 15 minutes, with a daily maximum, minimum and average calculated. These data are now being collected by the USGS at approved upon locations.

PROJECT JUSTIFICATION

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 Draft Monitoring Protocols, 2010):

- 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 proposal, SJRIP goal (2) above will be met in part. Specifically, achievement of this goal will occur through the tracking of species important backwaters (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.

PROJECT OBJECTIVES

The specific objectives of this Proposal correspond to the overall objectives of the draft monitoring protocols (2010) as well as several recommendations of the program work shop held in 2011. Specifically the direct linkage of objectives between this work plan 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.
- Objective 2)** Maintain continuous water temperature recorders at key locations from Navajo Dam to Mexican Hat, Utah to examine the influence of artificial manipulation of water releases from Navajo Dam on water temperature.
- Objective 4)** Periodically map river-wide habitat abundance and distribution in the San Juan River from the Animas River confluence (RM 180) to Clay Hills Crossing (RM 2) to track long-term trends in habitat (Done in 2014)
- Objective 8)** Develop relationships between habitat availability and antecedent flow conditions. Use key habitats for this analysis.
- Objective 9)** Track long-term trends of habitat availability ...

STUDY DESIGN

There are three major tasks included in the proposed monitoring program. They include:

- Task 1) Annual Habitat Mapping using geo-referenced video imagery for Islands, Backwaters and embayments
- Task 2) Field Habitat verifications of secondary channels
- Task 3) Water Temperature Monitoring

Each of the above tasks are described in detail in the following sections and cover methods, data analysis, schedule and deliverables.

Tasks 1 and 2. Annual Habitat Mapping and Field Verification - General Methods

- 1) Using the habitat categories: backwaters, embayments, islands, and total wetted area, map aquatic habitat at a scale of 1" = 200', using geo-referenced video imagery provided to the contractor by the program,
- 2) Examine the relationships between hydrology (especially recent antecedent hydrology conditions) and habitat conditions throughout the river, especially backwater habitats and island complexity.
- 3) Field verify the conditions of secondary channels at the remote mapping flow levels

Specific Methods for Annual Habitat Mapping

Digital videography of the San Juan River from the Animas River confluence (RM 180) downstream to below Clay Hills Crossing (RM 0) will be acquired from Reclamation at a flow of from 500 to 1,000 cfs in late July to early September each year. Digital single frames will be captured from this videography to provide full coverage of the river with about 20% overlap. The digital images will be rectified to the most recent digital orthographic quads (DOQs) prior to photo-interpretation and will be archived to DVD. Photo-interpretation will be completed to identify backwaters, embayments, islands, and total wetted area annually for RM 0 to RM 180. Once the digital frames have been registered, ArcGIS will be used to digitize the boundaries of the wetted channel, backwaters, embayments and islands. The data will be processed and summarized by river-mile to match existing datasets. In 2012, using video mapping, it was difficult to determine if smaller secondary channels were flowing. In 2015, field verification will determine secondary channel conditions at the mapping flow

Data Analysis

Data analysis is the same whether photo-interpreted or field mapped, except that the number of habitats analyzed will be different. 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.

Schedule

Base photography will be acquired in late July to early September 2015 (flow permitting). Image capture, and photo-interpretation will be completed by February 2016. The draft annual report will be completed by March 31, 2016 with the final report due June 1, 2016.

Deliverables

Annual tasks

- 1) Digital video image captures of channel and flood plane at a flow between 500 and 1,000 cfs.
- 2) Polygon area, perimeter and geo-referenced location of backwaters, embayments, islands, and channel margins
- 3) Flow at mapping (flight date) for each USGS gauge
- 4) Distribution and abundance (area and density) of backwaters, embayments and total wetted area in response to antecedent runoff conditions and other management actions. Channel complexity (e.g. island count and total wetted area per river mile)
- 5) Date of mapping
- 6) Antecedent runoff hydrograph
- 7) Data summarized by river mile, geomorphic reach and full range

Introduction to Temperature Monitoring

Miller Ecological Consultants, Inc (MEC) has monitored water temperature in the San Juan River and selected tributaries since fall of 2011. During that time MEC has made several recommendations to modify the water temperature data collection. These recommendations include adding a water temperature data logger in the San Juan River upstream of the confluence with the Animas River and cease collecting water temperature data at the base of Navajo Dam. These recommendations were made to better meet the current objectives of the Long Range Plan. The added location upstream of the Animas River provided a more detailed analysis of the water temperature changes between Navajo Dam and the Animas River. The recommendation to remove the logger at Navajo Dam was based on several factors; 1) this location was originally chosen when the tailwater fishery was part of the San Juan Seven Year Research Program, the tailwater is no longer included in the San Juan annual work plans, 2) coordination with the dam tenders adds another factor to logistics for the location, and 3) the logger at Archuleta provides an upstream water temperature that is very close to the release from Navajo Dam.

The data reporting for FY2012 resulted in several other recommendations. These were:

- Transfer the water temperature monitoring to USGS real time monitoring at the following gages:
 - San Juan at Archuleta, San Juan at Farmington, Animas at Farmington, and San Juan at Four Corners.

The USGS has a continuous monitor at Mexican Hat (USGS gage at Bluff). Transferring the data collection to USGS would provide a means to continue long term monitoring without some of the difficulties associated with separate loggers. It would provide real time retrieval for use by any researcher rather than end of year reporting. Further, the data would be archived in USGS permanent records and would simplify data base administration for the San Juan Program.

- Discontinue water temperature monitoring on unaged tributaries to the San Juan River, such as McElmo Creek.

The San Juan Program has no direct management of any of the tributary flows. The flows and resulting water temperatures are outside the control of the Program and therefore the Program does not have a means to directly change water temperature (e.g. through modified flow regimes). In addition, the remote PIT tag readers have the capability to monitor water temperature data.

- Continue the annual summary of water temperature data for inclusion in the annual meeting discussions and annual report.

- Conduct an analysis of water temperatures and the number, timing, and size of larval fishes in the San Juan River for the years 1998 through 2012, and, if practicable, for the years 1992 – 1997.

The following sections describe the tasks for the continued water temperature monitoring tasks

Task 3) Water Temperature Monitoring

The water temperature monitoring in the San Juan River and the Animas River at Farmington, New Mexico is now being collected by the USGS. The locations are as follows: San Juan River at Archuleta, NM; San Juan River at Farmington, NM; San Juan River at Four Corners, NM; San Juan River at Bluff (Mexican Hat), UT; and the Animas River at Farmington, NM. All locations except the Animas River at Farmington are real-time reporting stations at the USGS gage location. The Animas River at Farmington will be real-time reporting later in 2014.

Data Base and analysis

At the end of each water year, data for the water year will be compiled and the daily average temperatures plotted along with the daily hydrograph of the San Juan River at Four Corners, New Mexico. A summary report will be prepared that will include presentation of the daily average temperature data with a discussion of data collection procedures, data quality and repair requirements during the season. Anomalous data, if any, will also be discussed.

There will be an additional analysis in FY2054 that reviews the historical water temperature data base, USGS gage records and larval monitoring reports. This analysis will evaluate the data to determine if any patterns showing larval response in growth, number or timing of larval presence are apparent from the data set.

Proposed Methods

Data Collection

The data collection will be completed by USGS according to their standard protocols. Water temperature data for each location will be downloaded from the USGS web site and compiled for analysis.

Data Storage

The records will be maintained in a Microsoft Access database. The main data table will store the 15-minute data and will be constructed as shown in Table 3. Data tables summarizing daily maximum, minimum and average temperatures will be generated for each of the sites by query of the main data table and stored in the database in the format shown in Table 4. Table 5 shows the information stored to describe each session, including geo-spatial data to allow importation into a geographic Information System.

Data Analysis and Reporting

After the fall download, data for the water year will be compiled and the daily average temperatures plotted along with the daily hydrograph of the San Juan River at Four Corners, New Mexico. A summary report will be prepared that will include presentation of the daily average temperature data with a discussion of data collection procedures, data quality and repair requirements during the season. Anomalous data, if any, will also be discussed.

In addition to the data reporting, a retrospective analysis will be conducted on the existing water temperature data sets and larval fish data. The water temperature data for all years available will be evaluated in conjunction with the timing, size and number of larvae captured in the larval fish study. The objective of the analysis would be to determine if the data shows a linkage between the water temperature regime and the timing, size and number of larvae. These analyses would be used in evaluation of the review of flow recommendations and potential impacts from the water temperature depression on native fish larvae.

Deliverables

The water temperature monitoring will be conducted by USGS as per the FY2015 report recommendations. The tasks for FY2016 are analysis and evaluation of existing data. This analysis, while useful for integration with review of the flow recommendations, could be conducted in FY2016 with the initial work on the flow recommendation review.

The tasks for FY 2016 are:

Daily mean flow at each USGS gage

- Retrospective review of water temperature data for year data is available.
- Comparisons of larval capture rates, sizes and timing of capture with water temperatures.
- Report summarizing the analysis and submitted by March 31st of each year
- A final report submitted by June 1 of each year
- October 1, 2015 – September 30, 2016 data set from USGS gages for Recovery Program files
- An updated temperature database with all data collected to date, updated through September 2016.
- Attendance at the annual report meeting and one additional Biology Committee meeting

Table 2. Water temperature monitoring locations

Location	RM
Archuleta - San Juan at USGS Gage Location	218.6
Farmington - San Juan at USGS Gage Location	180.1
Four Corners - San Juan at USGS Gage Location	119.4
Mexican Hat - San Juan at Bluff Gage Location	52.1
Farmington - Animas at USGS Gage Location	n/a

Table 3. Temperature database main table format

Temp			
ID	RecDate	RecTime	DegC
4C	7/9/1999	4:04:27 PM	23.48
4C	7/9/1999	4:49:27 PM	23.74

Table 4. Daily temperature summary table format

AnimasFarminton				
ID	RecDate	Tmax	Tmin	Tavg
AF	7/8/1999	22.11	18.36	19.2
AF	7/11/1999	20.13	15.81	17.9

Table 5. Temperature station description database table

StationID					
ID	Location	Notes	Lat	Lon	Datum
4C	Four Corners	Located at the Four Corners USGS gage	37.00195	-109.0311	NAD83
AF	Animas at Farmington	Located an the Animas at Farmington USGS gage	36.72154	-108.2017	NAD83
AR	Archuleta	Located at the Archuleta USGS gage	36.80278	-107.699	NAD83
FM	Farmington	Located at the Farmington USGS gage	36.72221	-108.2251	NAD83
MH	Mexican Hat	Located right bank near the USGS mini-monitor enclosure upstream of Mex Hat bridge	37.15059	-109.8669	NAD83

2016 Budget

TASK	Labor	Direct Costs	Total by Task
Task 1 & 2 Annual Habitat Mapping			
Videography Clipping	\$2,534.00		\$2,534.00
Image rectification	\$48,840.00		\$48,840.00
Digitizing Mapped River	\$11,141.00		\$11,141.00
Back Water/ Embayment Identification	\$3,016.00		\$3,016.00
Data Analysis	\$4,034.35		\$4,034.35
Reporting	\$5,070.45	\$185.64	\$5,256.09
Meetings	\$650.00	\$774.18	\$1,424.18
Task 3 Water Temperature Monitoring			
Logger Deployment			\$0.00
Quarterly monitoring	\$1,623.60		\$1,623.60
Data analysis	\$10,882.60		\$10,882.60
Draft report	\$2,382.40	\$30.64	\$2,413.04
Final report	\$595.60		\$595.60
Meetings	\$1,300.00		\$1,300.00
Final report data delivery	\$399.28		\$399.28
Total Cost Estimate	\$92,469.28	\$990.46	\$93,459.74