

**Final**

**SAN JUAN RIVER BASIN RECOVERY IMPLEMENTATION PROGRAM  
WATER TEMPERATURE MONITORING**

**2014 ANNUAL REPORT**



**Submitted To:  
Ecosystems Research Inc  
Logan, Utah  
and  
US Bureau of Reclamation  
Salt Lake City, Utah**

**Submitted By:  
William J. Miller and  
Kristin M. Swaim  
Miller Ecological Consultants, Inc  
Fort Collins, Colorado**

**June 15, 2015**



**MILLER  
ECOLOGICAL  
CONSULTANTS, INC.**  
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**Table of Contents**

**INTRODUCTION ..... 1**  
    **Objectives ..... 1**  
**METHODS ..... 3**  
**RESULTS & DISCUSSION ..... 3**  
**REFERENCES ..... 9**

**List of Tables**

Table 1. Water temperature monitoring locations..... 4

**List of Figures**

Figure 1. Water temperature monitoring locations. Map courtesy of Google maps. .... 2  
Figure 2. Average daily water temperature at Archuleta compared to discharge at Archuleta. .... 5  
Figure 3. Average daily water temperature on the Animas River near Farmington compared to discharge on the Animas River. .... 6  
Figure 4. Average daily water temperature on the Animas River and the San Juan River at Farmington compared to discharge at Farmington..... 6  
Figure 5. Average daily water temperature at Shiprock compared to discharge at Shiprock. .... 7  
Figure 6. Average daily water temperature at Four Corners compared to discharge at Four Corners..... 8  
Figure 7. Average daily water temperature on McElmo Creek. .... 8  
Figure 8. Average daily water temperature at Mexican Hat compared to discharge at Mexican Hat. .... 9

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## INTRODUCTION

As part of the San Juan River Basin Recovery Implementation Program (SJRIP), water temperature and hydrology studies have been undertaken since 1992. This report summarizes the water temperature data collected from October 2013 to October 2014 as part of the long-term monitoring program.

### Objectives

- 1. Monitor water temperature at five existing locations in the San Juan River, NM and UT (Figure 1).**

HOBO Water Temp TidbiTv2 loggers have been deployed since fall of 2011 in the San Juan River and selected tributary streams. In 2013, nine locations were monitored for water temperature. At the end of FY2013, Miller Ecological Consultants made the recommendation to discontinue monitoring at several locations and to transfer the remaining locations to USGS real-time monitoring. Transferring data collection to the USGS provides a means to continue long-term monitoring without some of the difficulties associated with separate loggers. It provides real-time data retrieval for use by any researcher rather than end-of-year reporting. Further, the data are archived in USGS permanent records and simplify database administration for the San Juan Program.

The following locations were recommended for transfer to the USGS: San Juan River at Archuleta, San Juan River at Farmington, Animas River at Farmington and San Juan River at Four Corners. The USGS already maintains a real-time, continuous monitor at Mexican Hat (USGS gage 09379500, San Juan River near Bluff, UT). These locations were recommended because they currently have USGS gages that monitor discharge. The recommendation was approved by the Biology Committee in early 2014 and all four locations were transferred to the USGS in March 2014. Water temperatures in the San Juan River at Navajo Dam, CR5500 and Shiprock are no longer being monitored.

It was additionally recommended by Miller Ecological Consultants to discontinue water temperature monitoring on ungaged tributaries to the San Juan River, such as McElmo Creek. The San Juan Program has no direct management of tributary flows. 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).

- 2. Add FY2014 data to the water temperature database, which can be accessed at the SJRIP website.**

The database for water temperatures has been updated to include FY2014 data. These data are in the same format as the database for previous years.

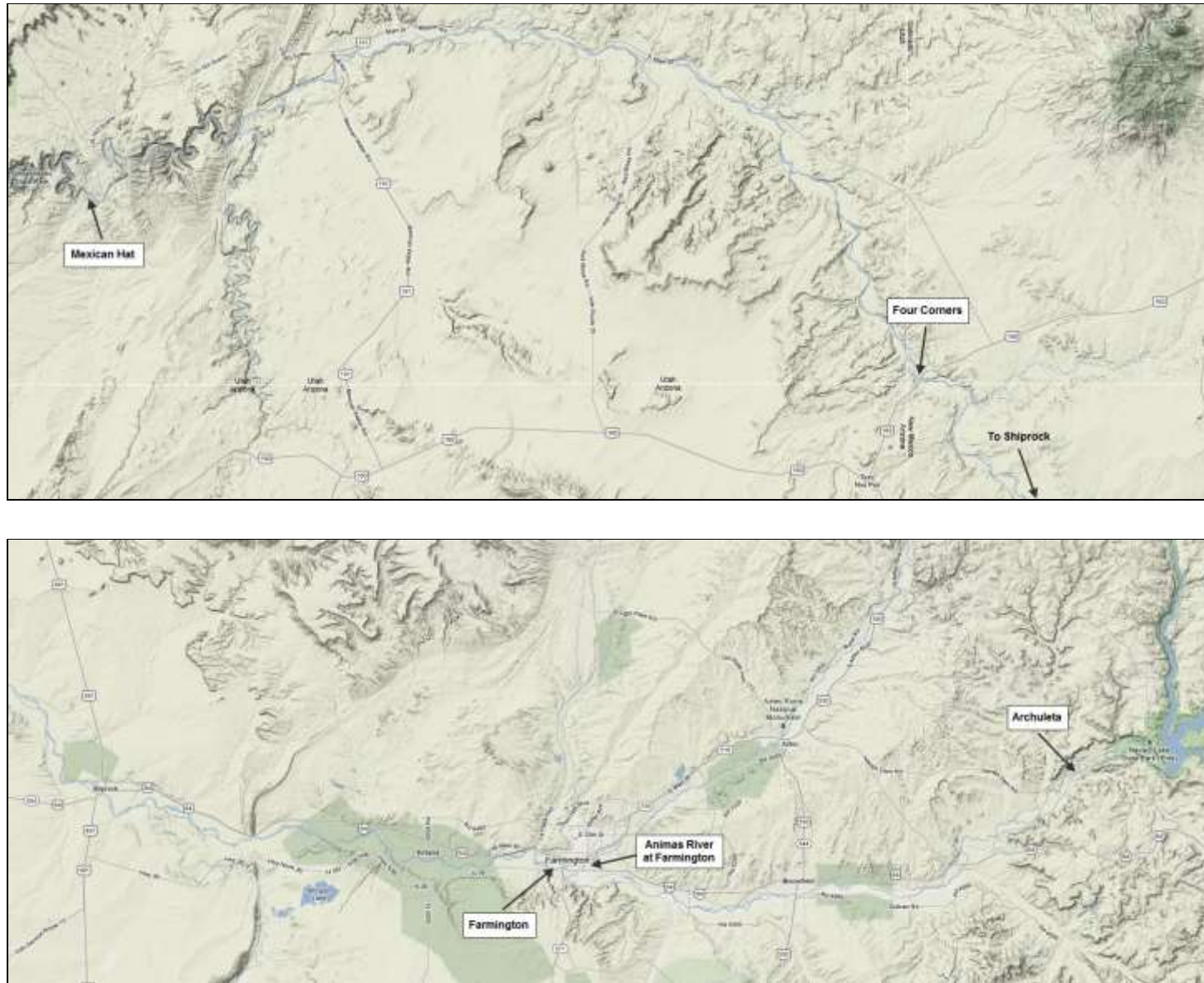


Figure 1. Water temperature monitoring locations. Map courtesy of Google maps.

## **METHODS**

Water temperature has been recorded since the summer of 1992 at the locations shown in Table 1 (not including the two locations established in 2011). Those data are found in reports posted to the San Juan River Recovery Implementation website. At the request of the Bureau of Reclamation and the San Juan River Recovery Implementation Program, we installed Onset Corporation HOBO Water Temp TidbiTv2 loggers with built-in thermocouple temperature sensors in October 2011 in the locations described in Table 1. Water temperature was recorded every 15 minutes. During the transition to the USGS, some of the loggers were kept in place in an effort to maintain the water temperature records.

HOBOWare Pro software was used to deploy and download data from the loggers. This software has built-in capability to summarize data into daily values from the individual 15-minute measurements. After each field visit, data were transferred to Miller Ecological Consultants (MEC)'s office where data were checked for quality and any erroneous or suspected incorrect data removed.

Once monitoring was fully transferred (March 2014), temperature data were downloaded from the USGS's website every 2-3 months. Fifteen-minute temperature data were summarized into daily values using R software (R Development Core Team 2013).

Quality-checked temperature data were added to the Microsoft Access database that contains all 15-minute data from each site. The database also contains tables that summarize daily maximum, minimum and mean temperature for each site. Daily average water temperatures at each site were then plotted along with the daily hydrograph of the San Juan River. Discharge data were obtained from the USGS gages listed in Table 1.

## **RESULTS & DISCUSSION**

During the October 2013 field visit, one logger each was missing from the San Juan River at CR5500, Farmington and Mexican Hat, as well as the Animas River at Farmington. The loggers were not replaced. During the February 2014 field visit, the loggers at Shiprock and McElmo Creek were removed. Also during this visit, the remaining logger at CR5500 was found to be missing, resulting in essentially no data for this location for FY2014. During the May 2014 field visit, the remaining loggers were removed from the San Juan River at Archuleta, Farmington and Four Corners, as well as the Animas River at Farmington.

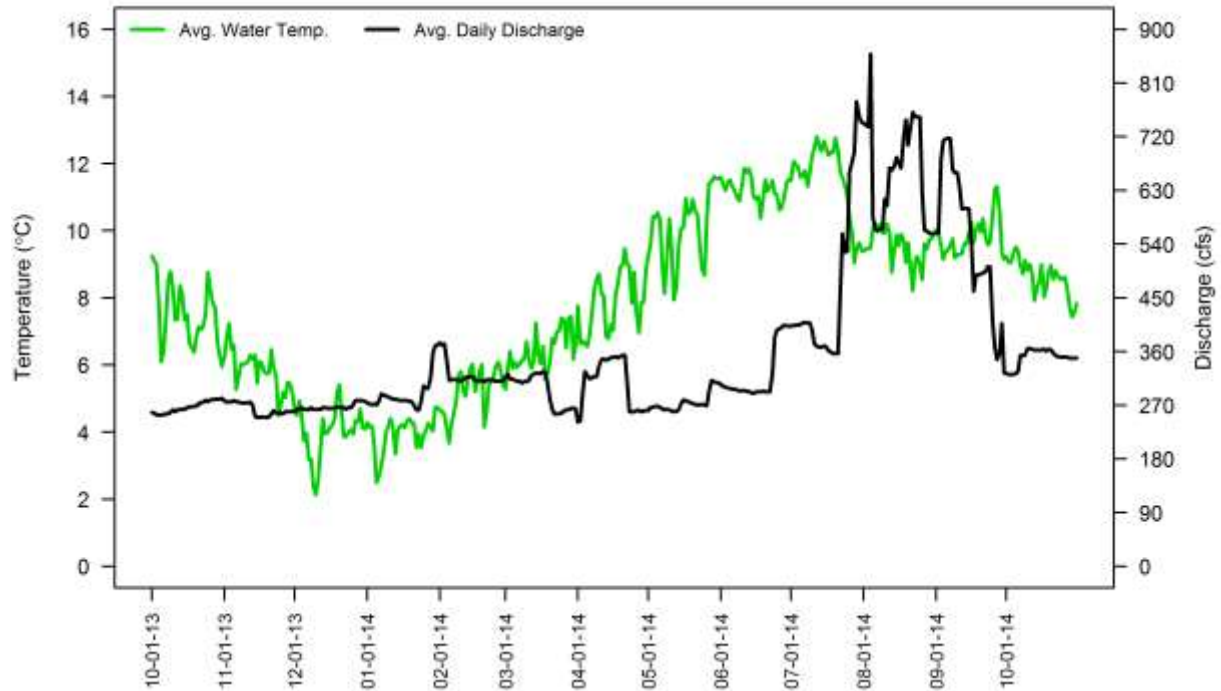
**Table 1. Water temperature monitoring locations.**

Location	River Mile	UTM Zone	UTM Northing (m)	UTM Easting (m)	Comments
Near Navajo Dam	225.0	13S	4076511	266784	Discontinued Feb. 2013
Archuleta – San Juan at USGS gage location	218.6	13S	4076301	259235	Discontinued May 2014; transferred to USGS
CR5500 – San Juan at CR5500 bridge near Lee Acres RV Park*	188.9	12S	4064363	759478	Both loggers lost as of Feb. 2014
Farmington – San Juan at USGS gage location	180.1	12S	4067579	747929	Discontinued May 2014; transferred to USGS
Shiprock – San Juan at USGS gage location	148.0	12S	4073096	706294	Discontinued Feb. 2014
Four Corners – San Juan at USGS gage location	119.4	12S	4096658	675400	Discontinued May 2014; transferred to USGS
Mexican Hat – San Juan near Bluff gage location	52.1	12S	4112151	600678	Loggers lost as of Oct. 2013; use USGS
Animas at Farmington – Animas River at USGS gage location	n/a	12S	4067756	749902	Discontinued May 2014; transferred to USGS
McElmo Creek at confluence with San Juan*	n/a	12S	4120599	660513	Discontinued Feb. 2014

\*Established in 2011/2012.

There was no large release of water from Navajo Dam in 2014. Average daily flow at the Archuleta gage peaked at 858 cubic feet per second (cfs) on August 4, 2014 (Figure 2). This was much lower than the peak of nearly 5200 cfs that came from the most recent release in 2012. Peak flows in August were not associated with the flow recommendations, since those releases aim to mimic the natural hydrograph and occur in May or June. Water temperature did decrease with the increases in flow in July and August. For example, when flows began to increase on July 22, average daily water temperature was 11.7°C. By July 28, average daily water temperature had decreased to 9.0°C. The peak average daily temperature at Archuleta occurred on July 12 and was 12.8°C.





**Figure 2. Average daily water temperature at Archuleta compared to discharge at Archuleta.**

Flows in the Animas River began to increase from base levels in April, peaking at 4650 cfs on June 2 (Figure 3). Once flows subsided in June, temperature rose steadily through the remainder of the month and through most of July. The maximum average daily temperature was 23.0°C and occurred on July 21, 2014. Peak temperatures may have actually occurred after July 21 but this is unknown since temperature data were missing from July 22 to July 29.

Temperatures in the Animas River were mostly cooler than the San Juan River at Farmington until mid-July (Figure 4). Since temperature data were not available for the San Juan River at CR5500, it is not possible to determine if the Animas River had a warming or cooling effect on temperatures in the San Juan River at Farmington. However, since flows were much greater in the Animas River compared to flows at Archuleta, it is likely that the Animas River served to cool temperatures in the San Juan River.

For the San Juan River at Farmington, average daily flow peaked at 4870 cfs on June 2 and was almost entirely due to flows from the Animas River. The maximum average daily temperature was 23.6°C and occurred on July 21 (Figure 4).

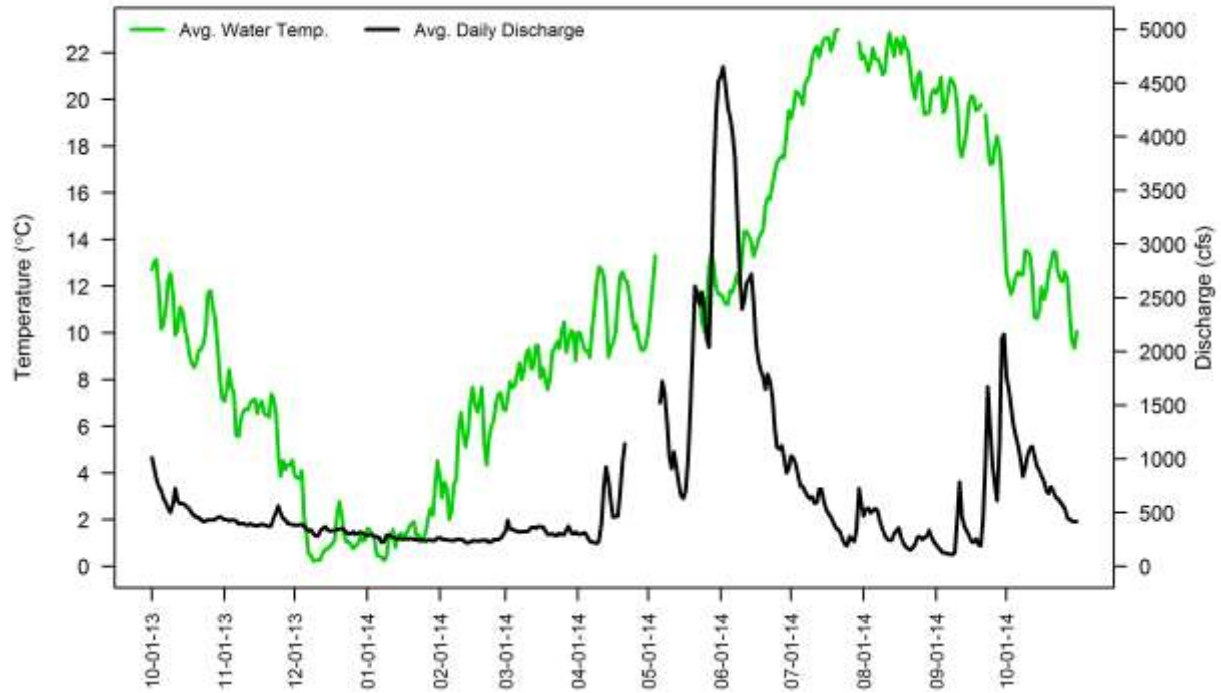


Figure 3. Average daily water temperature on the Animas River near Farmington compared to discharge on the Animas River.

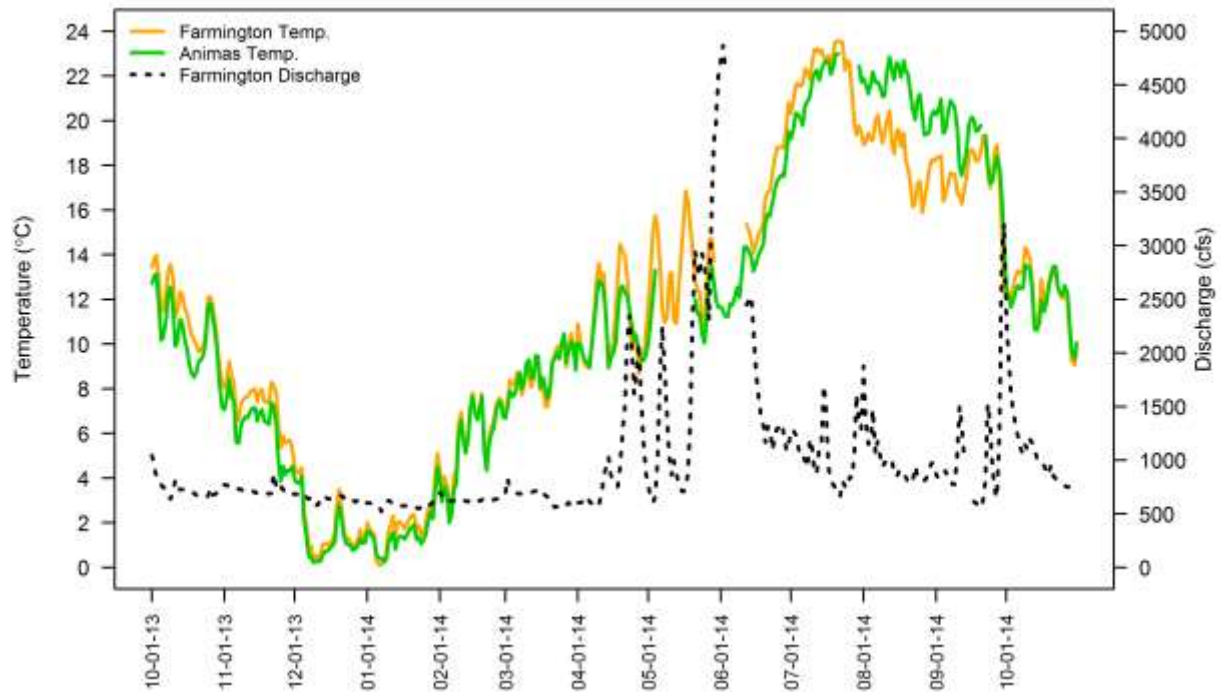


Figure 4. Average daily water temperature on the Animas River and the San Juan River at Farmington compared to discharge at Farmington.

At Shiprock, water temperature data were collected only until the end of February (Figure 5). At Four Corners, the maximum average daily temperature was 26.5°C and occurred on July 25 (Figure 6). A large storm event in the beginning of October produced flows greater than peak runoff flows (at Four Corners) or nearly so (at Shiprock).

At McElmo Creek, water temperature data were collected only until the end of February (Figure 7).

At Mexican Hat, the maximum average daily water temperature was 27.4°C and occurred on July 7 (Figure 8). Temperature patterns were generally similar to those observed at other locations. There was very little change in water temperature associated with the peak flow. This was likely due to the majority of the discharge at peak originating from the Animas River and not from a cold water release from Navajo Dam. A large storm event occurred in mid-August that produced flows not observed upstream at Four Corners.

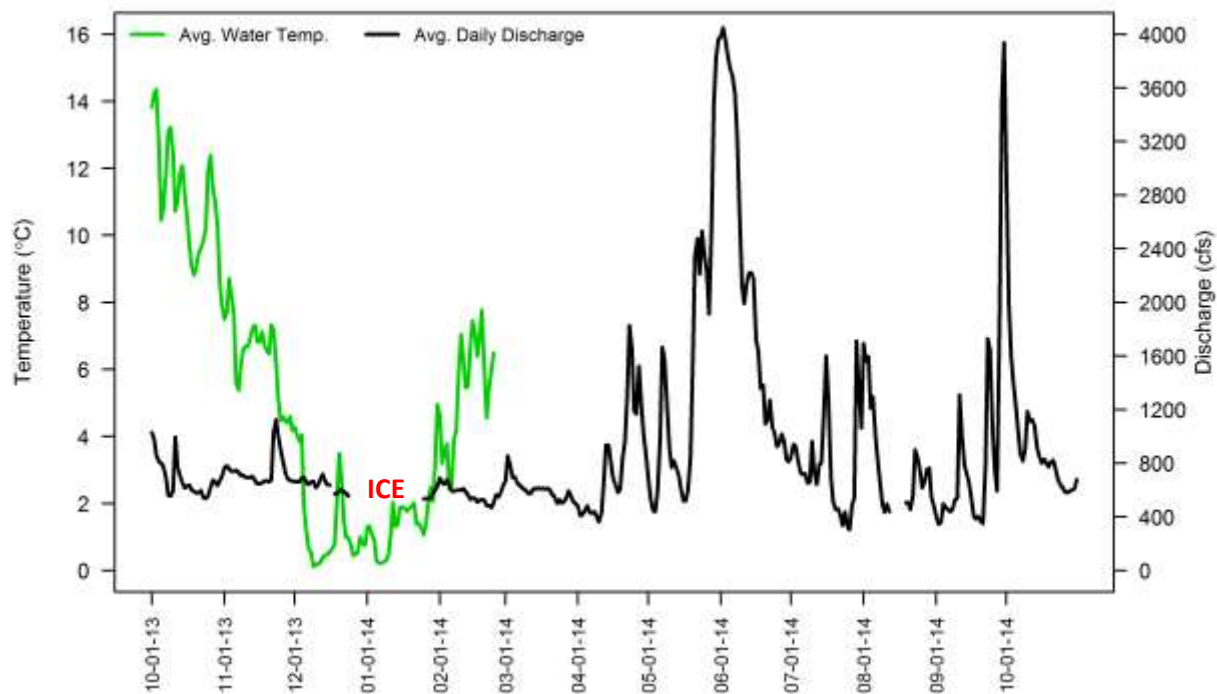


Figure 5. Average daily water temperature at Shiprock compared to discharge at Shiprock.

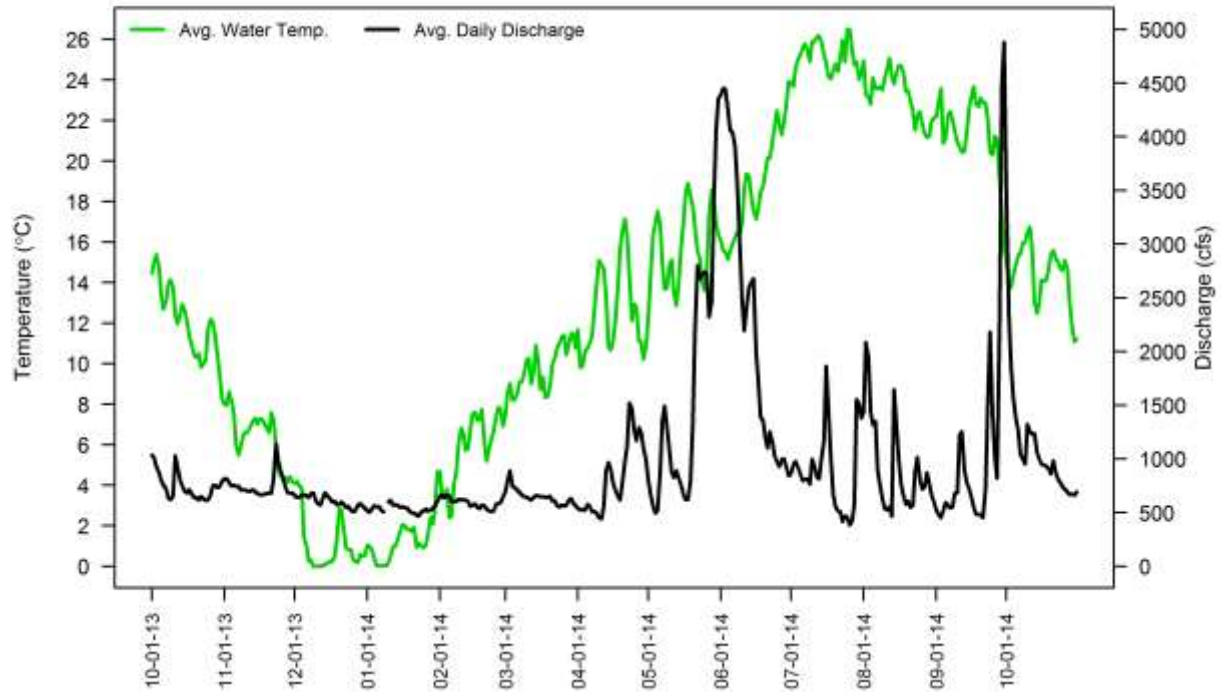


Figure 6. Average daily water temperature at Four Corners compared to discharge at Four Corners.

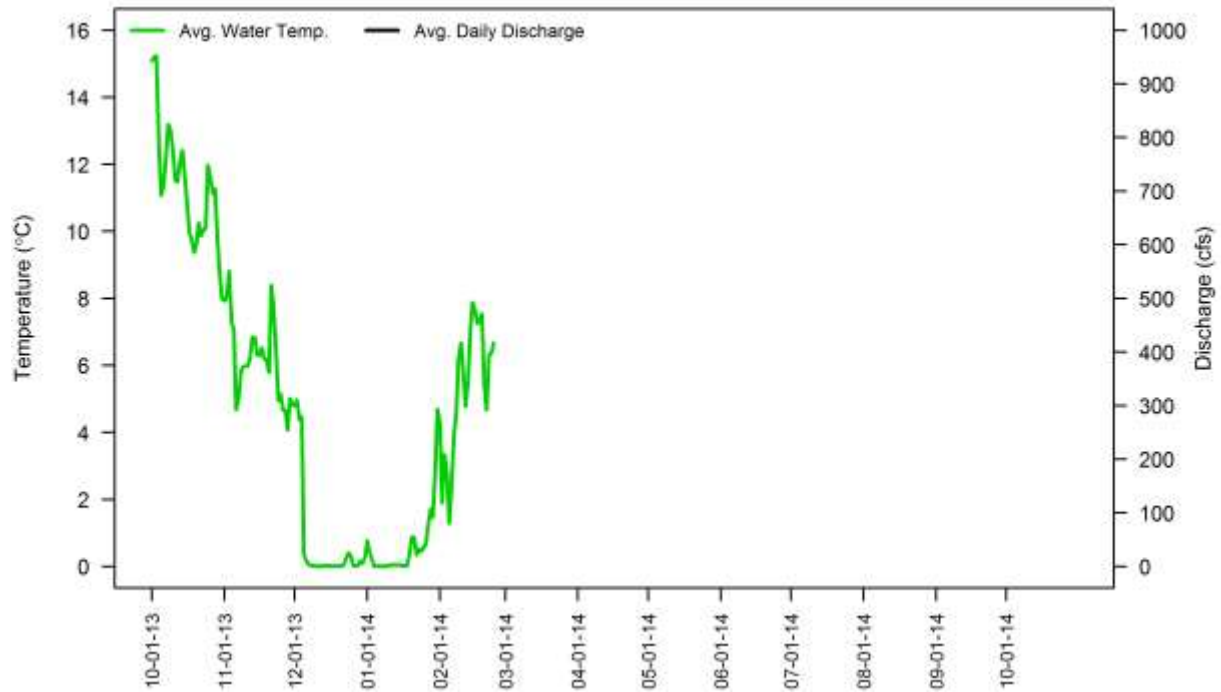
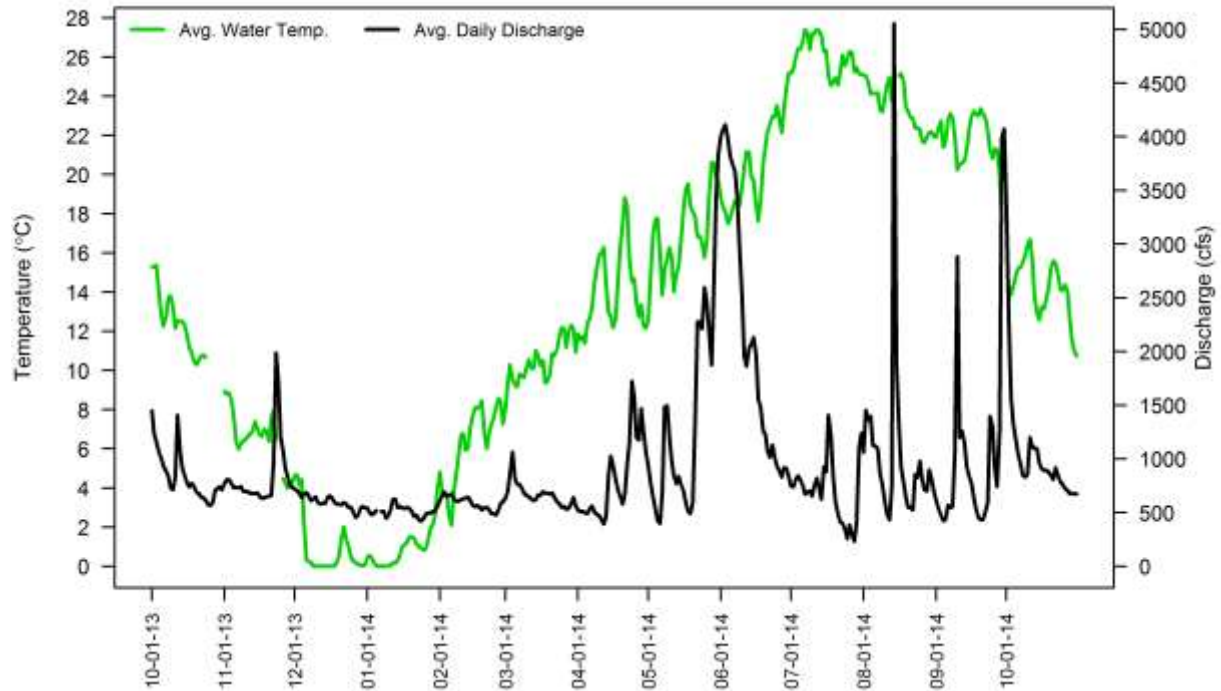


Figure 7. Average daily water temperature on McElmo Creek.



**Figure 8. Average daily water temperature at Mexican Hat compared to discharge at Mexican Hat.**

In summary, water temperature monitoring provides documentation of annual thermal regimes in the San Juan River. Water temperature monitoring is one component of the habitat monitoring program specified in the San Juan River Recovery Implementation Program Long Range Plan. These monitoring data could be used for investigations of impacts of water temperature on the San Juan River fish community.

## REFERENCES

R Development Core Team. 2013. R: A language and environment for statistical computing. R Foundation for Statistical Computing, Vienna, Austria.



**Miller Ecological Consultants, Inc.**  
**2111 S. College Avenue, Unit D**  
**Fort Collins, Colorado 80525**  
**970-224-4505**