



2013

Streams Monitoring at Gila Cliff Dwellings National Monument

Importance

Riparian habitats constitute less than 2% of the land area in the American Southwest, but support the highest density and abundance of plants and animals of any habitat type, making streams and associated riparian areas critical to the ecological integrity of the region. Riparian areas supply food, cover, and water, and serve as migration routes and habitat connectors, for a variety of wildlife. They also help control water pollution, reduce erosion, mitigate floods, and increase groundwater recharge. Riparian systems perform numerous ecosystem functions important to human populations, yet are one of the most endangered forest types in the United States.

Monitoring Objectives

The overall goal of the Sonoran Desert Network (SODN) streams monitoring program is to detect broad-scale changes in aquatic and riparian ecological condition by observing selected ecological drivers, stressors, and processes. Specific, measurable objectives for streams monitoring at Gila Cliff Dwellings National Monument (NM) are to determine the status of and detect long-term trends in:

- **Water quality** for daily, seasonal, and annual core water quality parameters (temperature, pH, dissolved oxygen, specific conductivity, turbidity), and seasonal nutrients, metals, inorganics, and bacteria.
- **Aquatic macroinvertebrates** for relative abundance of selected taxa and community structure and selected multimetric indicators of biotic integrity.
- **Surface water quantity** for seasonal and annual base flow conditions; frequency, magnitude, and duration of low flow and flood events; and extent of wet and dry areas.
- **Channel morphology** for cross-sectional area, sinuosity, channel slope, and sediment size distribution.
- **Riparian vegetation cover** for dominant and common (>10%) perennial species.
- **Fish** for communities on local and regional scales.

Status of the Effort

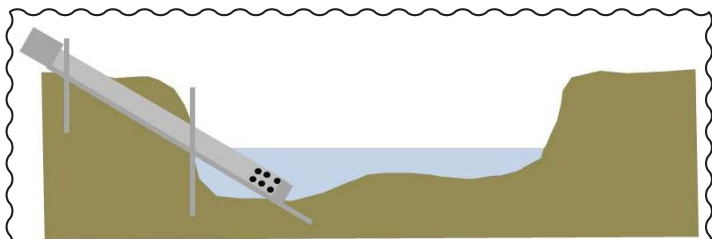
During 2012, SODN staff completed routine water quality monitoring at Gila Cliff Dwellings NM during quarterly site visits, including sampling of water quality and water quantity parameters. Aquatic macroinvertebrates were sampled in October 2011 and sent to Utah State University's BugLab for taxonomic identification and analysis. SODN also augmented routine streams monitoring in two ways. First, through a col-



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West Fork of the Gila River.

laboration with the U.S. Environmental Protection Agency, we began to collect and analyze water samples for contaminants of emerging concern—those that have not traditionally been tested for during water quality sampling and may not be adequately cleansed by current wastewater treatment methods—such as pesticides, personal care products, and pharmaceuticals. Second, SODN began to deploy a logging water quality probe at various sites for two weeks every quarter to investigate fine-scale temporal variability. The probe records core water quality parameters every 15 minutes. These two new data sets will provide useful baseline data and information on potential pollutants.



Probing the Depths of Water Quality

Over the past year, the SODN staff has been installing mounts for water quality monitoring equipment in all network parks where streams are monitored. The mounts provide "quasi-permanent" (so-called because some flow events do have the potential to render the mounts impermanent!) housing for stream probes that should prove stable and secure under most flow regimes.

This instrumentation will enable SODN staff to detect trends in important water quality parameters, such as temperature, pH, and dissolved oxygen, by examining variation across days, months, seasons, and years. The network's long-term goal is to install telemetry systems at these sites, enabling real-time streaming of water quality data.

Monitoring Fire Effects on Park Streams

All water quality parameters measured at Gila Cliff Dwellings NM in fall, winter, and spring 2011–2012 met state water quality standards. In summer, however, when the sample was collected following a rain event shortly after the Whitewater-Baldy Complex Fire, exceedances were noted for temperature, specific conductivity, turbidity, *E. coli*, and aluminum.

Those anomalous measurements, though likely short-term, are just one example of the many ways in which fire has dramatically changed the West Fork of the Gila River watershed in recent years, resulting in a highly dynamic stream and riparian system. In 2011, the Miller Fire burned a majority of the Cliff Dweller Creek drainage and the riparian area of the West Fork within park boundaries. In 2012, the Whitewater-Baldy Complex Fire affected a majority of the West Fork watershed upstream of the park. To monitor the short- and long-term effects of the fires, SODN field crews performed post-fire effects monitoring in June 2012, focusing on riparian vegetation and channel morphology metrics on both the West Fork of the Gila River and Cliff Dweller Creek.

Management Concerns

Habitat degradation

Following the Whitewater-Baldy Complex Fire, monsoon rains washed ash and sediment into the West Fork of the Gila River. These materials were deposited throughout the stream channel, affecting the aquatic habitat monitored by SODN. The percent of fine substrate (particles <4mm in diameter) increased 8% in riffles, and the percent of embeddedness of cobbles in riffles increased by 10%. These increases in fine sediment and embeddedness decreased the interstitial space available for use as habitat for macroinvertebrate fauna, potentially reducing the amount of food available for fauna higher up the food chain. The speed at which the aquatic community rebounds will likely depend on high-flow events, especially winter/spring flooding events that have the potential to scour the fine sediment and transport it downstream.

Invasive exotic plants

The 2011 Miller Fire created opportunities for invasions of non-native plant taxa, many of which are extremely efficient at populating recently disturbed areas. Preliminary data, comparing the frequency of vegetation taxa detected in the recent-

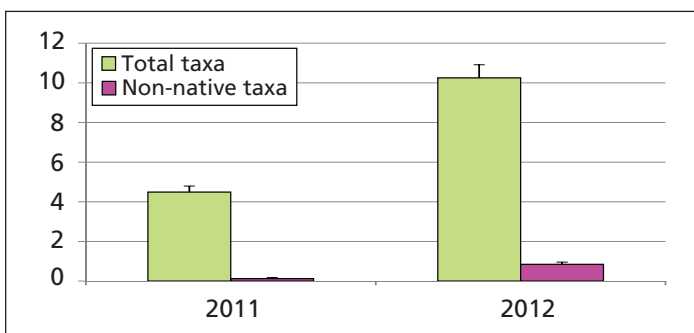


Figure 1. Frequency of total and non-native plant taxa, 2011 and 2012.



USFS GILA NATIONAL FOREST/K. GREER

Sunset on the Whitewater-Baldy Fire.

ly burned riparian area in 2011 and 2012, indicate that while there has been a twofold increase in the total number of taxa detected per plot, there has been only a small increase in the number of non-native taxa detected per plot (Figure 1). This lack of expansion of non-native species is good news, and is likely related to the monument's remote location and limited public access to much of the riparian area.

Flooding and channel change

Reduced vegetation cover and soil damage from intense fire throughout the watershed may result in sediment-heavy flows. Although Cliff Dweller Creek experienced high flows following the Miller Fire, channel morphology data indicated that the channel cross-sections and longitudinal profile did not change significantly, likely due to the resilient bedrock substrate. Flow events following the Whitewater-Baldy Complex Fire have not been large to date, leaving the channel of the West Fork of the Gila River largely unaffected on the landscape level. Severe bank erosion is evident in a few locations.

Conclusions

The West Fork of the Gila River within Gila Cliff Dwellings NM is a high-quality mountainous stream. Prior to the recent fires, monument waters were within the historic range of natural variability and relatively free of anthropogenic stressors. The fires have resulted in increased threats of flooding, erosion, and sedimentation, and an aquatic habitat that is degraded relative to its previous state. These conditions will likely be present for several years as ecological processes recover and stabilize. The recent fires provide an opportunity to monitor fire effects on the stream ecosystem, as well as the response of the riparian area. SODN will continue to evaluate and adjust our sampling strategy annually. A full analysis will be performed in a future comprehensive status and trends report.

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