



Streams Monitoring at Montezuma Castle and Tuzigoot National Monuments

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 Montezuma Castle National Monument (NM) and Tuzigoot 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 2013, SODN completed routine water quality monitoring during quarterly site visits to stream segments on Beaver Creek (Montezuma Castle NM, Castle unit), Wet Beaver Creek (Montezuma Castle NM, Well unit), and the Verde River (Tuzigoot NM). Water quality and water quantity were measured during each site visit. These efforts were aided by use of a logging multiparameter water quality probe, which automatically collects and stores data. The probe was deployed in Wet Beaver Creek for at least two weeks in fall, spring, and summer.



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Staff gage for measuring water depth on Wet Beaver Creek.

Aquatic macroinvertebrates were sampled in May and sent for taxonomic analysis at the National Aquatic Monitoring Center (BugLab) at Utah State University. SODN continued its collaboration with the U.S. Environmental Protection Agency (EPA) by sending water samples from fall and summer sampling to the EPA Region 8 Laboratory for analysis of emerging contaminants (e.g., pesticides, pharmaceuticals, personal care products, and wastewater indicators).

Working with park resource staff, we successfully moved the staff gage on Wet Beaver Creek. Sediment was filling in around the previous staff gage, whose purpose is to measure water depth. The new gage is further out in the channel, suspended by custom brackets (see photo, above).

SODN produced four field summary reports, presenting provisional data collected during quarterly sampling periods at Montezuma Castle and Tuzigoot NMs. Results indicated high-functioning but impacted aquatic ecosystems.

Management Concerns

E. coli

E. coli sampling results from all three streams met state criteria for a single sample during water year 2013. However, the summer sample from Beaver Creek measured just units 10 below the single-sample limit. A monsoon rain event occurred on the afternoon before the sample was collected. SODN's historical dataset indicates that *E. coli* is primarily a concern following such precipitation events, when runoff from the watershed contributes large amounts of sediment and organic material to the streams. Staff and visitors to these parks should use caution when wading in streams after rain events. In water year 2014, SODN will continue to examine the relationship between precipitation, flow events, and *E. coli*.

Low dissolved oxygen

During summer sampling, dissolved oxygen levels at Beaver Creek and the Verde River (5.52 and 5.46 mg/L, respectively) did not meet the minimum criterion of 6 mg/L for aquatic and wildlife warm water. Low flows and high air temperature can cause water temperature to increase and dissolved oxygen to decrease, negatively affecting sensitive aquatic organisms. Low flows are common on all three streams, especially during spring and summer.

Arsenic

At 0.037 mg/L, total arsenic exceeded the state's criterion for full body contact (0.030 mg/L) at Beaver Creek during summer sampling. The high arsenic level may be a result of runoff following monsoon rains. Further sampling will help determine whether this was a singular occurrence or part of a trend. Staff and visitors should exercise caution if wading in the stream.

Beavers

Beavers are a natural part of the riparian ecosystem on Beaver Creek. They are also nature's engineers and architects, modifying their habitat to maximize shelter and feeding opportunities. Beaver-dam construction removes riparian trees and creates pool-dominated habitat in place of a more active, flowing stream. These changes affect water quality—as well as SODN's ability to accurately monitor a variety of parameters, especially water quantity and quality. We will continue to work with park resource staff to maximize the quality of our monitoring data while allowing beavers to continue their natural activities.

Invasive species

Crayfish have been frequently observed during spring and summer on the Beaver Creek stream segment, and less frequently at the Verde River and Wet Beaver Creek (pictured below) stream segments. Northern crayfish have no natural

predators and feed on larval fish, plants, and insects, which can severely harm the aquatic environment. In summer 2014, SODN will host an international student researching aquatic invasive species in network parks. This project will address the distribution and impact of crayfish in SODN streams.

Conclusions

The three monitored stream segments at Montezuma Castle and Tuzigoot NMs are very small sections of larger stream systems. Parameters monitored by SODN are highly influenced by land-use activities upstream and in the watersheds. Runoff from urban areas, improvised septic systems, agricultural uses, climate, and other influences beyond the control of park managers can all have significant impacts on park resources. Continued monitoring and analysis of park resources will be necessary for park managers to make informed decisions about management, planning, and mitigation.

Citations

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