Sonoran Desert Network
Monitoring Brief

National Park Service
U.S. Department of the Interior

Intermountain Region
Inventory & Monitoring Program

2014

Streams Monitoring at Tumacácori National Historical Park

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 Tumacácori National Historical Park (NHP) 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 Tumacácori NHP. Water quality sampling and water quantity measurements were completed 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 for two weeks during each quarter. Network staff also installed a semi-permanent mount for the probe, which allows it to be deployed during monsoon season.

NATIONAL PARK SERVICE

Network partners survey for fish on the Santa Cruz River.

Aquatic macroinvertebrates were sampled in May and sent for 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, spring, and summer sampling to the U.S. EPA Region 8 Laboratory for analysis of emerging contaminants. Finally, in cooperation with park staff, the Sonoran Institute, the Arizona Game and Fish Department, and Friends of the Santa Cruz River, SODN conducted fish sampling on the Santa Cruz River, including a sample site in the park at Santa Gertrudis Lane (see photo, above).

SODN produced four field summary reports presenting provisional data collected during quarterly sampling periods. Results were indicative of an effluent-driven stream in an agricultural and residential area.

Management Concerns

Emerging contaminants

"Emerging contaminants" are pollutants that have not traditionally been tested for during water quality sampling and may not be adequately cleansed by current wastewater treatment methods. Examples are pesticides, pharmaceuticals, personal care products, and wastewater indicators. At Tumacácori NHP, analytes detected in 2013 included 24 different pharmaceuticals, including lidocaine, phenobarbital, and tramadol; four industrial chemicals, including (bisphenol A, tri(2-butoxyethyl) phosphate; the pesticide, propoxur; and the fragrance, galaxolide.

State standards do not exist for most of the detected compounds, and the few that do exist were not exceeded. However, there is limited information on the potential impacts of

these contaminants on aquatic resources. Repeat testing will help to establish whether these substances are persistent in Tumacácori NHP waters.

Trespass livestock

The intrusion of cows and other livestock (e.g., domestic goats) is a routine problem at the park when the boundary fence is damaged by flooding or purposefully cut. These trespass livestock tend to deposit fecal material near the river and trample riparian vegetation, eroding the stream bank.

Flow

The Santa Cruz River stopped flowing in the park from mid-April through August 2013 (see photo, below). The reduced flow is likely due to ongoing drought and decreased discharge from the Nogales International Wastewater Treatment Plant (NIWTP; see http://go.nps.gov/DrySC). The NIWTP is receiving less water for treatment than in the past because Mexico's new Los Alisos wastewater treatment plant is now retaining an estimated 1.5 million gallons/day (mgd) that previously flowed into the Santa Cruz. The effluent stream has also been reduced by continued leakage in the pipes and infrastructure that carries the untreated effluent to the plant. The projected seasonal lack of flow and decreased groundwater levels will likely negatively impact the riparian plant community and greatly decrease or remove vital habitat for many aquatic taxa, including aquatic macroinvertebrates and native fish. The amount of water discharged from the NIWTP will be further reduced in the near future as Mexico repatriates up to a total of 3 mgd of water that previously flowed into the Santa Cruz.

E. coli

During high-discharge events, surface runoff from the watershed increases the amount of sediment and organic material in streams. Fecal matter and its microbial components, such as *E. coli*, are carried into streams, along with the silts and sands that are eroded during overland flow events. *E. coli* readily binds to sediment in surface water bodies, and is able to survive for long periods that way (Sampson et al. 2006). Elevated *E. coli* concentrations are more likely to occur in connection with high-turbidity discharge events (Smith et al. 2008), such as those that typically occur after a large thunderstorm. If elevated concentrations also occur in clear water conditions, then a persistent source may exist (Van Grinsven et al. 2010).

Preliminary *E. coli* sampling results from the summer sampling period showed an exceedance of the Arizona designated use criteria for partial body contact. There was a rain event the night before sampling, which may have contributed to the increased levels. *E. coli* exceedances have been known to occur in the Santa Cruz River in the past. The unknown source of *E. coli* contamination could be domestic animals, humans, wildlife, or a combination thereof.

Conclusions

The Santa Cruz River is an effluent-driven system, with most water provided by the Nogales International Wastewater Treatment Plant, which has created a thriving riparian corridor in the Sonoran Desert. A reduction in flow from the plant, combined with ongoing drought and changes to local streamwater–groundwater interaction, will likely bring changes to the aquatic and riparian systems of Tumacácori NHP. SODN will continue to collect data and provide analysis to inform park managers' decisions and advocacy for park resources, both at Tumacácori NHP and in the region.

Citations

Sampson, R. W., S. A. Swiatnicki, V. L. Osinga, J. L. Supita, C. M. McDermott, and G. T. Kleinheinz. 2006. Effects of temperature and sand on E. coli survival in a northern lake water microcosm. Journal of Water and Health 4(3):389–393.

Smith, R. P., G. A. Paiba, and J. Ellis-Iversen. 2008. Short communication: Turbidity as an indicator of Escherichia coli presence in water troughs on cattle farms. Journal of Dairy Science 91:2082–2085.

Van Grinsven, M., D. Thoma, M. Malick, and M. Moran. 2010. Water quality in the Northern Colorado Plateau Network, 2006–2009. Natural Resource Technical Report NPS/NCPN/NRTR—2010/358. National Park Service, Fort Collins, Colorado.

Contact

Evan Gwilliam, evan_gwilliam@nps.gov