Status of Climate and Water at Tumacácori NHP

Water Year 2015

Groundwater-monitoring wells for the deep and shallow aquifers, Tumacácori NHP.

The main driver of the aquatic ecosystem at Tumacácori NHP is the consistent flow of 10–12 million gallons per day of treated effluent from the Nogales International Wastewater Treatment Plant (shown here).

TOP PHOTO: SANTA CRUZ RIVER, TUMACÁCORI NHP.
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Why Monitor Climate and Water?

Climate and hydrology are major drivers of ecosystems. Together, they dramatically shape ecosystem structure and function, particularly in arid and semi-arid ecosystems. Understanding changes in climate, groundwater, streamflow, and water quality is central to assessing the condition of park biota and key cultural resources.

Which Resources are Monitored?

At Tumacácori National Historical Park (NHP), the Sonoran Desert Network monitors climate parameters, such as precipitation, temperature, aridity, drought severity, and extreme weather events. Water resources include groundwater and streams. Groundwater parameters include depth-to-water and water-level elevation. In the Santa Cruz River, SODN monitors water quality and quantity, aquatic macroinvertebrates, and fish.

What's the Most Recent News?

Climate

Globally, 2015 was the hottest year on record. By contrast, local conditions at Tumacácori NHP were mixed, with cool-season minimum and maximum air temperatures generally well above normal, followed by a relatively cool fore-summer (May–June). Monsoon maximum temperatures were below normal. Extremely cold days (<26°F) occurred about 30% more often than normal.

Annual precipitation was nearly 150% of normal. The largest increases occurred in June—a month in which little to no rainfall typically occurs. Increased rainfall and mixed air temperatures indicated a degree of recovery from the drought of the early 2000s.

Groundwater

Tumacácori NHP is situated above a shallow and a deep aquifer. The shallow aquifer is influenced by infiltration from streamflow, groundwater subflow, pumping for irrigation and water supply, and transpiration by riparian trees and shrubs.

In water year 2014 (October 2013–September 2014), water levels in the shallow aquifer were at the lowest on record during the pre-monsoon period (May–early June). However, monsoon events near the end of water year 2014, coupled with the above-average precipitation during the winter and late spring of water year 2015, brought shallow-aquifer water levels back to near average.

Santa Cruz River

Four sampling visits were made to the Santa Cruz River index site for water quality monitoring in water year 2015 (October 2014–September 2015), one during each quarter. The samples were sent to a lab for analysis. Of 247 individual analyses, 88 were associated with Arizona state water quality standards. There were no exceedances observed. Nutrient concentrations remained low—a dramatic improvement over conditions at the park five years ago.

In addition, more than 15,000 measurements were collected from a logging multiparameter probe that takes measurements every 15 minutes. The probe was deployed for 2–3 weeks during each of three quarters of water year 2015. These data showed that the median values of temperature and

dissolved-oxygen concentration were within the expected range during all three deployments. The median values for pH and specific conductivity were outside the expected range during three quarters, for reasons that are uncertain.

Despite the unusually high amount of annual precipitation, river flow during water year 2015 was lower than the mean gage record in every month except September, likely due to reduced effluent contributions from the Nogales International Wastewater Treatment Plant (NIWTP).

The main driver of the aquatic ecosystem at Tumacácori NHP is the consistent flow of 10–12 million gallons per day of treated effluent from the treatment plant, combined with stochastic, high-flow monsoon events. Over the last few years, the NIWTP has contributed less effluent into the Santa Cruz River because a new treatment plant, in Mexico, has begun treating and redirecting a portion of the Ciudad Nogales waste stream back into Mexico. This decrease of effluent, combined with increased temperatures, has led to an increase in direct evaporation from the surface water of the river, and in evapotranspiration for riparian vegetation that use groundwater contributed by the river.

Since its return in 2009, following an upgrade to the NIWTP, the native longfin dace (*Agosia chryogaster*) continues to be encountered in the Santa Cruz. The non-native western mosquitofish (*Gambusia affinis*), which was detected most recently in water year 2012, has not been detected since that year. Apart from longfin dace and mosquitofish, no other fish taxa have been detected since 2009.

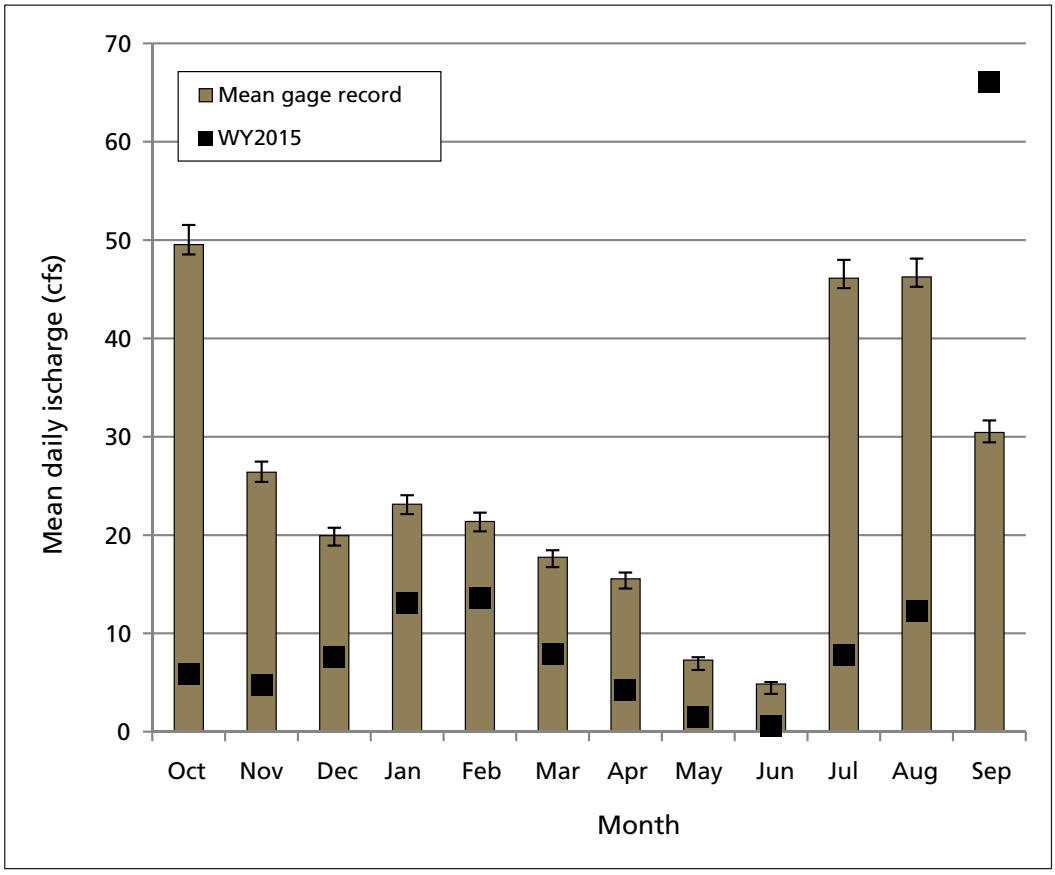
How is the Information Used?

It is expected that with climate change, temperatures throughout the desert southwest will continue to rise, while precipitation becomes less reliable. At Tumacácori NHP, water conditions are further complicated by the aquatic system's strong reliance on human-controlled flow from the NIWTP. This flow is expected to further decrease in coming years, making the future of the park's riparian gallery forest uncertain.

Park managers can use the long-term data provided by Sonoran Desert Network monitoring to assess threats to the riparian ecosystem along the river. Park staff can also use these data as they work with watershed stakeholders to achieve sustainable flows and conservation of local flora, fauna and ecological processes.

How Can I Learn More?

Visit http://go.nps.gov/sodn, or contact andy_hubbard@nps.gov.



Monthly mean daily discharge, Tumacácori National Historical Park, water years 1996–2015. The brown bars indicate the mean daily discharge (cubic feet per second) for the gage record (October 1995–present). Error bars indicate standard error. Black boxes indicate the monthly mean discharge for water year 2015. Data are from USGS gage 09481740 at Tubac, Arizona, located five kilometers downstream from the SODN sampling site in Tumacácori NHP.