

Cruz Control

For more than 11,000 years, people have lived along the watershed of the Santa Cruz River. However, climate change, agriculture, mining, groundwater-pumping and drought have left much of the river dry. That's where Claire Zugmeyer comes in. The 36-year-old ecologist is working to protect and restore the river's watershed, with the help of wastewater-treatment plants in and around Tucson.



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ON A WARM FALL MORNING, two teams of biologists creep slowly along the ankle-deep water of the Santa Cruz River in Marana, just north of Tucson. Mid-morning sun glints off the ripples of the braided stream as an electronic whine pulses through the air like a car alarm.

Along the river's banks, one member of each team probes the water under the overhanging grasses with a long wand attached to an electroshocking unit — a large, square backpack with a slender tail that drags behind in the water. Two “netters” flank each operator, with a fourth person following behind, carrying a bucket. The electronic pulses lure tiny mosquitofish toward the anode, which temporarily paralyzes them so they can be netted, placed into buckets and counted.

Ecologists Scott Bonar and Claire Zugmeyer use a large net to catch fish during a Santa Cruz River fish survey, which provides a snapshot of the river's ongoing recovery.

“We’re so linked to water, wherever there was water you’re going to find people. Thinking about that has been the biggest surprise: how much we’re part of the landscape in our history, how we shaped it.”
— Claire Zugmeyer



So begins the Sonoran Institute’s annual fish survey of the lower Santa Cruz River. Lean and fresh-faced, wearing hip-high waders and a wide-brimmed hat, 36-year-old ecologist Claire Zugmeyer leads the group, assembled from the U.S. Fish and Wildlife Service, the Arizona Game and Fish Department, Pima County and the University of Arizona.

Over the next few months, Zugmeyer will analyze and incorporate data from the survey into the institute’s *Living River* report series. The annual report documents the river’s health along a 23-mile stretch of the lower Santa Cruz using 16 indicators, the presence and types of fish being among them.

For more than 11,000 years, people have lived, farmed, mined and ranched along the watershed of the Santa Cruz, one of the continent’s longest-inhabited regions. They’ve pumped the groundwater that feeds the river and diverted its flow. Stretches that once flowed year-round have long since run dry, except during storms. But in a surprising way, the people who live along the river are beginning to give back some of what’s been lost.

Three wastewater-treatment plants discharge as much as 60 million gallons of effluent into the river each day, supporting about 40 miles of precious riparian habitat and its fish, birds and other species.

More than 46 organizations have worked to protect and restore the river’s watershed. The Tucson-based Sonoran Institute, which has been working in the watershed for 25 years, is documenting the river’s comeback and leading some pioneering efforts to help that process along.

FROM THE AIR, the Santa Cruz resembles a fishhook. From its headwaters in Southern Arizona’s San Rafael Valley, the river flows south into Mexico, passing the village that gave the river its name, before making a U-turn and flowing north into the United States, past Nogales, Rio Rico, Mission San José de Tumacácori and Tubac Presidio, all of them located where they are because of the river.

From Green Valley, the Santa Cruz once flowed through the Great Mesquite Forest, the largest known mesquite bosque in the country, before reaching Mission San Xavier del Bac. The forest is gone — likely the victim of overharvesting, groundwater-pumping, mining, agriculture and the deepening of the river channel, thanks in part to a Welsh immigrant named Sam Hughes.

In the 1880s, Hughes cut a ditch perpendicular to the river near what is now St. Mary’s Road in Tucson, intending to tap into the water table to irrigate farmland. But after a series of storms, the ditch eroded 9 miles to San Xavier del Bac, taking with it prime agricultural land and deepening the river channel. That helped lower the water table, decreasing the river’s flow.

As a result, the river no longer flows near the mission or downtown Tucson. A dike south of Martinez Hill, built in 1915, channeled the river into its present course. But Hughes wasn’t the first to use this method for irrigation. Archaeologists believe the Hohokam people may have done something similar long before.

From Martinez Hill, located on Tohono O’odham land, the river now continues downstream through Tucson, past where ancient Hohokam

OPPOSITE PAGE: Sonoran Institute ecologist Claire Zugmeyer says protecting the Santa Cruz comes down to how humans manage and conserve water.

RIGHT, ABOVE: A member of the survey team uses an instrument to measure the river’s pH levels.

RIGHT, BELOW: Recent efforts have allowed the longfin dace, a native fish species, to thrive in the river’s upper section.





From left, Scott Bonar, Christina Perez and Brian Powell catch and count fish in the Santa Cruz. Perez uses an electroshocking unit to stun the fish, which then are caught, counted and released unharmed.

villages once dotted its banks, and Marana, where the fish survey begins that fall day.

In the early 1900s, the Santa Cruz Reservoir Co. hoped to manage the seasonal runoff on the lower Santa Cruz for agriculture.

As part of the project, Colonel William C. Greene designed a 13-mile canal southeast of Picacho Peak to connect the Santa Cruz with a reservoir to the west.

Floods in 1914 and 1915 destroyed Greene's diversion dam and reservoir. As a result, rather than flowing past Eloy, Toltec and Casa Grande, the river now takes a more westerly course, eventually emptying into the Gila River near the village of Santa Cruz, a tiny census-designated place on the Gila River Indian Community.

In recorded history, water has flowed along the river's entire 200-mile course only during heavy floods, with year-round flows marking places where underlying bedrock forces water to the surface.

Springs and marshes once flowed around Martinez

Hill and Tucson's Sentinel Peak (commonly known as "A" Mountain). Tucson's very name was derived from an O'odham word meaning "springs at the foot of Black Mountain." But climate change, agriculture, mining, groundwater-pumping and drought have left them dry.

When Zugmeyer moved to Tucson, she had no idea the river used to flow there year-round: "I thought, *All the rivers here are dry most of the year. That's just the way it is in the desert.*"

IN A SENSE, concern about the Santa Cruz inspired the formation of the Sonoran Institute. Troubled by development near a Santa Cruz tributary, founder Luther Propst helped negotiate an agreement with a major housing developer in the 1980s, then organized a broad coalition to protect and care for the area's natural resources. He founded the Sonoran Institute in 1990 to extend this collaborative approach to conservation efforts all over the West.

Today, the institute maintains offices in Bozeman,

Montana; Glenwood Springs, Colorado; and Mexicali, Mexico, in addition to Phoenix and its headquarters in Tucson. One of the institute's first projects was to help conserve land along the headwaters of the Santa Cruz in the San Rafael Valley. It also worked to establish Las Cienegas National Conservation Area, protecting another of the river's tributaries.

These days, the institute focuses on the effluent-dependent stretches of the river and its tributaries, which include the upper Santa Cruz, between Rio Rico and Amado, and the lower Santa Cruz, between northwest Tucson and Marana. It started the *Living River* series after trees began dying along an 8-mile section of the river in 2005.

"It surprised a lot of people," Zugmeyer says. "Because it seemed to happen overnight. At that point they started thinking, *If we keep track of things on a regular basis, we might be more prepared for these kinds of things or avoid them altogether.*"

So with a grant from the Environmental Protection Agency, the Sonoran Institute developed the report series to document the health of the effluent-dependent stretch of the upper Santa Cruz below the Nogales International Wastewater Treatment Plant.

"The first time we did [a fish survey], we literally found one individual fish, a mosquitofish," Zugmeyer recalls. "They upgraded [the water treatment plant] halfway through 2009, and almost immediately, we were finding fish again," including the longfin dace, a native species.

The Sonoran Institute's approach considers human culture as well as nature. "They're really hard to separate, especially in this area," Zugmeyer says.

"We're so linked to water, wherever there was water you're going to find people. Thinking about that has been the biggest surprise: how much we're part of the landscape in our history, how we shaped it."

As human culture contributed to the river's decline, it must also be a factor in its recovery. So, in addition to tracking natural conditions, the institute is trying to find innovative ways the community can use water differently to ensure that the river flows during dry months.

"In arid environments, it comes down to how we manage and conserve water," Zugmeyer explains. "The Santa Cruz work is trying to look at the system as a whole."

Those strategies include the Conserve to Enhance program, launched in 2011. The program was the first in the nation to link personal water use to environmental benefits.

More than 150 Tucson-area participants save water, through methods such as installing water-efficient fixtures or harvesting rainwater for landscaping, and donate their savings to a fund that restores

and enhances the washes that feed the river. Another 800 households donate via their water bills.

The improved washes filter pollutants before they end up in the river and create green areas where people can enjoy the visible results of their donations. Participants have saved more than 6 million gallons of water and raised more than \$40,000, funding seven projects.

Finally, the Sonoran Institute co-sponsors Research Days, an annual event that grew out of research at Tumacácori National Historical Park. The two-day event allows people and organizations doing research along the river to share their findings.

It was during one of those events that Pima County learned of the institute's *Living River* series, which happened to record conditions along the upper Santa Cruz just before upgrades to the Nogales treatment plant.

"The second report was during the upgrades, and the third report was a full year after," Zugmeyer says. "So we had this really nice 'before,' 'during' and 'after.'"

Pima County planned a \$600 million upgrade to its own two facilities and wanted to apply the same model to the lower Santa Cruz.

THE MORE THAN 23 MILES the Santa Cruz River courses through northwest Tucson is Arizona's longest stretch of river dominated by effluent, according to a 2007 mapping. A million county residents turning on their showers each morning add a daily ebb and flow to fluctuations that occur seasonally.

Effluent from the Agua Nueva Water Reclamation Facility also feeds the Sweetwater Wetlands before percolating through the soil to replenish the local aquifer. Opened in 1998, the wetlands have become important bird and wildlife habitat. Bird sightings there include elegant trogons and other species rarely seen in Arizona.

At press time, the citizen-science database eBird (www.ebird.org), managed by the Cornell Lab of Ornithology, listed 294 species spotted in the wetlands, one of the highest counts in Arizona. The influx of birders gives a boost to the local economy. Pima County is also constructing trails along the river to enhance recreation.

During the fall fish survey, teams net about 200 pollution-tolerant mosquitofish on the lower Santa Cruz, but not the hoped-for longfin daces seen in the river's upper section. Nor do they find the catfish and carp that have been reported. Zugmeyer suspects they were flushed out during heavy monsoon flooding.

And while the survey finds fewer fish than the year before, it finds them at more sites. That may be thanks to significantly reduced ammonia levels after the upgrades, improving conditions for fish. Nitrogen levels also have decreased, accelerating the rate at which river water percolates into the aquifer. The improvements have also nearly eliminated effluent-related odor.

"The effluent isn't exactly a natural system," Zugmeyer explains. "But it's maintaining a lot of benefit the wildlife and the community are getting."

And while she wishes the treatment plants were built south of downtown, where the results would be more visible, she adds, "It's still great to have a flowing river, no matter where it is." **AH**

To learn more about the Sonoran Institute's work on the Santa Cruz River, call 520-290-0828 or visit www.sonoraninstitute.org.