

SONORENSIS

Arizona-Sonora Desert Museum

Santa Cruz River

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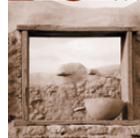
1 Introduction
By Richard C. Brusca &
Robert J. Edison



4 Oasis Cultures: Prehistoric Lifeways Along a Desert River
By Jonathan B. Mabry



10 The Changing Santa Cruz, 1680-1912
By Diana Hadley



18 The Santa Cruz Today
By Larry Marshall



24 El Río Santa Cruz: Three Nations, Two Communities, One River's Future
By Luther Propst



Introduction



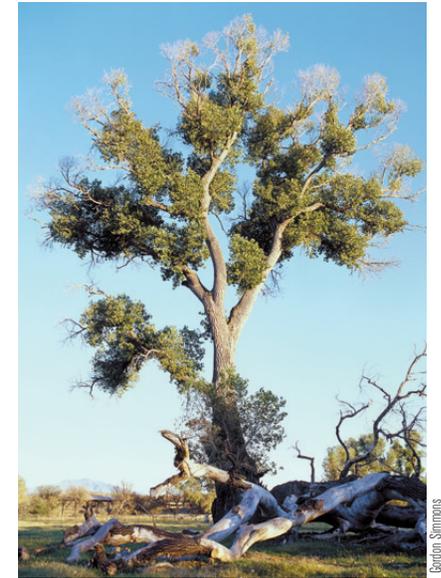
Bob Sharp

This issue of *sonorensis* explores and celebrates the past, present, and future of southern Arizona's Santa Cruz River. Like the Santa Cruz itself, the human story of this river is long. There is evidence of human presence along the river as early as 13,000 years ago, and a record of nearly continuous settlement and agriculture over the last 4,000 years in the floodplain near downtown Tucson – the longest occupied place currently known in all of the United States. Like the San Pedro River, its cousin to the east, the Santa Cruz flaunts the U.S.-Mexico border and is an ecological and cultural link between Arizona and Sonora.

Much of the Santa Cruz's long history is revealed as one follows the length of the River today. Traveling from its headwaters in southeastern Arizona, south through the beautiful rolling grasslands and oak woodlands of the San Rafael Valley, the River gradually widens from a stream to a small, but full-fledged river. By the time it crosses the border into Mexico, it is a broad fast-flowing river lined with dense groves of willow, cottonwood, sycamore, Arizona ash, hackberry and walnut – just as it has been for thousands of years. Embracing the margins of this lush riparian corridor are huge mesquite *bosques* (forests), so dense they are nearly impenetrable. This rich riparian ecosystem flows southward into Sonora 25 miles before making a U-turn to head back north toward Nogales. Following the river back toward the border, one is struck by its rapid diminution – within just a few miles the water flow narrows to become a creek, then a trickle, and then disappears altogether. All that's left of the lush riparian forest beyond this point are dead skeletons of cottonwoods and willows – mile after mile of arboreal graveyard. It is here that the Nogales well fields begin pumping water from the shallow water table that flows beneath the Santa Cruz – the "other" Santa Cruz River, out of sight but just as important as the surface water flow itself. The water table here is pumped down so low that the roots of the riparian trees can no longer reach it. From the well fields to the border, there is nothing but sandy wash and dead trees along the river's track all the way back to Arizona. ▶



Gordon Simmons



Gordon Simmons



Gordon Simmons



Aerial History

Just north of the border, back in Arizona, the river comes to life again. The cottonwood-willow riparian forest reappears, the Santa Cruz is once again a full-fledged river, and its flow is again perennial. However, here it is sustained year round by outflow from the Nogales Wastewater Treatment Plant, which “cleans” wastewater from the two Nogales’s and then pours the treated water into the Santa Cruz riverbed at Calabazas. As a result, the Santa Cruz is green and lush from Calabazas north to Tubac. Just north of Tubac, where giant commercial groves of pecan trees carpet the river valley, the Santa Cruz goes dry again, for here the basement rock that holds the water near the surface plunges down thousands of feet into the Tucson Basin and the river goes entirely underground. Before the days of modern groundwater pumping, it was driven back up to the surface where underground rock formations forced the hidden river back into view – as springs, cienegas, and surface flows. Where perennial surface water occurred, civilization clustered. But today, all those springs are dry because Santa Cruz and Pima County’s wells pump the water table ever lower to meet their growing water needs.

Father Eusebio Francisco Kino, a Jesuit missionary, was the first European to explore the upper and middle reaches of the Santa Cruz River Valley in the early 1690s. When Kino and the first Spanish colonists arrived in the Santa Cruz River Valley they found numerous villages of Piman Indians along the riverbanks. Over the next 150 years the Spanish and then the Mexicans established cattle ranches, farms, mines, missions, and presidios (forts) in the Santa Cruz River Valley, and with their Piman allies they defended themselves from constant Apache attacks.

Before the arrival of Europeans in the Santa Cruz Valley, grizzly bear, bison, muskrat, beaver, wild turkey, antelope, prairie dogs, Mexican gray wolves, and jaguar lived in the region, and many



Bob Sharp



Bob Sharp

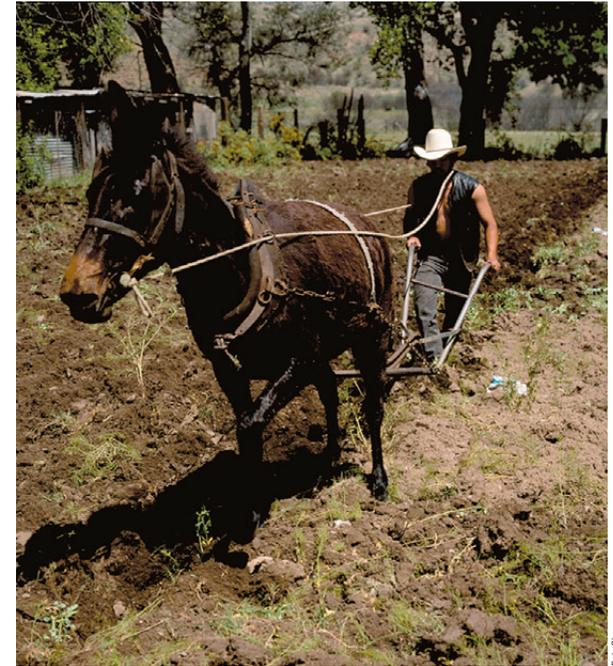
references to the abundance of animal life along the Santa Cruz appear in historical journals. Freshwater mussels (*Anodonta californiensis*) lived in great abundance in the river, and in the 19th Century these were a popular food of Chinese immigrants living in the valley. By the early 1900s, humans had extirpated all these species from the Valley. The Santa Cruz River also once supported an impressive number of native fish. Julius Froebel described the river near Tucson in 1855 as: "A rapid brook, clear as crystal, and full of aquatic plants, fish, and tortoises of various kinds." By 1950 the perennial river flow was gone and only three native fish species remained.

With the arrival of Europeans also came the introduction of species from the Old World. Some introductions were intentional, but many were not. To the Santa Cruz watershed, European's intentionally brought farm and domestic animals (e.g. horses, cattle, sheep, dogs, cats, pigs, chickens); less intentionally they brought English House Sparrows, Starlings, bullfrogs, crayfish, green sunfish, mosquito fish, brown garden snails and others. These exotic animals have spread by design or by accident and now threaten native species.

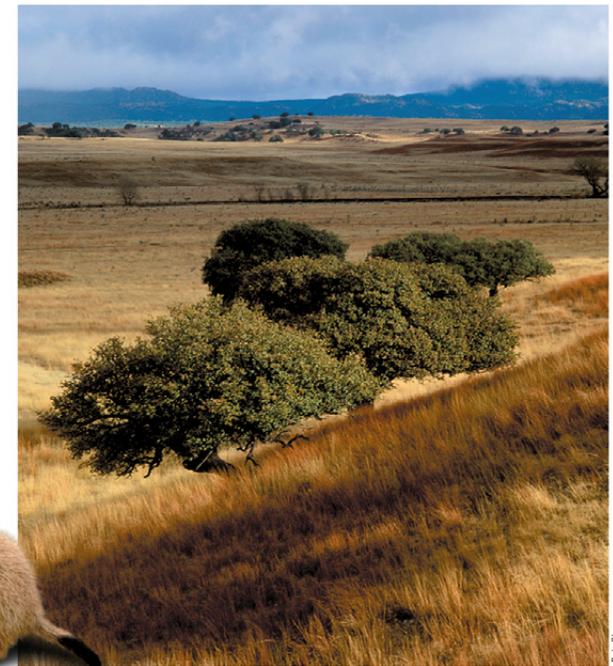
Since the late 1800s, the river's flow has fallen on hard times due to pressure from a booming population and its growing thirst for water. At the time of the 1860 census, the population of Tucson was 925; today it exceeds a half million. The U.S. portion of the Santa Cruz River Valley has one of the fastest growth rates in the country – just since 1990, the combined population of eastern Pima County and Santa Cruz County has risen by about a third, and is now near one million. Estimates suggest that another half million are crowded in and around Nogales, Sonora. While sprawling cities and outlying housing developments are steadily increasing the water demand, agriculture – mostly thirsty cotton and alfalfa – accounts for about 40% of the water use in the river's watershed.

Despite these changes and challenges, the future of the beleaguered Santa Cruz River is brightening. Some local governments, tribes, and conservation groups in Arizona and Sonora (Mexico) have developed plans to preserve the remaining surface flows, riparian habitats, and important archaeological and historical sites on its banks. In several reaches of the river and its tributaries, populations of native fish and other wildlife are being monitored, exotic plant and animal species are being removed, and riparian vegetation is being restored. Guiding urban development away from riparian habitats and other sensitive lands in the valley is a centerpiece of Pima County's Sonoran Desert Conservation Plan. The Arizona-Sonora Desert Museum is committed to conservation efforts in the region and is involved in numerous programs along the Santa Cruz River. Other participants working to protect the Santa Cruz River include the Friends of the Santa Cruz River, Sonoran Institute, Tohono O'odham Nation, National Park Service, The Nature Conservancy, Tucson Audubon Society, and others. Uniting these efforts is the goal of establishing a federal Congressional designation of a Santa Cruz Valley National Heritage Area. Such a designation would not restrict private property uses, but would result in a long-range management plan for the important ecological and cultural resources along the river, and federal match funding for their preservation, restoration, and promotion for heritage tourism and ecotourism. With the help of these grassroots efforts, the river will continue to sustain the landscape, wildlife, and cultural traditions that make this region unique.

Richard C. Brusca &
Robert J. Edison



Bob Sharp



Bob Sharp

Oasis Cultures:

PREHISTORIC LIFEWAYS ALONG A DESERT RIVER

JONATHAN B. MABRY, DESERT ARCHAEOLOGY, INC.



Douglas Taylor

Near the end of the Ice Age about 11,000 B.C., Paleoindian hunters of the Clovis culture traveled the Santa Cruz River Valley in search of mammoths and other now-extinct large mammals. Their spearpoints are currently the oldest evidence of human presence in the region, and they mark the beginning of the long and rich human history of the valley. Preserved on and beneath the valley surface are traces of a series of prehistoric cultures that flourished during various timespans between about 11,000 B.C. and the late 17th century A.D. These cultures included groups of the earliest





people on the continent, the first farmers and villagers in the Southwest, unique variants and blends of the Hohokam and Trincheras cultures of the Sonoran Desert, and the first southern

Arizona tribe to come in permanent contact with Europeans. All of these prehistoric cultures were centered on the linear oasis created by the river, the common thread through their histories.

▲ An artist brings to life archaeologists' vision of an early farming village along the Santa Cruz River. Illustration by Michael A. Hampshire.

◀ The first large, tempered pots for storage, cooking and other utilitarian purposes were made in the valley about A.D. 100.

◀ Archaic hunter-gatherers in the valley used spearthrowers to hurl darts tipped with flaked stone points like these.



San Rafael Valley

Bob Sharp

Natural Records of An Evolving River and Landscape

Since the 1930s, scientists have studied the sediment layers in floodplains, the fossil pollen preserved in those layers, the plant remains included in ancient packrat middens

in rock shelters, and other geological and biological archives of environmental changes in the region of the Santa Cruz River. They have learned that, during the time of the Clovis big-game hunters at the end of the Pleistocene global climatic era, the region's climate, landscape, and ecosystems were very different than today.

Rainfall was fluctuating dramatically, but in general winters were wetter and summers were drier than today, and less evaporation occurred during cooler summers. In the middle valley in the western Tucson Basin, the shallow but fast-flowing river had a braided, gravelly channel. The surrounding bajadas (broad, sloping aprons of sediment washed down from the mountains) were covered with chaparral and open woodlands of pinyon pine, juniper, and shrub live oak. Rivers, streams, and springs flowed stronger than today, and what are now dry playas were lakes. Two periods of continent-wide drought occurred during Clovis time (about 11,500-10,900 B.C.), and a combination of drought and overhunting may explain the extinctions of mammoths, horses, camels, ground sloths, and other large Ice Age animals which correlate with the end of the Clovis culture.

Over the following millennia the river and the regional landscape continued to evolve. There were local changes in where the river flowed on the surface and where the floodplain was building up or eroding, and valley-wide cycles of downcutting. Since the end of the Ice Age, long intervals of floodplain building in the middle Santa Cruz Valley have been interrupted by at least eight cycles of widespread downcutting. Prehistoric human impacts on the floodplain included burning grasslands during game drives, intensive foraging and firewood collecting, clearing of natural vegetation for fields, and diversion of surface waters and high water tables.

Archaeologists today are finding signs that many turning points in prehistoric subsistence strategies, settlement patterns, and population densities were responses to changes in the riverine oasis and its surroundings. Because adaptations and cultures did not suddenly replace each other, but overlapped by thousands of years, it is difficult to divide the prehistory of this region into discrete "periods."

DEVELOPMENT OF A SONORAN DESERT WAY OF LIFE



Jonathan Mabry

Geological and biological evidence indicate that water tables rose in southern Arizona during a global period of colder conditions between about 11,000 and 9,500 B.C. After this reversion to nearly Ice Age conditions, the climate began to warm rapidly at the beginning of a new global climatic era, the Holocene. A now-extinct form

of bison continued to be hunted by late Paleoindian groups in southeastern Arizona and some other regions in the West. Winter rainfall decreased while summer rainfall increased, and between about 8000 and 7500 B.C. the pinyon-juniper-oak woodlands retreated to higher elevations as desert plants became established in the basins. The Santa Cruz River flowed rapidly in a braiding channel.

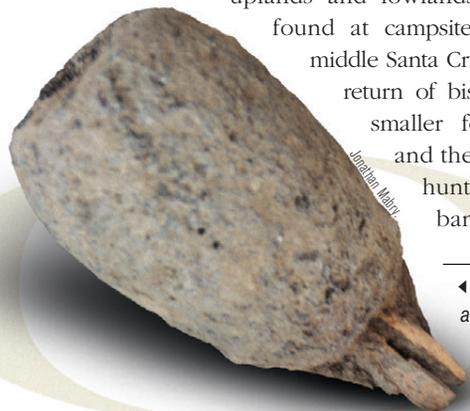
During this period was developed a new hunting and gathering way of life that was specifically adapted to the Sonoran Desert, and would last many thousands of years. The stone grinding tools, plant remains, and animal bones found at early Holocene sites in the region indicate that the focus of this "Archaic" adaptation was on smaller animals and the seeds, nuts, and fruits of wild plants. Site locations and characteristics indicate that small bands moved their campsites seasonally between floodplains, bajadas, and foothills as resources in those zones became available.

▲ A broken spearpoint recently found along a tributary of the middle Santa Cruz River was left behind by Clovis big-game hunters about 11,000 B.C.

CHANGING CLIMATES AND CULTURAL RESPONSES

Scientists debate whether or not a long period of generally hotter, drier climate began about 7500 B.C., but the lack of any archaeological sites that can be dated to the period between about 6500 B.C. and 3500 B.C. suggest that the Santa Cruz Valley and the rest of the desert lowlands of the Southwest were largely abandoned by people. In southern Arizona there are also signs that rivers, streams, springs, and lakes dried up, and sand dunes formed. Sediment layers show that the downcutting channel of the Santa Cruz River incised the floodplain while sediments eroded from the surrounding landscape accumulated at the channel margins. Bison, elk, mountain sheep, and pronghorn — the last remnants of the Ice Age fauna — appear to have shifted their ranges to higher elevations or to other regions.

The Southwest's climate became cooler and wetter about 3000 B.C., the beginning of the late Holocene. Lakes refilled, rivers and springs flowed again, and floodplains began to build up anew. The deep and wide channel of the Santa Cruz River began to fill with fine sediments. Hunter-gatherers returned to the low deserts, and the old way of life was revived, but with increasing reuse of the same locations. Groups camped on the banks of the Santa Cruz River during their seasonal movements between the uplands and lowlands. Butchered bones found at campsites in the lower and middle Santa Cruz Valley indicate the return of bison to the area (the smaller form living today), and their importance to the hunting and gathering bands of this time.



◀ Stone smoking pipes with tobacco residues found at a 1250-800 B.C. site north of Tucson are the oldest evidence of tobacco use in North America.

AN EARLY FARMING CULTURE

Direct radiocarbon dates on maize (corn) remains indicate that agriculture arrived in southern Arizona from Mexico by 2100 B.C. To supplement wild resources, hunter-gatherers in the region planted maize and grew some of their food for the first time. These part-time farmers built pithouses and storage pits in summer camps near their fields along the Santa Cruz River, and made the first ceramic figurines and pottery in the Southwest. This modest start was the beginning of two thousand years of increasing dependence on agriculture and sedentism in the valley, an unparalleled period of continuous cultural development during which this region was perhaps the center of population and cultural development in the Southwest.

By 1200 B.C., farmers living in early villages along the Santa Cruz River in the western Tucson Basin constructed the earliest known irrigation canals in North America. In addition to maize, they cultivated squash, tobacco, and possibly beans and cotton. Objects resembling spindle whorls for spinning yarn may be evidence that they were the first cotton weavers in the Southwest. A string of culturally related farming communities along the river maintained close social connections with each other, and also developed trade connections with distant parts of the Southwest, California, and northern Mexico to acquire volcanic glass for making dart points and sea shells for making jewelry. House

▶ Detail of hairstyle depicted on the heads of ceramic figurines from a 1250-800 B.C. village in the valley.



▲ A canal dating to 1250 B.C. — the earliest known canal north of Mexico — is the linear feature in the middle of this excavation next to Interstate 10.



▲ Seashell jewelry dating between 800 and 400 B.C. indicates that early farmers in the valley made trips to the Sea of Cortez and had trade connections with communities on the Pacific coast.

▶ Sherds dating to 2100 B.C. found at a site in the floodplain near downtown Tucson are the oldest pottery in the Southwest.



Jonathan Mabry



Jonathan Mabry

▲ Sunset shadows show the high density of pithouses found at an early farming village site in the middle valley.



Robert Ciaccio

▲ Construction details of a typical pit structure in an early farming village in the Santa Cruz Valley.

SIGNS OF NEWCOMERS?

Following a decline in the water table and a cycle of channel downcutting near A.D. 50, new types of architecture, pottery, stone tools, and burial types appeared in the Tucson Basin, perhaps indicating the arrival of a new cultural group from the uplands of the Southwest. If so, then overlapping radiocarbon dates mean that this new group coexisted for about a century with the older farming culture in the valley. Pithouses shifted from round to rectangular about A.D. 350. Large villages developed along the Santa Cruz River, with village locations moving to terraces above the floodplain. These communities grew and developed, some in the same locations for a millennium, as the river flow and floodplain remained stable.

A CULTURAL BORDERLAND AND TRADE CORRIDOR

Between about A.D. 550 and 750, styles of architecture, artifacts, graphic symbols, and burial practices of the Hohokam culture had spread from the Phoenix Basin into the middle Santa Cruz Valley and the rest of the Tucson Basin. Plazas became the central features of villages, the largest of which also had Mesoamerican-style ballcourts by about A.D. 800. By A.D. 1000, villages were spread out along expanded canal systems.

Ballcourts were no longer built in the Tucson Basin and most other Hohokam areas after about A.D. 1050.

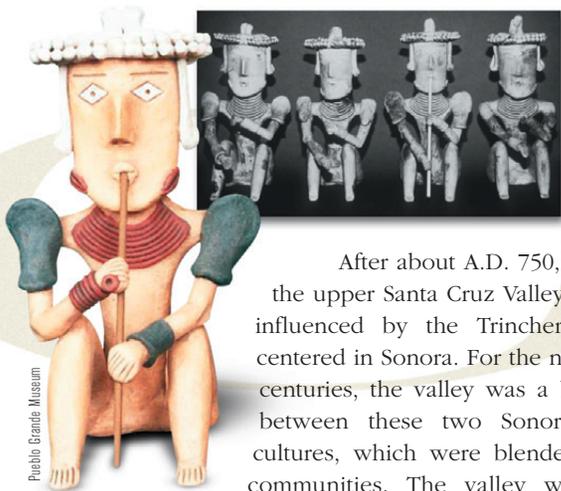
▲ Large buildings constructed between about 400 B.C. and A.D. 50 in valley villages are thought to be the earliest known structures in the Southwest used for communal ceremonies.

groups and large, special buildings that appeared in villages along the Santa Cruz River after 800 B.C. are indications that communities were composed of multiple households that were integrated by public meetings and ceremonies. Small stone projectile points suggest that the bow-and-arrow began to be used in southern Arizona about this time, earlier than in other regions of the Southwest.

▶ Carved stone censurs held incense or other special substances.



Douglas Taylor



David Doyle

◀ Ceramic figurines found near Tucson in 1937 depict the players and onlookers of a Mesoamerican-style ball game.

◀ Reproduction of one of the figurines showing original painted decoration.

COLLIDING CULTURES

After about A.D. 750, villages in the upper Santa Cruz Valley were also influenced by the Trincheras culture centered in Sonora. For the next several centuries, the valley was a borderland between these two Sonoran Desert cultures, which were blended in local communities. The valley was also a corridor of trade in locally made seashell jewelry, pottery, and probably cotton textiles, and macaws and copper items from Mesoamerica.

Near A.D. 1150, many Hohokam villages in the middle Santa Cruz Valley were abandoned and new ones were established, possibly in response to a major cycle of channel downcutting that forced the abandonment of canal systems in the floodplain. After this, new types of runoff farming were developed on the bajadas above the floodplain. Walled compounds and above-ground adobe architecture appeared in the new villages, and platform mounds were built as public ceremonial structures. The region's population became concentrated in a few large villages by A.D. 1275, perhaps in response to increasing warfare.

Between about A.D. 1400 and 1450, the Hohokam culture of southern Arizona collapsed after a population decline. In the Phoenix Basin, this decline was marked by malnutrition and high mortality rates, perhaps due to overpopulation and a series of droughts punctuated by large floods that destroyed most canal systems. What happened to the Hohokam villages in the middle Santa Cruz Valley is less well understood. To the south, the numbers and sizes of Trincheras villages also began to decline during this period for unknown reasons.

▶ A military macaw was buried at a village site near Nogales about A.D. 1100. Macaws and parrots from Mexico were imported into the valley and their colorful feathers were probably used in ceremonial costumes. Courtesy of Arizona State Museum.

During the period between about A.D. 1450 and the 1690s, several related Piman tribes lived in villages in the Santa Cruz Valley. They farmed the floodplain with floodwaters and canals, but continued to hunt and gather wild plant foods. Their material culture resembled those of other Piman peoples in southern Arizona and northern Sonora. Archaeologists have trouble saying much more about the peoples living in southern Arizona during this period because very few sites have been identified or investigated. However, gaps in the Santa Cruz Valley archaeological record may reflect intervals of abandonment, like in the neighboring San Pedro Valley.

The available archaeological and documentary evidence suggests that, at about the same time in the late 17th century, Apache peoples arrived from the north and began raiding native Piman villages, while Europeans entered the valley from the south. Spanish colonists founded cattle ranches in the upper Santa Cruz Valley in the 1680s, and in the 1690s Jesuit missionaries started a chain of missions in native villages in the upper and middle valley. With the establishment of these permanent contacts with Europeans that made maps and kept written records, the human story of the Santa Cruz River Valley entered into historical time. **S**



Arizona State Museum

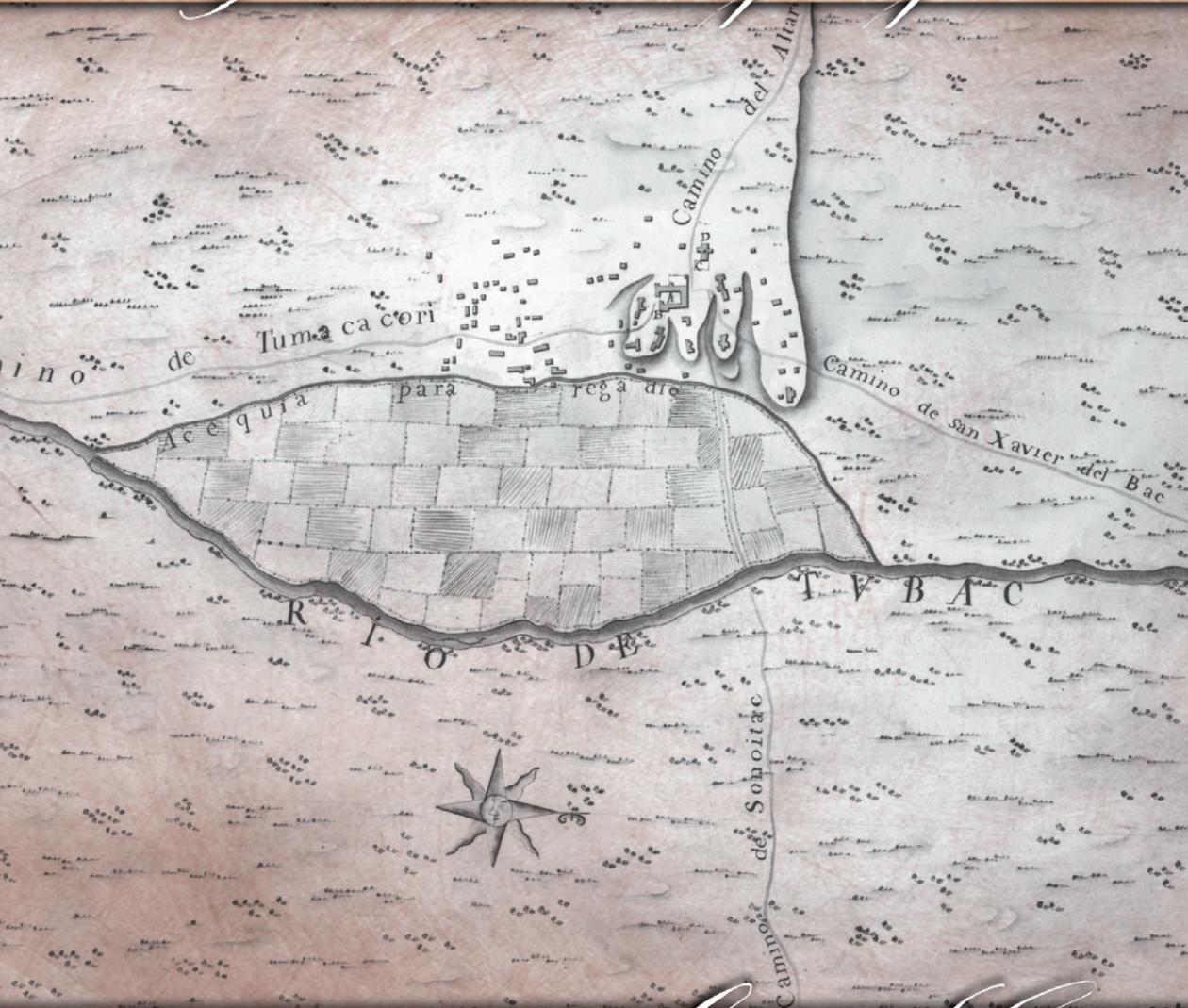


ISTOCK



▲ Pottery in the style of the Trincheras culture of Sonora was made in the upper Santa Cruz Valley between about A.D. 750 and 1450. Photograph by Robert Heckman. Courtesy of the Amerind Foundation, Inc., Dragoon, Arizona.

The Changing



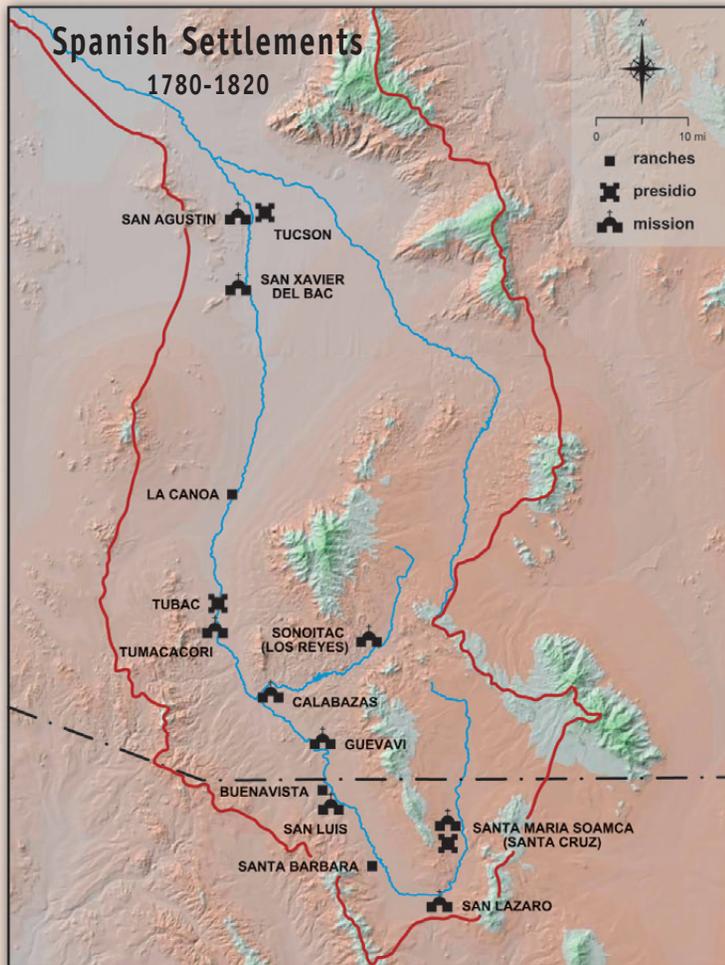
During the 1680s, when Europeans first viewed the Santa Cruz River, it meandered in multiple but intermittent streams through a lush riparian corridor of cottonwood and willow, with dense *bosques* (forests) of mesquite and hackberry stretching along its upper terraces. The *Pimería Alta* (land of the Upper Pimas) was part of the Spanish Empire from the 1680s until 1821, when Mexico gained its independence. Under the proud but impoverished Republic of Mexico, Apaches increased their hold on the river valley. After the United States acquired the northern portions of the river through the Gadsden Purchase in 1854, military protection was as scant as it had been under Mexico, particularly during the Civil War (1861-65). Apache war parties increased raiding and few settlers ventured into the valley. The completion of the Southern Pacific Railroad across southern Arizona in 1881 and peace with the Apaches following Geronimo's 1887 surrender brought an influx of American settlers and a cattle boom to the valley. Accustomed to wetter climates, the newcomers created unprecedented demands on the delicate resources of the desert river. Between the late 1880s and 1912, many portions of the river were irreversibly altered.

Diana Hadley | Arizona State Museum

Santa Cruz, 1680-1912



Steve Phillips



The scattered writings of early observers—Jesuit and Franciscan missionaries or leaders of American expeditions—provide information for the reconstruction of a composite picture of the Santa Cruz prior to intensive impacts, from which the extent and nature of change can be measured.

The earliest descriptions come from Jesuit missionary-explorer Father Eusebio Francisco Kino and his military escort Captain Juan Mateo Manje, who followed Indian trails along the banks of the Río Santa María Suamca, as the river was called when they visited in the 1690s. The explorers found several thousand people whom they called Sobaipuris (a branch of the northern Pimans) residing in more than a dozen small villages scattered along the perennial reaches of the river, often near *ciénegas* (marshes). The populations of these kin-based *rancherías* (encampments) varied from 80 to 900 persons. Their houses were constructed of poles and woven mats. Vaulted roofs covered by several layers of matting could withstand precipitation. Supplied by vast networks of irrigation canals, extensive fields produced a surplus of corn, beans, squash, melons, cotton, and tobacco. On seasonal gathering trips to the surrounding desert, the river-dwelling villagers supplemented their diet with agave, cactus fruits, desert “greens,” and saguaro fruit for making wine, the main

alcoholic beverage throughout the Spanish and Mexican periods. The villagers kept wild fowl, including *guacamayas* (Macaws or possibly Thick-billed Parrots), whose feathers they valued for decoration. Wearing garments of *gamuza* (expertly tanned antelope or deer skin) or woven cotton cloth, they greeted the missionaries with dancing, shouting, and banquets, and showered them with so many gifts of food, including fish from the river, that the visitors could scarcely carry it away. Early descriptions of Sobaipuri villages on the Santa Cruz depict a people living in a balanced relationship with their environment, employing a production system informed by subtle ecological understandings developed over many centuries.

The Spanish Empire employed the dual institutions of church and military to Christianize natives and impose Spanish control. Along the river, Jesuits established missions in populous native settlements, while the Spanish Army garrisoned *presidios* (forts) at strategically defensible locations. In their role of early agricultural extension agents, missionaries distributed livestock, seeds, rootstocks, and tools. Most important among the new plants were wheat and barley, frost-resistant crops planted in the fall to take advantage of winter rains, and harvested during the dry spring months, reducing the possibility of shortages.

Courtesy of Western Mapping Co.

Livestock, crops and implements reached the frontiers of the *Pimería* through long-established native trade networks that extended south to central Mexico and west to the Pacific coast. Kino documented that watermelons preceded his arrival in the *Pimería*. Unfortunately, Old World diseases often preceded actual contact with Spaniards. Native populations along the Santa Cruz, with little resistance to the new diseases, struggled against epidemics and population decline.

Supplied by vast networks of irrigation canals, extensive fields produced a surplus of corn, beans, squash, melons, cotton, and tobacco.

European livestock initiated a transformation of native societies and created subsequent ecological changes along the river. Native assistants from missions in southern Sonora drove small herds of mares, cattle, mules, sheep, and goats to missions and ranches on the Santa Cruz. Valued as a source of food, farm labor, clothing, and construction materials (leather door hinges), cattle brought vast areas of otherwise economically unproductive desert grasslands into native subsistence strategies. Horses increased the militarization of northern Piman society. Apaches quickly substituted horses for the dog teams they previously used for transporting their camps, and soon

developed an economy of raiding to which the horse was crucial.

Geronimo de la Rocha of the Spanish Royal Corps of Engineers described settlements on the Santa Cruz in 1780.

Visiting during a drought, he found the fields at Tumacácori Mission consuming all the river's water, leaving none for downstream settlers at Tubac. At Canoa, where the spring was very small, water could be obtained by digging in the river's sandy bed. At San Xavier del Bac, a huge *ciénega* (marsh) south of the mission created unhealthy breezes (*mal aire*, or bad air, from which the word for malaria is derived). Rocha described what was likely the river's first dam, south of Tucson. It diverted water from the *ciénega* by Sentinel Peak into three large *acequias* (irrigation canals) to supply the mission and presidio fields. While Spanish population along the river increased, Indian population at the missions decreased, despite periodic transfers of native people from other locations. In 1793 and 1819, *Apaches de paz*, peaceful Apaches from the Aravaipa and Pinal bands, settled near the Tucson and Santa Cruz presidios, where they received bi-weekly rations in exchange for abandoning their raids. The presence of many ethnic groups gave rise to competition for water.



Brian Anderson

Tumacácori



Steve Phillips

Tumacácori



Tucson in the late 19th century. The Convento is in the center right of the photo.
 Courtesy of Arizona Historical Society/Tucson, AHS#18233.

Although Spanish water law protected the missions' rights to water, Spanish soldiers and settlers often ignored the regulations.

Under Mexico, farming and settlement along the river declined. In 1828, despite what the future governor of Sonora described as excellent fields supplied by a "magnificent spring" on the river's west bank, residents of Tucson formally voted to abandon the settlement for a safer location farther south in Sonora. In 1849, when thousands of Forty-niners drove wagons along the Santa Cruz on their way to the California Gold Rush, they described many abandoned ranches and villages, but the residents of Tucson were still there, although extremely impoverished. The only other viable settlement on the river was at Santa Cruz, Sonora.

With the transfer from Mexico to the United States, little changed along the river. In 1859, when Julius Froebel viewed the Santa Cruz, its banks were covered with cottonwoods and ash. He found portions of the valley, particularly Tumacacori and San Xavier del Bac, to be of "such grand, rich, and simple beauty... that they would be remarkable in any part of the world." Agriculture was the main economic activity.

The majority of residents were Mexican. Farmers used horses and mules to thresh their barley and wheat and removed the chaff by tossing shovelfuls of grain into the air, raising tall columns of dust that could be seen for miles on the horizon. Every May 15th, a procession carried the patron saint of crops San Ysidro Labrador through the fields, accompanied by singing, dancing, firing of guns, and drinking of *tiswin*, a type of corn beer made by Apaches and other Indian groups. Tucson's Chinese farmers participated enthusiastically in this Catholic festival.

During the late 1870s Leopoldo Carrillo created a 70-acre pleasure garden on the east bank of the river in Tucson, with mulberry-shaded picnic tables, a dance pavilion, exotic animals and rare birds, carp ponds, and a small lake with boats. He planted 500 peach trees, 2,000 grape vines, quinces, pomegranates, and strawberries. By 1879, newspapers reported 40,000 acres of cultivated

land in the watered portions of the Santa Cruz Valley. Dams across the river backed up acres of water to create steady supplies for gristmills at Santa Cruz, Sonora and at Silver Lake and Warner's Lake south of Tucson. By 1886, eight unlined irrigation ditches crossed the Tucson portion of the valley, five of them seven feet wide with a flow 18 inches deep, supplying water to a reported 4,800 acres of cultivation. The following year, Tucson pioneer Sam Hughes began construction of the biggest irrigation ditch on the river, a ditch that would have disastrous consequences. At Warner's Lake beneath Sentinel Peak

**By 1879, newspapers reported
 40,000 acres of cultivated land
 in the watered portions of the
 Santa Cruz Valley.**

members of the Tucson Rod and Gun Club rented duck blinds, where they shot Mallards, teal, Canvasbacks, widgeons, and mergansers. Plover and Snipe were abundant. Pelicans, curlews, and ibis flew by.

After the 1890s, cumulative impacts from multiple disturbances began taking a toll on the river's resources. The 150,000 head of cattle in Pima County in 1889 (about twice as many as today) congregated on the river during dry spells, consuming grasses and shrubs that held soil in place. Ambitious irrigation



H. Buckman

Old Mission (Convento) near Tucson (1860s-1870s). Courtesy of Arizona Historical Society/Tucson, AHS#28266.

projects attempted to tunnel into the riverbanks to tap the underground flow for transport through wooden pipes to urban centers. Wood-fueled steam pumps appeared during the mid-1880s and quickly consumed the bank-stabilizing mesquite *bosques*. By the 1890s, disastrous floods began to tear down the Santa Cruz, creating head cuts at irrigation canals, repeatedly ripping out dams, and scattering expensive imported carp through Tucson's dirt streets, where small boys collected them for sale to unwary buyers. By 1912, when Arizona became a state, floods had channelized and downcut long

B By 1912, when Arizona
became a state,
floods had channelized and
downcut long reaches of the river.

reaches of the river. In many places, banks were steep and bare of vegetation. The head gates of canal were left "high and dry," sometimes several feet above the river's flow, making direct irrigation from the river impossible, even though underground water levels did not drop significantly until the post-World War II population boom. Throughout the Santa Cruz Valley, misguided human activities damaged valuable resources that can only be partially replaced through expensive restoration projects now underway. **S**



*Dramatic photo of the Santa Cruz taken during the 1905 flood.
Courtesy of Arizona Historical Society/Tucson, AHS#2922.*

the 20th Century

During the 20th century, changes occurred that shaped the present character of the Santa Cruz River.



- In the first decade of the 20th century, Tucson became dependent on groundwater; since 1900 the water table in central Tucson has dropped over 250 feet.
- The population of the Tucson area grew from 7,531 in 1900 to 486,699 in 2000. A significant and continued increase began in the 1940s and by 1950 the population was 45,454.
- In the last decade, Pima County had a population growth rate of 27 percent; by 2000 the population was 843,746.
- Downcutting or entrenchment of the Santa Cruz River began in the early 1890s. Today entrenchment between Tucson and San Xavier is over 30 feet deep in places.
- Perennial surface flow in the Tucson and San Xavier sections of the river disappeared by the late 1940s.
- By the early 1940s cutting of fuelwood to operate steam engines for pumping groundwater had destroyed the lush bosque (forest) of velvet mesquites that dominated the river valley for a distance of 15 miles south of Tucson.
- The pecan orchards (FICO Farms), extending for 13 miles and covering about 5,000 acres along the river east of Green Valley, were planted in the late 1960s.
- Activity at the three open pit copper mines to the west of Green Valley peaked between the 1960s and the 1980s.
- Groundwater pumping along the Santa Cruz River from Nogales to Marana peaked in the 1970s, then declined as priorities shifted from agriculture and mining to municipal needs.
- By the 1980s, most of the banks of the Santa Cruz and Rillito rivers in the Tucson area had been channelized (straightened) and stabilized with soil cement in an effort to prevent erosion during flooding.
- Segments of perennial surface flow between Nogales and Marana changed from natural flows to waters dominated by treated effluent (sewage treated).
- Several species of introduced exotic plants and animals have been documented as detrimental to native species.
- Central Arizona Project (CAP) water from the Colorado River arrived in Tucson in 1992.
- Today Large open pit sand and gravel mines dominate sites along the Tucson reach of the river.
- Numerous landfills along the Tucson reach of the river challenge recharge and restoration efforts.
- The San Rafael Valley is the only section of the river that has remained relatively unchanged during the 20th century.

Larry Marshall
Santa Cruz River Alliance
Friends of the Santa Cruz River
Pimeria Alta Historical Society
Environmental Education Exchange
Mesa Southwest Museum

the santa cruz river today

The Santa Cruz River is a natural treasure for three nations: Mexico, United States, and Tohono O'odham. It originates in the San Rafael Valley of southern Arizona, crosses south into Sonora, Mexico at Lochiel, bends north to reenter the U.S about six miles east of Nogales at Buena Vista, continues north to cross about a 10-mile stretch of the San Xavier District of the Tohono O'odham Nation, through Tucson, and then north-northwest to the Gila River west of Phoenix.

The river is traditionally divided into four reaches (parts): San Rafael Valley, upper Santa Cruz (Lochiel to Amado), middle Santa Cruz (Amado to Marana), and lower Santa Cruz (Marana to Gila River). The landscape of the reaches is markedly different. The San Rafael is a broad valley. The upper reach is in a narrow valley constrained by mountain ridges. The upper and middle reaches have a well-defined channel. In the middle reach the channel is notably entrenched and the valley broad. And, the lower reach is a system of ill-defined braided channels on a broad flood plain.

Life along the Santa Cruz River historically and presently centers on surface and ground water: where it is, where it comes from, how much there is, and how much there will be in the future. The priorities of water use and management change significantly along the 135-mile stretch of the river from its headwaters to Tucson. These priorities are governed by three nations, two counties in the U.S., three large urban areas, presence or absence of natural surface flow and/or effluent releases, size of the groundwater aquifer, availability of CAP water, and competition for land use and water supply.

Santa Cruz, Sonora, Mexico.

The Santa Cruz River watershed, the cumulative area of drainage of the river and its tributaries, encompasses about 8,550 square miles, of which 8,200 are in the U.S. (including 185 in the San Rafael Valley) and 350 in Sonora. The most significant tributaries include, from south to north: Nogales Wash, Sonoita Creek, Rillito River (including Sabino Canyon and Cienega Creek), Cañada del Oro, and Altar-Brawley Wash. The streams in the watershed have a collective length of about 9,720 miles, of which only about 120 miles have continuous or intermittent perennial (year round) surface flow. The total length of the main channel is about 225 miles: 15 miles in the San Rafael Valley, 40 miles in Sonora, and 170 miles from Nogales to the Gila River.



Historically, the river had four stretches of continuous or intermittent perennial surface flow: from its headwaters to Canoa (in summers and dry years it made it only to Tubac, and had numerous intermittent stretches in Sonora); at Martínez Hill next to San Xavier del Bac Mission; along the base of Sentinel Peak (“A” Mountain) at Tucson; and at the “9 mile waterhole” or “point of mountain” near the Arizona Portland Cement Company at the north end of the Tucson Mountains. From there to the Gila River there was no perennial flow, and early travelers referred to this stretch as the “90 mile desert.”

The historical flow of surface water is readily explained by the geology underlying the river. The upper Santa Cruz has shallow alluvium (the sediments that hold water) which creates a near-surface aquifer, often less than 100 feet deep. Below and around this alluvium is bedrock, which holds little or no water.

Near Canoa, the geology changes dramatically. Here the river encounters the southern edge of the 1,000 square mile Tucson Basin, formed by an east-west fault system, which dropped the underlying bedrock. The Tucson Basin is now filled with up to 7,500 feet of alluvial sediment, including silt, sand, and gravel. Perennial water from the upper Santa Cruz sinks into this alluvium and disappears as a shallow aquifer, eventually reaching and recharging the deep aquifer of the Tucson Basin.



The Santa Cruz River near Tumacácori.

The elevation at the headwaters of the river is 5,000 feet above sea level, at Tucson 2,350 feet, and at the Gila River 1,000 feet. The river thus drops an average of 19 feet/mile on its course from its headwaters to Tucson. When this “down hill” groundwater flow historically encountered the natural underground bedrock “dams” at Martínez Hill, Sentinel Peak, and the “9 mile water hole,” it was pushed to the surface to form springs, cienegas (wetlands), and perennial flows.

Today, natural perennial surface flow, often intermittent and varying with month, year, season and rainfall, occurs only in the San Rafael Valley in the U.S. (about 15 miles), and from the U.S./Mexico border to just east of San Lazaro in Sonora (about 20 miles). Tributaries with notable flow include Sonoita Creek (about 12 miles), Sabino Creek (about 10 miles), Cienega Creek (about 10 miles), and Davidson Canyon (about 6 miles). (Cienega Creek and Davidson Canyon join to form Pantano Wash and later join with Sabino Creek to form the Rillito River.) Peck Canyon,

Potrero Creek, and Arivaca Wash each have a mile or less of intermittent surface flow, as well as numerous creeks and springs mostly in the surrounding mountains. Other parts of the river have ephemeral (sporadic) surface flow only during heavy rains.

Cienegas were once common along the river, but most dried up as the water table dropped from pumping, and others from diversions or were drained because of malaria epidemics. These were havens for vegetation and wildlife, and provided water for early agriculture. The largest remaining cienega is Las Lagunas in the City of Nogales, located along Potrero Creek.

Effluent (treated sewage) water maintains lush riparian vegetation and provides recharge for the aquifers along two stretches of the river.

In Santa Cruz County, the Nogales International Wastewater Treatment Plant at Calabazas processes sewage for Nogales, Arizona and Nogales, Sonora. Today, about 30% of the water processed is from



Water treatment effluent at Nogales, Arizona.

Effluent Treatment

There are three levels of treatment of effluent water: primary (physical removal of solids), secondary (removal of organic matter and disinfecting the water), and tertiary (any treatment beyond secondary). Secondary effluent is recharged into the river in Santa Cruz and Pima counties, and is also used for turf irrigation at schools and golf courses. Tertiary effluent has different uses depending upon the class of treatment. Secondary and tertiary effluents are collectively called “reclaimed water.”

Nogales, Arizona and Rio Rico, and 70% from Nogales, Sonora. In January 2003, 390 million gallons of secondary effluent were discharged into the river at Calabazas. From there it flows north over shallow alluvium to sometimes as far as Canoa (about 25 miles) where it sinks into the Tucson Basin as recharge.

Pima County has two major wastewater treatment facilities: Roger Road Wastewater Treatment Plant and Ina Road Water Pollution Control Facility, and about 10 satellite facilities (including those in Green Valley and Avra Valley). In January 2003, the Roger Road facility discharged over 934 million gallons and the Ina Road facility over 685 million gallons of secondary effluent into the river. The discharges from Roger Road meet the discharges at Ina Road (about 5 miles downstream) and often continue for another 13 miles, and at times for another 25 miles to Red Rock. The City of Tucson is entitled to use 90% of the water treated at these county owned facilities. A man-made wetland has been created at Sweetwater along the river at Roger Road. This is owned by the City of Tucson and uses effluent water produced at the Roger Road Wastewater Treatment Plant.

natural history

The diverse variety of habitats in the Santa Cruz watershed provide home for many plant and animal species. At Tumacácori National Historical Park alone (including Calabazas and Guevavi), 414 plant, 8 fish, 7 amphibian, 15 reptile, 115 bird, and 28 terrestrial mammal species were recorded in surveys made during 2000 to 2003.

The riparian corridor along the river from its headwaters to Canoa is in the Desert Grassland Biome, and from Canoa to the Gila River is the Arizona Upland Subdivision of the Sonoran Desert Biome. At higher elevations south of Tucson is the Madrean Evergreen

Many animals once recorded in the Santa Cruz River watershed no longer occur here— they have been extirpated, but populations do exist elsewhere.

Woodland Biome: warm-temperate Mexican oak-pine communities with connections to the Sierra Madre range in northern Mexico. These comprise the “Sky-Island” vegetation communities or Apachean Highland forests on the mountains bordering the river.

The Santa Cruz River provides a riparian corridor of habitat similar to those in northern Mexico. Since the river has a north-south orientation, it is important as a flyway for migratory birds and bats. Its lush forests of cottonwood, willow, and velvet mesquite are a contrast to the adjacent dry desert and grassland. This enables some subtropical species, such as the Cactus Ferruginous Pygmy-Owl, to extend their ranges north into Arizona. For some species, such as the Gray Hawk and Rose-Throated Becard, the watershed is the U.S. “stronghold,” or place where a species is most readily found. Of the 36 species of raptors (birds of prey) that nest in Arizona, 31 do so in this watershed.



Aerial view of Central Arizona Project.

Central Arizona Project

Congress authorized the 336-mile-long Central Arizona Project (CAP) in 1968. Along a series of canals and lift stations, water from the Colorado River at Lake Havasu was delivered to Phoenix in 1985 and Tucson in 1992. The CAP line now takes water to San Xavier and extends to the south side of Pima Mine Road at Interstate 19, just south of the Tohono O’odham reservation. Prior to the arrival of CAP water, the Tucson area was dependent entirely upon groundwater beginning in the 1890s, while earlier people depended on surface water and/or shallow wells. CAP water is now being used to replenish the Tucson area aquifer at 11 recharge basins, and to replace groundwater for agricultural and municipal needs and for direct urban and agricultural consumption. CAP water usage is calculated in acre-feet: the amount of water one-foot deep that covers an acre of ground (325,851 gallons). CAP water is in finite supply and is not a permanent solution to increasing water demands in the Tucson area.



Subsidence

Pumping of groundwater without balanced recharge results in subsidence: the downward sinking of the earth's surface by removal of underlying support water. Imagine a cooling pie—as the pie cools, and liquid and air below the crust escape, the crust falls, and cracks develop along the edge. In the Eloy Basin north of Picacho, over 15 feet of subsidence resulted from groundwater pumping between 1952 and 1985. Areas of central Tucson are subsiding at a rate of 0.8 inch/year. Major subsidence in urban areas can result in cracking of building foundations, and disruption of gravity controlled water and sewer lines.

Numerous efforts are being made to restore parts of the river corridor in an attempt to increase riparian areas and improve habitat for wildlife. These projects include: San Lazaro (Sonora), South River Road Restoration Project (Nogales), Barrio de Tubac, San Xavier District of the Tohono O'odham Nation, Paseo de las Iglesias (Tucson), and Tucson Audubon's Santa Cruz River Habitat Project (Marana).

Many animals once recorded in the Santa Cruz River watershed no longer occur here—they have been extirpated, but populations do exist elsewhere.

Turkeys were extirpated in the early 1900s. Muskrat remains are reported from two approximately 2,000-year-old archaeological sites along the river in Tucson. From these same sites and others dated between 3,000 and 2,000 years ago, freshwater mussels, which attained a length of about three inches, are recorded. Residents in the Tucson area in the 1880s harvested and ate these



mussels, which were apparently extirpated by 1915. Beavers were reported from two localities in the watershed: one on the Rillito River near Fort Lowell in 1858, and the other on Sonoita Creek near Fort Buchanan in 1859. Black-tailed prairie dogs were poisoned out of the U.S. portion of the watershed in the early 1900s, but some may still occur in Sonora.

The last grizzly bear was killed in 1918 on the Coronado National Forest in the Catalina/Rincon mountain area. Occasional sightings of Mexican gray wolves still occur in the southern part of the watershed. The last wolf reported killed was in 1961 on the Vaca Ranch in the San Rafael Valley. About 20 jaguars have been recorded in the watershed since 1900. The last one reported killed was in 1971 near Kino Springs, while the latest sighting was northwest of Nogales in 2002.

Remains of bison or buffalo from the San Rafael Valley yielded a carbon 14 date showing that this species was in the area after the expedition of Fray Marcos de Niza in 1539. Sonoran pronghorn antelope were once common along the river, yet only a few hundred individuals survive in the Cabeza Prieta National Wildlife Refuge and adjacent Pinacate Biosphere Reserve in Sonora, far from the Santa Cruz. The American pronghorn, another subspecies, was introduced into the San Rafael Valley in the late 1900s.

river communities

There are three critical considerations to understanding water use issues along the Santa Cruz River. First, from its headwaters in the San Rafael Valley to the lower Santa Cruz at Marana, the river flows through the United States, Mexico, and Tohono O'odham Nation. Each of these nations have their own laws and traditions for managing surface and groundwater. Second, in an attempt to manage diverse water needs, especially those involving urban and agriculture demands over large areas, the State of Arizona passed the Groundwater Management Act in 1980 which resulted in the establishment of three Active Management Areas (AMAs) within the Santa Cruz watershed. And third, nine distinct communities exist along the 150-mile



Endangered Species

The Santa Cruz watershed is currently home to 15 endangered species, including five plants (Kearney's blue star, Nichol Turk's head cactus, Pima pineapple cactus, Huachua water umbel and Madrean ladies'-trusses), two fish (Gila topminnow and desert pupfish), two amphibians (Sonoran tiger salamander and Chiricahua leopard frog), four birds (Southwestern Willow Flycatcher, Masked Bobwhite, Cactus Ferruginous Pygmy-Owl, and Mexican Spotted Owl), and two mammals (lesser long-nosed bat and jaguar).

reach of the river from its headwaters to Marana, each with different geographical settings and priorities for water management.

In the San Rafael Valley, the headwater is defined by some as Bog Springs on the Vaca Ranch at the north end of the valley. However, it is not until farther south at Sheehy Springs where perennial surface flow occurs. The valley is bordered by 6,000-foot-high uplands in the Coronado National Forest, and includes



San Rafael Valley

Active Management Areas

These include the Santa Cruz, Tucson, and Pinal AMA. The goal of each AMA is to insure "safe yield" (the long-term balance between the annual amount of groundwater withdrawn and the annual amount of natural and artificial recharge), and "assured water supply" (the long term availability of the quality and quantity of water based on conservation standards) in each area.

about 15 sizable privately owned ranches. The river closely resembles its condition in the last century, with reaches of perennial flow, a few small cienegas, and intact riparian habitat. At the south end of the valley is the San Rafael Ranch State Park.

From the U.S./Mexico border to San Lazaro in Sonora, traditional ranching and farming continue under the *ejido* (communal land management) system established here in the 1980s. *Ejidors* negotiate for perennial surface flow to irrigate farms that produce wintertime vegetables and forage for livestock. The first Spanish era *acequias*

"A river might better be thought of as having a heritage rather than an origin."

(Leopold et al., 1964)

(irrigation canals) are found here along the river. In Mexico, livestock is allowed to graze along the river, while in the U.S. this practice is discouraged. Cottonwoods along the river are in good condition, while some higher elevation grasslands are severely overgrazed.

From San Lazaro, Sonora to the Mexico/U.S. border, sand and gravel mines are common in and along the riverbed. Ranching and farming were historically practiced in this reach, but there is no longer perennial flow of the river. The City of Nogales, Sonora gets about 45% of its water from the subsurface river flow in this area, and intense groundwater withdrawal is degrading the riparian habitat. There is an infiltration gallery (porous



Santa Cruz River near Canoa, just south of Green Valley.

ceramic or cement pipes buried in the river bed beneath surface water that collects and conducts water by gravity to Nogales) located between San Lazaro and Paredes, three deep wells at Santa Barbara, and six shallow wells just south of the U.S./Mexico border. The other 55% of Nogales, Sonora's water comes from a well field at Los Alisos (40-45%) in the Río Magdallena Basin, and from about 18 urban wells along Nogales Wash (10-15%).

Ranching from the U.S./Mexico border to Calabazas is encountering pressures from land development, and there is no longer perennial flow in the river. The City of Nogales, Arizona is extracting groundwater for municipal and industrial use. About 50% of the groundwater comes from the Santa Cruz River near Kino

Springs, and the other 50% from the deeper Potrero Creek aquifer to the northwest of Nogales. The city has also bought some of the larger ranches, or their groundwater rights, for growing water needs, and is developing a new Guevavi well field between Kino Springs and the Nogales Wastewater Treatment Plant at Calabazas. The water stressed riparian cottonwoods along this reach of the river and the one south of it in Sonora, are experiencing an infestation of the cottonwood borer beetle (*Lochmaeocles marmoratus*).

Along the Calabazas to Canoa reach, effluent water from the Nogales International Treatment Plant provides perennial surface flow and recharge for the aquifer. Because of the predictable effluent, there is



The Santa Cruz River from "A" Mountain.

today more water in this reach of the river than there was historically. Here ranching and farming are still practiced. The lushest riparian vegetation on the U.S. side of the border, with giant cottonwood and willow trees, occurs in the Tumacácori area.

In the Green Valley/Sahuarita reach, effluent perennial surface flow disappears into the Tucson Basin at or before Canoa. Pecan orchards and three copper mines, one now closed, are supported by deep well, large-volume pumps. Water demand to support rapidly growing development in this region is creating heavy pressure on groundwater supplies.

The San Xavier District of the Tohono O'odham Nation is experiencing a resurgence of interest in and work on the river, including riparian restoration, creative bank stabilization work, and reoccupation of long-abandoned farm fields. The district has access to CAP water.

The Tucson reach is challenged by loss of historic riparian habitat and natural perennial flow, and by massive municipal and industrial water demands. Along the main channel are sand and gravel mines, and sections have been stabilized by soil cementation. Releases of effluent from Pima County's regional wastewater treatment plants are supporting new riparian vegetation and restoration in the river north of Roger Road (because of the effluent, this reach is today perennial, while historically it was ephemeral).

In the Marana reach, which is extremely vulnerable to flooding, agriculture dominates water use. Effluent flow continues north through this area, and is being used for riparian restoration projects along the river. **S**



The Santa Cruz River in the Tohono O'odham Reservation.

El Río Santa Cruz:

Nations,

Communities

River's Future

From Tubac north to the Gila River, little remains of the once-magnificent cottonwood and mesquite *bosques*, or forests, along the Santa Cruz River. Bare banks and concrete have replaced them. This river is in danger of dying, yet it is the heart of one of the most ecologically important regions in North America, according to the Commission for Environmental Cooperation, which also designated this corridor linking the Mexican Sierra Madre with the Rocky Mountains as among the most threatened. More than eighty percent of Arizona's vertebrate species make their home in river habitats, or riparian corridors, including the Santa Cruz. Of the state's threatened and endangered species, more than sixty percent live in these critical waterways.

Luther Propst

Executive Director, Sonoran Institute



Brian Anderson

Aerial view of Tumacácori NHP and the Santa Cruz River.



Joaquín Murrieta

The Los Yaquis tributary pictured above provide intermittent water to the Santa Cruz.

The greatest challenge to the Santa Cruz River comes in reconciling ever increasing demands placed on the water supply from growing human presence in the region with protecting the wildlife and ecological values of this riparian corridor. Population pressures are enormous: the border cities of Nogales, Sonora and Nogales, Arizona have more than doubled in population since 1980. In the U.S., Santa Cruz County experienced the sixth highest growth rate of all counties in the state of Arizona. Pima County's growth rate is twice that of the national average.

With the delivery of Colorado River water to Tucson in 1992, the city of Tucson is no longer entirely dependent on groundwater; however, pressures on the water supply continue to increase. While this added inflow of CAP water will allow the city to grow, it has also delayed the inevitable future reality of a water shortage once the population and resource needs of Santa Cruz and Pima Counties outgrow the water supply.

Thus, we are at a fork in the road with two possible futures for the Santa Cruz River. We could choose a future based on status quo, in which the river continues to degrade under increasing population and water-use pressures. Or, we could choose a future where community-based conservation efforts protect healthy landscapes, support vibrant economies, and promote livable communities along the Santa Cruz.

There is hope. The people who have lived for generations along the Santa Cruz, and new residents, are beginning to work together with diverse groups to make their shared vision a reality: a healthy river that supports

thriving human and natural communities—now and for future generations. Several communities in particular are becoming models of river stewardship by working with scientists and other conservation partners to monitor river health, restore its habitats, and reach beyond their own regions to educate all people about its importance and need for conservation.



Joaquín Murrieta

Rancher-to-rancher exchange on building gabions for erosion control.

San Lazaro, Sonora

On its journey in Sonora, Mexico, the Río Santa Cruz flows through several *ejidos* or rural communities. However, daily conversations focus on families, weather, condition of grasslands, cattle herds, and crops. People depend heavily on the natural condition of the river, which flows continuously from the San Rafael Valley (Arizona) to San Lazaro and supports forests of cottonwoods and willows, as well as native fish and many breeding birds.

In 2000 the Sonoran Institute worked with the people of the San Lázaro *ejido* to launch their Community Conservation Center (CCC). The CCC depends on community participation and applied science to protect and restore the Santa Cruz. By involving residents in conservation activities like water quality monitoring, the first Santa Cruz River Sonoran bird survey, river habitat restoration, and sustainable ranching practices, local people have seen their actions directly benefit the natural environment and address their community well-being.

Perhaps the most surprising and dedicated conservationists in San Lázaro are the ranchers. By working together with the CCC, local ranchers are improving their livestock operations by reducing soil erosion and improving river water retention—both of which increase the amount of grasses for grazing. Put simply, these

ranchers have learned that improved water conditions, vegetation cover, and riparian restoration are good for the environment and for forage; and fatter, healthier cattle are good for the ranchers' business. This encourages ranchers to get involved in efforts that reduce soil erosion and protect cultivated land by re-establishing river habitat. The CCC, in collaboration with conservation groups, local authorities, and Mexican institutions like University of Sonora, continue to initiate community projects to protect the health of the Santa Cruz River, where the water still flows plentifully.



Steve Phillips

Tumacácori, Arizona

The successful, community-based approach to conservation in San Lazaro has encouraged similar restoration activities along the U.S. stretch of the river. The historic mission village of Tumacácori is nestled in the mesquites and cottonwoods of the Santa Cruz. A hub of river life since the 1600s, with the establishment of the Jesuit mission of the same name, Tumacácori remains a center for river stewardship today. Tumacácori National Historical Park staff coordinate with local scientists, community members, students, and groups such as the Sonoran Institute, the Arizona-Sonora Desert Museum, and Friends of the Santa Cruz River in Tubac to maintain active and regular water quality and animal monitoring programs. A National Park Service-Desert Museum partner project is locating original fruit trees planted by Father Kino in the region in order to reestablish historically accurate orchards at Tumacácori.

With strong local support, on January 23, 2002, Congress passed the Tumacácori NHP Boundary Revision Act (HR 2234). This Act expanded the boundaries of the Park to protect nearly 310 acres, including a 14-acre reserve along the Santa Cruz River. In addition, the Park has developed a teachers' guide highlighting the convergence of various cultures along the Santa Cruz River and their resulting impact on the river ecosystem. This nine-unit curriculum includes activities relating to the cultural and environmental history of southern Arizona. Combined, these monitoring and educational programs teach the historical importance of the river as it applies to the ecological health of the river today and in the future.

To foster cross-border conservation and secure the river for the next generation, partners from Tumacácori National Historical Park and the CCC at San Lázaro are bringing youth from San Lázaro to the park to learn what scientists and other students are studying in Arizona. Youth from the U.S. then travel to San Lázaro to visit the CCC and learn about the Santa Cruz River in Mexico. In this way, the past, present, and future of the river are linked not only to its communities, but also to its conservation.



San Xavier District of the Tohono O'odham Nation

A team composed of restoration ecologists, the Sonoran Institute, Tucson Audubon Society, and U.S. Fish and Wildlife Service is collaborating with the San Xavier District of the Tohono O'odham Nation on a pilot river habitat



Tucson Audubon Society's habitat restoration work, along with naturally emerging willows and cottonwoods, is improving wildlife habitat along the effluent-dominated Santa Cruz River northwest of Marana (Trico Road visible to the right). The survival and growth of plantings is enhanced by rainwater harvesting features such as basins and swales, which capture rainwater from the slopes and allow it to infiltrate around the roots of shrubs and trees. In this aerial image, planting basins can be seen on sloping berms on both the north and south sides of the river. Rupp Aerial Photography, Inc., courtesy of the Tucson Audubon Society.

restoration project. The 1.5-mile river restoration site, near the San Xavier Mission, focuses on the revegetation of 12 acres, including re-created wetlands, in order to simulate a riparian habitat similar to the one that once lined the banks of the Santa Cruz in this area. By creating a historically and biologically significant area, tribal members are establishing streamside locations that are culturally and aesthetically valuable to the Tohono O'odham Nation and its people—a place where tribal members can participate in the restoration and management of a desert riparian system. The site will also revitalize habitat for bird species traveling along their north-south migration routes.

A few miles north of the San Xavier restoration site is the City of Tucson's downtown revitalization project, Río Nuevo, meaning "New River"—a model for urban river restoration. Like many western towns, Tucson has grown tremendously in the last several decades and much of the resulting development has disturbed sensitive resources like the Santa Cruz River. New growth often lacks a connection with its natural surroundings, and can sometimes go as far as obliterating any presence of the resource, as in the east branch of the Santa Cruz along

the base of Sentinel Peak, known as "A" Mountain. To give both long-time residents and newcomers a "sense of place" along the Santa Cruz, the Río Nuevo project includes river habitat restoration, walking trails, parks, and low-intensity redevelopment along the river banks. This ambitious and visionary project provides a unique opportunity to promote new techniques of riparian resource management side by side with human needs, giving a new generation of people ties to the river.

Many other community stewardship projects are revitalizing the Santa Cruz River: Paseo de las Iglesias, Christopher Columbus Park, Cortaro Mesquite Bosque, and Tres Ríos del Norte. Partners on these diverse projects include Pima County, the Army Corps of Engineers, the Town of Marana, the City of Tucson, Tucson Audubon Society, and hundreds of citizen volunteers. Nearly at the end of the Santa Cruz River's run, the Audubon restoration project, Simpson Farm, comprises a 1,700 acre site on retired riverside farmland. In addition to replantings, the project includes a bird monitoring program that shares information with the communities of Tumacácori and San Lázaro, as the many efforts to protect and restore the Santa Cruz River continue to stream together.



Tucson Audubon Society

Profuse growth of Goodding's willows along the Santa Cruz River immediately west of Trico Road provides improved wildlife habitat.



ne River's Future

In these times of economic uncertainty, with a growing loss of our traditional attachment to our lands and waterways, and endless assaults on the environment, it sometimes seems like there is little chance of achieving meaningful conservation. But in the communities of the Santa Cruz River, where diverse people have come together to achieve their conservation goals, there is much hope. Habitat is being restored; water quality is being monitored; wildlife is being protected; and communities are thriving.

What form the river will take in ten, 50, or 100 years is tied to how we collaborate to preserve and protect the Santa Cruz today. Together, people from many nations, cultures, and languages can restore one of the Southwest's last great treasures—the diverse, yet united, people of the Santa Cruz River. **S**

Los Halcones at the Arizona-Sonora Desert Museum, February 2003.

Los Halcones

Engaging local youth in the science of birding



Joaquin Marrizuela

The Community Center for Conservation of the Santa Cruz River, established by the Sonoran Institute, is located in San Lázaro, Sonora, Mexico. The Community Center engages local residents in conservation activities, including water quality monitoring programs and sustainable ranching. Through the Center, the Sonoran Institute coordinates an

environmental education program with the local middle school, integrating science and community outreach. The Center assisted several young adults in developing a bird monitoring group called "Los Halcones," or "the Falcons." A group of students has become active participants in the different research activities and communicate their findings to the broader community. Fourteen-year-old Lalo Luzania from Los Halcones is an expert birder thanks to the involvement of scientists working on this project.

The first bird survey of the Santa Cruz River in Sonora, Mexico was completed in 2001, and used the services of professional scientists and Los Halcones. Using the point count method, a total of 176 bird species were detected during the first year of the survey. Los Halcones have become such expert birders that they identified two bird species (Harris's Hawk and Costas Hummingbird) that scientists had never before seen in the Mexican stretch of the Santa Cruz watershed.

In 2002 Los Halcones member Lalo Luzania participated in an international conference, *Partners in Flight*, on birding in North America. The children have taken field trips across the border to learn more about conservation and river restoration.

In 2003 the group visited with the Tucson Audubon Society and participated in a Santa Cruz project along the Tohono O'odham section of the River. By involving young people, the future holds promise for a more sustainable river and working landscape along the Santa Cruz watershed. Los Halcones offer a vision of how the Santa Cruz River can bring people together to accomplish a shared vision for conservation in their community.

Chronology of Natural & Cultural Events on the Santa Cruz River



B.C.

11,000

Paleoindian hunters cross the Tucson Basin in search of mammoths and other now-extinct large mammals under a generally cool and wet climate at the end of the Ice Age.

9500

The earth's climate becomes warmer. In southern Arizona, bison continue to be hunted by Paleoindians while a new hunting and gathering (Archaic) adaptation develops.

2100

Maize (corn) arrives in southern Arizona from Mexico. Part-time farmers settle along the Santa Cruz River and make the first ceramic figurines and pottery in the Southwest.

1200

Farmers in early villages along the Santa Cruz River build the first canals in North America. They cultivate maize, squash, and possibly beans and cotton, and trade with distant regions.

A.D.

550

Styles of architecture, artifacts, and burial practices of the Hohokam culture, centered in the Phoenix Basin, appear in the Santa Cruz Valley. Plazas become central features of villages.

800

Mesoamerican-style ballcourts are built, and Hohokam styles from the middle Gila Valley are adopted. The Trincheras culture in Sonora begins to influence the upper Santa Cruz Valley.

1400s

The Hohokam culture collapses after a population decline due to malnutrition, droughts, and floods that destroy canals in the Phoenix Basin. The Trincheras culture also begins to fade.

1680s

Spaniards visit the present Santa Cruz watershed in the area they call the *Pimería Alta* (Land of the Upper Pimas), name the river *Río Santa María Suamca* (present Santa Cruz River) and establish a livestock ranch at San Lázaro.

1692-1701

Father Eusebio Francisco Kino, S. J. and other Jesuits establish missions at Sobaipuri villages along the river, with a *cabecera* (headquarters) at Santa María Suamca (Santa Cruz, Sonora), missions at Guevavi and *Bac*, and a *visita* (visiting station) at San Cosme de Tjuk-shon (Tucson).

1751

Pima uprising led by Luis Oacpicagigua of Saric causes wide unrest and leads to establishment of a *presidio* (military garrison) at Tubac.

1767

Jesuits expelled from New Spain, replaced by Franciscans, who begin major construction projects and expand farming at the Santa Cruz missions.

1775

General Hugo O'Connor orders transfer of Tubac garrison to Tucson. Tucson becomes northernmost presidio in Apacheria. Spanish settlement develops near the presidio. *Manso* (peaceful) Apaches settle in the Tucson *establecimiento de paz* (peace settlement) in 1793 and 1819.

1787

Presidio of Santa Cruz is moved from Las Nutrias on the San Pedro River to the former mission and village at Santa María Suamca, which is renamed Santa Cruz. The river gradually takes on the name of the presidio, becoming *Río Santa Cruz*.

1821

Mexico achieves independence from Spain. Mexican government issues land grants for cattle ranches on or near the Santa Cruz at San Rafael de la Zanja, Buenavista, Los Nogales de Elías, La Canoa, El Sopori.

1840s & 1850s

Americans travel to California by way of the Santa Cruz River as members of the Mormon Battalion (1846) or as Gold Rush Argonauts (1849-50) and write descriptions of the Santa Cruz. The 1854 Gadsden Purchase incorporates the area of Sonora between the Gila River and the present international boundary into the United States. Tucson becomes the largest town in the watershed, with a population of 3,000 by 1870.

1881

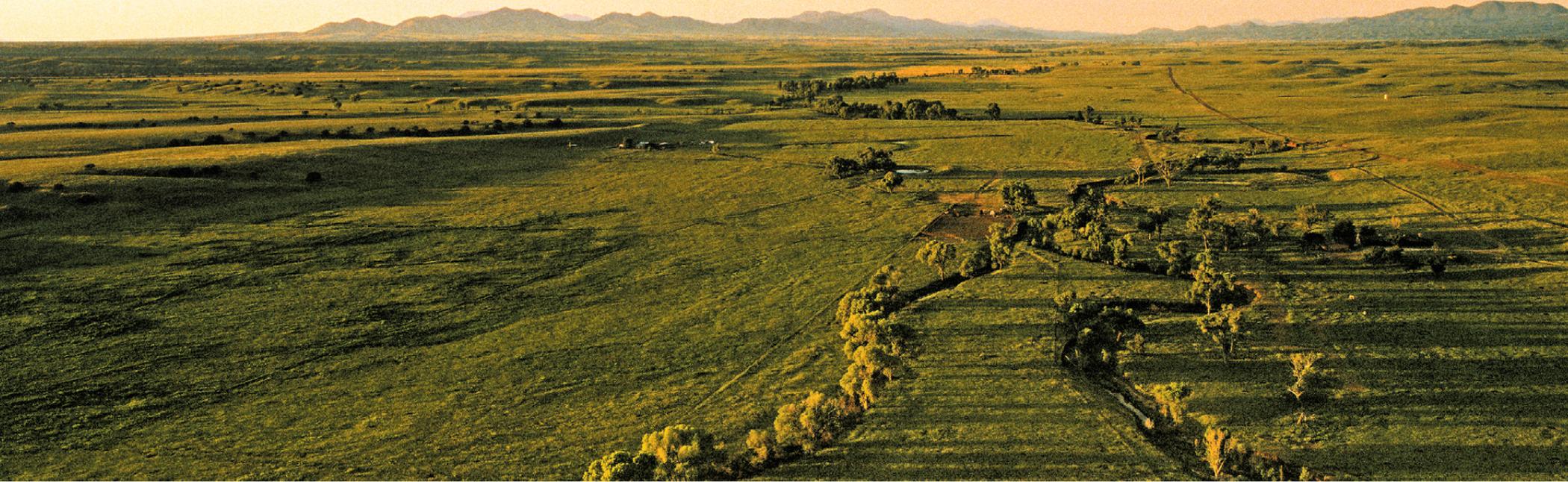
Southern Pacific Railroad completed across southern Arizona, facilitating a major cattle boom. Increased irrigated farming and woodcutting contribute to the degradation of Santa Cruz River, with major destructive floods in 1890-91.

Late-1940s

Post World War II military and air conditioning population boom begins along the Santa Cruz. Groundwater table begins on-going depletion.

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Arizona-Sonora Desert Museum



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