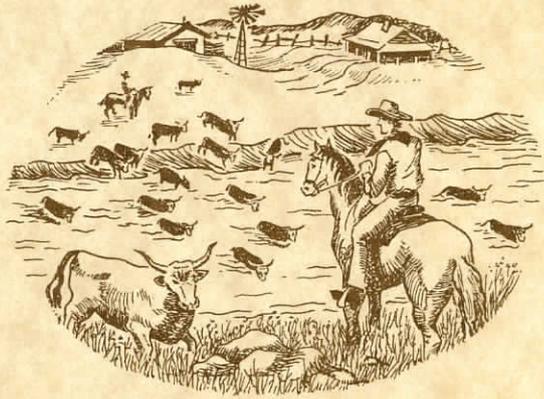


ARIZONA'S CHANGING RIVERS:

HOW PEOPLE HAVE AFFECTED THE RIVERS

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Barbara Tellman
Richard Yarde
Mary G. Wallace

Water Resources Research Center
College of Agriculture
The University of Arizona
March 1997

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Some Suggestions for Reading this Book

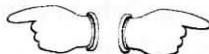
This book is organized unlike other books about rivers. Even the Table of Contents looks different. Rivers are interrelated into the lives of people and wildlife. Historical events are related to other events and many kinds of activities affected more than one river. For these reasons, the book is organized into history chapters alternating with chapters about specific rivers. The history chapters contain information needed to understand impacts on the rivers. They are not intended as a thorough history of the state. The river chapters contain information specific to each river, with frequent references to the history chapters for information common to several rivers. Short feature sections contain information on specific common topics. We have attempted to avoid technical terms, but those that are used are defined in the glossary. Similarly, we have used common names for plants and animals. Readers interested in the scientific names will find those in a special section of the glossary.

*The chapters are designed so that readers can start almost anywhere in the book and read chapters without having to read what went before. As you read the chapters, you will find a pointing hand symbol at the bottom of the page pointing to related materials on other pages. You will also find a hand symbol with an *M* inside that indicates that a relevant map is located on the page indicated.*

Some readers may prefer to read the chapters in a different order than we have presented them. People knowledgeable about Arizona history can start with the river chapters, while those with little historical background may wish to read all the history chapters before the river chapters. Readers primarily interested in a specific part of the state or a specific topic can start with those chapters.

While this format may appear confusing at first, we hope it will serve to make the reader aware of how, as the Navajos say, everything is related to something else— or as Norman Maclean said "All things flow into one and a river runs through it."

Related information symbols



Map symbol



San Pedro River

The San Pedro River is one of the longest undammed rivers in the Southwest. It has high value for migratory and resident wildlife as well as recreation. Its colorful history includes many boom-and-bust mining towns, ranching, farming, and the development of urban areas and military bases.

The River

The San Pedro watershed extends over 4,487 square miles and includes two main tributaries—the Babocomari River in the upper basin and Aravaipa Creek in the lower basin. The main stem of the river is about 193 miles long, from its headwaters in Mexico to its confluence with the Gila River.

The San Pedro River is surrounded by mountains ranging from 1,920 to 9,000 feet elevation. About 33 square miles of riparian habitat are found along the river and its tributaries.

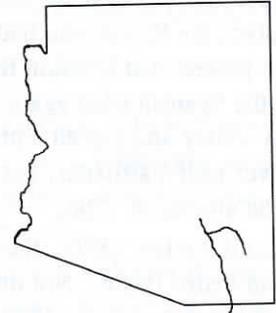
Early Inhabitants

The San Pedro Valley has been inhabited for at least 12,000 years. The earliest people hunted mammoths and other animals and harvested plants. By 500 A.D. people were irrigating crops near the mouths of major tributaries. Population expanded between 850 and

“... the Rio San Pedro it affords plenty good running water and runs north emptying I suppose into the Gila and seems to a bound with plenty of Fish. Our course was now down this River and quite a lot of salmon trout was taken, bands of wild horses were seen as also antelope and wild cattle. ... On the 11th of December while marching down the San Pedro a number of wild cattle I believe mostly bulls came running from the west and ran through our ranks plunging their horns into two team mules goaring them to death instantly and running over men.” Philip St. George Cooke, 1846.

1000, but by 1200 the civilization was in decline and by 1400 the villages were abandoned.

When Spaniards arrived in the sixteenth century, as many as 2,000 Sobaipuri lived in the area. They said they knew nothing about the previous occupants. Some consider the Sobaipuri to be ancestors of the Pima and Papago Indians. Apaches arrived in the area about the same time as the Spanish. Frequent conflicts arose among these three groups of people.



Spanish-Mexican Period

The San Pedro River has long been an important transportation corridor. Friar Marcos De Niza probably was the first European to pass through the valley in 1539 while seeking the “Seven Cities of Cibola.” Francisco de Coronado brought over 300 Spaniards, 1,000 Indians, and 1,500 horses and pack animals through the valley in 1539-1540. Father Kino also came several times between 1691 and 1702, trying to establish missions and to introduce European livestock and crops. He noted that the Sobaipuri villages used irrigation to grow corn, beans, cotton and squash as well as peaches and other European crops, but that they moved often, probably because of Apache attacks.

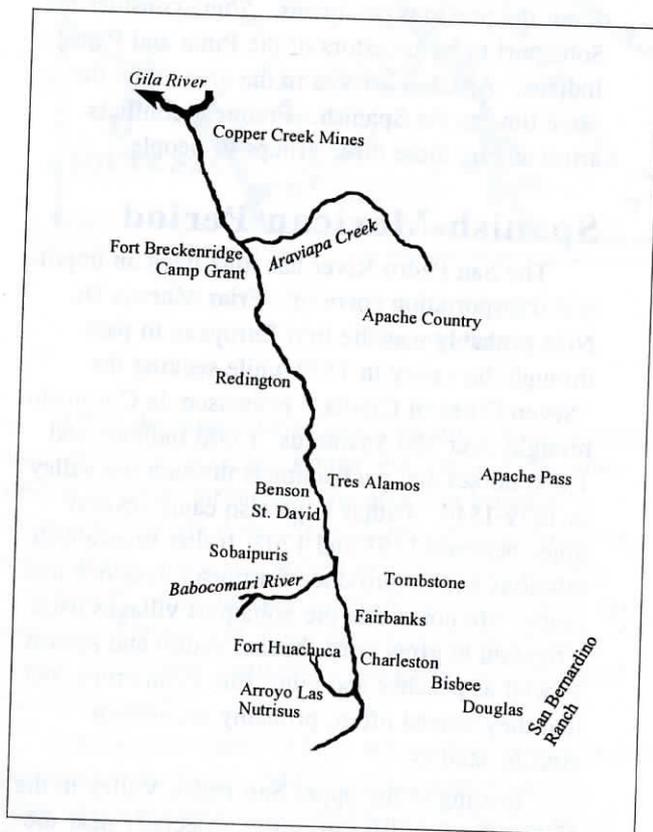
Settling in the upper San Pedro Valley in the 1700s, the Spanish ran cattle, especially near the headwaters. Because of Apache raids between 1700 and 1830, cattle numbers fluctuated. By



1710, the Apache controlled land and water use in the San Pedro Basin. By 1736, many of the Spanish ranches were abandoned.

The Apaches also forced the Sobaipuris out of the area, putting an end to most agricultural activities. A Spanish military escort moved about 250 Sobaipuri Indians from the San Pedro Valley to the Guevavi Mission near the Santa Cruz River in 1762 to replace the Pimas who had died from epidemics and to protect that Mission from Apache attacks. In 1775 the Spanish tried again to settle the upper San Pedro Valley and placed a presidio on the west bank of the river near Fairbanks, but were driven out by Apache attacks in 1780.

Until the late 1870s, the Apaches controlled most of the San Pedro Basin. Not until the Indian wars and capture of Geronimo in 1886 was Apache control over the area broken.



Historic sites along the San Pedro River.

"In the gorge below (Tres Alamos) and in some of the meadows, the stream [bed] approaches more nearly the surface [of the floodplain], and often spreads itself on a wide area, producing a dense growth of cotton-wood, willows and underbrush, which forced us to ascend and cross the out-jutting terraces. The flow of water, however, is not continuous. One or two localities were observed where it entirely disappeared, but to rise again a few miles distant, clear and limpid." J.G. Parke, 1854.

Early American Explorers

The Patties, who trapped beaver along the San Pedro River in 1826, called it the "Beaver River" because the animals were so plentiful. Beaver dams formed a series of pools and grassy marshes. Pattie described the river: "Its banks are still plentifully timbered with cottonwood and willow. The bottoms on each side afford a fine soil for cultivation. From these bottoms the hills rise to an enormous height, and their summits are covered with perpetual snow."

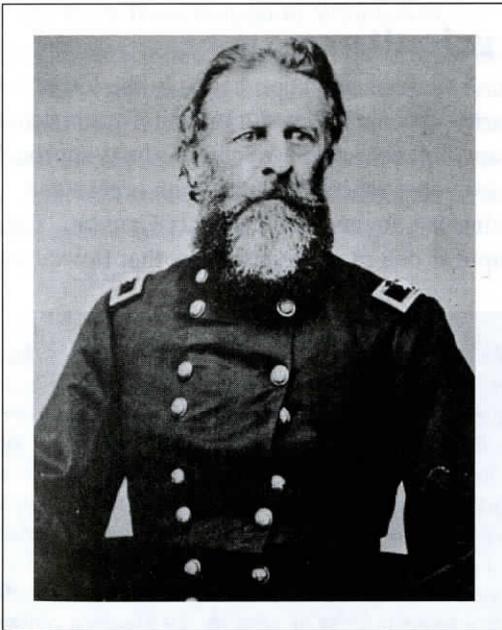
The first "official" exploration of the area was conducted by the Mormon Battalion in 1846. Their leader, Philip St. George Cooke, left us some of the best early descriptions of the San Pedro. He described the San Pedro as a "marshy bottom with plenty of water and grass" and as "a beautiful little river" with an abundance of fine fish, which they caught. One type that grew up to three feet long was called "salmon trout." These were almost certainly Colorado squawfish. Some areas were dominated by cottonwood or ash forests. Cooke wrote, "In those days the grass grew so tall that one could see only the herds of antelopes that roamed over the valley in large herds." Cooke, the leader of the battalion, feared attacks by cattle even more than by Apaches.

Cooke was followed by other explorers—some searching for riches such as gold in California, some escaping religious persecution, and others beginning a new life on the Western frontier. Asa Clarke, who explored much of the valley in the 1850s, reported a gun battle with a grizzly

bear and, when he replenished his canteen from an old irrigation ditch, also noted that the valley had been farmed, but abandoned. He said trees were "becoming common on the river; its direction is indicated by them for a long distance. They are principally cottonwoods, with some sycamore, willow, and mesquite."

After the Gadsden Purchase, many more people arrived. Routes were laid out for stage coaches and later, railroads. In 1854, J.G. Parke led a surveying party along the Gila River to Tucson and then to the San Pedro River. At the site of present-day Benson, he reported "... the stream is about eighteen inches deep and twelve feet wide, and flows with a rapid current, at about twelve feet below the surfaces of its banks, which are nearly vertical, and of a treacherous miry soil, rendering it extremely difficult to approach the water, now muddy and forbidding. ..."

Also In 1854, James G. Bell traveled the San Pedro en route to California. When he reached the San Pedro he "found plenty of water." Traveling up the river, he described the San Pedro as the "most hospitable place" he had seen since San Antonio. He noted: "The valley through which the San Pedro passes is a



Philip St. George Cooke.

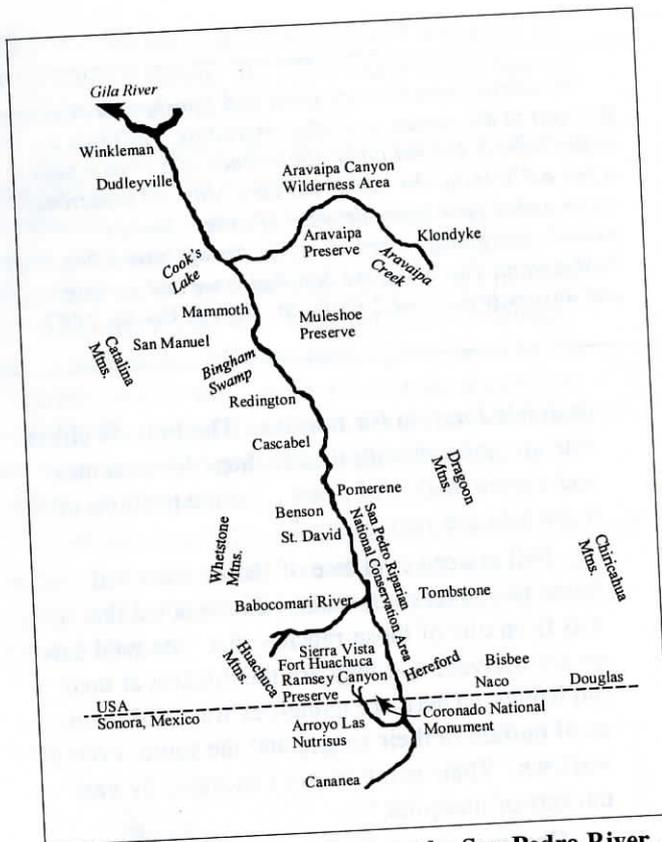
"My anxiety became very great and I pushed on at a fast gait to the guides, and after ascending a hill saw a valley indeed, but not other appearance of a stream than a few ash trees in the midst; but they, with the numerous cattle paths, gave every promise of water. On we pushed, and finally, when twenty paces off, saw a fine bold stream! There was the San Pedro we had so long and anxiously pursued." Philip St. George Cooke, 1847.

desirable location for ranches. The hills on either side are covered with timber, huge loose stones and a good quality of grass ... some portions of these hills are very pretty."

Bell noticed evidence of Indian wars and found two ranches in ruins. Cooke noted that it was from one of those ranches that "the wild cattle are derived, and they are the thickest at their old haunts. There are numerous traces of them, as of buffalo in their range; and the same, even to wallows. Their numbers are concealed by vast thickets of mesquite."

Construction of the first major road to cross Arizona, from El Paso to Ft. Yuma, began in 1858. The road followed the San Pedro River from the Dragoon Mountains to the mouth of Aravaipa Creek, where the road forded the river and headed towards the Gila River.

The flow of the river was unpredictable, with travelers placing bets on whether or not the stream would be flowing about 35 miles north of Tres Alamos. "Exceedingly to the surprise of every member of the expedition who had passed over this route in the months of March and April it was discovered after a march of a few miles that the waters of the San Pedro had entirely disappeared from the channel of the stream. ... So incredulous were many of those who were on the April Expedition that heavy bets were offered that Col M. was mistaken. A thorough examination proved his discovery correct much to the astonishment of many. Where the present reporter took quantities of fine trout in March and April 1858 not a drop of water was to be seen."



Twentieth century sites along the San Pedro River.

American Settlement

In the 1860s, the San Pedro Stagecoach Crossing near present-day Benson, was one of the first signs of the coming American settlement in the area. Grain for the station was grown at a small Mexican settlement on the river, nine miles below the station. Floods destroyed the stage station and a bridge at present-day Benson in 1883-1884.

Homesteading began in the upper San Pedro Valley in 1867, but early American settlement, like Spanish and Sobaipuri settlement, was marked by short periods of peace followed by abandonment due to Apache raids.

Military posts established after the Gadsden Purchase were quickly abandoned during the Civil War, leaving settlers unprotected. Fort Breckenridge (which became Fort Grant), at the confluence of Aravaipa Creek and the San Pedro River, was reestablished in 1862, as a base for fighting the Apaches. The Apaches were subdued after the Civil War and, in 1873, the Ara-

vaipa Apache were relocated to the San Carlos Indian Reservation, and Camp Grant was moved to Bonita, leaving the lower San Pedro without a military presence. A traveler in 1875 in the lower San Pedro Valley reported that "there was not a single resident. Only the ruins of former homes greeted the eye." However, in 1877-78, a steady stream of homesteaders began to move into the area, using water for irrigation, ranching and mining. Between 1878 and 1880 Benson, Hereford, Redington and St. David were established.

The arrival of the railroad in 1881 brought major changes to the entire area, linking it with California and the East Coast. Tracks also linked Benson with Guaymas, Mexico. Other routes were built later, to meet the needs of mining and ranching.

On May 3, 1887 a major earthquake struck the area, wreaking havoc as far north as the Gila River. The aftereffects were felt for weeks. Patterns of water flow changed. In some places, water spurted from fissures in the earth, and in others, spring-fed streams stopped flowing.

Agriculture

American irrigation began in the lower basin primarily to support Fort Grant and Tucson settlers. Many homesteads were located along approaches to canyons, especially those with creeks and spring-fed streams such as Carr Canyon. For example at one ranch five springs that flowed year

"The story of the farms was the saddest part of the history of the Lower San Pedro Valley. Once a hardy, ambitious, energetic class wrested many fertile acres from the mesquite and rocks. By 1904 the river had carved away the choice pieces of land. ... Ditches from the river were difficult to keep in place, and many an acre was allowed to grow into a mesquite thicket. Farmers found it easier to keep a few herd of cattle and forget about tilling the soil. ... Along the San Pedro where once, more than fifty fine farms were to be seen, by 1930 only a few remained, and they were fast deteriorating. ... The banks became higher thus making it more difficult to take water out of the river by the use of ditches." B.W. Muffley, 1937.

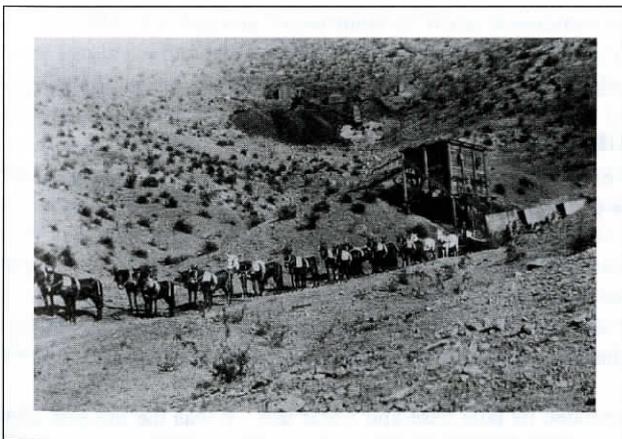
round provided water for a large swimming pond. Other homesteaders raised fresh fruits and vegetables, for their own use and for the growing Tucson market.

By 1899, 3,500 acres of land were under cultivation. Ten canals diverted irrigation water from the river. Ten years later there were four times as many canals, diverting more and more water. The first artesian well in Arizona was established in St. David in 1885, and irrigated agriculture soon expanded to 2,000 acres there. By 1903, there were more than 200 artesian wells between Benson and Fairbank.

Irrigated agriculture declined at in the lower basin around 1900. Much of this can be attributed to the problems in controlling the river. Today, alfalfa is grown on about 1,000 acres of land around St. David.

Agricultural activities in the upper basin also expanded during the end of the nineteenth century, with most of the irrigation and farming areas in the lower basin centered around Dudleyville. Until about 1890, Dudleyville was a prosperous town, with many of its residents engaged in cattle-raising and agricultural activities. By 1900, about 2,500 acres of land was being irrigated from Palominos to Winkleman, mostly from artesian water sources. Today alfalfa is still grown along the river from Benson to Winkleman.

Cattle were moved through Hereford for years. Huge herds were driven from Cananea to the railroad stockyards and shipped to California. The river from Charleston to Hereford was a haven for thieves who stole cattle and sold them across the border, stealing and selling Mexican herds on the way back.



Mules hauling ore near the San Pedro River.

"It was also during this time period that the Camp Grant Massacre occurred; Camp Grant was the site of a massacre of Apache Indian men, women and children in 1871 by a band of Anglos, Mexicans, and O'odham men, after livestock were stolen at San Xavier by Apaches. Over one hundred Aravaipai and Pinal Indians, over 90% of them women, were killed." Tom Sheridan, 1995.

Ranching

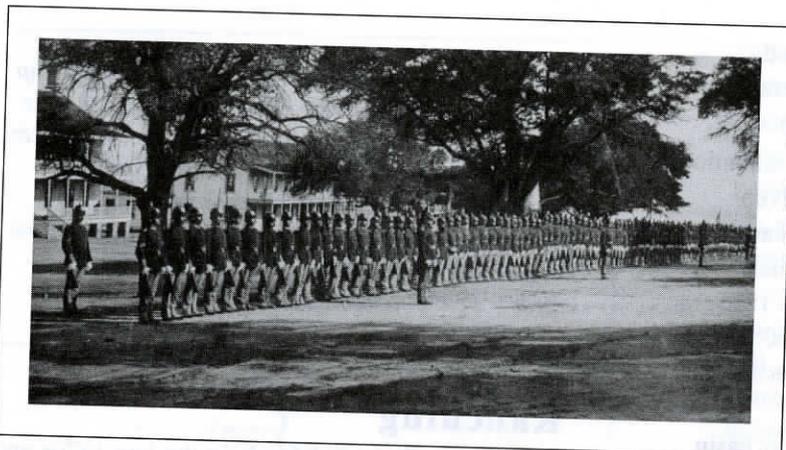
A drought in California in the late 1870s and the completion of the railroad, combined to bring an increase of sheep and cattle to the verdant grasslands of the San Pedro Valley. In 1879, one ranch just west of the Whetstone Mountains was reported to have 23,000 sheep. As ranching flourished during rainy years, overgrazing became a problem.

Small farms in the Redington area became consolidated into large ranch holdings. Droughts in Arizona in 1892-1893, 1895, and in later years, combined with overgrazing, resulted in the death of 50 to 75 percent of the livestock in Southern Arizona.

Overgrazing contributed to a cycle of erosion and channel-cutting. Droughts, followed by floods, also affected the river. Lands stripped of grasses and crisscrossed with cattle trails were subject to wind and water erosion. Grazing continues throughout the area today, but at much reduced levels.

Mining

Many "49ers" passed through the San Pedro Valley on their way to the California gold fields, with none known to stay. In 1863, silver was discovered at Copper Creek in the Galiuro Mountains. This started a boom period in the San Pedro Valley. Between 1887 and 1891 mines were established in Bisbee, Tombstone, Mammoth and San Manuel, across the border at Naco and Cananea, in Sonora at the headwaters of the San Pedro River and at six other places along the river.



Muster at Ft. Huachuca, 1887.

Tombstone was the most famous of these towns, both for its silver and for the many exciting stories it inspired. By the mid-1880s over 15,000 people moved into the community, hoping to get rich from the largest silver discovery ever made in Arizona. Nearly \$30 million worth of silver was mined between 1879 and 1886. Mill operations sprung up around the valley to process the ore.

Wood was needed for mining activities, and for personal heating and cooking. So much wood was cut that the area was denuded of trees, from mesquite bosques along the river to upland trees. After residents cut all the available trees near Tombstone, they went further afield to the Huachucas, Whetstones, and other mountains. The impact on the vegetation was immense. Tombstone alone is estimated to have used 120,000 to 130,000 cords between 1879 and 1886. If this wood were stacked four feet high in four-foot lengths it would reach almost 200 miles.

Ironically, the town that had to import water for domestic uses from the Huachuca Mountains fairly quickly "drowned" when groundwater flooded the major mines. Groundwater began flooding the silver mines in 1881.

Powerful pumps ran 24 hours a day to keep the groundwater at bay until a huge fire in 1886 burned down the pumps and other structures at the Grand Central Mine. Soon the "town too tough to die" came close to becoming a ghost town.

A good example of an Arizona town that lived and died by the vagaries of the mining industry was Charleston, now in ruins. Established in 1879 to mill ore from the Tombstone mines, it prospered for eight years until water flooded the mines. At its height, over 1,000 residents lived in the area.

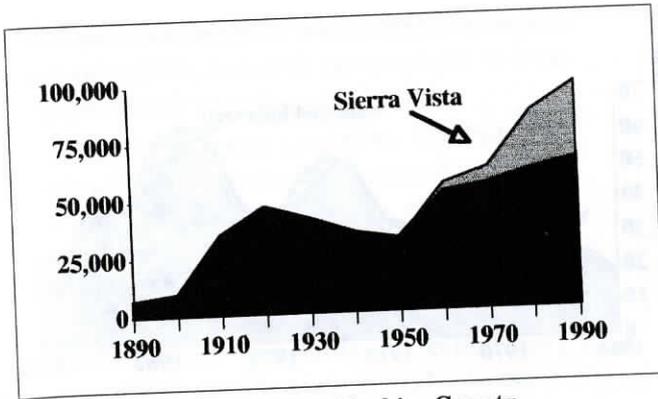
To supply water for the Charleston mill, a dam was constructed on the river. Water was led to the mill through a wooden flume. The surrounding area was virtually denuded of trees because of demand for construction and firewood. A 160 foot-long bridge was also constructed across the river in 1881 so that ore shipments would not be delayed by floods. The town, which lived by ore production, died when the Tombstone mines closed. Even the dam is now gone, although its site has been proposed several times during the twentieth century as a site for a dam.

Fort Huachuca

Fort Huachuca, one of the oldest active army bases in the Southwest, has a colorful history. It was established in 1877 to protect the settlers in southeastern Arizona. By 1920, it was the only remaining military outpost out of 70 cavalry posts established in the southwestern U.S.

The site for the fort was chosen largely because of the water supply, since natural springs in Huachuca Canyon could provide much of the water needed for the Fort. Selection of the mouth of the Huachuca Canyon for the camp site was based not only upon its elevation but upon the abundant supply of water, good grass and the presence of sheltering ridges overlooking the camp. Huge old cottonwoods and sycamores lined the creek, and the mountains were covered by dense forests of pine which supplied lumber for building.

During the twentieth century, Fort Huachuca gradually expanded its land base and water use. It was the nucleus around which Sierra Vista developed in the twentieth century.



Population in Cochise County.

In the lower basin, the Copper State Mining Company invested over one million dollars to develop mines along Copper Creek between 1908 and 1917. To supply water for the mine, a dam was constructed on Copper Creek. However, in 1917, a shortage of ore and "unsound business practices" closed the mine. In fact, most of the mining ceased during the early part of the century.

World War II caused a new demand for copper. Mining at Mammoth and Copper Creek again flourished. Since then, mines and a smelter have grown in San Manuel and Mammoth, as well as further north at Hayden and Winkleman along the Gila River. Huge tailings ponds mark the landscape near the San Pedro River at San Manuel.

Today, most of the mining in the basin is in the lower reach of the watershed, from north of Benson to Winkleman. The Magma Copper Company, which operates both an underground mine and an open pit mine, a smelter, and a refinery along the river in San Manuel, is the largest single water user in the San Pedro watershed. Its estimated annual usage is approximately 22,000 acre-feet.

Growth of Sierra Vista

Much of the upper basin settlement concentrated around Fort Huachuca, eventually giving birth first to a town named Fry and later known as Sierra Vista. Incorporated in 1956, Sierra Vista encompassed the communities known as Fry, White City, Hayes, Tanner Canyon, Overton, Buena, and Garden Canyon. The Sierra Vista area has become the largest user of municipal water supplies in the basin, with groundwater serving as the main water source, supplied by over a dozen small water companies. It is one of the fastest growing communities in the state because of its appeal as a military and retirement community. Sierra Vista is the largest town along the San Pedro River and has been growing rapidly since the 1970s, using increasing amounts of water. In 1994, a citizen group attempted to form a district

Riparian Vegetation Depends on Groundwater

In 1994, the Arizona Department of Water Resources examined what would happen to rivers like the San Pedro if groundwater levels declined as a result of pumping. Some species (such as willows) need to have their roots in the water most of the time, while others (such as mesquite) can send their roots deep to find water and can withstand some drought periods. The seeds of some species such as cottonwood, would have difficulty getting started if the water table dropped at all or if spring/summer floods did not occur.

Researchers looked at what would happen if the water table dropped three feet or six feet and found that a three-foot drop would eliminate the marshy species and a six-foot drop would prevent cottonwood and willow seedlings from sprouting. Mesquite and sacaton grass would occupy most of the floodplain, and most of the cottonwoods and willows would eventually die.

If pumping proceeds at the projected rate in the Sierra Vista area, they concluded that this would mean loss of 52 percent of the marsh vegetation, 42 percent of the cottonwood and willow seedlings, and 17 percent of the mature cottonwood-willow forest in ten to twenty years. Similar effects have already been experienced along the lower Santa Cruz River, the middle Gila River and other Arizona rivers, where even the deep-rooted mesquite died for lack of water.

to control groundwater pumping to protect river flow. This effort, however, was unsuccessful, and water use continues to increase.

Water Use

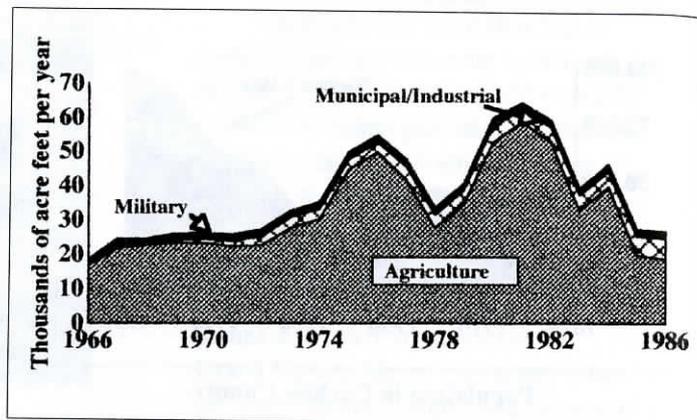
Historically, most of the water use in the basin was for agriculture and, during some periods, for mining. In the late twentieth century, however, much of the water used in the area is for Fort Huachuca and the rapidly growing Sierra Vista area. Most of the water used here is groundwater, but most of that groundwater is hydrologically connected to the river, so pumping affects river flows. Unlike Tucson where the water table has dropped so far that it is no longer connected to the river, the water table near Sierra Vista remains high enough to support riparian vegetation.

For a while, decreases in agricultural use made up for the increased urban use. Groundwater levels have been dropping at a rate of about 1.3 feet per year in recent years. This groundwater pumpage has created a "cone of depression" near the river, a low spot in the groundwater table. With such a cone, water that would naturally reach the river is intercepted so that the river receives less groundwater than in the past.

Wildlife

The San Pedro River supports growths of cottonwood forests, from its headwaters to St. David and also at various spots in the lower basin, especially beyond its confluence with Aravaipa Creek. A lush marsh near the confluence supports a wide range of wildlife, including many species of birds. The river has very little saltcedar compared with the Gila River. There may actually be more cottonwood trees along the river today than in the early 1800s, since cienegas which supported a different kind of wetland vegetation have disappeared. They have been replaced by cottonwood-willow forests and mesquite bosques. There are also more cottonwoods along the river today than at the heyday of woodcutting in the late nineteenth century.

The lower San Pedro River supports over 450 species of birds (two-thirds of all the bird species in North America), over 52 species of mammals, and 47 species of amphibians and reptiles. Fifty-five rare or endan-



Water use in the upper San Pedro Basin.

gered species live in the basin. The San Pedro River is one of the most important north-south bird migration routes in North America.

Grizzly bears, wolves, antelope, and beaver are gone from the region, although antelope have been reintroduced in the nearby Empire-Cienega area. The loss of predator species has led to increased damage of riparian areas by deer in some areas, and to an increase in rodents and rabbits and the animals that eat them. Loss of beaver has had the most direct effect on the river because their dams created marshy areas throughout the basin.

Another big change is the loss of many fish species. Colorado squawfish as long as three to five feet once were seen, but none of any size survive there today. Historically, at least 13 native fish species lived in the San Pedro River. Only the longfin dace and the desert sucker remain.

Preservation and Restoration

Efforts to conserve range and forest resources in the San Pedro basin began at the turn of the century. Forest reserves were created in the Huachuca, Dagoon, and Whetstone mountains. In the lower basin, the Nature Conservancy bought the Muleshoe Ranch, which it oversees in cooperation with the U.S. Forest Service and the U.S. Bureau of Land Management (BLM). They are working to restore landscapes previously damaged by overgrazing of cattle. The Nature Conservancy also manages Ramsey Canyon, where

perennial flow supports a wide diversity of plant and animal life, including many species of hummingbirds and an endangered frog.

In 1988 Congress created the San Pedro Riparian National Conservation Area (SPRNCA), the first of its kind in the nation, on an old Spanish land grant. BLM administers this 47,668-acre refuge along a 36-mile section of the river from the international border to about eight miles south of Benson, for wildlife and recreational purposes. Cattle have been removed from once heavily grazed riparian areas and off-road vehicle use is limited. Most importantly, the SPRNCA has retired some prior water rights in the area. Since establishment of the SPRNCA, vegetation has increased greatly, which has improved habitat. Many more birds now are seen than in the recent past.

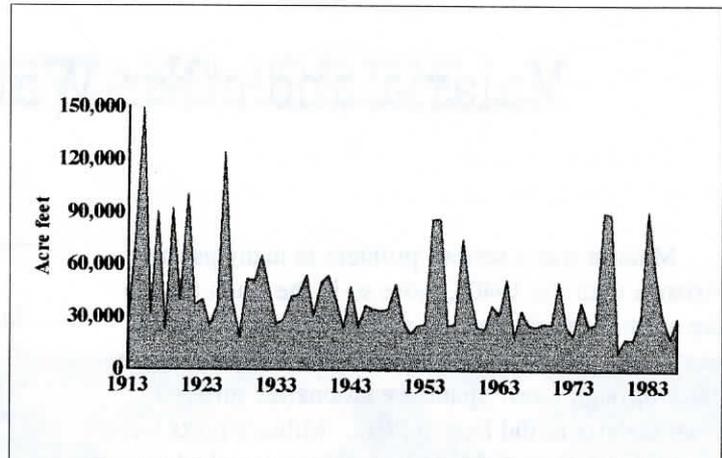
Pima County owns Bingham Swamp, near the San Pedro River about ten miles south of San Manuel. The Nature Conservancy operates this 300-acre preserve, which is open by appointment only, for Pima County.

Cook's Lake, a 270-acre wetland near the confluence of Aravaipa Creek and the San Pedro, is owned by the U.S. Bureau of Reclamation. One of only three wooded wetlands in Arizona, Cook's Lake has prime habitat for waterfowl and a variety of rare species. The Bureau purchased it from the ASARCO Mining Company in the 1990s as mitigation for damages to wetlands caused by modifications to Waddell and Camp Dyer dams on the Agua Fria River. As part of this project, ASARCO also is restoring 130 acres of abandoned farmland north of Cook's Lake to a mesquite bosque.

Changes in the River

In the 1800s the river was an irregularly flowing stream, marshy in places, free-flowing in others, and ephemeral in a number of stretches. The river and its tributaries wound sluggishly through grassy valleys dotted with cienegas and pools. One large cienega extended along the San Pedro from about modern-day Benson to the old site of Tres Alamos. Some areas were deeply entrenched.

Although the earthquake of 1887 affected the hydrology of the river, the most drastic changes



Annual flow of the San Pedro River at Charleston.

followed American settlement. Human activities have changed the river from a free-flowing stream with marshes and rich riparian vegetation to a stream with perennial flows in only portions of the river.

Beginning in the 1880s, the river began to change in response to increasing Anglo-American use of the land. The loss of the beaver, mining, overgrazing and woodcutting contributed to severe erosion and arroyo cutting. By 1912, most of the river below Redington was entrenched.

Surface water diversions, entrenchment, and groundwater pumping led to the disappearance of cienegas and surface flows. By the 1920s, most of the cienegas had dried up and were replaced by mesquite. Cienegas can still be seen today about ten miles south of San Manuel and on some tributaries. Only the section of the river from Hereford to Charleston remains perennial.

"I am a Missourian living far from the San Pedro River, but I believe this emerald strand, still strung precariously with the iridescence of hummingbird bellies and scintillance of clear waters and the glow of cactus blossoms, is something that does not belong to me although I belong to it: its beauty, its history, and most of all, its significance."
William Least Heat Moon, 1988.

Malaria and other Water-borne Diseases

Malaria was a serious problem in many parts of Arizona until the 1940s, more so in the south than in the north. Malaria-bearing mosquitoes breed in stagnant water, carrying the disease from one person to another through bites. Spanish missionaries suffered from malaria as did later settlers. Military posts were established near reliable sources of water, which often turned out to be the same water bodies that harbored mosquitoes. The cause of malaria was not known in the 1880s but one theory was that it was caused by the exhalations arising from swamps.

At Camp Grant at the mouth of Aravaipa Creek, each of the 215 men was hospitalized an average of ten times, nine of which were for malaria. Near Benson the Arizona Daily Star reported in 1879 that "[the San Pedro Valley] might well be called the valley of the shadow of death. Malarial fevers of the most malignant type are prevalent eight months of the year." Other diseases spread by mosquitoes in Arizona were dengue and yellow fever, neither of which are problems in Arizona today. Numerous swamps were drained to reduce these exhalations—and the problem was sometimes thereby solved.

By the 1930s few swamps remained—either because of deliberate draining or because the water supply had been diverted or pumped away. By then, the main

*The people here in Arizona
All look very pale and bony.
They shake and ache and burn and shiver
Up and Down the Gila River.
I'm freezing in the heat of day,
I feel like winter's here to stay.
I'm too cool for the month of June,
So bring me quinine and a spoon. ..."*
Old song, sung to the tune of Old Dan Tucker.

"Many Lagoons or slews were located along the Santa Cruz, two very large ones at Calabasas formed by the overflow of the Sonoita Creek and Santa Cruz, with others along the stream. The condition at Calabasas on account of this swampy land malaria was very bad and settlers suffered greatly with Chills and Fever and many were obliged to move away from that section." C.C. Wheeler, 1937, recalling earlier times.

breeding grounds for mosquitoes were man-made—drainage ditches, stock ponds, sewage disposal areas and long-standing puddles, especially in agricultural areas. Recommended control techniques included eliminating standing water, using DDT and other chemicals, pouring oil on standing water, and stocking ponds with the non-native mosquito fish.

By 1964 the fight accelerated. Big artillery was moved into the front line of the battle. Aircraft, tractors, bulldozers, trucks, and cars were used to carry the fight to the mosquito. Health authorities said that if the breeding areas were destroyed, half the battle would be won. The war on malaria eradicated the disease in Arizona. There are still mosquitoes that could carry malaria, but no infected humans to start the cycle.

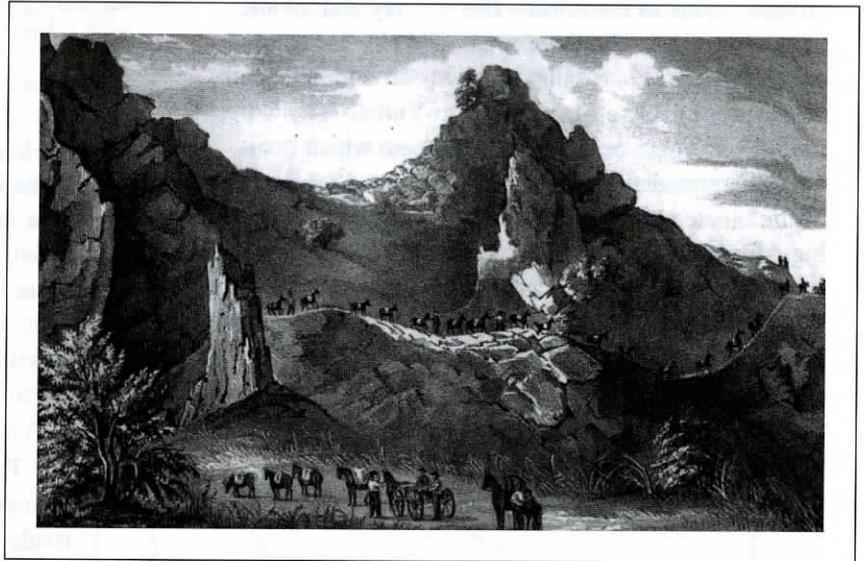
Another mosquito-borne disease, encephalitis, became a problem in the 1960s. Aerial flights mapped breeding sites and intense campaigns were waged. Again, the battle was successful. Mosquitoes are not considered a major health problem today, although they are still a nuisance. Many of the man-made breeding areas are better controlled and few swamps remain.

The long-term impacts resulted from draining of cienegas, and introduction of mosquito fish which invaded many of the streams to the detriment of native fish.

ANGLO-AMERICANS ARRIVE

The first Anglo-Americans to reach what eventually became Arizona were "mountain men" who came to trap beaver in the 1820s. James Ohio Pattie's company traveled down the Gila in 1824, collecting some 250 pelts. His journals provide much information about the period, although they contain obvious exaggerations. He returned in 1827, concentrating on the San Pedro and Colorado rivers, with a goal of "trapping the rivers clear," or getting all they could. Other trappers who explored Arizona's rivers at this time included Ewing Young in 1830, who sold 1,500 pelts in Santa Fe; Pauline Weaver, who returned as a guide in later years; William Wolfskill; and George Yount. Hat fashions changed from beaver to silk, and by the 1860s beaver populations had recovered on many of the rivers. Their numbers later were reduced again by other human activities, including overgrazing, urbanization and loss of water supplies in the rivers.

After most of present-day Arizona became part of the United States in 1848, more and more American travelers arrived. Many were just passing through on their



Surveyors' party exploring a tributary of the Gila River in 1848.

way to the California gold fields. The U.S.-Mexico boundary had to be surveyed, and wagon and later railroad routes had to be mapped. Whereas the Spanish routes tended to be north-south from Mexico, the new American routes most often were east-west, from the East Coast to California.

Travel Routes

Travel routes from the earliest historic times to the present tended to follow a few major routes, avoiding the very great barriers of the White Mountains, the Chiricahua Mountains, the Canyonlands of southern Utah and northern Arizona, and the Apaches. The Colorado River could be crossed in only a few places. Water was necessary, so travelers stayed within one or two days distance of drinking water. In Arizona, rivers

"The [Colorado at Yuma] river here is 170 yards in breadth, with a current of about 3 ½ miles an hour. It is crossed by means of a rope suspended from either bank—a mode of travel very disagreeable and somewhat dangerous. Capt. Thorn endeavoring to pass here ... on two log canoes lashed together, was upset, and together with three others, swept down on the current and drowned." Lorenzo Aldrich, 1849.

were important travel corridors, providing water and food for people and livestock. People ventured into rivers only to cross them, not to travel on them. Instead, they traveled along the river banks.

The Colorado River formed a barrier to exploration for most of its length in Arizona. Travel through the Grand Canyon by foot or mule was very difficult (although Indians had traveled there for centuries), and boat travel was risky. There were only two good crossing spots to the north—Lee's Ferry and another near what is now the Page area. There were about a dozen ferries and crossing locations around and south of the present Lake Mead down to Yuma. The Colorado River is the only Arizona river on which boats regularly traveled—and such travel ceased by the end of the nineteenth century, except for recreational boating. Even though travelers no longer are dependent on rivers for drinking water, many of today's major transportation routes, such as I-10, still follow the historic trails and roads.

To cross the state from the east in the nineteenth century, most travelers either followed the Gila River, entering Arizona about where I-10 is today, or they traveled south of the Chiricahua Mountains, crossing

The Great Surveys

Surveys to determine the boundary and to establish wagon roads and railroad routes produced a great deal of useful information about the territory and its vegetation and wildlife, as many of the survey teams included biologists. Captain Sitgreaves sought a road from Zuni to California in 1851. John Bartlett surveyed from southeastern Arizona to California in 1851 and 1852. Lt. Amiel Whipple surveyed for a transcontinental railroad in northern Arizona in 1853-54. At the same time Andrew Gray surveyed a railroad route along the Gila River.

In 1854-55 Lt. John Parke resurveyed the area along the eastern part of that route. When the U.S. became a territory Lt. Emory's survey in 1855 delineated the boundary. Joseph Ives, who had traveled earlier with Whipple, returned in 1858 to survey the lower Colorado River. In 1869, John Wesley Powell made the first of several investigations of the upper Colorado River. The most unusual survey was made by Edward Beale, who traversed northern Arizona in 1858 using a caravan of camels, to establish a wagon route.

"I with Samuel & James & My wife commenced to cork an old flat boat & by noon we were ready to cross [the Colorado River at Lees Ferry]. When we launched the Boat, My 2 sons hesitated to venture in such a craft. My wife ... Said that She would go over with Me & steer. Then we reached the opposite side, the [Navajos] Met us with open arms of Friendship. ... After Much difficulty we Succeeded in getting them & their luggage over safe. Next was their horses which we failed to swim over after 2 trials & nearly upsetting the Boat. ... Night fall closed the scene. For the last 3 hours I worked through fever and ague & when I reached the fire on shore I was so near exhausted that I Staggered. ..." [sic] John Lee, 1872.

the San Pedro River and then traveling up the Santa Cruz River. The southern route was longer than the northern route, but had the advantage of avoiding much of the Apache danger. A northern route left the New Mexico pueblos and met the Zuni and Little Colorado rivers, then headed west by either of several routes. Another route skirted Arizona, going through Utah and down along the Virgin and Colorado rivers.

Travelers adversely affected rivers on the more common trails. Wheeled vehicles rutted the roads, causing gullying and erosion. Firewood near the stopping places was gathered and trees were cut. Livestock trampled the shores at water holes and river crossings, especially when many animals traveled together. Livestock also ate whatever vegetation was available. This left the river vulnerable to erosion and more devastating floods.

In some areas so little vegetation was left near the trails that cattle starved. By the time travelers reached areas with vegetation, their livestock were ready to eat less palatable kinds of plants. When travelers were few and far between, or parties were small in number, the long-term impacts to rivers were small. On the more-traveled trails, however, the impacts could be significant, especially at major crossing points.

Stagecoach Routes

Stagecoach stops were located where there was adequate water and at comfortable distances for travelers and horses. All the stops across Ari-

"There was a big 7 steel-span bridge across the Gila River six miles up from San Carlos, but travelers from the East could not get up onto it and those from the West could not get off, because the Gila River's trenching had been to dig away the river bank on the east end of the bridge and to flow around it instead of under it." Apache Dancer, May 11, 1979.

zona on the Butterfield route were located by rivers, near springs or near lakes, except one where water had to be hauled in. The most famous stage station was at a spring at Apache Pass, a favorite watering source for Cochise as well as the travelers. The continual use of watercourses by livestock and people had an impact on those watercourses but after the stops were closed, the areas recovered and the long-term impacts were generally minor.

River Crossings

Most Arizona rivers were fordable during most of the year, but could become uncrossable raging torrents at other times. Only the Colorado River could seldom be forded and could be crossed at only a few spots. Enterprising pioneers set up ferry stations at the most desirable sites—Yuma, Lee's Ferry, and several others on the Colorado River, and Hayden's Ferry on the Salt River. Lee's Ferry in northern Arizona was the only feasible river crossing for hundreds of miles. The Yuma crossing was the most contested one, especially when travel to the California gold fields became popular. At least two pitched battles took place. Hayden's crossing over the Salt was principally needed only at flood time, but was essential then.

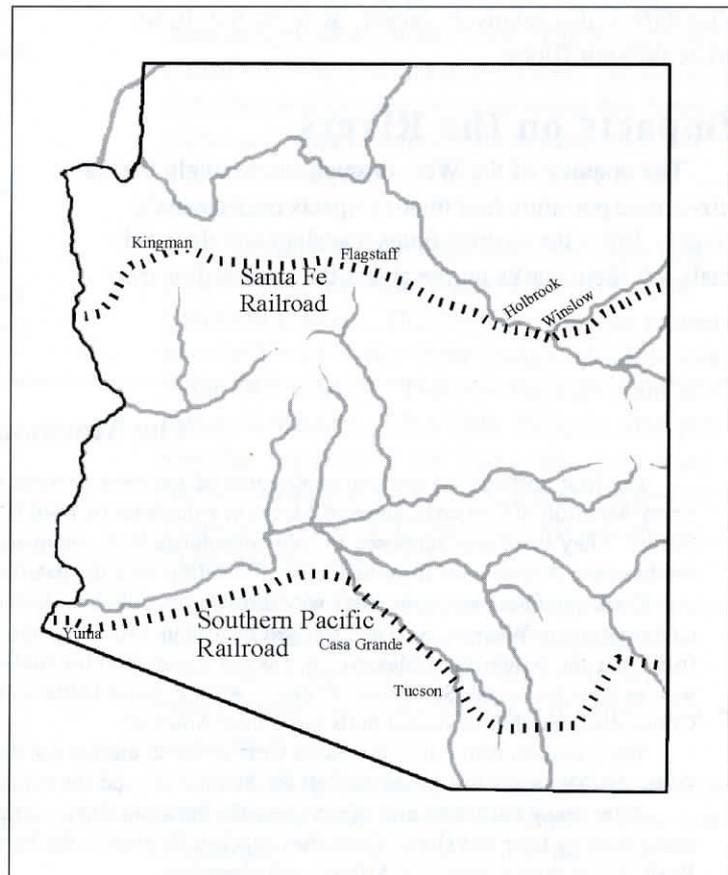
Railroads

Building of the railroads had a much greater impact on rivers than either trails or stagecoach routes. Lumber was needed for railroad ties and bridges. To provide an incentive for the investment needed, the federal government granted some major cross-country companies alternate sections of land for ten miles on both sides of the track. From these locations lumber and in the early days fuelwood could sometimes be gathered. Trains, however, soon converted to

coal and later oil. Lumber for ties was usually brought in rather than harvested on site. Most railroad companies later sold their lands for ranching and other purposes.

In order to minimize costs of construction, bridges often were originally built as narrow as feasible, in some cases leaving the channel narrower than was necessary to carry flood flows. Washouts were a serious problem during infrequent floods. The Southern Pacific track along Cienega Creek, for example, had to be rebuilt several times, and finally was moved to higher ground.

The greatest impact of the railroads was in opening up lands that had formerly been inaccessible, such as areas on the Colorado Plateau. When the railroad reached towns such as Tucson or Phoenix, large numbers of people now were



Major cross-country railroads.

able to reach the area in relative comfort, and all kinds of materials could be imported and exported. Ranching was initially profitable largely because the beef could be sold in the East. Some communities, such as Casa Grande, developed originally as railroad towns.

Highways

Many modern highways approximately follow the old trails. I-10 follows the old trails (north of Apache Pass) along the Gila River west to Casa Grande, with a curve south to Tucson. I-8 resumes that trail all the way to Yuma. I-19 parallels old trails from Tucson to Nogales. In the north, I-40 follows the routes of travelers from Santa Fe west. The old trail around the Guadalupe Mountains east of Douglas has been abandoned, but parts of it have become highways 80 and 82. Old trails from Prescott west and south and through Wickenburg are now highways. Most of the roads going through Phoenix are recent since the city was not on most older routes. North-south travel from Flagstaff is also relatively recent, as is the Salt River route through Globe.

Impacts on the Rivers

The opening of the West through increasingly mechanized transportation had major impacts on Arizona's rivers. From the earliest times travelers and their animals left their marks on the rivers they crossed or trav-

"After a wearisome ride I saw the wagons and the tall cottonwoods of the Gila, and when within half a mile of it, my tired mule smelt the running water. She pricked up her ears, gave one long bray, and made a beeline for the Gila directly through the thick chaparral. I hung on to her back like death to a deceased African and away we went like the wind to the banks of the Gila, into which she plunged her head and never raised it till her sides were distended like a hogshead. ... There was no checking their impetuosity; some of their riders were left hanging in the branches of the trees, some were thrown, and some were pitched headlong into the water. ..." John Durivage, 1849.

eled along. Beaver trapping radically affected the rivers by eliminating the many pools behind the dams. These pools created wildlife habitat and slowed river flow so that downstream floods were usually minimal. When the dams were eliminated, erosion damage to rivers increased and wildlife habitat was lost. Large numbers of livestock drastically reduced vegetation in some areas, leading to erosion and more devastating floods. Probably the greatest impact of improved transportation was to open up the West to large numbers of people who then impacted the rivers in many ways described throughout this book.

The Mormon Battalion

The first "official" American exploration of southern Arizona was led by Philip St. George Cooke, who took an ad hoc U.S. Army battalion of five companies of Mormon volunteers in 1846 from New Mexico to California to create a wagon trail to San Diego. They were also supposed to help consolidate U.S. victories over the Mexicans. Some of our best early descriptions of southeastern Arizona are from that trip. Traveling with the battalion were 36 wives and 54 children.

Cooke and his men made their way through the unknown terrain with the help of local Indians and experienced guides, including Pauline Weaver, who had trapped beaver in Arizona in the 1820s. They traveled the length of the San Pedro River from near the border with Mexico. It was not uncommon for soldiers, Mormons, and early explorers to battle wild cattle as well as Apaches in the San Pedro Valley. After a major battle with a herd of wild bulls (the only real battle of the journey) Cooke declared that he feared bulls more than Apaches.

The battalion went on to the Santa Cruz River to ensure that Mexican troops vacated the Presidio of Tucson. When they got there, the Mexicans had prudently left for San Xavier and the encounter was peaceful.

After many hardships and adventures, the battalion finally crossed the Colorado River at Yuma, having blazed an important route used by later travelers. Once they reached California the battalion dispersed and many of the soldiers joined the Gold Rush, while others settled in Arizona and elsewhere.