# A HISTORY OF LAND USE AND NATURAL RESOURCES IN THE CASCABEL-REDINGTON AREA OF THE SAN PEDRO VALLEY

**LOWER SAN PEDRO WATERSHED ASSESSMENT PROJECT, TASK 3**
WPF #00-109

Submitted to:
Redington Natural Resources Conservation District

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**September 2004**

## EXECUTIVE SUMMARY

This report documents historical natural resource conditions, land uses and management practices in a ~450,000-acre area around Cascabel and Redington in the Lower San Pedro River watershed. It is based on published documents, unpublished archival sources, and interviews with long-time residents and experts. The principal findings are as follows:

- The study area has been inhabited for at least 5,500 years and possibly twice that long. Agricultural communities based on irrigation of rich floodplain lands emerged not later than A.D. 1000.

- The area was abandoned by A.D. 1500 for reasons that are not well understood.

- Irrigated agriculture had revived in the area by the time of Spanish Jesuit missionary contact in the 1690s. The Sobaipuri Indians occupied half a dozen small villages at that time, supporting an estimated 285-575 persons. The Sobaipuris vacated the area under orders from the Spanish in 1762. Warfare with Apaches and general insecurity left the area largely unoccupied from then until approximately 1876.

- Reoccupation occurred in the late 1870s and 1880s based on irrigated agriculture along the river and livestock grazing on the surrounding public domain. Outside wage labor was a supplementary source of livelihood for many homesteaders. Small communities developed around Redington and Cascabel. Settlement also occurred in the uplands around mining prospects and natural water sources.

- At the time of reoccupation, the San Pedro River was perennial through most of the study area, running in a shallow channel 25-36 feet wide. Beaver and large fish were numerous. The floodplain was dominated by sacaton grass, with scattered broadleaf trees such as cottonwood, willow, ash and walnut. Dense forests occurred at only two locations, according to surveyors' notes; marshy areas or cienegas occurred at three sites. The uplands were dominated by grasses; palo verde and mesquite trees occurred but were too small to serve as landmarks for surveys.

- Livestock grazing boomed through the 1880s and 1890s, resulting in severe impacts on the river corridor and adjacent uplands during periods of drought. Other factors at work in the watershed—mining, timber cutting, beaver extirpation, road and railroad construction, agricultural clearing, irrigation diversions, and perhaps the 1887 earthquake—also affected overall watershed conditions.

- Extreme floods occurred with increased regularity after 1890, when the river channel began to incise. Steep cut banks 10-20 feet high, and in places higher, formed by the early 1900s. The ramifications of entrenchment included loss of agricultural fields and arable land; greatly increased costs for surface water

irrigation; drainage of cienegas; long-term conversion of sacaton grasslands to mesquite forests (bosques); and incision of floodplains in tributary washes.

- The combined effects of entrenchment, droughts and financial crises drove many homesteaders out of business, and in the half-century after 1890 ownership of private land consolidated into a smaller number of large farms and ranches. This development was accompanied by rationalization of tenure on surrounding state and federal lands under the Forest Service, State Land Department and Grazing Service (now the Bureau of Land Management). Fencing of farm and ranch boundaries, including their leased allotments, occurred between 1930 and 1970, and the number of livestock in the area declined. After 1960, interior fencing and rotational or deferred grazing management systems were implemented on most ranches in the study area.

- Agricultural production increased substantially in the mid-20th century, enabled by ground water pumping technology, post-war prosperity, and electrification. The acreage under irrigation in the study area increased 247 percent between 1935 and 1967, with the majority of the increase occurring after 1955. Most of this new cropland was cleared from mesquite bosques that had overtaken sacaton meadows in the preceding half century. Pasture grasses and hay were the major crops, with farms integrated into larger livestock production operations. Improved irrigation technologies increased the efficiency of water use per unit of land.

- Environmental changes during the mid-20th century included disappearance of perennial flow from long reaches of the river; invasion of saltcedar (tamarisk) trees in the river channel; and encroachment of woody species and invasion of Lehmann lovegrass in the uplands. The growth of the entrenched channel slowed after about 1955, although floods continued to erode the riverside terrace. Greater than normal winter rainfall in the latter third of the century favored establishment of cottonwood and willow trees along the river.

- Since 1980, two other land uses have emerged in the study area: conservation and subdivision into non-agricultural residential homesites. Subdivision has occurred on just over 11,000 acres of private land, mostly concentrated along the San Pedro River. Conservation land uses (other than those associated with production agriculture) have been implemented on almost 107,000 acres of private, state and federal land.

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## INTRODUCTION

### *Purpose and scope of this report*

This report presents research conducted to fulfill Task 3 of the Lower San Pedro Watershed Assessment Project (WPF Grant #00-109). The purpose of the research was to document the history of the watershed's natural resources and human uses, in order to provide a context for evaluating current resource conditions and management goals.

More specifically, this report reconstructs and interprets the past natural conditions of the study area and human activities that may have affected those conditions. The social history of the area is a colorful one, and it has not been comprehensively studied, but it is not the focus of this report. Social, political and economic topics are covered only to the extent that they bear on the use, ownership and management of land, water, vegetation, livestock and wildlife. Similarly, events that occurred outside of the study area are treated only insofar as they affected local conditions and activities.

The report is organized chronologically. It begins with a summary of prehistoric conditions and human activities. The research emphasis was on the historic period, however, for which human uses and impacts are better documented, more directly relevant to current conditions and issues, and generally more significant than in centuries past.

It was not the purpose of this report to assess current resource conditions in the Lower San Pedro Watershed. That task is undertaken in other project reports.

### *Geographical description of study area*

This report covers the Redington Natural Resources Conservation District (NRCD) plus land to the east that is outside the district boundaries but inside the San Pedro watershed (Figure 1).

The Redington NRCD encompasses approximately 430 square miles (275,000 acres) in the San Pedro River valley of southeastern Arizona, straddling the boundaries of Pima, Pinal, Graham and Cochise counties. It includes approximately 31 miles of the San Pedro River, which runs north-northwest through the middle of the district and is the area's most defining geographical, ecological and social-historical feature.

The district's southern boundary lies just north (downstream) of the Narrows, a bedrock intrusion that divides the upper and lower San Pedro basins. The western boundary runs along the crest of the Rincon and Santa Catalina mountains, which separate the San Pedro and Santa Cruz watersheds. The northern boundary lies along Alder Wash and Kielberg Canyon.

**INSERT HERE:**
**Figure 1. Map of study area showing NRCD and watershed boundaries.**

The eastern district boundary is an irregular north-south line through Range 20 East of the Gila-Salt River Meridian. It begins just northeast of the Narrows and ends on the southwestern flank of the Galiuro Mountains. The eastern watershed boundary, by contrast, bends in an arc along the crest of the Winchester and Galiuro mountains, as much as twelve miles from the district boundary. This additional land encompasses roughly 275 square miles (176,000 acres).

Elevations in the study area range from 2650 feet above sea level at the north end of the river corridor to over 8600 feet asl at the top of the Rincon Mountains. The San Pedro River falls roughly 750 feet on its way through the area. Average annual precipitation increases with elevation from roughly 10 inches to more than 24 inches. The terrain is extremely rugged, characterized by deep tributary canyons and washes cut into the foothills slopes on either side of the river. Vegetation communities include cottonwood-willow riparian forests and mesquite bosque terraces along the San Pedro River, mixed broadleaf forests in tributary canyons and washes, Upper Sonoran desertscrub on lower elevation uplands, Sonoran and Chihuahuan semidesert grasslands at intermediate elevations, and madrean oak woodlands in the surrounding mountain ranges. Conifer forests occur at the very highest elevations.

Development is very limited. The three roads that serve the area are unpaved and minimally maintained. Two towns—Redington and Cascabel—appear on the map, reflecting past locations of schools, stores and post offices, but neither has an identifiable commercial center at present. Electrification occurred in the late 1950s and telephone service arrived in 1993. The current population, estimated at 175 year-round residents, is less than was found in the area early in the 20th century, and probably less than occurred during some prehistoric periods.

Land ownership is a patchwork of public agencies, private individuals, and private non-profit groups (see figure 2). Private lands are a minority of the area, concentrated along the San Pedro River and around other naturally occurring water sources. Lands owned by the Forest Service (USFS), the National Park Service (NPS), and the Bureau of Land Management (BLM) dominate at higher elevations (above 4500' asl), although the BLM has recently acquired holdings along the San Pedro as well. The Nature Conservancy (TNC), Pima County, and the City of Tucson have purchased ranch and farm lands for conservation purposes. The largest single landowner in the area is the Arizona State Land Department, whose holdings dominate between the river corridor and higher-elevation federal lands.

Crop agriculture and livestock production have been the dominant land uses since the arrival of Spanish missionaries in the region over 300 years ago, although until the late 1870s these activities were limited and sporadic due to the threat of Apache depradations. State lands are leased to private ranchers for grazing, as are most national forest lands. A modest amount of mining activity occurred in the mountains early in the 20th century. Hunting is a long-standing land use throughout the area, now limited to fall and winter seasons; other recreational uses are generally concentrated on USFS and NPS lands at higher elevations. In the last twenty-five years, conservation and residential land uses

have increased in significance, but in terms of overall area they remain secondary to agriculture.

***Methods and sources***

Compared to the rest of the San Pedro River valley, the study area has experienced relatively little historic human activity and scholarly attention, and in consequence it is poorly documented in published sources. Prehistoric settlements occurred but are smaller and less well studied than sites elsewhere in the San Pedro Valley. The nearest sites of early significant historic activity were just upstream at Tres Alamos (Tuthill 1947)and downstream at Aravaipa (Hadley et al. 1991). Later, major mines were discovered to the south (at Cananea, Bisbee and Tombstone) and to the north (at San Manuel, Mammoth and Winkelman), but not in the study area. A railroad was contemplated through the area in the late 19th century, and a paved highway was planned in the 1960s, but neither was ever built. More recently, rapid residential growth and attendant environmental issues have drawn renewed attention to the upper San Pedro River around Sierra Vista, but the Cascabel-Redington area has remained comparatively obscure.

As a result, reconstructing the history of the Lower San Pedro watershed is often difficult. Census data, for example, tend to lump the study area together with surrounding locales such as Tucson, Benson or Willcox, making it difficult to determine population numbers with precision. Historical treatments of southeastern Arizona are numerous, but they rarely focus on the area in question here; there are only a few ecological studies specific to this reach of the San Pedro (Zimmermann 1969; Lombard 1998). Resource information is much more abundant from the Upper San Pedro (BLM 1998b), but its relevance to the study area cannot be assumed.

Archival research and interviews were the main methods employed for this report. Major archives included: the Arizona Historical Society, the University of Arizona libraries, the Tucson office of the Bureau of Land Management, the Tucson and Willcox offices of the Natural Resources Conservation Service (NRCS), the Supervisor's Office of the Coronado National Forest in Tucson, the Soza-Carrillo-Fremont House Museum in Tucson, the Center for Desert Archaeology and The Nature Conservancy in Tucson, and the Amerind Foundation in Dragoon. Water rights information for the area was obtained from the Tucson office of the Department of Water Resources. Reports completed under other tasks of the Lower San Pedro Watershed Assessment Project were also consulted.

Several topics were found to be very poorly documented. A complete soil survey of the study area is only now being conducted, so information on soils was largely unavailable (see Zimmermann 1969 for a brief description of major soil types). The State Land Department has virtually no historical archives regarding its lands, despite being the largest single landowner in the area. Old aerial photographs (from the 1930s and 1950s) for the northern half of the study area have apparently disappeared from the archives of the NRCS in Tucson, and they could not be located at the Willcox NRCS office or the Arizona Historical Society.

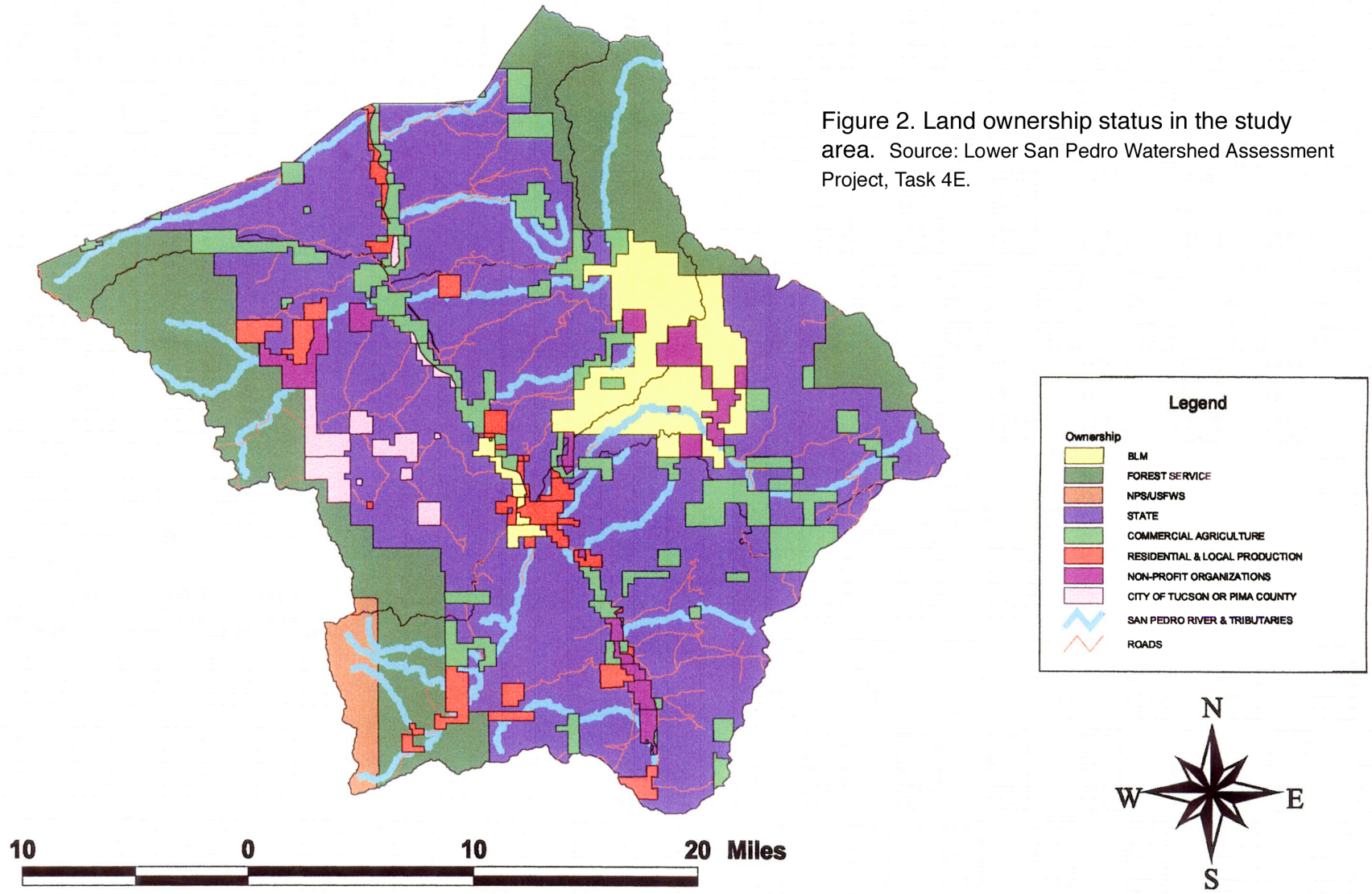


Figure 2. Land ownership status in the study area. Source: Lower San Pedro Watershed Assessment Project, Task 4E.

Interviews were conducted with past and current residents of the area, using a semi-structured interview protocol. Questions focused on land use and management practices for the times and places that the interviewee was present in the study area. An initial list of potential interviewees was produced by inquiring of current long-time residents; these interviewees in turn helped to identify others. Interviews were 1-2 hours in length and most were recorded digitally for future reference. Nineteen interviews were conducted (Appendix 1). With a few exceptions, interviews with current landowners proved less valuable than expected, because most properties in the area have changed hands at least once in the past twenty years. Conversely, almost all of the most valuable interviewees—those resident in the area between twenty and eighty years ago—no longer live in the study area, having moved to Tucson or Benson for reasons of work, family or health.

## PREHISTORIC PERIOD

*"No other river valley reveals the story of the first humans in the Greater Southwest as completely as the San Pedro River Valley."*

--Bruce B. Huckell (2003)

Archaeological research has conclusively documented human presence in the San Pedro valley going back more than 11,000 years. Based on sites excavated near Fairbanks, Charleston and Naco, paleontologists have hypothesized that early humans may have caused the extinction of Pleistocene megafauna such as the mammoth. Although sites of such age have not been found in the study area, humans almost certainly used the area for hunting and gathering. Human impacts from this period cannot be assessed in detail due to limited data and the fact that the climate at that time was considerably wetter and cooler than at present.

The San Pedro also contains sites from the Archaic and Early Agricultural periods (see figure 3). One archaic site has been identified in the study area, at Lone Hill west of Redington; it indicates hunter-gatherer lifeways from 5,500 to 3,500 years ago. Another, very large archaic site is located just south of the study area near Benson. Further upstream, the Fairbanks site has yielded evidence of maize agriculture 3,500-3,000 years ago, and by A.D. 50 crops there included corn, beans, squash, cotton and tobacco. These innovations were accompanied by construction of the earliest permanent, year-round settlements and irrigation canals.

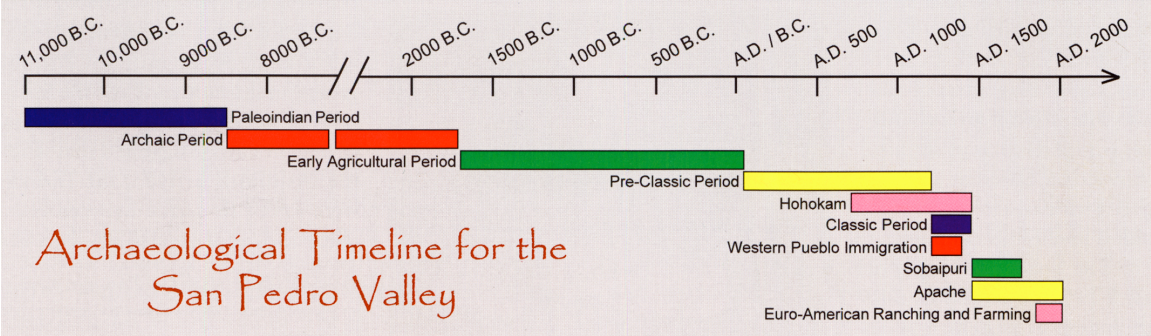


**Figure 3. Cultural periods in the study area.** Source: Lyons 2004. Courtesy of the Center for Desert Archaeology; used with permission.

During the pre-Classic period, from A.D. 50 to 1200, agriculture became increasingly important and settlements more permanent. Sites in the study area from this period reveal cultural practices and artifacts related to those of the Hohokam peoples of the Phoenix, Tucson and Tonto basins. A regional shift from seasonally mobile to more settled villages occurred around A.D. 500-600. Increasing inter-village organization developed over the following two centuries, culminating in a period of widespread ballcourt construction between A.D. 800 and 1050. This appears to have been a time of relative peace and favorable rainfall, enabling development of agricultural villages dispersed along waterways throughout the region, including in the study area. Cultivation appears to have extended up the terraces adjacent to the floodplain as well, as

evidenced by extensive rock piles, which archaeologists believe were constructed for growing agave plants.

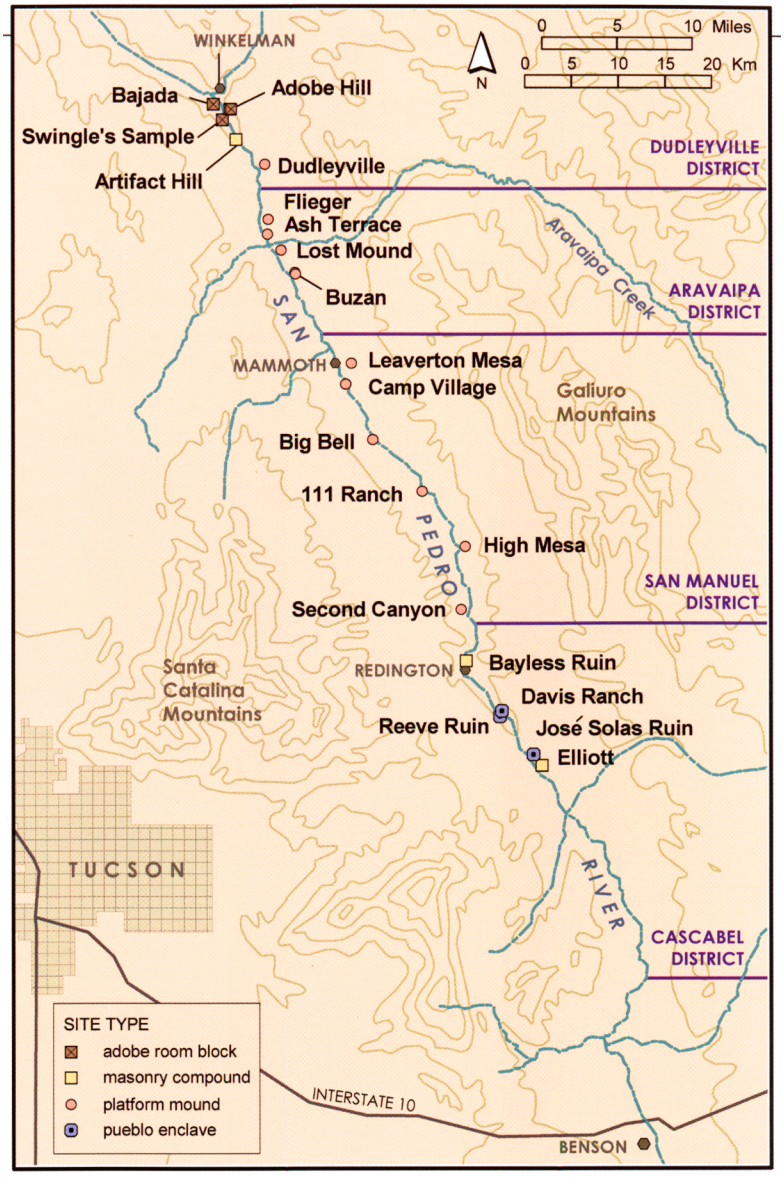


**Figure 3. Archaeological sites in the Lower San Pedro River valley.** Source: (Clark & Lyons 2003). Courtesy of the Center for Desert Archaeology; used with permission.

Sites in the study area display influences from several cultural groups, suggesting complex transitions and interactions among peoples over time and space. Five ballcourt sites have been found in the study area, including a major site at Redington, indicating Hohokam presence or influence. Differences in pottery and architecture between sites north and south of Mammoth, however, suggest that the study area was at the edges of

Hohokam influence and also experienced contact with peoples further east (e.g., from the Mimbres valley of southwestern New Mexico).

Major changes in settlement patterns occurred during the Classic period, from A.D. 1200 to 1450. First, migrants from the Mogollon Highlands and northeastern Arizona moved into the study area, especially after about 1300, bringing new architectural and artistic customs. Second, dispersed pithouse settlements contracted to form concentrated villages of masonry and adobe built near major irrigation systems. Eleven platform mound sites have been found along the San Pedro from Redington north, each associated with an irrigation system of up to 5 miles in length. South of Redington platform mounds are not found, and evidence from the Reeve Ruin and Davis Ranch sites suggests the arrival of peoples from northeastern Arizona, nearly 300 miles away. Although culturally distinct, these settlers clearly traded goods with their neighbors and shared some of their land use practices such as irrigated agriculture. Based on an exhaustive analysis of sherds, bones, stone fragments and pieces of shell at 29 sites throughout the lower San Pedro, the Center for Desert Archaeology (Clark & Lyons 2003) developed this summary of Classic period human land uses:

*The San Pedro floodplain was covered with maize fields fed by canal systems up to 8 km long. Each canal system was built and maintained by an irrigation community containing between 100 and 300 people. Beans and squash were also cultivated. Mesquite beans and various cacti fruits were favorite gathered resources. An occasional trip was made to obtain juniper berries from the mountain slopes far above the floodplain. Although cotton was grown in other river valleys of central and northern Arizona, we encountered no evidence of this raw material for textiles. Even more conspicuous is the near-absence of agave, considering the thousands of rock piles, presumably used in cultivating this plant, that line many of the terraces overlooking the floodplain.*

By 1450 the San Pedro Valley was depopulated. This was undoubtedly related to the collapse of Hohokam civilization throughout the region at this time, probably due to the prolonged and severe drought of the late 13$^{th}$ century. No archaeological sites have been found in the study area from the ensuing 200 years.

## SPANISH AND MEXICAN PERIOD

The expedition of Francisco de Coronado in 1540 is known to have traversed the San Pedro Valley, although exactly where remains a subject of scholarly debate. It appears Coronado's party did not pass through the study area, but they did bring herds of horses, cattle, goats, sheep and pigs into present-day Arizona for the first time. By the end of the 17th century, livestock were present in the southern part of the San Pedro valley, although their presence near the study area is not documented until later (Hadley et al. 1991).

The first documented contact between Europeans and the study area occurred in 1692, when Spanish Captain Francisco Ramirez pursued a band of suspected horse thieves to Baicatcan, a Sobaipuri village on the lower San Pedro River (Bolton 1984 [1936]). The location of Baicatcan has long been disputed, but recent archaeological research by the Center for Desert Archaeology suggests it was at Cascabel, on a mesa overlooking the mouth of Hot Springs Canyon.

The Sobaipuris lived all along the lower San Pedro (DiPeso 1953), and they soon became allies of the Spanish against their common enemy to the east, the Apaches. Late in 1697, the Jesuit missionary Padre Eusebio Francisco Kino traveled down the San Pedro and recorded the earliest documentary description of the study area. He found Baicatcan abandoned, but further downstream he encountered a string of occupied villages. Captain Juan Mateo Manje, who accompanied Kino, wrote that "The whole valley is wide, long, and very fertile. Their fields are irrigated with acequias," which watered crops of calabashes, beans, corn and cotton (Bolton 1984 [1936]). From Kino and Manje's writings, and from archaeological research, scholars estimate that the Sobaipuri villages in the study area supported between 280 and 575 persons in the late 1690s (William Doelle, Center for Desert Archaeology, written communication).

The Sobaipuri-Spanish alliance persisted, but so did the Apache threat, which intensified in the decades following Kino's death in 1711. In 1762 Spanish authorities ordered the Sobaipuris—numbering some 400—to withdraw from the San Pedro Valley and settle at the missions and presidios of the Santa Cruz Valley, which were struggling to maintain an adequate Indian labor supply (Wilson 1995). This did not help security along the Apache frontier, and it effectively eliminated the Sobaipuris as a distinct social and cultural group. Through assimilation with the Pima (O'odham) Indians, or by some other mechanism, the Sobaipuris soon disappeared. The lower San Pedro reverted to unoccupied frontier again, effectively controlled by the Apaches.

In the period 1790-1820 a relative peace prevailed while the Spanish colonial administration provided rations to the Indians. Spanish ranchers began to spread beyond the Santa Cruz valley, establishing ranchos and developing large herds of livestock. The prominent Elias Gonzales and Perez families dominated the upper San Pedro, where they successfully petitioned the government for three large land grants above present-day St. David; another petition, for an area around Tres Alamos, was unsuccessful (Mattison 1946). That Spanish ranching did not extend further downstream probably reflects the lower rainfall and forage productivity of the study area compared to the upper watershed.

The rations system broke down following Mexican independence, and by 1840 the San Pedro settlements had been abandoned. Livestock became feral and reproduced prolifically, becoming both a menace and a source of meat to soldiers, emigrants and Apaches in the 1840s and 1850s (Wilson 1995). These animals undoubtedly entered the study area, but their numbers and impacts on natural resources are undocumented.

### U.S.-APACHE FRONTIER WARFARE

For 22 years after the Gadsden Purchase transferred southern Arizona to U.S. sovereignty, in 1854, the study area was effectively a no-man's land in the ongoing guerrilla war between the U.S. military and the Apaches. The bulk of the fighting occurred elsewhere, but the insecurity was regional, and it prevented permanent settlement in the study area until 1876, when most of the Apaches were removed to the newly created San Carlos Reservation.

The road through the study area was first constructed in 1857-58 as part of the El Paso and Fort Yuma Wagon Road, built under contract for the Department of Interior. The Leach Road—named for superintendent of construction, James B. Leach—entered the San Pedro Valley by Nugent's Pass, at the current location of the Cascabel-Willcox ("Three Links") Road. It proceeded downstream along the east bank of the river as far as Aravaipa before fording the river and continuing west (Wilson 1995). The road did not spur settlement in the study area, however, both because of the Apaches and because the route was poorly chosen for local purposes. In seeking to facilitate cross-territory traffic (en route to California, for example), Leach had completely by-passed Tucson. When overland mail and stagecoach service expanded in the late 1850s, carriers chose alternate routes, such as one from Tres Alamos west to Tucson and thence north to the Gila.

Several natural resource conditions can be inferred from the U.S.-Apache war period. First, soldiers stationed along the San Pedro—at Aravaipa Creek and Bobocomari Creek, for example—experienced chronic malaria, apparently due to nearby cienegas where mosquitoes were abundant. The cienegas were associated with—and may in some cases have been created by—beavers, which were abundant in the river (Hutton 1859) and which may have been trapped as early as the 1820s (Wilson 1995). Second, the accounts of military and emigrant groups describe large fish—18-20 inches in length—in the river, indicating the presence of significant reaches of perennial flow and large pools. Third, these accounts do not indicate entrenchment of the river, except perhaps between Tres Alamos and the Narrows. Finally, the Apaches routinely set grasslands in the region on fire, whether by accident, for hunting or for tactical-military purposes (Dobyns 1981). These factors may have been interrelated, judging from events that followed.

## REOCCUPATION, 1876-1890

### *Settlement along the River*

According to some sources, six Anglo-American families from Tucson settled at the current site of Redington as early as 1865 (McKelvey 1958b). Documentary support for this claim is weak, however (Soza 1994), and even if the settlement did occur, it did not last long. Permanent reoccupation of the study area did not take place until the late 1870s and 1880s, when Mexican- and Anglo-American homesteaders began to establish small farms and ranches.

Reconstructing the precise dates, names and locations of these early settlements is difficult because documentary sources are limited, uneven and sometimes inconsistent. Most of the area was not surveyed until 1879, by which time many homesteads had already been established. As a result, even official homestead records may not reflect actual dates of settlement. The activities of a handful of settlers are recorded in newspaper clippings, memoirs and stories, but the majority of homesteaders left very little mark on the historical record.

By far the most thorough early descriptions of the study area are found in the notebooks and maps of surveyors employed under the U.S. Surveyor General. The area around the Narrows (Township 15 S Range 20 E) was first surveyed in 1873 by T.F. White. He recorded only one house, in section 15 and apparently abandoned, which he labeled "Nigger Brown's old house." He noted that there were no settlers north of the Narrows (see below). White also noted two acequias, however, in sections 21 and 31, as well as two "wood roads" leading west into the Rincon Mountains in section 31. All of these human improvements were just south of the study area, near Tres Alamos.

Most of the river corridor through the study area was first surveyed in 1879 by John L. Harris, who recorded 30 homesteaders by name (Table 1). Of these, 18 had Spanish or Mexican surnames; the rest were Anglo-American.[1] At almost all the homesteads, Harris also noted the presence of cultivated fields and acequias for irrigated agriculture.

For reasons not revealed in the surveyors' notes, one river corridor township at the southern edge of the study area (T14S R20E) was not surveyed until 1902. The original deeds for homesteads in this township were obtained from a subsequent owner of the properties. These records document the earliest successful claimants—those who perfected title—but may not reflect the earliest settlers. Table 2 lists the names, locations, and acreages of these claims.

An exhaustive archival study of General Land Office Homestead records was completed by Edward Soza (1994) in order to document early Mexican settlement in the San Pedro Valley. Soza identified 38 Homestead filings made in the study area between 1880 and

[1] One settler's last name appears Chinese: Ming, near the confluence of Hot Springs Canyon and the San Pedro, at the site later known as Pool Ranch. Most likely this was Daniel Houston Ming (or a relative of his), who also ranched downstream at Aravaipa and was not ethnic Chinese (Hadley et al. 1991).

1891 by persons with Mexican surnames (Table 1). Of these, the earliest date of actual settlement (rather than filing of claims) is 1877, by Angel Gonzales.

Presumably, official Homestead records were less prone to certain kinds of errors (e.g., misspellings, misattribution) than were the surveyors' notes, which were gathered during site visits (when settlers may have been absent). On the other hand, Homestead records were also subject to error (or intentional misrepresentation as to date of settlement), because they were not gathered in the field. In any case, the names and locations of settlers in the Soza study sometimes differ from those recorded in surveyors' field notes, and Soza did not attempt to gather information on settlers with non-Mexican surnames.

The early homesteads were small, being limited by the acreage restrictions of the Homestead Act and its successor acts (160-640 acres). Homesteaders undoubtedly grazed livestock on surrounding public domain land, but securing title to land required improvements related to crop agriculture. In almost all cases, settlers chose sites where alluvial deposits from tributary canyons had created broad, fertile areas adjacent to the San Pedro, and where water could be easily diverted from the river for irrigation. Most tributaries contained perennial water only at higher elevations where arable land was scarce, and they were generally not settled until slightly later (see below). The pattern of deeded land in the study area today—concentrated along the river and its major tributaries—is the direct result of the homesteaders' activities.

What the early homesteaders produced must be discerned from other sources, as surveyors' notes and Homestead filings are silent on this issue. The Arizona *Mining Index* of 4 October 1884 reported that Josiah Pool was manufacturing sugar and syrup from sorghum and sugar cane grown at his farm near the mouth of Hot Springs Canyon. In 1889, according to the Arizona *Citizen*, Pool had 100 fruit trees and 100 blackberry bushes, but he had lost "a beautiful bed of strawberry vines" to recent flooding.[2] Further downstream the Redfield brothers, Henry and Lem, who may have settled as early as 1875 and for whom Redfield Canyon is now named, produced butter for sale in Tombstone (Taylor No date). On his ranch at the mouth of Soza Wash and Soza Canyon, Antonio Campa Soza produced corn, wheat, barley, watermelons, squash, beans, apples, milk and cheese as well as cattle and hogs. Some of this produce was taken over Cebadilla (now Redington) Pass for market in Tucson (Carlos and Hector Soza, interview 15 June 2004).

On the whole, it appears that agriculture in this period was substantially oriented toward subsistence rather than commercial profit. The recollections of old-timers and their descendents describe large gardens, diverse farms, and neighbors who routinely bartered with each other for fruits, vegetables, meat, dairy and poultry products. Antonio Soza's

[2] Both articles are transcribed and located in the bio-files of the Arizona Historical Society in Tucson. The earlier article misspells Pool as "Poole," and the Historical Society has misfiled both articles under "Joseph" rather than Josiah Pool. (Joseph was one of Josiah's sons, but he was only 15 years old at the time of the earlier article.) Josiah Pool was a doctor as well as a farmer, and his farm became a significant center of community activity along the river: the site of a school, a post office, and a census precinct early in the 20th century. Pool Wash takes its name from Josiah Pool.

flour mill was used by residents up and down the river to process their wheat and corn (Soza 1939). In addition, many homesteaders relied on non-agricultural jobs or enterprises to obtain cash income. The Soza family had numerous business ventures and real estate holdings in Tucson, for example. Blas Sanchez, who homesteaded near the mouth of Kelsey Canyon in 1880, secured a contract to deliver the mail from Benson to Redington for $1200 a year (Alfredo Araiza biographical information). Particularly among Mexican-American families, homesteads were sources of food as much as, or more than, sources of income (Martin 2004).

### *Settlement Away from the River*

The dates of settlements away from the San Pedro River are difficult to determine. Much of the area is extremely rugged and was not surveyed until 1919-1935, by which time settlers were already established (Table 2). These settlements were based on ranching or, in a few cases, mining (Wilson 1995).

One upland site, at Hooker's Hot Springs in upper Hot Springs Canyon, was definitely settled much earlier. Dr. Glendy King arrived there in 1875, building two adobe houses and establishing a cattle operation. He homesteaded 480 acres and dreamed of creating a health spa to capitalize on the hot springs. The Apache threat intermittently drove him to Tres Alamos or Tucson for safety. In 1884, King was killed in a dispute with a neighbor, Edward Drew, who was attempting to homestead further down the canyon. The following year, King's property was acquired by Henry Hooker (see below), from whom the hot springs now take their name. Hooker quickly realized King's health spa dream, refurbishing the adobe houses and constructing bathhouses, a modest dining room, and croquet and lawn tennis courts. He also stocked the ranch with about 1,000 cattle by 1887 (Mills 1981). For a brief period in the early 1890s, Hooker's Hot Springs was a popular destination, attracting 400-500 guests each summer, and the area attracted sufficient settlers to warrant a post office, under the name Gatewood. Severe drought followed by national financial crisis and a devastating flood in 1893 spelled the community's demise, although Hooker and his sons retained the ranch until 1906.

**Table 1. Early Homestead Act settlement along the San Pedro River in the study area, as derived from two sources.** Column 2: names and locations of homesteaders identified in 1879 General Land Office surveyors' notes. Column 3: names, locations, and dates of original settlement of Mexican-surnamed homesteaders only, from Soza's (1994) study of Homestead Act records. All spellings are as found in original sources.

| Township | 1879 GLO Survey | Homestead records, Mexican surnames only |
|---|---|---|
| T10S<br>R18E | Webster, section 5<br>Shell, section 8<br>Shell, section 27 | Manuel Carasco, section 28, 1885 |
| T11S<br>R18E | Gardner, section 10<br>Boland, section 15<br>Henry Redfield, section 23 | Antonio Madrego, section 34, 1888 |
| T12S<br>R18E | Redfield, section 3<br>Wheaton, section 12<br>Comoduran, section 13<br>Ochoa, section 13<br>Ochoa, section 13<br>Ramirez, section 13<br>Valdez, section 13<br>J. Borquez, section 24 | Juan Valdez, section 2, 1890<br>Octaviano Durazo, sections 3 & 4, 1885<br>Timor Marquez, section 11, 1886<br>Mariano Azedo, section 11, 1885 (relinquished 1885)<br>Antonio Comaduran, section 13, 1879<br>Jesus Moraga, section 13, 1885<br>Pascual Ochoa, section 13, 1884<br>Angel Gonzales, section 24, 1877<br>Lasaro Borquez, section 24, 1884 |
| T12S<br>R19E | Gonzales, section 19<br>Soso, section 29<br>Thompson, section 29<br>Soso, section 30<br>Rodrigues, section 32<br>Pacheco, section 33 | Concepcion Gonzales, section 19, 1884<br>Lasuro Borquez, section 19, 1887<br>Jesus Ronquillo, section 19, 1886<br>Nicolas Soza, section 29, 1881<br>Placido Soza, section 30, 1878 (relinquished 1882)<br>Antonio Soza, section 30, 1881<br>Nabor Pacheco, section 32, 1880<br>Jose A. Rodriguez, section 32, 1878<br>Juan Soza, section 32, 1879<br>Antonio Soza, section 32, 1880 (cancelled 1885)<br>Antonio Rodriguez, section 32, 1884 |
| T13S<br>R19E | Mungia, section 4<br>Suviale, section 5<br>R. Zaen, section 9<br>Castillo, section 10<br>Antonio Van Alstine, section 10<br>Raul Mendoza, section 15<br>Lucas Mendoza, section 23<br>Semma, section 23<br>Ming, section 25<br>Juan Bojorquez, section 36 | Rafael Sacus, section 4, 1879<br>Mateo Pacheco, section 4, 1884<br>Estancia Saenz, section 4, 1885<br>Jesus Gonzales, sections 4 & 9, 1885<br>Refugio Saens, section 10, 1880<br>Blas Sanchez, section 10, 1880<br>Jose Castillo, section 15, 1885<br>Felix Ruelas, sections 10 & 15, 1884<br>Jose Robles, section 15, 1885<br>Antonio Boitano, sections 15 & 22, 1891 |

**Table 2. Successful Homestead claims in southern reach of the San Pedro River corridor in the study area.** Source: Papers of the Cascabel Land and Cattle Company, courtesy of Reese Woodling.

| Location | Name | Acres |
|---|---|---|
| T13S R19E secs. 26, 27 | Eliza Gibson | 158.18 |
| T13S R19E sec. 24<br>T13S R20E sec. 19 | Jesusa Bidegain | 157.31 |
| T13S R20E sec. 31 | Francisco Ronquillo Villa | 154.21 |
| T13S R20E sec. 31 | Jesse A. McClure | 126.83 |
| T14S R19E secs. 27, 28, 33, 34 | Don J. Cox | 600 |
| T14S R20E secs. 3, 4 | Jesus Maria Sanchez | 516.68 |
| T14S R20E sec. 6 | Benigno Y. Tautimez | 144.15 |
| T14S R20E sec. 17 | James B. Cook | 160 |
| T14S R20E secs. 12, 17 | Ezra ____hail [partially illegible] | 160 |
| T14S R20E sec. 8 | Blas Sanchez | 160 |
| T14S R20E sec. 20 | Ned Hillyard | 160 |
| T14S R20E secs. 28, 29 | Houston A. Pace | 160 |
| T14S R20E sec. 29 | Ned Hillyard | 480 |
| T14S R20E sec. 6 | Rosa Grijalba | 171.64 |


**Acequia on the Gamez-Araiza homestead, 1927.** Photo courtesy of Maria Troutner.

**Table 3. Dates of survey, and houses or settlers present at time of survey, for upland townships in the study area.** Source: General Land Office surveys.

| Township | Sections | Date of Survey | Houses or Settlers present |
|---|---|---|---|
| T13S R21E | 1-16, 21-28, 33-36 | 1902 | Goodwin, section 5<br>Unnamed house, section 6 |
| T12S R21E | 25-36 | 1910 | Joseph Dell, section 31<br>Charles Drew, section 31<br>Unnamed house, section 31 |
| T12S R21E | 1-24 | 1919 | Hancock, section 5<br>Angle, section 11<br>Edith Poore, section 12 |
| T15S R21E | All | 1919 | H.L. Johnson, section 1<br>Unnamed house, section 7 |
| T14S R21E | All | 1919 | Unnamed house, section 5<br>Unnamed house, section 18<br>Unnamed cabin, section 25<br>L.G. Johnson, section 28<br>W.L. Johnson, section 28 |
| T13S R18E | All | 1924 | Roy Seelinger, section 1<br>Salcido, section 4<br>Youtcy Ranch, section 6<br>P. McDaniel, section 11 |
| T11S R17E | All | 1924 | W.D. Parker, section 22<br>O.R. Parker, section 24 |
| T13S R20 | All (resurvey) | 1926 | B.Y. Tautiemez, section 32<br>B.Y. Tautiemez's sons, section 32 |
| T14S R19E | All but S half of section 31; portions resurveyed | 1926 | William Whelan, section 7<br>O.O. Barney, section 18<br>Owens, section 20<br>Deserted house, section 27<br>Don J. Cox, section 28<br>Unnamed house, section 30<br>School house, section 31<br>Unnamed house, section 31 |
| T11S R19E | All (resurvey) | 1927 | Unnamed house, section 10<br>Stone house, section 14 |
| T11S R20E | All | 1929 | Prides Ranch, section 26 |
| T12S R17E | All | 1935 | Brush Corral Ranger Station, sec. 9<br>O.B. Parker, section 10 |

## NATURAL RESOURCE CONDITIONS AT THE TIME OF REOCCUPATION

From the memoirs and recollections of old-timers, and especially from surveyors' field notes, it is possible to reconstruct natural resource conditions in the study area circa 1880 in greater detail than for any earlier point in time.

Frank Pool lived in the study area from 1883-1894, when he was a boy. In 1940, he recalled:

*The San Pedro valley at the time we located there was one of the most beautiful valleys I ever saw. The river was a living stream, a few farms were already under cultivation. Grass everywhere, fine cattle range from Mexican line to the mouth of the river where it joined the Gila River. Wild game in abundance. Deer. Antelope. Wild hogs. Beaver. Raccoons. Foxes. Wild cats. Mountain lions. Bear. Rabbits. Quail. Doves. Ducks and geese. River was teeming with fish. Suckers and Gila Salmon. We caught Gila Salmon 10 to 15 pounds each. (Pool 1940)*

Elena Vasquez Cruz was born on the Soza ranch in 1912. Her recollections of her grandparents' arrival in Redington, in 1884, were told to Patricia Martin (2004):

*The land was fertile; there was plenty of water for farming. My grandmother and her family settled on a little corner of land close to the river. They grew corn, squash, and beans. They collected honey from beehives. They were very happy because they had all the food they wanted. The boys grazed their milk goats across the river on a hill.*

Several years later her father started a homestead at Redington, where the family raised alfalfa, corn, wheat, barley, lentils, peanuts, peas, yams, garbanzos, tobacco, chiles, onions, carrots, potatoes, hogs and cattle.

The General Land Office surveys provide a more systematic account of conditions in the study area, albeit one with a narrower focus. Surveys were conducted by township (each township being a square six miles on a side). Surveyors began by identifying the boundaries of the township and marking them on the ground with posts or rock piles. They then located and marked the boundaries of the 36 sections within the township, proceeding east-west and north-south in straight lines one mile apart. As they went, they noted changes in topography and the location of fences, roads, houses, fields, washes and water sources, measuring their locations in relation to the section line. At each half-mile point between section lines, they noted the distance and bearing of any nearby trees to help "witness" the quarter-section corners. Finally, they composed a brief "general description" that summarized the prospects for human uses in the township: soil conditions, water sources, timber or grass, and evidence of mineral resources.

In his 1873 survey of Township 15 South, Range 20 East, which encompasses the Narrows and straddles the south boundary of the study area, Thomas White wrote:

*The San Pedro River runs through the center of this Township. Bordering on it is much good farming land, more particularly on the S. or S.W. portion: a number of settlers are there engaged in farming. In section 15, the valley closes in to a narrow canon, but afterward widens somewhat. There are no settlers along the river N. of the canon. The remainder of the township falls on hilly land, sometimes very broken. The most of this is good pasture land.*

North of the narrows, White wrote that "Mesquite timber is found along the river." This site—at the boundary of townships 14 and 15 south, range 20 east—is the only mesquite bosque site recorded in the original surveys. Six miles south, by contrast, White wrote: "Where this line crosses the valley, the soil is very rich, and considerable of the land under cultivation. The valley is bare of timber. The balance of the line is on the hills, and is mostly over poor land, some of it fit for pasturage." This contrast may have reflected natural conditions, or it may have been a product of past human wood cutting around Tres Alamos.

As noted above, most of the river corridor through the study area was first surveyed in 1879 by John Harris. His general descriptions of four townships, reproduced in full in Box 1, emphasize the rich soil of the San Pedro floodplain, sufficient water in the river for irrigation, and vegetation dominated by grass. Mesquite, cottonwood and palo verde trees were present along the river but not dominant. Portions of each township were not surveyed at that time due to the rugged topography of the surrounding mountains.

The surveyors' section line measurements and notes reveal further details about the area. "Grass" or "fine grass" was noted at almost all quarter-section corners, and trees large enough to serve as witness trees (which appears to have meant >3 inches in diameter and <200 feet distant) were unevenly distributed: very limited in the central portion of the study area, but more numerous at both the southern and northern reaches (Table 4). Witness trees included mesquites of up to 18 inches diameter; walnuts up to 18 inches diameter; a cottonwood of 28 inches diameter; a hackberry of 8 inches diameter; and an ash of 5 inches diameter. Dense thickets of trees were noted only twice, however: once south of the Redfield homestead (T11S R18E secs. 22, 23, 26, 27, 34) and once just downstream of the narrows (see above).

Finally, marshy or swampy conditions were observed near the Redfield homestead (T11S R18E sec. 23), between the Van Alstine and Mendoza homesteads (T13S R19E sec. 10), and just south of the study area near the Narrows (T15S R20E secs. 20,21,28,29). The San Pedro River appears to have had water throughout its length at the time of Harris's survey (November and December 1879): he measured the river as 25-36 feet wide at most locations, and as wide as 56 feet at a few places.

**Box 1: General descriptions of four townships along the San Pedro River in the study area, by surveyor John Harris, 1879.**

***T11S R18E***

The foregoing field notes describe all the lines of subdivision in Tp. 11 S. Range 18 E. that are practicable and cover all the ground in the Township that is surveyable. The surveyed portion of the Township embraces a portion of the rich San Pedro valley, the river flowing northerly through the Township and containing sufficient water for the irrigation of the agricultural land. The soil of the valley is deep and rich and very productive. There is a heavy growth of sacaton grass in portions of the Township. The lands bordering the valley are considerably broken but affording excellent grazing. There is Cottonwood and Mesquite timber in various portions of the Township. The W. half of the township is wholly impracticable, high broken ranges of hills cut by deep, precipitous canons and wholly waterless.

**T12S R18E**

The unsurveyed portion of Township 12 S. Range 18 E is wholly impracticable. W. of the range line running N. between secs. 33 & 34, a low range of broken mountains brs. N. & S. shutting in close to said range line, bowing out a little only at the W. side of sec. 21. I could not extend the lines to the W. of said range line except around sec. 21, as in a short distance they became impracticable from mountains and canons. The Surveyed portion of the Township embraces a portion of the San Pedro valley. The river runs through or across the N.E. portion of the Township and contains sufficient water for the irrigation of the agricultural land. The soil is rich and deep. The land bordering the valley are fine grazing lands and in many places have good soil. There is some mesquite, palo verde and cottonwood timber in the Township.

**T12S R19E**

The extreme East and northeastern portions of Township 12 S Range 19 E are unsurveyable. The ground is impracticable broken by low mountains and canons and the country inaccessible and worthless. The surveyed part of the township covers a portion of the San Pedro valley and the bordering grazing land. The San Pedro river flows through the Southwestern part of the Township and contains sufficient water for the irrigation of the agricultural land. The valley soil is rich, deep, and very productive. The valley is bordered by hills and rolling land with mesquite and palo verde in places. There is fine grass in some sections of the Township.

**T13S R19E**

The unsurveyed portion of Township 13 S. Range 19 E. is wholly impracticable, being the broken and very precipitous approaches to the Rincon mountains. The surveyed portion of the Township covers part of the San Pedro valley with abundance of water for irrigation. The soil of the valley is very rich while that of the bordering uplands is largely good. There are cottonwood and mesquite trees in the valley and mesquite and palo verde in places elsewhere. There is fine grass in parts of the Township.

*N.B. T14S R20E was not surveyed until 1902.*

**Table 4. Relative incidence of witness trees at quarter-section corners for five townships in the study area.**[a] Source: General Land Office surveys.

| Township | # of Sections Surveyed | "No trees near"[b] | Corners w/ witness trees | Tree species noted |
|---|---|---|---|---|
| T11S R18E | 18 | 13 | 15 | Mesquite, cottonwood, palo verde, walnut, ash, willow |
| T12S R18E | 19 | 42 | 6 | Mesquite, cottonwood, palo verde, walnut |
| T12S R19E | 26 | 62 | 0 | Mesquite, cottonwood, palo verde |
| T13S R19E | 17 | 27 | 7 | Mesquite, cottonwood, palo verde |
| T15S R20E[c] | 36 | 15 | 16 | Mesquite, hackberry, "tesote"[d] |

a. These figures should be interpreted with caution. Surveyors may have been inconsistent in choosing how far to go for a witness tree. Even where witness trees were not utilized, surveyors noted the presence of some trees in the vicinity. Moreover, some quarter-section corners had neither "no trees near" nor witness trees attributed to them. Thus, these figures are best used only as an indication of the relative abundance of large trees in different townships.

b. The phrase "no timber" also appears frequently in the surveyors' notes, but it is not included in the figures presented in this column. "No timber" meant that timber cutting would not be an economical land use, not that no trees were present at all.

c. This township was surveyed by Theodore White in 1873; the others were surveyed by John Harris in 1879. White appears to have noted the presence or absence of witness trees only at section corners, not at quarter-section corners.

d. The referent of this term is unknown—cottonwood?

A number of items are conspicuous by their absence from the early surveyors' field notes. There is no mention of beaver or livestock, for example. One may assume that both were present, perhaps in significant numbers, and that the surveyors simply did not consider it within their mandates to make note of them.

Also absent is any evidence of downcutting or incision of the main river channel anywhere downstream of the Narrows. In this case, the omission probably indicates that downcutting had not yet occurred in the study area. If it had, it would have made irrigation by acequias much more difficult, as diversions would have had to be located far upstream to deliver water to fields on the adjacent terraces—something that would not have escaped the surveyors' notice. Later surveyors notes specifically describe steep cut banks on both sides of the river (see below).

## THE CATTLE BOOM, DROUGHTS, AND ENVIRONMENTAL CHANGE, 1880-1905

The 1880s and 1890s were a period of dramatic growth in livestock production in southern Arizona, part of the post-Civil War Cattle Boom across the western United States. With the removal of the Apaches, vast areas of grasslands were suddenly available for settlers' sheep, goats and cattle, which moved into the area in enormous numbers from Texas, California and elsewhere (Morrisey 1950; Sayre 1999). The ecological effects of the Cattle Boom were complex, particularly because they unfolded simultaneously with the effects of mining, timber cutting, agricultural clearing, and the construction of roads, irrigation systems and railroads (Dobyns 1981). Nevertheless, it is well established that during recurrent severe droughts the number of livestock in southern Arizona was much higher than the grassland resource could support.

Outside of homesteads, the land was open to all users; fencing the public domain was both illegal and prohibitively expensive. Under these conditions, the key to controlling enough land for one's livestock was to control the limited natural water sources. A special report of the 1880 census remarked that in Pima County—which until 1881 included present-day Cochise County—"every water-claim adapted to the business had in 1880 a herd of cattle or less frequently a flock of sheep relying upon it" (Census 1883).

The census office estimated that the entire San Pedro valley contained not more than 8,000 cattle and 12,000 sheep in 1880. It described livestock production in the lower San Pedro[3] as dominated by small producers, mostly Mexican and Mormon, with cattle herds of 50 to 250 head each and/or small flocks of sheep. Unfortunately there are no comparably detailed accounts in subsequent censuses. Figures are available only for Cochise County as a whole. They indicate that the number of cattle in the county nearly tripled between 1884 and 1891, from 33,000 to 95,000.

Numbers plummeted due to the drought of 1891-1893, to a low of 43,000 in 1894, then rose steadily again until 1900. Another drought then brought numbers down once again, from 70,000 in 1900 to 30,000 in 1904. These numbers derive from tax assessors' records—the actual number of cattle was probably 1.5 to 2 times higher (Wagoner 1952). Significant numbers of goats and sheep may also have been present in some areas, such as Aravaipa (Hadley et al. 1991) and Happy Valley (see below).

Few details of the Cattle Boom in the study area have emerged previously or from the research conducted for this report. Interviewees made no mention of grazing during the period, probably because it predated their familiarity with the area. The public agencies that currently manage state and federal lands in the study area did not exist until after 1900, and their records contain no earlier information.

[3] Understood as the area downstream of Babocomari Creek. Curiously, the report described this as poor grazing land: "for many miles [these lands] are sandy and almost barren stretches, only relieved by the gietta-grass [sic] and greasewood, or in some localities by abundant mesquit brush and mescal, with varieties of the cactus, valueless to cattle."

The best descriptions available are those provided by two major ranchers whose herds extended into the study area: Henry Hooker and Charles Bayless. Hooker's Sierra Bonita Ranch was located at the headwaters of Aravaipa Creek, on the northeast side of the Galiuro Mountains. Hooker had between 10,000 and 20,000 head of cattle, and he estimated that the Sulphur Springs valley had 50,000 head in the 1880s (Griffiths 1901). Some of these animals undoubtedly ranged into the lower San Pedro valley. Bayless's father began ranching in the Redington area in 1885, and his lands eventually extended around the north end of the Santa Catalina Mountains to Oracle and Catalina (Santiago 1994). Both Hooker and Bayless responded to a questionnaire sent by David Griffiths of the U.S. Department of Agriculture in 1901, inquiring about past range conditions. Their answers are reproduced in Boxes 2 and 3.

**Box 2. Henry Hooker's description of past and present rangeland conditions, 1901.** Source: Griffiths 1901.

The San Pedro Valley in 1870 had an abundance of willow, cottonwood, sycamore, and mesquite timber, also large beds of saccaton [sic] and grama grasses, sagebrush, and underbrush of many kinds. The river bed was shallow and grassy and its banks were beautiful with a luxuriant growth of vegetation. Now the river is deep and its banks are washed out, the trees and underbrush are gone, the saccaton has been cut out by the plow and grub hoe, the mesa has been grazed by thousands of horses and cattle, and the valley has been farmed. Cattle and horses going to and from feed and water have made many trails or paths to the mountains. Browse on the hillsides has been eaten off. Fire has destroyed much of the shrubbery as well as the grass, giving the winds and rains full sweep to carry away the earth loosened by the feet of the animals. In this way many waterways have been cut from the hills to the river bed. There is now little or nothing to stop the great currents of water reaching the river bed with such force as to cut large channels and destroy much of the land under cultivation, leaving the river from 10 to 40 feet below its former banks. Thus it has caused much expense in bringing the water to the cultivated lands, and necessitated much labor to dam up the channel and keep the irrigating ditches in repair.

Hooker's description is rather general and may reflect conditions upstream or downstream of the study area; Bayless, however, was intimately familiar with the study area, especially around Redington. At the time, both men were involved in political efforts to create a lease system for grazing on the public domain, and this may have led them to dramatize the damage of the open range somewhat and to focus too narrowly on cattle. It is now understood that channel cutting occurred prehistorically as well, and that as a geomorphic-hydrological phenomenon it cannot be reduced to overgrazing alone (Hereford 1993). Mining, timber cutting, irrigation diversions, roads and railroads, beaver extirpation and perhaps the 1887 earthquake were other contributing factors, if indeed entrenchment was human-caused at all (Dobyns 1981; Hereford 1993; Bahre 1998).

**Box 3. Charles Bayless's description of past and present rangeland conditions, 1901.** Source: Griffiths 1901.

About twelve years ago the San Pedro Valley consisted of a narrow strip of subirrigated and very fertile lands. Beaver dams checked the flow of water and prevented the cutting of a channel. Trappers exterminated the beavers, and less grass on the hillsides permitted greater erosion, so that within four or five years a channel varying in depth from 3 to 20 feet was cut almost the whole length of the river. Every year freshets are carrying away new portions of the bottom lands. At present this valley is a sandy wash from bluff to bluff, while the few fields remaining are protected from the river at large and continuous expense. Thus, in addition to curtailing the area of good land, the deep channel has drained the bottoms, leaving the native grass no chance to recover from the effects of close pasturing. It also makes it more difficult to get irrigating water onto the surface of the land.

Of the rich grama grasses that originally covered the country so little now remains that no account can be taken of them. In some parts of the foothills alfilaria furnishes limited but excellent pasture during the spring and early summer. Where stock water is far removed some remnants of perennial grasses can be found. Grasses that grow only from seed sprouted by summer rains are of small and transitory value. The foliage of the mesquite and catsclaw bushes is eaten by most animals, and even the various cacti are attempted by starving cattle. However, the thorns and spines of the cacti more than offset the value of the pulp. No better pasture was ever found in any country than that furnished by our native grama grasses, now almost extinct…

Twelve years ago 40,000 cattle grew fat along a certain portion of the San Pedro Valley where now 3,000 can not find sufficient forage for proper growth and development. If instead of 40,000 head 10,000 head had been kept on this range, it would in all probability be furnishing good pasture for the same number to-day. Very few of these cattle were sold or removed from the range. They were simply left there until the pasture was destroyed and the stock then perished by starvation.

There is also no way to corroborate Hooker's and Bayless's figures for cattle numbers in the area or to infer stocking rates, since the range was not fenced. These are only minor qualifications, however, and the central details of their accounts are consistent with the available evidence for the study area and with patterns observed elsewhere in the region. During drought periods the demands of livestock far exceeded forage production, resulting in overgrazing at virtually all sites within five miles of a water source. When heavy rains returned, severe erosion ensued. Entrenchment in turn triggered a series of environmental changes: desiccation of former cienegas and floodplains, loss of sacaton meadows and streamside forests, and gradual encroachment of mesquite and other shrubs into the terraces adjacent to the new channel. These changes wiped out or rendered

useless existing diversions and acequias, forcing settlers to make expensive investments to repair, lengthen, and protect their irrigation systems.

The precise date of entrenchment in the study area is a matter of debate. There were areas further upstream that may have been entrenched in the 1850s (Cooke & Reeves 1976), although Hereford (1993) disputes this interpretation of early accounts. He argues that entrenchment occurred at a few sites in the Upper San Pedro after about 1882 and more generally after 1890. The latter date is consistent with Bayless's description, which suggests entrenchment occurred shortly after 1889. An unnamed farmer residing "in the river valley eighteen miles north of Tres Alamos"—perhaps Antonio Soza—told a newspaper that a flood in August 1890 had "dug down the channel of the San Pedro river an average of ten feet" (Dobyns 1981). This may well have been the same flood that washed away Soza's adobe house, his flour mill, and all but one of his hogs (Soza 1939).

Most likely, entrenchment began at discrete sites along the river and expanded rapidly during subsequent flood events. Severe floods recurred in the study area in 1891, 1905 and 1916 (Dobyns 1981), and by far the largest peak flow ever measured was in 1926, when the railroad bridge at Benson was destroyed (Hereford 1993).

When government surveyors returned to the study area in later years, they recorded the depth and location of steep cut banks adjacent to the river. Francis Jacobs' survey notes for T14S R20E, surveyed in 1901-1902, describe banks 14 and 15 feet high. The boundary of T13S between R19E and R20E was resurveyed in 1923; the notes describe the San Pedro as "a shallow stream of muddy water, 100 lks. [66 feet] wide, flowing…between banks 20 ft. high." Further north, the south boundary of T12S R19E was resurveyed in 1933. There, the surveyor encountered "dense mesquite" immediately east of the river and banks 7 and 8 feet high on the sides of the main channel—both new developments since 1879.

No comprehensive analysis of entrenchment has been done for the study area, but Hereford (1993) analyzed entrenchment of the Upper San Pedro. He found that the channel grew rapidly from 1890 to 1955, and that after that date the rate of growth declined abruptly. He concluded that in the post-1955 period, "the river system has adjusted to the entrenchment disturbance and has probably attained, or is close to attaining, a new equilibrium with a quasi-stable channel configuration" (Hereford 1993: 40-41). Hereford viewed entrenchment as at least partially due to shifts in climate rather than human activities, and he speculated that 450 years might be needed for the channel to aggrade on its own.

Entrenchment did have one benefit, which was widely acknowledged at the time: it eliminated the cienegas where malarial mosquitoes had bred (Dobyns 1981). Aside from this, however, entrenchment was a significant and enduring environmental change for the worse, one that has prompted remedial efforts ever since.

**Box 4. General descriptions of three sites in the study area from later surveys.**
Source: GLO surveyors' notes.

*Downstream of the Narrows* (T14S R20E), 1902:
The River Valley is covered with dense mesquite so thick that one cannot walk through it. The South East part slopes, from a high divide on the East, to the river, and is covered with various thornbushes and cacti… The San Pedro River flows through the Tp from S. to N. at the time of the survey there was about 1500 inches of water running in the River and the farms along the valley are irrigated therefrom.

*Buehman Canyon area* (T12S R18E), 1921:
There is very little timber of any kind. On the higher portions is some scattering mesquite and palo verde. A few sycamore, willow and alder are found along Buehman Canyon. The undergrowth is principally greasewood, ocotillo, Spanish dagger and catclaw. There is a fair growth of grass. Buehman Canyon contains an intermittent stream of water, which is the only water in the township… C.C. Parker has a homestead in sec. 7.

*Paige Canyon area* (T14S R19E), 1923:
…scattering growth of mesquite and oak on the mountain spurs, while along Turkey Creek in Paige Canyon are found sycamore and cottonwood trees, which are very large… The west half of the township is covered with a fair growth of nutritious grasses, which furnishes good pasture for horses and cattle, the southern and eastern portions having a heavier growth of brush undergrowth, which furnishes excellent pasture for goats and sheep. There is one settler in each of the following secs. 7,18,20,28 and 31, all of whom are engaged in stock raising to which the township is best adapted.

## CONSOLIDATION AND COMMERCIALIZATION

Homesteads were too small to be viable ranching operations by themselves, and entrenchment of the San Pedro made irrigated agriculture more difficult: longer ditches were needed to convey water to fields that now stood 10-20 feet above the main channel. Entrenchment also altered the flood regime and habitat characteristics of the river corridor: sacaton grasslands converted to mesquite bosques due to the dropping alluvial water table and the absence of periodic flooding. Combined with droughts and financial crises, these changes helped drive many homesteaders out of business. Between 1885 and 1940, landownership was consolidated into fewer and larger properties, and land tenure on state and federal lands was rationalized under systems of leasehold. Consolidation both responded and contributed to a decline in subsistence-oriented production and the rise of solidly commercial farms and ranches specializing in a smaller number of products.

### *Private landownership*

The largest and best-documented instance of consolidation was the Reddington [sic] Live Stock Company, a subsidiary of the Bayless and Berkalew Company. William Bayless purchased his first land in the study area in 1884, near Redington. With financial backing from Jehiel W. Berkalew of New York, William and his son, Charles, acquired dozens of homesteads over the following four decades. In 1886 they bought the Redfield ranch and three other properties. Drought and flooding forced seven families to sell to Damoetas Markham in 1890, and the following year Markham sold his holdings to Bayless and Berkalew. Some properties were acquired by payment of back taxes; others were bought from Louis Zeckendorf and Albert Steinfeld, Tucson merchants who had foreclosed on homesteads put up as collateral for loans. Still others were purchased outright, such as the homesteads of Jacob Youtcy (1900), Antonio Comaduran (1901) and Juan Ochoa (1901). By 1910 the Carlink Ranch extended nearly 20 miles down the San Pedro from above Redington to near San Manuel. In addition, the Bayless and Berkalew Company bought large land holdings near Oracle, Catalina and Tucson. They raised premium cattle, sheep, hogs, sorghum, alfalfa, vegetables and wheat (Santiago 1994). Near the end of his life, in the mid-1930s, Charles Bayless divided the ranch into three parts, giving his neice and nephew-in-law the Carlink Ranch and selling the other pieces to the Rhodes and Bingham families.

Elsewhere in the study area, Antonio Campa Soza played a similar role on a somewhat smaller scale, buying out the mostly Mexican-American homesteaders surrounding his family's homesteads. Soza had a chapel and a school built to serve the small community, and his children married into many of the homesteaders' families—Vigil, Apodaca, Saenz, and Gonzales, for example (Soza 2004). The present-day Three Links Farm, between Palomas Wash and the Narrows, was consolidated by Harry Saxon in the 1920s (Barbara Clark interview).

**Wheat fields on the Carlink Ranch, circa 1900.** Photo courtesy of the Smallhouse family.

Consolidation did not necessarily mean depopulation, however. The population of the Pool voting precinct—roughly the southern half of the study area—increased from 108 people in 1910 to 160 in 1920 and 175 in 1930 (Census rolls).[4] Enlarged farms required large labor forces for planting, cultivating, irrigating and harvesting crops. The declining level of the San Pedro increased labor demands further: longer and more robust irrigation works were required to transport the water, and the gradual conversion of floodplain grasslands to mesquite made clearing and maintaining cultivated fields more difficult. Large numbers of cowboys were needed to gather and work herds of cattle on upland ranges that remained mostly unfenced until the 1930s (see below). Subsequently, grazing allotments required fencing and the development of water sources (windmills, wells, improved springs, and earthen tanks) in addition to traditional cowboy work. Often, smallholders did not physically move when they sold out but instead became employees of the new owners, perhaps even remaining in their own old houses (Santiago 1994).

There were also smaller farm properties, especially in the southern half of the study area, that experienced only limited consolidation until the Depression. The 1920 Census rolls for the Pool voting precinct indicate that the Apodaca, Arandulez, Sanchez, Fautimes, Soza, Vasquez, Gamez, Salas, Rivera and Mungia families continued to own their own properties, and that all were held free (i.e., not mortgaged). It appears this community of Mexican-American small farmers persisted in the blend of subsistence production, barter, and outside wage labor that had characterized the earlier reoccupation of the area (Martin 2004). They grazed their livestock on the surrounding state or public domain rangelands—none of their names appears in the records of the Forest Service. Several of

[4] Comparable figures for the Redington area are not available, because it was lumped with the rest of northeastern Pima County, including the northeastern Tucson basin.

these properties consolidated in the late 1930s and 1940s to form the C Spear Ranch—apparently triggered by drought, the Depression, and the fencing that followed the Taylor Grazing Act. Further upstream, the Bidegain family consolidated holdings between Pool Wash and Palomas Wash during the Depression (Pete Bidegain interview, 28 April and 3 June 2004).

### *Fences and grazing leases on state and federal land*

The Santa Catalina and Galiuro Forest Reserves were created in 1902, followed in 1907 by the Rincon Forest Reserve. The Catalina and Rincon reserves were folded into the Coronado National Forest in 1908, at which time the Galiuro reserve became part of the Crook National Forest. In 1953, the Crook was incorporated into the Coronado (Hadley 2001).

Beginning in 1905, the Forest Service was legally empowered to allocate the forage resources of these lands among local ranchers. In theory, ranchers received grazing "preferences" based on historical use: where their animals had grazed and in what numbers. Ranchers were also expected to have private or leased land in the area sufficient to support their herds. The idea was to give individual ranchers long-term, exclusive legal tenure so that they would have an incentive to conserve the range. Similar legal mandates were given for Arizona state lands after statehood in 1912, and for the remaining public domain under the Taylor Grazing Act of 1934.

Assigning grazing preferences proceeded fairly quickly on the Forest Service lands; in 1908, for example, Ollie Barney received a preference for his goat herd in the Happy Valley area. Most state land sections had to be selected from the public domain by the State Land Selection Board, a legal process that ranchers often instigated in order to obtain secure tenure (Sayre 2002). The state land in the study area was selected no later than 1940 (Figure 4), and probably by about 1920.

To be fully effective, however, the lease systems required fencing to demarcate and enforce allotment boundaries, and in the study area this was an extremely expensive proposition because of the rugged terrain. State lands, although generally less steep than Forest Service allotments, had to be fenced at the lessees' expense. Forest Service files suggest that fencing was not widespread in the study area until the 1930s at the earliest, and that most allotment boundaries were not fully fenced until the 1960s (see below). Many fences may have been constructed by Civilian Conservation Corps crews such as the one that was based in the Rincon valley.

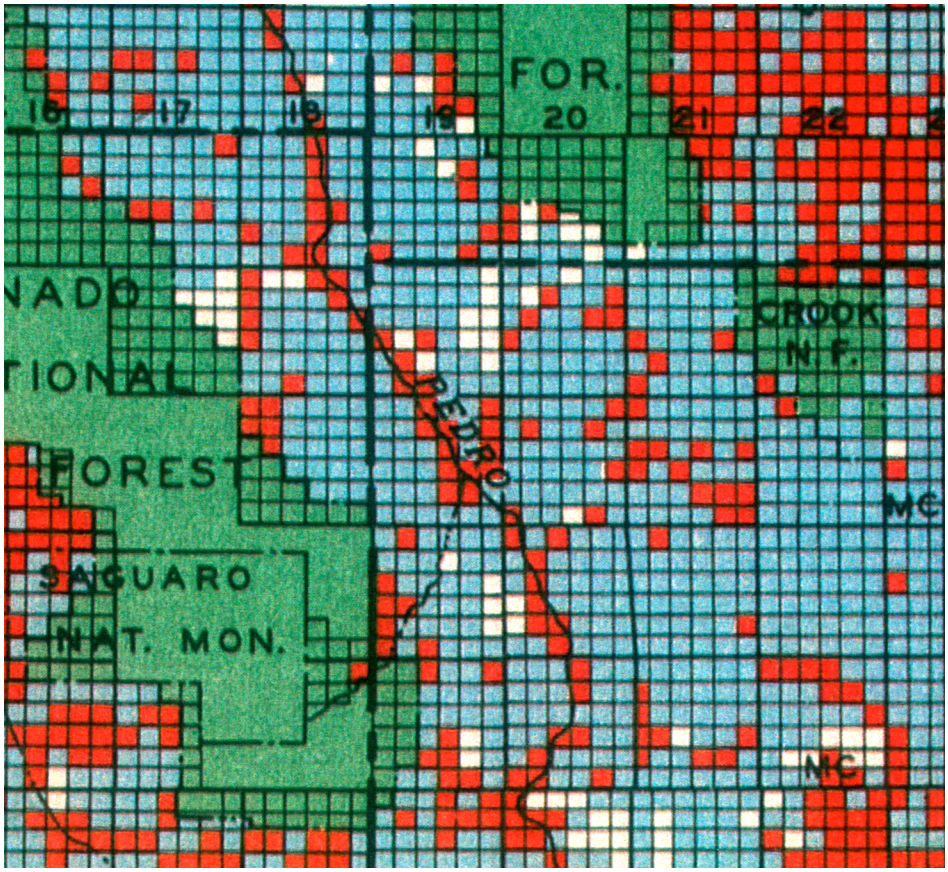


**Figure 4. Land status in the study area, 1942.** Red = private; blue = state; white = "vacant land" (future BLM). Source: (SCS 1949).

The recollections of interviewees are broadly consistent with this timeline, although the precise date of fence construction on non-forest lands is somewhat unclear. Pete Bidegain, whose father owned the Pool Ranch from the early 1930s to around 1960, recalls that fencing began in the 1930s, and that before that time his father used to capture wild horses in the area (interview, 28 April 2004). His sister-in-law, Scottie Bidegain, who lived at the ranch from 1941 to 1952, recalls that the range was fenced, but that rotational management was impossible for lack of interior ranch fences (interview, 5 May and 26 May 2004). But Jean Russell, who owned another ranch in the area in the 1940s, recalls that the range was open (interview, 7 May 2004)—this may have been the case longer on some ranches than others.

Unfortunately, the State Land Department has not maintained archives of records pertaining to its grazing leases. The Bureau of Land Management, which has administered Taylor Act lands since 1948, also has very little historical documentation.

The construction of fences fundamentally changed the conditions for grazing management in the study area. Previously, livestock movements were dictated by topography, water and forage availability, and (to a greater or lesser extent) by the

activities of cowboys or herders (including both herding work and the placement of salt blocks). Animals from neighboring ranches intermingled, concentrating in areas of better feed, water, or microclimates (e.g., shade during the summer). Annual and seasonal round-ups were necessarily joint undertakings by all the ranchers in the area.

With fences in place, the levels and locations of grazing pressure could be more easily controlled. Topography, forage and water availability, microclimates and human activities remained important factors within a fenced ranch or allotment, but mingling among herds and inter-ranch labor cooperation became the exception rather than the rule. Perhaps most important, fences enabled ranchers and agencies to regulate the number of animals utilizing a given area.

## MODERN FARMING AND RANCHING

Much as fences modernized grazing management in the study area, ground water pumping modernized farming, especially after electrification of the study area in the late 1950s. Pumping was particularly important because entrenchment of the river channel had made maintaining gravity-powered systems increasingly difficult and expensive. Combined with a growing array of modern agricultural technologies—from tractors and sprinkler systems to fertilizers, pesticides and modern seed varieties—ground water irrigation made farming an increasingly capital-intensive and large-scale enterprise.

Modern farming and ranching required less and less human labor (per unit land or output) over time, as capital investments substituted for the work of cowboys, irrigators and field workers. The population of the study area began to decline as people sought employment elsewhere or gave up agriculture altogether. World War II accelerated this trend, both by exposing local people to broader horizons and by compelling producers to get by with fewer employees. The development of a major copper mine just north of the study area, at San Manuel, further impinged on the labor pool and the agricultural ethos of Redington and Cascabel.

The overall trends within agricultural production during the middle and late 20$^{th}$ century were two: first, expansion of irrigated cropland by clearing mesquite and installing ground water-based irrigation systems; second, integration of farming and ranching by planting fields to pasture or hay species instead of market crops, or growing hay for sale to other livestock producers. The major exception was the Bingham family, which continued to grow a variety of vegetables for sale in towns such as San Manuel.

Natural resource conditions remained dynamic, although the changes in this period were less dramatic than earlier ones. Trees, cacti and brush encroached on grasses in upland ranges, due primarily to fire suppression and secondarily to livestock grazing. Lehmann lovegrass, a perennial bunchgrass introduced from South Africa, increased as well above about 3000 feet elevation. A non-native tree, saltcedar (tamarisk), colonized the river channel quickly in the 1950s; according to Zimmermann (1969), saltcedar was the dominant vegetation on 451 acres of bottomland between Tres Alamos and Redington in 1964, although it was absent from a 7-mile reach near Redington and virtually absent from tributary drainages. Based on field mapping and aerial photos, Zimmermann also reported that broadleaf forests—composed of walnut, hackberry, ash, sycamore, willow and cottonwood—were limited to tributary drainages, occurring at only one site on the San Pedro River proper, near the mouth of Edgar Canyon two miles downstream from Redington. More recent studies indicate that cottonwood and willow gradually reasserted themselves after 1965, apparently favored by higher than normal winter rainfall from 1975 to 1995 (Fichtel 1998). Loss of floodplain lands to entrenchment continued but at a much slower rate (see above). Perhaps most notable was the loss of perennial flow from long reaches of the San Pedro River after approximately 1940 (Jean Russell interview, 7 May 2004). This was presumably due to increased water use by trees in the river corridor and withdrawals for irrigation.

### *Surface and ground water rights*

The vast majority of surface water rights in the study area are dated to the 1880s (Table 5). After a flush in the 1910s, surface water development dropped off until the 1950s, then grew through the 1970s before diminishing again. These patterns probably reflect the overall intensity of agricultural expansion in the area, and secondarily, the need to develop new points of diversion as entrenchment proceeded.

Obtaining water from wells for domestic purposes began no later than 1909, if the dates attached to formal ground water rights are accurate. The earliest ground water right specifically for irrigation purposes is dated 1923. The 1950s witnessed a sharp spike in the establishment of ground water rights in the study area, including rights specifically filed for irrigation purposes (Table 5). Initially large pumps were powered by diesel or gas; electricity became available in the late 1950s. The pattern prevailed until the 1990s, when establishment of irrigation ground water rights declined but overall ground water rights increased, evidently due to residential development (Table 5, see below). As of 1990, an estimated 8,583 acre-feet per year of water were used for irrigation between the Narrows and Redington (Fichtel 1998; Lombard 1998).

**Table 5. Surface and ground water rights established in core of the study area, by decade.** Area covered is T11S R18-19E, T12S R18-19E, T13S R19-20E, T14S R19-20E. Note large number of undated rights and preponderance of surface water rights dated to the 1880s. Source: Arizona Department of Water Resources.

| Decade | A. Surface water rights (number) | B. Ground water rights (number of all kinds) | C. Ground water rights, domestic (number) | D. Ground water rights, irrigation (number) | E. Total capacity of wells in column D (gallons/minute) |
|---|---|---|---|---|---|
| 1870s | 33 | | | | |
| 1880s | 1977 | | | | |
| 1890s | 11 | | | | |
| 1900s | 112 | 6 | 2 | | |
| 1910s | 277 | 2 | 0 | | |
| 1920s | 50 | 6 | 1 | 1 | 750 |
| 1930s | 120 | 10 | 3 | 1 | 1000 |
| 1940s | 136 | 26 | 5 | 8 | 7000 |
| 1950s | 275 | 45 | 7 | 14 | 11215 |
| 1960s | 242 | 34 | 5 | 14 | 10797 |
| 1970s | 379 | 36 | 10 | 18 | 9552 |
| 1980s | 40 | 47 | 24 | 18 | 8067 |
| 1990s | 14 | 54 | 33 | 6 | 1355 |
| no date | 429 | 151 | 38 | 11 | 775 |

***Development of irrigated cropland***

Aerial photographs of the study area have been taken at roughly 20-year intervals going back to 1935. Although some sets are incomplete, these photos provide an objective measure of cultivated lands along the San Pedro over the past 70 years.

Table 6 presents acreage figures from the aerial photos for the 52 farmland parcels identified in Task 4E: Private Farmland and Residential Land Assessment. Acreages were derived by comparing 1996 aerial photos with earlier sets and visually estimating the size of each past field as a percentage of its 1996 size. Unfortunately, not all of the historical photo sets were complete.[5] An additional six fields are found in the historical aerial photos but not in the 1996 set or in Task 4E.[6]

Only two historical photo sets—1935 and 1987—are sufficiently complete to allow comparison for the entire study area. They show a 247 percent increase in irrigated acres over the fifty-two year period, from 1,292 to 3,186. In the subsequent nine years the total increased only five percent more.[7]

Looking more closely at those areas covered by the intervening photo sets, from 1955 and 1967, one can conclude that the majority of the increase occurred between 1955 and 1967, a period when agricultural prices were good and electricity made ground water pumping more convenient. In the southern half of the study area—for which the aerial coverage is complete—farmland totaled 687 and 690 acres in 1935 and 1955, respectively. In 1967, the same reach of the river had 1,617 acres under irrigation—a 234 percent increase. In 1987 it had increased another nine percent to 1,765 acres, and in 1996 the total was 1,893 acres. If one includes the 10 parcels covered in all sets except 1967, the rates of change are similar: a small increase from 1935 to 1955 (782 to 858 acres), followed by a 240 percent increase over the period 1955-1987 (2,061 acres).

In 1947, the Soil Conservation Service calculated that the Redington District had approximately 1,621 acres of farmland (SCS 1947); 1996 aerials indicate 3,284 acres cleared and 2,888 acres in use. If the 1947 figure is accurate, it suggests that the expansion commenced well before 1955, probably due to growth during and after World War II.

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[5] Two parcels were unavailable in the 1935 set, and another 14 had to be examined using the index photo rather than the original, full-sized photos, which have apparently been lost. The 1955 set was missing for 16 parcels, and 10 parcels lacked coverage in the 1967 set (which was taken for the Arizona Department of Transportation as part of its state highway evaluation rather than by the Soil Conservation Service/Natural Resources Conservation Service).

[6] The locations and dates of these are as follows: 1) north of field 11 and south of field 17—1955 photo set only; 2) east of the river and north of mouth of Paige Canyon—1935 and 1955; 3) east of Hot Springs Canyon and north of the river—1955 only; 4) west of river adjacent to field 28—1935 only (visible but overgrown in 1955); 5) opposite the river from field 14—1967 only; 6) opposite the river from fields 20 and 21—1967 only.

[7] The Nature Conservancy estimate of irrigated farmland is slightly higher: 3,770 acres as of 1990 (Fichtel 1998).

**Table 6. Development of farmland in the study area, 1935-1996 (in acres).** Fields numbered according to Task 4E. n/a = aerial photo of that site and date not available; blank = no farmland at that site and date. Source: NRCS and other aerial photo sets.

| Field # | 1935 size | 1955 size | 1967 size | 1987 size | 1996 size |
|---|---|---|---|---|---|
| 1 | | | 85 | 85 | 85 |
| 2 | | | 235 | 235 | 235 |
| 3 | | 25 | 100 | 100 | 100 |
| 4 | | | 200 | 200 | 200 |
| 5 | 75 | 75 | n/a | 75 | 75 |
| 6 | | | 35 | 35 | 35 |
| 7 | 50 | 50 | n/a | 50 | 50 |
| 8 | 75 | 75 | 153 | 153 | 153 |
| 9 | 150 | 150 | 150 | 150 | 150 |
| 10 | | | 28 | 28 | 28 |
| 11 | | 50 | 50 | 50 | 50 |
| 12 | | | 73 | 73 | 73 |
| 13 | | | | 23 | 23 |
| 14 | | | 50 | 50 | 50 |
| 15 | 10 | 10 | 20 | 20 | 20 |
| 16 | 43 | 43 | 43 | 43 | 43 |
| 17 | 20 | 20 | 100 | 100 | 100 |
| 18 | | | 40 | 40 | 40 |
| 19 | 63 | | 63 | 63 | 63 |
| 20 | | 4 | 4 | 4 | 4 |
| 21 | 100 | 100 | 100 | 100 | 100 |
| 22 | | 60 | 60 | 60 | 60 |
| 23 | 8 | 8 | 8 | 8 | 8 |
| 24 | 20 | 20 | 20 | 20 | 20 |
| 25 | | | 25 | 25 | 25 |
| 26 | 73 | 73 | 73 | 73 | 73 |
| 27 | | | 30 | 30 | 30 |
| 28 | | | n/a | 23 | 23 |
| 29 | 25 | 25 | n/a | 25 | 25 |
| 29A | | | n/a | | 20 |
| 29B | | | n/a | | 15 |
| 30 | | | n/a | 50 | 50 |
| 31 | 35 | 35 | n/a | 35 | 35 |
| 32 | 20 | 20 | n/a | 20 | 20 |
| 33 | 15 | 15 | n/a | 15 | 15 |
| 34 | 84 | n/a | 84 | 113 | 113 |
| 35 | 78 | n/a | 78 | 78 | 78 |
| 36 | | n/a | 50 | 50 | 50 |
| 37 | | n/a | 30 | 30 | 30 |
| 38 | | n/a | 70 | 70 | 70 |
| 39 | 64 | n/a | 98 | 98 | 98 |
| 40 | 106 | n/a | | 133 | 133 |
| 41 | | n/a | | 120 | 165 |
| 42 | 35 | n/a | 40 | 70 | 70 |
| 43 | 88 | n/a | 108 | 135 | 135 |
| 44 | | n/a | 20 | 80 | 140 |
| 45 | 37 | n/a | 43 | 43 | 43 |
| 46 | | n/a | | 45 | 25 |
| 47 | 18 | n/a | | 45 | 45 |
| 48 | n/a | n/a | 12 | 15 | 5 |
| 49 | n/a | n/a | n/a | n/a | 18 |

Prior to entrenchment, croplands had been developed out of sacaton grasslands. As the river channel lowered, the alluvial water table dropped below the root zone of sacaton, and the absence of periodic floods allowed mesquite trees to establish. By 1930, sacaton meadows had converted to mesquite bosque through most of the study area. With their tap roots easily accessing water 20-40 feet below ground, mesquites could grow large quite rapidly on the terraces along the river. A 1937 University of Arizona Agricultural Experiment Station Technical Bulletin (Nichol 1937) even characterized the mesquite bosques between Cascabel and Redington as "remnant areas of the original stands" known to have lined major rivers prior to Anglo settlement. This was clearly a misperception, as no significant bosques had been observed in that reach by surveyor John Harris in 1879 (Table 4).

At mid-century, then, cropland development generally required significant investments in mesquite removal, and most of the expansion of fields came at the expense of bosques. Some studies suggested that large mesquites consumed about as much water per unit area as alfalfa (Don Decker interview, 8 September 2004), and some farmers aggressively set about removing the bosques. "By late 1965, about 3,900 acres or about half of the mesquite forests growing on the presumed pre-1880 flood plain between Tres Alamos and Redington had been cleared" (Zimmermann 1969). At the Carlink Ranch around Redington, the costs of mesquite removal were offset (at least in part) by proceeds from the sale of lumber and charcoal (McKelvey 1958a).

### *Comparing two droughts: the 1930s and the 1950s*

Interviewees remembered the drought of the 1930s as much worse than that of the 1950s, even though climate experts consider the latter drought much more severe. There appear to be two reasons for this.

First, the farms and ranches in the area were insulated from the worst drought effects by their irrigated land. As long as there was water for irrigation, crops could be raised to sell or pasture could be grown to sustain livestock. The practice of irrigating pasture for livestock to use either in drought or during a portion of the year was common as early as the 1930s (Scottie Bidegain interview, 5 May and 26 May 2004). The development of ground water increased significantly in the 1950s (Table 5), perhaps in response to severe drought conditions.

Second, the 1930s drought occurred at a time of economic depression, when prices for agricultural commodities were extremely low. Cattle prices, for example, were so low that the federal government's drought relief program bought animals for ten dollars apiece and then killed them, on site, to prevent further range degradation. (Pete Bidegain's father found the program so abhorrent that he bid against the government for his neighbors' animals and took them to permanent pasture near Willcox (interview, 28 April and 3 June 2004).) The 1950s, in contrast, was a period of relative prosperity and significant growth for agricultural producers. (This could backfire on producers, however. Scottie Bidegain (interview, 5 May and 26 May 2004) recounted that her

family went into debt to expand their operation in the early 1950s, only to be caught during a price drop in 1952.)

### *Formation of the Redington Soil Conservation District*

The Redington Soil Conservation District—now known as the Redington Natural Resources Conservation District—was formed in April 1947. Its first supervisors were Kingston Smallhouse, Mike Bidegain and Carlotta Claflin. To explain the rationale for the District's creation, a short paper was prepared by the Tucson office of the Soil Conservation Service and read at the district's first official meeting. Entitled "The Redington Soil Conservation District: It's Problems, Their Solutions" (SCS 1947), the paper included a brief description of the area and a list of county, state and federal institutions that would serve as formal cooperators with the new district. Most of the paper described the problems of ongoing erosion and entrenchment in the study area:

*In its native state the San Pedro Valley was a large sacaton draw subject to seasonal flooding from rains upstream. It had a very minor channel which is believed to have been intermittent rather than continuous… Man-induced influence on the valley floor and the watershed above has caused serious flooding and deterioration. The channel of the San Pedro is now in places several hundred yards in width and has eroded to depths in excess of 20 feet. Huge areas of fertile land, almost complete farms, have been completely removed. Its present floor is a sand bed and for most of the year bears only a small stream of water. Following rains on the watershed, however, this stream becomes a raging torrent and continues to destroy its flood plain by bank cutting. Its silt-laden water in times of flood destroys the small dams which divert irrigation supplies to the land… The depth of the river channel has intensified the problem of diverting irrigation supplies and necessitated the maintenance of long irrigation ditches to bring the water on grade to the land.*

Other problems were mentioned much more briefly, including noxious weeds, rodents and insect pests. Some problems were contained within individual properties, but many were larger in scope. And because nearly all the farms bordered the river, flood and erosion were common problems. "The maintenance and improvement of the farming in the district is dependent upon concerted action to solve these problems. The district proposes to make a unified and comprehensive attempt toward their solution."

How the district's boundaries were chosen is not recorded in meeting minutes from the time. It is noted, however, that "the members in attendance represented 85 percent of farm land in [the] proposed district," suggesting that the boundaries reflected voluntary interest in participating.

### *Modernizing irrigation*

From 1947 on, most farmers and ranchers have coordinated their improvements with the Redington District, drawing on cost-sharing programs and technical expertise provided

by the Soil Conservation Service (now NRCS). A major element of farming has been updating and improving irrigation systems: to repair or prevent flood damage, improve water use efficiency, or capitalize on technological or market changes. Between 1967 and 1987, a farm at the mouth of Teran Wash converted an old field to a pecan orchard. Throughout the district, irrigation diversions and ditches gradually gave way to wells and pipelines; flood irrigation was replaced by sprinkler systems. This occurred, for example, in the late 1970s and early 1980s on the Cascabel Land and Cattle Company's farm at the mouth of Kelsey Wash. From aerial photos, it can be seen that center-pivot sprinkler systems began to replace side-roll technology in the southern portion of the study area between 1967 and 1987. Today, only the Carlink Ranch continues to divert water directly from the San Pedro, and most of its fields are irrigated with sprinklers instead.

Irrigation improvements have made water use more efficient (and less labor intensive) per acre of farmland, but gross water use has nonetheless increased due to the growing area of farmland in the study area. This increase correlates roughly with the disappearance of perennial surface flow in long reaches of the San Pedro, which Jean Russell (interview 7 May 2004) dates to around 1940. If Russell's date is correct, however, other factors must also be considered such as the 1930s drought and increased evapo-transpiration by mesquite bosques (compared to sacaton meadows), since the jump in ground water pumping occurred slightly later.

### *Regulated grazing on Forest Service Allotments*

As mentioned above, there is very little documentary information regarding state and BLM grazing lands in the study area. This gap makes historical analysis of the lower elevation rangelands difficult. For Forest Service lands, however, significant information can be found in the files for six allotments in the Catalina and Rincon Mountains and three allotments in the Galiuros. Although the files represent the perspective of Forest Service personnel almost exclusively, they nonetheless provide our best picture of the management issues faced by ranchers in the district since about 1930.[8] The most comprehensive reports date from around 1955 to 1980.

In general, the issues and problems were very similar across all nine allotments. In the earliest period, grazing could not be controlled for lack of fencing. The Barney Allotment in the Rincon Mountains was until 1927 grazed both by the Barney family's goat herd, under permit, and by trespass cattle from the Empire Ranch, who presumably entered the study area via Happy Valley.

Initially, most of the allotments showed signs of serious overgrazing in the recent past. After inspecting the Bellota Allotment in the Santa Catalina Mountains in March 1938, Acting Forest Supervisor H. Garvin Smith wrote: "All forage, curly mesquite, gramma [sic] and bunch grass types was found very short even in the rough almost inaccessible portions of the range. It looks like fully 100% utilization of all palatable forage plants,

[8] Files before 1930 either were not made or have been lost, although some contain references to conditions and permittees back to 1907.

except of course, some of the larger browse, and of course trees and these have been hedged where stock was able to reach them."

It was very difficult to determine, however, whether poor range conditions reflected current overgrazing, periodic drought, or both. When Forest Ranger E.L. McPhaul crafted the 1938 plan for the Bellota Allotment, he conceded: "As to whether the primary cause of the condition of the range was caused by severe drought or excess stocking, could not be definitely determined… This range was in excellent condition in 1935. Grama hay could have been cut along the Redington road after the 1935 growing season."

Ranch boundaries were fenced first, often encompassing a mix of private, state and forest lands. There were not interior fences—to separate forest allotments from adjacent non-forest land—until the 1960s, and in one case the allotment boundary has never been fenced. The boundary of Saguaro National Monument was not fenced until 1976-77. Most of the allotments in the Winchester Mountains are not fenced to this day (Don Decker interview, 8 September 2004).

An allotment's preference was supposed to reflect the forest land's portion of the overall forage needed to support the ranch herd. But this didn't necessarily work out in practice. Especially for the smaller allotments in the Happy Valley-Redington Pass area, officials frequently remarked that forest land was being disproportionately impacted by ranchers' herds.

Livestock distribution was the underlying problem. Cattle would congregate near water and on flatter or more sheltered areas. Terrain alone could generate severe maldistribution. The Redfield Allotment in the Galiuro Mountains was the extreme example of this: with few water sources other than a stream at the bottom of a steep-sided canyon, cattle rarely reached most of the allotment. A 1962 analysis concluded that only 3800 acres was suitable for grazing, out of total area of more than 22,000 acres. More than thirty years earlier, an inspection memo had remarked that the accessible areas of the allotment were "being used too heavy."

Distribution problems could be addressed in several ways. One was to manipulate critical resources such as water and salt. Artificial water sources could help distribute livestock more evenly across allotments; such improvements were made on several allotments as early as 1929, probably in conjunction with boundary fencing. The Forest Service also urged permittees to place salt blocks away from water sources in order to draw cattle into underutilized areas.

This approach appears not to have worked very well. Water development could be counterproductive, as it apparently was in the case of Parke Gilbert, permittee of the Last Chance allotment from 1953 to 1963. His investments in additional water sources reportedly led to deterioration by enabling him to stock more animals and impact a larger portion of the allotment. As for salting, forest reports from the 1940s to the 1960s are replete with complaints about permittees "salting on water." "The problem areas are the

same old 'easy areas' which have been punished for years because of lack of management," complained a 1966 inspection of the Bellota Allotment. "Attempts to achieve better management system by pasture fencing or by fencing the waters have been unsuccessful due to the reluctance of the permittee to change."

Another strategy was to change the number of livestock overall. When a permit changed hands, the Forest Service typically "adjusted" the preference downward by 10-20 percent to correct for excessively high past stocking rates.[9] The Barney Allotment dropped from 77 to 65 cattle year-long (CYL) in 1951, when the permit passed from Ollie Barney, Sr., to Ollie Barney, Jr. The Bellota preference was reduced from 747 CYL to 685 CYL between 1947 and 1957, as its various component pieces consolidated into a single permit held by Josephine Reeve. The Last Chance Allotment was transferred from Allen and Bidegain to Allen and Allen in 1940, at which time its preference was cut from 164 to 135 CYL; it was further reduced, to 100 CYL, when Wilbur Gavin acquired it in 1966. The Fresno Allotment preference was cut from 40 to 35 CYL in 1951, when Paul Watkins sold out to C.Z. Clopton. When the Ash Creek and Happy Valley allotments were merged under permittees Roderick J. and Evangeline MacKenzie in 1943, the combined preference was cut from 400 to 360 CYL.

These gradual cuts, and voluntary reductions during the 1950s drought, did not prevent long-term changes in vegetation over time, and by the 1960s forest officials were recommending further reductions in preference numbers for several allotments. Spanish dagger, or amole, was replacing grasses in the Barney, Fresno and Bellota Allotments. Manzanita, oak and juniper were encroaching into middle elevation perennial grasslands. Mesquite and acacia were problems at middle and lower elevations. A 1951 report for the Bellota Allotment is typical: "Due to amole, the usable area should be cut down 80% to approx. 50%--impossible to get good distribution on allotment in summer even with additional water developments. Heart of allotment gutted—long slow process of recovery." Conditions did improve on some allotments when rainfall was good, but the majority of allotment inspection reports and memos indicated poor or fair conditions and static or downward trends in forage species during the period 1930-1965.

A third strategy was to manipulate the temporal distribution of grazing. Beginning as early as the 1940s, forest officials stressed the need to develop interior fencing to enable rotational grazing systems; to defer grazing on portions of an allotment each year; or to switch from continuous year long grazing to winter-only use to allow forage plants to grow without grazing during the summer months.

Grazing was continuous and year-around throughout the study area, however, until the late 1960s and 1970s. Two permittees, Walter Gavin on the Last Chance Allotment and Joe Goff on the Finley Springs Allotment, were the first to implement rotational or deferred grazing in the late 1960s, and the files testify that conditions improved as a

[9]Reductions without a change in ownership were difficult to institute because the price a rancher paid to obtain a permit was determined by the preference. "Dick Reeve has indicated to me that he thinks 500 head yl [year long] is about right but does not want the permit reduced because of the loss if he should sell out," noted a 1966 report on the Bellota allotment.

result. The 1974 Bellota Allotment Management Plan instituted alternate year summer rest. A similar system was implemented on the Barney allotment in 1978, and by 1982 conditions were fair to good and trends were stable to upward. In 1977, the Happy Valley allotment was managed under a rotation between Turkey and Paige creeks. Allowing grasses time to recover from grazing, by rotation or deferment, appears to have been more successful than strategies aimed at uniform spatial distribution or reductions in permitted numbers.

The late 1960s and 1970s also saw chemical sprays and prescribed fires used to combat brush encroachment on forest allotments in the study area, particularly in the Bellota allotment on Redington Pass. Three hundred acres of mesquite were slated for spraying in Government Tanks pasture in 1967; the files do not indicate if this plan was carried out. A prescribed fire in South Italian Trap pasture in June 1977 resulted in 80 percent mortality of amole; another fire was planned for White and West Spring pastures in 1981. Apparently the mesquite persisted, however, for in 1985 another 300 acres in Government Trap were bulldozed and seeded to sideoats grama and other native species. As of 1988, the dominant grass at the site was Lehmann lovegrass.

Rotational or deferred grazing systems are now the norm on larger ranches in the study area, and interior fences have recently been constructed on many state and federal grazing lands. On some of the larger ranches in the study area—the C-Spear, Carlink, A7 and Three Links—interior fences have been constructed only in the past decade (Johnny LaVin interview; Don Decker interview, 8 September 2004). The river corridor has also been fenced to exclude livestock, both on active ranches and on properties acquired for conservation or residential purposes. Generally, uplands are grazed in the cool season, when the principal forage grasses are dormant and cattle are more likely to range across rugged terrain. During the hot, growing season, livestock are moved onto irrigated pastures along the river. This conforms to long-standing recommendations from the Forest Service to allow perennial forage grasses to rest from grazing during the growing season.

As lands along the river are retired from agriculture, however—whether for residential or conservation purposes (see below)—summer deferral of grazing in uplands has become impossible for some ranches and more difficult for others (Don Decker interview, 8 September 2004).

## 1980-PRESENT: EMERGENCE OF SUBDIVISION AND CONSERVATION

The majority of state and private lands in the study area are still used for agricultural production. Most Forest Service allotments are also still active. Since 1980, however, two other land uses have increased significantly: subdivision of private lands into parcels intended primarily for use as residential homesites, and conversion of private and leased lands to conservation purposes other than those associated with agriculture (see Figure 2). Although not necessarily incompatible with agriculture, both of these land uses represent potential competitors to agriculture as the study area's defining economic activity and cultural identity.

### *Subdivision*

Subdivision has occurred in four townships in the study area (Lower San Pedro Watershed Assessment Project Task 4E, Appendix B). Table 7 presents the number of landowners and the acreages involved, amalgamated to the township level. These data indicate that subdivision has affected a large area of land, principally along the San Pedro River corridor, but that it has not reached the high densities and small lot sizes typically associated with the term "subdivision." County zoning permits lots as small as 4.13 acres, but the average subdivided parcel in the study area is 68 acres. Individual parcel sizes vary widely, of course; some are as small as 4.6 acres, but 40 acre and larger parcels are much more common. Amalgamated at the section level, rates of fragmentation range from 25 to 640 acres per parcel.

**Table 7. Location, number and size of subdivided private lands in the study area by township.** Source: adapted from Lower San Pedro Watershed Assessment Project Task 4E, Appendix B.

| Township | No. landowners | Acres private land | Avg. parcel size |
|---|---|---|---|
| T12E R19S | 26 | 1800 | 69 |
| T13E R19S | 93 | 5360 | 58 |
| T13E R20S | 15 | 800 | 53 |
| T14E R20S | 31 | 3320 | 107 |
| Totals | 165 | 11280 | 68 |

Virtually all of the subdivision has occurred in the southern half of the study area, closer to Interstate 10 and the services available in Benson. Curiously, much of this subdivision can be traced to a pair of real estate transactions involving the City of Tucson.

The first occurred in the spring of 1960, when the City purchased the former Bidegain Ranch—2200 acres of private land and the state grazing lease to nearly 19,000 acres—from Mr. and Mrs. Lloyd W. Golder, Jr. The acquisition was extremely controversial in Tucson because of apparent conflict of interest and profiteering by third parties, who were compelled by public pressure to withdraw from the deal (see Arizona *Daily Star* May 7-21, 1960). The City's intended use for the land—as a source of ground water to be pumped over Redington Pass—was less controversial in Tucson but more

problematic in the end. A lawsuit filed by farmers in the Avra Valley—where the City was also acquiring so-called "water lands"—eventually led to the 1969 "Jarvis" ruling by the Arizona Supreme Court prohibiting inter-basin water transfers. In the meantime, the City leased the ranch for grazing.

The second transaction took place in 1985, when the City put its property up for sale by sealed bid auction. The winner was a development partnership, which subdivided the private land and marketed lots under the name Cascabel Ranch Properties. Sales were not brisk, requiring more than 15 years to sell out.

Another major property, also known as Cascabel Ranch (see Table 2 above), was split into six pieces and sold between 1992 and 1995. The owner, Reese Woodling, had bought the Wagner (formerly Russell) Ranch in 1976 and added the Harry Smith farm to it in 1980. He marketed the property as a single unit for three years before concluding that he would have to subdivide it in order to find buyers. Most of the parcels were large enough to remain in agricultural use. Some have subsequently been subdivided again, however, resulting in parcels that are effectively residential rather than agricultural. The Cholla Group, LLC, acquired much of the private land and the state leases associated with the former Cascabel Ranch in 1997, for development into a combined ranch-and-residential development with 65 homesites.

Many subdivided parcels are undeveloped and belong to absentee landowners. There are 165 landowners in the southern half of the study area (Table 7), but there are only 48 physical addresses. Of the 204 property owners identified from tax rolls for the entire study area, fewer than half (96, or 47 percent) have addresses within the study area (Lower San Pedro Watershed Assessment Project, Task 2B1 & 2B2 Report).

If current landowners are representative, the study area appeals to retirees who wish to live in a rural area—that is, an area where agricultural production is a defining feature of the landscape and community. Residents who attended open houses as part of the outreach component of this assessment were asked to complete a brief questionnaire about their backgrounds, properties, and reasons for living in the area. (The survey was non-random, so it cannot be taken as representative of all residents or landowners. Absentee landowners are, of course, grossly underrepresented.) Twenty-five out of 46 respondents (54 percent) were over 60 years of age, and 76 percent were over 50. Twenty-seven respondents (59 percent) had lived in the area less than 10 years, and the same number indicated that they had bought their properties for retirement. Twenty-eight respondents (61 percent) cited "rural lifestyle" as a reason for choosing to live in the area.

It appears that the market for subdivided parcels in the study area is relatively small at this time. Cascabel Ranch Properties had to significantly scale back plans for their "Air Park" development in the 1980s. The Cholla Group's Rancho La Joya has, by all indications, failed to attract buyers of its high-end lots. Properties often remain on the market for years, if one may judge from the presence of real estate signs (personal observation).

The lack of paved road access apparently makes the area less appealing than otherwise comparable areas for many retirees. The poor condition of the road is also a major issue for current residents (Lower San Pedro Watershed Assessment Project, Task 2B1 & 2B2 Report). Cochise County has extended the pavement at the south end of the study area approximately four miles in the past eight years. Paving the road all the way through to San Manuel would undoubtedly have a strong effect on subdivision and development patterns in the study area.

Because the road passes through three different counties, significant improvement is a complicated prospect politically and fiscally. It might be simplified by action at the state level, and beginning in the late 1960s a state highway was contemplated. Transportation officials saw benefit in providing a route between the Benson-Bisbee-Douglas area and the San Manuel-Mammoth-Kearney-Globe-Miami areas that would avoid traveling through Safford or Tucson. Fifty-one parcels were acquired for the widened right-of-way, and three major bridges were built (one at Tres Alamos Wash, south of the study area, and two at Redington). Officially, the DOT abandoned the highway plan in the late 1970s due to cuts in federal highway funds (ADOT 1978); many local residents recall it as a pet project of a local politician, which died when he lost his seat on the highway commission.

### *Conservation*

In the 1970s The Nature Conservancy named the San Pedro River one of the world's "Last Great Places" for conservation of biological diversity. Its importance derives largely from the aquatic and riparian habitat the river supports and from its geographical location along one of North America's major migratory pathways for neotropical birds. The study area, in particular, lies at the ecotone of three major biomes: the Sonoran desert, Chihuahuan desert and Apachean highlands (Fichtel 1998). Since 1980, habitat conservation or restoration has motivated a number of land acquisitions by public and private entities in the study area (Table 8).

**The Muleshoe Ranch** Cooperative Management Area (CMA) grew out of the acquisition of the Muleshoe Ranch by The Nature Conservancy (TNC) in 1982. The primary objective was conservation of aquatic species and riparian habitat in streams tributary to Hot Springs Canyon and Redfield Canyon. At acquisition, the property included private land and grazing leases administered by the Forest Service, the Bureau of Land Management and the State Land Department. The Nature Conservancy wished to cease livestock grazing, and the Forest Service agreed to retire the Redfield Allotment. The State Land Department could not legally permit TNC to retain the state lease without grazing livestock, and the BLM lease was challenged on similar grounds.

The situation was eventually resolved through two means. First, the BLM and the State Land Department executed a land swap in which most of the state's Muleshoe holdings were exchanged for other BLM parcels scattered around the study area. Second, through a lengthy series of public meetings, TNC and the BLM gradually established local

support for the Muleshoe Cooperative Management Plan (Conley 2003). The plan called for the BLM land to be rested from grazing until its perennial grasslands were restored, and for prescribed fires to be used as a central part of the restoration strategy (BLM 1998a).

**Table 8. Properties acquired for conservation purposes in the study area.** TNC = The Nature Conservancy. Sources: various.

| Property | Date of acquisition | Current owner | Landownership type(s) | Acreage |
|---|---|---|---|---|
| Muleshoe Ranch | 1982-84 | TNC | Private, BLM, Forest Service | 49,000 |
| Bingham Cienega | 1989 | Pima County | Private | 300 |
| Buehman Canyon | 1998 | TNC | Private | 2880 |
| Saguaro-Juniper Group | 1988 (initial purchase) | Saguaro-Juniper Corp. | Private, State | 9440 |
| A7 Ranch | 1998 | City of Tucson* | Private, State, BLM | 41,100 |
| 3 Links Farm | 2002 | TNC | Private | 2150 |
| BLM river parcels | 1998 | BLM | Formerly private | 1960 |

**Sale pending to Pima County*

Between 1995 and 2000, TNC and the BLM ignited four prescribed fires covering a total of 20,500 acres. Monitoring data collected before and after the fires indicates that four species of rare fish, riparian vegetation, water quality and quantity, and stream morphology all benefited from the fires, despite severe drought conditions during the period. Improvements were also above and beyond those attributable to livestock exclusion during the preceding 13 years (Brunson et al. 2001).

**Bingham Cienega** was acquired in 1989 by the Pima County Flood Control District, which subsequently signed a 25-year agreement with TNC to manage the property. The management objective is restoration of sacaton grassland in the spring-fed marsh adjacent to the San Pedro River, which had been altered by historical farming and mesquite encroachment. With funding from the Arizona Water Protection Fund and other sources, TNC has studied the hydrology of the preserve, identified areas to be restored to mesquite woodland and sacaton meadow, and tested methods for reestablishment of sacaton across the hydrological gradient of the property (TNC 2001).

**Saguaro-Juniper** is a private, for-profit corporation that owns private lands and leases state land in and around Hot Springs Canyon, downstream of the Muleshoe Ranch. Shares in the corporation are owned by roughly 60 people, mostly from the Cascabel and Tucson areas. Decisions are made by consensus under the Saguaro-Juniper Covenant,

which commits the group to stewardship and community with the land. The group grazes cattle to retain the state lease, and prohibits power lines, motor vehicles, off-leash pets and all but a handful of simple buildings on their lands.

**The A7 Ranch** issued from a complex real estate transaction executed in 1998 between the City of Tucson, TNC, the BLM, the Tanque Verde Guest Ranch, the Bellota Preservation Foundation, and Riley West, Inc., the then-owner of the Bellota Ranch. The City of Tucson acquired most of the private lands and leasehold to the state lands; TNC acquired lands adjacent to its Buehman Canyon Preserve (see below); the Tanque Verde Guest Ranch acquired the permit to graze on the Forest Service's Bellota Allotment; and the BLM acquired certain private lands along the San Pedro River. The principal objective behind the deal was to prevent subdivision of the ranch's private lands.

The City of Tucson initially envisioned converting the A7 into a Grassbank™ for use by surrounding ranches (Hutchinson & Mauz 2001). It secured funding from the WPF to implement a long list of range improvements and monitoring programs, while continuing to graze a moderate herd of cattle in order to retain the state grazing lease (see http://www.transview.org/a7/). The Grassbank™ plan has not materialized, however, and the City has recently decided to sell the A7 to Pima County. Pima County has indicated it will continue to operate it as a ranch and will permanently prevent subdivision of the private lands.

**Buehman Canyon Preserve** is another TNC property, encompassing lands donated by Riley West and adjacent areas obtained through the A7 Ranch transaction. It is tributary to the San Pedro from the eastern slopes of the Santa Catalina Mountains. Management objectives for the preserve include riparian conservation and restoration and maintenance of an unfragmented wildlife corridor between the Catalinas and the San Pedro.

**Three Links Farm** is the most recent TNC acquisition in the study area, purchased primarily to restore perennial flow in the San Pedro River in the southern portion of the study area. Hydrological research and modeling commissioned by TNC suggests that curtailing ground water pumping on the Three Links will eventually raise the alluvial water table and restore flow downstream; the property is considered uniquely important for this due to its location immediately below the Narrows (Lombard 1998). TNC plans to subdivide the farm into five large parcels and sell them, encumbered with conservation easements that limit ground water pumping and future subdivision. Inventory and assessment are underway to develop strategies for restoring the former croplands.

**BLM river parcels** are the private lands acquired by the BLM as part of the A7 Ranch transaction. These lands were obtained as part of a BLM plan to protect the river from both grazing and subdivision. They include former farmland, mesquite bosque, and cottonwood-willow forest.

Another conservation land use practice being utilized in the study area is conservation easements. Easements are held by TNC, the BLM, and the Cascabel Hermitage Association, a private non-profit formed by members of the Saguaro-Juniper group. The

easements vary in details, but generally prohibit subdivision and limit development to defined building envelopes. The Center for Desert Archaeology is also pursuing conservation easements as a tool for protecting cultural resources in the study area. The total area affected by easements in the study area is not known.

## CONCLUSION

The history of the study area reconstructed here provides a context for understanding current conditions and evaluating land management goals and objectives. Several conclusions are worth noting.

First, human occupation and use of natural resources is extremely longstanding. Irrigated agriculture has occurred for 1000-1500 years, and the population of the study area was probably higher during some prehistoric periods than in the 20th century. Impacts on natural resources are not directly correlated with population, however: water use increased over the past 70 years, for example, even as population declined.

Second, the landscape has been and remains extremely dynamic, changing in response to climatic and hydrological factors as well as land uses and management. The timing, frequency and intensity of droughts, floods and fires have all been critical drivers of environmental change, interacting with human impacts in complex ways. It is therefore difficult or impossible to assign causality to any single factor. Patterns observed in the past may or may not hold in the future.

Third, the most dramatic and enduring environmental change in the area has been entrenchment of the river channel after 1890. Whatever its causes, entrenchment ramified through the river corridor, affecting vegetation patterns, irrigation and farming systems, land ownership patterns, flooding and wildlife. It converted sacaton meadows into mesquite bosques, which were misrecognized as the "original" vegetation as early as the 1930s. Vegetation changes in the uplands have been less dramatic but no less enduring.

Fourth, these changes beg the question of any attempt to "restore" the Lower San Pedro watershed: restore to which conditions, from which time period? Restoration of sacaton meadows is unlikely to succeed on any significant scale absent restoration of the pre-entrenchment disturbance regime, including periodic fires as well as sheet (rather than gully) flooding. Cottonwood-willow riparian forests have received a lot of conservation attention, but they are more common today than they were at the time of reoccupation in the 1870s and 1880s; this is true not only in the study area but also regionally (Turner et al. 2003). Perennial bunchgrasses, even more than sacaton meadows, require periodic fires to outcompete shrubs. In short, any restoration plan must acknowledge the effectively irreversible nature of historical environmental changes and explain its conservation objectives in this light.

Fifth, although livestock grazing has unquestionably had a strong and extensive effect on the watershed, range management has evolved to the point that impacts today are quite different from before. In general, the impact of livestock has diminished since about 1970. Although data specific to the study area are lacking, stocking rates have probably declined by more than half since the cattle boom period. Artificial water sources have reduced the dependence of livestock on natural surface waters, including the river itself. The advent of rotational and deferred grazing systems in the 1970s, coupled with pasture

on irrigated private lands along the river, has reduced the direct impacts of livestock on upland perennial grasses. Many changes in upland vegetation—such as increased trees, shrubs and cacti—are unlikely to be reversed by livestock exclusion alone. Active management is required, particularly with regard to fire restoration and management.

Sixth, land use change may promote or undermine natural resource conservation, depending not only on the proportions of land devoted to agriculture, residential development and conservation but also on the interactions among them and how conservation is defined. At the present time, subdivision is not far advanced and landowners appear committed to an agricultural community. The conservation values of the area are widely recognized and increasingly protected. Resource conditions are greatly altered since 1870 but apparently improved since about 1960.

Interactions among land uses, land types and different natural resources are both complex and critical. Irrigated agriculture probably benefits upland range conditions at the potential expense of ground water in the river, for example. Reduced access to irrigated bottomland for pasture and hay production has already constrained livestock producers' management options, and drought continues to threaten their viability. Although irrigated agriculture is highly water consumptive, higher density residential land use would impact other habitat values such as connectivity between mountain ranges for migratory species. Designated conservation areas and restoration of surface flow may make adjacent private lands more attractive to residential buyers, especially if the main road through the study area were to be paved. This, in turn, might foreclose other management practices, such as fire restoration, that are important to achieving other conservation goals.

Finally, there is considerable uncertainty built in to many of the area's most important natural resource issues. How will ground water depletion and subdivision in the Upper San Pedro watershed affect the river downstream, or the local economy? How long will the current drought continue? Defining and achieving conservation in the area will require cooperation and constructive engagement among agricultural producers, resident and non-resident landowners, public agencies and private conservation interests.

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## APPENDIX 1: INTERVIEWS CONDUCTED FOR THIS REPORT

Araiza, Eddie. 28 April 2004, Tucson.

Bennett, Emma. 2 June 2004, Benson.

Bidegain, Marge. 2 June 2004, Benson.

Bidegain, Pete. With his wife, Chlorine, and his son, Peter. 28 April and 3 June 2004, Tucson.

Bidegain, Scottie. 5 May and 26 May 2004, Tucson.

Bingham, Pudge. 19 May 2004, Redington.

Clark, Barbara. 4 June 2004, Cascabel.

Decker, Don. 8 September 2004, El Coronado Ranch.

Gamez, Ray. With his wife, Julie. 1 May 2004, Benson.

Gori, David. 17 September 2003, Tucson.

Hughes, Jack and Norma. 2 June 2004, Benson.

LaVin, Johnnie. 14 February 2004, C Spear Ranch.

Russell, Jean. 7 May 2004, Tucson.

Smallhouse, Andrew and Stefanie. 19 May 2004, Redington.

Smith, Lamar. 29 December 2003, Cascabel.

Soza, Hector and Carlos. 15 June 2004, Tucson.

Taylor, Mary. 15 February 2004, Cascabel.

Troutner, Maria. 2 May 2004, Cascabel.

Woodling, Reese. 4 May 2004, Tucson.