CHAPTER 4

THE MIDDLE RIO GRANDE BASIN: HISTORICAL DESCRIPTIONS AND RECONSTRUCTION

This chapter provides an overview of the historical conditions of the Middle Rio Grande Basin, with emphasis on the main stem of the river and its major tributaries in the study region, including the Santa Fe River, Galisteo Creek, Jemez River, Las Huertas Creek, Rio Puerco, and Rio Salado (Fig. 40). A general reconstruction of hydrological and geomorphological conditions of the Rio Grande and major tributaries, based primarily on firsthand, historical descriptions, is presented. More detailed data on the historic hydrology-geomorphology of the Rio Grande and major tributaries are presented in Chapter 5.

Historic plant communities, and their dominant species, are also discussed. Fauna present in the late prehistoric and historic periods is documented by archeological remains of bones from archeological sites, images of petroglyph and pictograph sites, and recorded observations. Three major classes of vertebrates are discussed—mammals, birds, and fishes. A brief section on insects follows.

This chapter provides historical baseline data and context for determining environmental change, which is addressed in Chapter 5. Additional data are presented in the chronology at the end of the chapter.

GEOLOGY-PHYSIOGRAPHY-SOILS

The Rio Grande and its parent landform, the Rio Grande rift, dominate the physical setting of the study region. Both extend roughly north and south from southern Colorado through New Mexico to the Texas border, a total reach of 500 miles (Fig. 40). The upper part of the rift, or the Upper Rio Grande Basin, is included in the Southern Rocky Mountain Physiographic Province, while the remaining reach, or the Middle Basin, is part of the Basin and Range Province. The Upper and Middle basins are divided into smaller, structural subbasins, such as the Espanola and Albuquerque subbasins. These subbasins are separated by old terraces or basalt flows that constrict the Rio Grande to a narrow valley. These topographic units vary from 30 to 100 miles in length and from 10 to 35 miles in width (at their widest points). Constricting narrows occur near or at Cochiti, San Felipe, and Isleta pueblos; San Acacia, just north of Socorro; and north of San Marcial. The San Luis basin, which is closed, and the Taos Gorge, are special physiographic features in the Upper Basin (Crawford et al. 1993: 7; Fox et al. 1995: 52–54; Hawley 1986: 26).

The main two basins are flanked by fault-block mountains, such as the Sandias (Fig. 40), or volcanic uplifts, such as the Jemez, volcanic flow fields, and gravelly high terraces of the ancestral Rio Grande, which began to flow about 5 million years ago. Besides the mountains, other upland landforms include plateaus, mesas, canyons, piedmonts (regionally known as bajadas), volcanic plugs or necks, and calderas (Hawley 1986: 23–26). Major rocks in these uplands include Precambrian granites; Paleozoic limestones, sandstones, and shales; and Cenozoic basalts. The rift has filled primarily with alluvial and fluvial sediments weathered from rock formations along the main and tributary watersheds. Much more recently, aeolian materials from abused land surfaces have been and are being deposited on the floodplain of the river.

The Middle Rio Grande—including major tributaries such as the Santa Fe River, Las Huertas Creek, Jemez River, Rio Puerco, and Rio Salado—drains 24,760 square miles (Fig. 41). Headwater elevations range from 8,000 to 12,000 feet, and the Rio Grande channel in the Middle Valley reach descends from 5,225 feet at Cochiti to 4,450 feet at San Marcial (Crawford et al. 1993: 7).

Four broad soil types occur in the study region: entisols, which occur on the Rio Grande floodplain; aridisols, which occur over the warmer and drier portions in the lower elevations of the basins; mollisols, which occur on the cooler and wetter upland portions of the basin; and inceptisols, which occur in the higher elevations of the Sangre de Cristo and Taos mountains and in the San Juan Mountains of Colorado, at the headwaters of the river (Maker and Daugherty 1986: 65).

Entisols are recent occurrences of soil formation on floodplains, so no major soil horizons have developed. Derived primarily from transported sediments that historically were deposited by overbank flooding, they are relatively rich soils that have supported agriculture for centuries. The texture of arid soils ranges from loamy sands to clays, usually calcareous, and they are not suitable for dryland farming. They are subject to abuse by various land-use activities, resulting in relatively severe water and wind erosion. Mollisols, with deep, organic, surface-subsurface matter, are dominantly grassland soils. These are fertile soils of high organic content, but they are subject to severe erosion if abused. Inceptisols are young soils that occur on relatively steep mountain slopes where annual precipitation is above 14 inches. They are formed

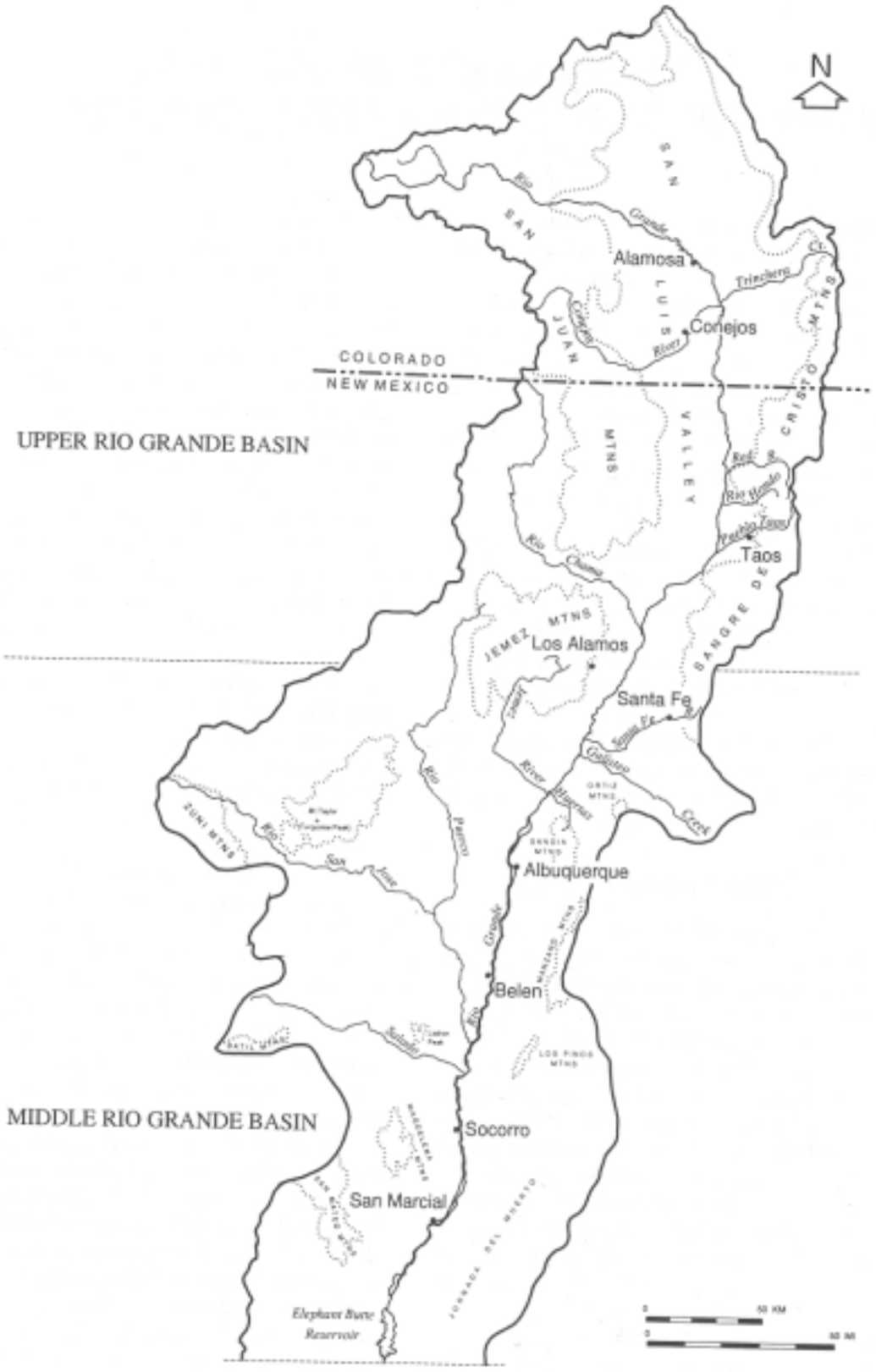

Figure 40—Study region: streams and mountain ranges.

Figure 41—Middle Rio Grande Basin: major streams, mountain ranges, and historic settlements.

from weathered rock sediments, including volcanic pumice (Maker and Daugherty 1986: 66).

HYDROLOGY-GEOMORPHOLOGY

Rio Grande

The Rio Grande, the fifth largest river in North America, flows 1,885 miles from southern Colorado to extreme southern Texas, where the river empties into the Gulf of Mexico. Across New Mexico, the river extends for some 470 miles from just above Ute Mountain to Anthony at the Texas border (Fig. 40). Its discharge area in the state is 32,207 square miles. For the Middle Valley, the Rio Grande flows for about 160 miles, with a total drainage area of 24,760 square miles (Fig. 42); the direct tributary drainage area is about 12,800 square miles (Crawford et al. 1993: 7; Snead and Reynolds 1986: 57; Table 44).

Early in the historic period the various Spanish expeditions applied different names to the Rio Grande (Hammond and Rey 1966):

Year	Expedition	Name
1540	Coronado	Tiguex
1540	Coronado	Tibex
1540	Coronado	Nuestra Senora
1581	Rodriguez-Chamuscado	Guadalquivir
1582–83	Espejo	Rio del Norte, Rio Turbio
1590	Sosa	Rio Bravo
1598	Onate	Rio Bravo and Rio del Norte

The only descriptive name for the physical condition of the river among these is turbio, which in English means "muddy." This term was no doubt used when the Rio Grande was carrying runoff water.

From 1598 until the arrival of the Americans, the river in New Mexico was generally known as the Rio del Norte. In the colonial period, the name Rio Grande was usually given to the stretch of the river below the mouth of the Rio Concho, below Big Bend National Park, to the Gulf of Mexico. Between this confluence and El Paso, the river was called the Rio Bravo. Early Anglos in New Mexico and Texas named the entire river the Rio Grande (Ayer 1965: 213; Pearce 1965: 134; Sanchez 1991, personal communication).

Figure 42—The Rio Grande at Albuquerque. Cottonwood, Russian olive, salt cedar bosque (center), Sandia Mountains (center back). Photo by author.

Some time later, in 1776, Fray Dominguez explained the name Rio del Norte: "The river is called the Rio del Norte because it comes from the north many leagues beyond Taos. . . . It is so many leagues long that even though the settlers of these regions have penetrated very far north for various purposes again and again, they have not found the source of this river" (Adams and Chavez 1956: 7).

When the first Hispanics reached the Middle Rio Grande, the valley ecosystem had been impacted relatively little by human activity. Perhaps some 25,000 acres of floodplain had been cleared by the Pueblo for cultivation, primarily irrigated by bank overflow or runoff from tributary streams or arroyos. Wing diversion dams and irrigation ditches were probably few in number. This ecosystem was one of dynamic equilibrium defined by a collection of environmental processes predicated on change. These processes included varied flow, including floods and associated shifting channels, erosion, and deposition

Table 44—Principal tributaries of the Rio Grande in the Middle Valley.

Tributary	Length (miles)	Drainage area (sq. mi.)	Mountain sources	Confluence with Rio Grande	Stream character
Rio Santa Fe	35	250	Sangre de Cristo	Below Cochiti	Perennial
Las Huertas Creek	15	29	Sandia	Below Algodones	Perennial in headwaters
Rio Jemez	60	1,060	San Pedro and Jemez	Above Bernalillo	Perennial in headwaters
Rio Puerco	140	6,220	Nacimiento	At La Joya	Ephemeral
Rio Salado	70	1,381	Datil	Above San Acacia	Ephemeral

Source: Harper et al. 1943: 7

of sediments. The Rio Grande was a "braided, slightly sinuous aggrading river with a shifting sand substrate." Riparian vegetation evolved and changed with these floods, deposition, and low flow caused by seasonal or more extended drought conditions (Crawford et al. 1993: 16, 19; Fig. 43).

Prehistoric and early historic evidence of large fish species in the river indicates that the Rio Grande "was a clearer, larger, and more stable stream than it is known to have been during the past century." These riverine conditions supported large fish species such as the longnose gar and shovelnose sturgeon, now extinct due presumably to the historic reduction in the river's flow (Gehlbach and Miller 1963: 7, 16–19). Historical flows were generally perennial, except for those periods of severe, extended drought. Flow levels were also seasonal, as they are today, with greatest flows in the late spring during peak runoff from snow melt, or in mid to late summer from rain runoff. Low runoffs usually occurred in June and October-November (Bullard and Wells 1992: 23–25). During high flows the river would sometimes shift from a higher channel to one of lower elevation on the valley floor, a process known as avulsion. Even during extended dry periods there probably was some flow, and relatively deep water holes in the streambed were maintained.

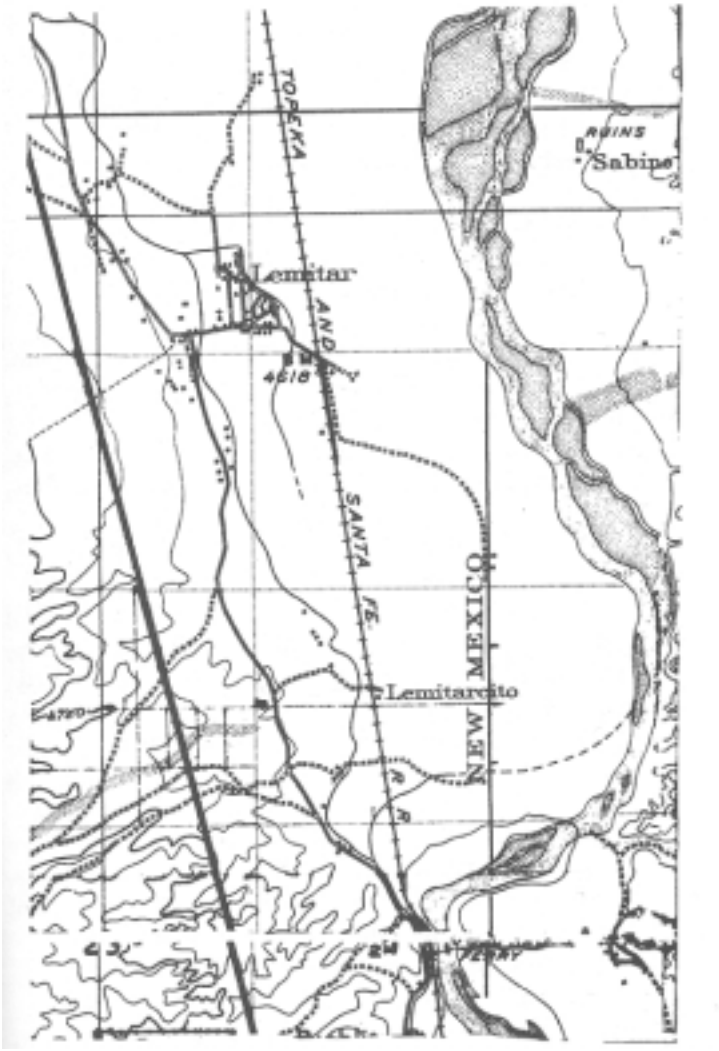

Figure 43—Meanders and multiple channels (braided) of the Rio Grande east and southeast of Lemitar, 1906. USGS 7.5–minute quadrangle map.

The Rio Grande above the mouth of the Jemez River was probably characterized by cooler water than that of the more recent past. The streambed was composed of mostly cobble and gravel. Below this confluence, the river was primarily a warmwater habitat characterized by shifting sand substrate. By the late 1800s this condition may have extended upstream, replacing the cooler water, as flows were depleted and sedimentation increased, resulting in a more shallow river (Crawford et al. 1993: 38).

A few early historical descriptions of the Middle Rio Grande follow:

> Alvarado, 1540:
> "This river of Nuestra Senora flows through a broad valley planted with fields of maize and dotted with cottonwood groves" (Bolton 1969: 184). He also described it as "a large and mighty river" (Hodge 1946: 352).
>
> Espejo, 1583 (near San Marcial):
> ". . . along the river banks there were many cottonwood groves and some patches of white poplars four leagues wide" (Hammond and Rey 1966: 219).
>
> Castano de Sosa, 1590:
> "A deep river" and "the river with much water" (Schroeder and Matson 1965: 129, 144).
>
> Obregon, late 1500s:
> ". . . swift and beautiful, surrounded by numerous meadows and farms . . ." (Hammond and Rey 1928: 291).
>
> Fray Benavides, 1630:
> "It has likewise many rivers in which fish are in great abundance; and great sloughs [esteros], and particularly the Rio del Norte" (Ayer 1965: 36–37).

Mention was made in the 1600s of an extensive stand of cottonwoods, which stretched from Alameda Pueblo to Albuquerque along the east side of the river (Adams and Chavez 1956: 145). Known as the Bosque Grande de San Francisco Xavier, it was a prominent feature in the valley until at least the early 1700s. South of this gallery forest were the open wetlands called the Esteros de Mejia. This mosaic of cienegas (marshes), charcos (ponds), and esteros (swamps) was located in the Albuquerque neighborhood of Barelas (Simmons 1982: 40). These riparian features were sustained by a high water table and periodic flooding of the Rio Grande.

Figure 44—Wetlands near Isleta Pueblo. Note cattail in foreground and cottonwood bosque in background. Photo by author.

Floods commonly caused shifts in the course of the river. The westward shift of various reaches of the Rio Grande from San Felipe to south of Belen in the early 1700s to about 1769 is relatively well documented. Before 1709 the Rio Grande flowed east of present Bernalillo, which was founded in the early 1800s. Earlier Bernalillo settlement sites were located to the north and on both banks of the river, at Angostura and Llanitos. As the channel shifted westward several hundred yards between 1709 and 1739, the church and several homes were washed away at colonial Bernalillo, then located on the west side of the Rio Grande. Another consequence of this avulsion was a subsequent boundary dispute between Santa Ana and San Felipe pueblos. By 1763 residents of upper Bernalillo had been forced to move upriver to higher land at Algodones (Adams and Chavez 1956: 152; Bayer et al. 1994: 90; Bowen and Sacca 1971: 51; Chavez 1957: 3; Sargeant 1987: 38–40; Snow 1976: 172–175).

In 1766, at the south end of the present Bosque del Apache National Wildlife Refuge, Royal Engineer Nicolas de Lafora found "plenty of pasture" in the valley, all the way north to San Acacia. He also noted "swampy ground with a great deal of coarse grass and reeds" (Kinnaird 1967: 88; Fig. 44). North of Tome, he continued to travel up the east side of the Rio Grande over "a plain extensively forested with poplar trees [cottonwood] along the river's edge" (Kinnaird 1967: 89–90).

The benefits of flood deposition of sediments rich in nutrients was long known to Pueblo and Hispano farmers. A Spaniard from the Rio Abajo commented "The water brings with it a thick mud which serves as manure for the land, leaving on top of the irrigated earth a glutinous scum resembling lard" (Simmons 1982: 96).

Fray Atanasio Dominguez, a fairly keen observer from the colonial period, recorded descriptions of the Rio Grande and various reaches in 1776. For the entire river reach in the region he wrote

> From the places where the headwaters on this river are to be seen, one observes a great abundance of water. As it declines toward the south it acquires more and more water from the many rivers (large and small) that keep joining it from the east and west from above Taos to below El Paso, where it joins still others (Adams and Chavez 1956: 7).

From Santo Domingo he wrote "The pueblo is located very near the Rio del Norte on a plain on the east bank.... It has a very fine view in all directions, made pleasant by the river and its woods and poplar groves" (Adams and Chavez 1956: 137).

And for the Albuquerque area he observed

> It stands on the same plain [as Santo Domingo] and so near to the Rio del Norte that the church and convent are about two musket shots from it. . . . The rest of what is now Albuquerque extends upstream to the north, and all of it is a settlement of ranchos on the meadows of the said river for the distance of a league. . . . Some of the lands are good, some better, some mediocre. They are watered by the said river through very wide, deep irrigation ditches. . . . (Adams and Chavez 1956: 144, 151).

And at Isleta he observed "The little rise on which the pueblo stands is as small as I said in the beginning, and it lies on the very meadow of the Rio del Norte, which sometimes overflows its bed up above the pueblo when it is very high and forms a very wide branch at a distance from it" (Adams and Chavez 1956: 207).

He also noted that the Rio Grande had shifted eastward from its channel, which had run close to Belen in 1769. Part of Tome's houses and agricultural fields were destroyed by this avulsion; some Belen residents subsequently planted cultigens in the abandoned river bed (Adams and Chavez 1956: 8).

In 1782 Fray Agustin de Morfi described the river:

> The Rio Grande del Norte crosses the kingdom from north to south, almost in a straight line. Its source is not yet known. . . . The river receives within and without the kingdom many others [tributary streams] which increase its flow. . . . From its sources [the Rio Grande] as far as the presidio of La Junta, its banks are shady . . . (Thomas 1932: 90).

Some observations were clearly made in drought years, such as 1803, when Governor Chacon wrote ". . . it does

not carry much water upon crossing it as is believed" (Simmons 1985: 164). Zebulon Pike, who traveled downriver from Taos in March 1807, described the Rio Grande as a navigable stream above Santa Fe, but found its flow diminished below, which he "attributed to numerous canals and the dry sand soil through which the river courses, where much of the water which flows from the mountains must be absorbed and lost." Even so, he noted the river to be 3 to 4 feet deep and about 300 yards wide at the Santo Domingo Pueblo ford, and 3 feet deep and 400 yards wide at the Barelas crossing south of Albuquerque (Coues 1987, II: 615, 621, 729–730).

Don Pedro Bautista Pino described the river in 1812 as follows:

> This imposing Nile is, so to speak, the heart of the territory, for the richest settlements are located on its banks, which are truly picturesque. The variety of its luxuriant groves, the beautiful forests that embellish it, the diverse perspectives presented by its vegas which are cultivated by a multitude of laboring men . . . The thousands of birds that live there, as well as the many palatable fish that live in its waters. . . . The waters . . . are in themselves sparkling and clear, but the Puerco de Abiquiu river, which flows into it at Chama, muddies them (Carroll and Haggard 1942: 21).

The channel of the Rio Grande changed again in the early 1800s in the Bernalillo-Alameda area. A westward shift of the channel forced Hispanic residents north of the Kuaua ruins from their homes. In about 1814, some residents resettled on the new east bank of the river on the north edge of Sandia Pueblo land in the Los Cocinitas part of present Bernalillo (Bowen and Sacca 1971: 48–49, 60; Lange and Riley 1970: 176).

In the 1820s farmers in the Middle Rio Grande Valley began to notice that cienegas and esteros were forming on the floodplain, apparently due to the dumping of excess water from irrigation ditches (Wozniak 1987). This phenomenon may have contributed to the increasing waterlogging of the valley throughout the remainder of the century.

More detailed descriptions of the Rio Grande and its valley were recorded with the coming of more Anglo-Americans in the 1830s and 1840s. Santa Fe Trail trader Josiah Gregg (1966, v. I: 140–141) observed

> The Rio del Norte . . . decreases in volume of water as it descends. In fact, above the region of tide-water, it is almost everywhere fordable during most of the year, being seldom over knee-deep, except at the time of freshets. Its banks are generally very low, often less than ten feet above low-water mark; and yet, owing to the disproportionate width of the channel (which is generally three or four hundred yards), it is not subject to inundations. Its only important rises are those of the annual freshets, occasioned by the melting of the snow in the mountains.

His estimate on the width of the river is consistent with earlier observations but inconsistent with later ones. For example, A. Wislizenus (1969: 34–35) described the Rio Grande near Albuquerque in mid July 1846 as "about 100 yards wide, and as usual, sandy, shallow, everywhere fordable and nowhere navigable, not even for canoes." Had this not been a drought year with apparently no or little summer rain on the watershed, the river flow would have been greater and therefore wider and deeper. Wislizenus did find a pond about 6 miles south of Valencia on the east side of the river.

In late September Lt. William Emory crossed the river just south of Albuquerque, where "its width was about twenty-five yards, and its deepest part just up to the hubs of the wheels" (Calvin 1968: 79).

Between Lemitar and Socorro, a doctor with the U.S. Army described the Rio Grande as ". . . a rapid stream, about 120 or 200 feet wide, dividing off, so as to make many islands, the water is muddy and reddish, near the color of the Red River" (Ames 1943: 20). The same individual described the river valley south of Cochiti Pueblo: "In one place it looked a little like the Missouri Bottom, the river here is a rapid stream, about 120 or 200 feet wide, dividing off as to make many islands, the water is muddy and reddish, near the color of the Red River" (Ames 1943: 20).

In October 1846 Lt. J.W. Abert (1962: 66, 72, 127) noted that the river near San Felipe "runs with great rapidity, and is from three to four feet deep." At Valverde on November 24 he observed "The river here is full of sand bars" and "the water is very low." He also recorded several ponds along the road between Bernalillo and Albuquerque.

The late summer rains of 1849 were probably at or above seasonal normals, as the Rio Grande was "over six feet deep" at La Joyita (Hannum 1930: 223–224), and "probably three hundred yards wide, the stream rapid, its depth four feet" at the Barelas crossing (McNitt 1964: 153).

Four years later, on November 10, Lt. A.W. Whipple described the river at the Barelas Ford:

> The bed of the stream is about 500 yards wide, with a channel upon each side from three to four feet deep, and a temporary island of sand and clay in the centre, occupying about one third of the width. In one or two places there were quicksands sufficient to make the passage laborious. The current of the stream is rapid. . . . Our own

observations made the fall five feet per mile at this place (Foreman 1941: 119).

This "quicksand" was sometimes a problem for other wagon caravans crossing at the Barelas ford, then just south of Albuquerque in the mid 1800s (Hall 1960: 169; McNitt 1964: 153).

In the early 1850s, a U.S. Army surgeon noted that the river in the Socorro area varied from 200 to 600 yards wide, depending on runoff amounts from upstream. He also observed that a change in the stream's channel occurred every year (Hammond 1966: 24–25).

At Atrisco, on the west bank of the river near the Barelas Ford, and to the south in the La Mesilla area, the river shifted to the west in 1860 and 1867–68, respectively. At Atrisco the avulsion was temporary, as the Rio Grande moved back to its former channel after a few weeks (U.S. Surveyor General and U.S. Court of Private Land Claims 1894). At Mesilla, it moved from the west edge of the town to the east side, where it flows today (Bell 1965: 242; Cozzens 1988: 277).

The severity and frequency of major flooding along the Rio Grande began to increase in the 1870s due to the aggrading riverbed and more rapid runoff in the watershed caused primarily by intensive grazing and logging. (Wozniak 1987).

In 1873 a traveler crossing the river at Barelas found the river to be about 4 feet deep and 200 yards wide (Beadle 1973: 491). Later in the decade another traveler along the Rio Grande crossed the river at Isleta, finding it about 300 feet wide and 3 to 4 feet deep (Cozzens 1988: 274–275). Just to the south, the 1884 flood caused a westward shift in the river's channel in the Los Lunas-Los Lentes area (Crawford et al. 1993: 24).

The aggradation of the river bed continued to increase over the last quarter of the 19th century due to increased sedimentation and diversion of water for irrigation, especially in the San Luis Valley of southern Colorado. In the summer of 1879 the Rio Grande ceased flowing from Albuquerque to El Paso, as it did often in the 1880s (Clark 1987: 89; Miller 1879: 69). During this period, before construction of any major dams in or above the Middle Valley, an estimated 75 billion pounds of sediment was carried annually in irrigation systems and floodwaters (Simmons 1991b: 69, 77). The sediment load carried by streams in the basin continued to increase into the early 1900s (Sullivan 1924: 6–7).

In 1893 Indian agent Henry R. Poore (1894: 111) described the river near Sandia Pueblo as having several large islands, which rose about 6 feet above the level of the river and were covered by cottonwood groves. The uppermost island was estimated to be 700 acres.

In 1907, W.T. Lee (1907: 31) described the Rio Grande north of El Paso as "mainly a floodwater stream subject to great fluctuations in volume."

The first streamflow gauging station in New Mexico and the United States was established by the U.S. Geological Survey (USGS) on the Rio Grande near Embudo in January 1889. A number of others were established along the river and major tributaries from 1895 to 1941 (Table 45).

Santa Fe River

The Santa Fe River, which has its headwaters at Santa Fe Lake in the Sangre de Cristo Mountains some 5,000 feet above Santa Fe, has a valley long occupied by various human groups (Fig. 45). As a result, this riparian system has been impacted severely, and the river's ecosystem has been modified greatly. The stream flows through the core of historic Santa Fe, westwardly, through Agua Fria, which in the early colonial period was a settlement of Hispanics on the Camino Real and before that the site of Quemado Pueblo. Now, Agua Fria is a neighborhood of the capital city. From this old village site the river continues its westerly flow, through new, scattered homes and businesses, past the airport, and on to Cieneguilla, the site of the late prehistoric-early historic pueblo and historic Spanish settlement. Flowing at the base of a basaltic mesa, the river moves west past ruins of corrals and field walls, the early colonial settlement of Cienega, and on to east of Tetilla Peak, an important landmark on the "Royal Road." Near here the stream receives waters from Cienega Creek and begins to flow through a canyon on La Majada Mesa, which eventually deepens to some 300 feet. At the south edge of the mesa's escarpment, the river leaves the canyon. This disengorgement was first named Las Bocas by the early Chamuscado-Rodriguez expedition of 1582. The near-deserted, 18th century land grant village of La Bajada,

Table 45—Upper and Middle Rio Grande streamflow gauging stations.

Station	Establishment date
Red River (near Questa)	April 1910
Near Taos	December 1916
Embudo	January 1889
Rio Chama below El Vado Dam	1913
Rio Chama near Chamita	October 1912
Otowi Bridge	February 1895
Santa Fe River (near Santa Fe)	June 1910
San Felipe	October 1925
Jemez River (near Jemez Dam)	June 1936
Albuquerque	October 1941
Near Bernardo	June 1936
Rio Puerco	July 1951
Bluewater Creek (near Bluewater)	June 1927
Rio San Jose (at Grants)	October 1912
Rio Puerco (near Bernardo)	November 1939
San Acacia	April 1936
San Marcial	1936

Source: Cruz et al. 1993

named for the steep escarpment that extends about 9 miles east-west from just below the Waldo interchange to almost the Rio Grande, is found here, and across the river are the ruins of San Marcos Pueblo. The river now turns even more westerly over its narrow, bosqueless floodplain until it meets the Rio Grande across from Cochiti Pueblo. From this confluence to its headwaters at about 12,000 feet elevation in the mountains, the river flows about 37 smiles.

As indicated above, the Camino Real followed the Santa Fe River from later Santa Fe through the canyon to La Bajada. Prior to the opening of this important Spanish road, which would link colonial New Mexico with Mexican settlements, Pueblo Indians had long followed the river from local and distant villages to trade, hunt, or gather various resources prior to Spanish arrival. They continued to use this route into the early colonial period and to occupy the villages of Tze-nat-ay (San Marcos), Tzi-gu-ma (Cienega), near the confluence of the river with Cienega Creek, Cieneguilla, and Quemado (Patterson-Randolph 1990: 6).

The first European to reach the upper Santa Fe River may have been Castano de Sosa on January 8, 1591. He described the event: "It was bitterly cold and snowing. When we emerged from the sierra, we came to a river, frozen so hard that the horses crossed on the ice without breaking through" (Hammond and Rey 1966: 280).

Eight years later the first Spanish colonists settled at San Juan Pueblo on the east side of the Rio Grande near its confluence with the Chama River, about 30 miles northwest of Santa Fe. After a few months, they moved across the river to a second pueblo called Yunque. The seat of government for the New Mexico Province remained here until 1609, but abuse of and conflict with the Tewa Pueblos, as well as competition for limited and decreasing natural resources, forced the Spanish viceroy to order relocation of the capital to the Santa Fe River, some 23 miles to the southeast. Here, the town of Santa Fe was founded on the banks of the mountain stream, at the foot of the Sangre de Cristo Mountains (Horgan 1965: 5, 14, 16–18; Simmons 1991: 182).

With the new provincial capital established at the northern terminus of the Camino Real, the road along the Santa Fe River was traveled frequently by residents, traders, and government officials. For example, in July 1613 Fray Isidro Ordonez walked from Santo Domingo Pueblo to Santa Fe, a trip of 9 hours (Sanchez 1987: 81). The mission supply caravans traversed this route every 2 or 3 years from 1620 to 1679, stopping at the paraje of the Alamo hacienda or nearby Rancho Golondrinas. Mission churches had been established at Cieneguilla, Cienega, and San Marcos pueblos along the Santa Fe River by the 1620s (Patterson-Randolph 1990: 6; Schroeder 1979: 244–247).

By the early 1660s Cienega had also become a Spanish village, consisting of scattered estancias or haciendas, like Alamo (Hackett 1937: 261). Sheep, cattle, and horses from these establishments were grazed along the river as well as in nearby uplands, and the floodplain and terraces were farmed by irrigation. Within 2 decades, however, the entire Santa Fe valley was depopulated by the Spaniards when driven out by the Pueblo uprising of August 1680 (Sando 1989: 55).

In late 1692, when Governor and General Diego de Vargas marched up the Camino Real to the Cieneguilla Pueblo, its inhabitants fled to nearby mesas (Bailey 1940: 138). In the following year, following reconquest and reoccupation by the Spanish, Vargas issued a land grant for the Cieneguilla area. Cienega and Quemado were also reoccupied on the grant early in the next century (Westphall 1983: 20). At this time, according to descendants of the original grantees, the Santa Fe River ran "full," and cottonwood and willow grew along its banks (Munoz 1945: 73). A cienega east of the Palace of the Governors was a prime, spring-fed habitat for livestock grazing (Ebright 1994a: 90–91). The river's water was noted to be clear in 1726, and in this same year the Pino Ranch was founded at the mouth of Cienega Creek, a major tributary.

Eighteen years later, the river was described as having "crystalline waters and abundant trout" within the capital village (Hackett 1937: 27, 34, 399). Santa Fe had by this time evolved into a rancheria, or a scattering of houses and fields along the river valley (Simmons 1974: 61). By 1760, the river was generally dry during the summer due to diversion for irrigation. Continuing cold temperatures caused the river to freeze over in winter (Adams 1954: 47, 65, 105). Periodically, the river flooded, as in 1767, when property was damaged and destroyed in Santa Fe and the river channel shifted into the Rio Chiquito, now covered by Water Street (Twitchell 1963, I: 447). Subsequently, a stone embankment was built to prevent flood damage in the village (Adams and Chaves 1956: 40).

River flow continued to be insufficient for irrigation farming along the reach below Cienega, according to Fray Dominguez in 1776. The springs at this location did result in a flow to the Rio Grande confluence the rest of the year, and the farmlands around the old pueblo of Quemado (later Agua Fria) and Cieneguilla were "fertilized" by overbank flooding of the Santa Fe (Adams and Chavez 1956: 41, 43). In 1782 Father Morfi provided basically the same description and referred to "excellent" trout in the river (Thomas 1932: 92).

By the late 1700s the Upper Valley population had so severely impacted the surface water, grazing lands, and fuelwood sources that the governor recommended moving the capital to the confluence of the river and the Rio Grande, across from Cochiti Pueblo (MacCameron 1994: 35). The center of government was not moved, of course.

As the flow of the river diminished from use, and as woodlands and forests were cut, the river ecosystem continued to decline (Hewett and Dutton 1945: 147). Around Cienega, especially at Rancho de las Golondrinas, however, the springs continued to flow, and harvests were good into

Figure 45—Cattle grazing along the Santa Fe River, ca. 1915. Note willow (left center) and cottonwoods (left back). Photo courtesy Museum of New Mexico Photo Archives, Santa Fe (negative no. 135254).

the 19th century. The area was known throughout the province for its dependable productiveness in the early to mid 1800s (Baxter 1987: 74–75). In October 1846 Abert (1962: 65) described Cienega as "well settled" and "a well watered place . . . and the neighboring hills are full of springs."

Degradation of the water quality of the river due to refuse and dirty streets in Santa Fe apparently was a problem by 1833, as the City Council issued regulations forbidding the throwing of trash or dead animals into irrigation ditches and streams and mandating the cleaning of streets. The burning of rubbish piles was also prohibited (Simmons 1992: 224).

When the American army arrived in the late summer and fall of 1846, during an extended drought, various military units found little or no grass for their livestock or wood for fires. Fodder and fuelwood were purchased at Santa Fe or Agua Fria, as Quemado was now called (Abert 1962: 65; Denevan 1967: 701; Frazer 1983: 11; Sunseri 1979: 75). No water was found in the river below Cienega on October 19 (Cooke 1964: 92–93). Four years later, however, troops found "good grass and water" and "sufficient fuel" at Agua Fria (McNitt 1964: 7). In contrast, a group of Anglo immigrants found denuded grasslands in 1849 from Santa Fe to Galisteo and noted that the area had been cut by deep arroyos, some to a width of 12 feet (deBuys 1985: 216–217).

In the 1850s Santa Fe experienced critical water shortages (Clark 1987: 33). The available river water, nonetheless, was described as "excellent" for drinking. Trees "for miles around" had been cut for fuelwood and construction (U.S. Surgeon-General's Office 1856). A dam was constructed near the headwaters of the Santa Fe River in 1866, but the water supply was still not sufficient to meet the town's needs (Clark 1987: 33).

Another flood struck, this one on the lower reach of the river, on July 13, 1866. Two years later, on April 18–20, rainstorms over the watershed caused the river to flood, and a bridge was washed out. This event was followed by still another flood on September 7 (Lange and Riley

Figure 46—Jemez River sandy streambed and floodplain at Santa Ana Pueblo ca. 1920–30. Photo by Jessie L. Nusbaum, courtesy Museum of New Mexico Photo Archives, Santa Fe (negative no. 158158).

1966: 339; Lange, Riley and Lange 1975: 107, 144, 445). On August 19, 1872, the river peaked at more than 1,000 cfs (USGS 1994). Eight years later the flow again could not meet the demands of the residents of Santa Fe, and reservoirs were subsequently constructed and wells drilled. A piped-water system was also constructed from one of the reservoirs above town in 1881 (Simmons 1992: 206; Thomas et al. 1963: D–10).

By 1899 irrigation farming on the Cieneguilla grant ceased, perhaps due to overuse of surface water upstream and general degradation of the ecosystem (Pratt and Snow 1988, Chap. 4: 46). Upstream wetlands, such as the cienega in Santa Fe, had been desertified by this time. Only Cienega Street remains as physical evidence of this marsh (Ebright 1994: 99–101).

Periodic floods continued, such as the one of September 29 or 30, 1904, and that of 1919, which had the highest annual daily flow recorded from 1910 to 1993. A flood on September 23, 1929, was estimated to be above 1,500 cfs (USGS 1994). In more recent years, the flow of the Santa Fe River has continued to diminish. In 1960, the acequia madre at Cienega flowed at 650 gallons per minute; in 1993 it flowed at only 133 gpm.

Grazing of the watershed continues, as does the development of houses and businesses in the valley (Fig. 45). The once "excellent" trout populations have long since disappeared, as have most of the fertile soils. Some cienegas occur, however, on the Ranchos Golondrinas property. Above Cienega, cottonwoods no longer occur along the river; some Russian olive is growing on the floodplain and appears to be spreading.

Jemez River

In February 1583 Espejo described the Jemez River near Zia Pueblo as "a fine river with a good volume of water" (Hammond and Rey 1966: 180). This general description suggests that the river was clearer and carried more volume than in the recent historic period. The Jemez, as other tributary streams, flooded periodically. These bank overflows damaged or destroyed Santa Ana Pueblo fields, which by the early 1700s, or perhaps even earlier, forced the residents to find better fields at its confluence with the Rio Grande (Kessell 1980: 168).

At Zia Pueblo in 1776 Fray Dominguez noted that the Jemez water was alkaline and, combined with sandy field soil, was at times unproductive. He also observed that the Jemez River at Jemez Pueblo was less alkaline and the fields more productive (Adams and Chavez 1956: 175, 181). At Santa Ana he wrote that the river flow was too

erratic to reliably produce crops each year (Adams and Chavez 1956: 170).

Much later, in October 1846, Lt. J.W. Abert (1962: 71) described the Jemez River valley below Santa Ana as ". . . very sandy; the bed of the stream three-quarters of a mile in width, contains, in many places, no water . . ." (Fig. 46).

In 1893 the river was divided into two channels above the Santa Ana Pueblo. These channels undoubtedly changed with floods. There was a major flood in 1890, and another slightly less severe flood, about 15,000 cfs, swept along the lower Jemez in 1900 (USGS 1994). The most severe flood of this century occurred May 6–15, 1941; 2 years later the Jemez daily mean flow on May 24 was zero. That was the lowest level reached since flow measurements were begun in 1936 (USGS 1994). The highest mean daily flow since that time, some 3,640 cfs, occurred on the lower reach of the river in 1958 (USGS 1994).

Las Huertas Creek

Las Huertas Creek originates at about 8,600 feet on the north side of the Sandia Mountains below Capulin Peak in the Cibola National Forest (Fig. 41). Several springs occur at this location, and many of them are situated on the Cooper-Ellis Ranch, a privately owned, late 19th-century homestead about 5 miles south of Placitas. The creek flows down a canyon along the north slope of the Sandias following a south-trending fault zone between the uplifted Montezuma Mountain block and the main Sandia block (Kelley and Northrop 1975: 90–91). The canyon has been formed by downcutting of the stream and is long and narrow with cliffs of Pennsylvanian Madera limestone. At about 6,000 feet, just outside the boundary of the national forest, the creek turns to the west past Ojo de la Casa, and the late Spanish Colonial site of San Jose 1768–1821, about a mile north of Placitas. Here the creek opens into a relatively wide valley bordered by hills and ridges covered with pinyon-juniper woodland, which becomes increasingly sparse at lower elevations downstream. The width of the valley floor varies from about 300 to 750 feet. Elevation in the valley ranges from 6,100 feet at Ojo de la Casa to 5,680 feet at San Jose to 5,480 feet at the south end of the study area (US Geological Survey 1954).

The valley fill is composed of alluvial fan material, which at some locations, such as San Jose, is made up of gently sloping (0–3 percent), silty clay loam soil derived from shale and sandstone, known as Haverson Loam. The adjacent terraced uplands consist of gravelly Ildefonso Sandy Loam on 10 to 35 percent slopes or Harvey Loam on 10 to 15 percent slopes (Soil Conservation Service n.d.). Chert nodules found eco-cultural contexts in the valley probably came from the Madera formation; Pedernal chalcedony and other cherts were brought from quarries in the Jemez Mountains (Hibben 1941: 28–30; Kelley and Northrop 1975: 97–98). Obsidian for some artifacts noted on the surface may have been obtained in the same range.

Several major springs are located in the drainage, and all were used historically for domestic and agricultural purposes (Delara and Delara 1983; Scurlock 1995b: 4–5). These springs are Rosa Castilla, San Francisco, Oso Negro, and Ojo de Casa. Not surprisingly, flows of these springs and Las Huertas Creek were reportedly greater in the past than at present (Delara and Delara 1983; Montoya 1983); trout were found in the deeper pools of Las Huertas Creek as late as the 1930s (Hibben 1941: 8; Jim Iknayan 1983, personal communication).

Five major plant communities were present during the historical period—mixed conifer, above 7,800 feet; pinyon-juniper, above 6,200 feet; a savannah pinyon-juniper woodland on the valley terraces, upper slopes, and ridge and mesa tops, above 5,800 feet; and a riparian or mesophytic plant community along Las Huertas Creek and around the springs (Naylor 1964: 95–95). Valley or narrow-leaf cottonwood and willow species were the major floral constituents. Below 6,000 feet were Great Basin grasslands, now a juniper-bunch grass savanna, down to about 5,500 feet (Fig. 47). Below this and extending across the bajada to the Rio Grande floodplain, the zone has been modified to a grassland-shrubland. Both of these communities have been altered by human activity such as overgrazing, farming, house construction, and the introduction of exotic species. The dominant plants of the terraces and mesas/ridges today include blue grama, ring muhly, galleta, three awn, sand dropseed, rabbitbush, broom snakeweed, pinyon, and juniper. During the historical period, dominant plants included black grama, sideoats grama, blue grama, New Mexico feathergrass, galleta, western wheatgrass, alkali sacaton, Indian ricegrass, Apache plume, winterfat, and sparsely scattered one-seed juniper and pinyon (Soil Conservation Service n.d.).

The dominant plants in the riparian community below 6,000 feet today include watercress, spearmint, willow, valley cottonwood, salt cedar (or tamarisk), and, along the margins, Apache plume. Watercress and spearmint were introduced by the Spanish in the early historic period; salt cedar was introduced by Anglos in the early 20th century (Campbell and Dick-Peddie 1964: 499; Scurlock 1983a: 7–8).

The fauna found in the valley and the adjacent bajada and Sandia Mountains also has changed during the last 400 years, primarily as a result of human activity. A number of large mammals hunted by the various eco-cultural groups of the area before 1900 have been decimated or extirpated, including the Merriam elk, pronghorn antelope, gray wolf, bighorn sheep, grizzly bear, and mountain lion (Bailey 1931: 22, 40, 310–312, 326, 362–363). Smaller mammals such as the coyote, rock squirrel, red squirrel, jackrabbit, desert cottontail, gray fox, badger, rock squirrel, and porcupine can still be found in varying numbers (Clothier 1957).

Figure 47—Juniper savanna on ridges above Las Huertas Creek. Sandia Mountains (center back). Photo by author.

More than 100 species of birds have been recorded in the Las Huertas canyon and valley and in the Placitas area (Scurlock 1995b). Two of these, the bald eagle and peregrine falcon, are considered endangered by the U.S. Fish and Wildlife and the New Mexico Game and Fish Commission. There remains some habitat for the rare and endangered willow flycatcher. Species that were important for their meat or feathers in the historic period include various ducks and geese, sandhill crane, wild turkey, blue grouse, scaled quail, mourning dove, band-tailed pigeon, golden eagle, red-tailed hawk, common raven, great-horned owl, and red-shafted flicker (Smith 1973: 96; Tyler 1979: 8, 52–53, 253).

Two invertebrates, the Sandia hairstreak butterfly and the blue silverspot butterfly, have been considered for inclusion on the federal list of endangered species.

In the century preceding Spanish arrival in northern New Mexico in 1540, there were a number of relatively large Pueblo villages along drainages east of Sandia and San Felipe pueblos. Some of the archeological manifestations of these include San Antonio, Paako, San Marcos, and Tonque. Tonque Pueblo, a pottery-making center located about 7 miles northeast of Placitas, supplied most of the glazewares that are found on sites in the area dating to these periods. Some of the lead used for the glaze decorations may have come from Sierra de la Mina, near Tecolote, about a mile northeast of Placitas. Along the entire "spring belt" of Tonque Arroyo, on which this village was located, are numerous "one- or two-room glaze sites situated on narrow stream terraces." These probable field house sites indicate that the people of Tonque were farming some distance from the main pueblo (Warren 1972: 36–38, 41).

Located on opposite sides of Las Huertas Creek in the center of the study area was a 15–20 room pueblo site dating to A.D. 1350–1450 on the south side, and a protohistoric pueblo on the north side, which later became the site of the land grant village of San Jose de las Huertas. Also present along these streams and large arroyos are numerous "field houses" dating to the late prehistoric and early historic periods (Scurlock 1995b).

The Pueblo population probably peaked in the valley between A.D. 1400 and 1650. During this 250-year period much of the canyon and valley floors was probably in cultivation, with the Pueblos living seasonally in small pueblos or one- or two-room field houses situated along both sides of the valley and located on geological terraces or benches. Runoff waters down tributary arroyos were directed onto agricultural fields, as probably were the floodwaters of the Las Huertas Creek during the spring snow melt upstream in the Sandias and following summer thunderstorms. Irrigation ditches may have been utilized in controlling some of this water, but certainly not to the extent nor with the sophistication that the Spanish later employed. Ditch irrigation was noted at the mouth of Las Huertas Creek by an early Spanish expedition of the late 16th century (Wozniak 1987).

This seasonal activity pattern among area pueblos continued into the recent past and was documented a little more than a century ago by anthropologist Adolph Bandelier. An informant at Santo Domingo related to him that almost all of the villagers were gone from the pueblos from April to September or October to work in the outlying farms or ranchos (Lange and Riley 1966: 265). Based on the relatively large number of Pueblo field house sites dating to this period, this land use pattern seems to have been the dominant one in the Las Huertas valley at the time of Spanish contact.

The first Spaniards probably visited the valley in the late 16th century, and within a few decades after Hispanic colonization, a few miners were working deposits of lead, copper, and silver in the northern portion of the Sierra de Sandia and living in the Tecolote area. Probably during this period the valley was named Las Huertas, or the gardens, by these early Spaniards. Rancho de Las Huertas was probably established in the area during the mid 17th century (Scurlock 1983a: 12–13).

Following their expulsion by the Pueblo Revolt, reconquest, and resettlement of the Middle Rio Grande Valley, some Hispanos returned to Las Huertas valley to raise livestock, mine, and perhaps trade with resident Pueblos. There is a 1714 reference (Chavez 1957: 4) to a watering hole (aguaje) known as Naranjo close to the north end of the Sandias. This landmark was probably along Las Huertas Creek because in the same document there is a reference to the minas paraje de las Guertas (Huertas) found within the vicinity of the aguaje (Chavez 1957). In 1765 nine Spanish families petitioned the governor to grant them land in the valley; 2 years later the San Antonio de las Huertas land grant was granted and settled. The village founded by the grantees, San Jose de las Huertas, prospered until intense Apache raids, and perhaps

drought, forced the settlers to retreat to more protected and well-watered settlements along the Rio Grande in 1823–26 (Scurlock 1983: 13–15).

The settlers soon constructed an irrigation system utilizing the waters of Las Huertas Creek, the nearby Ojo Rosa Castilla, and runoff from tributary arroyos (Fig. 48). Fruit trees and grapevines were planted, and corn, wheat, beans, squash, onions, and chile were cultivated. Cotton and punche, a local variety of tobacco, also were grown (Smith 1973: 90).

Livestock raising, primarily goats and sheep, was also a major subsistence activity. In summer, villagers herded their flocks on common grant lands or up Las Huertas canyon to meadows along the north slope of the Sandias. Winter grazing lands were located on lower areas of the grant or on nearby mesas between the grant and the river. The hunting of deer, bear, and small mammals and the gathering of wild edible plants supplemented the food produced by farming and ranching (Smith 1973: 90–95).

Trade was conducted with area Pueblos and, at times of peace, with the Faraon Apaches and Comanche. Spanish livestock and grain were exchanged for Pueblo pottery and woven items. Residents of San Felipe Pueblo brought pottery to later Placitas to trade as recently as the early 1900s (Delara and Delara 1983). The same items and punche were traded to the Apache and Comanche for hides, dried buffalo meat, and sometimes captives, who were adopted as household servants (Jones 1979: 143).

San Jose's isolation and nearness to the Faraon Apaches, who lived in the Sandia Mountains, did not preclude more families from coming to the village. By the first decade of the early 19th century the population had risen to 284 (Olmstead 1981: 144–147).

In 1810 the Faraon Apaches stepped up their raiding in the Rio Abajo, including the village of San Jose. Raids continued over the next few years, not only by the Apaches but also by the Navajos. As a result, the Alcalde of Alameda received an order to increase the mining of lead in Las Huertas for the production of musket shot "to castigate the enemies of the state" (Spanish Archives of New Mexico 1818). Nevertheless, the raiding continued, and in 1823 the governor ordered the residents of San Jose to abandon their village and to move to more protected settlements along the Rio Grande. Within a short time, most of the settlers had moved to the east bank of the river and established the settlement of Los Algodones, just south of San Felipe Pueblo (Smith 1973: 49–50). Others moved to Albuquerque, Cienega, or Socorro. A few families remained in the village, but they too left by 1826 (Smith 1973: 50–51). One informant (Montoya 1983) cited drought conditions as the reason for abandonment, while to others "there was not enough room to plant" (Delara and Delara 1983). The drought of 1815–21 and the onset of long, cold winters were probably causal factors of Apache and Navajo raiding.

Figure 48—Abandoned acequia madre (center) at Spanish colonial site of San Jose de las Huertas. Photo by author.

Within 15 years, some original and some new land grant settlers had returned to the valley, but instead of concentrating at the site of San Jose, which probably had fallen into ruin by this time, they dispersed over the land grant to establish ranchos and new plazas. Also, perhaps, the valley had been overfarmed and overgrazed to the point that relatively large numbers of individuals could no longer subsist at San Jose. However, a few families, some descended from original land grantees, continued to farm and raise livestock on a small scale in the Las Huertas valley using the colonial period irrigation system and a new ditch system that was constructed on the south side of the creek in the late 1840s. By the mid 19th century a new central village, the Plaza of San Antonio, or Las Placitas, was founded (Scurlock 1983: 15–17).

Following U.S. occupation and acquisition of New Mexico as a territory in 1846 and establishment of the Surveyor-General's Office in Santa Fe in 1854, villagers of the San Antonio de las Huertas land grant petitioned for confirmation of their title. They were denied because of confusion over the exact location of the east boundary. In 1881 the land grant heirs petitioned the Surveyor-General again, but they were refused for the same reason. In 1891 the Surveyor-General's office had been replaced with the Court of Private Land Claims to litigate the outstanding land grant claims. With Thomas Benton Catron as their attorney, the heirs' claim was heard by the court in 1897. Of the 130,000 acres claimed, the Court of Private Land Claims confirmed only 4,763 acres. As payment for his services, Catron received the east one-quarter, or 1,191 acres, of the grant (Montoya 1983; Smith 1976: 40–41).

Traditional irrigation farming and livestock raising continued throughout the first half of this century, although some of the homesteads in the valley were abandoned, perhaps due in part to the dry conditions of the 1940s–

50s. In the 1960s and 1970s the hippie commune of Tawapa, one of the largest in New Mexico, was concentrated along Las Huertas Creek from just south and east of San Jose to near Ojo Rosa Castilla. In more recent years, the area has experienced a housing boom, which has further degraded environmental conditions.

Rio Puerco-of-the-East

The Rio Puerco is a 170-mile-long tributary (the longest) of the Rio Grande with a drainage area of 6,220 square miles in the Middle Basin (Snead and Reynolds 1986: 57; Fig. 42). This river is the best documented of all of the tributaries in terms of associated land use and resultant environmental impact and change. It has been called the "abused basin" in recent decades, and as such, the environmental conditions of the drainage are still being studied by the U.S. Forest Service, the Bureau of Land Management, and the state's Environmental Improvement Division, to name just three concerned public agencies (Dortignac 1963; Harper et al. 1943).

The earliest historical description of the Puerco drainage is that of Juan de Onate in late October 1599. When he crossed the stream near Cabezon Peak on that date, Onate noted that the water was deep and had many cottonwoods along its banks. He called the stream "La Torriente de los Alamos" (a rapid stream with cottonwoods) and observed that the valley was "lush, rich, and fertile" (Lopez 1980: 71, 77).

Almost 100 years later, in 1692, General and Governor Vargas crossed the Rio Puerco west of the later site of Albuquerque, noting that the water was so deep that the soldiers had to carry provisions and equipment on their shoulders (Lopez 1980: 76; Twitchell 1963, I: 381). The Rio Puerco valley at this time was rich in grasses, bosques, springs, and charcos, small lakes or ponds. The floodplain was periodically inundated by overbank flows from the shallow stream channel (Lopez 1980: 71). Subsequent governors granted community and grazing grants within the drainage in the 1740s–60s. Also, the Navajo, with their many sheep, had moved into the area in the early part of this period (Bailey 1980: 98–99, 113; Lopez 1980: 72; Simmons 1982: 106–107; Wozniak 1987). In 1766 a Spanish traveler at the mouth of the stream noted that its waters were always "muddy and turgid" (Kinnaird 1967: 89). Intensive grazing by both groups and droughts resulted in topsoil erosion in the basin and the beginning of entrenchment of the Puerco during this period (Bailey 1980: 89–90; Love and Young 1983).

In 1774 a Spanish priest reported that poor crop harvests in the valley due to drought and related Navajo raids forced Hispanic settlers to abandon the upper and middle Rio Puerco. He wrote this about the river in 1776: "Its water is as dirty as the gutters of the streets, since its bed is of black clay and its bottom very treacherous with mire" (Adams and Chavez 1956: 254).

Spaniards, including the Montoyas, moved back to a grazing grant near Cabezon Peak on the Puerco in 1818, but fled when Navajos again stepped up their raiding on livestock in 1821. A member of the family returned in 1827 or 1828, but he and his family were forced to leave 6 or 7 years later (Rittenhouse 1965: 19).

Apparently recovered somewhat because of the Spanish hiatus, the environment of the upper Puerco valley was a "grassy wilderness" with "swampy vegas," "clear water," and "willow-lined banks" in the 1830s and 1840s (Maes and Fisher 1937: 10; Quaife 1967: 133). Seasonal dry periods and larger droughts caused the river to dry up over its lower reach part of each year, as it does now. In mid October 1846, west of Atrisco, Lt. Abert (1962: 74–78) described the valley as "wide, flat, overgrown with varieties of artemisias and coarse grass" and the river banks as "10 or 12 feet high" and "a few cottonwood trees" in the river bed, which was dry. To the north, near the abandoned town of Poblazon, the banks were 30 feet high. A short time later, 2 to 3 miles below the mouth of the Rio San Jose, Abert (1962: 92–93) noted that the Puerco's water was thick with mud.

North of Cabezon Peak in 1849, Lt. J.H. Simpson (McNitt 1964: 29) commented on the thin fringe of cottonwood along the Puerco and "water only here and there, in pools—the fluid being a greenish, sickening color, and brackish to the taste." He estimated the height of the river bank to be 20 to 30 feet and the width of the river at about 100 feet. Another member of Simpson's expedition wrote "The Puerco was a miserably dirty and little stream of brackish water lined with high cut soil banks and cottonwoods" (McNitt 1964: 29).

In 1853 the Puerco near present Interstate 40 was described at 100 feet wide and its streambed 18 feet deep with scattered pools of water (Foreman 1941: 119; Rittenhouse 1965: 27–28). About this same time, the channel at La Ventana was about 8 feet deep and in the lower reach of the river about 20 feet (Bryan 1928: 276; Dortignac 1962: 588).

A few years later, to the north, in the Cabezon-Casa Salazar area, the upper Puerco valley had marshy meadows (Maes and Fisher 1937: 1–4). This condition may have resulted from "rest from grazing" and "wet years" in the 1850s. By 1862, with the threat of Navajo raids almost nil, Hispanics and Anglos began to graze the upper Puerco intensively (Maes and Fisher 1937: 10–15). Irrigation facilities—dams, ditches, and headgates—were constructed in the valley. Water was easy to divert and relatively abundant because of the shallow channel and vegetation, which mitigated damaging floods (Maes and Fisher 1937: 12; Tuan 1966: 588–589).

In the Cabezon area, in the 1870s, the Rio Puerco channel was shallow, with a wagon road crossing marked by large logs laid in the stream bed. There were "large groves of cottonwood trees, high grass, and weeds." The chan-

nel at La Ventana was about 8 feet deep (Dortignac 1963: 507). By 1877 there were "high banks marked by recent cave-ins and falling trees" (Bryan 1928a: 268, 273). At the end of the decade there were some 10,000 acres under cultivation in the upper river drainage, and cut, native hay was being sold in Cabezon (deBuys 1985: 217; Rittenhouse 1965: 64). A major flood, which undoubtedly eroded banks and downcut the river channel more, occurred in the area in 1880 (USGS 1994). The farming and ranching communities of Cabezon, San Luis, Guadalupe, and Casa Salazar had a combined population of over 700 residents at this time (Garcia 1992: 5).

During this decade the number of sheep in the area increased to over 100,000, and there were about 9,000 cattle (Scurlock 1990a: 18; Fig. 49). Many of these animals were owned by ricos Jose L. Perea of Bernalillo and Mariano Otero of Las Vegas. By the turn of the century sheep numbers had increased to several hundred thousand head. Harvests of corn and other irrigated crops were good during this period, probably due to moister conditions from above-normal precipitation (Maes and Fisher 1937: 11–12, 14). By the turn of the century there were some 10,000 acres under irrigation in the upper Rio Puerco valley (deBuys 1985: 217).

Accelerating entrenchment of the Rio Puerco was underway, and irrigation farming became more difficult as the water level of the river dropped in the 1880s (Bryan 1928: 274, 279). Various facilities of an extensive irrigation project were constructed by the Rio Puerco Irrigation Company in the early 1890s, which were destroyed by flash floods (Bryan 1928a: 274; Dortignac 1962). Three Hispanic villages in the middle and lower reaches of the basin were abandoned between 1887 and 1894 (Bryan 1928a: 276–277).

In spite of the increasing number of livestock on the basin's rangelands, "good" bunch grass cover was present in the 1890s, probably due to two wet years during the decade (Bryan 1928; Dortignac 1963: 508). Intensive grazing continued into the early decades of the next century; in 1937 there were relatively large numbers of livestock on 75,284 acres of public lands in the Upper Basin. Droughts and intensive floods contributed to severe erosion during this period (Calkins 1937: 6; Maes and Fisher 1937: 15–19, 34; Fig. 50). Continued entrenchment of the river became a problem for irrigation farmers in the Cabezon area (Bryan 1928a: 274). Irrigated lands in the same area dropped to 3,000 acres, a decrease of 70 percent in less than 3 decades (Harper et al. 1943: 52). Some farmers may have shifted their operations to the Puerco valley above Cuba, where there were 5,500 acres under irrigation in 1939 (Dortignac 1960: 48).

A surveyor referred to a "new channel" for the river at Cabezon in 1899; it was 198 feet wide. Seven years later the channel at the same location had widened to 244 feet, with a depth of 20 feet. At nearby San Luis the depth of the Puerco channel was the same (Bryan 1928a: 271–273; Tuan 1966: 589; Fig. 49). To the north, at La Ventana, the river channel was 15 feet deep in 1913 (Dortignac 1962: 588).

As the river dropped farther below its floodplain, water for irrigation farming became increasingly difficult to obtain. Only about 3,000 acres were in cultivation in the valley from Cuba to Casa Salazar in 1925 (deBuys 1985: 217: Harper et al. 1943: 52). Two years later the depth of the Puerco channel was 22 feet at San Luis and about 40

Figure 49—Sheep grazing near Rio Puerco (center) and Cabezon Peak (back), 1880s. Note denuded soil (foreground). Photo by Henry Schmidt, courtesy Center for Southwest Research, University of New Mexico.

Figure 50—The Rio Puerco in flood near San Luis (?), 1905. Photo by R. H. Chapman, courtesy U.S. Geological Survey Photo Archives, Denver.

feet at La Ventana (Bryan 1928: 275; Dortignac 1962: 588; Tuan 1966: 589). To the south, below the Santa Fe Railroad tracks, the channel was also about 40 feet deep that year (Tuan 1966: 593). The following year, 1928, the channel depth at Cabezon had increased to 40 feet (Bryan 1928a: 274).

A major flood occurred on the Rio Puerco, contributing to the ongoing downcutting, at least in the upper and middle reaches of the river (Tuan 1966: 593; USGS 1994). Alluviation occurred on the lower Puerco, sometime between 1930 and 1940, and the river channel was raised about 14 feet (Tuan 1966: 593). The volume of the Puerco channel was 267,000 acre-feet (Dortignac 1960: 47).

Continued, intensive grazing and resulting erosion contributed to this process. In 1936–37 there were 14,500 cattle-units on the 150,715 acres of Upper Valley rangelands; the grazing capacity was estimated to be only 4,300 units. These lands included 56,240 acres of public domain, 19,044 acres of Forest Service land, and 75,431 acres of private land (Calkins 1937: 6; Maes and Fisher 1937: 34).

In an attempt to control grazing, the U.S. Forest Service began to fence its lands in the valley, as well as on Mesa Prieta and the Mount Taylor area in 1940 (Garcia 1992: 23). The newly created Grazing Service began reducing the numbers of livestock grazing on public lands in the basin through the issuance of permits (Forrest 1989: 159).

Residents of San Luis, Cabezon, Guadalupe, and Casa Salazar continued to leave as environmental conditions worsened in the late 1930s-early 1940s. Floods in 1941 and 1943 helped spur this exodus, as did the drought years of 1944–48. The most severe drought of this century followed in 1951–56 (Tuan et al. 1973: 58, 143–145; USGS 1994). By the 1960s the population had decreased to its lowest level over the past century.

Entrenchment continued in the 1950s and early 1960s in the Upper Valley (Tuan 1966: 589). The channel was about 55 feet deep at La Ventana in 1962 and 36 feet at San Luis, 43 feet at Poblazon, and 36 feet at San Ignacio in 1964 (Dortignac 1960: 47, 1962: 588; Tuan 1966: 589).

A summary of chronological change for the Puerco is given in Table 46. Impacts and changes are addressed in Chapter 5.

Table 46—Rio Puerco–of–the–East: historical conditions and environmental changes, 1599–1964.

Date	Descriptions of vegetation/water	Channel depth	Channel width	Source
1599	"Many cottonwoods"			Lopez 1980: 71
1700s mid	"Belly–high grasses, vast bosques, and wooded thickets"			Lopez 1980: 71
1760s		Lower R.P. began entrenchment		Love and Young 1983:
1845	"Grassy wilderness, swampy vegas, willow–lined banks"			Maes and Fisher 1937: 10
1846	"Few cottonwood trees"; "Overgrown with varieties of artemisias and coarse grass"; "Little pools of water"	10–12 feet (lower)		Abert 1962: 74
1846	"Thick with mud"	30 feet (Poblazon)		Abert 1962: 77, 92–93; Tuan 1966: 589
1849	"Slightly fringed with cottonwoods"	20–30 feet (near San Luis)	100 feet	McNitt 1964: 29
1850s (early)		8 feet (La Ventana)		Dortignac 1962: 588
1853		18 feet (Interstate 40 W)		Rittenhouse 1965: 27–28
1855		20 feet (lower river)		Bryan 1928a: 276
1860	"Marshy meadows"			Maes and Fisher 1937: 1–4
1860s		"Shallow" (Cabezon)		Maes and Fisher 1937: 12
1874		8 feet (La Ventana)		Dortignac 1963: 507
1875		"Shallow" (San Luis)		Tuan 1966: 588–589
1876–1880		"Shallow" (Cabezon)		Bryan 1928: 273
1877		"High banks" (San Luis)	26.4–29.2 feet	Bryan 1928a: 268, 275
1870s	"Large groves of cottonwood trees, high grass, and weeds"	"Shallow" (Cabezon)		Bryan 1928a: 273
1880 ca.	"Hand–cut hay"	8 feet (Cabezon)		Bryan 1928a: 274
1881		"Deepening" (lower)		Bryan 1928a: 277
1887		3 feet (Guadalupe)	30 feet	Bryan 1928a: 274– 275
1890		"Deepening" (Cabezon)		Bryan 1928a: 274
1895	"Native hay cut"			Bryan 1928a: 278
1899		198 feet (Cabezon)		Bryan 1928a: 271– 273
1900	"A good cover of bunch grasses"			Dortignac 1963: 508
1906		20 feet (San Luis and Cabezon)	244.4 feet (Cabezon); 405.9 feet (near Guadalupe)	Bryan 1928a: 271–274

continued on next page

Table 46—Rio Puerco–of–the–East: historical conditions and environmental changes, 1599–1964 (continued).

Date	Descriptions of vegetation/water	Channel depth	Channel width	Source
1913		15 feet (La Ventana)		Dortignac 1962: 588
1927		40–41 feet (La Ventana)		Bryan 1928a: 275
1927		22 feet (San Luis)		Tuan 1966: 589
1927		40 feet (lower)		Tuan 1966: 593
1928		40–41 feet (Cabezon)		Bryan 1928a: 274
1940		26 feet (lower)		Tuan 1966: 593
1959		50 feet (La Ventana)		Dortignac 1960: 47
1964		55 feet (La Ventana)		Dortignac 1962: 588
1964		36 feet (San Luis)		Tuan 1966: 589
1964		30 feet (Poblazon)		Tuan 1966: 589
1964		36 feet (San Ignacio, lower)		Tuan 1966: 589

Rio Salado

The Rio Salado rises on the north side of the Datil Mountains and flows south-south eastward, between the Ladron Mountains and the Bear Mountains. This stream empties into the Rio Grande near San Acacia.

Lorenzo Padilla, the first settler who came to Santa Rita on the river in 1880, said the channel was "inconsiderable, and the broad flat of the valley seemed a propitious place for farming." The area was surveyed into townships by Daniel Currey in 1882. About 100 inhabitants resided in Santa Rita at this time. The width of the stream bed varied from about 12 to 49 feet at one location. An intense rain and a flood in 1883 washed out the road and formed a new stream channel. A 1918 survey by Paul B. Moore of Magdalena at the same place reflects a radically different river than that recorded by Currey in 1882; the width of the Rio Salado ranged from 330 to 550 feet (Bryan 1927; Table 47). Since 1918 the channel has continued to widen, and most of the agricultural land in the valley has been destroyed.

Table 47—Changes in width of Rio Salado, 1882 and 1918.

	Width (feet)	
Location (sections in T2N, R4W)	1882	1918
Sections 23 and 24	13.20	525.00
Sections 14 and 23	18.48	330.10
Sections 14 and 15	11.88	441.30
Sections 15 and 16	48.84	550.00

FIRE

The Southwest is an excellent region to study fire patterns and statistics in montane woodlands and forests, owing to long and well-preserved tree-ring records. Forest lands have evolved since the last ice age with the influence of relatively frequent, episodic fires that were generally of low intensity. Fire frequency is correlated with the occurrence of fuel sufficient to effectively spread the fire over the landscape. This frequency, for pre–1900 fires, varies from 2 to every 10 years for ponderosa and mixed-conifer forests. Fires in the higher spruce-fir and lower pinyon-juniper occurred between 50 and 300 years and were of high intensity. These conflagrations generally killed most of the overstory trees, leaving some patches of live trees, with regeneration of conifers or aspen in the burned areas. Forest fires in this zone were generally large—5,000 to 50,000 acres (Baisan 1994: 1). Many of these large fires burned for months at a time, some beginning as early as April and persisting into August (Swetnam 1990: 9).

Fire history for the Southwest, regionally and in specific locales, has been examined by Ahlstrand (1979, 1980), Bahre (1991), Dieterich and Hibbert (1990), Humphrey (1974), Komarek (1969), Robinson (1990), Swetnam (1990), Swetnam and Baisan (1995), and Young and Evans (1980).

Climatic patterns of wet-drought cycles also affected the frequency and extent of forest fires in the region. Generally, the fire history of the study region is characterized by large, widespread fires occurring during drought years, but not all severe years were large regional fire years. The

most favorable conditions for fires in ponderosa pine forests were extremely dry years, preceded by wet years, which produced above normal amounts of vegetative fuels. During these wet periods, fires were small and infrequent. Conversely, smaller areas were burned in summer or fall after exceptionally wet springs. Most fires were probably low intensity which, spread generally up drainages and across grassy areas. Pre–1900 settlement fires maintained open stand conditions, and this thinning action prevented catastrophic crown fires, which have occurred in this century (Baisan 1993: 6; Swetnam and Baisan 1995: 2, 3, 5; Swetnam and Betancourt 1990).

Recent studies on the effects of sheep grazing on fire regimes of ponderosa pine forests in northern New Mexico indicate a correlation between the extent and duration of grazing and a decline in fire frequency. This decline occurred prior to organized fire suppression, which generally began about the turn of the century. Intensive grazing by sheep severely reduced grasses, which were the fuel necessary for the spread of fire in the regional, high frequency fire regimes of these forests. In some instances, the complete elimination of fires occurred due to this intense grazing (Savage and Swetnam 1990); Touchan et al. 1994: 1, 5, 8–9).

The largest fire year for the Southwest, documented by tree-ring analyses, was 1748, the second largest 1851, and the third largest 1773. These were all associated with extended drought periods. For 1700 to 1900 the "regional fire occurrence times series ... shows a pattern of about 20 large regional fire years (more than 19 sites) occurring against a background of smaller fire years" (Swetnam and Baisan 1995: 16, 18). In mixed-conifer forests, large fires occurred in extreme drought years with no consistent lagging relations.

Regional national forests have experienced the highest number of annual, lightning-caused fires in the United States (Swetnam and Betancourt 1990: 1017). In the southern Rocky Mountains thunderstorms with lightning occur on 70 or more days a year (Keen 1987: 43). Fires caused by lightning normally begin in the spring and reach their highest incidence late June to early July. A significant decrease usually follows as summer rains progress (Swetnam and Betancourt 1990: 1017).

Fire frequency in the study region generally declined sharply after 1880 until about 1900–10, when fire suppression became common. This change, according to Touchan et al. (1994), was also due to intensive grazing and trampling by livestock, which reduced or removed potential fuels.

In some specific areas, such as the El Malpais National Monument, where islands of lava rock were virtually inaccessible to livestock, fire frequency remained about the same throughout the protohistoric and historic periods. From 1407 to 1991 there were some 66 fires, or a fire every 8.2 years. At two sites in the Jemez Mountains, one in the central portion of the range and the other on the west slope where grazing was intensive at various times, the averages were 9.9 and 11 years, respectively. There was a decline in fire frequency beginning at the end of the 19th century at the first site, probably due to intensive grazing and initiation of fire suppression, while there was a decrease in fire occurrence in the late 18th and early 19th centuries at the other site, which also coincided with a period of heavy grazing (Touchan et al. 1994: 2–9).

Fire history studies on the Pajarito Plateau, in the southeastern part of the Jemez Mountains, revealed a fire frequency in the ponderosa forest of 15.1 years prior to 1894. This date marks the beginning of the ongoing period of fire suppression for the area. Tree-ring samples taken from Burnt Mesa and Escobas Mesa showed a fire frequency of 14 years between 1786 and 1792. Post-suppression fire frequency for 1894–1977 was 41.9 years, and none of these was a major fire until the La Mesa fire of 1977 (Foxx 1981: 7, 35). Fires were specifically dated to 1797, 1806, 1822, 1842, 1870, 1878, and 1893 (Robinson 1990: 142).

The forests and woodlands of the Sandia Mountains have been protected from fire since the early part of this century by the National Forest Service. There was one fire in the Juan Tabo-La Cueva canyons area early in July 1965 and a smaller fire in June 1990 near the headwaters of Las Huertas Creek. The earlier fire was the most extensive fire in the Sandias in this century; 550 acres were burned up the canyon to the crest at 10,678 feet elevation (Cooper 1988:4).

Preliminary work on the fire history of the La Luz area on the west side of the Sandia Mountains revealed a somewhat different pattern (Baisan 1993, 1994). From 1506 to 1675 fires were very frequent but patchy. No fire-scarred trees dating 1675 to 1706 were found. Fires for the period 1706 to 1781 were less frequent and patchy. No fire scars were found after 1781 until the present (Baisan 1994: 2).

Fires for the first period have been interpreted as a combination of natural (i.e., lightning-caused) and incendiary fires started by Pueblo or Apache groups. The hiatus from 1675 to 1706 may have been due to lack of fuel, as a result of fires in the previous period. The less frequent and patchy fires for the third period (1706–81) have been attributed to natural fires quickly sweeping through the area. The grazing of sheep on the site probably reduced the available grass fuels to the point that after 1781 no fires occurred (Baisan 1994: 2).

Another factor in reducing fuel loads was the herding of goats in the Sandias from the late 1700s to the mid 20th century. Their browsing pattern of feeding on shrubs would have removed even more fuels, virtually precluding any fires in the area. Also, intensive fuelwood cutting by residents of Albuquerque, Corrales, Alameda, Bernalillo, and Sandia Pueblo throughout the 19th century would have removed much of the pinyon-juniper and scrub oak species. Following establishment of the Cibola National Forest in 1906, a policy of fire suppression was another major factor in fire cessation here.

A fire history study in the northern Manzano Mountains indicates a period from 1550 to 1636 when relatively frequent, spreading fires occurred. This was followed by a period (1637–1723) of infrequent, spreading fires, and then, from 1724 to 1773, by a period of episodic, widespread fires. From 1773 to about 1810, there were no fires in the area. This absence of fires may have been due to intensive livestock grazing, especially sheep, and fuelwood cutting by Hispanic residents in the greater Albuquerque area (Baisan 1993: 4).

Fires did occur in the northern Manzanos from 1811 to 1842, then frequency declined until 1904, after which time no more fires occurred. Lack of intensive grazing and firewood cutting may have created the fuel to sustain fires until 1842. Sharp increases in grazing and cutting after that year may have caused the decrease, and organized fire suppression probably accounts for the cessation of fires after 1904 (Baisan 1993: 4–5).

PLANT COMMUNITIES

The following brief reconstructions of historic plant communities in the study region are based primarily on the work of Brown (1982), Brown and Lowe (1980), Crawford et al. (1993), Dick-Peddie (1993), Gross and Dick-Peddie (1979), Leopold (1951), and Watson (1912) and secondarily on various historical sources cited in the following pages. Changes in floodplain communities, and their dominant species, are presented in Table 48. Following these community descriptions are selected historical observations on the region's flora, included as supplemental material. The next section will deal with impacts on these communities over the last 150 years.

Riparian

As long as 2 million years ago a riparian cottonwood woodland, or bosque, existed along the Rio Grande. The cooler, wetter conditions that prevailed at that time in New Mexico also supported several associated plants, including birch (*Betula* sp.), western chokecherry (*Prunus virginiana*), willow (*Salix* spp.), and cattail (*Typha* sp.). When the Spanish arrived in the 16th century the banks, sand bars, and adjacent floodplain areas were vegetated with scattered bosques of varying-age valley cottonwood (*Populus deltoides* ssp. *wislizeni*) (Fig. 51), with a willow (*Salix* sp.) and salt grass (*Distichlis spicata*)-dominated understory (Table 48). Open, grassy areas, or vegas, were also present. Cattails and other wetland species grew in and around ponds, marshes, and swampy sites. Other major plants associated with the bosques included New Mexico olive (*Forestiera pubescens* var. *pubescens*), baccharis (*Baccharis wrightii*), false indigo bush (*Amorpha fruticosa*), wolfberry (*Lycium andersonii*), and, in southern reaches, mesquite (*Prosopis glandulosa*). All of these plant communities were considerably modified by human activity during the historic period (Crawford et al. 1993: 27–28; Dick-Peddie 1993: 151–152; Table 48).

Besides cattails, other common plants such as sedges (*Carex* spp., *Eleocharis* sp.) rush (*Juncus* sp.), scouring rush (*Equisetum hyemale*), buttercup (*Ranunculus cymbalaria*), pepperwort (*Marsilea vestita* ssp. *vestita*), mosquito fern (*Azolla mexicana*), reed grass, or carrizo (*Pragmites australis*), and yerba mansa (*Anemopsis californica*) grew around wetlands or on areas with high water tables. The deeper water of swamps and ponds held floating plant communities of algae (*Spirogyra, Vaucheria, Oedogonium*) and duckweed (*Lemna minor*). The submerged species of water plants were milfoil (*Myriophyllum spicatum*) and hornwort (*Ceratophyllum demersum*) (Crawford et al. 1993: 28; Table 48).

These plants and the communities they made up were adapted to a dynamic, moist, floodplain environment with an unstable substratum. Relatively high moisture availability originated from periodic floods, standing surface water, and shallow ground water. These floods scoured new and old channels, washed away stands of trees and understory vegetation, created new wetlands, and formed new channels and sand bars. Flood actions resulted in the creation of gradients across the floodplain, which resulted "in a dynamic successional sequence in a riparian habitat continuum" (Reichenbacher 1984: 15, 20). Flooding is basically an erosional-depositional process promoting "forest and age diversity on the floodplain" and in its meandering "creates the distribution of the different communities and age classes" (Crawford et al. 1993: 28). Fire, natural and human caused, probably played a lesser role in the creation, composition, distribution, and age structure of these communities. These dynamic processes were present until their alteration and modification in the early 1900s (Crawford et al. 1993: 29; Table 48).

Grasslands

Grasslands covered much of the study region between stream floodplains and up to 6,000 to 7,000 feet elevation in the early historic period. This botanical zone has been called desert grassland, desert-grassland transition, desert savanna, desert shrub grassland, and grassland transition. These various names suggest the obvious transitional nature of this plant community (Brown 1982: 122–131; Dick-Peddie 1993: 106–107). With intensive grazing of these communities for 200 to 400 hundred years, forbs and shrubs have replaced various bunch grasses favored by livestock. Various grama species and other bunch grasses were the dominant types in these "seas of grass," as they were sometimes called in the historic period. Prior to the arrival of the Spanish, various Native American groups intentionally burned these grasslands periodically. Lightning-caused fires may have occurred even more frequently. These burns may have killed encroaching woody forbs and shrubs and stimulated vigorous growth. The complete role of fire in the maintenance of these grass-

Table 48—Historic floral community dominant plant species, Middle Rio Grande Valley.

Period	Communities/dominant species
Spanish Colonial (1540–1680)	Bosque (riparian woodlands)
	Cottonwood groves—*Populus deltoides* ssp. *wislizeni* (discontinuous)
	Willows—*Salix exigua, S. gooddingii, S. amygdaloides* (understory areas and river edge)
	New Mexico olive—*Forestiera pubescens var. pubescens* (isolated understory areas)
	Seepwillow—*Baccharis salicifolia* (isolated understory areas)
	False indigo bush—*Amorpha fruticosa* (isolated understory areas)
	Wolfberry—*Lycium andersonii* (isolated understory areas)
	Mesquite—*Prosopis* sp. (southern reach; isolated understory areas)
	Salt grass—*Distichlis spicata* (understory areas)
	Common reed grass—*Phragmites australis*
	Cienegas, esteros, charcos (wetlands)
	Algae—*Spirogyra, Vaucheria, Oedogonium* (deeper water)
	Duckweed—*Lemna minor* (deeper water)
	Chara spp. (shallow water)
	Water–milfoil—*Myriophyllum spicatum* (shallow water)
	Hornwort—*Ceratophyllum* sp. (shallow water)
	Cattail—*Typha latifolia* (shallow water margins)
	Sedge—*Carex* sp., *Eleocharis* sp. (shallow water margins)
	Rush—*Juncus* sp. (shallow water margins)
	Scouring rush—*Equisetum hyemale* (shallow water margins)
	Buttercup—*Ranunculus cymbalaria* (shallow water margins)
	Pepperwort—*Marsilea vestita* ssp. *vestita* (shallow water margins)
	Mosquito fern—*Azolla mexicana* (shallow water margins)
	Coyote willow—*Salix exigua* (wet banks)
	Cottonwood (wet banks)
	Vegas (meadows)
	Sedges (wet meadows, water edges)
	Rush (wet meadows)
	Common Reed Grass (wet meadows)
	Salt grass (wet meadows)
	Yerba Mansa—*Anemopsis californica* (wet meadows)
	Appearance of naturalized exotic plants such as alferillo (*Erodium cicutarium*), horehound (*Marrubium vulgare*), dandelion (*Taraxacum officinale*), mallow (*Malva neglecta*), etc.
Middle–late Spanish Colonial–Mexican Republic (1681–1846)	Similar to plant communities distribution above but fewer or no stands of cottonwoods around settlements, more ditches with *Chara*, sedge, rush, bullrush, and willow species.
Territorial (1846–1912)	Bosque (riparian woodlands)
	Similar to above but fewer stands of cottonwood, with generally smaller trees; more ditchside habitat.
	Cienegas, esteros, charcos (riparian wetlands)
	Increase due to rising water table and increasing soil alkalinity, dense ditchside thickets and stands of willow, senna (*Senna bauhinioides*), sunflower (*Helianthus annuus*), and goldenrod (*Solidago* spp.).
	Vegas (meadows)
	Appearance and spread of exotic species such as curly dock (*Rumex crispus*), Russian thistle (*Salsola kali*), and Johnson grass (*Sorghum halepense*) (southern reach).

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Table 48—Historic floral community dominant plant species, Middle Rio Grande Valley (continued).

Period	Communities/dominant species
Statehood (1912–present)	Bosque (riparian woodlands)
	More extensive stands of young and maturing cottonwoods and understory willow species dominant until 1940s. Major reduction in wetland and aquatic species.
	Bosque eradicated in local areas inundated by major reservoirs or by floodplain clearing for development.
	Cienegas, esteros, charcos (wetlands)
	Extensive until 1930s drainage and reclamation or inundation by reservoirs.
	Appearance of tamarisk, or salt cedar (*Tamarix* spp.), Russian olive (*Elaeagnus angustifolia*), Siberian elm (*Ulmus pumila*), and tree of heaven (*Ailanthus altissima*) and spreading rapid.
	Increase in four–wing saltbush (*Atriplex canescens*), Russian thistle.

Sources: Crawford et al. 1993: 28; Hedke 1925: 23; Watson 1912, Hink and Ohmart 1984, Scurlock 1988a, 1993a, and Soil Conservation Service 1994

Figure 51— Three men in a "ferry" boat on the Rio Grande, 1880s. Note honey mesquite (left center), valley cottonwood seedlings on sandbar (upper center), and scattered, older cottonwoods (back). This locale is now inundated by Elephant Butte Reservoir. Photo courtesy New Mexico Bureau of Mines Photo Archives, Socorro.

lands, however, is uncertain (Bahre 1991: 138–141; Dick-Peddie 1993: 106–107). Intensive grazing has so denuded many stands that today their scant, patchy condition will not carry extensive fires. Other factors, such as climatic change and fire suppression, probably have a role in compositional change in this community (Bahre 1991: 42–53).

Various travelers across the region in the early to mid historic period commonly referred to the vast stretches of densely growing grama and other bunch grasses. By the middle 1800s, recorded historic observations, and particularly field notes from public land surveyors later in the century, indicate that changes in plant composition had already occurred or were in progress. The species of grass more palatable to livestock had been decimated, followed by encroachment of shrubs and woody or herbaceous species, including introduced ones. For determining more recent changes, the technique of repeat photography (i.e., rephotographing a view of vegetation at the same historical location) has been used to document these changes (Dick-Peddie 1993: 9–20).

Using surveyors' notes on public lands in New Mexico from the 1870s and 1880s, Gross and Dick-Peddie (1979) reconstructed "primeval vegetation types," including grasslands, for about 1880 (Fig. 52). Based on this map, desert grassland and sand scrub were generally found east of the Middle Rio Grande Valley, reflecting a subsequent change by an invasion of saltbush, creosotebush, juniper, sand sagebrush, or yucca. West of the river, juniper and pinyon at higher elevations constituted the major invader species into grasslands (Dick-Peddie 1993: 11). In some locations, the present composition has led to classification of this community as savanna.

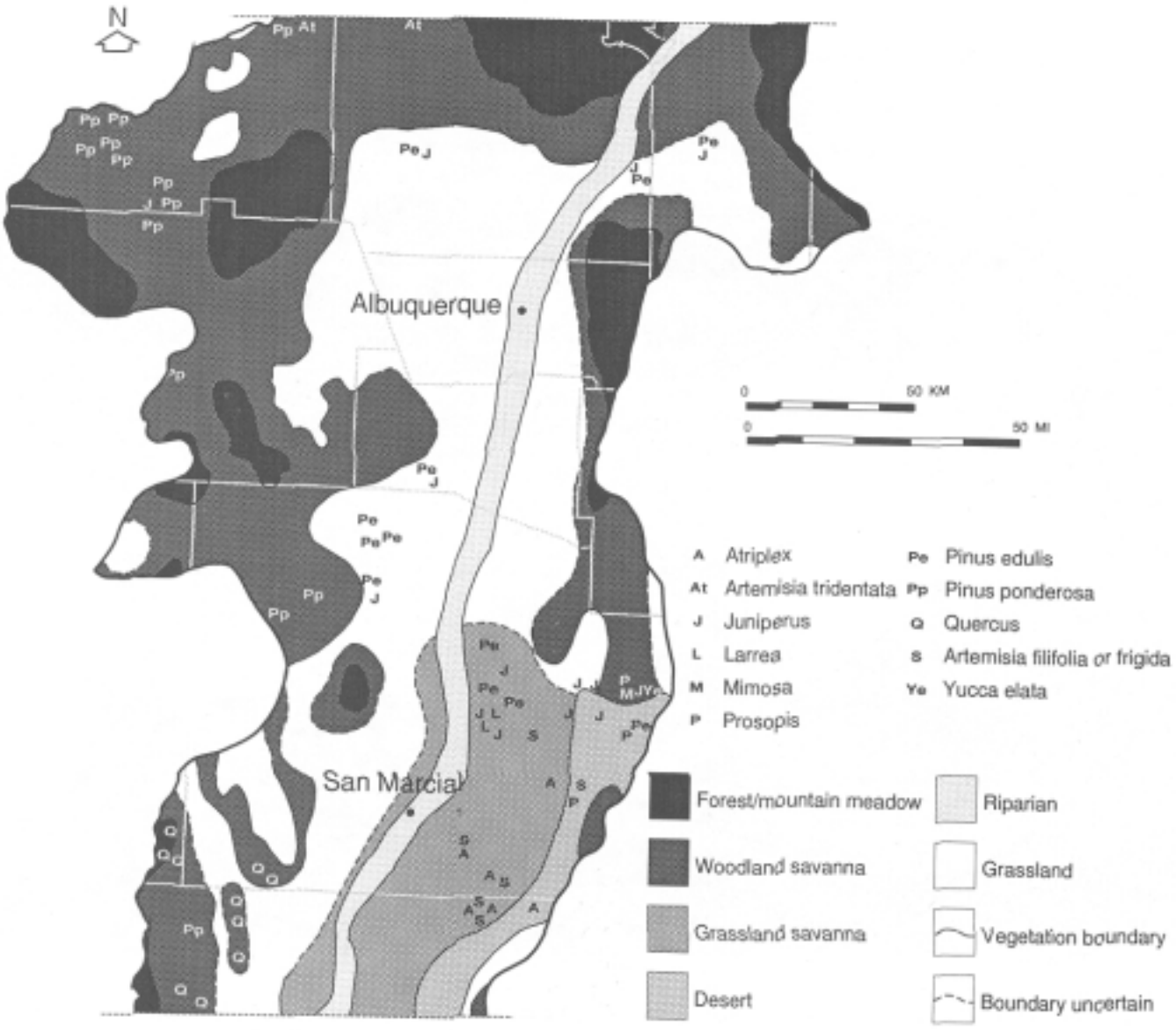

Figure 52—Reconstructed primeval vegetation types, 1870–1900 (after Gross and Dick-Peddie 1979).

Desert Grassland

The desert grassland community flanks the Middle Rio Grande Valley from the Cochiti Pueblo area to about Socorro (Fig. 53). Much of the desert grassland occupies sites that were previously plains-mesa grasslands. Intensive grazing, fire suppression, and perhaps other factors have resulted in the invasion of forbs and shrubs; their composition is highly variable. The dominant grass of this community is black grama (*Bouteloua eriopoda*). Other grama species are present, as are the dominants tobosa (*Hilaria mutica*), fluff grass (*Erioneuron pulchellum*), and bush muhly (*Muhlenbergia porteri*). Some common, associated shrubs and forbs include saltbush (*Atriplex* spp.), prickly pear (*Opuntia* spp.), *Yucca* spp., feather peabush (*Dalea formosa*), and snakeweed (*Gutierrezia sarothrae*) (Brown 1982: 112, 115–131; Dick-Peddie 1993: 106–108, 117–118; Fig. 51).

Plains-Mesa Grasslands

Generally occurring on intermountain mesas and bajadas at elevations between 5,500 and 6,500 feet are the plains-mesa grasslands, which were historically more extensive, but human disturbance over the last 200 years has reduced their range. These communities were made up of 90 percent grass species such as blue grama (*Bouteloua gracilis*) across the region, western wheatgrass (*Pascopyrum smithii*) and galleta (*Hilaria jamesii*) on northern mesas, and Indian ricegrass (*Oryzopsis hymenoides*) on bajadas. Various dropseed (*Sporobolus* spp.) species, along with Indian ricegrass, occur on some sandy northern and central mesas. At the extreme south end of the study region black grama and various dropseed species occur. Alkali sacaton (*Sporobolus airoides*) dominated swales across the region, sometimes in association with tobosa. A number of other shrubs, forbs, and herbaceous plants, such as *Yucca* spp., saltbush, sagebrush (*Artemisia* spp.), and rabbitbrush (*Chrysothamnus* spp.), make up the other ten percent of the vegetative cover. Due to climate and land forms, the plains-mesa grassland vegetation of New Mexico demarks the southwestern boundary of the continental grassland (Dick-Peddie 1993: 105–106; Soil Conservation Service 1994)..

Figure 53—Desert grassland near Isleta Pueblo. Bunch grasses, broomweed, and scattered four-wing saltbush (behind fence) are dominant species. Photo by author.

Scrublands

Four scrubland plant communities have been recognized in the region: Great Basin desert scrub, Chihuahua desert scrub, plains-mesa sand scrub, and montane scrub (Dick-Peddie 1993). Intensive grazing, fire, fire suppression, and climatic variations have shaped these associations in the historic period. These communities are dominated by shrub species adapted to lower moisture availability and other poor or severe climatic, geomorphologic, and edaphic conditions. The Great Basin desert occurs to the west and northwest of Albuquerque. Dominant species in the Great Basin community are shadscale (*Atriplex confertifolia*), fourwing saltbush (*A. canescens*), sagebrush, winterfat (*Krascheninnikovia lanata*), and rabbitbrush (Dick-Peddie 1993: 129–130; Soil Conservation Service 1994).

The Chihuahua desert scrub community occurs in the southern part of the study region, extending from Socorro south to the boundary below San Marcial. Originally smaller in extent, intensive grazing coupled with climatic fluctuations and fire suppression have resulted in extensive enlargement of its historical range in the last century or more. This increase has included the replacement of the two previously discussed grassland communities. The two major plant species are creosotebush (*Larrea tridentata*) and tarbush (*Flourensia cernua*), with soaptree yucca (*Y. elata*), white thorn (*Acacia* spp.), and various cacti species in association (Dick-Peddie 1993: 131–132; Soil Conservation Service 1994).

The third community, the plains-mesa sand scrub, flanks the Middle Valley from Cochiti to Socorro and is also found to the east of the Bosque del Apache National Wildlife Refuge. This vegetative type is determined by deep-sand areas, as well as by climatic conditions. Common plants include sand sagebrush (*Artemisia filifolia*), broom snakeweed, and *estafiata* (*Artemisia frigida*). Dominant grasses include hairy, blue, and sideoats grama (*Bouteloua hirsuta, gracilis, curtipendula*), alkali sacaton, and mesa dropseed (*Sporobolus flexuosus*) (Dick-Peddie 1993: 128–129).

The last scrub community, the montane scrub, generally occurs in patches or strips within more extensive types of upland vegetation. This community occurs on exposed rocky slopes or ridges subject to variable and severe climatic conditions. A number of species of common shrubs are present: mountain ninebark (*Physocarpus monogynus*),

buckbrush (*Ceanothus fendleri*), Mormon tea (*Ephedra torreyana*), mountain mahogany (*Cerocarpus montanus*), Apache plume (*Fallugia paradoxa*), scrub oaks (*Quercus* spp.), banana yucca (*Y. baccata*), and gooseberry (*Ribes* spp.) (Dick-Peddie 1993: 123–127).

Juniper Savanna

The juniper savanna community is an ecotone between grasslands and woodlands in the region; widely scattered juniper or oak species (less than 130/acre) occur in a grass matrix (Fig. 47). All of the regional juniper savanna is composed primarily of one-seed juniper (*J. monosperma*) and several major grasses, including three grama species, plains lovegrass (*Eragrostis intermedia*), galleta, sixweeks threeawn (*Aristida adscensionis*), and Indian ricegrass. Gambel oak (*Quercus gambelii*) or gray oak (*Q. grisea*) in place of juniper are less common in grassland stands. This community, which may have formed in the historic period, has expanded extensively due to intensive livestock grazing, climatic variation, and fire suppression (Dick-Peddie 1993: 87, 91–93).

Pinyon-Juniper Woodlands

The pinyon-juniper woodlands occur on lower mountain slopes and higher mesas, generally between 6,000 and 7,500 feet. The community is dominated by pinyon (*Pinus edulis*) and one-seed juniper or alligator juniper (*J. deppeana*) (Fig. 54). Blue grama grass is generally present, and in some instances understory shrubs such as mountain mahogany, skunkbush (*Rhus trilobata*), and Gambel or wavy leaf (*Quercus undulata*) oaks. The Gambel oak may be codominant with the conifers. This community has also extended its range into grasslands over the past 100 years or so, owing primarily to overgrazing and fire suppression (Dick-Peddie 1993: 87–90). This zone has been heavily used since the late prehistoric period for collecting of fuelwood, construction materials, and medicinal and edible plants. Understory grasses were intensively grazed throughout the historic period.

Ponderosa Pine

Ponderosa pine (*Pinus ponderosa*), the most important commercial species in the region, is dominant in this community, which occurs from about 7,200 to 8,500 feet. Other tree species, such as Gambel oak, pinyon pine, and Rocky Mountain juniper (*Juniperus scopulorum*), sometimes occur in association. Common understory shrubs include Fendler buckbrush (*Ceanothus fendleri*) and gooseberry (*Ribes* spp.). A number of grasses are found here, including Arizona fescue (*Festuca arizonica*), bluestems (*Schizachyrium* spp.) and gramas, mutton grass (*Poa fendleriana*), mountain muhly (*Muhlenbergia montana*), and pine dropseed (*Blepharoneuron tricholepis*). Severe disturbances, such as intensive logging or fires, have often led to prolonged midsuccessional dominance by oaks, junipers, or pinyon. Intensive grazing and fire suppression have also led to an interruption in successional stages in this community (Dick-Peddie 1993: 66–68, 76–78; Soil Conservation Service 1994).

Subalpine and Mixed Coniferous Forest

These forests generally occur in the region between 8,500 and 12,000 feet, where there is relatively heavy snow accumulation and a short growing season. These communities are important to the watershed because of their storage of water and discharge from deep snowpack. The two diagnostic tree species in the subalpine are corkbark fir (*Abies lasiocarpa*) and Engelmann spruce (*Picea engelmannii*). Engelmann spruce, Douglas fir (*Pseudotsuga menziesii*), and white fir (*Abies concolor*) form communi-

Figure 54—Pinyon–juniper at El Malpais National Monument, Cibola County. Photo by author.

Figure 55—Mixed conifer forest above riparian zone (leafless boxelder trees on right), Sandia Mountains. Photo by author.

ties in the lower part of this zone (Fig. 55). Limber pine (*Pinus flexilis*), Douglas fir, boxelder (*Acer negundo*), Rocky Mountain maple (*Acer glabrum*), and aspen are present in some ecological situations. Meadows with a diversity of grasses, sedges, and wildflowers occur in this community. Numerous grasses (32 species) are found scattered through the forest as well. The subalpine forest has been utilized historically for logging, hunting, plant gathering (medicinal and edible), and recreation, primarily hiking and skiing. These uses, and fire suppression since the turn of the century, have modified the composition of this community (Dick-Peddie 1993: 51–66, 76–77).

Alpine Tundra

The alpine tundra, which is the highest of all plant communities, is found in only one area in the Middle Basin, on the higher peaks of the Sangre de Cristo Mountains north of Santa Fe. This virtually treeless zone is found above 12,000 feet and is made up of several sub-communities, or associations, determined by microclimates, topography, and soil types or surface rocks (Dick-Peddie 1993: 47–48).

Perhaps the most common plant association is the "cushion," composed of several low-growing species, including *Carex rupestris*, a rhizomatous sedge that helps form sod. Some of the other dominant plants include alpine sage (*Artemisia scopulorum*), cushion yellow aster (*Tonestus pygmaeus*), and bistort (*Polygonum bistortoides*) (Dick-Peddie 1993: 49).

Another association is fellfield, or rock field, which supports cushion-like, perennial plants that "hug" the ground. Some of these plants include alpine forget-me-not (*Eritrichium nanum*), alpine clovers (*Trifolium* spp.), and moss-pink (*Silene acaulis*) (Dick-Peddie 1993: 48).

A third association is known as kobresia turf, named for the principal species found there, *Kobresia myosuroides* Another common plant of this sub-community is alpine avens (*Geum rossii*) (Dick-Peddie 1993: 48–49; Soil Conservation Service 1994).

Still another association is the rock outcrop, or rubbleland, made up of talus, stone-stripe, or rock-detritus. Characteristic plants include a groundsel (*Senecio atratus*) and two yellow, flowered saxifrages (*Saxifraga chrysantha* and *S. flagellaris*). A variety of lichens are widespread in this association (Dick-Peddie 1993: 49).

Native Americans camped and hunted in the tundra of the Sangre de Cristos as early as 3,000 years ago, perhaps to hunt bighorn sheep and snowshore hare in summer. In the historic period, Pueblo, perhaps Apache, and Hispano people hunted and herded their livestock here. The Pueblos also maintained shrines (and still do) on some of the higher peaks. In more recent years recreational use has caused some adverse impacts, especially affecting vegetation along trails and around camps (deBuys 1985: 21–27, 31–38).

FAUNA

Mammals

From the late prehistoric period to the arrival of the Spanish, Native Americans hunted virtually every species of mammals in the region for food, hides, or body parts. Bones and other physical remains of various mammal species, as well as various birds, reptiles, and amphibians, have been identified and recovered from a large number of late prehistoric archeological sites (Hewett and Dutton 1945; Hibben 1975; Marchiando 1977; Schaafsma 1980; Young 1980). Petroglyphs, pictographs, and especially kiva wall murals also document some of the local fauna (Table 49). From this evidence, and from early historic observations, the species, their ranges, and their relative numbers can be reconstructed to varying degrees.

The pre-Spanish Middle and Upper basins supported a diverse number of vertebrate species with relatively abundant populations. More than 140 mammals, more than 400 birds, a fair number of reptiles and amphibians, and 31 fishes were found in the study region. Important as game animals to Native Americans were bison, pronghorn, elk, deer, bighorn sheep, and various rabbit species. These mammals, as well as others such as grizzly bear, and black bear, wolf, beaver, and river otter, were hunted and trapped for their hides and furs by Indian groups, as well as by the later Spanish and early Anglo Americans.

At one Anasazi archeological site of the same period, Pottery Mound, near Los Lunas, 33 animal species have been identified, including bear, jaguar, mountain lion, wolf, coyote, fox (?), bald eagle, parrot, macaw, and whooping crane (Table 50). Macaws and parrots represent border or interior "Mexican" species, probably brought up the Rio Grande as caged or skinned specimens.

The early Spanish explorers and missionaries, in the period 1540–1766, primarily described the common large mammals, species that were of interest for their meat, hides, or coarse furs. These species included bison, mule deer, and white-tailed deer, elk, pronghorn, bighorn sheep, gray wolf, and Mexican wolf, black bear, grizzly bear, mountain lion, bobcat, cottontail, and jackrabbit. Two of these—buffalo and the elk—were curiosities, and live specimens of each were even shipped to the King of Spain (Simmons 1978: 19, 22). Other species, such as pine marten, ermine, beaver, river otter, porcupine, fox, and jaguar, are mentioned less frequently in the documents (Ayer 1965: 37; Bolton 1946: 353; Espinosa 1942; Hodge 1946: 350; Kinnaird 1958: 95; Weber 1971: 12–13).

Terms such as "large numbers, abundant, infinite, and inexhaustible" were used by various Spaniards in describing mammal populations. These descriptors were used into the early 19th century, especially for bear, bison, deer, elk, bighorn sheep, and rabbits. Wild horses were also present on grasslands in relatively large numbers (Ayer

Table 49—Fauna identified from faunal remains and kiva murals—Kuaua Pueblo.[a]

Mammals	Birds	Reptiles and amphibians	Insects
Pronghorn antelope	Goose sp.	Rattlesnake sp.	Butterfly sp.
Badger	Cooper's hawk	Water snake sp.	Caterpillar sp.
Bat	Red-tailed hawk	Tortoise	Cricket sp.
Bear	Sparrow hawk	Frog sp.	Bedbug sp.
Bison	Hawk sp.	Tadpole sp.	Worm sp.
Bobcat	Bald eagle	Newt sp.	
Coyote	Golden eagle		
Deer	Quail sp.		
Elk	Turkey		
Fox	Sandhill crane		
Gopher	Macaw (introduced through trade)		
Cottontail sp.	Roadrunner		
Jackrabbit	Owl sp.		
Mole	Hummingbird sp.		
Mountain lion	Swallow sp.		
Bighorn sheep	Jay sp.		
Crow			
Magpie			
Mountain bluebird			
Loggerhead shrike			

[a] *Occupied ca. 1325–1600.*
Sources: Dutton 1963

1965: 37; Carroll and Haggard 1942: 99–100; Coues 1987: 597; Hodge 1946: 350; Kinnaird 1967: 95; Simmons 1991b: 168; Thomas 1941: 112–113).

Hunting of mammals by Spaniards was generally at a subsistence level, and sport hunting, practiced by only the well-to-do explorer, landholder, or government official, was even rarer in the 16th and 17th centuries. Obviously, there was some impact on animal populations; for example, the Jicarilla Apache believed that bighorn sheep were driven from the valleys into the mountains of northern New Mexico by Spanish hunting pressure. Much more impact on these mammal populations was generated by governors, encomenderos, and traders, who obtained meat, furs, and hides for consumption, export, or personal use from various Native American groups. The most important meat and hide animals were bison, mule deer, elk, and pronghorn, but the total number of animals taken is unknown, although it was undoubtedly less than the Santa Fe Trail trade in hides that occurred from 1821 to the 1850s. For example, in 1639 the governor shipped 122 painted buffalo hides and 198 chamois skins (pronghorn? bighorn sheep?) south to present northern and central Mexico. In 1660 another governor exported 1,350 deerskins and a quantity of buffalo hides to Parral. At the end of his term he had 1,200 pronghorn hides and four bundles of elk skins. Under the encomienda at Pecos Pueblo in 1662, 18 buffalo hides, 37 buckskins, and 66 antelope hides were collected in 1 month from resident Indians (Weber 1971: 12–21).

Table 50—Fauna identified from Pottery Mound kiva murals.

Mammals	Birds	Reptiles	Insects
Jaguar	Mallard	Rattlesnake	Dragonfly
Mountain lion	Whooping crane	Gila monster?	Mosquito
Wolf	Red-tailed hawk		Grasshopper
Coyote	Bald eagle		
Skunk	Quetzal		
Bear	Military macaw		
Fox	Thick-billed parrot		
Pronghorn	Roadrunner		
Deer	Magpie		
	Great horned owl		
	Pileated woodpecker		
	Swallow		
	Raven or crow		
	Yellow-headed blackbird		
	Yellow warbler		
	Yellow-breasted chat		
	Horned owl		
	Phainopepla		
	Bluebird		

Source: Hibben 1975: 65–67, 110–111, 115

Hispanic settlers used hides and robes primarily for clothing and bedding. Other uses included the manufacture of teguas (moccasins, from skin), furniture (skin), picture "canvas" (skin), musical instruments (bone), and bedding (hide) (Boyd 1974: 118, 251, 256; Reeve and Cleaveland 1979: 155–156).

Pueblo and Spanish hunters, sheepherders, and farmers were sometimes attacked and mauled by grizzly bears. This species, as well as mountain lions and wolves, preyed on sheep, goat, and horse herds, but very limited attempts were made to control this predation. Dogs, which could fend off all but grizzly bears, were a deterrent to livestock losses of this kind (Ebright 1994: 229; Simmons 1978: 35).

Following Spanish resettlement in 1693–1700, trade in animal hides with regional Native American groups increased relatively sharply. Nomadic Indians brought skins to the settlements for trade, as well as to an annual summer or fall trade fair, where a brisk exchange in hides and meat occurred. Bison, elk, deer, and pronghorn remained the key barter items. The exchange of skins and coarse furs, encouraged by government officials and stimulated by market demand, increased over the century, and by the early 1800s they were probably the main export items of New Mexico (Adams and Chavez 1956: 252–253; Scurlock 1991b; Weber 1971: 22, 28, 30–31).

Bison ranged seasonally as far west as the San Agustin Plains and the grasslands of northeastern Arizona in the late prehistoric period (Callenbach 1996: 17–18) and the Salinas and Galisteo provinces in the early colonial period (Bailey 1971: 152–156). A herd was also reported in the Chama River valley as late as the 1690s. There was a mountain race of bison in the southern Rockies in Colorado, but whether they occurred in northern New Mexico is speculative (Christman 1971: 46). All of these bison were either exterminated or driven eastward due to pressure by Navajo, Apache, Pueblo, and Hispanic hunters. By the late 1700s, intensified hunting pushed them farther eastward, across the Pecos River (Bailey 1971: 12–13; Hammond and Rey 1966: 87; Weber 1988: 126). The Estancia valley and upper Galisteo basin were two areas so impacted. By the early 1800s, Hispanic buffalo hunters from the Rio Grande drainage, called ciboleros, were taking 12,000 animals annually from the Pecos River onto the Southern Plains. By the mid 1800s the hide trade, spurred by Anglo traders, began to decimate the Southern Plains herd. During this period remnant, small herds or individual bison sought refuge in secluded valleys and high mountains across the region. For example, two buffalo were killed near Santo Domingo Pueblo in the early 1800s (Christman 1971: 44–47; Griffin 1947: 22, 51; Henderson and Harrington 1914: 13–14).

Two species of mammals, the Norway rat and house mouse, that were introduced in the colonial period have been naturalized. The horse and burro, also brought by the Spanish, became feral by the 1700s (Findley 1987: 107–108, 149–150).

At the time of the opening of the Santa Fe Trail in 1821, with its subsequent flood of traders and trappers entering New Mexico (Hafen and Hafen 1993: 93), populations of hunted and trapped mammals, except for the buffalo, were probably near their early historic (1500s) levels. Trappers found beaver, black bear, and grizzly bear, deer, and elk to be common along unsettled riparian corridors and in the mountains. By 1826, however, beaver populations in the Upper and Middle Rio Grande and adjacent mountain ranges, especially the Sangre de Cristo and Jemez, were decimated overall and extirpated in reaches of many streams (de Buys 1985: 93; Flores 1992: 8; Weber 1971: 65,215, 224). Trapping of beaver, however, remained relatively intense in some areas of the region over the next 20 years, owing to the continued market demand back east. Traders also continued to obtain pelts through a brisk trade with Native Americans. Some 5,000 beaver skins were transported over the Santa Fe Trail from New Mexico in 1834 (Table 51).

A couple of trappers during this period saw "great numbers of bears," up to 220 in a single day, and a third trapper claimed to have seen 50 or 60 grizzly bears in a day in the region (Cleland 1963: 44; Pattie 1966: 52). The former number is probably an exaggeration, but the latter may be accurate. For the 1830s and 1840s bears, as well as wolves, were described as common. Deer and elk were noted by one observer as only fairly common regionwide, while another referred to them, as well as bear, as "well stocked" in the Sangre de Cristo Mountains (Bodine 1979: 255; Gregg 1966, I: 192–195; II: 207–210). Bighorn sheep were also still relatively common in some canyon and mountain locales, and pronghorn were still commonly found on the bajadas and other grasslands of the study region in the mid 1800s (Henderson and Harrington 1914:

Table 51—Beaver (pelts) trapped or shipped over the Santa Fe Trail,1824–1841.[a]

Year	Pounds/pelts[b]	Value[c]
1824	4,820/	$14,460
1825–26	33,333/	$100,000
1826	2,044/	
1827	1,843/1110	
1827–28	398/240	$1,194
1828	1,200/	$5,000
1829	951/240	$4,298
1831	993/	$2,980
1831–32	13,182/	
1832	4,700/	ca. $14,100
1833	3,088/1,860	$9,264
1834	8,300/ca. 5,000	$15,000
1836[d]	1,660/1,000	ca. $3,000
1837[d]	103/62	ca. $309
1839[d]	383/	ca. $1,149
1841[d]	365/	

[a] Almost all from central and northern New Mexico and southern Colorado.

[b] An average beaver pelt weighed about 1.66 pounds, a pack of beaver fur averaged about 31 pelts or 52 pounds.

[c] The 1823–33 mountain price averaged $3.00 per pound.

[d] From only one trader.

Source: Weber 1971

15). All of these mammals were reported to be common in the northern parts of the Sandia Mountains. These population numbers probably held until the 1860 or even into the 1870s.

By 1832 the illegal exchange of alcohol for furs had become a problem for Native Americans on the plains. Father Martinez of Taos complained to government officials that this trade was resulting in "these Indian nations [becoming] extremely demoralized and were prompted to greater destruction of buffaloes in order to satisfy their appetites for strong drink . . ." (Lavender 1954: 229–230). Increasing demands back east for robes dictated a rise in price, which exacerbated the alcohol trade and decimation of buffalo herds (Lavender 1954: 13; Carroll and Haggard 1942: 102). Most of the robes collected were shipped east over the Santa Fe Trail or south down the Chihuahua Trail, formerly called the Camino Real (Weber 1971: 217). Based on his observations in the early 1830s, Josiah Gregg (1966, II: 149, 212) warned that the buffalo might become extinct.

In late 1846–47, at the time of the arrival of the U.S. military and the first Anglo settlers, wildlife populations, excluding the buffalo, were still relatively high away from the region's settlements. Travelers commonly reported seeing black bears and grizzly bears, deer, elk, pronghorn, wolves, coyotes, prairie dogs, rabbits, and wild horses. Raccoons, mountain lions, bobcats, weasels, bighorn sheep, and beaver, which were still being trapped, were also recorded in army reports and diaries of civilians (Abert 1962: 18, 22–23, 29, 31, 33–35, 116–118, 138–139, 144–145; Bailey 1971: 310, 357, 364; Brown 1983: 15; Cooke 1952: 54; Hannum 1930: 221–222; Ligon 1961: 8; Marcy 1988: 244, 252; Ruxton 1973: 178; Weber 1971: 224; Wislizenus 1969: 33).

By the 1850s the Anglo instigated robe trade and hunting had severely reduced buffalo populations. No buffalo were reported in New Mexico, and hunters from the Rio Grande were having to travel at least 250 miles to find them. This situation existed until the late 1870s-early 1880s, when a few stragglers from the almost extinct Southern Plains herd wandered into the eastern part of the territory. Because of this scarcity, many Hispanic families increased the size of their sheep and goat herds (Bailey 1971: 14; Batchen 1972: 64–65; Weber 1982: 98). The Territorial Legislature had passed an act in 1880 to protect the buffalo, but it was too late and the last buffalo was seen in New Mexico in 1889 (Bailey 1971: 13–14; Gard 1960: 216).

Populations of other mammals were also subjected to increased hunting, as well as to loss of forage due to growing livestock herds and loss of habitat as a result of the growth of old settlements and the establishment of new ones in the 1860s and 1870s. Nevertheless, elk, bighorn sheep, pronghorn, and grizzly bear remained relatively common in isolated areas. In other locales there were reports of reduced populations, especially of deer and elk (Bailey 1971: 15–17; Barker 1953: 88; Batchen 1972: 49–50, 64, 66, 68; Henderson and Harrington 1914: 2, 16; Lange 1959: 130; Lange and Riley 1966: 167, 170–172).

At the time of the coming of the first railroads to the territory, 1879–81, several local extinctions of mammals occurred. For example, native elk were extirpated in the Jemez Mountains, primarily due to commercial hunting for railroad construction workers (Scurlock 1981: 31). Also, bighorn sheep disappeared from the Jemez Mountains and Merriam's elk from the southern Sangre de Cristo Mountains, primarily due to hunting pressure (Barker 1953: 88; Hewett and Dutton 1945: 105; Lange and Riley 1966: 94). By 1890 market hunters had killed the last Merriam's elk in northern New Mexico. Hunting pressure also severely reduced the pronghorn in a number of grassland locations (Barker 1976: 107; Tyler 1975: 32, 42, 55–56).

Overgrazing began to adversely impact wildlife as well, and livestock raisers also hunted and trapped such predators as the gray wolf, and Mexican wolf, and grizzly bear. These animals were increasingly preying on livestock as a result of the reduction of their prey species (Brown 1983: 31). Grizzlies were more heavily impacted than wolves by stock overgrazing, as they depended partly on grasses, forbs, and shrubs for food (Brown 1985: 100).

Federal involvement in predator control was initiated in 1885, when the Department of Agriculture began to study the use of poison on these animals (Dunlap 1984: 143). Also, a new steel leghold trap for grizzly bears was first used in the region at this time (Brown 1985: 114). By the 1890s bounties were offered on wolves and other predators, and professional trappers, known as "wolfers," began working in the region (Brown 1983: 43; Burbank 1990: 98). Wolves numbered several thousand over the entire territory at this time (Bennett 1994: 200).

The Territorial Legislature also passed the first game laws to regulate hunting of meat and hide animals during the 1890s (Findley et al. 1975: 329), but populations continued to decline. Bighorn sheep were exterminated in the Sandia Mountains by the end of the century, and beaver had been exterminated in virtually all of the region's mountain ranges by fur trappers and meat hunters by this time (Bailey 1971: 215; Findley 1987: 86; Pickens 1980: 83). Pronghorn and deer populations continued to decline in the study region and were reduced further due to ever-increasing hunting pressure.

In 1905 the U.S. Forest Service began to hire trappers to take wolves on federal forest lands, and 3 years later a bounty of $20 for black bears and up to $50 for grizzly hides was paid. The Territorial Legislature enacted a $15 bounty for wolves in 1909 (Barker 1953: 153; Burbank 1990: 98; Dunlap 1984: 143). These species, as well as mountain lions, bobcats, and coyotes, were hunted and trapped in increasing numbers, especially on forest lands (Brown 1985: 123–124). Perhaps the last grizzly was exterminated in the Sandia Mountains in 1906, and the species was re-

duced to small numbers in other more isolated ranges (Bailey 1971: 365; Barker 1953: 33; Cooper 1989). A total of 510 coyotes were killed on national forest lands in 1907, and some 271 bobcats were trapped or shot on these same public lands (Bailey 1971: 293, 212; Table 52).

In 1900, Congress passed the Lacey Act, which prohibited market hunting and illegal importation of exotic wildlife (Borland 1975: 122). The New Mexico Game and Fish Department was created by the Territorial Legislature in 1904 (Barker 1970: 185). Black bears and wolves remained relatively common, but bighorn sheep were extirpated in several mountain ranges (Bailey 1971: 17, 309, 349–368; Barker 1953: 88; deBuys 1985: 280).

Northern Rocky Mountain elk were introduced to Vermejo Park by its owner in 1908, and within a few years to the Pecos District of the Santa Fe National Forest (Barker 1953: 93–95; Ligon 1927: 71). Pronghorn, reduced to a couple of thousand animals statewide, were removed from the legally hunted game list (Barker 1970: 1982; Matthieson 1959: 283). However, the pronghorn population in the state dropped to a low of 1,200 to 1,700 in 1915–16. This contrasts with an estimated population of 100,000 animals around 1850 (Barker 1970: 192; Findley et al. 1975: 334). Competition with cattle, sheep, and goats, as well as intensive hunting, caused this decrease (Table 52).

Mountain lion and black bear populations were holding their own in the Jemez and Carson National forests, but gray wolves and grizzly bears were becoming rare in the period 1910–20 (Bailey 1971: 286; Henderson and Harrington 1914: 29; Rothman 1992: 140). Increased trapping and poisoning was spurred by congressional action in 1914 mandating the U.S. Biological Survey to take wolves and other livestock predators on public lands. Aldo Leopold of the Forest Service and J. Stokely Ligon with the New Mexico Game and Fish Department were in charge of the program to eradicate wolves in the state. Some 300 trappers and hunters were employed by this program in 1914–15 (Brown 1983: 52, 126–127). Fifty-seven gray wolves and Mexican wolves were killed on national forest lands in 1915, and over 100 were killed in 1916. Mountain lions, coyotes, grizzly bears, and black bears, and bobcats also were taken in relatively large numbers during these 2 years. Loss of some 24,350 cattle, 165,000 sheep, and 850 horses, valued at almost 3 million dollars, was attributed to wolves, mountain lions, grizzly bears, coyotes, bobcats, and "wild dogs" in 1916 (Brown 1983: 57). These livestock figures, which were probably inflated, were used to justify increased hunting, trapping, and poisoning of predators (Brown 1983: 54–57, 1985: 127–133).

The grizzly bear population declined to only 48 animals by 1917. Predator control intensified this year and the next to help produce more beef for U.S. soldiers fighting in Europe in World War I. An estimated 33 black bears, 84 mountain lions, and 103 wolves were killed in 1917, and 123 wolves were trapped in 1918. Poisoning of grizzly bears was initiated by the U.S. Biological Survey in 1918; 28 animals were killed (Bailey 1971: 272, 287, 307, 311, 313, 353; Brown 1983: 57–58; Table 52).

Government trapping-poisoning and private trapping-poisoning, motivated in part by bounties, continued at an intensive pace into the 1920s (Bailey 1971: 307; Brown 1983: 58, 64, 67, 137, 272; Burbank 1990: 106). The grizzly bear, Mexican wolf, and gray wolf were near extinction in the region. Trapping and hunting had also severely reduced the deer, pronghorn, beaver, pine marten, mountain lion, bobcat, coyote, and prairie dog populations (Bailey 1971: 29, 215, 296; Findley 1987: 86; Ligon 1927: 15). By the early part of the 1930s the grizzly bear was probably extinct in the study region, and the gray wolf was extirpated in central and northern New Mexico. The last grizzly in the state may have been killed in 1931 (Barker 1953: 189–190; Brown 1983: 25, 1985: 155–156; 1985: 150, 160–161; deBuys 1985: 280; Ligon 1927: 15; Scurlock 1981a: 148).

Small numbers of pronghorn were reported near Santa Clara Pueblo and about 10 miles south of Santa Fe in the early 1940s (Hewett and Dutton 1945: 108; Hill 1982: 52). A few mink were observed in the Middle Rio Grande Valley in 1947, the same year that the bullfrog, which was probably introduced in the 1930s, was commonly reported in the area (Pillow and DeVaney 1947: 16–17; Sargeant and Davis 1986: 41).

The New Mexico Game and Fish Commission had been given full regulatory powers to manage the wildlife of the state, including establishing hunting seasons and bag limits (Barker 1970: 188; Findley et al. 1975: 29; Flader 1978: 105). Black bears were given protection by the state in 1927,

Table 52—Mammal populations, 1900–1935.

Species	1900	1905	1910	1915	1920	1925	1930	1935
Merriam elk	VR	E	R[a]	R	R	U	U	U
Grizzly bear	U	U	R	VR	VR	VR	E	E
Black bear	C	C	C	C	U	U	U	U
Gray/Mex. wolf	U	U	R	VR	VR	VR	VR	E
Coyote	C	C	C	C	C	U	U	U
Mountain lion	C	C	U	R	R	R	R	R
Pronghorn	U	R	R	R	R	R	U	U
Bighorn sheep	R	R	VR	VR	VR	VR	VR	R
Beaver	R	R	R	R	R	R	R	R
Bobcat	C	C	U	U	U	U	U	U
Pine marten	U	U	R	R	R	R	R	R

A = abundant, C = common, U = uncommon, R = rare, VR = very rare, E = extinct.

[a] Reintroduced.

Sources: Bailey 1971; Barker 1970; Brown 1983, 1985; Findley et al. 1975; Ligon 1927

and in 1933 bighorn sheep from Banff National Park were released into the Sangre de Cristo Mountains. Six years later the Federal Aid to Wildlife Act was passed by Congress, and the state acquired some 30,000 acres of wildlife habitat with available funds (Barker 1970: 100–101). Thirty-seven elk from Yellowstone National Park were released in the Sangre de Cristos, and other elk from Oklahoma were released on Mount Taylor in 1940–42 (Barker 1970: 109–110; deBuys 1985:356). La Joya State Waterfowl Refuge was also established during this period (Barker 1976: 104).

Federal and state programs to control or eradicate predators in parts of the region continued into recent decades. With the wolf and grizzly bear eliminated, the focus was primarily on the coyote, which preyed on game species and livestock. The bobcat and mountain lion were also targeted in the 1950s and 1960s. In 1949 the federal Predatory Animal Control introduced the compound 1080, a highly lethal rodenticide, for control of predators and rodents. In 1954 the Federal Government outlawed the indiscriminate use of poison to kill livestock predators. Some sheep raisers began using the "coyote getta," a tube that was stuck in the ground and baited on the end, such that when a coyote, fox, or bobcat bit the bait, a cyanide pellet was propelled by a charge into the animal's mouth. A number of other nontarget mammals, such as badgers, skunks, domestic dogs, and cats, were killed by this apparatus (Brown 1983: 103; Schaefer 1975: xxiii-xxiv).

Trapping, poisoning, and hunting by personnel from various public agencies continued as well. For example, in 1963 over 6,300 coyotes were killed, but notably, there was no decrease in the statewide population. Larger "problem" animals such as black bears or mountain lions were trapped or tracked down and shot by government hunters (Findley et al. 1975: 281–282; McDonald 1985: 12; Moyer 1979: 71).

Birds

Uses of birds by Native Americans were discussed in Chapter 3. Twenty-nine species have been identified in late prehistoric kiva murals; they are listed in Tables 49 and 50. The close relationship between the Pueblo and birds was discussed by Henderson and Harrington (1914) and Tyler (1979).

As with mammals, early Spanish explorers only commented generally on species that occurred in large numbers, such as sandhill cranes, geese, turkeys (domesticated and wild), crows, and starlings (blackbird sp. ?). Spanish hunting of birds was limited; turkeys were usually acquired through trade with the Pueblos. Hunting of "quail, partridges . . . grouse" is mentioned in documents, but apparently this activity was limited (Carroll and Haggard 1942: 99). Numbers of species such as wild turkey, prairie chicken, and "partridges" (probably grouse) appear to have been greater than in more recent history, and their ranges were more extensive (Bolton 1946: 353; Hodge 1956: 353–354; Kinnaird 1967: 95).

Early Anglo American accounts, such as that by Gregg (1966, I: 195) in the 1830s, refer to large numbers of sandhill cranes, Canada and snow geese, and various ducks. Gregg may have been the first Anglo to record roadrunners in the region. In October 1841 Texan George Kendall (1935) wrote the following about birds in the Middle Valley: "Among the stubble, on either side of the road, we noticed immense flocks of blue and white herons and wild geese, so exceedingly tame that we could approach within a few yards of them. The Mexicans seldom kill them, and hence their tameness." Five years later another traveler down the river noted "an abundance of geese, ducks, and pelicans . . ." (Wislizenus 1965: 34).

In 1846 Lt. William Emory (Calvin 1968: 79, 83) recorded "myriads of sand crane, geese, and brant" between Albuquerque and Padillas, and "immense flights of sand cranes and geese" up and down the valley from Padillas to La Joya.

Of the early American observers, Lt. James Abert was the most keen and comprehensive in respect to collecting and describing animal species, recording a number of mammals and 26 species of birds along the Middle Rio Grande (Abert 1962: 65–142; Table 53).

Sandhill cranes remained common throughout the valley over the remainder of the century, and Merriam's turkeys were found in virtually every isolated riparian reach in the study region (Henderson and Harrington 1914: 33, 35). In addition to the above species, army personnel in the 1850s also recorded a single whooping crane, swans, pelicans, blue herons, bitterns, quail, doves, blackbirds, meadowlarks, cardinals (*Pyrrhuloxia* ?), robins, bluebirds, and "snow-birds" (?) (U.S. Surgeon-General's Office 1857: 250–251).

Perhaps the earliest trained naturalist to collect and report on mammals and birds of the region was Samuel Washington Woodhouse, Assistant Surgeon, U.S. Army. He accompanied an army expedition in 1850–51 that

Table 53—Birds recorded by Abert (Alameda to south of Socorro), fall 1846.

Loon sp.	Red-winged flicker (common)
Swan (*C. americanus*)	Sapsucker (yellow-bellied?)
Brant	Gold-winged woodpecker (?)
Goose-snow	Steller's Jay
Teal sp.	Raven
Mallard	Creeper (brown)
Duck	Robin
Merganser	Mexican blue bird (western? mountain?)
Bald eagle	Butcher bird (loggerhead shrike?)
Sparrow-hawk (kestrel)	Blackbird
Wild turkey	Meadowlark (western)
Quail (scaled or Gambel)	
Blue crane (great blue heron?)	

Source: Abert 1962: 71–99, 117–125

marched up the Rio Grande from El Paso to Santa Fe (Ligon 1961: 7). Another army doctor, T. Charlton Henry (1856), recorded 170 species of birds while stationed at forts Thorn, Fillmore, and Webster in 1853–54. His lists include comments on range and seasonal occurrences.

In 1853 U.S. Army surgeon Caleb Burwell Kennerly followed the same route as Woodhouse but only upriver to Albuquerque. Leaving the Ives expedition at this point, he joined the Whipple railroad survey party that marched west to El Morro and Zuni Pueblo via Laguna and Ojo del Gallo. He, too, observed and collected birds in the region (Ligon 1961: 8).

The best known ornithologist of the historic period who worked in New Mexico was Florence Merriam Bailey. She reported trumpeter swans as a rare migrant to New Mexico; whistling swans, once a rare migrant, apparently were extinct by the time she published her *Birds of New Mexico*. She recorded goshawk as an uncommon nester, golden eagles as common residents in the mountains, and ferruginous hawks as a common summer resident on the St. Augustine Plains. Bald eagles were common in western Socorro County. Sage grouse were recorded as common about 1900–08 but soon were extirpated. Band-tailed pigeons, according to Bailey, were fairly common in the higher ranges of the regions, and loggerhead shrike were common nesters in lower elevations (Bailey 1928: 103, 104, 156, 172, 177, 180–181, 211, 297, 597).

By the late 1800s hunting, poisoning, and development had reduced many bird populations and contributed to the extirpation of others, such as the whooping crane, sage grouse, trumpeter swan, and whistling swan. Some locales still supported relatively large numbers of ducks, geese, blue grouse, and turkeys until the early part of this century (Henderson and Harrington 1914: 34–35, 37, 45; McDonald 1985: 22; Nims 1980: 126). A relatively comprehensive list of birds of the region was compiled by Fannie Ford at this time (1911); she reported 314 species and subspecies.

J. Stokely Ligon (1927), who with Aldo Leopold directed the predator control program, headed up a wild game survey of the state in 1926–27. Birds covered included golden eagles, which Ligon viewed as "a serious enemy of certain species of game," as well as the young of cattle, goats, and sheep. He noted the "slaughter" of hawks, which he considered both beneficial and harmful, had severely reduced their populations. He called for legislation that would protect all birds of prey because of their controlling rodents through predation. Magpies were considered "enemies" of quail, pheasants, and turkeys, and Ligon recommended that federal and state wildlife personnel initiate control programs for magpies (Ligon 1927: 31, 49–52, 55, 58–59, 114–119, 134).

Ligon (1961) later published his *New Mexico Birds and Where to Find Them*, which included historical data on 399 bird species in the study region. Included with species descriptions are notes on former ranges and status of rare, endangered, or threatened species. Ligon (1961: 3, 6–13) also discussed earlier ornithologists and their works (Chapter 6).

Fish

The indigenous fish fauna of the Upper and Middle Rio Grande in the late prehistoric and early historic periods was much more diverse than that of today. The native fish fauna of the two basins at the beginning of the historic period numbered about 27 species (Sublette et al. 1990: 2). Six large species, now extinct, are evidenced by bone or scale remains in prehistoric Anasazi sites or identified from early Spanish records. At least five other species were extirpated later in the historic period (see Chapter 5, Table 62) by morphological and hydrological changes in the basin's drainages, high siltation, overfishing, introduction of aggressive exotic fishes, construction of dams and reservoirs, climatic changes, and probably introduced pollutants (Gehlbach and Miller 1961; Miller 1961: 365, 394–398; Sublette et al. 1990: 2, 9–11).

The late prehistoric-historic Pueblo harvested fish from the Upper and Middle Rio Grande drainages, probably in limited numbers (Hewett and Dutton 1945: 132, 136). Early Spanish reports are replete with superlative adjectives for the size of native fish populations, such as "abound," "large quantities," "teemed," and "great abundance" (Ayer 1965: 37; Espinosa 1936: 34; Kinnaird 1967: 94). Some members of these early expeditions, as well as later colonial travelers and settlers, caught and ate fish, including eels, from the Rio Grande and tributary streams (Adams and Chavez 1956: 40, 58–59; Espinosa 1936: 34; Galvin 1972: 55, 57). Thirteen species have been identified from early Spanish records (Table 54).

Trout, unidentified as to species, were "abundant" in the Santa Fe River according to Dominguez (Adams and Chavez 1956: 40) in 1776 and Gregg (1966, I: 142) in the 1830s. In 1782 Fray Morfi described the Rio del Norte (Grande) as "crystalline" above the mouth of the Chama River. On fish in the river, he wrote

> It is stocked with fish that are quite good, some of them more than three quarters of a vara [= 33.3 inches] long, having a small mouth placed where other fish have the gill, very few bones and being very appetizing. Matalote, species of barbel larger by a third [of a vara] is a delicious fish, very bony; bagre, a rock fish like sea-brim and of its large size, without more bones than those serving as ribs. It is most pleasing. Cat-fish does not have scales nor bones but in place of these a long nerve from the head to the mouth, ending in a pyramidal point like three fingers. The largest will be about a third of a vara in length (Thomas 1932: 112).

During this period trout were reported to be abundant in various locales in the region, a condition that continued into the 19th century.

Six large species of fish were extirpated in the early territorial period (1846–1912). The shovelnose sturgeon was last taken from the Rio Grande near San Ildefonso in 1874 by members of the Wheeler Geographical and Geological Exploration Survey. They also noted the occurrence of American eel near Santa Fe. Some 14 years later an unidentified species of catfish, weighing from 75 to 100 pounds, probably now extinct, was being caught in the Rio Grande near Rincon (Clark 1987: 32; Schissel et al. 1989: 159).

After the early influx of Anglo settlers (1846–79) into central and northern New Mexico, which placed new pressures on water and fish populations, the Territorial Legislature passed a law in 1880 making it a misdemeanor to use drugs, explosives, or artificial obstructions in taking fish. Trout could be taken only by hook and line. Additionally, operators of mills or factories could not legally discharge harmful waste into trout waters. Another act, passed 9 years later, authorized fish wardens for every county to assist sheriffs and commissioners in enforcing fish laws, including a closed season for fishing, except for members of needy families. This legislation also directed that a sluice for the passage of fish had to be maintained at all dams (Clark 1987: 32).

In spite of the new laws passed in the late 19th and early 20th centuries, native trout and other game fish populations began to decrease in various locations. The exotic and competitive rainbow trout and brook trout were introduced into many rivers and creeks in the region in 1907–08 and 1928. Other species were introduced by the Game and Fish Department in later years (Barker 1953: 54–56; Kuykendahl 1994: 3; Sublette et al. 1990: 67, 77, 166, 331). Still other exotic species, used as bait, were introduced accidentally by fishermen in this century.

Between the early 1900s and the 1940s native trout populations were decimated, or even extirpated, in many locales in the study region due to overfishing, diminishment of stream flows, increasing sedimentation, pollution, and introduction of aggressive exotic species (Hewett et al. 1913: 35; Pillow and DeVaney 1947; Sublette et al. 1990: 49–74; Fig. 56).

Only limited scientific collections were conducted in the early part of this period, until the work of William J. Koster

Table 54—Fish identified from Spanish records.[a]

bagre—channel catfish (*Ictalurus furcatus*), yellow cat (*Ameiurus natalis*)
corbina—"sea trout" (?)
matalota—"suckers," bony-tail chub (humpback?) (*Gila robusta, G. elegans*)
casona, cazon—gar-pike (*Lepisosteus platystomus*)
sardina—"shiner," "silvery" chub (*Notropis dilectus*)
mojarra—"sardine" (?)
trucha—trout (*Salmo spilurus*)
anguila—eel (*Anguilla chrysypa*)
boquinete—sucker (*Moxostoma congestum*)
aguja—long gar pike or shovelnose sturgeon (*Scaphirhynchus platyrhynchus*)
pescadito—Rio Grande chub (*Leuciseus nigrescens*)
corcobado—"hunchback" buffalo fish
gaspregou—sheepshead (*Aplodinotus granniensa*)

[a] *Scientific name identifications were made by Dr. David Star Jordan pre 1916.*

Sources: Ayer 1965: 37, 261–262; Espinosa 1936: 34, 38; Hodge and Lummis 1916

Figure 56—Fishermen on Brazos River, Rio Arriba County. Photo courtesy Museum of New Mexico Archives, Santa Fe (negative no. 72377).

at the University of New Mexico began in 1939. Koster published an overview of his work in 1957 (Crawford et al. 1993: 37). In recent years the U.S. Fish and Wildlife Service and the New Mexico Game and Fish Department have worked to control exotic species and have reintroduced some native fishes, especially trout, to several streams in the region.

Insects

Except for mosquitoes, insects are mentioned infrequently in the Spanish colonial, Mexican, and territorial periods (1540 to 1912) in New Mexico. Chinch bugs and grasshoppers (or locusts) were the most common insects alluded to by observers. In 1846 George Ruxton recorded 75 varieties of grasshoppers and locusts (Hafen 1950: 150). "Worms," moths, honey bees, "lantern bugs," beetles, lice, tarantulas, mosquitoes, and flies were less commonly mentioned. Mosquitoes were a nuisance, and moths, on at least one occasion, destroyed a large amount of wool in a warehouse in Albuquerque (Simmons 1982: 115). Apparently, the common house fly was introduced to New Mexico between 1840 and 1915 (Gregg 1966, I: 195).

SUMMARY

The Middle Rio Grande Basin, as well as the inseparable Upper Basin, had sustained millennia of human use by the time of first European contact in 1540. Environmental forces such as droughts, floods, and erosion were the primary determinants of the physical and biological conditions over time.

Pueblo, Navajo, Apache, and Southern Ute Indians had modified the landscape, as they, or their predecessors, had for centuries hunted, gathered, farmed, burned, and done other activities. Changes were minimal, temporally and spatially, compared with later modifications generated by the coming Spanish and Anglo Americans due to world view, small populations, and limited technology of these Native Americans. These indigenous peoples were, in fact, as they viewed themselves, entities interrelated with other environmental components of the region. This was reflected in their rituals, songs, languages, and other ecocultural traits. Also, changing environmental conditions significantly shaped the behavior and activities of these indigenous human populations.

Following the later arrival and settlement of two dominant Euro-American groups, historical conditions began to change more dramatically. The Spanish and Anglo views of the environment, their introduced infectious diseases, metal weapons and tools, new cultigens, and exotic plants, and their rapidly expanding populations (after 1750) brought new and extensive impacts to the study region. These impacts resulted in even more complex changes, sometimes extreme, not only for the physical landscape and associated biological components but also for the indigenous peoples as well. Attempts to regulate and manage the forces at work began in the late 1800s, but effective efforts of new laws, agencies, and programs were not able to reverse some processes such as species extinction. More recently, management and preservation of environmental conditions have been more successful, owing to changing environmental views of the private sector, as well as those of government agencies. Clearly, the historical conditions of 1540, or 1750, or even 1920 will never be replicated.

CHRONOLOGY

1400s–1600s	Based on archeological evidence, 54 species of birds were used at Las Humanas and Pueblo del Encierro for meat, feathers, and personal adornment (Snow 1981: 364).
1540	Alvarado, one of Coronado's chroniclers, wrote this description of the Tiguex Province (Isleta to near San Felipe): "This river of Nuestra Senora flows through a broad valley planted with fields of maize and dotted with cottonwood groves. There are twelve pueblos, whose houses are built of mud and are two stories high. They have a food supply of maize, beans, melons and turkeys in great abundance" (Bolton 1969: 184). He also described the Rio Grande as "a large, mighty river" (Hodge 1946: 352).
1540	From first European contact and throughout the historic period, the main items traded by the Pueblos to other Native American groups were corn flour, pollen, and husks; pinyon nuts; turquoise; salt; feathers of eagles, hawks, turkeys, and a number of small birds; and woven baskets and pottery (Sando 1989: 29–30, 38).
1540	The Rio Grande floodplain was 35 to 40 feet lower than the 1962 levels (Titus 1963: 11).
1540	The Pueblos gathered large quantities of herbs . . ." for food (Hammond and Rey 1940: 256).
1540	The Tiguex Pueblo kept poisonous snakes (probably rattlesnakes) in their villages. Poison was extracted from the snakes and placed on arrow-points to facilitate killing of prey animals (Bandelier and Hewett 1937: 169).
1540–41	The Pueblos collected pine nuts, and some were stored for later consumption (Hodge 1946: 350).
1540–94	Spanish explorers noted the abundance, utility, and trade value of furs and skins (Weber 1971: 14).
1541	(fall) Castaneda reported a large number of cranes (probably sandhill), wild geese, crows, and "starlings" (probably a species of black-

bird) in the Tiguex Province. He also noted that there were a "great many native fowl in these provinces, and cocks with great hanging chins [wild turkey]" (Hodge 1946: 353–354).

1541 Alvarado, with the Coronado expedition, reported "There are large numbers of bears in this province, and lions, wildcats, deer, and otter [beaver ?]" (Hodge 1946: 350).

1581 (late September) At the Galisteo pueblos, Chamuscado and Rodriguez were told of Plains Apaches to the east who subsisted on buffalo meat in winter and harvested prickly pear and yucca fruit in summer. They lived in buffalo hide tipis and also traded hides, meat, and deerskins for corn and blankets at the Pueblo villages. The buffalo, they said, were "as numerous as the grains of sand in their hands, and there were many rivers, water holes, and marshes where the buffalo ranged." Residents of the San Marcos Pueblo told members of the expedition that "during certain seasons of the year the buffalo came within eight leagues of the settlement" (Hammond and Rey 1966: 86–87).

1581 The Chamuscado-Rodriguez expedition called the lower Galisteo valley "Valle Vicioso because of its fertility . . ." (Hammond and Rey 1966: 59).

1583 (February 1) At the Piro village of San Felipe the Espejo expedition recorded its inhabitants as wearing cotton cloth and tanned deerskin clothing, buffalo hide moccasins, cotton blankets, and turkey feather robes (Hammond and Rey 1966: 172).

1583 (February 10–12) The Salinas Pueblos had "abundant corn, turkeys, and other supplies" and wore clothes made from buffalo hides, cotton blankets, and "chamois skins." Their villages were located on the west edge of the buffalo range (Hammond and Rey 1966: 222).

1583 (February) A member of the Espejo expedition described the Jemez River near Zia Pueblo as "a fine river with a good volume of water, though it was not so large as the Del Norte" (Hammond and Rey 1966: 180).

1583 (February) Espejo reported "many cottonwood groves and some patches of white poplars four leagues wide" and "quantities of grapevines and Castilian walnut trees" as he traveled up the Rio Grande from the San Marcial area to the Keres pueblos (Hammond and Rey 1966: 219).

1583 (late February) Espejo noted a magpie in a cage at a Keres pueblo (Hammond and Rey 1966: 223).

1583 (late February) Near Cochiti Pueblo the Espejo expedition gave inhabitants of the area sleigh (hawk?) bells and "iron articles" for buffalo hides (Hammond and Rey 1966: 179).

1583 (early) In the San Marcial area Espejo noted "... along the river banks there were many cottonwood groves and some patches of white poplars four leagues wide" (Hammond and Rey 1966: 219).

1583 (March 5–6) At Acoma, Espejo was given "blankets, tanned deerskins, turkeys, and a quantity of corn" (Hammond and Rey 1966: 182).

1583 (March 7) Antonio de Espejo wrote this about Acoma, "These people have their fields two leagues distant from the pueblo, near a medium-sized river, and irrigate their farms by little streams of water diverted from a marsh near the river" (Hammond and Rey 1966: 182, 224).

1583 (June) Cottonwoods were growing near Kuaua Pueblo (Riley 1987: 228).

1583 Diego Perez de Luxan, with the Espejo expedition, wrote "This province ... has many forests of pine and juniper trees...." On the way to Pecos, he noted their travel "through a forest of pines, mostly juniper and white pines. The pine trees were all laden with cones the size of unshelled walnuts. Each cone contains at the most about thirteen or fourteen good-sized kernels" (Hammond and Rey 1966: 176, 206). From about San Marcial to Socorro, Espejo himself noted "mesquite groves and cactus fields, and over mountains wooded with pine forests producing pinon nuts like those of Castile, as well as with savins and junipers" (Hammond and Rey 1966: 219).

1583 Espejo's expedition exchanged iron and small bells for corn, tortillas, turkeys, pinoles, and buffalo robes at Cochiti (Riley 1987: 238).

1591 (January 8) Castano de Sosa may have been the first European to reach the Santa Fe River. He described the event: "It was bitterly cold and snowing. When we emerged from the sierra we came to a river, frozen so hard that the horses crossed on the ice without breaking through" (Hammond and Rey 1966: 280).

1591 (late January) South of Pecos Pueblo, in the Galisteo area, Sosa's expedition traveled "through thick pine forests, then camped "for the night at a ravine with many juniper trees" (Hammond and Rey 1966: 287).

1591 (early) Wood-burning "ovens" were noted by Castano de Sosa at San Ildefonso (Riley 1987: 235).

1591	Explorer Sosa referred to the Rio Grande at San Juan Pueblo as a "deep river," and later as "the river with much water" (Schroeder and Matson 1965: 129, 144).
1598	(late May) North of the Jornada del Muerto, the Juan de Onate expedition procured corn from the Piro Pueblo of Qualacu, which helped alleviate the food shortage for the Onate expedition. Travel continued to be arduous due to the soft, deep sand. The wheels of the supply carts sank to their hubs. As the expedition moved northward, a rainstorm provided needed water, as well as substantially decreasing air and ground temperatures (Simmons 1991: 105–106).
1598	(spring) Onate found "many pueblos and planted fields on both sides of the Rio Grande" from Casa Colorado to north of Albuquerque (Moorhead 1958: 24–25).
1598–99	Onate's colonists complained about living in Pueblo rooms, which they found poorly ventilated and infested with bedbugs and other biting insects (Ellis 1987: 19).
1598–1602	Onate recorded wild turkeys in the province and listed the following mammals for the region: "buffalo, goats with hideous horns [bighorn sheep], lions, bears, wolves, tigers [jaguars ?], penicas, ferrets, porcupines, and other animals" (Bolton 1946: 353).
1598–1630	With the construction of more irrigation systems and the introduction of livestock by the Spanish, the demand for surface water increased significantly (Meyer 1984: 50).
1598–1630	By growing winter wheat brought by the Spanish, the Pueblos extended the farming season, and by adopting livestock, they had to hunt less for meat and hides. The use of cow dung for firing pottery and heating homes may have begun during this period (Schroeder 1975: 53).
1598–1680	New Mexico's governors dominated the export trade in furs and skins, such as those of buffalo, antelope, elk, and deer (Weber 1971: 18–19).
1598	(post) A grass native to Eurasia, sheep fescue (*Festuca ovina*), may have been introduced to New Mexico via the fleece and droppings of domestic sheep brought by Onate (deBuys 1985: 225).
1599	(early) Onate moved his headquarters and capital to the west side of the Rio Grande to San Gabriel Pueblo. Most of the Pueblo inhabitants left, but some remained to haul water and fuelwood for the Spaniards (Simmons 1991a: 1458–149).
1599	(late October) Juan de Onate described the Rio Puerco-of-the-East in the Cabezon Peak area as having many cottonwoods and fairly deep water where he crossed the stream. He named the river "La Torriente de los Alamos" and described the valley as "lush, rich, and fertile" (Lopez 1980: 71, 77).
1599	Hunters with Onate shot a large number of ducks and geese (Espinosa 1936: 34).
1500s	(late) Obregon wrote that the Rio Grande was "swift and beautiful, surrounded by numerous meadows and farms..." (Hammond and Rey 1927: 291).
1600	(post) The area along the east side of the Rio Grande between Alameda Pueblo lands and the Mexia "swamps" was called "Bosque Grande" (Adams and Chavez 1956: 145).
1600–34	Spanish livestock herds nearly doubled every 15 months (Gutierrez 1991: 57).
1600–50	The Spanish conquistadores and military officers brought mastiffs and large greyhounds to New Mexico. These "war dogs" were used in combat, which terrorized Native Americans. They were also used in hunting, especially the greyhound (Simmons 1991b: 36).
1604	Spanish carpenters trained Pecos Pueblo men in wood-working skills. The accessibility and diversity of woodlands and forests in the area provided the basis for a vigorous craft over the next 150 years. Carved corbels and vigas, doors, window frames, and furniture were crafted to meet local and regional demands (Kessell 1975: 132–133).
1610	Villagra, who accompanied Onate's 1598 expedition, wrote "The rivers abound with fish, turtles, eels, trout and sardines. These exist in such quantities that a single Spaniard with a large bare hook was able to catch six arrobas [240 pounds] weight" (Espinosa 1936: 34).
1600s	(early) Under the encomienda system, Spaniards took Pueblo lands for grazing of livestock. Localized overgrazing and soil erosion resulted. Water was also diverted to Spanish fields, causing a shortage for Pueblo crops (Sando 1989: 53).
1600s	(early) (to 1680) Pueblo residents were forced to collect firewood, salt, and pinyon nuts in large quantities, to prepare hides, and to manufacture cotton blankets, causing stress among the villagers (Snow 1981: 368).
1600s	(early) (to 1680) Items exported south from New Mexico included sheep, raw wool, hides (buffalo, deer, and antelope), pinyon nuts, salt, Indian blankets, and El Paso brandy (Moorhead 1958: 49).

1610	(post) According to Aldo Leopold, mountain meadows and foothills were overgrazed by Hispanic livestock (Brown and Carmony 1995: 230).
1626	(pre) Fray Alonso de Benavides recorded that the Tewa were experiencing famine due to insufficient irrigation water (Hodge, Hammond, and Rey 1945: 39, 69).
1620s	(to early 1700s) An extensive stand of cottonwoods was found along the Rio Grande in the Albuquerque area. It was known as the Bosque Grande de San Francisco Xavier. South of this woodland was the open wetlands called Esteros de Mejia (Simmons 1982: 40).
1630	Fray Benavides (Ayer 1965: 36–37) described the regional rivers as having "... fish in great abundance; and great sloughs [esteros], and particularly the Rio del Norte. This, when it carries least water, and we can ford it, comes up to the saddle; and when it goes swollen, it is of rapid and great current, with the water it receives from the melted snows alone."
1630	As an endurance test, a candidate for membership in one of the secret Pueblo societies or orders had to sit naked all day on a large ant hill and endure stinging bites without making a sound (Ayer 1965: 31–32).
1630	Fray Benavides wrote "The abundance of game appears infinite." He noted that foxes, wolves, mountain lions, wildcats, jackrabbits, and cottontail rabbits were numerous. Bighorn sheep was a common species in the uplands (Ayer 1965: 37).
1630	Fray Benavides listed the following fish found in the Rio Grande Basin: bagre (blue catfish, *Ictalurus furcatus*), trucha (trout, *Salmo* spp.), yellow bullhead, *Ictalurus natalis*), anguila (eel, *Anguilla rostrata*), boqeinete (sucker, *Moxostoma* sp.), sardina (chub, *Notropis* sp.), aguja (gar shovel-nose sturgeon, *Scaphirhynchus playtyrhynchus*), cazon (longnose gar, *Lepisosteus osseus*), and matalote (Gila chub, *Gila intermedia*) (Ayer 1965: 37, 261–262).
1630s	(early) Grasshoppers and rabbits destroyed crops at various Rio Grande pueblos (Schroeder 1972: 5).
1635–37	Governor Francisco Martinez de Baeza forced converted Indians to collect and pack large quantities of pinyon nuts for shipment down the Camino Real (Kessell 1979: 155–156).
1639	Governor Rosas shipped 122 painted buffalo hides and 198 "chamois" skins south on the mission supply caravan (Weber 1971: 20).
1600s	(mid) Prairie chickens were found in the Salinas Province (Schroeder 1968: 102).
1600s	(mid to late) The market for buffalo hides in Mexico sharply increased demand. Spanish traders by-passed the Pueblo middlemen and dealt directly with Plains Indians for the hides. Colonists and government agents exerted pressure on the Pueblo to procure even more hides, causing more stress among the villages (Snow 1981: 367–368).
1659	Some priests traded with various Indian groups for pronghorn skins (Weber 1971: 19).
1660	Governor Mendizabal received a shipment of 23 fanegas of pinyon nuts from Pecos Pueblo (Kessell 1979: 156).
1660	Governor Lopez de Mendizabal shipped 1,350 deer skins and a number of buffalo hides to Parral to market. He sent two other large shipments of skins there during his term. Some 1,200 pronghorn skins and four bundles of elk skins were later found at his property in Santa Fe (Weber 1971: 20–21).
1661	Some 60 Pueblo laborers from Quarai were conscripted by the Spanish to harvest and transport loads of pinyon nuts. Nineteen Indians from Abo worked for 6 days carrying maize from Tabira and Las Humanas pueblos to the house of Captain Nicolas de Aguilar in the Salinas District (Scholes 1937: 394–395).
1661	Also, some 40 Indians of Jemez Pueblo were forced by the Spanish to transport pinyon nuts to "depots" at Santa Fe, Cochiti, and San Felipe (Scholes 1937: 394–395).
1661	Pueblo Indians from Tabira collected salt at a nearby salt marsh and transported it to the Las Barrancas estancia of Sargento Mayor Francisco Gomez (Scholes 1937: 395).
1661	The mission livestock were moved from Las Humanas to Abo because the Pueblos exhausted themselves hauling water for the stock from deep wells to the west of the village (Scholes 1937: 401).
1661	An organ for the church at Abo was purchased with money made by selling pinyon nuts (Toulouse 1949: 4).
1662	At Tome, the Rio Grande channel was located east of its present location (Kessell and Hendricks 1992: 480).
1662	Encomienda system payments made by Indians at Pecos Pueblo included 66 pronghorn skins, 21 white buckskins, 16 large buckskins, and 18 buffalo hides (Weber 1971: 18).
1667	Locusts devastated crops, especially at Santo Domingo Pueblo (Kessell 1979: 218).
1675–1706	No fires appear to have occurred on the west-

central slopes of the Sandia Mountains during this period (Baisan 1994: 2).

1675–1710 The pueblo and later land grant of Alameda was located on the west side of the Rio Grande. Sometime after this, and before 1769, the river shifted westward, leaving the village of Alameda on the west side of the Rio Grande (Sargeant 1987: 38–40).

1680 (August) Revolting Pueblo Indians forced Spanish Governor Otermin to abandon his defense of Santa Fe by cutting off the settlement's water supply from the Santa Fe River (Sando 1989: 55).

1681 (December 11) The Spanish army found little firewood in the vicinity of Alameda Pueblo (Hackett and Shelby 1942: 224).

1681 At Puaray Pueblo, near the Rio Grande, there were meadows on either side of the river. They provided "good pasturage and stubble, and there is an abundance of firewood on the other side" (Hackett and Shelby 1942: 220–221).

1692 (pre) Blue catfish occurred in the Rio Grande in the Espanola-Santa Fe area. It is now only found south of Albuquerque, and populations are dwindling (Sublette et al. 1990: 238).

1692 (late August) The condition of the Camino Real was degraded following 12 years of little or no traffic. In many places grasses, forbs, and shrubs had grown up in the road bed. Vargas sent the sheep, cattle, and horses ahead to trample the vegetation, providing a clearer and smoother road for the wagons and settlers in the caravan. In some places, the road was gullied due to water runoff, and Vargas had men ready to repair the road (Hendricks 1993: 81).

1692 (September 4) The Spanish army of the reconquest rested at the abandoned rancho of Felipe Romero near the abandoned Sevilletta Pueblo. This site was selected for its excellent grasses and adequate water (Espinosa and Chavez n.d.: 22).

1692 (September 6) General Vargas led his army up the Camino Real over a "very sandy" road and camped within sight of the hacienda of Tome Dominguez, which then was on the west bank of the Rio Grande. The condition of the road prompted the commander to send the pack animals back for cargo on the laboring wagons so there would be provisions in his camp (Kessell and Hendricks 1992: 375–376, 480).

1692 (late October) Diego de Vargas, who crossed the Rio Puerco west of the later site of Albuquerque with his command, noted that the water was so deep that the soldiers had to carry provisions and equipment on their shoulders (Lopez 1980: 71; Twitchell 1963, I: 381).

1692 (late) Vargas reported that "the river has ruined the fields" of Senecu Pueblo (Kessell et al. 1995: 114).

1692 (late) Vargas described the environment of Zia Pueblo as having "alkaline soil, bad water, no firewood, and is infertile . . ." (Kessell et al. 1995: 113).

1692 (late) Vargas described the environment of La Cienega Pueblo and the El Alamo hacienda as "the terrain and soil are of dry, fine gravel, are well drained, and where the sun shines from the time it comes up . . ." (Kessell et al. 1995: 111).

1692–93 The Esteros de Mejia, which extended along the east side of the Rio Grande from the present Central Bridge to the Barelas Bridge, was the site of a "hacienda" on the Camino Real. Made up of charcos (small lakes) and cienegas (marshes), which supported lush grasses, sedges, and other forage plants, these wetlands were utilized by legal and trespass livestock ranchers. This led to a near fatal altercation among several individuals (Simmons 1982: 10, 40, 87, 112).

1693 (late summer-early fall) The pueblos of San Felipe, Santa Ana, and Zia lost their potential crop harvest due to "worms and the many locusts" (Kessell et al. 1995: 408).

1693 (November 10) Vargas found a "good" campsite at a ford opposite the abandoned hacienda of Ignacio Baca on the Rio del Norte (Kessell et al. 1995: 403).

1693 (November 15) Spanish soldiers and settlers were camped in an "ancon opposite Isleta Pueblo" (Kessell et al. 1995: 407.

1693 (November 19) Vargas ordered his troops and Spanish settlers to the outpost he designated "Plaza de Armas," at the abandoned hacienda of Cristobal de Anaya. This site was north of present Bernalillo and had "abundant firewood and pasture, near the Rio del Norte..." (Kessell et al. 1995: 421).

1693 (December 10) Vargas (Espinosa 1942: 148) described a watering place at San Marcos Pueblo in the Galisteo basin as ". . . where the bountiful water hole and crystal clear stream were certainly a blessing."

1693 There was no late summer-fall harvest due to worms and grasshoppers at Santa Ana, San Felipe, and Zia pueblos (Bailey 1940: 95–98).

1694 (January) Vargas described Jemez Pueblo as on "a height" and "in a good location" with "the necessary conveniences of pasture, water, and firewood" (Kessell et al. 1995: 558).

1694 (May) Plains Apaches visited Governor Vargas at Pecos Pueblo and presented him three buffalo hides and an elk-hide camp tent as gifts. They promised to bring buffalo, elk, and deer hides to trade in the fall (Weber 1971: 22).

1694 (July) Vargas found bison between the Rio Grande and Rio Chama (Bailey 1940: 152–154; Bailey 1971: 152–156).

1695 (summer) An infestation of worms ate most of the crops, which contributed to a famine in the following year (Twitchell 1963, I: 409).

1696 A famine impacted the Pueblo and Hispanic settlements. Various wild animals and plants, in the valleys and the mountains, were commonly harvested and eaten (Twitchell 1963, v. 1: 409).

1600s Bones of the smallmouth buffalo (fish) were found in archeological sites dating to this period along the northern Rio Grande drainage (Sublette et al. 1990: 222).

1600s The Jicarilla Apache believed that the bighorn sheep were driven from their valley habitat into the mountains by the guns of the Spaniards (Tiller 1992: 22).

1600s (late) Rafts were used to cross the Rio Grande to reach the pueblo of San Felipe located on the west bank of the Rio Grande (Strong 1979: 392).

1600s–1706 A bosque extended south from the Alameda Pueblo, along the Rio Grande, to the swamps or marshes of Mexia on the south side of Albuquerque (Adams and Chavez 1956: 145).

1700–1800 About 27,000 new acres were put into cultivation by the Spanish in the Middle and Upper Rio Grande valleys (Hedke 1925: 23).

1701 The Rio Grande channel was several hundred yards east of its late 19th century position in the Bernalillo area (Bowen and Sacca 1971: 51).

1705 The Rio Grande was located east of present Bernalillo, and at times, the river flowed along the east side of the valley from Angostura to below Albuquerque (Chavez 1957: 3).

1706 April The site of Albuquerque was chosen for the availability of good water, tillable land, good grazing grasses, and fuelwood. This location was also selected due to its being on slightly elevated ground, on the Camino Real, and having a good, close ford over the Rio Grande (Simmons 1982: 81–82).

1706 The east bank of the Rio Grande was heavily wooded from modern Ranchos de Albuquerque to below Central Avenue (Simmons 1980: 202). The area settled by the new residents of Albuquerque was known as the Bosque Grande de San Francisco Xavier. The Esteros de Mexia, located just south of Old Town, was avoided by the settlers (Oppenheimer 1962: 15).

1709 Wildfires were common and widespread (Swetnam and Baisan 1995: 18).

1709–39 The channel of the Rio Grande between Algodones and Bernalillo shifted westward. The church and several homes at colonial Bernalillo (near present Llanito) were washed away in 1735 or 1736 (Snow 1976: 172–175).

1709–63 Santa Ana Pueblo purchased lands from Spanish settlers at Ranchitos, located on the east side of the Rio Grande, along the north boundary of the Bernalillo Grant. Some of the land was used for irrigation farming and the remainder for livestock grazing. The latter area was covered with cottonwood trees (White 1942: 27).

1710 (January 27) The Alameda land grant was given to Captain Francisco Montes Vigil. At this time the village and grant land was located on the west side of the Rio Grande (Adams and Chavez 1956: 152).

1710 (post) The Rio Grande, then located east of Alameda, began shifting westward. By 1768 the channel had moved to its present location, placing the village of Alameda on the west side of the river (Sargeant 1987: 38–39).

1700s (early) The Rio Grande shifted its channel and at times ran east of Bernalillo, Alameda, and Albuquerque (Chavez 1957: 3).

1700s (early) Due to continuing flood damage to their agricultural fields, Santa Ana Pueblos began buying land along the Rio Grande, to the east, where they established ranchos. They moved to these new settlements from spring planting to fall harvest and then returned to the old pueblo for the winter. Later, in the next century, these Keresans established permanent residence at the Ranchos de Santa Ana and returned to their Jemez River pueblo only for ceremonies (Kessell 1980: 168).

1700s (early) Residents of Agua Fria reported to geologist Oscar Loew (1875) that the Santa Fe River had run "full" and that cottonwood and willow species grew along its banks.

1700s (early) Overgrazing had become a problem around the older plazas such as Atrisco, Albuquerque, and Corrales (Baxter 1987: 24).

1700s (early) Sedge grasses and other wetland vegetation were abundant in a cienega located in

	the eastern part of Santa Fe. This was a special-use property where these plants were "mowed" and fed to the horses of the presidial troops, who escorted town residents to the mountains, where they collected fuelwood or timber (Ebright 1994: 90).
1700s	(early to mid) As the flow of the river diminished, which Loew attributed to the disappearance of extensive forests at the river's headwaters and a decrease in precipitation over the area mountains, the trees diminished (Hewett and Dutton 1945: 147).
1713	A lagoon (estero) was located near Bernalillo (Mayer et al. 1994: 80).
1714–17	At least one crop failure due to drought occurred (Simmons 1982: 111).
1715–16	Wildfires were common and widespread during these years (Baisan 1994: 3; Swetnam and Betancourt 1990: 1019).
1722	Captain Antonio Cobian Busto reported "From the city of San Felipe el Real [Chihuahua] to Santa Fe in New Mexico... there are innumerable valleys, streams, and plains, very rich and suitable for breeding cattle and sheep, and sowing wheat, corn, and other foodstuffs..." (Baxter 1987: 19).
1724–25	Wildfires were common and widespread (Swetnam and Baisan 1995: 18).
1726	Pedro de Rivera visited the Valencia area noting spacious, fertile valley land with extensive cottonwood bosques. He passed several ruined ranches in the Valencia area still uninhabited following the Pueblo revolt (Rivera 1946: 51).
1729	Wildfires were common and widespread (Swetnam and Baisan 1995: 18).
1736	(early) Five Albuquerque farmers requested that the alcalde allow them to move their livestock back to the Isleta area where better grazing conditions existed (Baxter 1987: 24).
1739	(July 30) The alcalde of Albuquerque, who presented the governor's decree on the Tome land grant, noted that the location was "very damp and in danger of being inundated again" (Ellis 1955: 91–93).
1739	Some residents of Albuquerque, who were experiencing scarcity of wood, insufficient pasture for livestock, a scarcity of irrigation water, and encroachment of footpaths on their land, requested and received the Tome land grant (Ellis 1955: 91; Oppenheimer 1962: 16).
1739	(ca.) The Rio Grande shifted westward in the Angostura area, which resulted in a later boundary dispute between Santa Ana and San Felipe (Bayer et al. 1994: 90).
1730s	(late) (to early 1742) Pedro Sanchez claimed that wolves attacked and bit his sheepherders on the Ramon Vigil grant and caused him to remove his sheep (Ebright 1994: 229).
1740	(November 15) The governor granted land to Hispanic settlers who founded Belen, Jarales, and other area communities. Ditches from the Rio Grande to fields were dug with palas de palo (wooden shovels). The uplands along the Rio Puerco-of-the-East and the Manzano Mountains were common lands for grazing livestock, collecting fuelwood, and hunting (Espinosa and Chavez n.d.: 75–78).
1744	The Santa Fe River was described as a flowing stream with crystalline waters and abundant trout within the capitol (Hackett 1937: 27, 34, 399).
1744	Valley cottonwoods extended more than 10 miles along the Rio Grande around Alameda (Galvin 1972: 58).
1744	Albuquerque experienced an infestation of moths, which were eating large stores of raw wool. Fortunately, a buyer from Mexico City arrived and purchased the wool before the insects destroyed very much (Simmons 1982: 114–115).
1748	The frequency of wildfires was substantially above normal (Swetnam and Betancourt 1990: 1019).
1748–1846	Sandia Pueblo lost a significant portion of its lands to Hispanics because of its fertility and available water (Clark 1987: 22).
1749	Belen residents were in a legal dispute with Nicolas Duran y Chavez, whose cattle, they claimed, were damaging and fouling the acequia madre. He said that finding pasture for his cattle and sheep was difficult (Horvath 1980: 111).
1700s	(mid) Intensive livestock grazing and fuelwood cutting led to denudation and soil erosion along Abiquiu Creek. Water from the stream tasted and smelled like cattle manure (McDonald 1985: 120).
1700s	(mid) The Rio Puerco Valley at this time was rich in grasses, bosques, springs, and lakes. There were "belly-high grasses, vast bosques, and wooded thickets." The floodplain was broad and flat, and flood waters overflowed the low banks and spread out over the valley. Many lakes dotted the valley, and springs were numerous (Lopez 1980: 71).
1750	Santa Fe had evolved to a rancheria of houses and fields distributed along three leagues of the Santa Fe River valley. Residents wanted to be near their fields for convenience and to

protect their crops against thieves and foraging animals (Simmons 1974: 61).

1750 By this year Albuquerque and nearby communities were experiencing some pressures of overpopulation. Suitable agricultural land was taken, and livestock overgrazed some pastures and outlying range lands. By this year, the bajada between Albuquerque and the Sandia-Manzano mountains was virtually denuded of grass by livestock. Outmigration to "new" lands, such as the Rio Puerco-of-the-East, began (Simmons 1982: 106–107, 1988: 7).

1751 Timber for use as vigas in the Sandia Pueblo church then under construction was cut in the Sandia Mountains. Since the pueblo had no oxen to pull the logs down from the mountains to the village, residents of the five Keres pueblos to the north and Spaniards from Bernalillo were recruited to do this. In about 20 years, the roof of this new church collapsed due to poor engineering or shoddy construction (Kessell 1980: 136).

1752 Wildfires were common and widespread (Swetnam and Baisan 1995: 18).

1753 (October 21) Several Albuquerque families, seeking adeuate grazing for their livestock, petitioned the governor for a grazing grant on the Rio Puerco (Simmons 1982: 106–107).

1754 A priest described the Rio Grande as "a beautiful image of the celebrated Nile" (Timmons 1990: 39).

1750s As the Navajos were forced south by Utes, conflict over resource competition in the Rio Puerco basin with Hispanos accelerated (Lopez 1980: 72).

1750s (late) (to 1760) Major Spanish settlement of lands along the Middle and Upper Rio Puerco and on the south and west sides of Mount Taylor occurred (Wozniak 1987).

1760 Bishop Tamaron noted that the Santa Fe River was dry during the summer months prior to harvest, and the Rio Grande had ice during the severely cold winters (Adams 1954: 47, 65, 105).

1763 July 7 Representatives of Santa Ana Pueblo exchanged over 200 head of livestock and several items for a tract of land south of Angostura and extending from the Rio Grande to the foot of the Sandia Mountains (Bayer et al. 1994: 80–81).

1763 By this time, an "upper" and a "lower" Bernalillo were recognized. Soon, however, the upper settlement was forced upriver to Algodones, a location of higher elevation, by floods (Snow 1976: 175).

1763 Wildfires were common and widespread (Swetnam and Baisan 1995: 18).

1765 Eight residents of the Los Quelites grant on the nos Puerco and San Jose requested Governor Capuchin's permission to withdraw from the grant, claiming that there was insufficient and salty water in the two streams. Water from springs and a cistern were used for watering their corn, chile, and cotton (Ebright 1994: 10).

1765 Wildfires were common and widespread (Swetnam and Baisan 1995: 18).

1766 (August 12–13) Nicolas de Lafora passed the Senecu and San Pasqual pueblo ruins, and found "plenty of pasture" in the area. From here to the Vueltos de Acomilla, he passed through "swampy ground with a great deal of coarse grass and reeds," which included the Bosque del Apache (Kinnaird 1967: 88).

1766 (August 14) Opposite the ruins of Sevilleta Pueblo, Lafora wrote about the mouth of the Rio Puerco "whose waters always flow muddy and turgid" (Kinnaird 1967: 89).

1766 (August 15–16) Lafora continued to travel north up the east bank of the Rio Grande. His expedition reached Las Nutrias, then Tome, passing over a "good level road." The population of Tome was given at 70 Spanish residents. Lafora noted that "all kinds of grain abound, as well as sheep, and there is plenty of good pasture everywhere in the vicinity. On the next day he traveled 10 leagues north over "a plain extensively forested with poplar trees along the river's edge" (Kinnaird 1967: 89–90).

1766 Lafora (Kinnaird 1967: 95) wrote "There is a great variety of birds. Partridges are abundant and are caught by hand after their first flight."

1766 Lafora noted "large quantities" of fish in New Mexico's rivers (Kinnaird 1967: 94).

1766 Lafora reported for central and northern New Mexico that "There is more than enough pasture, which is grama grass for the most part" and "There are several rivers containing a large quantity of fish, particularly the Rio Grande del Norte" (Kinnaird 1967: 94–95).

1766 Lafora listed buffalo, bear, wolf, coyote, bighorn sheep, elk, deer, and "partridges" (grouse ?) as game animals. He noted that the fur-bearing beaver, ermine, and marten, which were abundant, were ignored by Hispanic residents (Kinnaird 1967: 95).

1767 A severe flood on the Santa Fe River impacted Santa Fe. The river channel shifted into the Rio Chiquito, which is now covered by Water Street (Twitchell 1963, I: 447).

1768 (April) Residents of Atrisco received a grant of grazing lands to the west, along the Ceja de Puerco (Wozniak 1987).

1769 Dominguez related a report "... in the year '69 of this century the river flooded (turning east) the greater part of Tome, to the total destruction of houses and lands. It follows this course to this day [1776], and as a joke (let us put it so) it left its old bed free for farmland for the citizens of Belen, opposite Tome (and they still have it, and Father Claramonte, from whom I heard this tory, has seen it planted)" (Adams and Chavez 1956: 8).

1760s The lower Rio Puerco began entrenchment, a process that continues today (Love and Young 1983).

1771–75 The annual crop harvests at San Ildefonso Pueblo were diminished due to infestations of "locusts" (Adams and Chavez 1956: 71).

1771–76 Locusts caused losses in crop production (Adams and Chavez 1956: 71).

1770s (early) To prevent depletion of provincial resources, New Mexico governors banned exports of wool and livestock. Sheep flocks increased, and officials allowed sale of woolen products and wethers. Late in the century, sheep numbers increased until export of the animals increased dramatically. Ranchers brought their animals to la Joya de Sevilleta in August to begin the drive south down El Camino. As this was the rainy season, the flocks and men would have adequate water on their journey (Baxter 1993: 109).

1773 A New Mexican of the Rio Abajo commented on a positive aspect of Rio Grande floods: "The water brings with it a thick mud which serves as manure for the land, leaving on top of the irrigated earth a glutinous scum resembling lard" (Simmons 1982: 96).

1774 Spaniards at San Juan de los Caballeros, Rancho del Embudo, and Picuris Pueblo were taking trout and eels for food (Galvin 1972: 57).

1774 O'Crouley recorded trout, eels, ahujas, and besugos as food fish caught by residents (Galvin 1972: 55, 57).

1774 Don Pedro Alonso O'Crouley described the Alameda area as "a plain that for a distance of four leagues is covered with poplars [cottonwoods] (hence its name), which beautify the country. The Rio Grande crosses its central region, making it fertile. On its banks is a settlement of a few families under the spiritual care of a friar attached to the mission of Albuquerque, three leagues away" (Galvin 1972: 58).

1774 Poor harvests in previous years, due to the drought, and Navajo raids, forced Hispanos to abandon the Rio Puerco from San Luis to Casa Salazar. The Rio Puerco was reported to be so named because "its water is as dirty as the gutters of the streets, since its bed is of black clay and its bottom very treacherous with mire" (Adams and Chavez 1956: 254).

1775 (May 13) A party of Taos Pueblos left their village "to round up some wolves," but a battle with Comanches diverted them (Thomas 1940: 181).

1776 (pre) The flow of the lower Rio Nambe had been reduced to a trickle due to upstream use (Adams and Chavez 1956: 71) and probably the drought.

1776 (pre) At the village of Canada de Cochiti, composed of scattered ranchos along the canyon floor, crop harvests were small due to the intermittent flow of the Rio Chiquito (Adams and Chavez 1956: 159).

1776 (pre) Zia Pueblo depended primarily on upland dry farming in raising crops; there were irrigated plots along the Jemez River, but water was only available following intense rains (Adams and Chavez 1956: 98).

1776 (pre) The farmlands of Zia Pueblo were located "in several small canadas of the hills to the south and for two leagues along the Jemez River. The alkaline river water and sandy soil was relatively unproductive, especially in drier years (Adams and Chavez 1956: 175).

1776 (pre) Jemez Pueblo farmlands along the Jemez River were relatively rich and produced good crops. The river water was less alklaine than at Zia and Santa Ana pueblos. A large number of fruit trees also were productive (Adams and Chavez 1956: 181).

1776 (pre) Groves of cottonwoods grew along the Rio Grande at Santo Domingo, and agricultural fields were located along both banks of the river above and below the pueblo. These fields were irrigated by Rio Grande water. Other fields along the Camino Real from the river to Santa Fe were dry farmed. Good harvests of various crops, including melons and watermelons, were common, as were "very tasty peaches and apricots" (Adams and Chavez 1956: 137).

1776 (pre) A stone embankment had been built on the Santa Fe River to prevent flood damage to property in the villa (Adams and Chavez 1956: 40).

1776 (pre) The Chama River at Abiquiu had "very fine meadows on both banks, with corre-

sponding groves of beautiful poplars" (cottonwoods). The farmlands were "extremely fertile," including those at a small plaza near the shrine of St. Rose of Lima. Fields were irrigated with water from the Chama River. At the foot of the hill, where the Genizaro occupants of the pueblo were located, there were "two little springs of very good water, and since it was good, it is used for drinking" (Adams and Chavez 1956: 126).

1776 (pre) Plagues of "locusts" periodically adversely impacted crop harvests (Adams and Chavez 1956: 30).

1776 (late October or early November) A trade fair was held during this and previous years at Abiquiu. Utes brought deerskins to trade for horses; 15 to 20 good deerskins would get a horse. They also brought deer or buffalo meat, which they exchanged for corn or corn flour. Sometimes they brought young captives from other nomadic groups to trade with the Spanish (Adams and Chavez 1956: 252–253).

1776 Residents of Jemez Pueblo were using charcoal for heating (Adams and Chavez 1956: 179).

1776 An extensive cienega was located a short distance west of Taos Pueblo. Cattle were pastured there to graze the lush plants, and some sedge and grasses were cut as "hay" for other livestock. This marsh vegetation was burned each spring to foster vigorous growth of new plants (Adams and Chavez 1956: 111).

1776 Fray Dominguez reported that farmlands around Quemado and Cieneguilla were "fertilized" by overbank floodwaters of the Santa Fe River (Adams and Chavez 1956: 41).

1776 Fray Dominguez described the Rio del Norte, or Rio Grande: "From the places where the headwaters on this river are to be seen, one observes a great abundance of water. As it declines toward the south it acquires more and more water from the many rivers (large and small) that keep joining it from the east and west from above Taos to below El Paso, where it joins still others" (Adams and Chavez 1956: 7).

1776 Fray Dominguez (Adams and Chavez 1956: 40–41, 43) described the Santa Fe River: "... although it carries enough water to be called a river,it is not overabundant. Indeed, it is usually insufficient, and at the best season for irrigating the farms, because there are many of them, it does not reach the lowest ones ... only in a very rainy year is there enough for all." Springs in the Cienega area produced a flow in the river, most years, all the way to its confluence with the Rio Grande near Cochiti.

1776 The priest at San Felipe de Neri in Albuquerque pastured his horse in a marsh "back of the convent on the Rio del Norte" (Adams and Chavez 1956: 150).

1776 Fray Dominguez (Adams and Chavez 1956: 170), at Santa Ana Pueblo, reported: "They are really dependent on the rains, because in addition to the inadequacy of the river, which sometimes helps irrigation when there is heavy rain, the uneven site, now uphill, now off at a distance, does not permit the formation of pools to quicken and fertilize the plants. This results in completely unfavorable crops."

1776 Dominguez described the location of Isleta Pueblo: "The little rise on which the pueblo stands is as small as I said in the beginning, and it lies on the very meadow of the Rio del Norte, which sometimes overflows its bed up above the pueblo when it is very high and forms a very wide branch at a distance from it. This cuts off the settled part as if it were an island, which is doubtless the reason why it was named Isleta. This place stands, as has been said, on the very meadow, open to the plain which slopes down from those hills I mentioned at Atlixco of Albuquerque" (Adams and Chavez 1956: 207).

1776 Father A. Dominguez referred to the lake, four-tenths of a mile from Laguna Pueblo, as "almost round and very large" and estimated it to be over 100 feet deep, with bulrushes on one shore (Adams and Chavez 1956: 187).

1776 The skins of buffalo, mountain lions, wolves, and sheep were used as floor coverings, sleeping pads, and covers at Nambe Pueblo (Adams and Chavez 1956: 50).

1776 There were trout in the river at Quemado, near Santa Cruz, at Picuris, and Pecos, which Spanish residents caught and ate (Adams and Chavez 1956: 83, 91, 213).

1779 The meadows south of Cochiti Pueblo were severely damaged by overgrazing of livestock (Lange 1959: 37).

1770s Albuquerque residents resorted to the use of horse manure as a fuel because of the scarcity of wood in the area. Threat of attacks by Comanches or Navajos may have precluded their venturing from the village to collect firewood (Moorhead 1958: 24; Thomas 1932: 101).

1781 Teodoro de Croix, commander general of the interior provinces of New Spain, wrote "The species of deer, antelope, and bison there

[New Mexico] are inexhaustible" (Thomas 1941: 112–113).

1782 Taos Pueblo was described by Fray Morfi as having extensive, fertile fields watered by more than 300 springs and 4 streams. Timber for use in construction and as fuelwood was close by (Thomas 1932: 96).

1782 Near Taos was a large pond, located at "a little more than a musket shot north of Taos Pueblo, where are estimated more than three hundred springs of good water which irrigating the lands nearby produce the best pastures of the Kingdom. The timber for construction and fuel is close to the pueblo and in abundance" (Thomas 1932: 96).

1782 About 8 miles south of Taos Pueblo there was a Spanish ranch "with abundance of arable lands even more fertile than those of the pueblo.... There is a free-flowing spring of hot water" (Thomas 1932: 97).

1782 Fray Morfi described the Santa Fe in relation to its river of the same name: "It occupies a plain on the western skirt of a sierra and is distant about a league and a half (!) from its summit where there is a pool which provides the source for a river, meager in truth, the waters of which in years of little rain are dissipated before reaching the Rio Grande del Norte. However, it provides abundantly the Villa..." (Thomas 1932: 91). Further on, he reported "... the river is poor and can only fertilize some fields. It has besides excellent trout..." (Thomas 1932: 92).

1782 The banks of the Rio del Norte were described as "shady" (Thomas 1932: 90).

1782 Sandia Pueblo was described as located on "a plain upon the meadow" that had "sufficient cultivated lands with ordered and abundant pastures" (Thomas 1932: 101).

1782 Around the ruins of Tonque Pueblo were "fine lands and three springs for its use" (Thomas 1932: 97).

1782 There were several hot springs between Sandia Pueblo and the Espiritu Santo spring along the Rio Salado (Thomas 1932: 111–112).

1782 At the site of a former Spanish ranch, known as Encinal, Navajos were cultivating land. They also used good grazing lands to the south (Thomas 1932: 106).

1782 Fray Morfi recorded beaver, otter, and "water-dogs" in the region (Thomas 1932: 112).

1782 King Charles III of Spain requested that eight elk be captured in New Spain and shipped to the royal zoo in Madrid. This task fell on Governor Juan Bautista de Anza in Santa Fe, and the elk were captured in nearby mountains and brought to pens behind the Governor's Palace, then sent south with the fall caravan to Mexico City. All but one of the eight animals reached Madrid safely (Simmons 1969: 41–44).

1782 Fray Morfi recorded the following fish in the region: matalote (humpback chub), barbel (?), and bagre (catfish) (Thomas 1932: 112).

1782 "Excellent trout" were present in the Santa Fe River (Thomas 1932: 92).

1785 Regional fires were common and widespread (Swetnam and Betancourt 1990: 1019).

1780s (late) Hispanic authorities encouraged Navajos to bring pelts to settlements to trade (Weber 1971: 28).

1791 Grass for livestock around Belen was scarce (Espinosa and Chavez n.d.: 177).

1797 Based on tree-ring evidence, a forest fire occurred on the Pajarito Plateau (Robinson 1990: 142).

1799–1800 The Montoya family on the La Majada grant protested to the governor that the large cattle herds and sheep flocks of Miguel and Manuel Ortiz had destroyed a spring that the Montoyas had tapped to irrigate their fields. Paulo Montoya, part owner of the La Majada grant, filed suit against the two men (Snow 1979; 228; Wozniak 1987).

1700s (late) Decimation of grasslands and fuelwood, and total appropriation of water in the Santa Fe area, caused the governor to recommend moving the capital to the confluence of the Santa Fe River and the Rio Grande (MacCameron 1994: 35).

1700s (late) (to early 1800s) Pedro Baptista Pino ran "a large-scale livestock operation in the Galisteo Basin ..." (Bustamante and Simmons 1995: xiii).

1800 By this year residents of Abiquiu were traveling up to 20 miles to gather fuelwood (McDonald 1985: 121).

1800–46 Raids by nomadic Indians forced ranchers to keep their stock close to settlements, and grasslands were soon overgrazed as a result (Kelly 1955: 395).

1801 Wildfires were common and widespread (Swetnam and Baisan 1995: 18).

1803 Governor Chacon described the Rio del Norte: "... it does not carry much water upon crossing it as is believed" (Simmons 1991: 164).

1803 Elk, deer, bighorn sheep, buffalo, bears, mountain lions, wolves, foxes, and coyotes were reported as common in the region (Simmons 1991: 168).

1805 (ca.) The channel of the Rio Grande, which ran past the pueblo ruins of Alameda, changed its location (Lange and Riley 1970: 176).

1805 (ca.) (to 1824) The Rio Grande's channel was located at the present site of Bernalillo. At this time the old village was situated upstream, some 2 miles to the west. The river began a shift to the northwest. Two groups of Bernalillo citizens living on the west bank of the Rio Grande north of Kuaua were forced from their homes by a westward shift in the flow of the Rio Grande. Landless, they petitioned for tracts of land on the new east bank of the river at the north edge of Sandia Pueblo land. Overgrazing of the area on the west side of the Rio Grande during the colonial period may have been a factor in their move as well (Bowen and Sacca 1971: 60). Some 20 Hispanos, displaced by a westward shifting Rio Grande, moved onto a tract of land "loaned" to them by Sandia Pueblo. This land was south of the present, old church of Nuestra Senora de Dolores in Bernalillo on the east side of the new Rio Grande channel. This cluster of residences was called "Los Cocinitas" (Bowen and Sacca 1971: 48–49).

1806 Wildfires were common and widespread (Swetnam and Baisan 1995: 18).

1807 (March 2) Zebulon Pike (Coues 1987, II: 602–603) reported that Father Baptiste Lalande at San Juan Pueblo was "a great naturalist, or rather florist; he had large collections of flowers, plants, etc., and several works of his favorite studies, the margins and bottoms of which were filled with his notes in the Castilian language."

1807 (March 5) There was a ford across the Rio Grande at Santo Domingo Pueblo. At normal flow the river was 3 to 4 feet deep and about 300 yards (feet?) wide (Coues 1987, II: 615).

1807 (March 7) Pike described the Rio Grande at the Barelas ford as "400 yards wide, but not more than three feet deep and excellent fording" (Coues 1987, II: 621).

1807 (March) Pike described the Rio Grande in general: "It cannot ... be termed a navigable stream, owing to the sand-bars," and "In the mountains above Santa Fe it afforded amply sufficient water for canoe navigation, and even more than appeared to be flowing in its bed in the plains. This must be attributed to numerous canals and the dry sandy soil through which the river courses, where much of the water which flows from the mountains must be absorbed and lost" (Coues 1987, II: 729–730).

1807 According to Pike, the Rio Grande was called the Rio del Norte above El Paso and Rio Bravo, or Rio Grande, below (Coues 1987, II: 641).

1807 Elk were reported as common by Pike (Coues 1987, II: 597).

1800s (early) Some 20 Hispanos, displaced by a westward shifting Rio Grande, moved onto a tract of land "loaned" to them by Sandia Pueblo. This land was south of the present, old church of Nuestra Senora de Dolores in Bernalillo; this cluster of residences was called "Los Cocinitas" (Bowen and Saca 1971: 48–49).

1800s (early) Rancho de las Golondrinas, located south of Santa Fe on the Chihuahua Trail, was known throughout the province for its productive agricultural fields and always dependable springs (Baxter 1987: 74–75).

1800s (early) A shortage of lead for ammunition continued, and the governor ordered the residents at San Jose de las Huertas to extract the ore from the north end of the Sandia Mountains and in the Cerrillos area (Schroeder 1977: 24).

1800s (early) Pinyon nuts gathered in the Ojo Caliente area were shipped down the Camino Real in large quantities (Swadesh 1974: 61).

1800s (early) Animal skins, hides, and furs were probably the main export items to Mexico (Weber 1971: 30–31).

1800s (early) A Tewa Pueblo Indian reportedly killed two buffalo near Santo Domingo Pueblo (Bailey 1971: 13).

1800s (early to mid) An elderly San Ildefonso man claimed to have hunted pronghorns near Rio Grande Canyon on the Pajarito Plateau (Henderson and Harrington 1914: 15).

1811 Hispanics were hunting elk, pronghorn antelope, mule deer, buffalo, rabbits, jackrabbits, quail, and "partridges" (Bustamante and Simmons 1995: 12–13).

1812 Pino recorded buffalo, elk, deer, bighorn sheep, jackrabbit, wild turkey, grouse (blue? sage?), and quail as common game animals (Carroll and Haggard 1942: 99–100).

1811 "Trout, eels, catfish, stickleback, cardume, land turtle, and water tortoise" were found in New Mexico's rivers (Bustamante and Simmons 1995: 13).

1812 Wild horses, or mustangs, were reported "in great abundance" in the province (Carroll and Haggard 1942: 100).

1813 (pre) Santa Ana's governor charged San Felipe Pueblo with destruction of timber on some of its land at Angostura (Bayer et al. 1994: 91).

1813 The alcalde mayor of the Jemez jurisdiction issued a proclamation calling for livestock raisers to keep their animals away from fields from planting to harvest time and off the banks of irrigation ditches. He further stated that an adequately strong bridge must be constructed where livestock must cross (Simmons 1968: 8–9).

1815 (fall) A French trapper wrote that the streams of northern New Mexico "abounded with beaver" (Weber 1971: 46).

1815 Three Anglo Americans were trapping in the Sangre de Cristo Mountains in southern Colorado (Connor and Skaggs 1977: 30).

1817–30s Adequate water was a problem at Carnue at the west end of Tijeras Canyon. As a result, the population shifted to higher settlements in the Sandias (Quintana and Kayser 1980: 48).

1817–80s Wood cutting was a common activity of Tijeras Canyon Hispanic settlers (Quintana and Kayser 1980: 48).

1819 Wildfires were common and widespread (Baisan 1994: 3; Swetnam and Baisan 1995: 18).

1820–40 There were few or no fires over much of the region during this period. This may have been due to generally wetter conditions and intensification of sheep grazing, which reduced fuel (Swetnam 1990: 10).

1821 Most rangelands around settlements in the Rio Grande basin had become overgrazed by this year. Some livestock owners sent their flocks to the llano east of the Pecos River (Rebolledo 1987: 100).

1821 The ruins of the Felipe Romero house were located south of Belen and about 200 yards east of the Rio Grande. By early 1897 the river shifted eastward, to within 5 yards of the ruins (Wilson 1977: 14).

1821 With independence from Spain, the Mexican government viewed Pueblo Indians as citizens, and therefore they had the right to sell land either as individuals or as a tribe (Carlson 1975: 100).

1821 Three parties of Anglo traders came over the Santa Fe Trail, and members of these groups trapped beaver and other fur-bearing animals on the Rio Grande from below Santa Fe and north into the San Luis Valley (Hafen and Hafen 1993: 93).

1822 (January-June) A party of some 22 Anglo trappers took fur-bearing animals around Taos (Connor and Skaggs 1977: 32–33).

1822 Wildfires were common and widespread in the region (Baisan 1994: 3).

1822 Based on tree-ring data, a forest fire occurred on the Pajarito Plateau (Robinson 1990: 142).

1822–23 James Baird came back to Mexico and within 3 years was operating a distillery near Taos. In 1826 he moved to El Paso and began to trap beaver. Subsequently, he complained about Anglo trappers wiping out the beaver populations, taking pelts worth $100,000 over a year-and-a-half period of trapping (Sonnichsen 1968: 102).

1822–24 The first area to be intensively trapped was the southern Sangre de Cristo Mountains between Santa Fe and Taos (deBuys 1985: 93).

1822–26 Taos trappers virtually took all of the beaver in the Sangre de Cristo and Jemez mountains (Flores 1992: 8).

1824 (December 3) In the Rio Grande valley, below Socorro, James O. Pattie (1966: 52) saw "great numbers of bears, deer, and turkeys." One bear, which charged one of the members of his trapping party, was killed.

1824 Two groups of Bernalillo citizens living on the west bank of the Rio Grande north of Kuaua were forced from their homes by a westward shift in the flow of the Rio Grande. Landless, they petitioned for tracts of land on the east bank of the river on the north edge of Sandia Pueblo land. Overgrazing of the area on the west side of the Rio Grande during the colonial period may have been a factor as well (Bowen and Sacca 1971: 60).

1824 Some 2,000 pelts and furs that went back east over the Santa Fe Trail were valued at about $15,000 (deBuys 1985: 97).

1824 Some trappers took 1,500 pounds of beaver pelts from New Mexico (Weber 1971: 84).

1824 Beaver populations in the Rio Grande and Pecos River basins were rapidly decreasing due to Anglo trapping (Weber 1965: 65).

1825 Twelve beaver pelts obtained from the Comanches were sold at Abiquiu (Weber 1971: 163).

1825 (late) (to October 1826) Several groups of trappers illegally took $100,000 worth of furs out of New Mexico (Weber 1971: 118).

1826 James O. Pattie, a trapper, wrote "When the dry season returns, this grass [native bunch] may be said to be cured standing. The cattle feed and fatten upon it, when in its state of verdant tenderness. It afterwards sustains them as substantial hay" (Pattie 1966: 268).

1826 A Santa Fe Trail caravan transported 2,044 pounds of beaver back east (Weber 1971: 100).

1826–41 William Workman operated a still at Taos and may have been involved in smuggling hides and pelts (Weber 1971: 156–157).

1827 (September to February 1828) Two Hispanics

and two Frenchmen trapped eight tercios (240 pelts) of beaver fur on the headwaters of the Rio Grande and the Conejos River (Weber 1971: 161).

1827 (November) A French American trader bought an unknown amount of furs at Abiquiu. These had been obtained by Hispanics in an exchange with Ute Indians (Weber 1971: 163).

1827 Anglo and Franco trappers virtually harvested all of the beaver in the Sangre de Cristo Range by this date (Ungnade 1972: 48).

1827 Anglo trappers harvested beaver from wooden rafts while floating down the Rio Grande from Cochiti Pueblo to El Paso. At the latter settlement, they dismantled their rafts and sold the "lumber" and logs to local residents. The trappers then turned eastward to the Anglo frontier, thus avoiding payment of export fees (Weber 1971: 157).

1827 Over 1,100 beaver skins taken by Ewing Young and associated trappers on the upper Pecos and San Juan rivers and confiscated by government officials in Santa Fe were threatened with deterioration when "a great rain" saturated the pelts. To save them, they were sold. This rain also "almost ruined all the houses in town" (Cleland 1963: 217, 220, 224).

1828 Some 1,200 pounds of beaver pelts, valued at over $5,000, were shipped over the Santa Fe Trail (Weber 1971: 173).

1829 A single trapper returned over the Santa Fe Trail with 951 pounds of beaver pelts valued at $4,297 (Weber 1971: 175).

1820s Local farmers began to notice formation of cienegas and esteros in the Middle Rio Grande Valley. These resulted from the dumping of excess water from irrigation ditches (Wozniak 1987).

1820s Trapper George Yount claimed to have seen 50 or 60 grizzly bears in a day. James Ohio Pattie claimed to have observed 220 in a single day (Cleland 1963: 44).

1820s (late) (to early 1830s) Some "foreign" trappers told government authorities that they had purchased furs from Native Americans or Hispanic residents, when in fact they had trapped the animals. Then they sold them to Santa Fe Trail traders, who transported them back to Missouri (Weber 1971: 159).

1830 (late) (to spring 1831) Gervais Nolan led a trapping expedition from Taos to an unidentified area and returned with 50 pounds of beaver fur (Weber 1971: 183).

1831 (summer) William Sublette, a Santa Fe Trail trader, exchanged his merchandise for 55 packs of beaver pelts (1,705) and 800 buffalo robes, which he took back to Missouri (Weber 1971: 147).

1831 About $50,000 worth of beaver pelts and bison robes were shipped east over the Santa Fe Trail. Some $17,500 worth of these were harvested in New Mexico, amounting to 55 to 60 packs of beaver and 200 robes (Weber 1971: 206).

1831–33 Trading and trapping by Anglos and Hispanos resulted in the shipment of a substantial amount of beaver pelts east over the Santa Fe Trail (Weber 1971: 206).

1832 (fall) The Charles Bent and Company returned from Santa Fe with 13,182 pounds of beaver, representing at least 131 packs of pelts. These were taken over the past 2 years. There were also 355 buffalo robes included with this shipment (Weber 1971: 206–207).

1832 About 90 packs, or about 2,790 beaver pelts, went east over the trail from Santa Fe. About one-third of these were trapped in New Mexico (Weber 1971: 206–207).

1833 The city council of Santa Fe issued a proclamation with regulations requiring draining of stagnant pools, cleaning of streets, and removal of garbage. Throwing trash or dead animals into irrigation ditches and streams and burning of rubbish piles were prohibited (Simmons 1992: 224).

1833 An estimated 60 packs of beaver were shipped from Santa Fe (Weber 1971: 207).

1834 The annual caravan from Santa Fe carried $15,000 worth of beaver pelts and 50 packs of buffalo robes (500) east over the trail (Weber 1971: 218).

1830s Fewer beaver were taken as a result of population reduction due to trapping and falling prices. The taking of buffalo robes increased due to demand and rising prices (Weber 1971: 208–210, 215).

1830s (mid) Hat-making technology improved, and techniques to substitute raccoon, rabbit, and nutria for beaver were found back East, resulting in the rapid decrease in beaver pelt prices (Muldoon 1987: 70).

1830s (mid) The popularity of buffalo hides as sleigh lap robes and floor rugs was growing in the eastern United States. As a result, the price of robes increased (Lavender 1987: 13).

1835 Coal mining in the Cerrillos area was begun (Elston 1961: 166).

1836 One merchant transported 1,000 beaver skins and 1,000 buffalo robes over the Santa Fe Trail (Weber 1971: 219).

1837 Another Santa Fe trader carried 200 buffalo robes and 2 packs of beaver pelts to Missouri (Weber 1971: 219).

1837 Regional fires were common and widespread (Swetnam and Betancourt 1990: 1019).

1838 A band of French trappers went into the Sangre de Cristo Mountains above Mora, but owing to prior trapping along the streams, they caught no beaver (deBuys 1985: 159).

1839 Businessman Manual Alvarez shipped 383 pounds of beaver pelts over the Santa Fe Trail to St. Louis (Weber 1971: 219).

1839 No significant trapping apparently occurred in New Mexico (Weber 1971: 225).

1830s Josiah Gregg described the Rio del Norte (Rio Grande) as "so shallow for the most part of the year, that Indian canoes can scarcely float in it" (Gregg 1966, I: 138).

1830s Gregg (Quaife 1967: 133) noted that the Rio Puerco was dry at its mouth part of the year.

1830s Gregg (1966, I: 160–161) wrote the following on the grama species in New Mexico: "... it cures upon the ground and remains excellent hay—equal if not superior to that which is cut and stacked from our western prairies. Although the winters are rigorous, the feeding of stock is almost entirely unknown in New Mexico; nevertheless, the extensive herds of the country, not only of cattle and sheep, but of mules and horses, generally maintain themselves in excellent condition upon the dry pasturage alone through the cold season, and until the rains start up the green grass again the following summer." Gregg (1966, I: 159) also noted that mesquite, pinyon, and cottonwood were the most popular fuelwoods in New Mexico. Pinyon resin was used to make lamp oil. Cottonwood along streams was described as "scantily scattered along their banks." He also commented "Those [banks] of the Rio del Norte are now nearly bare throughout the whole range of the settlements and the inhabitants are forced to resort to the distant mountains for most of their fuel."

1830s Josiah Gregg (1966, II: 202) wrote the following about fire's role in maintaining grasslands: "It is unquestionably the prairie conflagrations that keep down the woody growth upon most of the western uplands. The occasional skirts and fringes which have escaped their rage, have been protected by the streams they border. Yet may not the time come when these vast plains will be covered with timber? ... Indeed, there are parts of the southwest now thickly set with trees of good size, that, within the remembrance of the oldest inhabitants, were as naked as the prairie plains; and the appearance of the timber in many other sections indicates that it has grown up within less than a century. In fact, we are now witnessing the encroachment of timber upon the prairies, wherever the devastating conflagrations have ceased their ravages."

1830s Wolves were reportedly taking cattle, horses, and sheep in the region (Gregg 1966, I: 194).

1830s Gregg (1966, I: 192–195; II: 207–210) noted that black bears and grizzly bears were relatively common in the region and the wolf abundant in northern New Mexico. Elk and deer, according to him, did not occur in large numbers. Gregg also mentioned pronghorn, bighorn sheep, prairie dogs, and wild horses.

1830s Gregg (1966, I: 195–196) observed that geese, ducks, and cranes were the most numerous birds in the territory, and turkey were numerous in some mountain ranges. Partridges and quail were scarce.

1830s Trout were reported as abundant in the Santa Fe River (Gregg 1966, I: 142).

1830s–40s Hispanic settlers, who were descendants of residents of San Jose de las Huertas, came from the Rio Grande to start a new village in the valley. They found that the old fields were no longer fertile and that the creek flow had decreased (Batchen 1972: 86).

1830s (late) Almost all felt for hats was made from furs like raccoon, which were much cheaper than beaver. With a decreased price in the beaver market, large trapping companies went out of business (Murray 1979: 32).

1840s (pre) The bison may have ranged west to the Rio Grande in northern New Mexico and across the grasslands of north-central and northwestern New Mexico to the San Francisco Peaks-Grand Canyon area (Henderson and Harrington 1914: 13–14).

1840 The Sangre de Cristo Mountains near Taos Pueblo were "well stocked with deer, elk, bear, turkey, grouse, and squirrel" (Bodine 1979: 255).

1841 (early) Santa Fe merchant Stephen L. Lee sold 365 pounds of beaver fur to Charles Bent (Weber 1971: 182).

1841 (October 21) Falconer (1963: 93–95), traveling near Sandia Pueblo observed "The Rio Grande, even at this distance N., is very broad, running over a bed of red sand, but very shallow." A few days later he crossed the river at Parida, where its depth was about 2 feet. He

described the Rio Grande above Alameda as "very broad, running over a bed of red sand, but very shallow."

1841 The European honey bee had not yet reached New Mexico (Gregg 1966, I: 195).

1841 Notes and the mineral collection of Thomas Falconer, a member of the Santa Fe expedition and a Fellow of the Geological Society of London, were seized by Mexican officials (Northrop 1961: 85).

1842 Wildfires were common and widespread (Swetnam and Baisan 1995: 18).

1842 Based on tree-ring data, a forest fire occurred on the Pajarito Plateau (Robinson 1990: 142).

1843 Father Martinez of Taos reported that buffalo, deer, and other game were becoming more scarce due to increased hunting pressure, which in part was fostered by traders on the Southern Plains. He warned that extinction would eventually take place (Keleher 1982: 68–69).

1844 Josiah Gregg (1966, II: 149, 212), based on observations made in the early 1830s, also warned that the buffalo might become extinct in the West and decried their slaughter.

1845 The upper Rio Puerco was a "grassy wilderness" with "swampy vegas and clear water" and "willow-lined banks" (Maes and Fisher 1937: 10).

1845? Lorenzo Labadie established a temporary ranch at Los Ojuelos, 10 miles east of Tome Hill (Simmons 1973: 147).

1840s (mid) As beaver trapping continued to decline, coarse furs again dominated the hide trade in New Mexico (Weber 1971: 227).

1846 (May) Captain Donaciano Vigil stated that Anglo trappers were shipping $200,000 worth of beaver skins annually from Abiquiu and Taos (Cleland 1963: 153).

1846 (July 9) Frederick A. Wislizenus (1969: 29) noted *Artemisia*, or sagebrush, as he traveled south through the Galisteo Basin. Near the "foot of the Placer Mountains" he recorded "dwarfish cedars."

1846 (July 11) Wislizenus (1969: 33) found excellent grass and water 3 miles south of San Antonio on the east side of the Sandias. That night, in his camp, "wolves, deers, and other innocent animals" frightened his picketed horse.

1846 (July 14?) Rain made the valley branch of the Rio Grande, 3 miles above Albuquerque, virtually impassable. Some of the wagon traffic shifted to the upper branch, which ran north-south near present Edith Boulevard, N.E. (Wislizenus 1969: 34).

1846 (July 18) Returning to the main valley road near Albuquerque, Wislizenus (1969: 34) described the landscape: "The Rio del Norte is here about 100 yards wide, and as usual, sandy, shallow, everywhere fordable and nowhere navigable, not even for canoes. In the river we saw an abundance of geese, ducks, and pelicans; the latter bird is very common all along the water. Fishes and shells appear to be very scarce. On the banks of the river, heretofore quite bare of trees, occasionally a few cotton trees are seen."

1846 (July 18) Wislizenus (1969: 34) recorded large numbers of geese, ducks, and pelicans (probably white) on the Rio Grande south of Albuquerque.

1846 (July 19) Wislizenus (1969: 35), traveling down the river, "reached a fine grove of cotton trees, called bosque, or alamos de Pinos ..." on the east bank of the Rio Grande south of Isleta Pueblo.

1846 (July 21) From the Chavez "hacienda" near Pinos, south to 6 miles below Tome, Wislizenus (1969: 35) described the area along the route: "soil and road getting better." He and his party stopped at a pond about a mile from the river.

1846 (July 22–24) About 6 miles south of Valencia, Wislizenus (1969: 35) stopped at a pond at noon. Farther south, below Casas Colaradas, he found "tolerable grass," and below that "good grass."

1846 (July 23) Four miles below Casas Coloradas and one-half mile east of the river, Wislizenus (1965: 35) noted "tolerable grass."

1846 (July 24–26) Near La Joya, Wislizenus (1969: 93–95) collected creosotebush (*Larrea tridentata*), mesquite (*Prosopis juliflora*), and narrow-leaf yucca (*Yucca angustifolia* [*glauca*]).

1846 (July 28) In the mountains west of Socorro, Wislizenus (1969: 37, 39) found a new species of yucca (*Y. baccata*). A week later he discovered a new species of *Echinocactus* along the trail near Dona Ana. This cactus was 4 feet high and more than 6 feet in circumference.

1846 (July 30–31) At Bosque del Apache, Wislizenus (1969: 37) "camped in a fine grove of cotton trees near the river." Below Valverde, he camped in another grove of cottonwoods and on the next day found "many wild turkeys" in the bosque.

1846 (August 1–2) Traveling the Jornada del Muerto, Wislizenus (1969: 38) found no water but "tolerable grass, and an abundance of mezquite and palmillas." The latter two spe-

cies were collected and used as fuel. En route to the Ojo del Muerto east of the road, "many antelopes" were encountered.

1846 (mid August) The U.S. Army found grass, water, and wood from Las Vegas to Santa Fe. These resources were characterized as "abundant" near the recently abandoned Pecos Pueblo (Clarke 1966: 71–72).

1846 (August) Grass around Santa Fe was scarce; the U.S. Army had to send their horses from 12 to 15 miles to graze (Calvin 1968: 60).

1846 (late August-September) Lt. Abert (1962: 18, 22–23, 29, 31, 33–35) recorded the following mammals in northern and central New Mexico: grizzly bear, gray wolf, black-tailed deer [mule], white-tailed deer, elk, pronghorn, raccoon, cottontail, rabbit, and prairie dog.

1846 (September 2) South of Santa Fe, Emory reached the Galisteo River, "...which, at that time, was barely running. The bed of the creek is sand and pebbles of the primitive rock.... From this place to its mouth there is scarcely the sign of vegetation. At the dry mouth of the Galisteo..." (Calvin 1968: 62–63).

1846 (late August-September) Lt. James Abert (1962: 25, 27, 29–33, 36, 39, 42) recorded the following birds in northern and central New Mexico: duck spp. hawk sp., night heron sp., turkey, "skylark," cowbird sp., yellow-headed blackbird, raven sp., Stellar's jay, and western meadowlark.

1846 (September 6) A contingent of the Army of the West stopped for lunch at "a beautiful cotton-wood grove," Bosque de Pinos, south of Isleta Pueblo. Later, they passed a section of the river where "grass was only moderate—wood scarce" (Connelly 1907: 232).

1846 (September 6–7) From Los Padillas to Peralta to the Chihuahua Trail on the east side of the Rio Grande there was "deep sand, and the country is perfectly barren" (Calvin 1968: 70).

1846 (September 23) Abert (1962: 37–38) noted "very good pasture grounds along the Rio Moro[a]."

1846 (September 26) Soldier Henry Smith Turner (Clarke 1966: 76–77) described the landscape south of Santa Fe: "past the Del Gado Rancho, plenty of water in the creek that crossed the road near it." He found water at the crossing of Galisteo Creek, but it was dry a "few hundred yards below," and no grass on the road today "until camp was made across from San Felipe pueblo."

1846 (September 29) Lt. William Emory crossed the Rio Grande at Albuquerque where "its width was about twenty-five yards, and its deepest part just up to the hubs of the wheels" (Calvin 1968: 79).

1846 (September 29) Between Albuquerque and Los Padillas, Emory recorded "myriads of sand crane, geese, and brant." He also found "a sandy plain, destitute of wood, and with little grass" (Calvin 1968: 79).

1846 (September 29) On the road from Santa Fe to the old Placer mine, Abert (1962: 46) recorded juniper, pinyon, cactus, yucca, and "a scant growth of grass."

1846 (September 30) Emory (Calvin 1968: 81) found hawks building nests in holes in the basalt escarpments west of Isleta. In the valley around Peralta he recorded "a considerable growth of cottonwood; among which are found some signs of beaver."

1846 (September 30) Traveling west from Los Padillas, Emory (Calvin 1968: 80) recorded "a succession of rolling sand hills" with walking stick cholla, sagebrush, and "scrub cedar, about as high as the boot-top."

1846 (September) Near Tome was "a filthy lake hard by [the river] ..." (de la Vega 1976: 39).

1846 (late September-early October) Henry Smith Turner noted a lack of wood for fuel along the Rio Grande from San Felipe Pueblo and south to almost Socorro, although good grass and water were found. Only a few sparse cottonwood groves were seen. These were "preserved with great care." Numerous sandhill cranes, wild geese, and ducks were observed. He found less sand on the road below Barelas along the west side of the river (as opposed to the east side) (Clarke 1966: 76–79).

1846 (October 3) Camped on the Rio Grande, near La Joya de Sevilleta, Emory (Calvin 1968: 82–83) described the river bank as "fringed with large cottonwoods growing at intervals." Flocks of geese and sandhill cranes, ducks, plovers, doves, and meadowlarks were observed. Several "large cat-fish and soft-shell turtles were caught" in the river.

1846 (October 4) In the La Joya area, Emory (Calvin 1968: 85) recorded cholla, mesquite, romeria, a composite, stickleaf, and chamisa. Below the village, and on either side of the Rio Grande, the grass was described as "excellent." Cottonwood along the river became more common as he moved downstream.

1846 (October 5) Emory (Calvin 1968: 86) encountered creosotebush and "a little stunted acacia near Socorro, and cane grass [*Phragmites*] and salt grass in the river valley."

1846 (October 6) About 11 miles below Socorro, Turner's army contingent encamped "where grass and wood were abundant on the bank of the Del Norte" (Clarke 1966: 79).

1846 (October 7) Abert (1962: 59–60) was told that snow fell every month in the Taos area. Wheat, corn, beans, pumpkins, melons, and chiles were the main crops. Surrounding hills were "covered with very good grass, which furnishes subsistence to herds of cattle and horses, as well as to fine flocks of sheep and goats."

1846 (October 7–8) Traveling down the Rio Grande, north of the Fray Cristobal Range, Emory (Calvin 1968: 88–90) noted that the cottonwood was larger and denser and the grama grass adjacent to the floodplain taller. He shot two or three quail (scaled ?), a small hawk (merlin ?), and a deer. A "few black tailed rabbits" were seen as well. He commented on the scarcity of game in the territory.

1846 (October 8) Along the road from Santa Fe to Agua Fria, Lt. Abert (1962: 65) noted threadleaf groundsel, sagebrush, and several species of cactus. He had to purchase "fodder and wood" for his camp near Agua Fria.

1846 (October 9) Emory (Calvin 1968: 91), west of the Fray Cristobal Range and north of San Diego, surveyed the Rio Grande; its width was 118 feet, with a mean depth of 14 inches.

1846 (October 9) Abert (1962: 65) left camp at Agua Fria and passed through Cienega, which he referred to as "well settled" and a "well watered place . . . the neighboring hills are full of springs." He recorded cranes and wild geese in the area.

1846 (October 10) Abert (1962: 65) recorded narrow-leaf yucca as abundant along the road from Galisteo Creek to San Felipe Pueblo. The Rio Grande at this point was "three to four feet deep," and "large flocks of geese and blue cranes; also some teal" were seen.

1846 (early October) Below Socorro, Captain Turner noted that trees were much more abundant than upriver, and the grass remained good (Clarke 1966: 80–81).

1846 (October 12) Magoffin's caravan experienced slow travel through sand just north of Isleta Pueblo (Drumm 1962: 152).

1846 (October 12) Moving up the Jemez River from Ranchitos, Abert (1962: 71) described the valley as "very sandy; the bed of the stream three-quarters of a mile in width, contains, in many places, no water. . . ."

1846 (October 12) Lt. Abert (1962: 71) found Santa Ana Pueblo virtually abandoned; most of the residents were gathering corn from fields at the confluence of the Jemez River and the Rio Grande. The military contingent camped near the pueblo, where they found little firewood or forage for their mules. No grass was found in the vicinity of the camp.

1846 (October 13) Back at Ranchitos on the Rio del Norte, Abert (1962: 71 72) wrote that the river "was full of wild geese," and at Bernalillo, he saw "large flocks of blue cranes; they kept up a great whooping."

1846 (October 14–15) Ponds along the road from Bernalillo to Albuquerque "were filled with ducks, geese, and cranes" (Abert 1962: 72).

1846 (October 16–17) West of Atrisco, Abert (1962: 74) and his men followed the Rio Puerco upstream over a sandy road. He initially described the valley as "wide, flat, overgrown with varieties of artemisias and coarse grass, fit only for sheep and goats." The river banks were "stiff loam; they are 10 or 12 feet high, and stand vertically." He described the surrounding landscape as "broken with sand hills, that are overgrown with cedar trees, the only kind of timber to be seen, except a few cotton-wood trees that are found in the bed of the river." Abert moved his men and wagons slowly up the river through deep sand and, in some places, dense stands of sagebrush. They encountered a corn field or forked-pole hogan and archeological ruins. The height of the river banks where they crossed was 30 feet; this was near the abandoned town of "Poblazon."

1846 (October 18–19) Having crossed the Puerco, Abert (1962: 77–78) found no water in a tributary of the river as he moved west, and the valley around seemed "destitute of grass." Lacking wood for fuel, the men used "dry branches of the artemisia to build a cooking fire." On the second day Abert reached Moquino, a Laguna Pueblo village. Here, his mules ran off in search of grass and water.

1846 (October 20) Abert (1962: 81–82) moved on to Paguate Pueblo, where he "saw several large flocks of sheep and goats." Following the Rio Paguate south, he passed through corn and pumpkin fields where "large flocks of cranes were whooping." At Laguna, the lake to the west of the pueblo held only a small pool of water. Along the Rio San Jose were large flocks of snow geese. To the northwest was the village of Cubero, which Abert was told had good grass and water. At the pueblo

Abert noticed turkeys, chickens, and "tame macaws."

1846 (October 22) A contingent of the U.S. Army reached the Galisteo River and found water for themselves and their animals (Cooke 1964: 94).

1846 (October 22–23) Abert (1962: 92) moved northeast from Acoma, toward El Rito, and found travel to be difficult in the deep sand. Light rain fell on their camp on a sandy knoll, and there was no grass for the animals. On the next day the ruins of El Rito were reached; the village was abandoned some years before when residents had their irrigation water diverted upstream. Camping near the ruins, Abert found "plenty of wood and of water" and "the pasturage was good."

1846 (October 24) Susan Magoffin put on rubber boots and waded into the Rio Grande near Bosquecito. She wrote of this experience: "... I found myself standing on a sand-bar and the wide Rio Grande curling its dark waters around me. There is something wildly sublime in the deep murmur of a mighty river, as it rolls by us with stately pride, its course pending to the fearful Ocean" (Drumm 1962: 161–162).

1846 (October 24) Abert (1962: 92–93) traveled east-southeast, down the Rio de San Jose to its confluence with the Rio Puerco. Two to 3 miles down the Puerco "some water, that was quite thick with mud" was found.

1846 (October 25) Abert's (1962: 95) command awoke to a "heavy frost and a skim of ice on the water." Moving toward the Rio Grande, they "collected enough wood to last a couple of days." Atrisco was reached, and a camp was made.

1846 (October 25) Abert (1962: 96) wrote ". . . no wood is to be obtained within less than 9 or 10 miles of Albuquerque. . . ."

1846 (October 27–28) A rain and windstorm struck Abert's (1962: 99) party camped at Pajarito, and the temperature dropped. In the morning and early afternoon, Canada and snow geese were "very abundant" and incessantly "honking."

1846 (October 30) Moving west from Isleta Pueblo into the Manzano Mountains via Infierno Canyon, Abert (1962: 100) described the road as "fine" and "compact." In the foothills were "several species of yucca and cacti." The Manzanos were "covered with snow, and the temperature dropped." A "stream of cold water" flowed through the canyon, and "cottonwood trees and grape vines" grew along its banks. Juniper and pinyon were noted on canyon slopes.

1846 (October 31) A "terrible storm," accompanied by "rain, hail, snow, and great gusts of wind" struck Abert's (1962: 103–104) camp. He recorded "holly" [agarita or *Mahonia*?], juniper, fir, and "some stunted oaks" along the trail, as well as "numerous signs of bear." As the party left the canyon and the Manzanos, and took the road south toward the "salt lakes," the strong, cold winds forced Abert to make camp in the "densest grove of pine trees" and to build a huge fire of "pitch pine" (pinyon?). "A number of Mexicans, with eleven carretas loaded with corn, stopped and encamped" nearby.

1846 (October) Near La Joya, Emory (Calvin 1968: 83) saw "immense flights of sand cranes and geese," which were feeding near houses and villages, not only here, but up and down the Rio Grande.

1846 (late October-early November) Captain P. St. George Cooke (1952: 54) noted that beaver, bear, and deer were present in and along the Rio Grande from just below Socorro to San Diego.

1846 (November 1) Abert (1962: 104–105) moved south over "an extended plain" on the road to Chilili, which in recent years had moved up the drainage from an earlier village site in order to find a more reliable water supply. Around the community were "flocks of sheep containing several thousand [animals]." The rangelands here afforded "excellent pasturage." At Tajique, the party camped above the village near a stream.

1846 (November 2–3) Col. P. St. George Cooke (1952:) and his U.S. troops camped in an "open grove of the river bottom" with "plenty of fuel" south of San Marcial. On the second day, camp was on "a high plain, covered with grama grass." For the last 40 miles of travel south along the valley he noted "the flat river bottom is perhaps two miles in width" and with "forests covering perhaps one-fourth of the bottoms, and the mountains also covered with cedar very near." He also observed mesquite and cactus (?) 10 feet high along the route.

1846 (November 5–6) After visiting the Abo ruins, Abert (1962: 116–118) followed the road west, through Abo Pass, and on to Casa Colorado on the Rio Grande. On the bajada he saw a "large band of antelope dash across the road. Farther along the route, cattle were found

grazing near "several little ponds of water," where the party camped. North of the village were several large ponds whose "surfaces were covered with ducks and geese, and long-legged cranes" and a number of vineyards.

1846 (November 7–8) From Casa Colorado, Abert (1962: 118–119) turned south, down the east side of the Rio Grande for about 12 miles, where camp was made "on a salt plain, by the side of the river, close by some cottonwood trees." There were "some pools of beautifully clear water," which was "perfectly saturated with salt." A windy weather front struck, bringing colder temperatures. Abert stopped at La Joya, where corn was purchased for the mules and horses. He continued downriver and made camp in "a large grove of cottonwood trees in the vicinity of an acequia." During the day's march, "great quantities of mezquit" and creosotebush were seen.

1846 (November 9) From La Joya south, Abert (1962: 119–120) noted that the river banks were "heavily timbered with cotton wood, and the weather was warmer." Along the road were scattered mesquite and four kinds of cactus." Many flocks of sheep that the pastores had driven in from the mountains" were observed. Below Sabino there were goats, in addition to sheep. Below Parida the route became more sandy and traversed some steep hills.

1846 (November 10) Lt. Abert (1962: 120–121) noted "cockle burs" (*Xanthium strumarium* var. *canadense*) and "sand burs" (*Cenchrus* sp.) in New Mexico. These were nuisances, as they stuck to clothing, blankets, the manes of horses, and the tails of mules. The screw-bean mesquite was also recorded.

1846 (November 15–19) While hunting near Valverde, Abert (1962: 125–126) and a few men killed several merganser ducks, and a bald eagle was sighted on a sand bar in the middle of the Rio Grande.

1846 (November 19–28) The livestock of Ruxton's party suffered from a lack of grass and severe cold as they traveled from El Paso to Valverde (Hafen 1950: 167).

1846 (November 20–27) The river at the Valverde camps was "full of sand bars," and the river level was low. Carrizo grass, or *Phragmites*, grew along the banks. As the weather turned colder, Abert (1962: 126–28) moved camp to "a more sheltered position" with "plenty of cotton wood trees. Construction of houses was begun, and adobes for the chimneys from the ruins of Valverde" were collected.

1846 (November 28) At Valverde large cottonwoods extended a half-mile back from the Rio Grande "without any undergrowth of bushes" (Hafen 1950: 167).

1846 (November) A U.S. soldier reported that many of the horses from his unit were perhaps becoming ill from browsing cottonwoods. He also noted that the "cotton-wood trees here are so thickly clad with mistletoe, that they present a green appearance" (Stanley 1950: 62).

1846 (late November) George Ruxton (1973: 179) and two hunting companions saw about 30 turkeys in the bosque at Valverde.

1846 (November-December) The large number of U.S. troops and Santa Fe Trail traders camped at Valverde almost exhausted the fuelwood, grass, and game in the area (Moorhead 1958: 167–168).

1846 (December 1–9) A hunting party at Valverde "saw many deer and wild turkeys," but were able to kill none. Several coveys of quail in the area were hunted (Abert 1962: 129–130).

1846 (December 14) Ruxton (1973: 183) crossed the river to the west bank at the Valverde ford and described the village of San Antonio: "Crossing Del Norte, we proceeded on its right bank ten or twelve miles, encamping in the bottom near the new settlement of San Antonio, a little hamlet of ten or twelve log-huts, inhabited by pastores and vaqueros—shepherds and cattle-herders. The river is but thinly timbered here, the soil being arid and sterile; on the bluffs, however, the grass is very good, being the gramma or feather-grass, and numerous flocks of sheep are sent hither to pasture from the settlements higher up the stream."

1846 (December 14–19) Three different contingents of the invading U.S. Army, under Colonel Doniphan, marched south, staggered over these 6 days so there would be adequate forage for their animals (McGaw 1972: 158).

1846 (December 16–19) Abert (1962: 135–137) and his command continued north through Socorro and on to Lemitar, where some residents had mules for sale. He bought two of the animals. At the Jose Chavez "hacienda" Abert bought hay for his animals. At Belen, he obtained specimens of selenite, which was used locally for covering windows.

1846 (December 19) A physician in Albuquerque related that many Hispanic children had died from measles and whooping cough (Abert 1962: 135–137).

1846 (fall) The U.S. military could find no cattle feed within 50 miles of Santa Fe, owing partly

to recent fires set by Indians (Frazer 1983: 11; Sunseri 1979: 75).

1846 (fall) (to summer 1847) Augustus Fendler, a Prussian botanist, collected 1,026 plant specimens along the Santa Fe River and the Rio Grande Valley to the west. Two genera in the saxifrage family were named for him, *Fendlera* and *Fendlerella* (Dickerman 1985: 168–169).

1846 (December 21) Camped above Galisteo Creek, George F. Ruxton (1973: 187) noted there was no grass or "timber" at this site.

1846 (December 21–23) About a mile north of San Felipe, Abert (1962: 138–139) and his command camped in an "old cultivated field, which afforded grazing for our animals." On the road the next day, near Santo Domingo, they shot at four coyotes. At Galisteo Creek there was "plenty of water," and the command camped there. Near Cieneguilla, Abert's mule became mired in marsh mud, but the animal was extricated with some effort. Santa Fe was reached around noon of the 23rd.

1846 (December 22–23) Abert (1962: 138–139) reached the Galisteo River, where "we found plenty of water, which, although covered with ice, yet that could be easily broken." The next day was cold, and the ground was covered with snow.

1846 (December) Ruxton (1973: 178) reported deer, pronghorn, hares, and rabbits as abundant in the Valverde area. He also killed a mountain lion in this locale.

1846 Santa Fe-Chihuahua trails trader James Josiah Webb noted that the area roads were so bad that they made only 2 to 10 miles a day (Bieber 1931: 188–189).

1846 Abert described the Tierra Amarilla grant as having "prime stock range" (Swadesh 1974: 62).

1846 Ruxton recorded 75 varieties of grasshoppers and locusts, "lantern bug," an "endless variety" of beetles, and tarantulas (Hafen 1950: 150).

1846 Three years after cura Antonio Jose Martinez warned that the Anglo-spurred market for buffalo hides would severely reduce, if not exterminate, this animal, New Mexico hunters had to travel over 250 miles east to find only small herds. He also warned that Plains Indians would increase their raiding on New Mexico as their food base, the buffalo, dwindled (Weber 1982: 98).

1846 Governor Charles Bent reported that Jicarilla Apache were stealing livestock for their meat because there was little game in the region (Worcester 1979: 44).

1846 (post) Several plants collected and described by Frederick Wislizenus were named in his honor: *Ferocactus wislizeni*, valley cottonwood (*Populus deltoides* ssp. *wislizeni*), and spectacle pod (*Dithryea wislizeni*) (Dickerman 1985: 166).

1847 (January 2–3) After crossing the Rio Gallinas, Abert (1962: 144–145) saw "large herds of antelopes, apparently from two to three hundred animals in each herd. . . ."

1847 (January 29) General Sterling Price found the old camino militar near Embudo impassable for his wagons and artillery. Opposing rebels had deployed among the junipers, pinyons, and boulders, making an attack on them difficult (Twitchell 1963, II: 240).

1847 (March 18) An Anglo trading party, below El Paso, burned the tall grass around their camp so fire would not sweep across them while asleep (Drumm 1962: 224).

1847 (April 26) G. Gibson and his companions traveled north from Valverde on the Chihuahua Trail to camp, 1 mile above the ford of the road to Socorro. Here, they found water, wood, and grass at their camp in cottonwoods. The Rio Grande was running high, precluding their crossing the river to Socorro to procure needed items (Frazer 1981: 33).

1847 (April 27) Ducks and geese were plentiful along the Rio Grande from the Socorro ford to north of Bosquecito (Frazer 1981: 33).

1847 (April 29) From north of Bosquecito to above La Joya de Sevilleta, George Rutledge Gibson's unit found no grass for their animals or wood for fuel (Frazer 1981: 35).

1847 (May 1) From 3 miles south of Tome to near Isleta Pueblo, Gibson reported there was no wood or water and little grass (Frazer 1981: 36).

1847 Regional fires were common and widespread (Swetnam and Betancourt 1990: 1019).

1847–61 The army set up a number of sawmills across the region. Some lumber was contracted from private sources, but soldiers cut and sawed most of the lumber used in construction (Frazer 1983: 187).

1848 (August 27-September 1) A party of trappers found no grass for their horses and mules from Santa Fe to Abiquiu. They did find "fine grass" on the Chama River above Abiquiu (Hafen and Hafen 1993: 344–345).

1849 (June 13–19) Anglo travelers found "very poor grazing" and "no grass" from Cerrillos to San

Antonio, on the east side of the Sandia Mountains (Bloom 1945: 146).

1849 (June 20) Emigrant William H. Chamberlin also observed that there was no fuelwood "in the neighborhood of the place," and that gathered at some distance from Albuquerque sold for $30 per cord. Traveling south from Albuquerque on the next day, Chamberlin wrote "For the most part of the time we traveled through very heavy sand beds and hills, which was drifting, and almost suffocated us at times" (Bloom 1945: 146–147).

1849 (June 20) William Chamberlin (Bloom 1945: 146) described the Rio Grande at Albuquerque as a "noble river, so celebrated in history of late years, is nearly a mile wide at this point. Its waters have been higher this season than ever known before, and although considerably abated, is still very much swollen, and more than bank full in many places. . . . The current is very swift, the water cold, and of a muddy or turbid nature."

1849 (June 21) Following the old Camino Real south from Albuquerque, Chamberlin's party encountered "heavy sand beds and hills, which was drifting," and "as far as the eye can reach nothing but a bleak, barren continuation of sand hills is visible" (Bloom 1945: 148).

1849 (June 22) Chamberlin described the Rio Grande environment in the Valencia-Tome area: "The channel of the river frequently narrows to 150 yards, where it runs very rapid, boiling, foaming and roaring, as its turbulent waters rush along. The sand hills frequently extend into the river, obliging us to cross them, and at times we cannot find the bank of the Rio Grande, where we had pretty good grazing for our stock, but were very much annoyed by mosquitoes, which swarm along the river in myriads ..." (Bloom 1945: 148–149).

1849 (June 22) South of Peralta, Chamberlin and his compan-ions camped on the bank of the Rio Grande, where they found "pretty good grazing" for their livestock. Swarms of mosquitoes were a nuisance (Bloom 1945: 149).

1849 (June 25) At, or near, Parida, Chamberlin and his com-panions crossed the Rio Grande in a "large dug out" operated by a "ferryman." The river apparently still flowing above normal was "about 250 yards wide..." (Bloom 1945: 150).

1849 June 28 Camped south of San Antonio, Chamberlin recorded "good grass, lots of mosquitoes . . ." (Bloom 1945: 151).

1849 (June 30) In the San Marcial area, Chamberlin wrote "The bottom land along the river becomes narrower as we travel down," and "the growth of cottonwood on its banks becomes more extensive," and at camp "we had plenty of grass" (Bloom 1945: 152).

1849 (June 30) South of San Marcial, Chamberlin described the vegetation on the uplands, adjacent to the river, as short, dry grass ". . . which affords good pasture for sheep. The hills and plains are covered with a great variety of mezquite and other bushes, plants and flowers peculiar to the country . . ." (Bloom 1945: 152).

1849 (summer) The Abo ruins were "inhabited by owls and coyotes" (Hannum 1930: 222).

1849 (August 16) Colonel John M. Washington's troops found "good grass and water" and "sufficient fuel" at Agua Fria on the Santa Fe River (McNitt 1964: 7).

1849 (August 17) From the mouth of the Santa Fe River to the east bank of the Rio Grande, across from Cochiti, Lt. James H. Simpson recorded grassland with no trees (McNitt 1964: 8).

1849 (August 20) Lt. Simpson saw a small, gray wolf close to Canoncito on the Rio Guadalupe (McNitt 1964: 15).

1849 (August 22) Lt. Simpson camped near San Ysidro, where there was "good water, tolerable pasturage, and wood in the vicinity" (McNitt 1964: 24).

1849 (August 24) Lt. Simpson described the Rio Puerco, above San Luis, as about 100 feet wide at the bottom of its channel. The vertical banks were 20 to 30 feet high; they were graded down by the contingent so that the artillery and pack animals could cross the river. The river was "slightly fringed with cottonwood" and with "water only here and there, in pools —the fluid being a greenish, sickening color, and brackish to the taste." (McNitt 1964: 29).

1849 (August 24) Another member of the Simpson-Washington contingent, Richard Kern, wrote in his journal "The Puerco was a miserable, dirty and little stream of brackish water lined with high cut soil banks and cotton woods" (McNitt 1964: 29).

1849 (August 24) The 15-mile march north from the Rio Puerco passed through "pine and cedar of a dwarf growth, very thinly scattered; and the artemisia [sagebrush] has been seen everywhere" (McNitt 1964: 30–31).

1849 (August 24–25) After passing over grasslands

and scattered juniper and pinyon pine, Lt. Simpson camped on the Torreon Arroyo. A few cottonwoods along the arroyo were noted (McNitt 1964: 32).

1849 (summer) Wild horses were seen north of San Pedro. Near this settlement, "grass was scarce." Wolves were common along the road east of the Sandias (Hannum 1930: 221–222).

1849 (late summer) Fuelwood, grass, and water were found at La Joya (Hannum 1930: 223).

1849 (late summer) About 15 miles south of San Antonio, on the Chihuahua Trail, "there was good grass . . ." Opposite Valverde, there was a "patch of timber . . ." (Hannum 1930: 226).

1849 (late summer) Near La Joyita the Rio Grande was over 6 feet deep. The nearest "timber" was 3 miles away, and local residents gathered "brushwood" there for fuel (Hannum 1930: 223–224).

1849 (September 20) The Rio Grande, at the Barelas crossing, was described as "probably three hundred yards wide, the stream rapid, its depth four feet, and its bottom of a quicksand character" (McNitt 1964: 153).

1849 (September 21–22) Lt. Simpson reported that residents of Albuquerque had to travel 25 miles to find fuelwood. There were scattered trees sparsely distributed along the Rio Grande (McNitt 1964: 152, 154).

1849 (late September) Lt. Simpson wrote in his journal "The valley of the Rio Grande for a number of miles above Albuquerque presents the finest agricultural and pastoral country I have yet seen in New Mexico. The breadth of the valley under cultivation is, probably, not quite a mile." Farther north, he wrote "The face of the country today has presented, with some trifling exceptions—along the Rio Grande, at Delgado's, and between Agua Fria and Santa Fe—one extended barren waste of uncultivable soil" (McNitt 1964: 154, 158).

1849 Rangelands around Santa Fe, perhaps for up to 20 miles, had been denuded of grass by livestock of wagon trains. At nearby Galisteo, erosion, which began at this time, had been cut by deep arroyos, and the Galisteo Creek has eroded to a depth of 12 feet. The channel today is about 200 feet wide; in 1849 a plank spanned the creek (deBuys 1985: 216–217).

1849 A military officer who had been stationed at Socorro recommended the Canadian River-Gila River route to southern California as best because the Santa Fe area had little grass to support emigrant caravans (Bearss and Gibson 1979: 207).

1849 Several cattle died from eating poisonous plants in the Abo area (Hannum 1930: 222–223).

1849 A wolf with rabies reportedly attacked a party of men and bit six of them; one later died (Cox 1925: 135–136).

1849–50s A U.S. military officer noted "Horses and mules turned out to graze always prefer the grass (grama and other bunch grass) upon the mountain sides to grass of the valleys" (Marcy 1988: 113).

1849–50s In some valleys in and near the southern Rocky Mountains, "immense herds of pronghorn antelope" congregated. Mounted Native Americans in the region surrounded the herds, then ran the animals until they tired. Large numbers of the exhausted animals were then approached and killed (Marcy 1988: 244).

1840s Corn was a popular exchange item in the fur trade with Native Americans (Muldoon 1987: 71).

1840s Most beaver pelts going over the Santa Fe Trail were obtained in New Mexico through trading rather than trapping (Weber 1971: 224).

1840s–60s (falls) Parties of men from the Placitas area went east onto the Southern Plains to hunt buffalo. These hunters carried ground corn, dried peas, beans, onions, and raisins as provisions. Buffalo hides were used in making clothing, moccasins, rugs, and balls used in a game. The meat was dried while on the plains and transported back to the home villages. As the buffalo became increasingly scarce, families increased the size of their goat and sheep herds (Batchen 1972: 64–65).

1840s–70s Bears in the Sandia Mountains were reportedly common and were considered a menace to the goat and sheep herds and their herders. Attacks on these livestock occurred, and a few herders were mauled or killed. Wildlife such as deer, wild turkey, and grouse were abundant in the northern reaches of the Sandia Mountains. Pronghorns were common on the Bajada de Sandia. They were hunted with guns, bows and arrows, and box traps by Placitas area Hispanics (Batchen 1972: 49–50, 64).

1850 About 100,000 acres were in irrigated cultivation in the Middle Rio Grande Valley. "Native hay" was a major crop (Hedke 1925: 5).

1850 Colonel McCall (1851: 5) wrote the following about New Mexico livestock: "There are in New Mexico grazing lands of great extent, where countless flocks and herds may be

reared at a very trifling expense. They require neither stabling nor forage during the winter; the numerous 'gramma,' a species of grass found on the mountain sides and the adjoining uplands, affording abundant sustenance during that season."

1850–51 The U.S. Assistant Surgeon accompanied Lt. Lorenzo Sitgreaves on his expedition from El Paso to Santa Fe, then west to El Morro and the Zuni area. He was the first scientist to collect birds and mammals in the region. He collected and described, for the first time, grey-headed junco (now lumped with two former species into one), black-capped vireo, Cassin's sparrow, Abert's squirrel, Ord's kangaroo rat, and the coyote (Hume 1942: 497–503).

1850–1911 Sandhill cranes were common along the Rio Grande during migration (and probably late fall-winter) (Henderson and Harrington 1914: 33).

1851 (April 19–20) About 30 miles north of El Paso the dominant vegetation on the uplands bordering the Rio Grande was mesquite chaparral, creosotebush, sagebrush, two species of yucca, and patches of grama grass. On the floodplain were cottonwood trees. About 50 miles north of the same town, the river valley supported "fine groves of large cottonwood, with occasional mezquit" (Bartlett 1965, I: 199–200).

1851 (April 27) Bartlett's (1965, I: 215–216) party crossed "the old fording place" at San Diego. He described the crossing: "In fording the river, one of the wagons, in consequence of diverging a little from the proper course, got into a quicksand, and was near being lost."

1851 (April 27) Part of the boundary survey contingent crossed the Rio Grande at the old ford site at San Diego. The entire valley in this area was described as being "more or less wooded ..." with "excellent grass." The party camped at Santa Barbara, above San Diego, near a mile-long lake that was probably a former channel of the Rio Grande (Bartlett 1965, I: 216–217).

1851 (August 17) Galisteo Creek, east of present I–25, "was barely running." From here to its confluence with the Rio Grande there was "scarcely the sign of vegetation" (Dillon 1970: 53).

1851 Regional fires were common and widespread (Swetnam and Betancourt 1990: 1019).

1851 J. R. Bartlett noted that wolves were abundant on the plains and valleys of southern New Mexico (Brown 1983: 15).

1851–52 The Territorial Legislature declared that the acequia alignments in use at the time should not be disturbed and should remain public, and their use for irrigation should take precedence over all other uses, such as grist mills (Wozniak 1987).

1851–60 Based on tree-ring evidence, precipitation was below 20th century means (Fritts 1991: 155).

1852 At Albuquerque, Franz Huning described the water used for domestic activities as "always more or less oily and in winter hard to get at" (Browne 1973: 57).

1852 Merriam's turkey was found on every wooded riparian reach in the territory (Henderson and Harrington 1914: 35).

1852 Grizzly bears were reported common in the valleys of southwest New Mexico and the Rio Grande in the south-central part of the state (Bailey 1971: 357).

1852 Naturalist S.W. Woodhouse reported that wolves were common across New Mexico (Bailey 1971: 310).

1852 (ca.) The El Tajo ditch was constructed to "relieve the high water overflows at Albuquerque." The de los Padillas acequia, on the other side of the river, was primarily used for flood control (Wozniak 1987).

1852–55 Army doctor Thomas Charlton Henry described New Mexico's wildlife: "The plains swarm with antelopes; the hills with deer and 'grizzlies'; the rivers with swans, ducks, and wild geese; while among the timber generally, are to be found many curious birds, peculiar to the country, some specimens of which are undescribed. There is a great profusion of lizards, salamanders, and chameleons; I should say more than thirty species..." (Hume 1942: 210).

1852–55 Army surgeon Henry wrote "This is a curious and unique country—New Mexico, full of ... lizards, tarantulas, and flies in profusion (Hume 1942: 209–210).

1850s (early) A U.S. Army surgeon described the Rio Grande in the Socorro area as 200 to 600 yards wide, depending on runoff amounts from the basin above. High water occurred from the first of May to late July, and more severe floods destroyed "hundreds of acres" of agricultural fields. Change in the channel reportedly took place every year (Hammond 1966: 24–25).

1850s (early) The Rio Puerco channel at La Ventana was about 8 feet deep (Dortignac 1962: 588).

1853 (May 2) A military contingent crossed the Rio Grande at Cieneguilla, located about 18 miles

southwest of Taos. The men dismounted and swam the horses across the river (Bennett 1948: 36).

1853 (October 3) Lt. A.W. Whipple (Foreman 1941: 109) described the Rio Galisteo: "The channel is sandy, and several hundred feet wide, evidently bearing much water at certain seasons. The flowing stream is only a few feet in width."

1853 (November 7) Lt. Whipple (Foreman 1941: 116) described the Rio Grande at Pajarito: "... the river bottom is wide and low as at Albuquerque." And further south at Isleta "The bed of the river is sandy, and the depth of water three to four feet. The usual ford is about one hundred yards below. Few trees occur in the valley, except at Bosque de los Pinos, five miles below Isleta, where the wide bottom lands are covered with quite a forest of mesquites and cotton-woods."

1853 (November 7) Between Albuquerque and Bosque de los Pinos, Lt. Whipple noted that there were few trees in the valley. At the latter location, 5 miles below Isleta, he noted ". . . the wide bottom lands are covered with quite a forest of mesquites and cotton-woods" (Foreman 1941: 116).

1853 (November 10) At the Barelas ford, just south of Albuquerque, Lt. Whipple described the Rio Grande: "The bed of the stream is about 500 yards wide, with a channel upon each side from three to four feet deep, and a temporary island of sand and clay in the centre, occupying about one third of the width. In one or two places there were quicksands sufficient to make the passage laborious. The current of the stream is rapid. . . . Our own observations made the fall five feet per mile at this place" (Foreman 1941: 119).

1853 (November 12) Leaving the Rio Grande and moving westward, Lt. Whipple (Foreman 1941: 120) reached Sheep Springs, also known as El Alamo, 17 miles east of the Rio Puerco and on the road to Laguna Pueblo. He wrote, "The water seems to issue from beneath a stone ledge, but is neither palatable nor abundant."

1853 (November 12–16) Lt. Whipple (Foreman 1941: 120–129) and his men reached the Rio San Jose, which he described as a "... fine wide valley ... the stream that now flows by the foot of the hill is narrow, and, a short distance below, shows strong symptoms of sinking below the surface. The banks are covered with a rich soil, which, in some places, is white with efflorescent salts. Ascending the narrow valley, the stream became larger . . . forming lagunas, and fertilizing some very broad bottoms." Farther west, he refers to the San Jose as ". . . a pretty brook . . ." and beyond, at the "Hay Camp," probably near modern McCarty, wrote "The valley spreads out into a wide vega, covered with an abundance of grama, which is occasionally cut to supply hay to the military posts." The Ojo del Gallo was reached on the next day.

1853 Zoologist C.B.R. Kennerly observed that black bears and grizzly bears were common in the foothills from Mount Taylor to the Zuni Mountains. He also reported that both species, when food shortages occurred in the mountains, came down to the valley and frightened away sheepherders and attacked their flocks (Bailey 1971: 364).

1853 Indian Agent E.A. Graves of Dona Ana reported that the buffalo population was still decreasing due to Plains Indian-trader activities (Keleher 1982: 89).

1853–54 Indian agent Steck reported that game was scarce due to Anglo-American hunting and other activities. Older Gila Apaches recalled the time when buffalo were near (Cole 1988: 80–81).

1853–54 Lt. Col. Henry (1856) recorded 170 species of birds while stationed at forts Thorn, Fillmore, and Webster (Ligon 1961: 7–8).

1854 (spring) The only large tract of cottonwoods found along the Middle or Upper Rio Grande Valley was located below Isleta Pueblo on the east side of the river according to W.W.H. Davis (1982: 356). He wrote "Wood is exceedingly scarce all over the country. The valleys are generally bare of it."

1854 (April 28) Bartlett (1965, I: 217–218) and his party camped at Santa Barbara, on the west bank of the Rio Grande, near a "pond or laguna, extending a mile or more." He commented ". . . I think it must have been formerly the channel of the Rio Grande . . . it is continually changing its bed, where great bends occur. The laguna is now supplied by overflows from the river."

1854 W.W.H. Davis (1982: 353) described Albuquerque "As a place of residence it is far less pleasant than Santa Fe. At some seasons of the year high winds prevail, when the sun is almost obscured by the clouds of fine dust that is whirled through the air, and which finds an entrance into the houses through every nook and cranny. Then there are flies and mosquitoes, which swarm in and out of doors in un-

told millions, which neither day nor night allow man or beast to live in peace. The weather is oppressively warm in the summer season. The water used for all purposes comes from the river, and is so muddy that you can not see the face in it until it shall have settled several hours."

1854 Perhaps the last whooping crane in New Mexico, prior to its reintroduction in 1975, was recorded by Henry near Fort Thorn in the Rio Grande Valley (Ligon 1961: 106).

1854 On a river cut-off at Santa Barbara, Bartlett 1965, I: 218) noted "many wild fowl. . . ."

1855 (July) A bosque was present in the Rio Grande Valley near Algodones (Davis 1982: 389).

1855 On the Rio Puerco, south of the Santa Fe Rail line, the channel was 20 feet deep (Bryan 1928: 276).

1857 Santa Fe was described as "pleasantly situated on an extensive plateau" and produced "good crops of wheat, corn, beans, red pepper, and many of the vegetables . . ." and "apples and the smaller fruits. . . ." The area around "for miles" was destitute of trees. The "large growth" was reportedly "cut away, at an early date in the history of the place, for fuel and for better security against hostile Indians . . ." but "stunted cedars are very common." Pinyon was "the almost sole supply of fire-wood," which was "brought for miles on the backs of donkeys and sold by the load, in the plaza, at from twenty-five cents to one dollar...." The "river-water is very extensively used for drinking purposes, and is excellent." Potable water was found by digging wells 10 to 40 feet deep (U.S. Surgeon-General's Office 1857).

1857 Lieutenant E.F. Beale (1858) described the vegetation along the Rio Grande near Ft. Craig: "The grass on the river bottoms is not good, and we therefore camped on the nearest hills to the river, where we found excellent gramma."

1857 Near Fort Craig were black bear, grizzly bear, gray wolf, mountain lion, bobcat, and weasel. Birds included "swans, pelicans, wild geese, brant, and almost every species of duck . . . as well as sand-hill cranes, blue herons, bitterns, and several species of snipe." Away from the post in the foothills and mountains there were "turkey, quail, blackbird, meadowlark, robins, doves, sparrows, bluebird, cardinal bird, snow-bird, and many others. The Rio Grande abounded in "catfish, buffalo, and white fish," and "beavers and muskrats" were "found in great numbers within a mile of the post." Drinking water was collected from the Rio Grande (U.S. Surgeon-General's Office 1857: 250–251).

1857 Fort Wingate was situated in an "open and grassy" valley "with some pine timber and scrubby oak scattered through it, and has well-wooded hills back of it." The fauna was composed of "antelope, black-tailed deer, black bear, large gray wolf, coyote, wild cat, fox, beaver." Birds included various species of ducks, ravens, blackbirds, "Canada" jay, "speckled" woodpecker, northern flicker, kestrel, several species of hawks and owls, mourning dove, a flycatcher, western meadowlark, magpie, mountain and western bluebird, and a swallow. There was "very little game in the neighborhood of the post, it having been thinned out of late years by the Navajo Indians" (U.S. Surgeon-General's Office 1857: 311).

1858 The first Hispanic families began to settle Ojo de la Casa east of Placitas, where there was fertile soil and water from Las Huertas Creek (Batchen 1972: 6).

1859 (summer) At Isleta Pueblo, Samuel W. Cozzens (1988: 274–275) noted "acequias nicely kept, and the vineyards yielding abundantly." He and his two companions forded the river, which was 3 to 4 feet deep, about 300 feet wide, and muddy. They camped for the night on the bank of the river at the pueblo. On awakening the next morning, the Rio Grande was flowing between the men and Isleta, a half mile away. Part of a vineyard and a corn field were destroyed during the movement of the river. Cozzens (1988: 275) described the ford at Isleta: "Its bottom is nothing less than a mass of quicksand; and as we had been informed that the ford here is hazardous and very uncertain it was with no enviable feeling that we looked at the muddy, turbid water, and realized the difficulties we might encounter in getting our mules and heavily-laden wagon safely across the stream and up the steep bank on the opposite side."

1859 On the road from Isleta to Laguna Pueblo, Cozzens (1988: 279) described the landscape as "quite destitute of vegetation, and presenting altogether a most barren and cheerless aspect." Reaching the Rio Puerco he noted that "the valley is quite extensive and very flat, and is covered with a species of coarse grass, valuable for sheep and goats, thousands of which were seen grazing on every side." Shepherds and their dogs were with each flock.

1859 Near the ruins of Valverde, Cozzens (1988: 77) observed that "cottonwood trees ... line[d] the banks of the Rio Grande" and he camped at a location "where there was a prospect of our poor animals obtaining a supply of grass."

1859 Captain Randolph Marcy (1988: 252) wrote this about bighorn sheep meat: "The flesh of the bighorn, when fat, is more tender, juicy, and delicious than that of any other animal...."

1859 The imposition of duties on imported goods ended the annual trade caravans of Pueblo Indians to Sonora. They took serapes, buffalo hides, and other items to exchange for rebozos, oranges, and so forth (Lange and Riley 1966: 237).

1859–76 No buffalo were observed in New Mexico (Bailey 1971: 14).

1850s Santa Fe experienced critical water shortages, and a search for a new source was initiated. A dam was constructed at the headwaters of the Santa Fe River in 1866, but the resulting reservoir did not supply all of the needed water (Clark 1987: 33).

1850s (late) Manuel Chaves moved his family to the Ojuelos Ranch, east of Tome Hill. An upper and lower spring provided water, and their livestock fed on abundant grass. The ranch was located on an old trail connecting Tome and Comanche Canyon on the west side of the Manzano Mountains (Simmons 1973: 147–149).

1860 The Rio Grande shifted to a new channel, which left La Mesilla and Las Cruces on the same side of the river (Cozzens 1988: 277).

1860 (ca.) Floodwater runoff in the upper Rio Puerco drainage was "lost" in marshy meadows at the lower end of the Cuba Valley in the Cabezon-Casa Salazar area (Maes and Fisher 1937: 1–4).

1861 Wildfires were common and widespread (Swetnam and Baisan 1995: 18).

1862 (February 25) There was a river ford east of Lemitar (Hall 1960: 193).

1862 (March 5) Confederate soldier A.B. Peticolas found wood to be "very scarce near Judge Spruce Baird's in Albuquerque's South Valley." "Dry cow chips" were used instead for fuel (Alberts 1993: 59).

1862 (March 5) In the Padillas area there was a road on the floodplain along the west side of the Rio Grande; this road was "very sandy." Paralleling this road was an upland road, located along the edge of the floodplain. This was "a much better road for wagons" (Alberts 1993: 59).

1862 (March 8–9) Sergeant Peticolas' unit camped at "Soda Spring" in Tijeras Canyon, where the men burned dead wood and green "cedar" (juniper). The weather "was bitter cold and disagreeable" and "windy, with frequent showers of snow . . ." (Alberts 1993: 67).

1862 (March 11) Sergeant Peticolas described the route north, along the east side of the Sandia Mountains, as "altogether the best road I have traveled for many a day. The mountains on either side are covered with a dense growth of pine and cedar..." (Alberts 1993: 68).

1862 (late March) Some 11,000 sheep were taken from Chavez's Ojuelos Ranch by Navajo raiders (Simmons 1973: 186).

1862 (April 12) Sergeant Peticolas' unit crossed the Rio Grande at the Barelas ford on a "flatboat" (Alberts 1993: 101).

1862 (April 14) The road, wrote Sergeant Peticolas, from the South Valley to Los Lunas, along the west side of the Rio Grande, was "very heavy with sand," and the wagons could not travel very fast" (Alberts 1993: 102).

1862 (April 16) Peticolas' unit found "plenty of wood" at a Hispano rancho near Belen. The severe dust storm continued all day (Alberts 1993: 107).

1862 (April 17) At Magdalena the "pines were plentiful all along the road." The men camped at Ojo del Pueblo, where three bears were flushed but not shot (Alberts 1993: 110–113).

1862 (April 19) A Confederate contingent reached the Saracino Spring near the confluence of the Rio Salado and the La Jencia Creek. The Salado Valley was "very boggy where the salt creek seeps, or crawls sluggishly along down the valley." Continuing northwestward, the contingent shot three pronghorns and a bear (Alberts 1993: 110–111).

1862 May) The Los Pinos rancho, owned by Governor Henry Connelly, was leased by the U.S. Army for use as a supply depot. The army had rights to cut and use shrubs and trees on the property (Miller 1989: 214).

1862 (spring) The cottonwood bosque in the Peralta area provided protection for the Confederate troops being assaulted by Union forces (Cook 1993: 6).

1862 There was a ford on the Rio Grande at Mesilla (Horgan 1954, II: 831).

1862–90 Sheep herds in the upper Rio Puerco basin produced intensive grazing pressure, and erosion was accelerated (Maes and Fisher 1937: 10–15).

1863 June Captain Rafael Chacon and a military contin-

gent camped at Cebolleta, where they found "wood, water, and grass in abundance." Moving southwest the next day, they found water in arroyos and holes, abundant grass, but no wood (Meketa 1986: 227).

1863 (summer) Camping at Gallinas Spring in the Gallinas Mountains, military personnel found an abundance of trout, some of which they caught and ate (Meketa 1986: 235).

1864 A father and son from Ojo de la Casa were herding goats and sheep in a "grassy canyon above La Madera." Late in the afternoon, as they were setting up camp, they discovered a flock of turkeys roosting in a pine tree. They started a grass fire below the tree, and the smoke caused the turkeys to panic and become disoriented. As a result, the two herders managed to capture over a dozen of the birds (Batchen 1972: 68–69).

1865 The military experimented with using mesquite beans as livestock feed (Miller 1989: 95).

1866 (July 12) James F. Meline (1966: 101) saw four large flocks of sheep near Ocate. A gray wolf was seen later in the day.

1866 (late July) Meline (1966: 118). described the plant environment south of Santa Fe: "... we found ourselves, at the end of four miles, out on the sandy plain covered with cactus, scattered and stunted cedars, and liberally intersected by arroyos...." Fourteen miles farther south, he noted "little grass" and still farther, crossing Galisteo Creek, "we see but little water."

1866 (late fall) The new settlers of San Francisco Xavier on the Rio Puerco used cottonwood along the stream to construct their houses and outbuildings. This new town was located at a spring, El Ojito del Rio Puerco (Lopez 1988: 72–76).

1866 The Santa Fe River was dry 5 miles below the town of Santa Fe (Meline 1966: 151–152).

1866 A new road from Santa Fe to El Paso, which was periodically covered by blowing sand, was constructed, "replacing the old road" (Bayer et al. 1994: 171).

1866 James F. Meline (1866: 151–152) noted that the Santa Fe River had "a wide pebbly bed, showing capacity for frequent mountain torrents," and "in ordinary seasons its waters are lost in the granite sands, some five miles below town."

1867 (April 3) Bell (1965: 241–242), traveling below Albuquerque, observed "The greater part of the valley is here almost entirely destitute of trees. This may be partly accounted for by the fact that the banks of the river are of a sandy, friable nature, and that the bed of the stream is always changing its position, sometimes to one, sometimes to the other; thus destroying fields of corn, irrigating canals, and villages...."

1868 Just below Albuquerque, the Middle Rio Grande changed its course, moving westward, close to Atrisco. The river only ran here for a few weeks, and when it shifted back, a remnant channel was left (U.S. Surveyor-General and Court of Private Land Claims 1894).

1869 The 40-stamp mill at the Ortiz mine in the Old Placers district was operating (Elston 1961: 155).

1869–77 There were two charcos, or small lakes, near Tome. One of these, on Father Ralliere's land, was drained in 1877 (Ellis and Baca 1957: 25–27).

1860s An estimated 18,000 acres of new irrigated land was developed in the Middle Valley (Wozniak 1987).

1860s Constructing successful irrigation facilities on the upper Rio Puerco, in the Cabezon area, was easy because the stream channel was relatively shallow (Maes and Fisher 1937: 12).

1860s The influx of Anglo traders, trappers, military hunters, and miners reduced populations of various game animals on which the Jicarilla Apache depended for food. They turned more to raiding as a means of subsistence (Tiller 1992: 64–66).

1860s (late) Elk herds of more than 100 animals were seen in the Rociada Valley. Hunting pressure subsequently reduced these herds dramatically (Barker 1953: 87).

1860s–70s A relatively large influx of new Spanish settlers to the upper Rio Puerco valley led to overgrazing and scarcity of irrigated cropland (Carlson 1979: 34).

1860s–70s The women of Placitas harvested a "tall, brown, tender grass and tied it into neat bundles and exchanged it for whatever they could get in Bernalillo" (Batchen 1972: 43).

1860s–70s Malarial fevers, diarrhea, dysentery, and venereal diseases were common illnesses among the military (Miller 1989: 43).

1860s–1912 The river bed at San Marcial aggraded between 12 and 14 feet due to the reduction of the Rio Grande's historic flow, which had, before, scoured out the stream channel (Clark 1987: 205).

1870 By this year, silt and sand from arroyo runoff were adversely impacting irrigable lands on the end of the Galvan-Sanchez-Sandoval grant near San Ysidro. Some members of these

families were forced to move due to the loss of these arable lands. The silt deposits probably resulted from intensive grazing of sheep and goats and resulting erosion on surrounding uplands (Swadesh 1978: 46–47).

1870 Wildfires were common and widespread (Swetnam and Baisan 1995: 18).

1870 Based on tree-ring evidence, a forest fire occurred on the Pajarito Plateau (Robinson 1990: 142).

1870 Jose L. Perea and Mariano Otero grazed over 24,000 sheep in the Cabezon-Bernalillo area (Maes and Fisher 1937: 11).

1871 (July) "Chinch" bugs were damaging cabbage plots in the Albuquerque area. A priest suggested sprinkling lime water on the infested plants, which apparently was successful (Steele 1983: 84).

1871 Mice were causing so much damage to food and clothing at military posts that the Quartermaster General issued orders to keep rat terriers and cats around storage areas (Miller 1989: 231).

1872 (August 19) The Santa Fe River flooded near Santa Fe with a flow that probably exceeded 1,000 cfs (US Geological Society 1994).

1872 J.H. Beadle (1973: 486, 488) described the mesa above San Felipe Pueblo as "treeless" and grassless." He compared the Middle Rio Grande Valley to the Nile.

1873 Bighorn sheep were common in the Sangre de Cristo Mountains northeast and east of Santa Fe and Taos (Bailey 1971: 16–17; Barker 1953: 88).

1874 (pre) Informants stated that there had been two varieties of buffalo in New Mexico; one lived on the plains, and the other inhabited the mountains (Bailey 1971: 15).

1874 The Rio Puerco channel at La Ventana was about 8 feet deep (Dortignac 1963: 507).

1874 Elk were reported on a high plateau near Tierra Amarilla (Henderson and Harrington 1914: 16).

1874 A shovelnose sturgeon (*Scaphirhynchus platorynchus*) was taken from the Rio Grande near Albuquerque. No other specimens have been reported since (Koster 1957: 23).

1874–75 Severe arroyo cutting had begun by these years as a result of overgrazing and droughts (Harris et al. 1967: 11).

1874–98 Prairie dog and jack rabbit populations generally increased on regional rangelands due in part to the widespread killing of wolves and coyotes by ranchers, homesteaders, and government trappers. As rangelands were overgrazed, prairie dog and rabbit populations were forced to move onto previously unoccupied areas and compete with livestock for the grass there. Less desirable range plants, such as cactus and thorny shrubs, spread due to the overgrazing and drought (Smith 1899: 14–15).

1875 (March 3) The Right of Way Act provided for a 200-foot right-of-way for railroads and 20 acres for station grounds every 10 miles across public domain (Westphall 1965: 93–94).

1875 Joseph Rothrock, south of Gallup reported the following: "Gaining the summit a thousand feet above Fort Wingate, we were at an altitude of about 8000 feet above the sea, a fine, open, park-like region with a large growth of yellow pine (*Pinus ponderosa*) and fir covering the hillsides. A diversified herbaceous vegetation was out in the most brilliant colors, beautifying alike the woods and open grounds.... Good forage was abundant" (Cooper 1960: 130).

1875 The Rio Puerco channel at San Luis was shallow; a low irrigation dam of "brush and poles" easily diverted water from the stream (Tuan 1966: 588–589).

1875 Bears, probably both black and grizzly, were reported as common in the Sandias. Placitas area herders and their goats and sheep were sometimes attacked by bears, but being poorly armed, the herders usually let one or two of their animals be taken (Batchen 1972: 49–50).

1875 (ca.) Most bajadas were still covered by grassland, but intensive livestock grazing, followed by soil erosion, and later fire suppression, resulted in three changes—reduced grass cover, the invasion of juniper from the adjacent woodlands, and the proliferation of desert shrubs (Dick-Peddie 1993: 29).

1875–85 The volume of silt in the Middle Rio Grande Valley peaked (Hedke 1925: 28).

1876 (to ca. 1880) The Rio Puerco channel near Cabezon was shallow, and a road crossing was marked with large logs laid parallel (Bryan 1928a: 273).

1877 The Rio Puerco near San Luis was described as having "high banks marked by recent caveins and falling trees." An older stream channel was situated to the east (Bryan 1928: 268).

1877 The Rio Puerco near Guadalupe was between 26 and 29 feet wide (Bryan 1928a: 275).

1877 A military officer with the U.S. Geographical Exploration and Survey reported that elk, once plentiful in the Jemez and Ortiz mountains, were rarely seen (Henderson and Harrington 1914: 2).

1877–78 (summers) Grasshopper infestations destroyed most of the wheat in the Taos Valley (Miller 1988: 157).

1878 Based on tree-ring data, a forest fire occurred on the Pajarito Plateau (Robinson 1990: 142).

1878 J.W. Powell issued his *Report on the Lands of the Arid Region of the United States,* in which he observed that there was more potentially irrigable lands than the water necessary to irrigate them (Worster 1985: 133).

1878 A young bear was killed by a sheep herder on the north end of the Sandias while attempting to eat the herder's cheese (Batchen 1972: 67).

1878–79 Native Americans (Pueblo?, Jicarilla Apache?) were burning forests and woodlands in northern New Mexico to drive deer down into canyons where they could be more easily hunted (Cooper 1960: 138).

1879 (summer) The Rio Grande ceased flowing from Albuquerque to El Paso due to diversion from the river by farmers in southern Colorado (Miller 1989: 69).

1879 John Wesley Powell believed the sole major problem inhibiting maximum timber production in the western forests was fire (Cooper 1960: 137).

1879 Regional fires were common and widespread (Swetnam and Betancourt 1990: 1019).

1879 A resident of Laguna stated that extensive cutting of timber for railroad ties or locomotive fuel had occurred in the area. He also noted that those forests in the Santa Fe area had been "destroyed" (U.S. Lands Commission 1880: 455–458).

1879 Commercial mining of the lead-zinc veins in the Cerrillos district began (Elston 1961: 155).

1870s As El Paso's population increased significantly, using more and more water, the level of the Rio Grande began to fall. The major cause, discovered later, however, was the diversion of the river's waters by numerous new settlers in southern Colorado, who had been lured to the area by the Denver and Rio Grande Railroad (Sonnichsen 1968: 382).

1870s Bear, deer, blue grouse, and turkey were plentiful in the Sandia Mountains. Pronghorn antelope were common on the foothill and bajada grasslands. Increase in the number of hunters and the availability of better weapons, resulted in the depletion of these game animals by the end of the decade (Batchen 1972: 64, 66).

1870s Bears were relatively common in Canon de Agua, at the north end of the Sandia Mountains (Batchen 1972: 67–68).

1870s The Rio Puerco was described as "without a deep channel" and having "large groves of cottonwood trees, high grass, and weeds." A small bridge spanned the river near Cabezon, and a diversion dam of cottonwood logs, limbs, and poles was constructed for irrigation at San Luis (Bryan 1928a: 273).

1870s (late) Mariano Otero brought 25,000 to 30,000 pounds of corn annually at Cabezon (Maes and Fisher 1937: 14).

1870s (late) Intensive hunting of deer in the north end of the Sandias forced the last of these animals to take refuge around Osha Springs (Batchen 1972: 66).

1870s–80s Hispanic farmers, would-be colonists, and Anglo miners from Pena Blanca and La Jara moved onto the Espiritu Santo land grant, hoping to use water from the Rio Puerco to irrigate their crops (Bayer et al 1994: 158–159).

1870s (to about 1900) Good harvests of wheat, corn, and beans were realized along the Rio Puerco, and "natural hay" was cut for local use or sold in Albuquerque (Bryan 1928a: 278).

1870s (to early 1900s) Fires on Anglo rangelands were suppressed by a "beef drag," slaughtering the nearest steer, splitting it, attaching forelegs to one saddle horn and the hind legs to another, then dragging the carcass, with loose skin flopping behind, along the edge of the fire. Back fires were begun by dragging a rope soaked in kerosene and ignited, especially along cow trails. Fuel breaks, or "fire guards," were sometimes made by plowing two or three strips about 100 feet apart (Pyne 1982: 93–94).

1880 (pre) The flow of the Rio Grande was sufficient to scour sediment from its channel. After this year, the stream bed began to aggrade due to continued decreasing flow and increasing silt load (Harper et al. 1943: 49).

1880 (pre) Las Vegas residents got their water from the Gallinas River, but with the formation of the Agua Pura Co., water was piped from a small reservoir on the river. This water soon became "dirty" compared with the clear, clean water from the free-flowing river (Perrigo 1982:28).

1880 (pre) Deer, bighorn sheep, and turkeys were common in Frijoles Canyon (Lange and Riley 1966: 167).

1880 (pre) Cochiti Pueblos hunted buffalo in the Estancia Valley. Hunters from this village also "trapped" pronghorn and deer in a tributary canyon of the Rio Grande above present Cochiti Dam (Lange 1959: 130).

1880 (spring-summer) There were some 10,000 acres under irrigation in the upper Rio Puerco valley (Cuba to Casa Salazar) (deBuys 1985: 217).

1880 (April 15) The Territorial Bureau of Immigration was organized. "Valuable mines of gold and silver" and ranges "capable of producing sheep for the million" were extolled (Bureau of Immigration 1881: 7–8, 53).

1880 (October 14) Adolph Bandelier noted that the vegetation below, or south of, the La Majada Mesa was more "destitute" than that on the mesa (Lange and Riley 1966: 145).

1880 (October 25) Bandelier encountered some Cochiti Pueblo men who had been gathering zacate, or popote, grass (*Stipa* sp.) on the Potrero de las Vacas for making into brooms. This area was also utilized for pinyon nut gathering (Lange and Riley 1966: 170–172).

1880 (October 25) Bandelier observed that most game, including bears, was "abundant" in the Jemez Mountains (Lange and Riley 1966: 170–172).

1880 By this date, the flow of the Rio Grande had been so reduced by upstream use that irrigation systems and hundreds of acres in the Mesilla Valley-Las Cruces area were abandoned (Wozniak 1987).

1880 The flow of the Santa Fe River had become insufficient for the needs of Santa Fe residents. Reservoirs had to be constructed and wells drilled in this century to meet community needs (Thomas et al. 1963: D–10).

1880 Cottonwoods (common?) were found in and around Pena Blanca (Lange and Riley 1966: 91).

1880 A major flood occurred along the Rio Puerco (US Geological Survey 1994).

1880 Some 64,034 acres of forests burned regionally (Ensign 1888: 82).

1880 By this year bighorn sheep were extinct in the Jemez Mountains (Hewett and Dutton 1945: 105). This species was an important source of meat and figured in ritual ceremonies and mythology (Tyler 1975: 118–131).

1880 A resident of Santo Domingo Pueblo related that bighorn sheep "were driven out of the Sierra del Valle, etc., by the Apache" (Lange and Riley 1966: 94).

1880 The New Mexico Territorial Assembly passed an act to protect the buffalo, but this species was virtually exterminated by this date, and enforcement of the statute was impossible (Gard 1960: 26).

1880 The Santa Fe railroad line was constructed a few miles east of the Rio Grande because company officials thought the land in the valley north of Albuquerque was too soft to adequately support the tracks (McDonald 1992: 12).

1880 White wine and hand-cut hay was being sold at Cabezon (Rittenhouse 1965: 64).

1880 Los Lunas residents Louis and Henry Huning and Solomon and Tranquilina Luna ran 60,000 to 70,000 sheep and over 150,000 cattle, respectively (Roberts 1963: 9).

1880 A fish and game law was passed by the Territorial Legislature that made it a misdemeanor to take fish by use of drugs, explosives, or artificial obstructions. Trout could be taken only by hook and line. Operators of mills or factories could not discharge any waste harmful to trout. Commercial sale of fish was also limited (Clark 1987: 32).

1880 Commercial mining of sandstone copper deposits began in the Nacimiento Mountains (Elston 1961: 155).

1880 Mining of the fluorspar-barite-galena veins in the Placitas district occurred (Elston 1961: 160).

1880 (ca.) Jose Antonio Padilla and his family moved from Belen to Rito Quemado, located west of Magdalena. The creek was so-named either because of the sagebrush and rabbitbrush had been burned off by Indians or because of the volcanic landscape in the area (Pearce 1965: 128).

1880–85 Bandelier (1892: 150) reported that black bears climbed into the top of pinyon trees in search of nuts in the Jemez region.

1880–87 EuroAmerican settlers moved onto the public lands that became the Jicarilla Apache Reservation in 1887. Overgrazing decimated much of the rangeland. All of the arable lands and surface water were claimed as well (Tiller 1992: 87–97).

1880–91 Several trading posts and a general store were operating in Cabezon, serving local residents, travelers on the Star Line Route, Navajos, and area Pueblos. Calico, other fabrics, "fancy" metal buttons, perfume, tobacco, tools, candy, cookies, coffee, sugar, and flour were sold or traded. Navajos brought weavings, jewelry, and sheep to trade for these goods. Two Hispanic residents owned herds of 16,000 and 10,000 sheep. The first also owned 2,000 cattle. By 1891 the village residents owned enough sheep to fill 17 freight wagons with wool (Rittenhouse 1965: 16–17, 31, 33, 36–39, 64–67, 70, 79).

1880–91 Trout were common in Frijoles Creek, which was described as a "gushing brook, enlivened by trout." The stream also had "many pools . . .," which were nonexistent by 1910 (Henderson and Harrington 1914: 54).

1880–98 Poor drainage and alkaline build-up caused abandonment of farmlands in lower areas. There were about 75,000 acres of arable lands between Albuquerque and the mouth of the Rio Puerco, but only about one-fourth was in cultivation. Some tracts were abandoned because the farmers went to work for the Santa Fe Railroad (Follett 1898:87–88).

1880–1900 Lateral arroyos to the Rio Grande carried large quantities of silt into the acequia madre at San Pedro. An elevated canal siphon was constructed to correct this problem (Marshall and Walt 1984: 284).

1880–1905 Overgrazing removed the main source of the grizzly bear's diet—herbaceous vegetation. For survival they turned to predation of livestock (Brown 1985: 100).

1880–1910 The combined population of Casa Salazar and Guadalupe averaged 359 persons; about the same number was recorded for Cabezon-San Luis (Garcia 1992: 5).

1880–1924 The Rio Grande river bed aggraded 7 feet at the Isleta bridge, 8 feet near San Antonio, and 9 feet at San Marcial (Sullivan 1924: 7).

1880–1925 Increasing volumes of silt were due to decreasing flows of the Rio Grande and overgrazing and subsequent erosion in the Upper and Middle River basins (Hedke 1925: 11).

1880–1929 The bed of the Rio Grande began to aggrade and subsequently the river bed was 2–3 feet above the level of San Marcial. The construction of Elephant Butte dam and reservoir and dense growth of tamarisk and other riparian vegetation increased the volume of silt deposition from 1915 to the 1920s. The August 1929 flood destroyed the adobe and frame structures and buried the village in silt (Calkins 1937a: 9–10; Marshall and Walt 1984: 283–284).

1880–1940 Livestock grazing, farming, mining, and other land use resulted in deterioration of land, which caused some settlements to be abandoned in the Middle Rio Grande Basin. The carrying capacity of rangelands decreased 50 to 75 percent during this period (Kelly 1955: 308).

1880 (post) Extensive clear-cutting on the Rio Chama drainage, primarily on private lands, removed the ponderosa pine forest (Harper et al. 1943: 55).

1880 (post) The Chili Rail Line, completed south from Colorado to Espanola, carried sheep, cattle, hogs, pinyon nuts, apples, mica, quartzite, lepidolite, and mica from northern New Mexico (Gjevre 1969: 18–19).

1881 Santa Fe completed a piped-water system, which included damming the Santa Fe River above town (Simmons 1992:206).

1881 There were no trees growing along the Santa Cruz River near the town of the same name (Kessell 1980: 87).

1881 The railroad extended rail construction across the Zuni reservation, and contract lumbermen built logging roads and cut "tens of millions of board feet of lumber" on the Zuni River watershed (Hart 1991: II/3).

1881 A "sacred grove" of cottonwood trees, about 2 by 0.5 miles, was located near Taos Pueblo (Nims 1980: 95).

1881 The San Luis Valley had "a profusion of wild geese and ducks" and "swans, also, are found there, and white brant, or snow geese, as well as sand-hill cranes" (Nims 1980: 126).

1881 A. Bandelier reported that beaver were common along the Rio Grande in the Pena Blanca area; much less common here were river otters. However, he noted that both species were more abundant in the Valle Grande (Lange and Riley 1966: 214).

1881–83 The last native elk in the Sangre de Cristo Mountains northeast of Santa Fe were observed or reported (Barker 1953: 88). Elk were extirpated in these mountains by settlers, miners, and market hunters (deBuys 1985: 280).

1881–84 A hunter and specimen collector found beaver dams common near the headwaters of the Pecos River. In the pools formed behind the dams he found the "best trout fishing of any locality I have ever visited in the Rocky Mountains" (Bailey 1971: 214).

1882 (July 13) The Santa Fe River, carrying high water, flooded part of the valley across the Rio Grande from Cochiti (Lange and Riley 1966: 339).

1882 Bandelier noted that the Rio Grande was "treacherous" and divided into five narrow and swift-running branches at Pena Blanca. Also, he observed that the river "changes its bed almost daily" (Lange 1959: 79–80).

1882 There were a "considerable number of bears" in the Manzano Mountains (Lange and Riley 1966: 383).

1882 The General Land Office in Washington, D.C., ruled that "when a mountain was a boundary [of a land grant] the summit was to be taken as the dividing line, unless otherwise indicated" (Ebright 1994: 239).

1882 A. Bandelier recorded the exotic *Ailanthus*, or tree-of-heaven, growing at the plaza of Ojos Calientes, 3 miles from Socorro (Lange and Riley 1966: 318).

1882–1900 Coal production in Santa Fe County increased from 3,600 tons to 252,731 tons (Elston 1961: 155).

1880s (early) The Newhouse, steel leghold no. 6, grizzly bear trap was first used (Brown 1985: 114).

1880s (early) Elk were extirpated in the Jemez Mountains by commercial hunters working for the "Chili" Railroad and local subsistence hunters (Scurlock 1980: 31).

1883 (pre) Taos Pueblo hunters reported there were two kinds of bison—a smaller variety in the mountains and a larger one on the Southern Plains in the past (Bailey 1971: 14–15).

1883 (March) A. Bandelier described the Agua Azul spring near Grants as "A large pool of deep, crystalline water, extensive enough to allow skiffing, and many ducks in it" (Lange and Riley 1970: 64).

1883 (November 1) Bandelier (Lange and Riley 1970: 155) wrote "At Alamillo, cottonwoods cover the river bottom, and thence on they continue to beyond San Marcial, with much more vegetation besides....At San Antonio ... the east bank is exceedingly bleak and denuded."

1883 (December 21) Bandelier described the Rio Grande Valley below Rincon as "... wooded up to four miles from Rincon, 'alamos.'" He also observed open and marshy conditions (Lange and Riley 1970: 181).

1883 Texas cattleman W.C. Bishop concentrated his 3,000 cattle in Pajarito and Water canyons, which had perennial springs, on the Pajarito Plateau (Rothman 1992: 29).

1883 The Franz Huning property, south of the "castle" in Albuquerque, was "open fields with bosques, lagoons, and occasional clumps of cottonwoods dotting it" (Browne 1973: 136).

1884 (May 23-June 3) The Rio Grande shifted and cut a new channel between the Socorro railroad station and the center of town. Residents were able to divert the river back to its original channel (Carter 1953: 21).

1884 (May 31) By this time, the ongoing flood had increased the capacity of the Rio Grande channel through scouring action (Carter 1953: 19).

1884 When the Rio Grande shifted its course to the west between Los Lentes and Los Lunas, the river cut the acequia madre and left it on the east side of the river. Three other ditches "moved" from west of the river to the east side in the area (Wozniak 1987).

1884 Commercial mining of the "contact-metamorphic copper" deposit in the San Pedro Range began (Elston 1961: 155).

1884–1957 Brick and tile were made at the old State Penitentiary near Santa Fe. The raw material used in making bricks was shale mined from a deposit east of Palace Avenue (Elston 1961: 163).

1885 (July) The Rio Grande between Cochiti and Santo Domingo ran in three channels, with "the main channel reaching to above the knee on horseback." And, "The river is constantly encroaching on the right hand side" (Lange et al. 1975: 59).

1885 (August 1) The Rio Grande, south of Santo Domingo, was falling, and crossing was difficult due to "quicksand" (Lange et al. 1975: 75).

1885 (September 26) Adolph Bandelier described the flow of the Santa Fe River through its canyon of the same name as "like a small stream..." (Lange, Riley, and Lange 1975: 107).

1885 The main, still discontinuous, channel of the Rio Puerco had a volume of about 17,000 acre-feet (Dortignac 1960: 47).

1885 Federal involvement in predator control began when the Department of Agriculture began to study ways of poisoning rodents, pest birds, and predators (Dunlap 1984: 143).

1885 Clarence E. Dutton's geological work on the Mount Taylor and Zuni Plateau areas was published (Northrop 1961: 85).

1885–1905 Some competent ranchers and observers considered the grizzly's reputation as a stock killer undeserved, particularly on the larger ranches before overgrazing became widespread (Brown 1985: 101).

1885–1963 An estimated 600,000 to 800,000 acre-feet of sediment washed from the Rio Puerco watershed into the Rio Grande (Hay 1972: 290).

1880s (mid) Intensive hunting severely reduced pronghorn numbers; by the end of the decade they were not found on many grassland locales where they formerly were common. The pronghorn was an important meat source and played a significant role among the western Pueblos and at Hopi (Tyler 1975: 32, 42, 55–56).

1886 (April 18–20) Wind and rainstorms hit central and northern New Mexico. The Santa Fe River flooded on the 20th, and at least one bridge washed out (Lange et al. 1975: 144, 445).

1886 (September) A severe thunderstorm struck

Santa Fe, causing flooding of the Santa Fe River. High winds and hail accompanied the storm (Lange et al. 1975: 175).

1886 The Texas, Santa Fe and Northern Railroad Co. was formed to construct a rail line from Espanola to Santa Fe. A.J. Hager had a sawmill in dense timber above Santa Fe and furnished trestle timber for the line (Chappell 1969: 13–18).

1887 (pre) Residents of Los Ranchos lost their acequia due to a "rise of the river." One individual, Guadalupe Gutierrez, stated that the high water table and wetlands had been caused by "surplus water from the acequias" (Wozniak 1987).

1887 (May-July) The largest recorded fire in the Sangre de Cristo Mountains started in Tesuque Canyon. It burned north to Santa Fe Baldy and east to the Las Vegas Range, where it was stopped by a railroad tie-cutting crew (Ungnade 1972: 73).

1887 The Rio Puerco channel at Guadalupe was about 3 feet deep and 30 feet wide (Bryan 1928a: 274–275).

1887 Some 74 Acoma hunters killed 744 pronghorn antelope in 1 day near Datil (Tyler 1975: 37–38).

1888 About one-fourth to three-eighths of the forest area of Rio Arriba County had burned (Ensign 1888: 145, 148).

1888 An unidentified species of catfish, weighing from 75 to 100 pounds, was being caught in the Rio Grande near Rincon (Schlissel et al. 1989: 159).

1888 The river was dry at Socorro (Hedke 1925: 26).

1888 Citizens from southern New Mexico and El Paso organized a company that advocated the construction of a reservoir on the Rio Grande, above the Palomas Valley. From the reservoir they wanted water to be conveyed to the Mesilla and El Paso valley to relieve their shortages of irrigation water. By this year, irrigated acreage along the Dona Ana ditch decreased form an initial 7,000 acres to about 4,600 (Wozniak 1987).

1888–91 John W. Powell, head of the U.S. Geological Survey, initiated irrigation surveys in river basins of the West. The Rio Grande was studied in 1889–1900, which also included surveys for reservoir sites (Wozniak 1987).

1888–1913 The total capacity of acequias diverting water from the Santa Fe River was 117 cfs. Flow of the river was affected by the 4,000-acre-foot capacity reservoir located above the town. This structure enabled "much of the flood water to be utilized for irrigation which would otherwise flow to the Rio Grande." River flow only reached the Rio Grande during floods (Follansbee and Price 1915: 424).

1889 (January 31) Springs used by the village of Tome were protected by territorial legislation (Clark 1987: 29).

1889 Legislation was passed to create fish wardens in every county to assist county sheriffs and commissioners in enforcing the fish laws, including a closed season of fishing, except fishing by members of needy families. The law also directed that a sluice for passage of fish had to be maintained at all dams or other obstructive facilities constructed for purposes other than irrigation. Also, operators of mills or factories could not discharge waste of any kind, injurious to trout, into any stream (Clark 1987: 32).

1889–1930 A few river otters were recorded near Espanola, Rinconada, and Cieneguilla (Bailey 1971: 324).

1880s Due to overgrazing and logging in the Zuni Mountains, the upper Zuni watershed began to seriously erode (Hart 1991a: II/3).

1880s A large fire burned for weeks in the mountains above Santa Fe until it went out on its own (Tucker and Fitzpatrick 1972: 49).

1880s Trout were reported in Rito de los Frijoles (Hewett and Dutton (1945: 118–119).

1880s With most of the prey animal populations decimated, wolves became dependent on livestock for sustenance (Brown 1983: 31).

1880s Meat from a deer killed near the Ellis Ranch in the upper Las Huertas drainage was sold in Madrid for $13 due to the scarcity of wild meat (Batchen 1972: 66).

1890 (about July 14) Charles Lummis described the feast day dance at Santo Domingo as taking place during a "furious sand-storm" of 2 hours, followed by an intense rainstorm that ended the dancing (Lange 1959: 344).

1890 J.W. Powell (1891: 271) reported "From Albuquerque to San Marcial, drainage of the lower of the Rio Grande Valley is exceedingly poor. Many ponds, some of them 8 or 10 acres in extent, are full of water during the early part of the year, and others show by the alkali coating on their sides and bottoms that the water has but recently left them."

1890 The soil at Santa Ana Pueblo was "sandy and untillable"; the village had been "long since abandoned" and was only used "for autumn and winter residence." There was a single cottonwood tree at the old pueblo. Beyond the

Jemez River, to the south, there were "undulating plains of wind-swept sands, dotted by stunted cedars growing at intervals, and often forming the nucleus of new mounds during wind storms" (Poore 1894: 431–432; White 1942: 29).

1890 From just north of Albuquerque to Los Lunas the valley was "bordered by barren hills of blown sand" (Powell 1891: 271).

1890 Market hunters killed the last elk in northern New Mexico (Barker 1976: 107).

1890 The American Turquoise Company began mining operations in the Cerrillos area (Elston 1961: 155).

1890–91 According to J.W. Powell (1891: 272), a number of houses in the low-lying areas of the valley south of Los Lunas "have fallen in by the sinking of the foundations. A large part of the valley ... is overgrown with cottonwood thickets or bosques, as they are called."

1890–91 On the east side of the river, below Bernalillo and Belen, once productive fields were "alkali flats" caused by a "lack of drainage" (Powell 1891: 270).

1890–91 Powell (1891: 270–271) described the Rio Grande: "The river from Pena Blanca to San Marcial occupies a broad sandy bed, dividing in low stages into a number of narrow and crooked channels, but in flood covering in many places nearly half of the valley."

1890–91 Drainage of the low-lying valley land from Albuquerque to San Marcial was "exceedingly poor." Numerous ponds, 8 to 10 acres in size, were full of water during the early part of the year. Extensive deposits of alkali along the valley between Los Lunas and Belen appeared as "light snow" (Powell 1891: 271).

1890–91 Low-lying ditches in the Tome-Los Lunas area were subject to "frequent overflow" and "being washed out or being filled with silt" (Powell 1891: 271).

1890–95 The Rio Puerco Irrigation Company constructed masonry and earthen dams, canals, acequias, and pipelines from below Cuba, south to the Lagunitas land grant. Before the system was fully operational, flash floods washed out the dams (Dortignac 1962).

1890–1900 The deepening Rio Puerco channel became a problem for irrigation farmers in the Cabezon area (Bryan 1928a: 274).

1890–1900 A trapper took wolverines "in considerable numbers" on the headwaters of the Rio Grande (Warren 1942: 68).

1890–1904 In areas of rugged terrain, homesteaders herded goats, which resulted in the overgrazing of the steepest slopes (Brown 1985: 98).

1890–1906 Deer, rabbits, blue grouse, wild turkeys, eagles (probably golden), and mourning doves were common in the Bosque Peak area of the Manzano Mountains (McDonald 1985: 22).

1890–1915 Most wolves killed during this period were killed because of the widespread use of bounties (Brown 1983: 43).

1891 Some 12 million acres of forest burned in the Sangre de Cristo Mountains (Ungnade 1972: 48).

1892 The Rio Grande flow was depleted as far upstream as Los Lunas (Hedke 1925: 26).

1893 (pre) Santa Ana Pueblo was abandoned in the spring and summer due to poor fertility of farmlands and high winds. Farming was practiced at Ranchitos on the Rio Grande. The village was reoccupied in the fall and winter. Santa Ana cattle grazed on the mesa above, but there was little grass. Duning was caused by lack of vegetative cover and high winds. Coyotes and rattlesnakes were common in this area, which was "dotted by stunted cedars growing at intervals, and often forming the nucleus of new mounds during wind storms" (Poore 1894: 108).

1893 Based on tree-ring data, a forest fire occurred on the Pajarito Plateau (Robinson 1990: 142).

1893 The agricultural fields of Sandia Pueblo were located below the village. The acequia madre began at the Rio Grande, 2 miles above the pueblo. Large cottonwoods grew along most of the length of the ditch. Several large islands, rising about 6 feet above the river level, and covered by "groves of cottonwood and willows," were located below Sandia. The uppermost island was some 700 acres in size (Poore 1894: 111).

1893 By this year the exotic cheat grass had spread across much of the state (Frome 1962: 253).

1893 San Felipe Pueblo had extensive agricultural lands along the Rio Grande. Perhaps the most productive was located a mile south of the village, where the Rio Grande divided. An "island" of loamy soil, 1.5 miles long and about a third of a mile wide, was found at this location (Poore 1894: 110).

1893 A large island "overgrown by cottonwood trees" in the Rio Grande at Santo Domingo served the pueblo as a "park." The valley was 1 to 1.5 miles in width here, and the pueblo lands occupied a 5.5-mile reach. The old church and many houses were destroyed in recent years. Some orchards and "small plots"

of corn and vegetables were located on the east bank of the river, but low-lying tracts of land were not being farmed due to threat of flood damage. Santo Domingo had about 1,200 horses, 1,200 cattle, some oxen, and a few goats. The horses ranged on land covered with sagebrush, south of the cultivated lands (Poore 1894: 109–110).

1893 The legislature passed the Territorial Bounty Act, authorizing counties to pay bounties on "predatory wolves, big bears [grizzlies], mountain lions, bobcats and coyotes" (Brown 1983: 43).

1893 The New Mexico Territorial Legislature passed a law allowing counties to raise money for paying "wolfers" and other predator hunters for their services (Burbank 1990: 98).

1894 (October) The first confirmed report of Russian thistle in New Mexico was made (Wooton 1895: 3).

1894 Zia Pueblo lacked adequate potable water owing to the salinity of the Jemez River (White 1962: 54).

1894–96 San Francisco and San Ignacio on the Montano grant in the Rio Puerco basin were abandoned (Bryan 1928a: 276).

1895–1924 The mean flow of the Rio Grande at Buckman was 1,444,000 acre-feet (Hedke 1925: 37).

1895 (pre) Native grasses, watered by overbank flooding of the upper Rio Puerco, were cut and dried for use as hay. Some of this hay was hauled to Albuquerque and sold (Bryan 1928a: 278).

1895 By this year virtually every acre of available grassland in the region was stocked with sheep or cattle. Rangelands that should have been stocked with one cow on every 40 acres were stocked with four animals (Barnes 1926: 7).

1896 Ditches with a capacity of 406 cfs were diverting water from the Rio Grande between Embudo and Buckman (Follansbee and Dean 1915: 120).

1896 The irrigation ditches between Buckman and San Marcial diverted an estimated capacity of 1,779 cfs of water from the Rio Grande (Follansbee and Dear 1915: 141).

1896 There were about 105,000 acres of irrigated acreage in tributary drainages of the Rio Grande (Dortignac 1956: 30).

1896 There were some 14,000 acres under irrigation along the main stem of the river above the Middle Valley (Dortignac 1956: 30).

1896 Drought and increasing use in the San Luis Valley caused a decline in irrigated farmland in the Middle Rio Grande Valley to 32,000 acres (Wozniak 1987).

1896–1910 Irrigated acreage in the Rincon Valley decreased from nearly 10,000 acres to less than 4,500 acres due to shortages of irrigation water (Wozniak 1987).

1897 The Organic Act authorized the sale of timber on forest reserves, granted local residents free use of timber and stone on these lands, set forth broad directions for management of the reserves, and appropriated funds to regulate them (Clary 1986: 2, 29).

1897 Otero gave out 60,000 sheep on a partido basis in the upper Rio Puerco basin (Maes and Fisher 1937: 14–15).

1897 The Santa Rosa de Cubero acequia, located between San Felipe and Santo Domingo pueblos, had disappeared due to a change in the course of the Rio Grande (Wozniak 1987).

1897 The first game laws to regulate hunting of meat animals such as mule deer were passed by the Territorial legislature. Nevertheless, populations continued to decrease to less than 20,000 animals statewide by 1924. Two years later a bag limit of one buck deer was set (Findley et al. 1975: 329; Huey et al. 1967: 42).

1898 About 19 percent of New Mexico was forested according to a USGS study (Baker et al. 1988: 34).

1898 There were an estimated 70,000 wolves in the territory (Bennett 1994: 200).

1899 A surveyor described a "new channel" of the Rio Puerco at Cabezon that was 198 feet wide. Seven years later the channel at the same location was 244 feet wide and 20 feet deep. These changes were attributed, in part, to land use activities by residents of the area (Bryan 1928a: 271–273).

1899 (ca.) Irrigation farming on the Cieneguilla grant ceased (Pratt and Snow 1988, chapter 4: 46).

1890s Widespread forest fires, probably started by railroad operations or ranchers creating meadows, burned in the mountains between the lower Chama River and the Colorado border, west of the Rio Grande (McDonald 1985: 122).

1890s The Newhouse steel trap, with a double-spring and offset jaws, sometimes with teeth, proved to be very effective in catching wolves (Burbank 1990: 99).

1890s (late) Bighorn sheep were exterminated in the Sandia Mountains (Pickens 1980: 83).

1800s (late) The Mexican Government complained to the U.S. Government about shortages of irrigation water at Ciudad Juarez. The Mexi-

cans advocated construction of a reservoir in the narrows of the Rio Grande above El Paso. New Mexicans did not support this site location (Wozniak 1987).

1800s (late) Two grizzly bears charged into a flock of sheep in the Pecos high country, and the herder shot one of the bears and wounded the other. This animal turned and mauled the young man, who was able to kill the bear with a knife (Barker 1953: 193–194).

1800s (late) All five races of southwestern wolves were extant in the state (Brown 1983: 24–25).

1800s (late) (to early 1900s) Florence Merriam and Vernon Bailey conducted research and wrote a number of books on the birds and mammals of New Mexico (Ligon 1961: 11).

1800s (late) (to early 1900s) Brook trout were introduced into the Rio San Jose near Laguna, then into the Rio Grande and drainages in the territory (Sublette et al. 1990: 72).

1800s Mosquitoes caused widespread malaria in the area (Stanley 1966: 13).

1900 (pre) "A good cover" of galleta, blue grama, and alkali sacaton grasses was found over much of the Rio Puerco watershed (Dortignac 1963: 508).

1900 (pre) Fires created extensive stands of aspen, ponderosa pine, and Douglas fir in the upper montane coniferous forest zone, about 8,000–10,000 foot elevation (Dick-Peddie 1993: 58).

1900 (pre) Native trout disappeared from El Rito de los Frijoles on the Pajarito Plateau (Hewett et al. 1913: 35).

1900 (pre) Before the construction of major dams on the Rio Grande, an estimated 75 billion pounds of sediment was carried annually in irrigation systems and floodwaters. This silt was rich in phosphate, potash, and nitrogen (Simmons 1991b: 69, 77).

1900 (pre) An old San Ildefonso man claimed he had hunted antelope on the eastern side of the Pajarito Plateau (Hewett and Dutton 1945: 108).

1900 May The Lacey Act, ending market hunting for pelts, plumage, eggs, meat, and so forth, and outlawing illegal importation of foreign wildlife, was passed by the U.S. Congress (Matthiessen 1964: 172).

1900 May A jaguar was trapped near Grafton in Socorro County (Bailey 1971: 283).

1900 Extensive use of cottonwoods for fuel, construction, and livestock feed in the Middle Rio Grande Valley had subsided by this year (Dick-Peddie 1993: 151).

1900 In precinct 12, "Lower Tome," there were 593 residents. In precinct 29, "Upper Tome," there were 325 residents (U.S. Census Bureau 1900).

1900 The decrease in rangeland productivity due to overstocking and overgrazing over the previous 4 decades began. The number of head of livestock continued to increase to a high of 177,000 animals in 1930. By 1935 the total had dropped to 54,000, but it began to increase again after the 1930s drought (Dortignac 1956: 59–60).

1900 There were 533,000 head of livestock grazing in the Middle and Upper Rio Grande basins (Hay 1972: 290).

1900 By this year residents in the Mesilla Valley were promoting the Elephant Butte site for construction of a dam and reservoir. The Reclamation Service favored this site and began studies (Wozniak 1987).

1900 By this year beaver had been virtually exterminated by trappers and hunters in all of the territory's mountain ranges (Findley 1987: 86). Also by this year, elk became extinct in southern New Mexico, primarily as a result of commercial and sport hunting (Findley et al. 1975: 328).

1900 A huge swarm of grasshoppers descended on Bland Canyon, drowning in the stream and polluting the water. Reportedly, they were piled over a foot deep along the stream's banks, and residents of Bland were forced to dig out springs for their drinking water (Sherman and Sherman 1975: 13).

1900 Thomas A. Edison tried unsuccessfully to work the Old Placers deposits using a dry method of extraction (Elston 1961: 155).

1900–10 Overgrazing and logging on the Zuni River watershed accelerated soil erosion (Hart 1991a: II/3).

1900–10 Black bears were reported as common in most mountain ranges in New Mexico. Grizzlies were less common, but they still inhabited the more remote mountains (Bailey 1971: 349–368).

1900–16 Non-Pueblo grazing and road-building, as well as overgrazing and timber cutting on adjacent lands, damaged Santa Ana Pueblo lands (Bayer 1994: 183–185).

1900–26 Construction of railroads, bridges, and dikes and levees prevented the Rio Grande channel from shifting (Rodey and Burkholder 1927: 15).

1900–41 Only a few records of the river otter were recorded in southern Colorado, where populations were more common in the 19th century (Warren 1942: 72).

1900–50 The ponderosa forests on the east side of the Sandia Mountains disappeared due to logging and fire suppression (Baisan 1994: 2).

1900 (ca.) Fire suppression, which began about this time, resulted in an increased proportion of Engelmann spruce and corkbark fir in the subalpine coniferous forest zone, 9,500 to 12,000 feet elevation (Dick-Peddie 1993: 51, 56).

1900 (post) Pinyon-juniper woodlands spread at lower elevation ecotones onto grasslands during this century as a result of fire suppression, livestock grazing, and other factors (Dick-Peddie 1993: 91–92).

1902 The first Yellowstone cutthroat trout were introduced into northern New Mexico (Sublette et al. 1990: 56).

1902 The last Rocky Mountain bighorn sheep in the Taos Mountains was shot. This subspecies had been reported as abundant a quarter of a century before this event (Bailey 1971: 17).

1903 (summer) Elliott Beatty and two companions caught 438 trout in 6 hours from the Valdez Creek and the Mora River (Barker 1953: 54–56).

1903 By this year Russian olive had been introduced at Mesilla Park (Freehling 1982: 10).

1903 Gray wolves were "fairly common" in the Manzano Mountains (Bailey 1971: 309).

1903 Mountain lions were reported as common on the headwaters of the Pecos River (Bailey 1971: 286).

1903 Black bears were relatively common along the headwaters of the Pecos River (Bailey 1971: 352).

1903 Bighorn sheep were seen for the last time in the Truchas Peak area (Barker 1953: 88).

1903 The last bighorn sheep were extirpated in the Sangre de Cristo Mountains. Competition with domestic sheep for grazing, diseases transmitted from the domesticated to the native sheep, and hunting were the primary causes of their demise (deBuys 1985: 280).

1903–04 Intensive trapping of beaver occurred along the Rio Grande north of Santa Fe (Bailey 1971: 215).

1903–06 Black bears were reported as common in most mountain ranges in New Mexico (Bailey 1971: 350–351).

1903 (and 1905, 1909) The Territorial Legislature passed acts authorizing counties to levy taxes to be used for paying bounty claims on predatory animals (Hagy 1951: 91).

1904 (pre) There was no bosque at Corrales except at one location (Eisenstadt 1980: 13).

1904 (October 11) A peak discharge of 50,000 cfs occurred on the Rio Puerco (Snead and Reynold 1986: 57).

1904 There were 30,000 sheep owned by small operators grazing in the Cabezon-Cuba area. One sheepman in Cuba owned 32,000 animals, and another had 20,000 (Maes and Fisher 1937: 15, 18–19).

1904 The New Mexico Game and Fish Department was created by the Territorial Assembly (Barker 1970: 185).

1904 (ca.) A jaguar was killed on the west slope of the Caballos Mountains (Bailey 1971: 284).

1904–06 The Rio Grande carried an estimated annual sediment load of 14,580 acre-feet. A USGS employee observed "The deposition of sand and silt in the erosion basins causes frequent changes in the course of the river, so that bayous, sloughs, and oxbow lakes are common in the bottom lands" (Lee 1907: 24).

1904–06 Turquoise mining in the Cerrillos district "declined sharply" (Elston 1961: 160–161).

1905 (spring) At the north end of the Mesilla Valley, floods caused the river to move about a mile to a new channel (Lee 1907: 24).

1905 (summer) (to 1908) The Reclamation Service completed work on the Leasburg diversion structure and ditch system, which served Dona Ana, Las Cruces, and Mesilla acequias (Wozniak 1987).

1905 Between Albuquerque and Cabezon several large herds of sheep and goats were seen along the freight road. Prairie dog villages were relatively common along the route, as were associated burrowing owls, rattlesnakes, hawks, and eagles (Schmedding 1974: 90–92).

1905 Exotic trout species were introduced into the Santa Fe River (Kuykendahl 1994: 3).

1905 The Forest Service began to hire trappers to kill wolves on national forest grazing land (Dunlap 1984: 143).

1905 A few resident black bears and grizzly bears were reported in the San Mateo Range near Grants (Bailey 1971: 365).

1905–08 The freight road between Albuquerque and Cabezon traversed sand hills, clay soils, deep arroyos, and quicksands at fords. Some wagon ruts, especially on steeper grades, became arroyos (Schmedding 1974: 78–79, 88–90).

1905–15 U.S. forest rangers trapped or shot grizzly bears, wolves, and mountain lions to help maintain good relations with local ranchers and to collect bounties (Brown 1985: 123–124).

1906 A ford across the Rio Grande was in use at

Las Canas, located on the east bank of the river south of Parida (Marshall and Walt 1984: 276–277).

1906 "Cattle barons" were opposed to statehood because free-grazing on the public domain would be disallowed, and they would be forced to make rental payments to the state fund. "Lumber barons" were opposed because large timber holdings were assessed at less than 10 percent of their value (Larson 1968: 243).

1906 The Rio Puerco channel at San Luis was 20 feet deep (Tuan 1966: 589).

1906 A moderate earthquake caused severe damage to Socorro and the surrounding area (Northrop 1980: 85).

1906 The church of San Antonio de Aquinas was destroyed in an earthquake (Marshall and Walt 1984: 303).

1906 Homesteader Fred Rhea, concerned about fire in the tall grass surrounding his home on Bosque Peak in the Manzano Mountains, moved his sheep onto this vegetation and they "grazed it down" (McDonald 1985: 22).

1906 Perhaps the last grizzly bear in the Sandias was killed by Augie Ellis near the Ellis Ranch (Cooper 1989).

1906–07 A series of earthquakes occurred in the Socorro area (Sanford 1986: 19).

1907 (pre) Local Hispanics grazed cattle and cut the indigenous grasses for hay along Abo Creek (Clark 1987: 329).

1907 (January 16) An agreement between the United States and Mexico was ratified; it gave Mexico the right to divert up to 60,000 acre-feet of water from the Rio Grande for agricultural use (Hay 1972: 299).

1907 W.T. Lee (1907: 31) described the Rio Grande north of El Paso as "mainly a floodwater stream subject to great fluctuations in volume."

1907 This was perhaps the last year that the lower Rio Puerco-of-the-East was perennial (Titus 1963: 81).

1907 The first rainbow trout, an exotic species, were stocked in the Santa Clara Creek and Rio Puerco near Espanola (Kuykendahl 1994: 3).

1907 Five hundred ten coyotes were killed on national forest lands (Bailey 1971: 312).

1907–10 Snakeweed, *Gutierrezia* spp., had invaded the grasslands of the mesa and foothill zones by this time (Watson 1912: 202).

1908 (April 16) The name, Manzano Forest Reserve, was changed to Manzano National Forest (Tucker 1992: 112).

1908 (June) Elliott Barker (1953: 33) killed four grizzly bears on Spring Mountain in the Sangre de Cristo Range.

1908 The Rio Grande was dry just below Cochiti Pueblo (Harrington 1916: 101).

1908 Most of the timberland in the Manzano National Forest had been cut for ties and other railroad construction material (Baker et al. 1988: 78).

1908 Salt cedar, or tamarisk, was "commonly planted" in Albuquerque as an ornamental plant (Watson 1912: 80).

1908 The exotic brook trout was introduced into the Rio Grande at Embudo, Santa Barbara, and Pueblo (Kuykendahl 1994: 3).

1908 A $20 bounty was paid for dead bears, and up to $50 was paid for grizzly bear hides. Some 271 bobcats were killed in the national forests, and many more were harvested by trappers or killed by ranchers statewide (Bailey 1971: 293; Barker 1953: 153).

1908 W.H. Bartlett, owner of the Vermejo Park, reintroduced elk there (Barker 1953: 93).

1909 The New Mexico Territorial Legislature enacted a $15 bounty for wolves (Burbank 1990: 98).

1909 The estimated saw timber volume on national forests in New Mexico was 16,200 million board-feet (Baker et al. 1988: 78).

1909 Pronghorns were removed from the list of legally hunted game animals to afford them protection (Matthiessen 1959: 283).

1909–11 Elliot Barker (1976: 10–11, 14) observed that sheep had damaged "high elevation slopes" in the Sangre de Cristo Mountains. This impact apparently occurred because of "close herding and trailing" and repeated bedding of the sheep at the same location.

1909–11 Botanist J.R. Watson (1912: 202), following his field study of plant communities, wrote this about the adjacent uplands of the Rio Grande: "This was undoubtedly originally a grassland, and is so yet where it has not been too seriously over-grazed. . . . Now thanks to lack of scientific control of grazing, it has been invaded by the composite *Gutierrezia* ... as to merit being called a Gutierrezia formation."

1909–26 The river bed at San Marcial aggraded about 12 feet. The rising river bed caused a widening of the Rio Grande channel and encroachment on farmland from Belen south (Rodey and Burkholder 1927: 15).

1910 (pre) The housefly was introduced to New Mexico (Henderson and Harrington 1914: 59).

1910 (pre) Bighorn sheep were extirpated in the Tewa area (Henderson and Harrington 1914: 3).

1910 (August 19) A pair of bald eagles was observed in Frijoles Canyon (Henderson and Harrington 1914: 37).

1910 A pair of spotted owls nested along Frijoles Creek in the Jemez Mountains (Henderson and Harrington 1914: 37).

1910 Wild turkeys were relatively common on the east slopes of the Sandia Mountains, but only a few were found several years later (Ligon 1927: 114).

1910 Salt cedar was reported growing at Mesilla Park (Scurlock 1988: 138).

1910 Mountain lions were declared "fairly abundant" in the Carson National Forest and "very common" in the Jemez Mountains by Forest Service officials (Bailey 1971: 286).

1910 Archeologist Neil Judd reported that black bears were common in and around Frijoles Canyon (Rothman 1992: 140).

1910 (ca.) The waters of the Rio Grande commonly disappeared into its sandy bottom a short distance above Bernalillo (Harrington 1916: 101).

1910–11 Young *Juniperus monosperma* plants were spreading into the lower grasslands of the Estancia Valley (Watson 1912: 206).

1910–11 The gray wolf was seen occasionally in the Taos Mountains according to Tewa Pueblo informants (Henderson and Harrington 1914: 29).

1910–11 More than 900 permits to take beavers were issued to individuals who claimed damages to their property. At the same time, the Santa Fe Water Company was offering $50 for each pair of live beavers to transplant to the upper Santa Fe Canyon, where they would help conserve water for the city by their dam building (Bailey 1971: 219).

1910–11 Gunnison prairie dogs were reported as abundant in the Valle Grande. River otters were recorded in the Rio Grande from Taos to the Albuquerque area, as were mink. Black bears were noted as common, and coyotes were also reported as common, but the gray wolf was "very scarce" in the Tewa Pueblo area, but "occasionally seen" in the Taos Mountains. Wild horses were noted on the mesa south of Buckman (Henderson and Harrington 1914: 21, 23–29, 31).

1910–11 Carapaces of the tortoise, a common species in the Tewa area, were used to make dance rattles (Henderson and Harrington 1914: 52).

1910–11 Blue grouse and wild turkey were common in the Jemez Mountains. Western bluebirds were also common on mesa tops of the Pajarito Plateau (Henderson and Harrington 1914: 34–35, 37, 45).

1910–18 Fifty-five new irrigation ditches went into operation in the Middle Rio Grande Valley (Hedke 1925: 22).

1900s (early) The introduced tamarisk formed dense stands, especially along riparian corridors, and became a fire hazard for cottonwood-willow bosques (Pyne 1982: 187).

1900s (early) An agricultural field below Nambe Falls was abandoned and subsequently revegetated by prickly pear, cholla, junipers, pinyons, and unidentified shrubs (Ellis 1978: 62).

1900s (early) Intensive grazing, suppression of fire, and a "wet" period led to a "dramatic expansion of woody vegetation and a concomitant decay of the grass lands" (Pyne 1982: 524).

1900s (early) The Federal Government constructed reservoirs for pueblos that did not have a reliable water supply. These quickly began to silt up, resulting in a reduction of their capacities (Vlasich 1980a: 28).

1900s (early) The American Lumber Company was established in Albuquerque. Logs for the mill came from the Zuni and San Mateo mountains north of Grants (Balcomb 1980: 56).

1900s (early) By this time grizzly bears, elk, bighorn sheep, wolves, and pine martens had been exterminated by hunters and trappers in the Sangre de Cristo Mountains (deBuys 1985: 280).

1900s (early) San Felipe Pueblo was still conducting an annual rabbit hunt at this time. Clubs and rocks were used to kill the rabbits, as well as prairie dogs, gophers, lizards, snakes, and birds. Each year's hunt would take place at a new area, allowing the fauna in the previous year's area to recover (Balcomb 1980: 47–48).

1900s (early) Beavers had been largely extirpated in most mountain ranges in New Mexico (Bailey 1971: 251; Findley 1987: 86).

1900s (early) The Rio Grande beaver was extinct in the Middle Valley by this time (Huey et al. 1967: 188).

1900s (early) Sage grouse had been hunted to near extinction in the area between Taos and Tres Piedras (Pickens 1980: 83).

1900s (early) Florence M. Bailey (1928: 103, 156, 177, 180–181, 189–190, 211, 237) reported whistling swans and whooping cranes as extinct, goshawks as uncommon nesters, golden eagles as common residents in the mountains, bald eagles common in western Socorro County, peregrine falcons nesting west of Santa Fe, sage grouse common in the north until about 1908, band-tailed pigeon as fairly common in all of the high mountain ranges, and loggerhead shrike as a common nester for the study region.

1900s (early) The white-tailed ptarmigan was extirpated in the Sangre de Cristos (de Buys 1985: 280).

1911 (October) S.L. Fisher and Elliott Barker killed four male mountain lions in the Pecos District of the Santa Fe National Forest over 2 weeks of hunting. Barker (1953: 86) wrote "The two-week, thrill-packed lion hunt was over and we had four of the big male horse-and-deer-killers to our credit...."

1911 (post) Personnel from the State Engineer's Office constructed a levee to protect San Marcial from floods (Calkins 1937: 7–8).

1911–12 Salt cedar, or tamarisk, trees were being planted in Albuquerque as an ornamental. The species quickly spread over the Middle Rio Grande Valley (Scurlock 1988: 136, 138).

1911–26 Elk were reintroduced onto two Colfax County ranches, the Santa Fe National Forest, and a ranch in the Gila National Forest (Ligon 1927: 71).

1912 A new bridge connecting Alameda and Corrales was constructed, replacing the bridge destroyed in the 1904 flood (Eisenstadt 1980: 13).

1912 Apples, pears, peaches, apricots, quinces, and grapes were commonly raised in the Middle Valley. Vegetables raised included alfalfa, wheat, corn, and oats, with the first being farmed on about half the total tilled acreage. Chiles, onions, tomatoes, several varieties of beans, and cabbages were the main vegetables grown in the area (Nelson et al. 1912: 11–19).

1912 Personnel from the USDA Bureau of Soils conducted a soil survey of the Middle Rio Grande Valley. Based on field data, including soil corings, a detailed classification of soil groups, series, and types was developed. Some 1,500 borings were made to determine the depth of the shallow groundwater table under the floodplain. Crop plants, and their relationships to the water table and soil types, were also studied. The survey found that the water table ranged from 6 inches to 6 feet deep, with an average depth of 23 inches over 90 percent of the floodplain (Nelson et al. 1912: 8–9, 44–46).

1912 One-seed juniper was spreading into the grasslands of the Estancia Basin (Watson 1912: 206).

1912 "Many old abandoned river channels in the valley" had "been reclaimed and" were being "used for crops" (Nelson et al. 1912: 39).

1912 The last indigenous sage grouse in New Mexico was killed southwest of Chama. The New Mexico Game and Fish Department reintroduced the species to northern New Mexico with birds captured in Wyoming (Ligon 1961: 93).

1912–20s Access to common grazing lands previously used by La Tierra Amarilla land grantees was cut off as fencing for the Carson National Forest was initiated. The numbers of animals were reduced by implementation of permits as well. This action was taken to help restore the overgrazed, eroding forest lands (Wilson and Kammer 1989: 53).

1913 Hewett et al. (1913: 20) wrote "The Rio Grande and many smaller streams show evidence of volume formerly much greater than at present."

1913 The Rio Puerco channel at La Ventana was 15 feet deep (Dortignac 1962: 588).

1913 Vernon Bailey (1913: 74) described New Mexico's rangelands: "Many of the arid valleys in New Mexico have been for years so overstocked that the best grasses have been killed out and parts of the range rendered almost worthless. Some of the valleys show mile after mile of ground almost bare or overgrown with worthless vegetation that stock does not eat. Around most of the watering places the grass is killed for a long distance, often from 1 to 3 miles, the ground is trampled, and baked, and the little rain that falls runs down the trails and is wasted."

1913–15 The Forest Service advertised 117 million board-feet to be harvested in the Carson National Forest, near La Madera, Rio Vallecitos, and in the higher Valle Grande area. A new sawmill was put into operation at La Madera, which had a capacity of 60,000 board-feet per day (Gjevre 1969: 37).

1914 (pre) The Santa Fe Railroad operated an average of 15 locomotives to pull its transcontinental trains. Each engine had a tender that held 7,500 to 10,000 gallons of water (Worley 1965: 37–38).

1914 (pre) The Tewa Pueblos declared that the gray wolf was rare in their hunting area. They did report occasional sightings in the Taos Mountains (Henderson and Harrington 1914: 29).

1914 (pre) The Mexican bighorn sheep, a subspecies, was extirpated in the southern portion of the study region (Huey et al. 1967: 78).

1914 (June 30) The U.S. Congress authorized the Predatory Animal and Rodent Control (PARC) branch of the Biological Survey of the U.S. Department of Agriculture. Congress made this group responsible for experiments

and demonstrations in destroying wolves, prairie dogs, and other predators on livestock. Some 300 hunters were employed under this program in 1914–15 (Brown 1983: 52, 126–127).

1914 There were 8,500 acres of cultivated Rio Grande floodplain in Valencia County. An estimated 67 percent of this total was adversely affected by seepage (Bloodgood 1938: 13).

1914 A firm purchased logging rights to 117 million board-feet of timber in the Carson National Forest. Ponderosa pine and Douglas fir were the two principal species harvested and sent to the company's sawmill at La Madera (Chappell 1971: 129–130).

1914 Aldo Leopold, a Forest Service employee, joined J. Stokely Ligon of the New Mexico Game and Fish Department in a program to eradicate the wolf in New Mexico and Arizona. Leopold later reversed his view toward wolves and other predators, which he eloquently explained in *A Sand County Almanac* (Burbank 1990: 101, 107–108; Leopold 1949: 129–133).

1914 The dramatic decrease in large game animals in northern New Mexico over the preceding 3 decades was attributed to the increase in Anglo hunters, and some Native Americans, with improved rifles and ammunition (Henderson and Harrington 1914: 2).

1914 late (and April 1915) The New Mexico Cattle Growers' Association voted to pay bounties of $25 for each hide of adult wolves or mountain lions taken on the ranges of its members. The organization also passed a resolution requesting Congress to provide funds to exterminate predators on public lands (Hagy 1951: 91).

1914–16 Some 115 black bears were killed on national forests (Bailey 1971: 353).

1914–25 More than 200 rail-car loads of apples were shipped annually from the Espanola area (Gjevre 1969: 18).

1915 The village of Paraje was condemned because of the construction of Elephant Butte Dam and was subsequently inundated by the reservoir (Marshall and Walt 1984: 279).

1915 Some 108 short-term grazing leases held by non-Indians on 509 Jicarilla allotments at the southern part of the reservation were generally overgrazed (Tiller 1992: 112).

1915 The demand for beef and mutton increased sharply with the start of World War I, and grazing restrictions on the national forest reserves were relaxed (Brown 1985: 129–130).

1915 Beaver populations were increasing along the Rio Grande above and below San Marcial (Bailey 1971: 215).

1915 The Forest Service released 37 elk from Yellowstone National Park into the Pecos District of the Santa Fe National Forest. In less than 20 years this small herd increased to about 300 animals, and hunting resumed within a short period (Barker 1953: 94–95, 163).

1915 Black-footed ferrets were reported from several locales in New Mexico (Bailey 1971: 326).

1915 Some 57 wolves were killed in New Mexico's national forests (Bailey 1971: 311).

1915–16 The pronghorn antelope population reached an all-time low of an estimated 1,200 to 1,700 animals in the state. In the 19th century there were an estimated 100,000 of these animals (Barker 1970: 192; Findley et al. 1975: 334).

1915–16 J. Stokely Ligon took charge of predator control in the New Mexico-Arizona district. He hired 32 hunters and trappers, including renowned bear hunter Ben Lilly. Nineteen grizzly bears and at least six mountain lions were killed. His staff of wolf hunters also killed 69 wolves in their first year in New Mexico and Arizona. An estimated 300 wolves remained in New Mexico at the end of the year (Brown 1985: 127; Burbank 1990: 102–103).

1916 (May 12) Construction on the Elephant Butte Dam was completed, creating a reservoir 40 miles long and covering some 40,000 acres of land with 2,638,860 acre-feet of water (Writer's Work Project 1940: 21).

1916 (December) J.B. Archuletta of La Jara reported that a wolf attacked his flock of 200 sheep at night, killing 70 of the animals (Ligon 1971: 310–311).

1916 An estimated loss of 24,350 cattle, 165,000 sheep, and 850 horses, valued at $2,715,250, was attributed to wolf, mountain lion, grizzly bear, coyote, bobcat, and "wild dogs" predation (Brown 1983: 57).

1916 U.S. Biological Survey personnel killed 100 wolves. Some 117, including those taken by the U.S. Forest Service, were killed in the national forests (Bailey 1971: 311).

1916 The U.S. Forest Service initiated a predator control program in the Jemez Mountains. The gray wolf, mountain lion, and coyote were targeted for trapping (Barker 1970: 113; Scurlock 1981a: 144).

1916 One thousand eighty-four coyotes were killed in the state (Bailey 1971: 313).

1916 About 1,740 pronghorns were reported in the state (Bailey 1971: 25).

1916 The Rio Grande Commission was authorized by the State Legislature. This group was to address regional and Middle Rio Grande water problems (Clark 1987: 205).

1916 Congress passed the National Park Act leading to the creation of the National Park Service (Udall 1963: 153).

1916 The governor proclaimed arbor and bird days for the state (Robinson 1993: 34).

1916 With completion of the Elephant Butte Dam, eels (*Anguilla rostrata*) could no longer return to the Upper Rio Grande (Koster 1957: 79).

1916 (ca.) Santa Ana residents cut "pines" in the Jemez Mountains to use as vigas in a new roof on their church. They also bought rough green lumber for use as tables or ceiling slabs (Kessell 1980: 168).

1916 (post) Following completion of Elephant Butte Dam, water "backed up" the Rio Grande, contributing to water-logging of agricultural lands in the lower reach of the Middle Valley (Forrest 1989: 31).

1916–17 Ashley Pond founded a sportsman's club that included a game preserve and hunting and camping areas at the north end of the Ramon Vigil land grant. The water source for this endeavor, a spring in Pajarito Canyon, dried up, and Pond abandoned the preserve (Ebright 1994: 244–245).

1916–18 When the United States joined the allies in World War I, the Forest Service increased the number of permitted livestock on national forest lands. Conditions caused by previous overgrazing and logging worsened (deBuys 1985: 231).

1916–19 The U.S. Forest Service issued livestock grazing permits for the sacred Blue Lake area to non-Indians (Sando 1989: 83).

1916–23 The density of black grama grass on New Mexico ranges decreased during this dry period (Gatewood et al. 1964: B43).

1916–24 When available, pinyon nuts were shipped by rail from the Taos junction area. The average annual shipment was 10 carloads; in 1921 there were 17 carloads (Gjevre 1969: 19).

1917 (January-May) An estimated 33 black bears were killed in the state, and some 157 still remained in forested areas (Bailey 1971: 353).

1917 The average depth of ground water in the floodplain of the Rio Grande in Sandoval County was 2.5 feet (Bloodgood 1930: 20).

1917 Congress increased grazing fees on public lands, and politicians, ranchers, and others protested vigorously (Clark 1987: 146).

1917 By this year half of the previously farmed land in the North Valley was no longer suitable for agriculture due to alkali deposits and a high water table that flooded extensive surface areas (Sargeant and Davis 1985: 19).

1917 The Sherwin-Williams Paint Company began mining lead and zinc deposits in the Magdalena Mountains (Fergusson 1951: 307).

1917 The grizzly bear population across New Mexico had declined to only 48 animals (Bailey 1971: 368; Brown 1985: 133).

1917 As the United States entered World War I, demand for beef increased sharply, and Stokely Ligon and Aldo Leopold used the situation to justify an intensified predator control effort (Brown 1983: 57).

1917 The Bureau of Biological Survey received $25,000 funding to control predatory animals and rodents in New Mexico. This amount was matched by the state (Hagy 1951: 93).

1917 Professional trappers took 103 adult wolves in the state (Bailey 1971: 307).

1917 The plains gray wolf population had been reduced to less than 100 in the state (Gehlbach 1981: 81).

1917 An estimated 84 mountain lions were killed; some 400 others were found in the state (Bailey 1971: 287).

1917 (ca.) The wood-fired stamp mill was shut down on Baldy Mountain (McDonald 1985: 51).

1917–18 Maximum numbers of livestock were reached in New Mexico because of the increased demand for food and wool during World War I (Donart 1984: 1240).

1917–18 Trespass livestock were common on Forest Service lands, which contributed to overgrazing (Roberts 1963: 120–121).

1918 (January) The Los Alamos Ranch School opened, and the water supply was a problem until a small dam was constructed in a canyon above the school 5 years later (Church and Church 1974: 7).

1918 (July) Government employees trapped 45 wolves (Bailey 1971: 307).

1918 (fall) Influenza struck all over the world, and many towns in New Mexico were hit hard. A majority of families in the state lost at least one member or friend to this disease (Melzer 1982: 221).

1918 The width of the Rio Grande "flood channel" varied from 300 to 4,000 feet. The river bed was aggrading at a "high rate" (Sullivan 1924: 6).

1918 Taos was the hardest hit community in the United States by the influenza epidemic (Tucker and Fitzpatrick 1972: 48).

1918 Numerous deaths due to influenza occurred at Lemitar (Scurlock 1982a: 14).

1918 There were 65 ditches with a water-carrying capacity of 1,957 cfs in the Middle Rio Grande Valley. These acequias irrigated about 47,007 acres (Hedke 1924: 20).

1918 Cerrillos experienced an earthquake, and many ceilings and chimneys fell (Northrop 1976: 85).

1918 During the influenza epidemic, villagers at Sandia Pueblo feared that they would be totally decimated by the disease. A delegation from Sandia went to Isleta Pueblo and deeded all of their lands to the latter (Parsons 1974: 204).

1918 The State Engineer reported that nearly 60,000 acres in the Middle Rio Grande Valley were covered with alkali, salt grass, or swamp (Rodey and Burkholder 1927: 17).

1918 There were 58,000 acres classified as alkaline or swamp, and some 47,000 acres were under cultivation (Hedke 1924: 25).

1918 Congress passed the Migratory Game Bird Treaty Act, making the U.S. Biological Survey (later the U.S. Fish and Wildlife Service) responsible for nationwide management of waterfowl and other migratory species (Huey et al. 1967: 153).

1918 Prairie dog "towns" were estimated to cover 20,000,000 acres of rangeland in the state (Mortensen 1983: 72), perhaps an inflated figure.

1918 Some 93 adult wolves and 30 pups were taken by the U.S. Predatory Animal and Rodent Control Division of the Biological Survey and New Mexico A&M College employees (Brown 1983: 58).

1918 Poisoning of grizzly bears was initiated by the U.S. Biological Survey (Brown 1985: 272).

1918–19 During this fiscal year, state and federal animal and rodent control killed 28 grizzly bears in New Mexico (Brown 1985: 137).

1918–29 Coal production in the Madrid area peaked (Elston 1961: 66).

1918–41 The Middle Rio Grande floodway aggraded at the rate of 1 foot about every 12 years. In the Bosque del Apache-San Marcial area the rate was about 1 foot every 5 years (Happ 1943: 2).

1919 (pre) San Ildefonso Pueblo lost more land to squatters than any other pueblo. Non-Indian removal of timber for commercial use severely impacted the Rio Grande-Pojoaque River watershed on their land (Arnon and Hill 1979: 312).

1919 Major losses in the flow of the Rio Grande above Elephant Butte Reservoir were attributed to evaporation of water from undrained areas and to percolation along the main river channel (Wozniak 1987).

1919 Of the 206,012 acres of floodplain land in the Middle Rio Grande Valley, about 51,977 acres were classified as "alkali and salt grass" (Bloodgood 1930: 5).

1919 Production of molybdenum began in the Questa mineral district of Taos County (Strauss 1947: 127).

1919 The highest annual, daily mean flow of the Santa Fe River near Santa Fe between 1910 and 1993 occurred (USGS 1994).

1919 (ca.) Pronghorn antelope and good grama grass were found on the west bajada of the Manzano Mountains in the La Cabra Spring area (Otero 1989).

1919–25 Sixty new irrigation ditches went into operation in the Middle Rio Grande Valley (Hedke 1925: 22).

1919–29 Scabies infected cattle herds in Valencia County, which was followed by a poor economic market and high feed prices (Magnum 1990: 71).

1920 (pre) The last mink in the Los Lunas area were reported. This species historically occurred as far south as Elephant Butte (Hink and Ohmart 1984, pt. I: 34).

1920 The Forest Service adopted a policy of no light burning in ponderosa pine forest, based on the belief that fire every 2 to 3 years would prevent restocking of the tree (Pyne 1982: 522).

1920 The first motorized vehicle to drive to the Sandia Crest was an Army Signal Corps truck (McDonald 1985: 11).

1920 The town at the Hagan coal mine was constructed (Olson 1976: 90).

1920 The U.S. Census Bureau counted 360,350 persons in New Mexico (Workers of the Writers' Program 1940: 434).

1920 The elk population on all of the national forests in New Mexico was 585 (Baker et al. 1988: 177). By this date the Rocky Mountain elk had almost been exterminated in Colorado (Warren 1942: 277).

1920 The U.S. Biological Survey's predator control program in New Mexico had reduced wolves from an estimated 300 to an estimated 60 (Brown 1983: 64; Flader 1974: 60).

1920 The pine marten was probably extirpated in the Sangre de Cristo Mountains by this year (deBuys 1985: 280).

1920 (ca.) Erosion created a new arroyo that cut

Abo Creek and diverted most of the water, diminishing the stream flow (Clark 1987: 329).

1920 (ca.) Aldo Leopold planted a tamarisk in front of his house in Albuquerque (Robinson 1965: A5).

1920–25 The cattle industry, and wildlife in general, declined due to rangeland abuse. Hunting pressure was also a factor in the decrease in indigenous animal populations (Ligon 1927: 31).

1920–33 Bootlegging alcohol was common in the Bernalillo-Corrales area during prohibition (Olson 1976: 91).

1921 Created earlier by the State Legislature, the Rio Grande Survey Commission, in cooperation with the U.S. Reclamation Service, began to study environmental conditions in the Middle River Valley (Wozniak 1987).

1921 Fifty-six gray wolves were killed in New Mexico and Arizona (Brown 1983: 64).

1921–25 The Bluewater-Toltec Santa Cruz irrigation districts were formed (Clark 1987: 204).

1922 An estimated six grizzly bears were in New Mexico (Brown 1985: 140).

1922–24 The White Pine Lumber Co. was organized; included in the operation was a rail line from the mill extending northward to the main logging camp in Guadalupe Canyon of the Jemez Mountains. Timber was cut on the upper San Diego land grant (Glover 1990: 5–6; Scurlock 1981a: 148).

1920s (early) An estimated 48,750 acres were cultivated, while 58,000 acres were waterlogged or otherwise not suitable for farming in the Middle Rio Grande Valley (Wozniak 1987).

1920s (early) Wolf eradication efforts reached their peak as over 100 animals were killed in New Mexico and Arizona (Burbank 1990: 106).

1923 The Reclamation Service was converted into the Bureau of Reclamation (Clark 1987: 189).

1923 Tamarisk were observed growing along an irrigation canal, but none along the Rio Grande west of Albuquerque's Old Town (Robinson 1965: A5).

1923 The most valuable crops per acre in the Middle Rio Grande Valley were cotton, sweet potatoes, cabbage, and alfalfa (Sullivan 1924: 15).

1923 Range managers considered intensive livestock grazing of woodlands or forests beneficial from the viewpoint of minimizing fires. Grazing kept herbaceous understory plants from accumulating and becoming fire fuel (Pearson 1920: 129–130).

1923 The U.S. Biological Survey and cooperating ranchers put out 103,000 strychnine poison baits to control coyotes and other predators (Brown 1985: 142).

1923 Thirty-two wolves were trapped, poisoned, or shot in New Mexico (Brown 1983: 67).

1923 The last grizzly bear in the high country of the Pecos District of the Santa Fe National Forest was killed (Barker 1953: 189–190).

1923–24 Robert Thompson purchased 55,000 acres of land, a tract that was the Alameda land grant. The headquarters was located on the north edge of Corrales. Some 3,000 to 5,000 herefords were on the ranch (Eisenstadt 1980: 21–22).

1923–25 The State Legislature passed the Conservancy Act, creating a district with a governing board to initiate projects to prevent flooding, regulate stream flow, reclaim waterlogged lands, develop irrigation works, develop or reclaim sources of water, and generate electrical energy (Clark 1987: 207). The Middle Rio Grande Conservancy District structure was formed within 2 years. About 277,760 acres were included in the district (Scurlock 1988a: 136).

1923–1941 Joseph M. Budagher owned a store in Domingo and homesteaded land 3 miles to the southeast. He sold fruit, fuelwood, and gasoline (Olson 1976: 182–183).

1924 (June 7) Congress passed the Pueblo Lands Act, which provided for the appointment of a commission to investigate Pueblo land titles and to litigate the thousands of non-Indian claims against Pueblo lands. Known as the Pueblo Lands Board, this commission was empowered to compensate Indians and non-Indians alike for lands lost via decisions (Brayer 1938: 29).

1924 (September) The White Pine Company sawmill at Bernalillo began operation and in 3 years was producing 145,000 board-feet of lumber per day (Olson 1976: 65, 67).

1924 Passage of the Pueblo Lands Act resulted in Hispanos acquiring legal title to about 18,200 acres of northern Pueblo land through adjudication. Most of this acreage was irrigable, and water rights were appropriated with land title (Forrest 1989: 58).

1924 There were about 40,000 acres of first-class cultivated land, 8,500 more acres of second-class cultivated land, 52,000 acres that were waterlogged or alkaline saturated, 6,500 acres inundated, and 37,500 acres of bosque (Sullivan 1924: 13).

1924 Alfalfa, beans, chile peppers, fruit, and indig-

enous salt grass were the main crops in the Middle Rio Grande Valley south of Bernalillo (Hedke 1925: 31).

1924 About 16.6 percent of New Mexico was forested (Baker et al. 1988: 34).

1924 Wild horses on the Carson National Forest were contributing to an overgrazing problem. Some 1,200 horses were rounded up; some were sold to residents surrounding the forest (Tucker and Fitzpatrick 1972: 79–80).

1924 New Mexico's wildlife populations reached their lowest numbers, and more species were threatened with extinction than at any other time. Several species, such as the gray wolf, elk, and grizzly bear, were extirpated within a few years (Ligon 1927: 15).

1924 The wild turkey population declined to its lowest figure in the historic period (Huey et al. 1967: 107).

1924 Thirty-four wolves were taken in the state, mostly along the southern border (Brown 1983: 70).

1924 (ca.) Seventy-five percent of the Middle Rio Grande Valley shallow ground water was less than 3 feet below the floodplain surface (Sullivan 1924: 7).

1924–25 Sixteen grizzly bears were killed in New Mexico (Brown 1985: 148).

1924–32 Black grama grass density on New Mexico ranges increased until the drought in subsequent years reversed this process (Gatewood et al. 1964: B43).

1925 (spring-summer) Some 565,000 acre-feet of water was depleted for the year. A shortage of 200,000 acre-feet at Buckman occurred (Hedke 1925: 14).

1925 (August) There was a demand for 68,000 acre-feet in the Middle Rio Grande Valley (Hedke 1925: 32).

1925 By this year there was only one large, roadless area (1/2 million acres) in New Mexico. Fifteen years before there were six such areas (Flores 1992: 8).

1925 Thirty-four wolves were killed in the state, and only a few were left on the Jicarilla Apache Reservation and along the southern border (Brown 1983: 71).

1925 The last grizzly bear east of the Rio Grande was killed near Raton (Brown 1983: 150).

1926 The Achison, Topeka, and Santa Fe Railroad contracted to provide 34,256 linear feet of trestle piling, 237,498 board-feet of native pine bridge timber, 81,610 board-feet of native pine box culvert timber, and 60,000 native pine track ties for construction of the Cuba Extension rail line from San Ysidro to north of Cuba (Glover 1990: 48).

1926 The statewide deer population was estimated at 41,000 (Huey et al. 1967: 42).

1926–27 The average depth of ground water below the surface of the floodplain of the Tome-Valencia area was 2.32 feet (National Resources Committee 1938: 274).

1927 (fall) Some wolves entered north-central New Mexico from Colorado. They took a large number of young cattle along the Rusas River in the Tres Piedras country (Brown 1983: 79).

1927 Predators, such as wolves, coyotes, bobcats, and mountain lions, were considered "the most serious enemy of game conservation in New Mexico" (Ligon 1927: 49–50).

1927 The last plains gray wolf in the state was exterminated by this year (Findley et al. 1975: 28).

1927 U.S. Biological Survey trappers Homer and Albert Pickens took seven gray wolves in the Canjilon Creek-upper Brazos drainages, the last of this species in the area (Pickens 1980: 11).

1927 Mule deer were rare or extinct "in the valleys, especially in the more settled parts" (Bailey 1971: 29).

1927 An estimated 2,950 pronghorns were found in the region (Ligon 1927: 25).

1927 Black bears received legal protection in New Mexico (Findley et al. 1975: 29).

1928 An estimated 16 grizzly bears remained in New Mexico (Brown 1985: 153).

1928 The exotic rainbow trout was stocked in 187 rivers, creeks, and lakes across the state (Kuykendahl 1994: 3).

1929–30 San Acacia Lake, drained by the Conservancy District in 1929–30, contained a large fish population and supported other wildlife (Marshall and Walt 1984: 281).

1920s Intensive grazing decimated plant cover, which resulted in severe erosion in the region (Forrest 1989: 140).

1920s There was commercial mining of copper-silver ore in La Bajada Canyon, Santa Fe County (Elston 1961: 161).

1920s A retail clothing store in Las Vegas sent two buyers to New Mexico and Arizona to buy furs, hides, and wool (Perrigo 1982: 62–63).

1920s Local bounties were paid for bobcats, and most sheep ranchers hunted them vigorously (Bailey 1971: 296).

1920s Wolves were virtually exterminated by trappers and hunters working for the Forest Service, U.S. Biological Survey, and ranchers (Brown 1983: 25).

1930 By this year Frank Bond controlled the best grazing lands in the Jemez Mountains. He leased land for grazing his sheep from the Forest Service, and after 3 years of use, his forest grazing rights became permanent (Rothman 1992: 129).

1930 By this year permits for grazing on the Santa Fe National Forest were reduced to correlate with carrying capacities (Rothman 1992: 159).

1930 The valley of the Rio Grande in the Socorro area supported dense stands of willow, tornillo, cottonwood, and rabbitbush. On waterlogged soils, vegetation was more sparse, and the open alkali flats were covered with salt grass. In wet depressions or around charcos, bullrush and sedge grasses were dominant. The adjacent dry uplands supported mesquite, creosote bush, rabbitbush, and sparse bunch grasses. Livestock were grazed throughout the year on salt grass pastures and in the bosques of the Rio Grande and lower Rio Puerco in Socorro County (Poulson and Fitzpatrick ca. 1930: 7).

1931 (March 2) Congress appropriated $10 million to fund predatory animal control in the West (Hagy 1951: 94).

1931 (March 2) Congress passed an act that provided $1 million to the Secretary of Agriculture to completely eradicate predatory animals over 10 years (Hagy 1951: 94).

1931 The U.S. Forest Service sold an estimated 207,900,000 board-feet of timber in the Rio de las Vacas watershed to the White Pine Lumber Company. This sale involved about 40,000 acres of land (Glover 1990: 26).

1931 The entire state reported a good pinyon crop (Brugge 1980: 383).

1931 The New Mexico Legislature passed a law giving the State Game Commission full regulatory powers to manage the wildlife of the state, including setting hunting seasons and bag limits (Barker 1970: 188; Flader 1978: 105).

1932 The net annual depletion of Rio Grande surface waters between Otowi and San Marcial was 480,000 acre-feet (Nelson 1946: 24).

1932–33 The Forest Service surveyed watershed conditions in the Rio Grande basin above Elephant Butte. Rapid deterioration of vegetation cover due to livestock overgrazing in the 1880s and subsequent accelerated erosion and gullying was documented. Increased sedimentation in the river had caused the loss of about 13 percent of Elephant Butte Reservoir's capacity (Clark 1987: 258).

1932–66 Nineteen bighorn sheep were introduced into the Sandia Mountains (Huey et al. 1967: 222).

1930s (early) More than 1,500 horses were removed from the Jemez River District of the Santa Fe National Forest (Tucker and Fitzpatrick 1972: 81).

1934 To control and manage grazing on the public lands, the Taylor Grazing Act was passed, establishing the Grazing Service within the Department of the Interior. In 1946 this agency was combined with the General Land Office to form the Bureau of Land Management (Clawson 1971: 34–38). The bulk of unappropriated grassland (80 million acres) was closed to further settlement by the act. These lands were to be kept as a grazing resource and managed by local livestock growers organized in districts and supervised by the Department of the Interior (Worster 1979: 190).

1930s (pre) Crested wheat grass was introduced into New Mexico and adjacent mountain states Hitchock 1935: 48.

1935 An earthquake rocked Belen and damaged the high school and two elementary schools to the extent that classes were suspended until the necessary repairs could be made (Northrop 1976: 85).

1935 By this year, irrigation works were constructed by the Middle Rio Grande Conservancy District for 118,000 acres between Cochiti and the northern boundary of the Bosque del Apache Wildlife Refuge (Nelson 1946: 12).

1935 Virtually all of the Tewa basin was described as "tragically overgrazed" (Weigle 1975: 36).

1935 Overgrazing of grant and public lands around El Rito resulted in a reduction in the number of livestock (Weigle 1975: 152).

1935 Pueblo rangelands at Laguna and Acoma were badly overgrazed, which, along with the drought, led to starving livestock. "They all knew, also, that there were many 'denuded areas' and 'the most nutritious plants' had disappeared from the range, leaving less digestible weeds or even poisonous plants" (Aberle 1948: 63).

1935 Deforestation 35 miles up the Rio En Medio and Chupadero watersheds by several lumber mill operations and local cutting for fuelwood resulted in severe soil erosion. Some 20 acres of farmland were lost near the Chupadero village (Weigle 1975: 66).

1930s (mid) Most of the residents from the middle Rio Puerco-of-the-East valley moved upstream to the higher Cuba area, where agri-

culture was still relatively reliable (Calkins 1937b: 18–19).

1936 The average depth of ground water below the surface of the floodplain in the Tome-Valencia area was 5.99 feet (National Resources Committee 1938: 274).

1936 The consumptive agricultural use of water between Isleta Pueblo and Casa Colorada was 2.7 acre-feet per acre (Titus 1963: 84).

1936 The New Mexico Lumber and Timber Co. of Bernalillo purchased the timber rights to the Baca No. 1 location in the Jemez Mountains. Here, and on nearby lands of the Santa Fe National Forest, there were an estimated 400 million board-feet of timber (Glover 1990: 36).

1936–41 The rate of floodplain aggradation of the Middle Rio Grande floodway was about 1 foot per year (Happ 1943: 2).

1936–47 Cottonwood, willow, and tamarisk cover increased from 38,400 to 51,120 acres in the Middle Rio Grande Valley (Lowry 1957: 4).

1937 A flood along the Middle Rio Grande washed out levees in a number of locations (Happ 1944: 3).

1937 All of Santa Ana's rangelands, except the mesa, were severely overgrazed and eroded. Extensive sand dune areas had formed along the Jemez River, siltation had ruined crops and clogged one of two wells, and desirable grasses had been replaced largely with ring muhly and snakeweed. The range agent reported that the rangelands "could support only 39 head of cattle and horses on a yearlong basis" (Bayer et al. 1994: 231, 233).

1937 About 85 percent of New Mexico's 77,488,536 acres was in a state of active erosion, with more than half of that suffering serious loss of topsoil and severe gullying. The legislature passed a soil conservation act (Clark 1983: 270).

1937 Three soil conservation grants totalling 174,000 acres were allocated to the Pueblos. These lands had a carrying capacity of 1,656 cattle. Three other such grants totalling 187,000 acres with a carrying capacity of 1,601 cattle were made to non-Indians, but primarily for Hispanic use (Forrest 1989: 141).

1937–66 Some 952 pronghorn antelope were transplanted into the Middle Rio Grande Basin (Huey et al. 1967: 221).

1938 (January) Jemez, Zia, and Laguna pueblos were granted grazing rights to a portion of the Espiritu Santo land grant (Bayer et al. 1994: 233–234).

1930s Electricity was introduced to the Valencia-Los Lunas area (Gallegos 1970: 75).

1930s Spanish livestock overgrazed the lands around Vadito, including locales on Picuris Pueblo land (Carlson 1979: 36).

1930s Trucks replaced horses in logging operations (Glover 1990: 37).

1930s Wild horses, which grazed the Manzano Mountains bajada, grazed inside the Albuquerque airport boundaries, even after it was fenced (Speakers 1965: 31).

1930s–40s Large herds of goats and sheep were grazed in the Los Pinos and Ladrone mountains. This intensive grazing changed the floristic composition of rangeland on the Sevilleta land grant (Manthey 1977: 10–11).

1940 The U.S. Forest Service and Bureau of Land Management began to fence federal land in the Rio Puerco-of-the-East valley and traditional grazing lands on Mesa Prieta and the San Mateo Mountains, including Mount Taylor (Garcia 1992: 23).

1941 (pre) Residents of Santa Clara Pueblo caught carp, sucker, eel, catfish, and trout for food (Hill 1982: 59).

1941 (May) The highest daily mean flow since late 1939, 5,980 cfs, occurred on the lower Rio Puerco (US Geological Society 1994).

1941 Probably owing to the abnormally high precipitation, fires burned perhaps the smallest area ever in a year (Swetnam 1990: 11).

1941–43 Each family on the Rio Puerco was permitted to graze 15 head of sheep in their grazing precinct by the Grazing Service. This number of livestock was considered below the minimum needed for subsistence (Forrest 1989: 159).

1942 There were 14,972 acres under cultivation in the Rio Puerco basin (Harper 1943: 11).

1942–56 The carrying capacity of grazing lands in New Mexico steadily decreased during this extended drought period (Gatewood et al. 1964: B43).

1943 (June 29) A flood on the Rio Puerco above Arroyo Chico probably exceeded 5,000 cfs (USGS 1994).

1940s (mid) The rapid aggradation of the Middle Rio Grande streambed was considered the most severe problem by local residents. This process, caused by the large amount of sediment carried by the river, was resulting in the reduction of the carrying capacity of the river, the waterlogging of farmland, and the increased danger of disastrous flooding (Clark 1987: 531).

1945–62 Seventy-four irrigation wells were drilled on the Rio Grande floodplain in eastern Valencia County (Titus 1963: 85).

1946 (pre) Sedimentation of the river channel had

raised it to within 40 inches of the Alameda truss bridge (Nelson 1946: 18).

1946 There were about 4,700 farms in the Middle Rio Grande Valley, 66 percent of them were 15 acres or less in size. The remainder ranged from 16 to more than 160 acres (Nelson 1946: 13–14).

1946 There were 3,819 Pueblos living in the Middle Valley; land holdings totalled 379,732 acres. Average per capita cultivation was 3.2 acres (Nelson 1946: 70–71).

1946 About 60,000 acres were irrigated farmlands in the Middle Valley. Some 118,000 acres of irrigable lands were uncultivated (U.S. Bureau of Reclamation 1946: 3).

1946 An average of about 37 million tons of sediments were carried into the valley between Cochiti and San Marcial. About 25 million tons, or 13,500 acre-feet, of these were deposited in the valley (Nelson 1946: 19).

1946 Water used by native vegetative cover equalled or exceeded that used for irrigation of cultivated lands in the Middle Valley (Nelson 1946: 25).

1946 By this year "numerous drains" in the Middle Rio Grande Valley were partially "filled with vegetative growth," and their mouths were "sediment-clogged" (Nelson 1946: 15).

1946 The Isleta diversion dam was "in poor condition because of settlement after being undermined" (Nelson 1946: 40).

1947 There were 60,640 acres of native and exotic vegetation in the Middle Valley. Their water use depleted river flow by an estimated 238,700 acre-feet, or about 44.5 percent of the total depletion (Hay 1963).

1947 Four lakes in the San Marcial area provided good largemouth bass fishing. Good catches of crappie and channel catfish were also made (Pillow and DeVaney 1947: 10).

1947 The lower Rio Jemez provided no fishing because of species depletion (Pillow and DeVaney 1947: 10).

1948 Congress directed the Army Corps of Engineers and Bureau of Reclamation to prepare plans for district improvement. Subsequently, the Corps constructed river levees near Albuquerque, and the Bureau deepened river canals to drain water from agricultural lands. In the southern part of the valley, channel rectification was carried out as well (Sorensen and Linford 1967: 156–157).

1948 (ca.) A sawmill was built at Gilman just below the tunnels on the Guadalupe River in the Jemez Mountains (Glover 1990: 44).

1949 Some 72,989 acres were in irrigation in the Middle Valley (Sorensen and Linford 1967: 154).

1940s (late) The mink was still common throughout the northern half of the state (Huey et al. 1967: 189).

1950 (pre) The yellow perch was introduced into the Rio Grande, Pecos, and San Juan drainages (Sublette et al. 1990: 331).

1950 The population of the Middle and Upper basins was 275,000, of which about 15 percent were actively engaged in agriculture. There were 158,000 livestock units in the basins (Dortignac 1956: 56, 78–79).

1951 Invader shrubs had replaced black grama grass on upland sites from San Marcial to the mouth of the Rio Puerco. Older residents of this reach remembered grama being cut and baled here previously (Branson 1985: 38).

1954 (July 1) (to June 30, 1955) Belen residents used 158,835,996 gallons of water from three municipal wells (Titus 1963: 86).

1955 The average annual stream flow production in the Rio Grande above Elephant Butte was almost 3 million acre-feet. More than 900,000 acre-feet of water was consumed between the Colorado-New Mexico state line and Elephant Butte Dam. This was almost two-thirds of the water produced in this region. More than 400,000 acre-feet of the total was considered wasted or nonbeneficial use (Dortignac 1956: 29).

1955 There were an estimated 1,500 elk and 25,000 deer on national forests in the Upper and Middle basins (Dortignac 1956: 71).

1956 Some 22,600 acres were in cultivation from the southern boundary of the Isleta reservation to Bernardo. About half of crop production was alfalfa (Titus 1963: 3).

1956 The Bureau of Indian Affairs returned grazing control to the Navajo. Stocking increased steadily, causing severe overgrazing of rangelands by the mid 1980s (Eastman and Gray 1987: 106–107).

1958–66 Some 4,966 Afghan white-winged pheasants were released by the Game and Fish Department in the state (Huey et al. 1967: 169).

1959 The estimated average annual evaporation at Elephant Butte and Caballo reservoirs was 254,800 acre-feet (Sorensen and Linford 1967: 166).

1950s The overall population of band-tailed pigeons was declining (Huey et al. 1967: 155).

1950s The fathead minnow was introduced into the Gila and San Juan drainages, and in the next decade into the Zuni and San Francisco river drainages (Sublette et al. 1990: 166).

1950s Timber sales and logging occurred in the Capulin Springs area in the Sandia Mountains. Logging was "camouflaged" because of complaints of local residents and visitors. Firewood cutting was common (McDonald 1985: 11).

1960 The population of the Rio Grande basin was 484,700; 132,400 were rural residents. Some 241,216 persons lived in Albuquerque (Sorensen and Linford 1967: 152).

1960 The population of eastern Valencia County was an estimated 16,100. Belen and Los Lunas had populations of 5,031 and 1,186, respectively (Titus 1963: 3).

1960 The Pueblos, with a population of 13,611, owned 1,460,838 acres in the Rio Grande basin (Sorensen and Linford 1967: 150).

1960 By this year Russian olive had become a major understory component of the Middle Rio Grande bosque (Freehling 1982: 10).

1960 (late) The American Gypsum Co. began quarrying at White Mesa near San Ysidro. The raw gypsum was transported to the company's plant north of Albuquerque (Elston 1961: 164).

1960–62 About 84,600 acre-feet of water were diverted annually in the Rio Grande basin; this included surface and ground waters. About 42,000 acre-feet of this total was depleted; some 29,800 acre-feet, or 71 percent, was depleted by Albuquerque (Sorensen and Linford 1967: 163).

1962 Sagebrush (*Artemisia* spp.) made up 3–4 percent of the vegetative cover on the Rio Puerco watershed (Dortignac 1963: 508).

1960s (early) The fall-winter duck population varied from 100,000 to 200,000 birds (Huey et al. 1967: 161).

1960s (early to mid) There were a few reports of white-tailed deer in the San Mateo Mountains in Socorro County and the Sangre de Cristo Mountains (Huey et al. 1967: 52).

1963 (pre) Several springs along the Ojuelos fault ceased flowing, perhaps due to wells drilled nearby (Titus 1963: 79).

1963 About 16,400 acres of land in the Rio Grande basin were dry-farmed; most of this acreage was cultivated in wheat and barley. Some 3,000 acres were in corn (Sorensen and Linford 1967: 159).

1963 About 39,739,000 board-feet were harvested in the Rio Grande basin (Sorensen and Linford 1967: 159).

1963 Kokanee salmon were introduced into northern New Mexico streams (Sublette et al. 1990: 67).

1963 About 134,500 cattle and 135,500 sheep were on rangelands of the Rio Grande basin. Of these, 76,800 cattle and 64,600 sheep were grazed on national forest lands in the summer (Sorensen and Linford 1967: 159).

1963 State and federal trappers took more than 6,300 coyotes and 1,500 bobcats (Huey et al. 1967: 197, 199).

1964 About 20,000 acres were under irrigation in the Middle Valley. Almost all of this was within the Middle Rio Grande Conservancy District (Sorensen and Linford 1967: 157).

1964 There were an estimated 3,000 black bears in the state (Huey et al. 1967: 22).

1964 There were an estimated 301,750 deer, 11,046 elk, 15,000 pronghorn antelope, and 300 to 400 bighorn sheep in the state (Huey et al. 1967: 26).

1964 Some 72 bighorn sheep were counted in the Sandia Mountains (Huey et al. 1967: 70).

1964 There were an estimated 25,000 wild turkeys in the state (Huey et al. 1967: 26).

1966 There were an estimated 350 mountain lions in the state (Huey et al. 1967: 195).

1967 The beaver population of New Mexico was estimated to be 6,000 (deBuys 1985: 97).

1967 The white-tailed ptarmigan was "very rare" in the Sangre de Cristo Mountains and other northern New Mexico ranges (Huey et al. 1967: 129).

1960s Northern pike were introduced into several large reservoirs (Sublette et al. 1990: 77).

1970 The estimated saw timber volume on national forests in New Mexico was 12,645 million board-feet (Baker et al. 1988: 78).

1977 About 17 percent of New Mexico was forested (Baker et al. 1988: 34).