Crossroads of Change: An Environmental History of Pecos National Historical Park

Appendices and Bibliography

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Appendix A.

Summary Historical Overviews of Pecos Natural Resource Condition Assessment Reporting Areas[1]

Pueblo Unit

Comprising the area immediately around the pueblo and mission ruins, the Pueblo Unit borders Glorieta Creek on the west and includes the meadow on the east side of the mesilla. Constructed in 1425 C.E., Pecos Pueblo served as a habitation site until 1838 when the last Pecos emigrated to Jemez Pueblo. Following Spanish contact in 1540, Pecos became a Franciscan mission. Beginning in the 1600s, four churches were constructed and either destroyed or abandoned on the mesilla. The mission and pueblo ruins became a popular tourist attraction in the late 1800s. In 1935 the ruins were designated a state monument and, in 1965, were designated a national monument under the management of the National Park Service (NPS). The ruins were incorporated into Pecos National Historical Park in 1990.

The Pueblo Unit has experienced intensive human presence and use for centuries, and its environment has always reflected the effects of that use. Density of piñon and juniper around the mesilla before the arrival of humans is uncertain; however, the Pecos probably chose the mesilla as the site for a pueblo in part because the rocky outcrop offered a clear view of the surrounding valley. Following the construction of the pueblo, vegetation around the mesilla diminished rapidly. The Pecos used wood for firewood and construction, and human traffic prevented the growth of herbaceous species. The Apaches participated in an annual trade fair and camped in the meadow east of the mesilla, a short term, but intensive use of the area. Spanish sources suggest that the mesilla was clear of substantial vegetation for approximately one-and-a-half miles around the pueblo.

The Spanish introduced livestock, including sheep, into the Pecos environment. From the early 1600s through the mid-1900s, livestock grazing occurred on the Pueblo Unit. Numbers of livestock waxed and waned. In the 1600s, the Franciscan friars owned fairly large herds. These numbers diminished during the 1700s due to Comanche raids. During the 1600s and 1700s, the Pecos kept livestock close to the pueblo in corrals on the mesilla. Numbers rose once again in the mid-1800s as Pecos was integrated into the American capitalist economy. Grazing continued on the Pueblo Unit until 1967 when the NPS installed a boundary fence around the national monument.

The Pecos planted numerous fields throughout the valley, including some directly west and northwest of their pueblo. The easily irrigated land alongside Glorieta Creek supported agriculture, and the Pecos probably maintained fields there until the 1800s. The Franciscan priests at Pecos cultivated a kitchen garden directly west of their mission. Archeological investigations and accounts of standing water among the ruins suggest that the Pecos engineered a system of water supply and control on the mesilla. Ditches, check dams, grid gardens, and other methods were employed to control the water flowing to their crop fields.

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[1] The Natural Resource Condition Assessment (NRCA) for Pecos National Historical Park was conducted during the same time frame as the environmental history. Providing brief historical summaries of the reporting areas used in the NRCA was an idea that arose from discussions we had with the NRCA team. Throughout the process, we tried to address specific questions asked by the NRCA researchers and shared information and sources. See K. Johnson, T. Neville, and R. E. Bennetts, "Natural Resource Condition Assessment for Pecos National Historical Park," Natural Resource Technical Report NPS/SOPN/NRTR-XXXX/XXX (Fort Collins: National Park Service, forthcoming).

Archeological excavations of the ruins, beginning in 1915 and occurring at intervals through the 1960s, disturbed the soil on the mesilla. While the excavations were being conducted, plant growth was inhibited. However, the disturbed soil proved to be a perfect host for weedy species, many of them exotics. *Kochia scoparia*, Mexican fireweed, became a particularly troublesome weed on the ruins. Both state and Park Service land managers have undertaken numerous weed-control programs on the ruins. In 1969 the Park Service initiated a grassland restoration project in the meadow east of the mesilla.

Pecos River Corridor

The Pecos River descends from its headwaters in the Sangre de Cristo Mountains, rushes through a steep canyon, and hurries into the valley. Many tributary streams, including Glorieta Creek, feed into it. The river and the fertile lands along its banks first attracted humans to the valley thousands of years ago and continued to encourage settlement in the valley for both practical and aesthetic reasons through the centuries that followed. Because riparian corridors are sensitive environments yet also conducive to human settlement and use, they are quick to exhibit the effects of environmental change. The Pecos River is no exception—many of the land use and management activities that have occurred in the valley have affected the riparian ecosystem.

The Pecos used many of the plants that grow along the river, including willows, and also fished in its waters for Rio Grande cutthroat trout, among other species. Most of the Pecos' fields were located in the low-lying, fertile area along the river to the northeast of the pueblo, known as a ciénega. Acequias, or irrigation ditches, were constructed by the Pecos and also by Hispanic farmers to divert water to their fields. The majority of the ditches were in the ciénega; however, minor ones existed further down the Pecos River. One directed water to a grist mill, constructed during the early 1900s and located on the east bank. An apple orchard was also planted along the river, probably around the same time. When livestock arrived along with the Spanish in the early 1600s, cattle and sheep began grazing along the riverbanks, creating erosion and denuding riparian plants. Once Hispanic settlers started building homes along the river in the early 1800s, numbers of livestock increased sharply and the effects of grazing accelerated. Grazing continued through much of the twentieth century, including during Tex Austin's ownership of the Forked Lightning Ranch in the 1920s and 1930s, and the subsequent ranch managed and owned by E. E. Fogelson and his wife, Greer Garson Fogelson.

Fur trapping in the 1820s caused the local extinction of beaver in the Pecos River, which affected ecosystem dynamics. Beaver had returned, however, by the 1930s. In 1921 the state of New Mexico constructed the Lisboa Springs Fish Hatchery to the north of the village of Pecos and began releasing brown and rainbow trout into the river. The Forest Service may have undertaken similar fish stocking enterprises earlier as well. Following the introduction of non-native species, the numbers of Rio Grande cutthroat trout declined sharply. By the twentieth century, fishing was a popular leisure activity and remains important today. In the 1990s the Rio Grande cutthroat trout was reintroduced into the upper reaches of the river.

Extensive timber cutting in the Pecos canyon during the late 1800s and early 1900s caused upstream erosion and contributed to more severe flooding. The worst flood of the twentieth century occurred in September of 1904 and caused widespread destruction along the river. The operation of the Tererro mine along Willow Creek up the Pecos canyon in the late 1920s and 1930s also negatively affected the river. Mining, as well as the extraction of ore at a mill, leached heavy metals, particularly lead, into the water. Following a fish kill at the Lisboa Hatchery in 1991, remediation efforts began to clean up the toxic remnants of the mining

activity. Following the cessation of mining, and extensive grazing and timber cutting, the riparian corridor along the Pecos River began to recover. In 1990 the first twenty miles of the river from its headwaters to just above Tererro were designated as a National Wild and Scenic River.

Glorieta Creek

Glorieta Creek parallels the Pecos River before turning to the east and joining the river directly below the Forked Lightning Ranch house. Kozlowski's Trading Post, constructed in the early 1800s, is also included in the Glorieta Creek Unit. By the twentieth century, Glorieta Creek was sometimes described as an intermittent stream, but water flow has been constant, if variable, over the past fifty years. Accounts from the Spanish period and early American period suggest a more consistent water level; however, it is sometimes uncertain if the source refers to the creek or the Pecos River, as specific names are rarely used. A diminishing water flow over time is a possibility, as increasing human population, erosion, and denuded vegetation may have lowered the water table.

The Forked Lightning Ruin, an early habitation site dating to the Coalition Period (1200-1325 C.E.), is located along the creek banks a short distance south of Pecos Pueblo. The Pecos themselves cultivated fields along Glorieta Creek and utilized many of the plant species that grew along the banks. During the Spanish Colonial period at Pecos Pueblo, livestock corrals were built on both sides of the creek. Because the Pecos kept livestock close to the pueblo, particularly during periods when Comanche or Apache raiding occurred frequently, the riparian vegetation probably suffered from overgrazing and erosion. The Kozlowskis also possessed some small fields irrigated by the creek during the mid-1800s and early 1900s. Grazing associated with Kozlowski's Trading Post during the nineteenth century, and with Tex Austin and E. E. Fogelson during the twentieth century, also negatively affected riparian vegetation. Photos from the early twentieth century show a general lack of riparian vegetation on the banks of Glorieta Creek.

The extensive timber cutting and overgrazing in the area during the late 1800s and early 1900s contributed to more severe floods, which deepened the Glorieta Creek arroyo. Alfred Kidder recorded one specific flood event in 1927 that widened the creek channel. A flood in 1935 destroyed the bridge that crossed Glorieta Creek below the Forked Lightning Ranch house. Following the construction of I-25 in the late twentieth century, arroyo formation and erosion increased to the west of the creek, affecting the creek environment as well.

The National Park Service kept several horses at the Trading Post during the 1990s and documented extensive degradation along the creek. The horses were removed after a few years. Two gravel beds along the creek, directly below the Trading Post, used during the twentieth century, also harmed riparian vegetation and water quality. During the late 1990s, the Park Service undertook an extensive restoration project on Glorieta Creek that involved removing the gravel beds and replanting native species. The project proved successful. Riparian vegetation along the creek has flourished in the late 1990s and early 2000s due to this project and the cessation of grazing.

Forked Lightning Ranch East Unit

The east Forked Lightning Ranch Unit currently encompasses a mix of grassland and woodland habitats. The site of the Forked Lightning Ranch house, constructed in 1926, is also located on this unit. In recent years, National Park Service officials have been concerned with the

issue of piñon-juniper encroachment onto grassland areas and have undertaken several projects to clear away trees and restore pastures that were present on the Fogelsons' Forked Lightning Ranch. E. E. Fogelson initially cleared these pastures in the 1960s using bulldozers and chaining—a method that severely damaged many archaeological sites. Aerial photos taken in 1929 during Tex Austin's management of the ranch also show a mix of grassland and piñon-juniper woodland. It is unknown, however, if Austin actively maintained or created pastures on his ranch.

The ratio of piñon-juniper woodland to grassland over time in the Pecos area is difficult to determine. Although some grassland existed naturally, tree densities were also influenced by human activities. Particularly during the 1800s and early 1900s, when populations of both humans and livestock increased rapidly, many trees were consumed for firewood, charcoal production, and construction, or cleared to make pastures. Grazing affects woodland density as well by diminishing herbaceous species and encouraging tree growth. The sudden cessation of heavy grazing, in particular, may trigger woodland expansion. Fire, too, influences the process. Although the role of fire in piñon-juniper woodlands is uncertain, human actions have altered the fire regime in the Southwest. Particularly in the early 1900s, when the Forest Service instituted a policy of fire suppression in the national forest surrounding Pecos, the natural role of fire was virtually eliminated. Before these policies, ranchers and farmers in the Upper Pecos valley, as well as the Pecos before them, may well have used fire to rejuvenate grasslands and prevent tree infill. No specific historical evidence exists, however, to support the role of anthropogenic fires at Pecos.

Besides fire, other factors, particularly disease and climate, affect woodland density. A number of influences have acted together throughout the history of the Pecos area to determine the ratio of woodland to grassland in the valley. It is probably impossible to say for certain what the valley looked like before extensive human occupation began in the Early (1325-1400 C.E.) and Middle (1400-1525 C.E.) Classic Periods. The piñon-juniper infill observed in the twentieth century simply may be trees returning to areas they occupied before human activities changed the environment of the valley now that intensive grazing and tree removal has ceased.

The Pecos hunted and gathered plants and piñon nuts in the meadows and woodlands around their pueblo. They also undertook dry farming, using a variety of methods to trap and distribute water. When the pueblo reached its height of population in the 1400s, every patch of land that had the potential to produce crops needed to be utilized. Beginning in the early 1800s, Hispanic settlers began building homesteads in a few locations in this unit, often close to the Pecos River. These settlers kept small numbers of livestock and attempted to cultivate gardens and crop fields. The Santa Fe Trail, opened in 1821, cut through the Forked Lightning Ranch East Unit, passing by Kozlowski's Trading Post. After 1848 when New Mexico became a U.S. territory, traffic on the Trail became particularly heavy. The thousands of animals and the lumbering wagons driven by traders severely affected the environment on either side of the Trail—denuding vegetation, increasing erosion, and polluting water sources. Ruts from the Santa Fe Trail remain visible on the unit today.

Through the 1800s, livestock was allowed to wander and graze freely in the Upper Pecos valley. By the late 1800s and early 1900s, though, land ownership in the valley was solidified through surveys and legal titles to tracts of property. In the late 1800s, the owner of the parcel of land that became the Forked Lightning Ranch began posting signs warning against trespassing. Under Tex Austin and E. E. Fogelson, fences were put up to define ranch boundaries, and grazing was limited to the livestock owned by Austin and Fogelson. Grazing continued on the

unit until December of 1988 when the last of the Fogelsons' cattle were sold. In 2000 the Monument Fire burned across the southern portion of this unit.

Forked Lightning Ranch West Unit

This unit, which comprises the area of the Forked Lightning Ranch to the west of Glorieta Creek, has experienced much the same history as the Forked Lightning Ranch East Unit. The Santa Fe Trail also passed through this unit. Several other important transportation routes were located on or adjacent to this unit as well. In 1880 the Atchison, Topeka, & Santa Fe railroad constructed its tracks close to the unit's western boundary. In the 1920s and 1930s, Route 66 was constructed and brought growing numbers of tourists to the valley in their automobiles. By the late twentieth century, I-25 had replaced earlier highways and the railroad as the main transportation route through Pecos.

Backcountry Unit

The Backcountry Unit encompasses the piñon-juniper woodland to the east of the Pecos River. Little specific information exists for the backcountry; however, it was affected by many of the same influences as the Forked Lightning Ranch Units. The Pecos, as well as later settlers of the valley, hunted in the woodland. Gathering firewood and piñon nuts were also important activities. Grazing has also occurred in the woodland, probably from the mid-1800s through the Fogelson period at the Forked Lightning Ranch. Three small pastures date to the Fogelson ranch era and currently are maintained by the Park Service.

Pigeon's Ranch Unit

The Pigeon's Ranch Unit includes the remains of Alexander Valle's Santa Fe Trail hostelry as well as the majority of the battlefield where Union and Confederate armies clashed during the Battle of Glorieta Pass on March 26-28, 1862. The area around Pigeon's Ranch and Glorieta Pass was not settled until the 1800s, although the Pecos certainly hunted and traveled through the area. Glorieta Pass served as a natural route into the Rio Grande drainage and many travelers crossed over it. The Santa Fe Trail crested Glorieta Pass before continuing to Santa Fe. Alexander Valle built Pigeon's Ranch in the early 1850s as a hostelry serving travelers on the Trail. Pigeon's Ranch was an extensive ranch complex. Valle owned livestock himself and also housed the animals of travelers and traders. Valle probably cultivated a few crops in the vicinity as well. Civil War accounts refer to a logging road, and by the 1880s extensive logging was conducted in the vicinity. Photos from the 1880s show an open landscape immediately around the ranch. In the photos, the banks of Glorieta Creek are fairly barren, with only a few cottonwoods growing—the result of years of grazing and heavy traffic along the Santa Fe Trail.

Pigeon's Ranch was used as a headquarters and hospital by both Union and Confederate troops during the battle that raged in the hills around the ranch in March 1862. Valle sold his ranch in 1865 and by 1887 it had ceased operation as a hostelry. Pigeon's Ranch slowly fell into decay until 1925 when it was purchased by Tom Greer and turned into a tourist attraction. Highway 84/Route 66 passed directly through the old Pigeon's Ranch complex. During the twentieth century, riparian vegetation along Glorieta Creek recovered. Trees and shrubs began encroaching on many of the fields around the ranch, particularly those to the north that were specifically mentioned in Civil War accounts. As in other units, grazing, fire suppression, and tree cutting influenced woodland density over the years.

Cañoncito Unit

The Cañoncito Unit encompasses the location of the Confederate's camp during the Battle of Glorieta Pass, March 26-28, 1862. A hostelry owned by Anthony Johnson stood nearby along the Santa Fe Trail. On March 28 Union troops descended Glorieta Mesa, which rises sharply to the east, and destroyed the Confederates' supplies while the main force was occupied in the fighting around Pigeon's Ranch. Two days before, on March 26, Union and Confederate forces fought in Apache Canyon, a short distance up Glorieta Pass from their camp.

Settlement around Cañoncito probably began in the late 1700s after the Spanish government awarded the Cañada de los Alamos grant, located a short distance to the west. Anthony Johnson either bought or built his ranch and hostelry in 1858. By the early 1900s, the ranch had been abandoned and was falling into decay. Known as Cañoncito by the late 1800s, between 1880 and 1891 locals built the Nuestra Señora de Luz church, located directly north of the unit. The Atchison, Topeka, & Santa Fe railroad tracks, built in 1880, pass through the unit, and by the late twentieth century, I-25 had been constructed, replacing an earlier highway.

Photos from the late 1800s and early 1900s taken around Johnson's ranch and in Apache Canyon show a severely eroded landscape with sparse vegetation due to overgrazing and heavy traffic through Glorieta Pass. Reports from Forest Service rangers in the early twentieth century also refer to the poor condition of land around Cañoncito. One report recommended completely closing the Apache Canyon allotment to grazing.

Appendix B.

Environmental History Timeline

This timeline lists important events in Pecos history, as well as a more detailed overview of climatological data and recorded disease epidemics.

10,000 B.C.E. to 1200 C.E.

10,000-5500 B.C.E.: Climate growing drier, but still wetter and cooler than today

5500 B.C.E. – 600 C.E.: Climate continues to grow warmer and drier

5500 B.C.E. – 600 C.E.: Over this period, corn is introduced to the Southwest from Mexico and Puebloan culture transitions to a sedentary, agricultural lifestyle

600-1200 C. E.: Humans begin building long-term sedentary habitation sites in the Pecos valley

1200 C.E. to 1400 C.E.

1005-1014: Intense, low period of spring precipitation recorded at Arroyo Hondo[2]

1130-1139: Intense, low period of spring precipitation recorded at Arroyo Hondo

1200-1325: Several early pueblos built in the Pecos valley, including the Forked Lightning, Rowe, and Black-on-White House

1215-1231: PDSI recorded dry period[3]

1234-1240: PDSI recorded dry period

1248-1267: PDSI recorded dry period

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[2] "Spring" precipitation encompasses the period from March to June. The authors argue that spring precipitation is generally more variable than annual (July through February) precipitation and thus is a good indicator of drought periods. Located 4.5 miles south of Santa Fe, the Arroyo Hondo Pueblo is near Pecos and precipitation would probably have been similar at both sites. (Rose, Dean, and Robinson, *The Pat Climate of Arroyo Hondo*, 92-93. All precipitation data for Arroyo Hondo comes from this source.

[3] PDSI—Palmer Drought Severity Index. The PDSI, "which is 'an index of meteorological drought, as opposed to a specific biological or hydrological measure,' is calculated using estimates of potential evapotranspiration and is based on tree-ring indices." It offers a general measure for the Southwest as a whole. Head and Orcutt, *From Folsom to Fogelson*, 1:165. All PDSI data comes from this source.

1250-1255: Intense, low period in spring precipitation recorded at Arroyo Hondo

1274-1298: PDSI recorded dry period

1275-1300: Known as "The Great Drought" in the Southwest. At Arroyo Hondo, annual precipitation showed more variability in this period, but spring precipitation did not exhibit an appreciable low.

1295-1335: Above average spring precipitation recorded at Arroyo Hondo

1304-1310: PDSI recorded dry period

1316-1319: PDSI recorded dry period (mild)

1324-1331: PDSI recorded dry period

1335: High in spring precipitation recorded at Arroyo Hondo

1336-1356: PDSI recorded dry period

1360-1370: PDSI recorded dry period

1365: Low in spring precipitation recorded at Arroyo Hondo)

1370: High in spring precipitation recorded at Arroyo Hondo

1377-1386: PDSI recorded dry period

1380: Low in spring precipitation recorded at Arroyo Hondo

1390-1394: PDSI recorded dry period (mild)

1397-1403: PDSI recorded dry period

1400 C.E. to 1500 C.E.

1400-1415: Extended high in spring precipitation recorded at Arroyo Hondo

1415-1428: PDSI recorded dry period

1420: Intense, ten year low in spring precipitation recorded at Arroyo Hondo centered on this date

1425: Pecos Pueblo constructed

1445-1465: PDSI recorded dry period

1450: Population has aggregated at Pecos Pueblo; all other pueblos in valley abandoned

1450-1475: Population peaks at Pecos Pueblo

1471-1484: PDSI recorded dry period

1495-1501: PDSI recorded dry period

1500 C.E. to 1600 C.E.

1506-1510: PDSI recorded dry period (mild)

1516-1520: PDSI recorded dry period

1523-1528: PDSI recorded dry period

1540: Coronado's expedition arrives in New Mexico. Delegation under Hernando de Alvarado arrives at Pecos in September or October.

1542-1553: PDSI recorded dry period

1558-1566: PDSI recorded dry period

1573-1577: PDSI recorded dry period (mild)

1579-1591: PDSI recorded dry period

1582: Antonio de Espejo expedition

1590-1591: Castaño de Sosa expedition

1598: Don Juan de Oñate establishes Spanish colony in New Mexico

1600 C.E. to 1700 C.E.

1600-1605: PDSI recorded dry period

1608-1610: PDSI recorded dry period (mild)

1610: Spanish capital moves to Santa Fe

1617: Franciscans establish mission at Pecos Pueblo

1622: Franciscans order construction of second, largest church at Pecos Pueblo

1625-1629: PDSI recorded dry period

1640s-1670s: Recurring Apache raiding at Pecos

1644-1652: PDSI recorded dry period

1658-1673: PDSI recorded dry period

1667-1672: Severe famine strikes the Spanish and Pueblos of New Mexico

1678-1680: PDSI recorded dry period (mild)

1680: Pueblo Revolt—Spanish driven from New Mexico

1685-1689: PDSI recorded dry period

1692: Diego de Vargas leads the Reconquest of New Mexico

1694: Franciscan ministry at Pecos resumes

1695: First *recorded* disease epidemic at Pecos Pueblo

1696-1699: PDSI recorded dry period

1700 C.E. to 1800 C.E.

1704: Disease epidemic at Pecos Pueblo

1705: Franciscans order construction of fourth and final church at Pecos

1706: First accounts of Comanche raiding in New Mexico

1728: Disease epidemic at Pecos Pueblo

1730: Disease epidemic at Pecos Pueblo

1730s: Comanche raiding severe and recurrent at Pecos

1738: Disease epidemic at Pecos Pueblo

1739: French traders from Louisiana arrive at Santa Fe

1740: Major low in spring precipitation at Arroyo Hondo

1745-1765: High interval of spring precipitation at Arroyo Hondo

1746: Severe Comanche attack at Pecos

1748: Severe Comanche attack at Pecos—Spanish and Pecos fight Comanches before walls of pueblo. Disease epidemic at Pecos Pueblo.

1750: Squad of Spanish soldiers garrisoned at Pecos

1752-1767: Alternating periods of peace and war between Spanish and Comanches. Peace broken in 1767.

1771: Severe Comanche attack at Pecos

1774: Severe Comanche attack at Pecos

1776: Fray Domínguez refers to the "drought of the past years" during his visit to New Mexico

1779: Juan Bautista de Anza defeats the Comanche leader Cuerno Verde

1780: Smallpox epidemic in New Mexico, including at Pecos Pueblo

1782: Franciscans declare Pecos a visita of Santa Fe—friar no longer in permanent residence

1786: Peace agreement between Spanish and Comanches—lasts until 1821

1794: San Miguel del Vado land grant awarded

1800 C.E. to 1900 C.E.

1800: Disease epidemic strikes Pecos Pueblo and Hispanic community

1802: Disease epidemic strikes Hispanic community

1803: The United States purchases the Louisiana Territory

1810-1814: Spanish Cortes meets—passes law regarding unused Pueblo lands

1815: Los Trigos and Cañon de Pecos (Alexander Valle) land grants awarded

1816: Disease epidemic strikes Pecos Pueblo and Hispanic community

1821: Mexico declares its independence from Spain. William Becknell opens the Santa Fe Trail.

1821-1840s: Comanche raiding at Pecos resumes

1823: Unused Pecos Pueblo land granted to Hispanic settlers

1825: Beaver trapped out of southern Sangre de Cristo Mountains

1838: Remaining Pecos emigrate to Jémez Pueblo

1846-1848: Mexican War

1847: First sawmill in New Mexico begins production

1848: Treaty of Guadalupe Hidalgo makes New Mexico a U.S. Territory

1850s: Pigeon's Ranch, Kozlowski's Trading Post, and Johnson's Ranch built/opened as hostelries on Santa Fe Trail. Army records mention drought in early 1850s, ending with heavy rains in 1852.

1858: Pecos Pueblo grant confirmed by Congress

1861-1865: American Civil War

1862: Battle of Glorieta Pass fought at Pecos, March 26-28

1877: *United States v. Joseph* finds that Pueblos are not "Indians" and thus Hispanic and Anglo settlement of their lands is legal

1880: Atchison, Topeka, & Santa Fe railroad lays tracks through Pecos

1886: Pecos River floods

1888: Elk hunted out of Pecos region

1890-1900: Sustained low in spring precipitation at Arroyo Hondo

1892: Pecos River Forest Reserve created

1897: *United States v. Sandoval* finds that Hispanic communal lands belong to U.S. government

1900 C.E. to 2000 C.E.

1903: Bighorn sheep hunted out of Pecos region. Timber wolves also hunted out by early 1900s.

1904: Pecos River floods

1905: USDA Forest Service created

1905-1945: Sustained high in spring precipitation at Arroyo Hondo

1905-1920: Unusually high period of precipitation

1912: New Mexico achieves statehood

1914: Gross Kelly Company quiet title suit settles titles of land in Pecos

1915: Pecos River Forest Reserve renamed the Santa Fe National Forest. Elk reintroduced into Pecos region.

1915-1929: Alfred Kidder conducts archeological excavations at Pecos

1916: National Park Service created

1917-1919: U.S. involvement in World War I

1920: Pecos Pueblo and mission ruins donated to Archbishop of Santa Fe

1921: Lisboa Springs Fish Hatchery constructed north of village of Pecos

1923: Last grizzly bear in Pecos region killed

1924: Pueblo Lands Act passed

1925: Tex Austin purchases land in Pecos and starts the Forked Lightning Ranch. Tom Greer purchases Pigeon's Ranch and turns it into a tourist attraction. The Fred Harvey Company and the AT&SF railroad begin their Indian Detours business.

1927: The American Metal Company begins operation of the Tererro Mine

1929: Pecos River floods

1930s: The Great Depression causes economic hardships for many residents of the Pecos valley. Beaver return to Pecos River watershed.

1931-1932: Extremely heavy snowfalls in northern New Mexico

1935: The State of New Mexico obtains ownership of Pecos Pueblo and mission ruins—declares the site a State Monument. Slight dip in spring precipitation at Arroyo Hondo

1939: Tererro Mine shuts down

1941: E. E. "Buddy" Fogelson purchases the Forked Lightning Ranch

1941-1945: U.S. involvement in World War II

1950-1955: Intense low in spring precipitation at Arroyo Hondo. Other sources record a severe drought in New Mexico in the 1950s.

1950:	First on-site caretaker installed at Pecos State Monument
1956:	The National Park Service's Mission 66 program begins
1958:	Santa Gertrudis cattle introduced on Forked Lighting Ranch
1965-1970:	Major pasture clearing operations on Forked Lightning Ranch
1964:	Passage of the Wilderness Act; Pecos Wilderness established; Interstate 25 constructed
1965:	Pecos National Monument established
1966:	Passage of the National Historic Preservation Act (NHPA)
1969:	Passage of the National Environmental Policy Act (NEPA); Park Service begins grassland restoration project east of the mesilla at Pecos
1971:	Pecos River freezes in March
1973:	Passage of the Endangered Species Act
1983:	Construction of the Pecos National Monument Visitor Center begins
1988:	Livestock grazing halted on Forked Lightning Ranch
1990:	Pecos National Historical Park established
1991:	Remediation efforts at Tererro Mine begin
1999-2000:	Glorieta Creek restoration project
2000:	Monument Fire; Viveash Fire

Appendix C.

Historical Information Regarding Non-Native, Invasive, and Extinct Plant Species

Table 1. Non-native or invasive species mentioned in E. O. Wooton and Paul C. Standley, "Flora of New Mexico," in *Contributions from the United States National Herbarium*, volume 19 (Washington D.C.: Government Printing Office, 1915) that occur in Pecos National Historical Park.[4]

Species	Remarks
Tamarix gallica (salt cedar)[5]	"A cultivated plant, used very effectively for hedges in many places, often escaped." (427)
Salsola tragus (prickly Russian thistle)	"Common at lower altitudes throughout [New Mexico]. One of the commonest introduced weeds on waste lands, along roadsides, and to some extent in fields on the open range. In some places it covers cultivated fields as closely as to appear like a sown crop. It was first noticed about fifteen years ago at Lamy by Prof. T. D. A. Cockerell…It is now to be found in practically every locality in the State except in the higher mountains" (199-200).
Chenopodium album (lambsquarters)	Grows on "cultivated and waste ground throughout [New Mexico]. The young plants are gathered and cooked as greens. Among the native people they are known by the name of 'quelite'" (208).
Kochia scoparia (Mexican fireweed)	"Has been cultivated at Albuquerque, and probably will be found escaped" (209).
Ulmus pumila (Siberian elm)	Not mentioned by Wooton and Standley
Bromus inermis (smooth brome)	"Native of Europe, locally established in the United States." New Mexico: found in Farmington and Mesilla Valley (97)
Dactylis glomerata (orchardgrass)	"Widely distributed in North America, introduced from Europe and often cultivated. New Mexico: Shiprock; Cedar Hill; Chama; Winsor's Ranch; Mesilla Valley." Winsor's Ranch was on the Upper Pecos River (98).
Poa compressa (Canada bluegrass)	"Native of Europe and Asia, widely naturalized in the U.S. New Mexico: Harvey's Upper Ranch; Raton" (100).
Poa pratensis (Kentucky bluegrass)	New Mexico: "Tunitcha Mountains; Chama; Santa Fe Canyon; Truchas Peak; Rio Pueblo; Reserve; Cloudcroft;

[4] This list is not comprehensive.
[5] Later inventories of New Mexican flora refer to both *Tamarix gallica* and *Tamarix pentandra;* William C. Martin and Charles R. Hutchins, *A Flora of New Mexico*, vol. 2 (Vaduz, Liechtenstein: J. Cramer, 1980), 1284.

Species	**Remarks**
	Raton; Albuquerque; White Mountains. Meadows and woods, in the Transition Zone" (100).
Phleum pratense (Timothy grass)	Found in "fields and meadows nearly throughout North America, introduced from Europe and often cultivated for hay….New Mexico: Chama; Raton; Cedar Hiss; Fort Bayard; Santa Fe; Ruidoso Creek; Gilmore's Ranch" (73).
Agrostis stolonifera (creeping bentgrass)	"Range: California and Texas to Mexico….New Mexico: Carrizo Mountains; Farmington; Sandia Mountains; Santa Fe; Las Vegas Hot Springs; Burro Mountains; Socorro; Fort Bayard; Berendo Creek; Rincon; Cloverdale; Mesilla Valley; Organ Mountains; Malone's Ranch; Roswell. Wet ground and borders of streams, in the Upper Sonoran and Transition zones" (78).
Conium maculatum (poison hemlock)	Not mentioned
Cirsium arvense (Canada thistle)	Not mentioned
Cirsium vulgare (bull thistle)	Not mentioned
Agropyron desertorum (desert wheatgrass)	Not mentioned
Agrostis gigantea (redtop)	Not mentioned, although *Agrostis alba* is mentioned
Bromus catharticus (rescue grass)	Not mentioned
Bromus japonicus (Japanese brome)	Not mentioned
Bromus tectorum (cheatgrass)	Not mentioned
Festuca aruninaceae (tall fescue)	Not mentioned
Psathyrostachys juncea (Russian wildrye)	Not mentioned
Lactuca serriola (prickly lettuce)	Not mentioned
Leucanthemum vulgare (oxeye daisy—called *Chrysanthemum leucanthemum subpinnatifidum* in Wooton and Standley)	"New Mexico: Near Pecos….In the East it is a troublesome weed, but it is still very rare in most parts of the West" (734)
Sonchus asper (spiny sowthistle)	"New Mexico: Farmington; Carrizo Mountains; Pecos; Santa Fe; Sandia Mountains; Mangas Springs; Berendo Creek; Cloverdale; Mesilla Valley; Fresnal; Round Mountain. A common weed in gardens and cultivated fields, widely introduced into North America from Europe" (623).
Onopordum acanthium (Scotch thistle)	Not mentioned
Taraxacum officinale (common dandelion)	"New Mexico: Santa Fe; Las Vegas; Farmington; Chama; Raton. Open fields and waste ground" (626).

Species	**Remarks**
Scorzonera laciniata (cutleaf vipergrass)	Not mentioned
Tragopogon dubius and *Tragopogon pratensis* (yellow salsify and meadow salsify)	Not mentioned; however, *Tragopogon porrifolius* is mentioned—"New Mexico: Pecos; Santa Fe; Ramah; Mesilla. The plant is frequently cultivated in gardens and often escapes" (621).
Alyssum simplex (alyssum)	Not mentioned
Barbarea vulgaris (garden yellowrocket)	Not mentioned
Camelina microcarpa (littlepod false flax)	"New Mexico: Pecos National Forest" (289).
Cardaria draba (hoary cress)	"New Mexico: Mesilla Valley. An introduced weed…it probably occurs elsewhere in the State, since the seeds are often distributed with those of garden or field crops or with grass seeds. It has been well established in the Mesilla Valley in alfalfa fields for several years" (271).
Chorispora tenella (crossflower)	Not mentioned
Nasturtium officinale (watercress)	"New Mexico: Farmington; Pecos; Santa Fe; Las Vegas; Mogollon Mountains; Berendo Creek; Gilmore's Ranch; Roswell" (284).
Roripa sylvestris (creeping yellowcress)	Not mentioned
Sisymbrium altissimum (tall tumblemustard)	"New Mexico: San Juan Valley. A native of Europe, widely introduced in the U.S., a noxious weed in the Northwest" (286).
Thlaspi arvense (field pennycress)	Not mentioned
Convolvulus arvensis (field bindweed)	"In New Mexico introduced from the east or from Europe. New Mexico: Farmington; Cedar Hill; Raton; Santa Fe; Chama; Clovis; Kingston; Silver City; Rio Gila; Mesilla Valley. This is a very variable species, but it seems ill advised to attempt to separate any of the forms. In New Mexico it is common in some localities in cultivated fields, where it is evidently introduced, as it doubtless is everywhere in the Rocky Mountain region" (519).
Dipsacus fullonum (Fuller's teasel)	Not mentioned
Euphorbia davidii (David's spurge)	Not mentioned
Lathyrus latifolius (perennial pea)	Not mentioned
Medicago sativa (alfalfa)	"Escaped in cultivated and waste ground in nearly all parts of the State" (343).
Medicago lupulina (black	"New Mexico: "Tesuque; Taos; Santa Fe; Pecos; Mangas

Species	**Remarks**
medick)	Springs. And introduction from Europe, occasional along irrigating ditches and in wet fields" (343).
Melilotus officinalis (yellow sweetclover)	"New Mexico: Mesilla Valley; Farmington; Cedar Hill. The plant is well established in orchards in the Mesilla Valley" (343). *Mellilotus indica* is also mentioned with the note that, "No weed is more common in alfalfa fields. Its seed is a common adulterant of alfalfa seed, and frequently the sweet clover seedlings are more numerous than the alfalfa plants" (343).
Trifolium pratense (red clover)	"New Mexico: Harvey's Upper Ranch; Winfields Ranch; Winsor's Ranch; Mesilla Valley; Pecos; Raton Farmington. Red clover has been noticed in only a few places in the State. Occasionally it appears in alfalfa, but it does not seem to survive long. It has been tried in cultivation at various places, but cannot compete with alfalfa on the market and has been cultivated but little" (345).
Trifolium repens (white clover)	"New Mexico: Chama; Winsor's Ranch; Santa Fe; Pecos; Farmington; Shiprock" (345).
Erodium cicutarium (redstem stork's bill)	"Introduced into nearly all parts of [New Mexico]….In certain parts of the Southwest it has been found to be a valuable forage plant, but it has never been utilized in New Mexico. Nowhere is it very abundant" (381).
Marrubium vulgare (horehound)	"In all the moister parts of [New Mexico]; often abundant, especially where sheep range" (556).
Asparagus officinalis (garden asparagus)	"New Mexico: Farmington; Santa Fe; Mesilla Valley. The cultivated asparagus thrives in New Mexico and is a not uncommon escape in the valleys" (139).
Plantago lanceolata (English plantain)	"New Mexico: Farmington; Mesilla Valley; Lake Valley….It grows in New Mexico chiefly in alfalfa fields, where it spreads rapidly" (603).
Plantago major (common plantain)	"Nearly cosmopolitan; a common weed throughout the U.S. New Mexico: Nearly throughout the State" (603).
Rumex crispus (curly dock)	Called yellow dock. "New Mexico: Common nearly throughout the State. The plant is often a troublesome weed in alfalfa fields and along ditch banks. The leaves are sometimes gathered and cooked as 'greens'" (192).
Verbascum thapsus (common mullein)	"New Mexico: Cedar Hill; Pecos; Mogollon; Ruidoso Creek" (577).

Table 2. Non-native or invasive species mentioned in E. O. Wooton, *Trees and Shrubs of New Mexico*, Bulletin 87 (Albuquerque: New Mexico Agriculture Experiment Station, 1913).

Species	**Remarks**
Tamarix gallica (salt cedar)	"One of the most satisfactory introduced plants in cultivation in this state….Once established it is almost impossible to kill it. As a plant to be used upon alkaline soils where other plants do poorly orin situations where too little water is available, there is no other plant which is quite so satisfactory" (124).
Elaeagnus angustifolia (Russian olive)	Not mentioned

Table 3. Non-native or invasive species mentioned in E. O. Wooton, *The Range Problem in New Mexico*, Bulletin 66 (Albuquerque: New Mexico Agriculture Experiment Station, 1908).

Species	**Remarks**
Sheep weed or snake weed or *yerba del vibora* (possibly *Guttierezia sarothrae* [broom snakeweed]?)	It "is taking over thousands of acres of our higher plains" (18-19).
Salsola tragus (prickly Russian thistle)	"The Russian Thistle has been introduced practically all over the Territory and seems to be taking possession of some ranges where the grass is badly killed out….It is now too late to hope to eradicate it, as might have been done years ago….These plants can hardly be called weeds, for they are not displacing better plants, but their room might be occupied by others of value if these latter could once be introduced" (18-19).

Table 4. Non-native or invasive species not mentioned by Wooton (1915) that are or are not mentioned in Ivar Tidestrom and Sister Teresita Kittell, *A Flora of Arizona and New Mexico* (Washington, D.C.: The Catholic University of America Press, 1941).

Species	**Remarks**
Conium maculatum (poison hemlock)	Not mentioned
Cirsium arvense (Canada thistle)	Introduced from Europe. Weed (499).
Cirsium vulgare (bull thistle)	Not mentioned
Agropyron desertorum (desert wheatgrass)	Not mentioned

Species	**Remarks**
Agrostis gigantea (redtop)	Not mentioned, although *Agrostis alba* is mentioned.
Bromus catharticus (rescue grass)	"Open ground and waste places. New York to Oregon, southward to Florida and California. Native of Argentina (858).
Bromus japonicus (Japanese brome)	"Waste places; Vermont to Washington, southward to North Carolina and California" (860).
Bromus tectorum (cheatgrass)	"Open ground and waste places. Nearly throughout the United States; introduced from Europe" (860).
Festuca aruninaceae (tall fescue)	Not mentioned
Psathyrostachys juncea (Russian wildrye)	Not mentioned
Lactuca serriola (prickly lettuce) – called *Lactuca scariola integrata* here	"Introduced weed" (359).
Onopordum acanthium (Scotch thistle)	Not mentioned
Scorzonera laciniata (cutleaf vipergrass)	Not mentioned
Tragopogon dubius and *Tragopogon pratensis* (yellow salsify and meadow salsify)	Not mentioned
Alyssum simplex (alyssum)	Not mentioned
Barbarea vulgaris (garden yellowrocket)	Not mentioned, although *Barbarea verna* and *Barbarea stricta* are mentioned
Chorispora tenella (crossflower)	Not mentioned
Thlaspi arvense (field pennycress)	"Introduced weed in waste places. Labrador to British Columbia, southward to Florida and Utah" (55-56).
Dipsacus fullonum (Fuller's teasel)	Not mentioned
Euphorbia davidii (David's spurge)	Not mentioned
Lathyrus latifolius (perennial pea)	Not mentioned

Table 5. Non-native or invasive species not mentioned by Tidestrom and Kittell (1941) that are or are not mentioned by William C. Martin and Charles R. Hutchins, *A Flora of New Mexico*, 2 vols. (Vaduz, Liechtenstein: J. Cramer, 1980).

Species	**Remarks**
Conium maculatum (poison hemlock)	"Introduced from Eurasia; now widely established in the United States" (1432).
Cirsium vulgare (bull thistle)	"Introduced from Europe, now widespread in North America" (2000-2001).
Agropyron desertorum (desert wheatgrass)	"Introduced from Eurasia; now occasional in the U.S., especially in the western states" (260-261).
Agrostis gigantea (redtop)	Not mentioned, although *Agrostis alba* is mentioned.

Species	**Remarks**
Festuca aruninaceae (tall fescue)	Not mentioned
Psathyrostachys juncea (Russian wildrye)	Not mentioned
Onopordum acanthium (Scotch thistle)	Not mentioned
Scorzonera laciniata (cutleaf vipergrass)	Not mentioned
Tragopogon dubius and *Tragopogon pratensis* (yellow salsify and meadow salsify)	Both introduced from Europe (1952-1954)
Alyssum simplex (alyssum)	Not mentioned
Barbarea vulgaris (garden yellowrocket)	"New Mexico: Wet meadows and waste places; occasional; 3,00-6,500 ft" (821).
Chorispora tenella (crossflower)	"Introduced from Asia; now occurring sporadically in western United States" (849).
Dipsacus fullonum (Fuller's teasel)	Not mentioned
Euphorbia davidii (David's spurge)	Not mentioned
Lathyrus latifolius (perennial pea)	Not mentioned

Table 6. Non-native or invasive species not mentioned by Martin and Hutchins (1980) that are or are not mentioned by Robert Sivinksi, "A Botanical Inventory of Pecos National Historical Park, New Mexico." Report on file, Pecos National Historical Park, Pecos, New Mexico, 1995.

Species	**Remarks**
Agrostis gigantea (redtop)	Mentioned
Festuca aruninaceae (tall fescue)	Mentioned
Psathyrostachys juncea (Russian wildrye)	Mentioned
Onopordum acanthium (Scotch thistle)	Mentioned
Scorzonera laciniata (cutleaf vipergrass)	Mentioned
Alyssum minus (alyssum)	Mentioned
Dipsacus fullonum (Fuller's teasel)	Not mentioned
Euphorbia davidii (David's spurge)	Not mentioned
Lathyrus latifolius (perennial pea)	Mentioned

Table 6. Extirpated grass species. Taken from Dan Scurlock, "From the Rio to the Sierra: An Environmental History of the Middle Rio Grande Basin," General Technical Report, RMRS-GTR-5 (Fort Collins, CO: U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station, 1998), 293.

Species	**Location**	**Year Last Collected**
Setaria verticillata (bristlegrass)	Mesilla Valley	1907
Sporobolus vaginiflorus (Sacaton or dropseed)	Las Cruces and Bernalillo County	1895
Bothriochloa wrightii (Wright's Bluestem)	Grant County (two locations)	1885, 1904

Species	**Location**	**Year Last Collected**
Spartina gracillis (cordgrass)	Santa Rosa	1945
Tripsacum lanceolatum (gamagrass)	Guadalupe Canyon	1915 pre
Muhlenbergia arsenei (muhly)	Soda Dam, Sandoval County	1938
Muhlenbergia andina (muhly)	Upper Pecos River	1908
Bromus brizaeformis (rattlesnake chess)	Pecos National Forest	1913 pre
Eragrostis hypnoides (lovegrass)	Elephant Butte Dam	1941

Table 7. Plant species extensively decimated or extirpated. Taken from Dan Scurlock, "From the Rio to the Sierra: An Environmental History of the Middle Rio Grande Basin," General Technical Report, RMRS-GTR-5 (Fort Collins, CO: U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station, 1998), 293.

Species	**Range**
Mentzelia albicaulis (stickleaf)	NW and W New Mexico
Portulaca spp. (purslane)	NW and NC New Mexico
Cycloloma atriplicifolium (winged pigweed)	NW and NC New Mexico
Kallstroemia spp. (contrayerba)	NW New Mexico
Allium macropetalum (wild onion)	NW New Mexico
A. cernuum var. obtusam (nodding onion)	C and W New Mexico
Tradescantia occidentalis (spiderwort)	NW and C New Mexico

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