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Prehistory and Early History of the Malpai Borderlands: Archaeological Synthesis and Recommendations

Paul R. Fish
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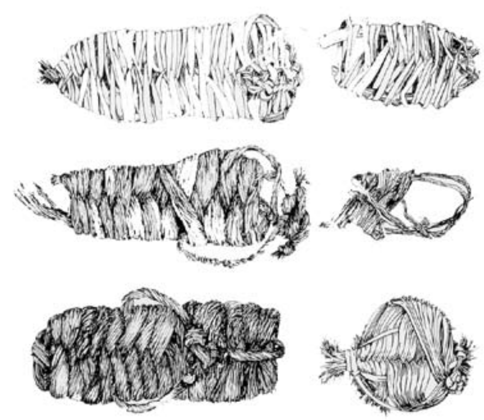

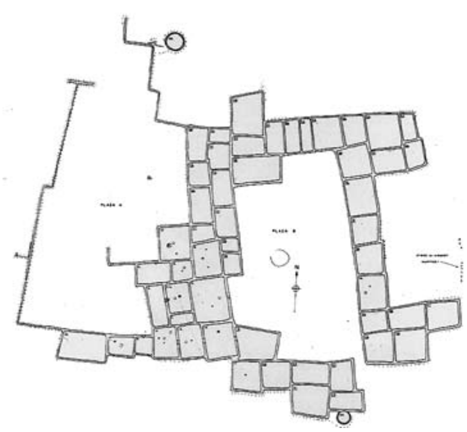

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Abstract—Prehispanic and early historic archaeological information for the Malpai Borderlands of southwest New Mexico and southeast Arizona is reviewed using data derived from field reconnaissance, discussion with relevant scholars, archival resources from varied agencies and institutions, and published literature. Previous regional research has focused on late prehistory (A.D. 1200 to 1450), shaping the scope of cultural historical overview and providing an opportunity to examine relationships with Casas Grandes (Paquime) to the south. A second important objective of current study is the exploration of pre-hispanic and early historic human impacts to Borderlands ecosystems, particularly in relation fire ecology. A recommended sequence of future research is intended to address significant questions surrounding both culture history and anthropogenic environments in the Malpai Borderlands.

Key Words: Malpai Borderlands, archaeology, Mimbres culture, Animas phase, Paquime

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Cover photos: *top left:* Cloverdale Playa
top right: Sandals
bottom left: Map of Box Canyon
bottom right: Photo of feature at Box Canyon

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Preface

Considerable time has passed since we began this project, and indeed, since we submitted this report. The volume has been through various rounds of editing, but publication has been delayed; its present form is much as it was when submitted in 2000. We have updated the text and references where feasible, but revising the entire document to reflect the last six years of research would have meant revisions beyond available time and resources. The volume must stand on its merits as a synthesis of archaeological and environmental research on the Malpai Borderlands study area at that time.

We appreciate the efforts of the U.S. Forest Service Rocky Mountain Research Station to bring the volume to final publication, and particularly Carl Edminister. Su Benaron of the Arizona State Museum provided invaluable editorial oversight in the final round of preparation. Her commitment and skill are greatly appreciated. We also thank Todd Pitezel, Department of Anthropology at the University of Arizona, for many tasks of compilation, editing, and attention to detail.

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Paul R. Fish
Suzanne K. Fish

Chapter 1.

Introduction

Malpai Borderlands Ecosystem Study Area

The Malpai Borderlands study area is in those portions of southeastern Arizona and southwestern New Mexico that have been biogeographically described as the Madrean Archipelago (DeBano and others 1994: 580). The area covers approximately 1,600 square miles of the Basin and Range Physiographic Province south of the Rocky Mountains and north of the Sierra Madre Occidental (fig 1.1). Arbitrarily bounded on the south by the international border with Mexico, it includes large sections of the San Bernardino, San Luis, Animas, and Playas Valleys.

Low elevations range from about 1,220 m (4,000 ft) in the San Bernardino Valley basins to 1,525 m (5,000 ft) in the Animas Valley and to 1,370 m (4,500 ft) in the Playas Valley. Highest elevations in the Animas and Peloncillo Mountains are over 2,240 m (8,000 ft). These elevation differences, combined with variation in climatic regime along the 120 km (75 miles) east-west width of the study area, create a region of considerable biological diversity; in fact, this is one of the most biologically diverse regions in North America (DeBano and others 1994: 580). Within the study area, lowlands are characterized by Sonoran Desert and thornscrub vegetation in the San Bernardino Valley in the west, by Plains Grassland in the centrally positioned Animas Valley, and by Chihuahuan desertscrub and grassland in the Playas Valley (Brown and Lowe 1980). Mountain ranges support oak and pine-oak woodlands, pine forests, and spruce-fir forests on the highest peaks.

Rainfall is highly correlated with elevation. Between 250 and 350 mm (9.75 and 13.65 inches) falls on valley floors and over 500 mm (19.50 inches) on the mountain crests. These patterns become increasingly summer-dominant as they move eastward across the study area. Hydrologically, sustained surface water is patchy, occurring in cienega locations on valley floors and spring localities at the edges and in the mountain masses. Interior drainage in the San Luis and Playas Valleys create large ephemeral lakes.

Because of this biological diversity and because of intense historic human impacts on the landscape, Federal and State land management agencies and local landowners are exploring use of the Malpai Borderlands as a natural laboratory to develop a comprehensive program of ecosystem management. Proposed and ongoing research to support this management program includes long-term studies of the ecosystem from population, community, and landscape perspectives and a focus on interactions between grasses and woody plants in relation to soils, climate, and human disturbance. From the onset, program research has emphasized invasion of woody plants into grassland environments and a resulting loss of ecosystem diversity.

The invasion of woody plants is variously attributed to drought, overgrazing by livestock, and the suppression of fire. Restoration of a "natural role" for fire, with prescribed burns and changes in wildfire suppression practices, is seen as an appropriate management technique to counter invasion trends (Allen 1994: 386–388). The role of fire and its long-term effectiveness in ecosystem management practices are a particular focus of Malpai Borderlands research goals.

The purpose of this present book is twofold: first, to synthesize existing archaeological information about the Borderlands to provide a long-term background of changing prehistoric environment due to climate and human impacts, including the use and suppression of fire; and

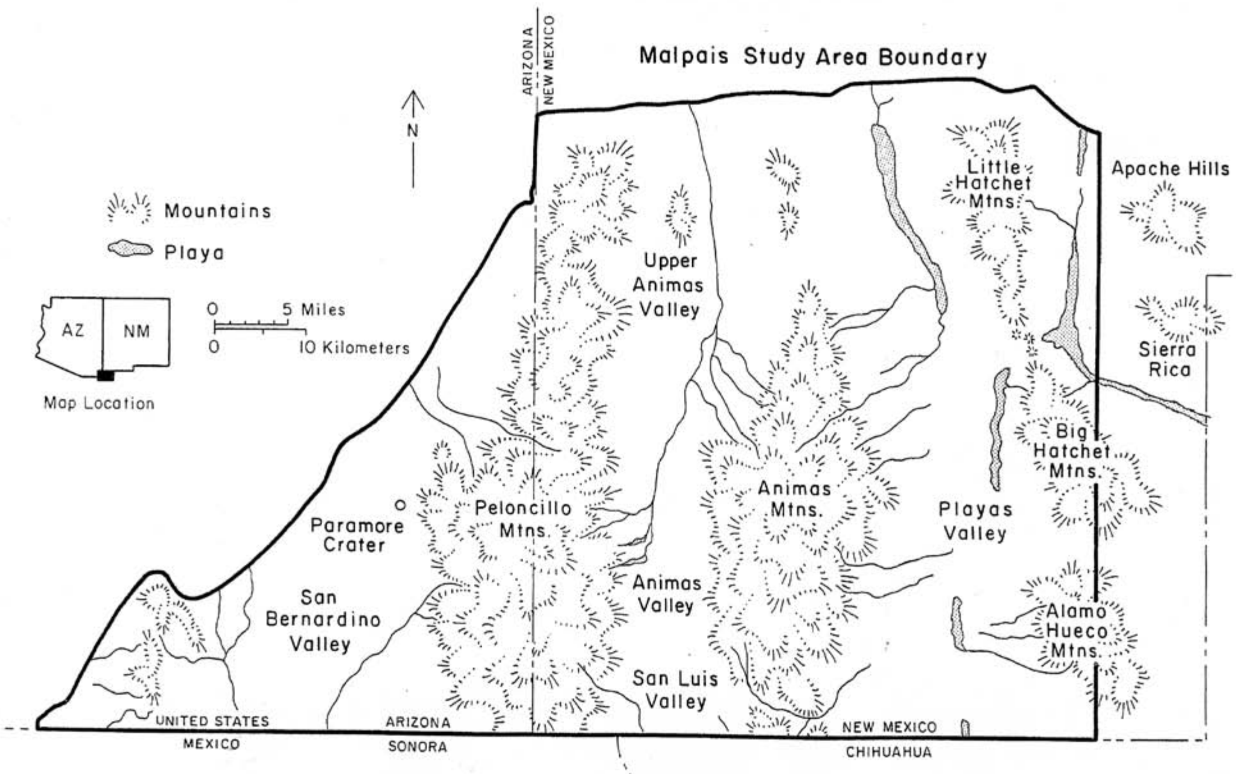

Figure 1.1. Major geographic features of the Malpai Borderlands study area.

second, to develop a plan for continuing investigation of these phenomena.

Borderlands Archaeological Context

The archaeological manifestations of the Malpai Borderlands study area are intermediate between the homelands of several better defined and relatively well-studied archaeological cultures. To the northwest, the Hohokam represent a persistent cultural expression throughout ceramic times. To the north and northeast, before A.D. 1200, the Mimbres culture created dominant styles. Thereafter, archaeological cultures in a broadly Mogollon tradition are represented by Salado and Casas Grandes spheres, to the north and south, respectively.

Located between some of the more dramatic developments in Southwest prehistory, the Malpai Borderlands have played a key role in regional synthesis and the development of interpretive constructs about frontiers (De Atley 1980), interaction spheres, political dominance (Di Peso 1974; Wilcox 1995), and short-term sedentism with cycles of abandonment and migration (Nelson and Anyon 1996; Nelson and LeBlanc 1986). These regional models and related constructs necessarily incorporate fragmentary data from the Borderlands and reflect perspectives based on better understood cultural systems in other regional sectors.

Local typological, chronological, and cultural sequences are poorly developed for the Malpai Borderlands. Instead, archaeologists typically have projected established schemes from adjacent cultures. Borderlands research invariably has been designed to address Casas Grandes, Mimbres, or Salado issues, and there has never been a sustained, intensive investigative focus on locally generated problems. Because the study area has not had significant pressures from urban or agricultural development with direct Federal and State involvement, cultural resource management investigations have been limited to a few surveys, and high-quality, large-scale excavation programs have not been undertaken.

Goals for This Overview

Four objectives for this overview were defined by the Coronado National Forest and the authors. First, we were to assemble and organize existing site information for the Malpai Borderlands study area. Second, a synthesis of study area culture history and ecology was to place local developments in a regional context and to serve as an annotated bibliography to facilitate future investigations. Third, a model of prehistoric human impacts from the particular perspective of fire ecology was to be constructed to frame questions for future research. Finally, a series of recommendations and stages of investigation were to be identified to direct future archaeological research by the Coronado National Forest and the Rocky Mountain Research Station, USDA Forest Service.

Project Methodology

Introduction to Study Area Archaeology

We gained insight into the archaeology and environment of the Malpai Borderlands study area through a 3-day field trip in January 1996 led by Thomas O'Laughlin of the Jornada Anthropological Research Association, John Douglas of the Department of Anthropology at the University of Montana, and John Carpenter of the Department of Anthropology at the University of Arizona. The first day was devoted to the Animas Valley with stops at an early ceramic site, Maddocks Ruin, Cloverdale Ruin, and Paleoindian and Archaic sites along Cloverdale Creek and at the edge of the Cloverdale Playa. We visited Joyce Well and Culberson Ruin on the second day and then visited a large Animas-phase pueblo in the Carretas Basin in Chihuahua. The third day was devoted to Boss Ranch and other sites in the San Bernardino Valley.

Paul and Suzanne Fish made additional visits to the study area in spring 1995 to gain additional familiarity with the environment. Extended discussion with others knowledgeable about Malpai Borderlands archaeology included Curtis Schaafsma, Paul Minnis, Stephen Lekson, Michael Foster, John Ravesloot, Michael Whalen, Jim Ayres, John Roney, Thomas Holcomb, and Diana Hadley. These reconnaissance visits and interchanges with area researchers provided insight and background to prepare us for writing this overview.

Project investigators returned to the study area two times in spring 1996. The first visit was an attempt to locate the ballcourt described by Roger Kelley (1963) and to conduct reconnaissance level survey around Box Canyon, the Cowboy site, and Clanton Draw. The ballcourt could not be located. The second visit was to archaeological sites located by Jeff Shauger, an employee of the Gray Ranch, and to examine collections made by him at these sites. Shauger has systematically recorded archaeological sites during the course of his survey of ranch facilities such as fencelines, roads, water tanks, and old homesteads. His archaeological efforts represent a valuable resource that we discovered only in April 1996, and unfortunately could not integrate into this overview in any systematic manner.

Annotated Bibliography and Historical Overview

We first prepared an annotated bibliography of archaeological literature directly bearing on the Malpai Borderlands study area and submitted it to the Coronado National Forest as a separate resource for its use. Although the bibliography is not included as an overview chapter, a majority of the entries have been incorporated into text references for chapter 4.

John Madsen reviews study area history in chapter 5 and in appendix D. The review covers the colonial and Mexican periods of study area land use and exploration to about A.D. 1850. Later ethnographic resources that pertain to Apache use of the study area are also incorporated.

Records and Archival Compilations

During spring and summer 1995, site files and report archives were consulted at the Arizona State Museum (including the records of the Gila Pueblo), Amerind Foundation, Bureau of Land Management (San Simon and Las Cruces offices), University Museum at New Mexico State University, School for American Research, and the Museum of New Mexico. Site and survey locations were plotted on USGS 7.5-minute topographic maps. Copies of these maps have been provided to the Cultural Resource Management office of the Coronado National Forest and are also on file at the Site File Office at the Arizona State Museum.

A database was developed from assembled site records that includes information on location, elevation, culture, ownership, and architectural and artifactual characteristics. The database is appendix A of this report. An electronic version also has been provided to the Heritage Program office of the Coronado National Forest for future expansion. Agency and other institutional surveys are listed by topographic quad in appendix B, and appendix C displays a concordance between site numbers and names assigned to study area sites by different institutions and surveys. Those interested in consulting literature on the Malpai Borderlands in addition to those cited in this volume, please refer to the section entitled "Supplementary Malpai Borderlands References."

General Land Office Survey maps and notes for the study area were obtained on microfilm from the Bureau of Land Management State Offices in Albuquerque, New Mexico, and Phoenix, Arizona. All relevant surveys date from the late 1890s to the early 1930s. Maps and notes were reviewed for information on water sources, evidence of farming, and old roads and trails. These maps contain considerable information of historic value, such as homestead locations and mines. The microfilm copies of maps and notes have been placed in the Arizona State Museum library.

Environmental Background

A survey of information of potential relevance in understanding Malpai Borderlands past and present environment was made by Guadalupe Sanchez de Carpenter and A.C. MacWilliams. Chapter 2 is a guide to published information directly pertaining to the study area and should be used as an annotated bibliography on subjects such as lithic resources, vegetation, soils, and studies of environmental change. It also provides discussion of environmental variability within and between study area valleys. Table 1.1 provides a list of common and scientific names for plants and animals used in this volume.

Finally, a major objective of this overview has been to explore possibilities of prehistoric human impacts to the environment, from the particular perspective of fire ecology (chapter 5). In view of the nature of available archaeological data, this study emphasizes the period of late prehistoric pueblos postdating A.D. 1200. Because both environmental and archaeological data are limited for the study area, the assessment draws heavily on ethnographic practices and interpolations from surrounding Southwestern regions. A model of impact specific to Malpai Borderlands vegetation and settlement patterns is presented in chapter 6.

Postscript and Acknowledgments____

This report was prepared in 1997 as part of a contract between the University of Arizona and the Rocky Mountain Research Station, USDA Forest Service. It was revised only slightly before publication to accommodate important new findings and critical literature. With the exception of research by New Mexico State University (Skibo and others 2002) in the "bootheel," and reanalysis of past excavations (Douglas 2004; Skibo and others 2002), few new investigations have been conducted and published within the Malpai Borderlands study area. However, intensive investigations south of the international border have significantly changed our understanding of regional culture history. Changes in the original manuscript have been limited to only the most important of these findings.

Acknowledgments

Carl Edminster (Rocky Mountain Research Station, USDA Forest Service), Patricia Spoerl (Recreation and Lands Staff Officer, Coronado National Forest) and James MacDonald (Forest Archaeologist, Coronado National Forest), were constant sources of information, advice, editorial comment, and administrative support throughout the process of preparing this overview. Conversations with numerous colleagues helped refine our understanding of local prehistory and often led us to new sources of data; these individuals include Jim Ayres, John Carpenter, Jeffrey Dean, John Douglas, Patricia Gilman, Diana Hadley, Thomas Holcomb, Stephen Lekson, Paul Minnis, Thomas O'Laughlin, David Phillips, John Ravesloot, John Roney, Curtis Schaafsma, and Michael Whalen. Curtiss Schaafsma particularly stands out for generously sharing his wealth of information and data on the bootheel section of the Borderlands. Archives and site files at the Amerind Foundation, Arizona Bureau of Land Management, New Mexico Bureau of Land Management, Arizona State Museum, Museum of New Mexico, Gray Ranch, and the New Mexico Bureau of Mines provided information important in the preparation of the overview. Ben Brown and Jeff Shauger of the Gray Ranch offered important information about study area archaeology and environment. John Douglas (University of Montana), William Gillespie (Coronado National Forest), and John Ravesloot (Gila River Indian Community) supplied numerous suggestions in their peer review of the final draft manuscript.

Table 1.1. List of common and scientific names used in this publication.[a]

Common name	Scientific name
Acacia	*Acacia* sp.
Acorn	*Quercus* sp.
Agave	*Agave* sp.
Alligator juniper	*Juniperus deppeana*
alkali-sacaton grass	*Sporobolus wrightii*
Antelope (pronghorn)	*Antilocarpa americana*
Apache pine	*Pinus engelmannii*
Ash	*Fraxinus* sp.
Aspen	*Populus* sp.
Bean	*Phaseolus* sp.
Bear-grass	*Nolina* sp.
Blue grama	*Bouteloua gracilis*
Bobcat	*Lynx rufus*
Border pinyon[b]/ Mexican pinyon	Pinus discolor[b]/ Pinus cembroides
Bottle Gourd	Lagenaria siceraria
Bulrush	Scirpus *sp.*
Burro-weed	*Aplopappus tenuisecta*
California Partridge	*Callipepla californica*
Catclaw	*Acacia Greggii*
Cedar	*Juniperus* sp.
Chihuahua pine	*Pinus leiophylla* var. *chihuahuana*
Cholla	*Opuntia* sp.
Colorado chum	*Gila* cf. *robusta*
Corkbark fir	*Abies lasiocarpa* var. *arizonica*
Corn	*Zea mays*
Cottontail	*Sylvilagus* sp.
Cottonwood	*Populus* sp.
Coyote	*Canis latrans*
Creosote-bush	*Larrea tridentate*
Cucurbit	*Cucurbita* sp.
Deer	*Odocoileus* sp.
Dock	*Rumex* sp.
Dog	*Canis Familiaris*
Douglas-fir	*Pseudotsuga menziesii*
Emory oak	*Quercus Emoryi*
Engelmann spruce	Picea Engelmanni
Evergreen Oak	*Querqus* sp.
Fir	*Abies* sp.
Fox	*Vulpes* sp./*Urocyon* sp.
Goat	*Capra hircus*
Grama grass	*Bouteloua gracilis* sp.
Gambel oak	*Quercus Gambelii*
Gray oak	*Quercus grisea*
Grizzly bear	*Ursus horribilis*
Hawk	Accipitridae
Heron	Ardeidae
Honey mesquite	*Prosopis juliflora*
Jackrabbit	*Lepus* sp.
Juniper	*Juniperus* sp.
Macaw	*Ara* sp.
Mammoth	*Mammuthus* sp.
Mescal	*Agave* sp.
Mesquite	*Prosopis* sp.
Mesquite grass	*Panicum obtusum*
Oak	*Quercus* sp.
Ocotillo	*Fouquieria splendens*

Table 1.1. *Continued*.

Common name	Scientific name
One-seed juniper	*Juniperus monosperma*
Owl	Strigiformes
Palmilla	*Yucca elata*
Panther (Mountain Lion)	*Felis concolor*
Pine	*Pinus* sp.
Pinyon pine	*Pinus* sp.
Ponderosa pine	*Pinus ponderosa*
Prickly pear	*Opuntia* sp.
Quaking Aspen	*Populus tremuloides*
Rabbit-brush	*Chrysothamnus* sp.
Rock Squirrel	*Spermophilus variegates*
Salt-bush	*Atriplex* sp.
Scarlet Macaw	*Ara macao*
Skunk	Mephitinae
Snakeweed	*Gutierrezia* sp.
Soap-weed	*Yucca* sp.
Sotol	*Dasylirion Wheeleri*
Spruce	*Picea* sp.
Squawfish	*Ptychocheilus lucius*
Sycamore	*Platanus* sp.
Tar-bush	*Flourensia cernua*
Tiger salamander	*Ambystoma tigrinum*
Turkey	*Meleagris gallopavo*
Yucca	*Yucca* sp.
Walnut	*Juglans* sp.
White Pine	*Pinus Strobiformis*
Willow	*Salix* sp.
Wolf	*Canis lupus*
Wolfberry	*Lycium* sp.
Wood rat (packrat??)	*Neotoma*

[a] Plant Nomenclature according to Kearney and Peebles (1960) unless otherwise indicated.
[b] Border Pinyon (Bailey and Hawksworth 1983) was described and distinguished from *P. cembroides* (Mexican Pinyon) after publication of Kearney and Peebles' most recent edition (1960).

Guadalupe Sanchez de Carpenter
A.C. MacWilliams

Chapter 2.

Borderlands Environment, Past and Present

The major mountain ranges in the study area today were produced by Middle Miocene and younger extensional faulting. Faulting continued into the late Pleistocene as evidenced by fault scarps along the margins of the Animas, Hachita, and Playas Valleys. These long-term geologic events resulted in the present basin and range physiography of the Malpai Borderlands, as summarized by Hawley (1993).

The area is classified as Mexican Highland within the Basin and Range Province. Basins below 1,525 m (4,600 ft) form the bulk of the Chihuahuan Desert region in the Mexican Highland Section (Hawley 1993: 40). Broad intermontane basins often drain internally into playas. Integrated drainages exist only in the San Bernardino Valley, which drains into the Rio Yaqui system to the south, and in nearby areas such as the Gila River drainage system north of the Borderlands. Roughly north-south trending mountain ranges separate the basins. Low gradient bajadas extend several kilometers from mountains and their pediments toward basin centers. The few sizable drainages in the area form alluvial fans that also extend outward into basins. Much of the ground surface is covered with gravels.

Post-Pleistocene Environmental Change

There are several, sometimes competing, models for post-Pleistocene environmental change in the Borderlands region. Models are derived from geomorphological reconstructions of pluvial lake history, paleofaunal studies, palynology, and analyses of packrat (*Neotoma* sp.) middens. Climatic reconstructions from tree-ring data would be especially useful for archaeological studies; important new data encompassing much of the late prehistoric archaeological record for the Malpai Borderlands will soon be made available by Thomas Swetnam and his students.

Each approach to climatic reconstruction derives from a different body of information and provides a different perspective on change. Interpretations may be contradictory because of the spotty nature of databases, differing theoretical perspectives, and the lack of an integrated effort to reconstruct past environment. Furthermore, it may not be possible to relate climatic reconstructions directly to potential behavioral responses reflected in the archaeological records. The tree-ring record is a good example. Reconstructions are based on the Palmer Drought Severity Index (PDSI) for June because tree ring width is highly correlated with the severity of local spring drought. However, as discussed in the section on contemporary climate in this chapter, spring moisture was much less critical to prehistoric farmers dependent on summer rains, which show less variability from year to year.

Geomorphological Reconstructions of Pluvial Lakes

Three post-Pleistocene pluvial lakes existed in the Borderlands study area. These are Lake Hachita to the west of the Little Hachet Mountains, Lake Playas in the middle of the Playas Valley, and Lake Cloverdale

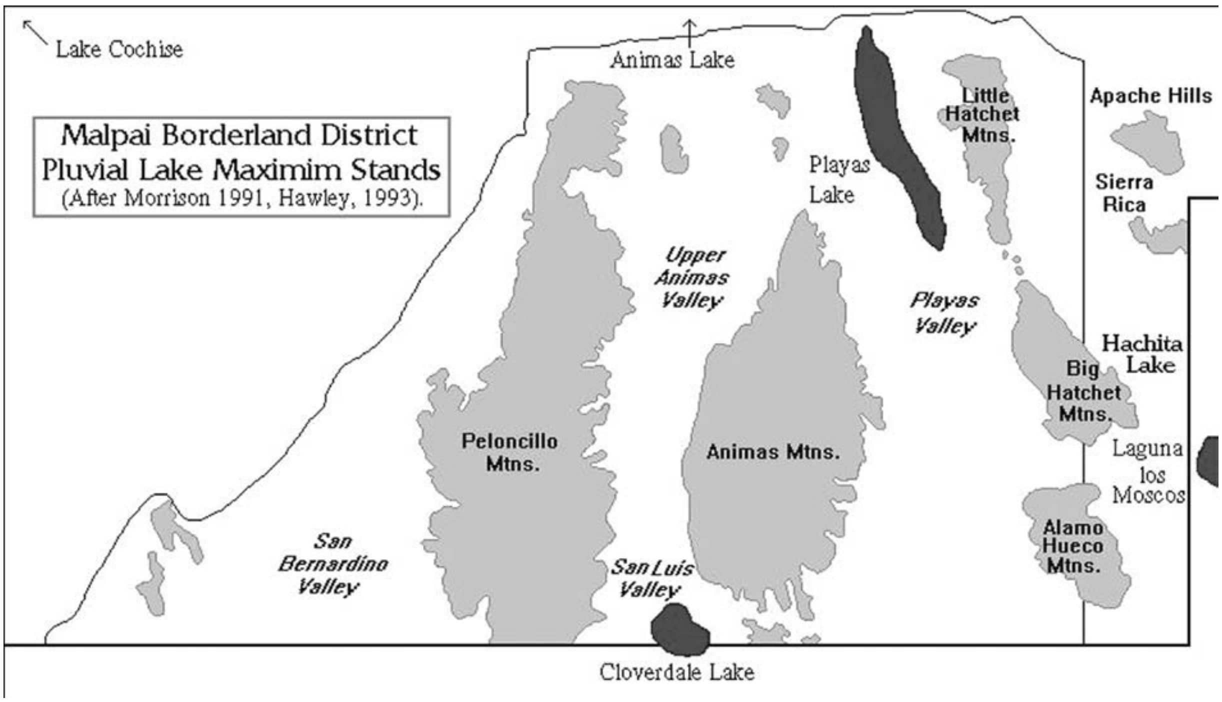

Figure 2.1. Maximal extent of post-Pleistocene pluvial lakes in the study area.

(San Luis Lake) in the San Luis Valley. Two main shore embankments have been identified around Lake Playas (Morrison 1991: 365). Fleischhauer and Stone (1982) state that this lake covered nearly 65 km^2 (25 square miles) until about 4500 B.P., reappeared briefly about 3000 B.P., and again at 1000 B.P. High pluvial lake stands in the study area are shown in figure 2.1.

Reconstructions of two lake histories north of the Borderlands deserve mention. High-stands at Lake Cochise (Wilcox Playa) have been radiocarbon dated to 13,500 and 8900 B.P., and it has been an ephemeral playa since mid-Holocene times (Waters 1986; Waters and Woosley 1990: 163). Lake Animas in the lower Animas Valley is believed by Fleischhauer and Stone (1982: 9) to have had a similar history. As with Lake Playas, shoreline age is estimated by comparison of shoreline soils with soils of known age in other basins.

Implications of Faunal Remains for Pluvial Lake History

A 12,000 year stratified sequence of vertebrate fauna from Howell's Ridge Cave in the Little Hachet Mountains in the northeastern corner of the Borderlands study area helps place the pluvial lake reconstructions in perspective (Van Devender 1995: 89–92; Van Devender and Worthington 1977). The cave is a vertical chimney in a steep limestone ridge on the dry lake bed of the Playas Valley. Thousands of bones and teeth of small vertebrates were continuously deposited in owl (Stragiformes) and hawk (Accipitridae) pellets during the entire cave sequence. Riparian fauna including Tiger salamander (*Ambystoma tigrinum*) and Colorado chum (*Gila cf. robusta*) indicate the playa contained perennial water from 12,000 to 4000 B.P., once again about 3000 B.P., and finally about 1000 B.P., supporting the geomorphological reconstruction by Fleishhauer and Stone (1982: 19).

Heavily disturbed desert grassland in portions of many Borderlands valley floors is dominated by creosote-bush (*Larrea tridentate*), salt-bush (*Atriplex* sp.), honey mesquite (*Prosopis juliflora*), yucca (*Yucca* sp.), and tar-bush (*Flourensia cernua*). These shrubs appear to have been restricted to drainages in a grassy landscape prior to 1890 (Van Devender 1995: 90). Quantitative analyses of reptile bones from Howell's Ridge Cave document similar increases in shrubs and succulents at 3900, 2500, and 990 B.P. (Van Devender and Worthington 1977).

Packrat Midden Studies

Packrat midden records from a variety of Chihuahuan Desert locations to the north and east of the study area provide evidence for the sequence of desert grassland development (Van Devender 1990; summarized in Van Devender 1995: 88–95; Van Devender and others 1987). Vegetation of the lower mountain slopes shifted from a pinyon-juniper woodland to oak-juniper woodland about

11,000 years ago and then to desert grassland about 8500 years ago. Honey mesquite dispersed into the northern Chihuahuan Desert about 9000 years ago and widespread desertscrub—notably creosote-bush and ocotillo (*Fouquieria splendens*)—appeared in these grasslands about 4500 years ago.

These data appear to contradict a mid-Holocene Altithermal drought as postulated by Antevs (1955) on the basis of geological studies in the northern Great Basin. Instead of an Altithermal drought from 8500 to 4000 B.P., Van Devender (1995: 89) suggests that the summer monsoons and desert grasslands were better developed than they are today, and in fact, attained their greatest area. This reconstruction also fits the faunal evidence from Howell's Ridge Cave.

Palynological Reconstructions

On the basis of pollen sequences from early archaeological sites at Double Adobe, Lehner, and Murray Springs just to the west of the study area, Martin (1963a,b) also argued for a wetter mid-Holocene and, in fact, for the establishment of Chihuahuan Desert grasslands in southeastern Arizona by the terminal Pleistocene. This reconstruction based on records from basin floors indicates the presence of grasslands several thousand years earlier than Van Devender's packrat midden interpretation. That middens do not directly monitor vegetation at such low elevation settings may be a factor in this discrepancy.

A study by Davis and others (2001) provides Holocene paleoecological data within the Borderlands. He reports cores from seven cienegas; six are adjacent to the study area and a seventh is from the Animas Creek Cienega on the Gray Ranch. Here, the basal ^{14}C date is about 7000 B.P. Corn (*Zea mays*) and agricultural weed pollen were recovered in a level dating approximately to 3400 B.P. (Davis and others 2001: 408).

A mid-Holocene increase in grass pollen is apparent. Davis and colleagues (2001) interpret this increase in grass frequencies, deteriorated pollen, and high fungal spore counts to indicate increased desiccation between 7000 and 5000 B.P. After 5000 B.P., there is a gradual increase in aquatic plant pollen, and the same researchers suggest standing water was present in the Animas Creek Cienega between 3700 and 1900 B.P. Based on all seven cienegas, they summarize an expansion of aquatic vegetation at 3000, 1800, and 500 to 300 B.P.

Historic increase in wetland indicators coincides with a decrease in microscopic charcoal (Davis and others 2001). Older sediments contain less organic material and fewer fungal spores, from which he concludes that annual prehistoric burning probably occurred. Before the historic period, frequent burning by indigenous peoples prevented woody plants and bulrush (*Scirpus* sp.) from reaching maturity. Pollen profiles also document prehistoric disturbance of cienega environments through the presence of corn and agricultural weeds.

Historical Changes to the Grassland

As a result of historic land use, Southwest grasslands have experienced rapid and extensive modification. The native grass growth has declined, and trees and woody shrubs, such as mesquite (*Prosopis* sp.), acacia (*Acacia* sp.), burro-weed (*Aplopappus tenuisecta*), snakeweed (*Gutierrezia* sp.), and one-seed juniper (*Juniperus monosperma*), have increased, replacing the grassland. Bahre (1991) believes that the areal extent of grasslands has not changed significantly, but that grass has been replaced by the scrubby trees and shrubs since the 1870s. The mechanisms by which this increase has taken place are not well understood, but the increase of the woody component is attributed to a combination of overgrazing and wildfire suppression. Other factors that have contributed to changes in the grassland include agricultural clearing, urban and rural development, range management policies, and the introduction of exotic plant species (Bahre 1991; Brown 1950; Brown 1994b; Cornelius 1988; Gould 1951; Hennessy and others 1983; Humphrey 1958, 1985). All of these factors affect the potential human resource distributions between historic and prehistoric times.

Precipitation and Growing Season

The Malpai Borderlands has a continental desert climate with distinct seasons. Valley locations receive about 250 mm (9.75 inches) of annual precipitation (Gabin and Lesperance n.d.; Sellers and others 1985; Tuan and others 1969). Over 60 percent of the annual rainfall occurs in the summer (fig 2.2). A marked spring drought during March, April, May, and June is characteristic. Wind intensity is also greatest during the spring months, increasing evapotranspiration. These high westerly winds spur spring dust storms, particularly in the western portion of the study area.

Precipitation totals for the 12 study area weather stations are strongly correlated with elevation (Gabin and Lesperance n.d.; Tuan and others 1969). There is also a marked reduction in precipitation from south to north as lesser mountain masses stimulate less orographic rainfall. Drawing upon higher precipitation in the mountains, drainages with upland watersheds carry the majority of water available to farmers. The spring drought is sufficiently pronounced, and snowmelt in moderate-sized

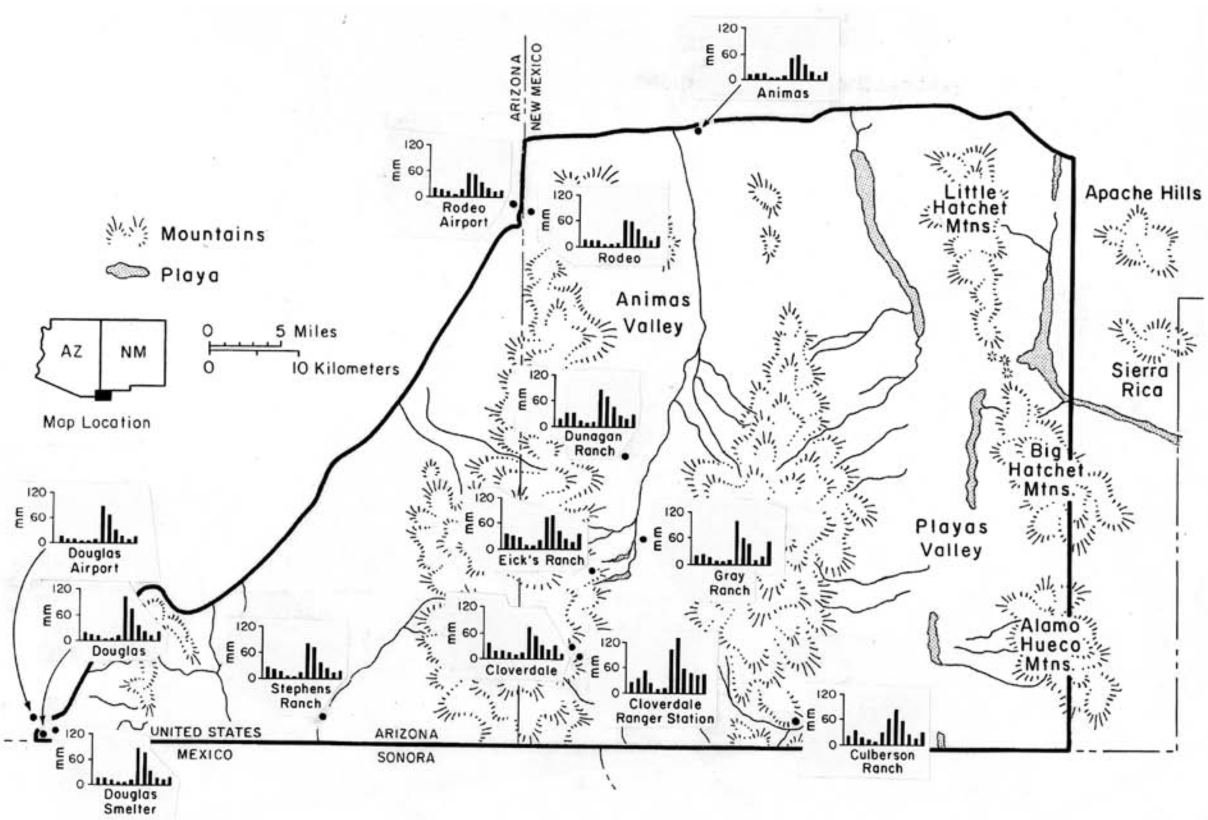

Figure 2.2. Annual distribution of rainfall for weather stations in the study area.

mountain masses is sufficiently limited that few drainages from the uplands could have supported spring crops. Although there is high year-to-year variability in annual rainfall, the amount and timing of summer storms is relatively predictable (Shaw 1993).

Summertime temperatures often exceed 40 ^{o}C (90 ^{o}F) and wintertime lows are often below zero. Although average growing season length is 215 days in some lower valley locations, temperatures as well as the seasonality of precipitation restrict the effective length for agriculture. In many parts of the study area, cold air drainage is pronounced (Mueller 1988: 28). A significant chance for killing frosts occurs relatively late in the spring and early in the fall. For instance, there is a 5 percent probability of a frost until the third week of May near Animas and a 5 percent probability again by early October. This interval leaves only 140 days where there is less than a one in 20 chance for a crop-killing freeze.

Low winter rainfall, an intense spring drought, and a frost threat as late as mid-May suggest that crops generally were not planted in the study area until after the onset of the summer monsoon season in July. Even so, planting in response to the arrival of summer rains was the previous pattern of Tohono O'odham farmers who depended on summer-dominant rainfall and hydrological sources similar to those available in the Borderlands (Bryan 1929; Castetter and Bell 1942; Nabhan 1983, 1986). Early frost or a delay in summer thunderstorms must have posed risks to successful harvests. Elevational situations above the limits of cold air inversion may have presented localized opportunities for early plantings where high water tables or springs permitted irrigation.

Borderlands Biotic Communities______

Following the classification system of Brown and others (1979; Brown 1994a), several biotic communities dominate the Borderlands study area. Semidesert grassland is present in the San Bernardino Valley, in the lower Animas Valley, and throughout most of the Playas Valley. Plains grassland is concentrated in the upper Animas Valley. Chihuahuan desertscrub occurs as patches in the northeastern sector of the study area, and in the lower section of the San Bernardino Valley. Riparian vegetation is found along drainages. In some cases in closed basins, playas often display sparse, salt-tolerant species. Patches of Madrean evergreen woodland occur in the mountains above approximately 1,515 m (5,000 ft). Petran montane conifer forest occurs only at the highest elevations of Animas Peak, which rises to 2,519 m (8,519 ft) above mean sea level (figs 2.3, 2.4, and 2.5).

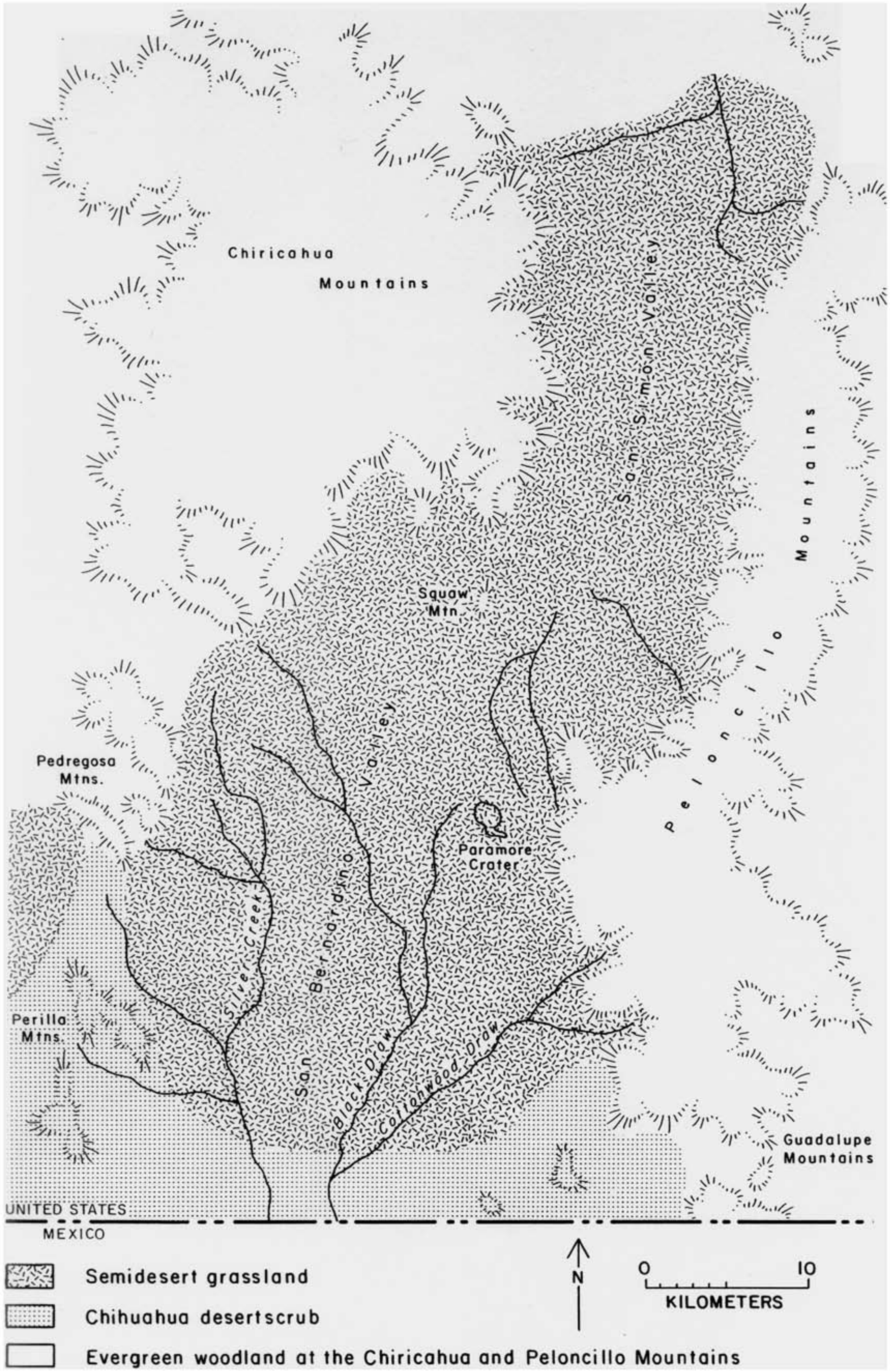

Figure 2.3. Vegetation map of the San Bernardino Valley.

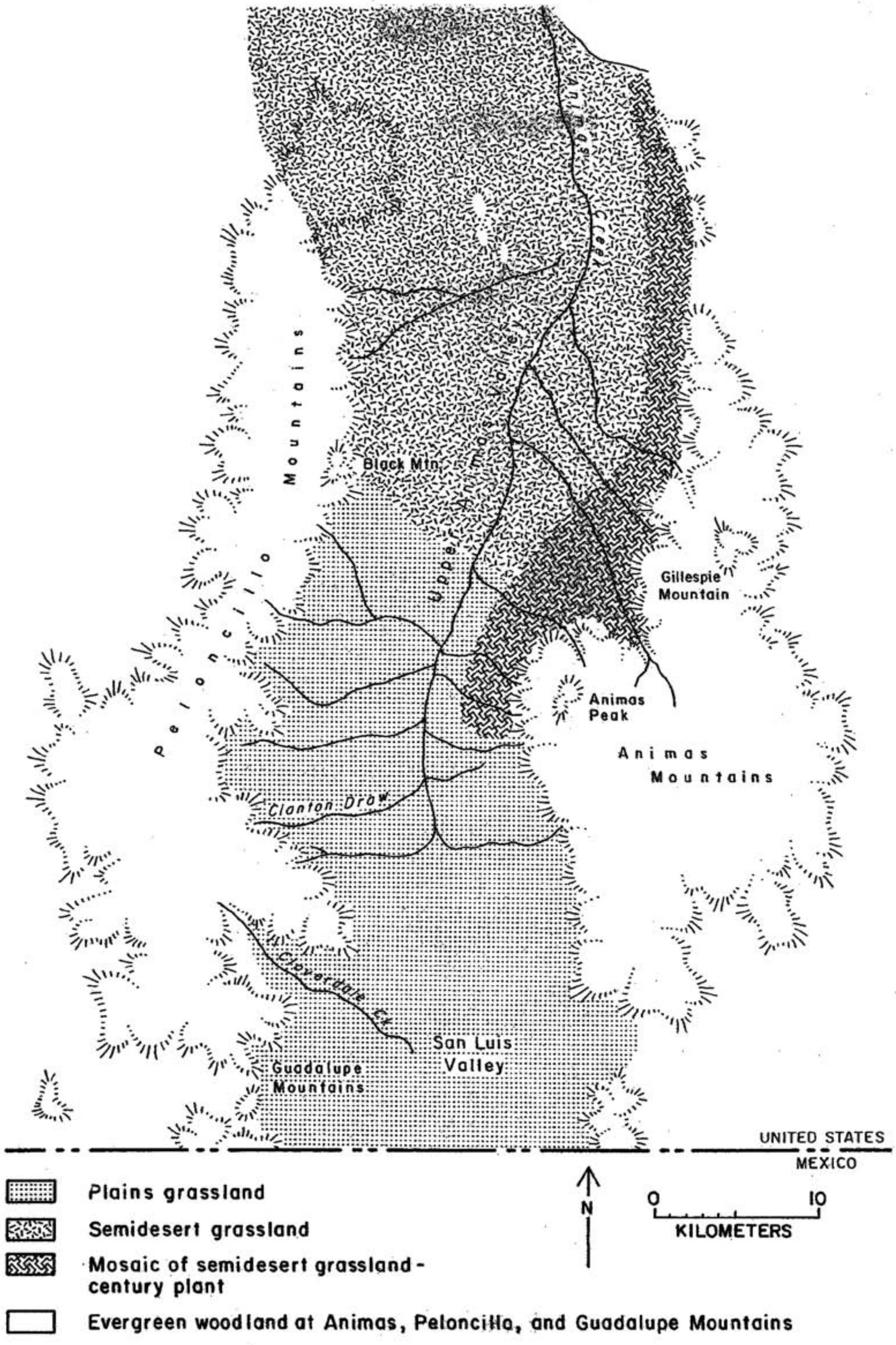

Figure 2.4. Vegetation map of the Animas and San Luis Valleys.

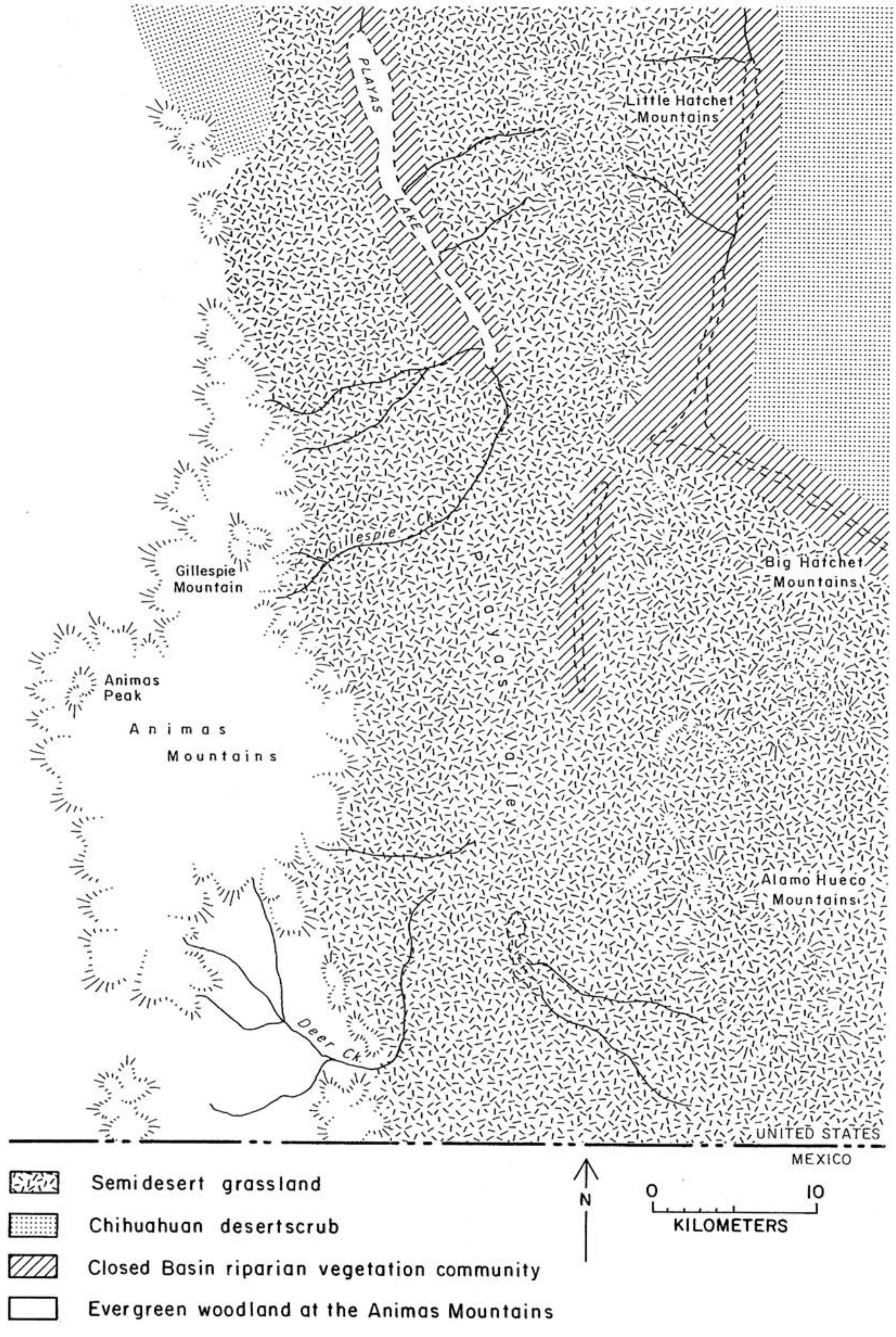

Figure 2.5. Vegetation map of the Playas Valley.

Grassland Biotic Community

Semidesert Grassland—The semidesert grassland is the most widespread Borderlands biome on the basin floors and in the lower elevations of the mountain ranges. The semidesert grassland is a transitional zone between plains grassland and Chihuahuan desertscrub and shares some of the floral and faunal constituents of both. It is nonetheless a distinctive and separate biome (Brown 1994b: 126–127). According to Dick-Peddie (1993:107), much of the desert grassland and desertscrub land in New Mexico occupy areas that were previously grassland. It is difficult to determine recent successional-disturbed desert grassland invaded by woody shrubs from original desert grassland (Brown 1994b: 127).

In general, the semidesert grassland covers gentle and moderate slopes of coarse sandy soils derived from extrusive rocks (Cornelius 1988: 1). Where it makes contact with the Chihuahuan desertscrub, it creates a complex and alternating landscape pattern over many miles. At its upper elevations, this biome usually makes contact with evergreen woodland or plains grassland. Within Chihuahuan desertscrub, semidesert grassland occurs in isolated pockets as the vegetation of enclosed-drainage playas (Bahre 1991: 23; Brown 1994b: 123).

Formerly, the grasses were perennials with reproduction principally from seed. Heavy grazing has reduced these grasses and increased low-growing sod grasses such as Mesquite grass (*Panicum obtusum*). The semidesert grassland is a perennial grass-scrub dominated landscape. Because the rainy seasons are short and somewhat uncertain, grasses and shrubs tend to grow and set seed rapidly, with most of the growth taking place during August. The vegetation ranges from pure grass landscapes to any combination of shrub, trees, and cactus. The community physiognomy of semidesert grassland is one of a landscape broken up by the uneven stature of large, diverse, and well-spaced scrub species (Bourgeron and others 1995: 20; Brown 1994b: 127; Humphrey 1958: 195). There are vast areas where climax grasses have been much reduced by competition with a wide variety of shrub, small tree, and cactus life forms.

Shrubs and small trees are locally important. In general, with the exception of mesquite and some juniper (*Juniperus* sp.) at the higher elevations, trees are restricted to riparian habitats. Stem and leaf succulents, including sotol (*Dasylirion Wheeleri*), agave (*Agave* sp.), bear-grass (*Nolina* sp.), and yucca species, are particularly well represented and characteristic of semidesert grassland in some places. Palmilla (*Yucca elata*) is often a particularly visible plant in the landscape (Brown 1994b: 127). In the mid-elevation western slope foothills of the Animas Mountains, a semidesert grassland with abundant agave forms a grass-century plant mosaic (Bourgeron and others 1995: 19).

Plains Grassland—The plains grassland biome within the study area is present in the upper Animas Valley and the San Luis Valley. These areas of plains grassland represent the southwesternmost extension of the North American Prairie. The primary upper grassland contact is with woodland; the lower elevation contact is with semidesert grassland (Brown 1994b: 115; Dick-Peddie 1993). Almost all the plains grassland is composed of short-grassland communities. These communities were significantly altered by cattle grazing and fire suppression, resulting in the current uncluttered perennial grass-dominant landscape (Brown 1994b).

The principal grass constituents are perennial sod-forming species of which blue grama (*Bouteloua gracilis*) and other gramas (*Bouteloua* sp.) are usually important. Shrubs such as salt-bush, Cholla (*Opuntia* sp.), soap-weed (*Yucca* sp.), rabbit-brush (*Chrysothammus* sp.), and snakeweed may be scattered throughout the landscape. The snakeweeds now form extensive disclimax communities over many miles of former grassland. Junipers also have invaded large acreages (Brown 1994b: 119). Cacti are locally represented in patches of plains grassland of the study area.

The San Luis Valley located south of the Animas Valley is bisected by the international border. Much of its area was encompassed by a former playa, and its unique vegetation is Great Plains grassland composed. In eastern New Mexico, dry and irrigated farming have greatly reduced the amount of plains grassland. The vegetation is widely in a state of succession shifting toward desert grassland (Dick-Peddie 1993: 104).

Chihuahuan Desertscrub Biotic Community

Areas of Chihuahuan desertscrub are covered with a low scrub vegetation. The vegetation ranges from a creosote-bush-dominated scrub on gently sloping plains to a more species-rich mixed desertscrub on upland rocky bajadas. The most common plant association of the region is creosote scrub. This association occurs on extensive areas of intermontane arid alluvial or outwash plains and bajadas that are dry most of the year. Creosote-bush is often quantitatively or at least visually dominant. These areas may have either sandy or, commonly, clayish soils that are generally of uniform texture. The diversity of plants increases in deeper soils and along minor drainage where tar-bush, acacia, mesquite, and catclaw (*Acacia Greggii)* frequently grow. The only other desertscrub communities that occur in a widespread area are salt-bush on fine-grained soils of valley bottoms and open stands of shrub mesquite on sandy, wind-eroded hummocks (Brown 1994c: 173). Outcrops, arroyos, bajadas, and foothill habitats are populated by a rich aggregate of shrubs and frequently succulents. Common plants include yuccas, sotols, agaves, and bear-grass.

In southern New Mexico and southeastern Arizona are large areas that supported grassland prior to the second half of the last century. Today these areas are occupied by Chihuahuan desertscrub vegetation. This rapid vegetation shift appears to be the result of large concentrations of domestic livestock of the late 1800s. It is difficult to tell whether present desertscrub areas are occupied by original or recently established Chihuahuan desertscrub.

Madrean Evergreen Woodland Biotic Community

This mild winter-wet summer woodland in southeastern Arizona and southwestern New Mexico is a northward extension of similar vegetation in the Sierra Madre of Mexico. The arboreal species of the evergreen woodland are locally varied combinations of oak (*Quercus* sp.), juniper, and pines (*Pinus* sp.) with lower elevation species grading upward into pine species of higher elevations. Emory oak (*Quercus Emoryi*), gray oak (*Quercus grisea*), alligator juniper (*Juniperus Deppeana*), border pinyon (*pinus discolor*), and Chihuahua pine (*Pinus chihuahuana*) are important species within the Borderlands (Brown 1994d: 59; Bourgeron and others 1995).

The mountains of the Borderlands region are so-called sky-islands of woodland vegetation surrounded by grassland and desertscrub at the lower elevations. Many of the cacti and leaf succulents of the semidesert grassland extend well up into the Madrean evergreen woodland. Interior chaparral species can also be present and are especially prevalent in thin eroded soils and on limestone (Brown 1994d: 63).

Petran Montane Conifer Forest

Montane conifer forest is confined to an isolated area of the highest Borderlands peaks in the Animas Mountains. Ponderosa pine (*Pinus ponderosa*), Douglas-fir (*Pseudotsuga taxifolia*), and aspen (*Populus* sp.) are prominent trees in these locales (Bourgeron and others 1995). Aspen tends to occur in disturbed and open habitats among other forest vegetation types.

Riparian Biotic Community

Riparian communities in southeastern Arizona and southwestern New Mexico cross-cut the entire range of vegetation zones. The communities are composed of unique riparian species as well as species that are common elsewhere. Riparian vegetation forms corridors of highly diverse habitats that are attractive to animals (Dick-Peddie 1993: 145, 147; Minckley and Brown 1994; Szaro 1989: 70); the longer the stream and the greater the elevation gradient, the more diverse the overall pattern (Szaro 1989: 87). In the Borderlands, riparian vegetation is restricted to drainage systems, most of which sustain water only occasionally, and the enclosed basins, or playas.

In the natural vegetation of the Borderlands region, cottonwood (*Pupulus* sp.) and willow (*Salix* sp.) commonly share dominance among riparian trees of low to medium elevations (Dick-Peddie 1993: 151). Other trees that are locally important in the better watered riparian communities of the Borderlands include oak, walnut (*Juglans* sp.), sycamore (*Platanus* sp.), and ash (*Fraxinus* sp.) (Szaro 1989). Floodplains have been heavily affected by historic activities over the past 150 years. One of the most obvious manifestations is the rapid and extensive invasion of alien shrub or tree species.

Internally drained depressions with watersheds of diverse size support relatively mesic habitats. The vegetation also could be included under grassland or scrub vegetation but occurs in response to the conditions of a drainage system. The typical shrubs of the closed basins are salt-bush, and occasionally wolfberry (*Lycium* sp.) occurs as a codominant; ground cover is sparse, often with clumps of grass (Dick-Peddie 1993: 153; Swanson and others 1988). Higher saline soils not subject to flooding may support an extensive grassland of specialized species. Shrubs and succulents are scattered around the edges of the playas on low Pleistocene beach ridges.

Gray Ranch Vegetation Study

An ecological inventory was performed for the Gray Ranch within the Borderlands study area (Bourgeron and others 1995). The ranch is a 130,000-ha (320,000-acre) cattle operation that includes a portion of the upper Animas Valley, the southern half of the Animas Mountains including Animas Peak, and a portion of the Playas Valley, incorporating approximately 35 percent of the study area. Vegetation patterns representative of the Borderlands region as a whole are represented. Bourgeron and others (1995) carried out the inventory using the Western Regional Vegetation Classification System (Bourgeron and Engelking n.d.). Their findings are summarized in table 2.1. This study is significant for its systematic observations of study area plant communities that refine more general descriptions of regional patterns.

Table 2.1. Vegetation classification (alliance level) at the Gray Ranch and adjacent ecoregion.[a]

Evergreen needle-leaved forest with conical crowns
Pseudotsuga menziesii alliance (Douglas fir)
Cold-deciduous alluvial forest
Platanus wrightii alliance (Arizona sycamore)
Evergreen coniferous woodlands with rounded crowns
Juniperus deppeana alliance (Alligator bark juniper)
Pinus dicolor alliance
Pinus engelmannii alliance (Apache pine)
Pinus ponderosa alliance (ponderosa pine)
Cold-deciduous alluvial woodland
Populus fremontii alliance (Fremont cottonwood)
Evergreen broad-leaved shrublands
Arctostaphylos pungens alliance (point-leaf manzanita)
Quercus arizonica-Quercus grisea alliance (Arizona white oak-gray oak)
Quercus emoryi alliance (emory oak)
Quercus toumeyi alliance (Toumey oak)
Temperate deciduous shrublands
Cercocarpus montanus alliance (mountain mahogany)
Deciduous subdesert scrublands without succulents
Rhus microphylla alliance (littleleaf sumac)
Deciduous subdesert scrublands with succulents
Fouquieria splendens alliance (ocotillo)
Prosopis glandulosa alliance (honey mesquite)
Mid-grass steppe with shrubs (shrub canopy cover is 11 to 25 percent)
Cercocarpus Montanus alliance (mountain mahogany)
Quercus toumeyi alliance (Toumey oak)
Mid-grass steppe without woody plants (tree or shrub canopy cover is 0 to 10 percent)
Bouteloua curtipendula alliance (sideoats grama grass)
Hilaria mutica alliance (tobosa grass)
Munhlenbergia emersleyi alliance (bush muhly grass)
Panicum bulbosum alliance (panic grass)
Panicum obtusum alliance (vine mesquite grass)
Sporobolus flexuoses alliance (Sacaton grass)
Sporobolus wrightii alliance (giant Sacaton grass)
Short-grass steppe without woody plants (tree or shrub canopy cover is 0 to 10 percent)
Bouteloua gracilis alliance (blue grama grass)
Bouteloua eriopoda alliance (black grama grass)
Bouteloua hirsuta alliance (hairy grama grass)

[a]Modified from Bourgeron and others 1995: 51–55.

Soil Types

In semiarid and arid regions, soil variation is correlated with slope and topographic position; these variables are related to topographic gradients, nutrition rating, and fertility (Bourgeron and others 1995). In southern Arizona, soils that support grasses usually contained a larger percentage of clay (25 to 50 percent), and have a higher percent available moisture (11 percent) than soils of shrub communities. Shrubs, and particularly creosote-bush, are most abundant on sites where shallow, sandy soils with low available moisture, caliche hardpan, or erosion pavement result in relatively unfavorable moisture for the growth of other species (Johnson 1957: 39).

Soil Types of the San Bernardino Valley

Because soil surveys conform to state boundaries, the soil classifications and descriptions for the San Bernardino Valley are different from those for the Borderlands valleys in New Mexico. The middle section of the San Bernardino Valley is characterized by a Bonita-Graham-Rimrock Association. These are shallow-to-deep, fine-textured soils on plains and hills. This association consists of well-drained soils formed in colluvium and alluvium weathered from basalt, andesite, ash-flow tuffs, cinder, and related volcanic rocks. Riparian zones are prominent in this valley because there are three significant perennial drainages that cross the valley and contain alluvial soils conducive to farming. Silver Creek flows from the Pedregosa Mountains, Black Draw originates in the Chiricahua Mountains, and Cottonwood Draw from the Peloncillo Mountains (Hendricks 1985: 108).

The west slopes of the Peloncillo Mountains, including the piedmont, are represented by Lithic torriorthents-Lithic Haplustolls-Rock Outcrop Association. The soils are shallow, cobbly and gravelly, with generally steep slopes and rocky outcrops on hills and mountains. The soils are weathered from many different parent rocks including granite, gneiss, rhyolite, andesite, tuffs, limestone, sandstone, and basalt (Hendricks 1985: 99).

Soil Types of the Upper Animas Valley and the San Luis Valley

Figure 2.6 illustrates soil types for these valleys. The San Luis Valley, a drained lakebed on the southern edge of the Upper Animas Valley, extends to both sides of the international border and contains a unique soil type within the study area, Anamite silty clay loam. Cloverdale Loam, Cloverdale-Stellar Association and Cloverdale Stony Clay loam soils are distributed in the lower slopes and on the basin floor of the southern half of the Upper Animas Valley. The Cloverdale Series are well-drained soils on old alluvial fans in upland areas. This soil is formed from materials derived mainly from rhyolite and basalt. The Cloverdale-Stellar Association has few limitations for agricultural practices, and almost any crop can be planted (Cox 1973: 12).

In the northern section of the Upper Animas Valley on the piedmont and alluvial plain, from approximately Animas Peak to the north, the most common soil type is the Eba series. The Eba series consists of well-drained soils formed in old cobbly alluvium from mixed igneous rocks, mainly rhyolite. Eba soils are gravelly loams and are not used for agriculture at the present time (Cox 1973: 12).

Animas Creek divides the valley into eastern and western sectors. The alluvial plain of Animas Creek and its tributaries are represented by the Pima-Hawkeye complex. This soil complex is mainly in the upper Animas Valley. It occurs along Deer Creek and Whitewater Creek at the southeastern end of the Animas Mountains piedmont. These soils are used for irrigated cropland (Cox 1973: 30).

Three patches of Yturbide soils are located around the ancient San Luis Playa. The Yturbide Series consists of excessively drained soils that formed in coarse-textured alluvium on alluvial fans and slopes. A few acres have been used for irrigated cropland (Cox 1973: 42).

The terraces and lower slopes of the northern half of the Upper Animas Valley are composed of Forrest gravelly loam and the Forrest-Stellar Association. The Forrest soil is found on slightly elevated ridges, and Stellar soil is associated with the broad swales that occur between the ridges. Within the Animas Valley, these associations support short grasses and leaf succulents such as agave and yucca (Cox 1973: 15).

Soil Description of the Playas Valley

There are four soil types in the Playa Valley (fig. 2.7): the Mohave Series, the Hondale Series, the Mimbres Series, and the Yturbide Series (Cox 1973). The most widespread soil of the southern half of the Playas Valley is the Mohave Series. Mohave soils are substantial in the plain formed between the east piedmont of the Animas Mountains and the Playas Lake. These are well-drained soils formed in old alluvium from mixed igneous rocks. Mohave soils are now used for irrigated cropland.

The Mimbres Series are well-drained soils developed in old alluvium from mixed igneous and sedimentary rocks on alluvial bottoms and occur as small patches along most of the Playas Valley bottom. Mimbres soils are used for irrigated cropland. Soils of the Yturbide Series are also distributed in small intermittent patches. These are poorly suited to modern cultivated crops (Cox 1973: 42, 50).

Hondale soils are well-drained soils near playas. In the Playas Valley, saline Hondale soils surround the Playas Lake and extend to the south. Higher saline soils not subject to flooding support extensive grasslands of alkali-sacaton grass (*Sporobolus airoides*).

Study Area Lithic Resources

Resources suitable for flaked stone tools such as chert, felsite/rhyolite, and basalt are widespread in the study area. Abundant chert zones are present in southeastern Arizona; for example, the Swisshelm Formation that outcrops near Boss Ranch (Boyd 1978: 57–58) would likely have been an important source of raw materials. Usable nodular cherts also are present in the Keating Formation of the Pedregosa, Big Hachet, and Peloncillo Mountains (Armstrong and Mamet 1978: 6, 186) and in the Black Prince Formation and Horquilla Limestone of the Big Hachett Mountains (Drewes and others 1988: C12). Pleistocene terraces as well as channels of current watercourses are likely locations of secondary

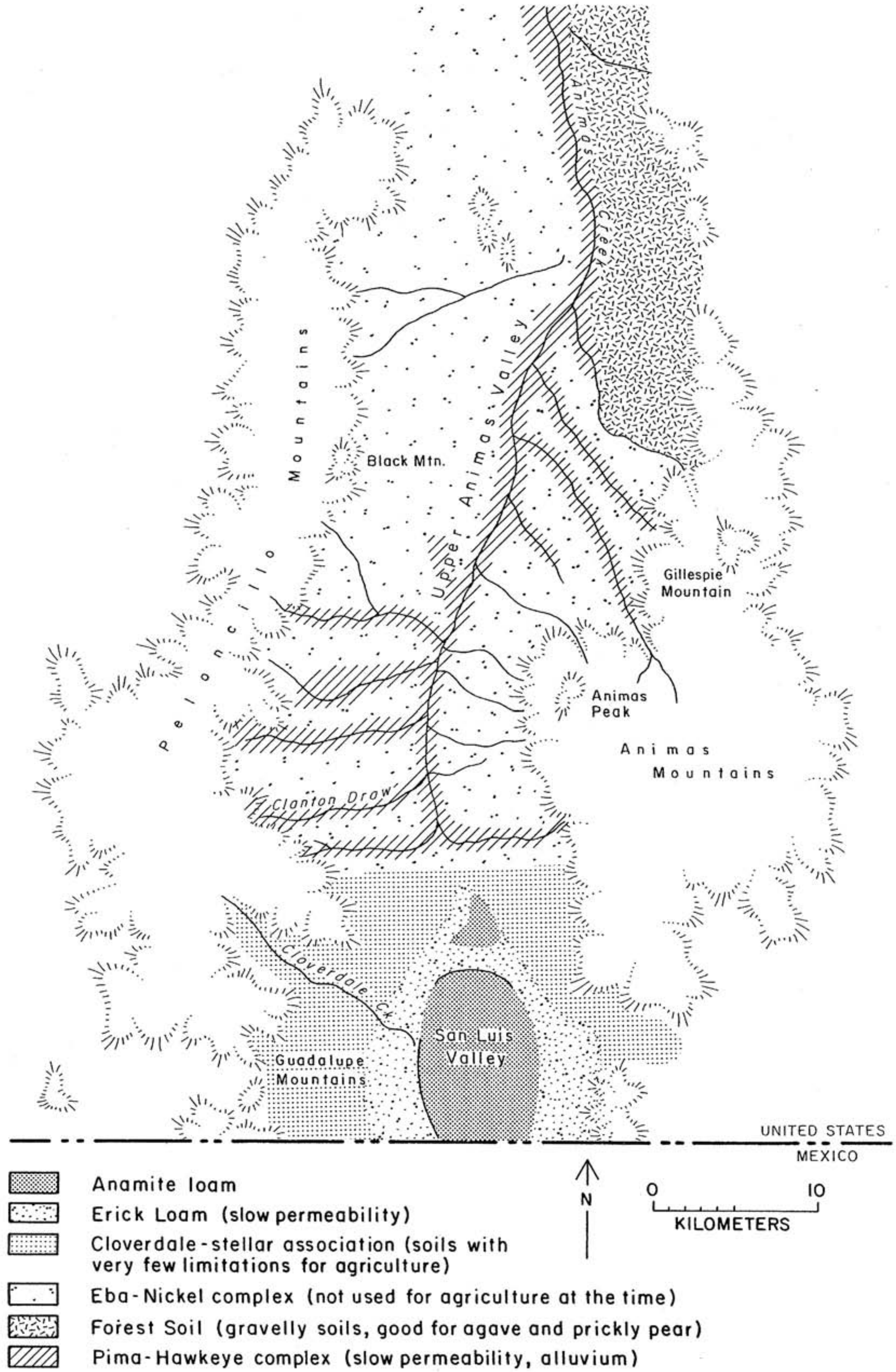

Figure 2.6. Soil types of the Upper Animas and San Luis Valleys.

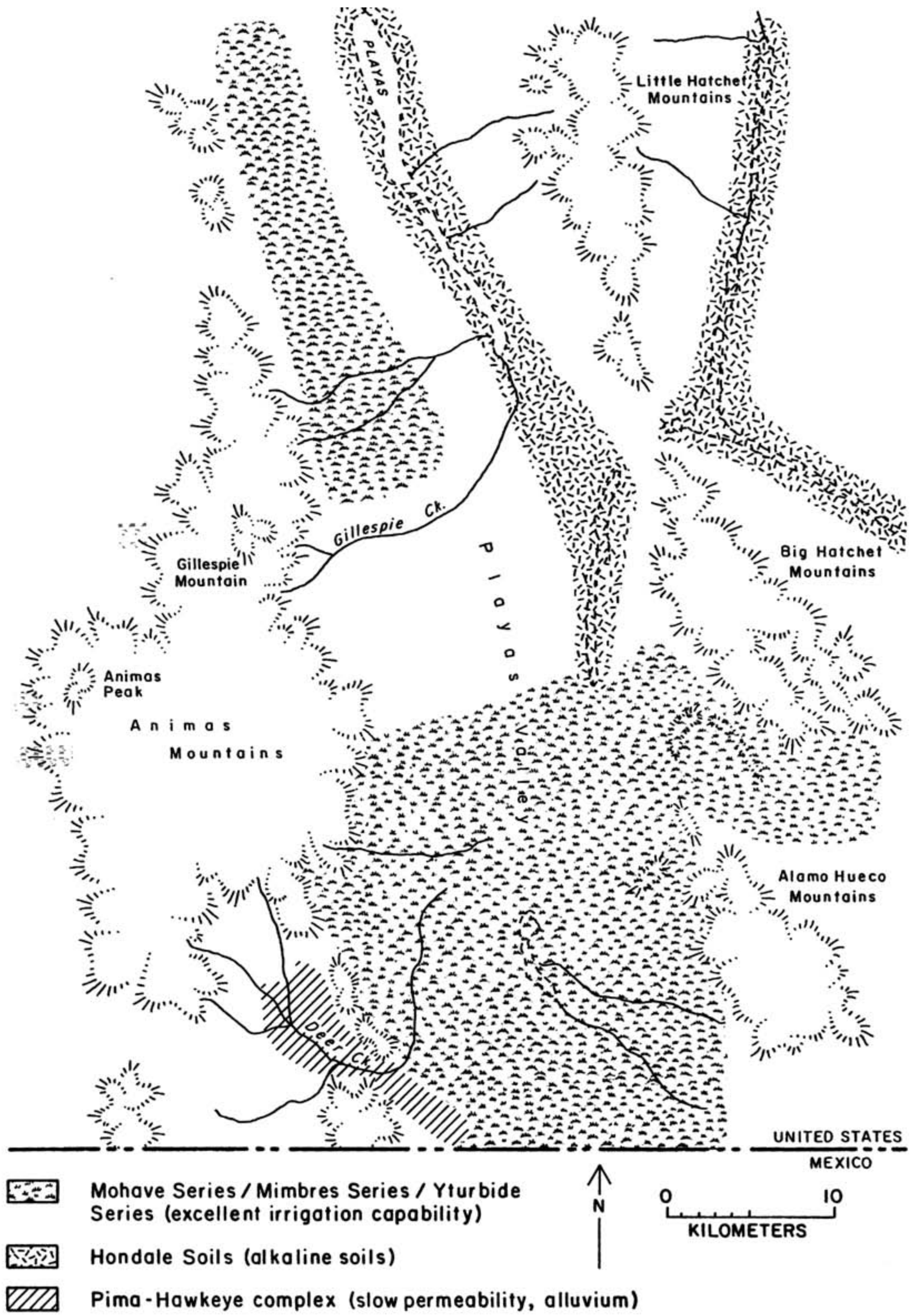

Figure 2.7. Soil types of the Playas Valley.

sources, even where the primary formations are not widely exposed.

Field reports (Fitting 1972a), file descriptions of 10 sites in the Borderlands database, and reconnaissance related to this overview suggest intensively used quarry localities for chert, felsite/rhyolite, and basalt materials throughout the study area, but no systematic study of material acquisition patterns has yet been undertaken for the Borderlands. Although no quarries for groundstone materials have been reported, basalts suitable for this purpose are widespread. Numerous basaltic flows are reported in the San Bernardino and Animas Valleys.

Antelope Wells volcanic glass is excellent for flaking and was widely sought during the late prehistoric period (Findlow and Bolognese 1980; Hughes 1988; Shackley 1988). Colors include translucent brown-green, dark gray, green-brown banded, and opaque black. The obsidian occurs as nodules (Apache tears) in the lower portions of three formations: Gillespie Tuff, Felsite formation, and Park Tuff (Findlow and Bolognese 1980: 228). Findlow and Bolognese (1980) observed obsidian nodules in Clanton Draw at the eastern edge of the Peloncillo Mountains and elsewhere in that range. Shackley (1988: 761) reports that the primary source for this material is along Deer Creek in the southeastern Animas Mountains, but that nodules also occur along Cloverdale Creek and elsewhere in the Peloncillo Mountains. Nodules also occur 15 to 20 km (9 to 13 miles) east from Deer Creek and south into Chihuahua (Shackley 1988: 761). Current distributional information indicates at least two noncontiguous sources in separate mountain ranges.

Turquoise is a lithic resource that strongly deserves further investigation. An extensive turquoise quarry is reported on the east side of the Little Hatchet Mountains at about 1,465 m (4,800 ft) above sea level (Clemons and Mack 1988: 20; Hill 1938). Known as the "Old Aztec" workings (Anonymous 1909: 762), extensive remains of prehistoric mining activity are present; Weigand and Harbottle (1993: 163) report about 200 chambered mines. The temporal span of these activities is unknown. No good description of the quality or character of this turquoise could be found in the literature.

Salt likely was available in the surroundings of playas. McCluney (1973) makes passing reference to inhabitants of the region collecting salt in such locations at the time of Coronado's expedition in the 16th century; the documentary reference or other source for this statement is unknown. Salt figured prominently in historic Southwest exchange, however, and its acquisition is even accorded a ritual context by puebloan groups such as the Hopi. Salt collecting probably was a patterned activity over long intervals and should be carefully considered in playa investigations.

Settlement Potential of Borderlands Valleys

A limited number of late ceramic habitation sites have been recorded in the Borderlands (fig 3.3), although this is by far the best known prehistoric interval. The distribution is heavily biased toward the largest sites and a few more thoroughly examined locales. The distribution of smaller settlements is so incomplete that generalizations about areas capable of supporting correspondingly small populations are difficult. Despite the lack of systematic archaeological studies, most of the largest villages probably are recognized (chapter 3).

The locations of the largest villages presumably mark relatively favored locales in which it was possible to support the most aggregated populations of the archaeological sequence. None are on perennial streams, but, with one exception, are on large ephemeral drainages near relatively wide stretches of floodplain amenable to small-scale irrigation. The exception, Pendleton Ruin, is on an alluvial fan of Cloverdale Creek in the San Luis Valley, where extensive floodwater farming would have been possible. The largest villages are all within grassland or desert scrub vegetation. This association reflects a strong need for proximity to the wild resources of low elevation zones as much as: (1) locations in a downstream position receiving combined flow from the upstream watershed, and (2) a sufficiently low gradient to successfully divert water onto fields with small canals or floodwater ditches. The following section further describes and preliminarily analyzes the potential of each study area valley for agricultural settlements, based on physical features and recorded site locations.

San Bernardino Valley

The San Bernardino Valley is bordered on the west by the massive Chiricahuas and Pedregosas (outside the study area) and the Perilla Mountains. The Peloncillo and Guadalupe Mountains are to the east. The valley continues south into Mexico. This broad Borderlands basin has no mid-valley drainage that combines runoff from the mountains to both east and west. Streams from the northern portions of the mountain ranges drain north and enter the adjacent and interconnected San Simon Valley.

In the southern part of the San Bernardino Valley within the study area, drainages flow to the south. Near the border with Mexico, streams from the mountains on both sides and streams draining a large mid-valley area begin to converge, a trend that continues south into the Mexican part of the basin. Black Draw, Silver Creek, and Cottonwood Draw are the largest drainages. Making this area even more amenable to agricultural use, the water table becomes increasingly shallow to the south (Arizona Department of Water Resources 1974), and it is shallowest of all beneath the San Bernardino Ranch. This locale was settled in the Spanish Colonial period and thereafter in historic times when springs were developed for irrigation. Sites of a variety of prehistoric periods, including the Slaughter Ranch site, cluster in the vicinity. Large sites are in the Mexican portion of the valley as well.

Sites near the middle of the San Bernardino Valley within the study area are located along southerly drainages originating in the Chiricahuas. These mountains are larger than any of the other study area ranges and create a greater orographic rainfall effect. Farther north, a site is recorded along a stream heading north from the Peloncillos. Other farming settlements are probable in similar locations along the mountain fronts and on tributaries, as drainages with upland watersheds emerge and flow onto the bajada. Possible prehistoric hot springs in the Douglas area (Swanberg 1978: 350) may have attracted special use.

The vegetation of the San Bernardino Valley is primarily semidesert grassland. Chihuahuan desertscrub occupies a southernmost sector below the mountains and near the border. The current development of desertscrub in this area may have been exacerbated by a long history of grazing. Livestock were introduced here in Colonial times (chapter 5) and ranching activities continue to be centered in the area of springs fed by the converging watercourses. Conditions in the past may have favored grassland more than conditions of today.

Animas and San Luis Valleys

The Animas Valley is bounded by the Peloncillo and Guadalupe Mountains to the west. The Animas Mountains are on the east. The Upper Animas Valley lies within the study area and is so designated by reference to its upstream position in a northward drainage pattern. The Animas Valley is conjoined without internal barriers with the San Luis Valley, which continues south into Mexico. A drainage divide separates the two valleys. The San Luis Valley receives water flowing south from the Peloncillos, a mid-basin catchment, and a narrow strip along the western edge of the Animas range.

The drainage divide between the valleys coincides with a large, transverse sandy ridge known as the Indian Dam. This natural feature marks the former maximal shoreline of a pluvial lake in the San Luis Valley. The dunes on the ridge contain numerous surface and partially buried artifact scatters, apparently representing most of the prehistoric sequence. Active springs are a few miles west of the San Luis Mountains near the Mexican border.

In the southeastern quadrant of the Peloncillo Mountains, multiple habitation sites have been recorded along Cloverdale Creek past the point where it emerges onto the valley slope. These include the large Pendleton Ruin on the fan and the Cloverdale Ruin farther upstream. The relatively broad, flat floodplain of Cloverdale Creek intrudes into and is surrounded by the mountain mass, thus receiving the benefit of higher orographic rainfall as well as the runoff from a large upland watershed. The plains grassland vegetation type of the valley floor extends upstream along an appreciable length of the floodplain, where resources of higher elevation zones also are conveniently accessible.

The San Luis Valley and adjacent segment of the Upper Animas Valley support a plains grassland vegetation, grading into a semidesert grassland farther to the north in the study area. Grassy forage is optimal among Borderlands basins. Today, antelope are most visible in this part of the study area.

Beginning near the southern end of the Animas Valley, drainages from the Animas and Peloncillo mountains join to form Animas Creek. The Animas Valley is unique among Borderlands basins in possessing such a well-integrated network with a primary drainage running almost throughout its length. Nevertheless, flow in Animas Creek is not perennial (Reeder 1957).

Habitation sites are recorded near the midsection of both mountain ranges. One settlement is situated on a tributary near the Peloncillo mountain front, and others, including Clanton Draw and Box Canyon, are located along Animas Creek. Farther to the north in the Upper Animas Valley, residential settlements again occur on tributaries from the Animas Mountains and along Animas Creek. The tributaries likely supplied short diversions of agricultural water at wider points in the floodplain and floodwater farming on alluvial fans. Optimal stretches of Animas Creek probably permitted modest irrigation. Sites in addition to those currently known seem almost a certainty along eastern and western mountain fronts and tributaries, and along the length of Animas Creek.

A shallow perched water table exists in the Upper Animas Valley, whereas ground water flow is largely unconfined in the Lower Animas Valley with the exception of an area just north of the town of Animas (Hawkins and Stephens 1983: 734). Seasonal and more extended boggy conditions occur in the areas of highest water table, including the Gray Ranch and Maddox Ranch cienegas along the margins of Animas Creek.

The only montane conifer forest in the Borderlands occurs on Animas Peak. Past this peak to the north, the low basin vegetation is semidesert grassland. Also north from the peak, agave is abundant on the low western slopes of the Animas Mountains (Bourgeron and others 1995).

Playas Valley

The Playas Valley is bordered by the Animas Mountains on the west. To the east, a series of smaller and disconnected mountains bound the basin. From north to south are the Little Hatchet Mountains, the Big Hatchet Mountains, and the Alamo Hueco Mountains. Together, these are of smaller mass than the major Borderlands ranges and produce less of an orographic effect on precipitation.

The Playas Valley is marked by internal drainage. Today there are two major concentrations of runoff in the Playas Valley proper and one outside of it, to the east of the Big and Little Hatchet Mountains. The largest playa within the basin is to the west of the Little Hatchet Mountains, receiving drainage from both sides. The other large playa is to the west of the Big Hatchet Mountains. A third small playa is the destination of streams flowing west from the Alamo Hueco Mountains.

The Animas Mountains provide the largest upland watersheds for drainages serving settlements in the Playas Valley. A large catchment in the southeastern sector of this range culminates in Deer Creek, with a relatively broad, flat floodplain along its final reaches in the mountains. Joyce Well and the Culberson Ruin are located on this segment of Deer Creek.

A cluster of habitations sites in the vicinity of the Timberlake Ruin have been recorded near the middle of the Animas range, where drainages extend onto the bajada. Although the mountains narrow and watersheds become smaller to the north, settlements are likely along the mountain front and adjacent bajadas. Sites have been discovered in similar situations along the skirts of the Alamo Hueco Mountains. To date, no habitation sites have been registered along the western edges of the Big or Little Hatchet Mountains or their tributaries but likely are present.

Basin-floor vegetation of the Playas Valley is semidesert grassland throughout. Preceramic camps or habitations might be anticipated along the shorelines of Pleistocene lakes now represented by the remnant playas. Specialized plants of saline and seasonally moist soils along playa margins also may have attracted the earliest farmers and even later inhabitants; it appears that the latest Holocene highstands of the lakes during the agricultural era may have produced persistently moist habitats and true aquatic resources.

Closing Observations

Important resources such as water, arable land, key plant and animal foods, and useful minerals have patchy distributions in the Malpai Borderlands. Alluvial valley floors are broad and have relatively homogenous vegetation cover. These valleys are bounded by high, linear, and abruptly rising mountain ranges that create spatially compressed biotic diversity because of the rapid ascent of the uplands. These diverse upland resources have restricted distributions often distant from the arable land on the valley floor. Agriculturalists wanting to procure upland resources would have traveled several days, or developed regular regional exchange. Likewise, hunting and gathering societies dependent on seasonal resources would have required large territories involving at least biseasonal residential movements from low valley floors to mountain bases.

Paul R. Fish
Suzanne K. Fish

Chapter 3.

Malpai Borderlands Prehistory

History of Research

Systematic archaeology in the Malpai Borderlands begins with D. D. Gaillard's (1896) map of the elevated Cloverdale Playa beachline in the San Luis Valley. During his involvement with the U.S.-Mexico International Border Survey, Gailard was drawn to this feature by local ranchers' reports of a massive Native American dam. Familiar with the scale of prehistoric irrigation in the Phoenix Basin, he accepted the raised beachline as evidence of a massive water control construction and reported his findings in the *American Anthropologist*. The dam was almost immediately recognized as a prominent but natural topographic feature by a variety of geographers and archaeologists, such as Ellsworth Huntington (1914) and E. B. Sayles (n.d.). Nonetheless, the Cloverdale Indian Dam continues to appear in listings of prehistoric Southwestern reservoirs and other water control features (for example Crown 1987a: 220).

Archaeological reconnaissances in the study area from the 1920s to as late as the 1960s were intended to document the northern extent of the Chihuahuan polychrome tradition (Brand 1943; Carey 1955, 1956; Kidder and others 1949; Sauer and Brand 1930; Sayles 1936) or were the byproducts of several excavation programs in the boot heel region of New Mexico (Lambert and Ambler 1961; McCluney 1965a). Generally, the reports for these surveys disclose repeated visits to the same large late prehistoric pueblos, and publications provide minimal descriptive detail and locational information. When available, however, archival notes and records of these investigators hold the potential for important clues to features and site structure no longer visible because of vandalism and other degrading forces.

Systematic surveys have been infrequent. Frank Findlow and Suzanne De Atley (De Atley 1980; De Atley and Findlow 1982; Findlow and De Atley 1976, 1978) surveyed randomly placed 3.25 by 0.1 mile transects in each of the 16 Animas and Playas Valley townships defined as their Hidalgo Project study area. They estimate systematic coverage of 4 percent of the study area, and they recorded, collected, and in some cases conducted limited excavations at over 100 sites. The records and materials are not currently available in any public repository; evaluation of survey results must rest on published literature. John Douglas (1987) conducted a survey of similar intensity on approximately 1,700 ha (4,200 acres) or 1.7 percent of the San Bernardino Valley in southeastern Arizona.

There is a long history of poorly reported, small excavations by both archaeological professionals and amateurs in the Malpai Borderlands (for example, see Carey 1931; Mills and Mills 1971; Myers 1985; Osborne and Hayes 1938). However, larger excavation programs, culminating in detailed reports, are far fewer in number. The work by A. V. Kidder and the Cosgroves (1949) at the Pendleton Ruin constitutes the most intensive excavation at a single site in the study area (table 3.1 and fig. 3.1). They considered the site to be an "outpost" of Casas Grandes at the start of work at Pendleton in 1933. The absence of a variety of Casas Grandes-style architectural traits (for example collared postholes, platform and scalloped hearths, keyhole doorways), high frequencies of local Cloverdale Corrugated utility wares, and relatively low amounts of Chihuahuan polychrome pottery suggested a "peripheral" development for which they adopted the term "Animas," previously used by Gladwin (1933) and Sayles (1936). A focus on the relationship between the late

Table 3.1. Summary of large site excavations in the Malpai Borderlands.

Site	Location	Estimated total rooms	Number of rooms excavated
Pendleton Ruin	Animas Valley	100 to 125[a]	93 excavated or outlined[b]
Box Canyon	Animas Valley	120 to175;[a] 350[c]	18 excavated, 39 outlined[c]
Clanton Draw	Animas Valley	20+ [c]	11 excavated
Joyce Well	Playas Valley	50+;[d] 150 to 250[a]	45 excavated
Slaughter Ranch	San Bernardino	40+[e]	14 excavated [f]
Boss Ranch	San Bernardino	20+[g]	11 excavated[h]

[a] O'Laughlin and others n.d.; [b] Kidder and others 1949: 124; [c] McCluney 1965; [d]McCluney n.d.;
[e] Arizona State Museum site card; [f] Mills and Mills 1971; [g] John Douglas, personal communication;
[h] Douglas 1996

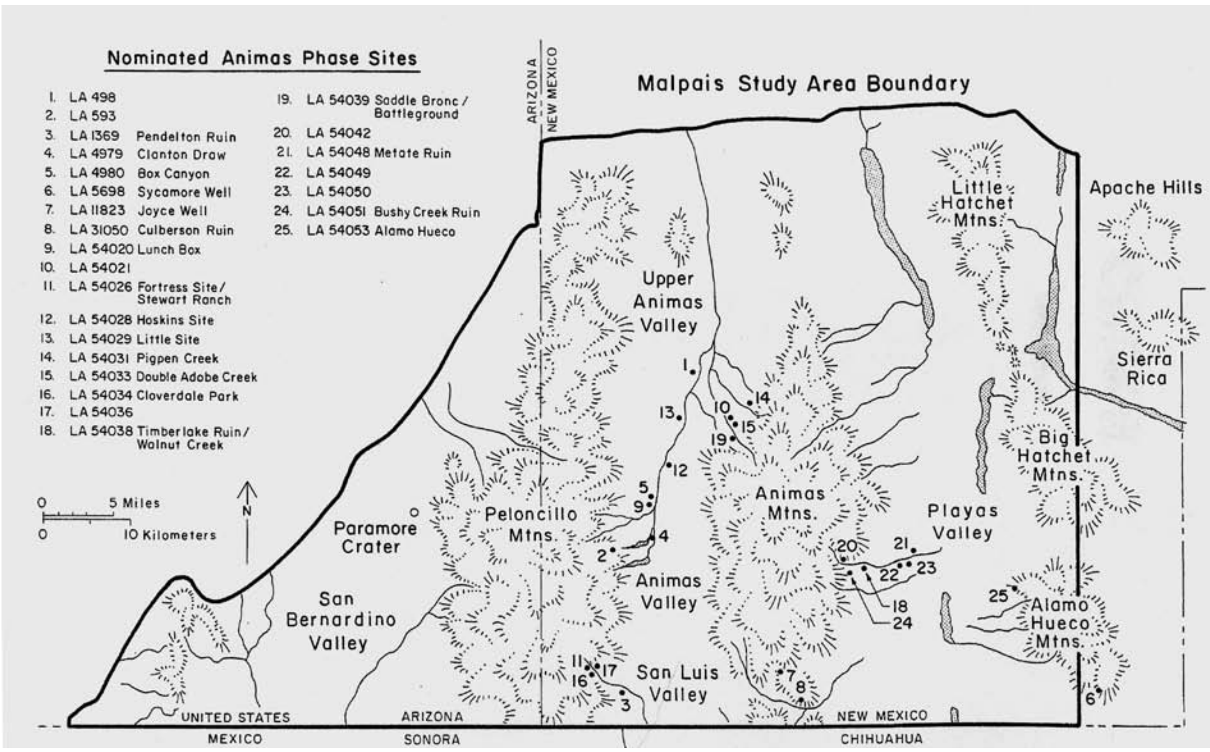

Figure 3.1. Locations of sites in a thematic nomination to the National Register of Historic Places (Duran 1992).

prehistoric pueblos of the Malpai Borderlands and Casas Grandes has stimulated most subsequent excavations.

At least limited excavation has been conducted at six other late prehistoric sites in the study area (see table 3.1 and fig. 3.1). E. B. McCluney (1965a) from the School of American Research excavated at the Clanton Draw and Box Canyon sites in the upper Animas drainage and exposed a portion of the Joyce Well site on Deer Creek in the Playas Valley (McCluney 2002: 16). Several excavations in the San Bernardino Valley have also been conducted at late prehistoric or Animas phase pueblos. Jack and Vera Mills (1971) excavated a large portion of the Slaughter Ranch pueblo, the largest site in the valley, but these remains have only been minimally reported. John Douglas (1990, 1996) and Richard Myers (1985) conducted excavations at the related Boss Ranch and San Bernardino sites as part of Cochise College field classes. Douglas' work represents the only instance of excavations in the Borderlands study area using contemporary recovery techniques, such as systematic screening of fill and flotation.

One of the most comprehensive and well-documented investigations in the Borderland study area pertains to an unpublished reconnaissance survey of Animas phase sites by T. O'Laughlin, J. Ravesloot, and M. Foster (n.d.) of the Jornada Anthropological Research Association. This survey developed background information on 25 sites for a thematic nomination to the National Register of Historic Places (fig. 3.1). This nomination was prepared by

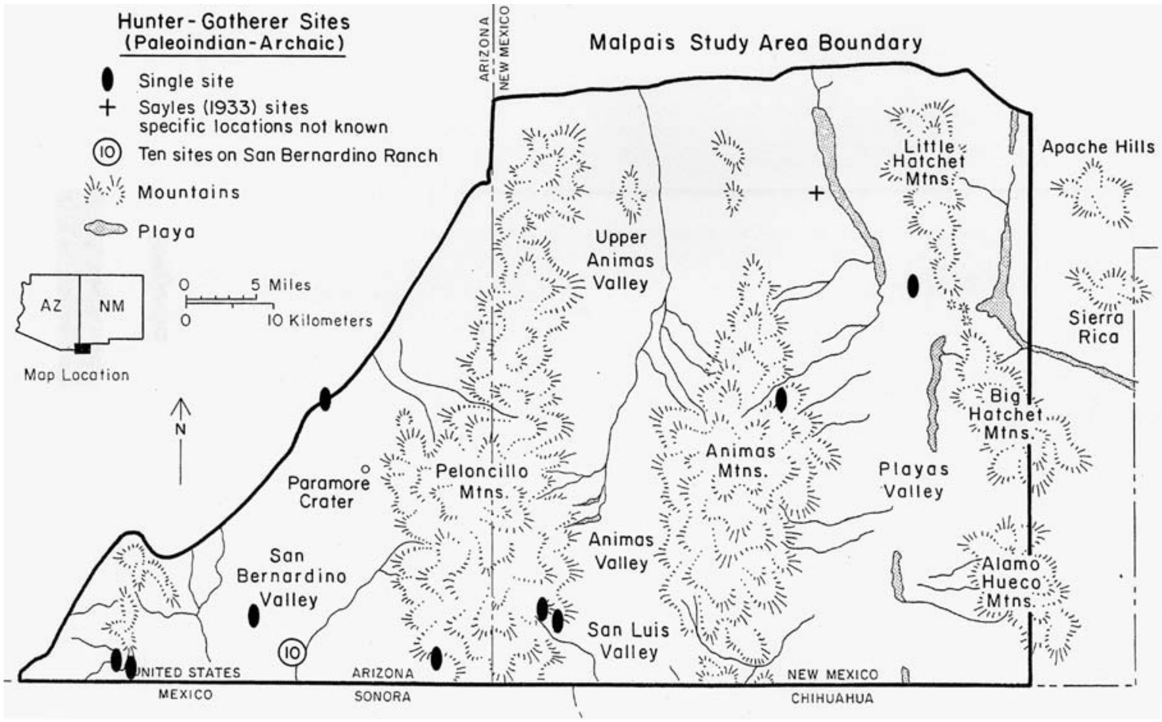

Figure 3.2. Distribution of Paleoindian and Archaic sites based on site file information.

Meliha S. Duran (1992) and is currently pending review. Development of the nomination led to proposals in the U.S. Senate by New Mexico Congressman Ralph Blending for a National Monument centering on the Animas sites. The interpretive theme for this Monument emphasized continuity with Casas Grandes and Mexican high cultures to the south (Schaafsma n.d.a). Support for a National Monument could not be generated among local ranchers and landowners, and the proposal lapsed. The plans for a major exhibit focusing on Malpai Borderlands study area sites with the theme "A Gateway to Mexico" (Schaafsma n.d.b) have been temporarily put on hold.

The presence of Casas Grandes, only 100 km (62 miles) to the south, is probably the single most important factor influencing interpretation of Malpai Borderlands prehistory. Casas Grandes is without question the largest and most complex site in the Greater Southwest. This late prehistoric town had a population numbering several thousand and an impressive array of public architecture, including several ballcourts and 18 ceremonial mounds or platforms. The presence of similar polychrome ceramics and architectural styles in the Malpai Borderlands made early investigators look to Casas Grandes for their comparisons and expectations. Detailed and largescale excavations by Charles Di Peso (1974) at Casas Grandes during the 1960s reinforced this point of comparison. Extensive reconnaissance surveys south of the San Luis and Playas Valleys (Brand 1943; Sayles 1936) and the San Bernardino Valley (Braniff-C. 1992; Di Peso n.d.; Sauer and Brand 1930) demonstrated spatial continuity in ceramic and architectural styles. The level of information for the intervening area did not approach that available for the Borderlands and Casas Grandes for many years. Only recently have systematic survey efforts begun to provide measures of Casas Grandes influence at varying distances to the north from that site (Braniff-C. 1992; Whalen and Minnis 2001).

Culture History

Paleoindian Hunters (10,000 B.C. to 7000 B.C.)

Widely distributed projectile points typical of both early and late portions of the Paleoindian period have been found on the surface as isolated artifacts within and immediately adjacent to the Borderlands study area (Di Peso 1965; Huckell 1971; Myers 1967, 1976). James Fitting and T. Price (1968) report a late Paleoindian surface assemblage consisting of points, unifacial tools, and debitage from a terrace above Cloverdale Creek in the Animas Valley. A high frequency of debitage in this assemblage suggests workshop activities (Fitting and Price 1968: 7–8). Figure 3.2 combines site location information for the Paleoindian and Archaic periods.

Although only surface artifacts have been discovered to date, the Borderlands study area may offer opportunities to examine the human role in Pleistocene extinctions of an array of small and large mammals. U-Bar Cave in the Hachita Mountains has produced deposits of mid-to-late Wisconson age (30,000 to 15,000 B.P.) with extensive fossil mammal, bird, and reptile assemblages (Harris 1985, 1987). Near the western edge of the study area, buried late Pleistocene/early Holocene deposits occur in Whitewater Draw (Waters 1986: 41), and these stratigraphic units have also yielded a variety of extinct large mammals (Antevs 1983; Haury 1960; Sayles and Antevs 1941). Significantly, the study area is near the classic Clovis kill and butchering sites of Lehner, Murray Springs, Escapule, and Naco (Haury 1953; Haury and others 1959; Haynes and Hemmings 1968; Huckell 1982).

Archaic Foragers (7000 B.C. to 1500 B.C.)

There is limited evidence for Early and Middle Archaic utilization of the study area. The two largest systematic surveys (De Atley 1980; Douglas 1987, 1990) record numerous lithic artifact scatters but none that could be unequivocally dated to the Archaic with diagnostic artifacts. Stephen Lekson (1992a: 64) suggests that casual collection of surface artifacts may produce a distorted impression of the intensity of Archaic occupation, using an example from Findlow and De Atley's survey (1976, 1978) in the vicinity of Playas Lake. They located 25 extensive scatters of flaked stone and fire-cracked rock on old beach lines and concluded, in the absence of stylistically diagnostic artifacts, that these were the remains of resource exploitation by ceramic period peoples (Findlow, personal communication in Lekson 1992a: 64). Lekson notes that the well-documented collection of hundreds of Middle and Late Archaic projectile points by Donald Formby (1986) from Playas Lake beaches suggests intensive earlier use, and that previous collecting may be in large part responsible for the failure to recover these diagnostic artifacts during survey. On the other hand, the authors observed large numbers of stylistically Archaic projectile points in well-documented collections recently made by Jeff Shauger while mapping fencelines and other modern features on the Gray Ranch in the Animas and Playas Valleys. These fencelines crosscut many of the Findlow and De Atley transects; the fact that Shauger could find points suggests that the intensity of previous investigations rather than depletion by collectors limited the recovery of Archaic diagnostics.

Another biasing factor for Archaic representation in survey results may be the burial of relevant deposits. Buried Archaic sites have been recorded in the San Bernardino Valley (for example see Neily and Beckwith 1985), and E. B. Sayles (n.d.) reports Archaic remains 1 m (3.3 ft) or more below the surface of former Lake San Luis beachlines. Studies of such buried contexts in Whitewater Draw (Sayles 1983; Sayles and Antevs 1941), adjacent to the western edge of the study area, have allowed definition of the Cochise Archaic sequence for southern Arizona and New Mexico. More recently, investigations here have produced numerous radiocarbon dates and geological assessments of environmental change (Waters 1986).

Preceramic Farmers (1500 B.C. to A.D. 200)

Late Archaic settlements with numerous houses, large bell-shaped storage pits, burials, formal groundstone, high ubiquity of maize in flotation and pollen samples, and instances of well-developed middens are now well documented in the Santa Cruz and San Pedro Valleys of southern Arizona (S. Fish and others 1990, 1992; B. Huckell 1990, 1996; Mabry 1994, 1996). Probable Late Archaic houses have been reported to the north of the study area along the upper Gila River and in the Sulphur Springs Valley (Fitting 1972b; Minnis 1980; Sayles 1945, 1983) and to the east along the Rio Grande (Honea 1965; Lekson 1992a: 62–64; O'Laughlin 1980). Charred corn of Archaic age has been dated immediately to the east of the study area in Dona Ana County, New Mexico (Upham and others 1987).

Projectile points (Lambert and Ambler 1961: 33, fig. 19) and perishable remains such as atlatls and certain types of sandals (Lambert and Ambler 1961: 84–85) suggest stylistically Late Archaic occupations at U-Bar Cave in the Hachita Mountains. However, these artifacts cannot be clearly associated with the copious amounts of corn and other domesticates recovered at this site. Frequent San Pedro, Cienega, and Cortaro projectile point forms in the Jeff Shauger collections from the Gray Ranch indicate widespread Borderland occupations contemporary with those in the San Pedro and Santa Cruz Valleys. Owen Davis (2001: 408) identified corn pollen in an Animas Creek cienega near the Gray Ranch headquarters. It is associated with a radiocarbon date of approximately 3400 B.P. Davis' analyses of cores from other cienega deposits immediately adjacent to the study area have also yielded corn pollen in the 2000 to 3500 B.P. range.

Late Archaic settlement locations may be buried in alluvium along primary and secondary drainages and on alluvial fans as is frequently the case in the Santa Cruz and San Pedro Valleys (S. Fish and others 1992; B. Huckell 1996). A second possibility is that at least some hill and mountain occupations in northwestern Chihuahua,

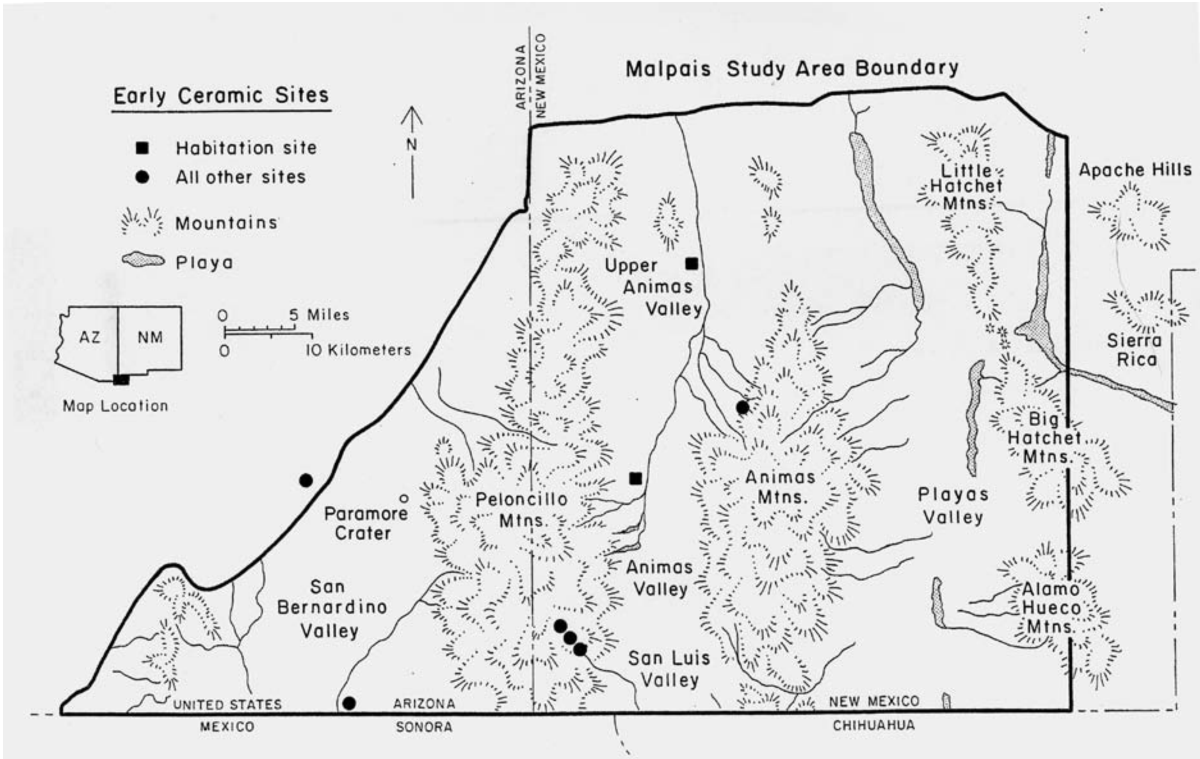

Figure 3.3. Distribution of Early Ceramic (Pithouse Hamlet) sites based on site file information.

southwestern New Mexico, and southeastern Arizona date to preceramic times (Hard and Roney 1999; Roney and Hard 2004). These villages share most of the characteristics of the later *cerros de trincheras* village sites of southern Arizona and northern Sonora in having dry-laid masonry terraces and other features constructed on dark volcanic hillsides (Downum and others 1994). Several of these sites near Janos, Chihuahua, mapped in detail (Roney and Hard 2004), have dark midden deposits that contain diverse flaked and groundstone assemblages and suggest residential refuse. The associated artifacts are stylistically Late Archaic. Construction and hillside modification at some of these sites is massive. For example, at Cerro Juanaqueña, Hard and Roney (1998; Hard and others 1999) calculate that the summit and hillside have been transformed by 8 km (5 miles) of terrace wall and that all rock has been removed from over 10 ha (25 acres) of the hill summit. A terraced hillside without ceramics has been reported in the upper reaches of Deer Creek in the Playas Valley (Cosgrove and Cosgrove n.d.; Kidder and others 1949: 149; Osborne and Hayes 1938: 22), and such sites are believed to be present in the San Bernardino Valley (John Douglas, personal communication). The authors observed basin metates, many one-handed manos, and a stylistically Late Archaic projectile point during a visit at the Deer Creek terraced hillside or fortified site.

Pithouse Hamlets (A.D. 200 to A.D. 1000)

Survey records reveal only a few habitation sites in the Borderlands study area that can be assigned to this ceramic interval with any certainty (fig. 3.3). Findlow and De Atley (1978; De Atley 1980; De Atley and Findlow 1982) recorded eight "early" San Luis phase sites in their Hidalgo Project investigations in the Animas and Playas Valleys. Systematic survey has revealed several additional sites of this period in the San Bernardino Valley (Douglas 1990; Neily and Beckwith 1985). Although brownware sherds are ubiquitous, occasional occurrences of Mogollon Red-on-brown, Three Circle Red-on-white, and Mimbres Boldface Black-on-white ceramics demonstrate later pithouse period use of the study area as well. Excavations (Minnis and Wormser 1984; Sayles 1945) in adjacent desert areas suggest that many of the numerous brownware sherd and lithic scatters recorded in the study area may similarly reflect habitation remains; a relatively complete sequence of occupation may be present as in the adjacent Sulphur Springs Valley (Sayles 1945, 1983) and nearby San Simon Valley (Gilman 1997).

In mountainous zones to the north, early pithouse villages are frequently found on high, steep-sided mesas and occasionally have dry-laid masonry walls (Lekson 1992a: 13), raising the possibility of continuity with previous Late Archaic hillside sites (Hard and Roney 1998). Some scholars have inferred defense as a primary location consideration (LeBlanc 1980a), but Lekson (1992a: 13) points out that distance and difficulty of access to water limit the power of this explanation. To Lekson (1992a,b), Cable and Doyel (1987), and a variety of other Southwestern archaeologists, there appears to be synchroneity in changing village layout over time in the southern deserts from the Rio Grande to the Phoenix Basin during the pithouse period. The earliest pithouse settlements are invariably small with an average of seven structures (Lekson 1992a: 13). Sites such as Cave Creek and San Simon villages just north of the study area had an estimated 20 to 30 people (Cable and Doyel 1987: 61). By A.D. 500, larger villages with one or two large communal, "great kiva-like" structures were built in many parts of the region (Anyon and LeBlanc 1980; Cable and Doyel 1987, Di Peso 1956, 1958, 1974). A few of the latest pithouse sites in east-central New Mexico are large; for example, the late pithouse component at Galaz site has approximately 100 pithouses (Anyon and LeBlanc 1984: 94), and there are perhaps 200 at Lee Village (Lekson 1992a: 14).

Shifting seasonal occupation has been the dominant model used to interpret pithouse period settlement patterns in the southern deserts. On the basis of ethnographic analogy, Patricia Gilman (1987, 1997) has argued that pithouse architecture is most frequently associated with seasonal mobility and movement of residence during the year. Applying these precepts to San Simon settlement data northwest of the Malpai Borderlands, Gilman (1987: 207) infers that villages were occupied during the winter, near agricultural fields and stores. Sherd and lithic scatters are the remains of summer and spring foraging activities. So few sites have been assigned to the early ceramic period in the Malpai Borderlands study area that no clear picture of settlement pattern emerges (fig 3.3). Study area reconnaissance and site visits during investigations for this study suggest that early ceramic remains are dramatically underrepresented in current archival information and that systematic searches of site surfaces would yield diagnostics indicating many more components of this period.

Mimbres Horizon Villages (A.D. 1000 to A.D. 1200)

The widely distributed complex of Mimbres style ceramics, architecture, and settlement organization extends far beyond the Mimbres Valley of southwestern New Mexico—east to the Rio Grande (Lekson 1989a; M. Nelson 1993), north to the San Francisco Mountains (Lekson 1992a,b), south to the Janos area of Chihuahua (Brand 1943; Carey 1931), and west to the San Bernardino and Gila Valleys of southeastern Arizona (Douglas 1990; Sauer and Brand 1930). This phenomenon is sometimes conceptualized as an interaction sphere or regional system resembling that of the pre-Classic Hohokam (Lekson 1993, 1992a,b; Upham 1992; Wilcox 1991). The transition from pithouse to pueblo architecture and the florescence of the Classic Mimbres Black-on-white pottery mark this period. Although none have been excavated, sites of this period in the study area appear to contain both pithouse and pueblo architecture and may yield low frequencies of Mimbres Black-on-white pottery.

Mimbres pueblos in the homeland of this horizon are occasionally large, with a few exceeding 300 rooms. In the Malpai Borderlands, the Maddox Ruin in the Animas Valley may be such a site. Locational continuity with major pithouse period villages is frequent in the Mimbres Valley. Although great kivas may have been present at a few large Mimbres pueblos and at dispersed communities of small sites (Anyon and LeBlanc 1980; Lekson 1989b), open plaza areas replaced kivas as communal features at most settlements. A majority of large settlements and settlement clusters in the Mimbres Valley and some other locales in New Mexico appear dependent on irrigation strategies for agriculture (Creel and Adams 1986; Herrington 1979, 1982; Lekson 1992a: 16). A close correlation exists between the total number of Mimbres rooms and amount of irrigable bottomland in valleys (Lekson 1986).

Variable estimates of terminal population for the Mimbres Valley range from 1,500 to about 5,000 (Blake and others 1986; Minnis 1984, 1985; Nelson and others 1994), and there is a consensus that regional population for the larger extent of Mimbres style probably does not exceed 10,000 or 20,000 (Lekson 1992a: 18). Small populations spread over large distances are consistent with the perception of an "essentially egalitarian people. . .with the emergence of an incipient elite" at some locations (LeBlanc 1983: 148). Between A.D. 1180 and 1200, a rapid demographic and social collapse of the Mimbres heartland was followed by a hiatus and then reoccupation by later and culturally distinct peoples. This progression is considered a landmark event of regional prehistory (LeBlanc 1989). A climatic downturn, the attraction or competition occasioned by the florescence of Casas Grandes, and marauding Apaches (LeBlanc 1989) have all been considered as causal agents. Recent investigators have suggested that changes at the end of

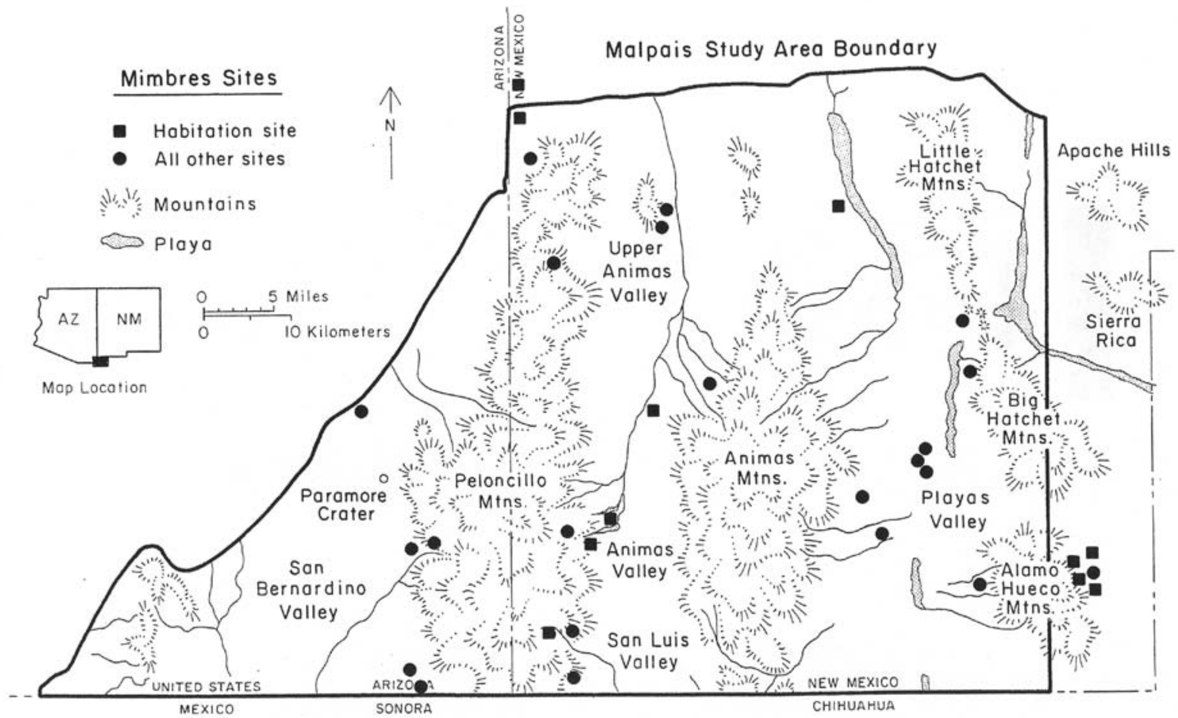

Figure 3.4. Distribution of Mimbres horizon sites based on site file information.

the Mimbres horizon may not have been so dramatic as previously portrayed, and that the transition may have extended over a considerable period (Creel 1997; Lekson 1992a). Instead, it may be useful to view the Mimbres "collapse" as part of a broader reorganization of population and society that occurred at about this time across the southern deserts and throughout the Southwest (Cordell and Gumerman 1989; P. Fish and Fish 1994).

Pueblos with Mimbres ceramic types exceeding 100 rooms are known along Animas Creek in the Borderlands, and smaller pueblos and pithouse settlements are scattered throughout the bootheel of southwestern New Mexico (Lekson 1992a: 16). John Douglas (1990: 174) considers pithouse architecture as the dominant form throughout the period in southeastern Arizona. No excavated architectural plans or materials are available within the study area. Although site densities certainly never approached those of the Mimbres Valley, available survey data suggest that the Animas Valley, and probably the San Bernardino Valley as well, had significant Mimbres period populations.

Figure 3.4 depicts the settlement pattern of the Mimbres Horizon as revealed in site file information. With the exception of a habitation locale at the edge of the large playa in Playas Valley, sites classified as having residential characteristics are near relatively permanent water sources on major mountain drainages as they emerge onto basin bajadas or at the edges of cienegas. Diagnostic painted pottery in assemblages dating prior to A.D. 1200 is relatively rare in the Borderlands and undoubtedly contributes to an underestimation of the frequency of these components, as does the infrequency of readily visible puebloan architecture at this time.

Late Prehistoric Pueblos (A.D. 1200 to 1400/1450)

The adobe pueblos of southwestern New Mexico and southeastern Arizona that recall Chihuahuan styles have attracted sporadic archaeological attention since the 1920s (Brand 1943; Gladwin and Gladwin 1934; Kidder and others 1949; Sauer and Brand 1930; Sayles 1936). This stylistic complex has been termed the Animas phase in the archaeological literature. It is characterized by large, puddled adobe pueblos, roomblocks built around plazas, an absence of kivas, the sporadically recorded occurrence of Casas Grandes style ballcourts, and a high proportion of Ramos Polychrome and other Chihuahuan ceramics. Interpretation of these manifestations is almost always in terms of interaction with the regionally preeminent site of Casas Grandes, although the nature and strength of such relationships have been hotly debated.

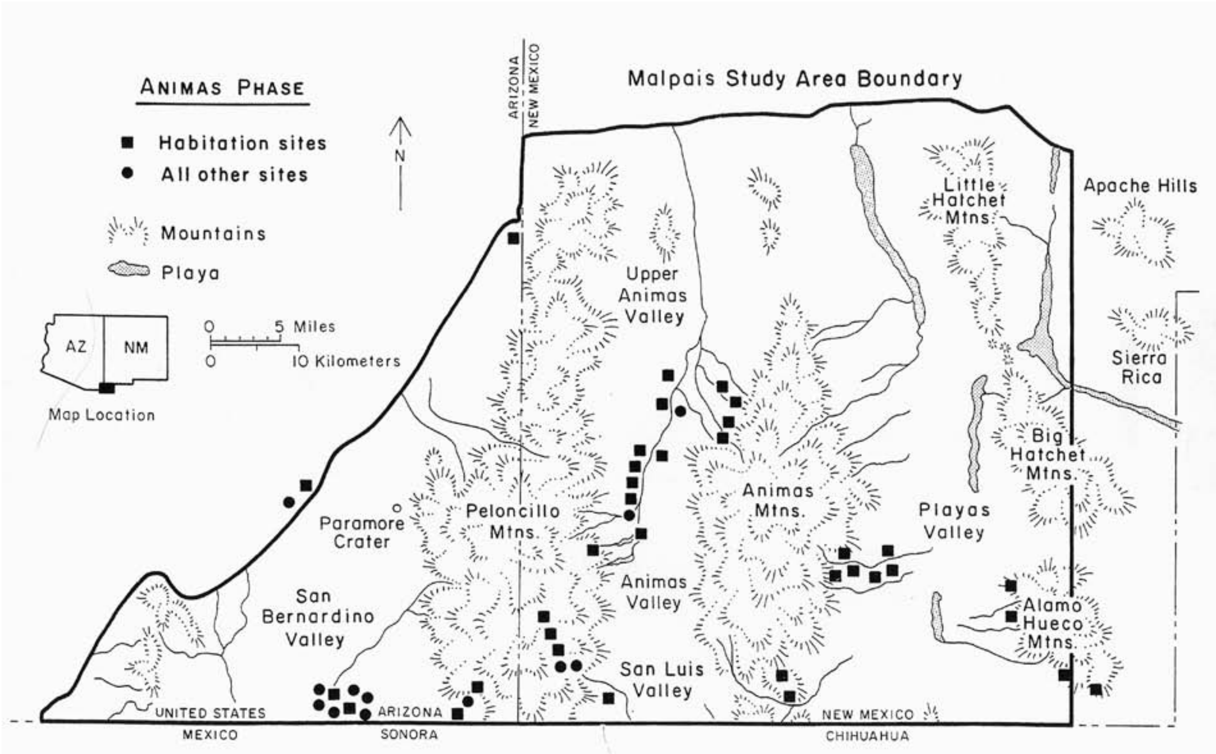

Figure 3.5. Distribution of Animas phase (late prehistoric) sites based on site file information.

The Database

Boundaries for the Malpai Borderlands study area almost precisely correspond to the northern distribution of ceramic assemblages with high proportions of Chihuahuan polychromes and sites assigned to a Chihuahuan tradition (Sauer and Brand 1930). Locations of the largest pueblos (100 or more rooms) are well known in regional archaeological reconnaissances (Brand 1943; De Atley 1980; Kidder and others 1949; Sayles 1936). Sample survey in the bootheel region of New Mexico has suggested to Suzanne De Atley (1980: 30) a hierarchical settlement pattern with large central sites (100 to 500 rooms) separated by distances of approximately 15 km (9 miles). On the other hand, John Douglas (1995) infers largely autonomous villages from settlement distributions in the western part of the study area. Detailed maps and descriptions for 30 sites were prepared in conjunction with a thematic nomination of Animas sites to the National Register of Historic Places (Duran 1992).

Figure 3.5 shows the locations of late prehistoric sites recorded in the study area. Although the largest sites are well known, systematic survey data are limited. Regional surveys in the bootheel segment of New Mexico and in the San Bernardino Valley of Arizona are environmentally stratified samples at 2-percent levels. Nothing comparable to full-coverage data exists for any significant subsection of the Borderlands study area; consequently, relationships between large pueblos and the smaller units of settlement pattern are unknown. Without sufficient settlement pattern data on a regional scale, inferences about village autonomy (Douglas 1995), settlement hierarchy (De Atley 1980), multisite communities (P. Fish and Fish 1994), and interaction between territorial units are somewhat speculative.

Chronology

Chronology is key in interpreting late prehistoric developments in the Malpai Borderlands study area. Table 3.2 compares current regional chronologies for southwestern New Mexico, southeastern Arizona, and northern Chihuahua. On the basis of ceramic cross-dating, most archaeologists working in southwestern New Mexico and southeastern Arizona placed the large, late pueblos in the range of A.D.1250 to 1450 (Brand 1935; Kidder and others 1949; McCluney 1965a, 2002: 39). In fact, the constellation of decorated ceramic types occurring at these sites (St. Johns Polychrome, Gila Polychrome, Tonto Polychrome, Pinedale Polychrome, El Paso Polychrome, Chupadero Black-on-white, and an assortment of Chihuahuan types) has come to be regarded as the hallmark of 14th and 15th century occupations in the southern Southwest (Doyel 1976; Thompson n.d.;

Table 3.2. Comparison of relevant chronological sequences for the Malpai Borderlands study area.

	Phase sequence southwest New Mexico	Period sequence southwest New Mexico[a]	Revised Casas Grandes phase sequence[b]	Revised Casas Grandes period sequence[b]	Phase sequence Malpai Borderlands[c]	Ceramic period sequence used in this overview
A.D.						
1500 -			Diablo			
1400 -	Cliff (Salado)		Paquime	Medio	Salado	
1300 -	Black Mountain (Animas)	Late Pueblo			Animas	Late Prehistoric Pueblos
1200 -			Buena Fe			
1100 -	Classic Mimbres	Early Pueblo	Perros Bravos			
1000 -						Mimbres Villages
900 -	Three Circle			Viejo	San Luis	
800 -	San Francisco	Late Pithouse				
700 -						
600 -	Georgetown					Pithouse Hamlets
500 -						
400 -	Cumbre	Early Pithouse				
300 -					??????	
200 -						
100 -	Late Archaic	Late Archaic				Preceramic Farmers
A.D. 1 -						

[a] Nelson and Anyon 1996; Stuart and Gauthier 1981.
[b] Dean and Ravesloot 1993.
[c] De Atley 1980.

Wilcox and Shenk 1977: 64–68). This same ceramic assemblage also characterizes the major construction episodes at Casas Grandes and provided the basis for a 14th century dating assignment in most early regional syntheses (Carey 1931; Gladwin 1957; Kidder 1924; Sauer and Brand 1930; Sayles 1936).

With Di Peso's (1974) large-scale excavations at Casas Grandes in the 1960s, general consensus on regional chronology was shaken. Tree-ring dates appeared to place major construction at the site to an interval between A.D. 1060 and 1340. Therefore, Di Peso's interpretations emphasized comparison with cultural developments at the same time in the Mimbres and Chaco regions to the north. This radical transformation of Southwestern culture history was met by a combination of skepticism, criticism, and adjustments to local sequences to better fit this new framework (Braniff-C. 1986; LeBlanc 1980b, 1986; Lekson 1984; Ravesloot 1979; Wilcox 1986). For example, Stephen LeBlanc (1980a, 1986) developed a model for the Mimbres Valley in which there was collapse and abandonment at about A.D. 1100, an occupational hiatus, and reoccupation by participants in the Casas Grandes interaction sphere, which he dated between A.D. 1200 and 1300. Recent reevaluation of the tree-ring evidence for Casas Grandes clearly demonstrates that the major occupation at this pivotal site occurred between A.D. 1300 and 1500 (Dean and Ravesloot 1993: 96–97).

Further complicating regional chronology, Di Peso (1974: 46) accepted and reported three radiocarbon dates suggesting a 16th century occupation at Joyce Well (table 3.3). He interpreted these dates as evidence that scattered Tardio period populations from Casas Grandes occupied the bootheel section of New Mexico and nearby areas after the collapse of that site. Both De Atley (1980) and Carpenter (1992) point out that these dates were all derived from carbonized corn and never corrected for differential absorption of ^{13}C and ^{14}C fractions. If an estimated average correction of 200 years were made, all three samples would date to the latter half of the 1300s.

Table 3.3 presents chronological data from excavated sites with radiocarbon and tree-ring dates in and immediately adjacent to the Malpai Borderlands study area. Obsidian hydration dates from two analyses (De Atley 1980: 77–80; Stevenson and others 1989) tend to broadly conform to associated radiocarbon dates and estimates from ceramic assemblages. Table 3.3 underscores the limited number of absolute dates from the study area and vicinity. Problems resulting from poorly understood proveniences and lack of current correction factors for radiocarbon dating further complicate the chronological picture. Available dates from nearly all large sites

Table 3.3. Absolute dates for sites in and immediately adjacent to the Malpai Borderlands.

Site	Ceramic cross-dating	Radiocarbon	Tree ring	Archaeomagnetic
Clanton Draw	1350–1375[a]			
Box Canyon	1350–1380[a]			
Joyce Well	1250–1400[b]	1620 ± 110; 1590 ± 100; 1565 ± 110[i]	1249p–1308vv[j]	late 1300s[k]
Pendleton	1300–1375[c]			
Culberson	1200–1450[d]	1360 ± 60[h]	1183–1282vv; 1185–1284vv[j]	
Boss Ranch	1150–1450[e]	1400 ± 80; 1430 ± 50[e]		
Kuykendall	1300–1450[f]			1385 ± 23; 1375 ± 18[j]
Slaughter Ranch	1300–1500[f]			
Ojo de Agua	1250–1450[g]	1580 ± 180; 1522 ± 41; 1420 ± 70; 1666 ± 40[g]		
Double Adobe Cave	?	545 ± 90[h]		
Maddox Ruin	1000–1400[d]	1230 ± 60[h]		
Hildalgo Survey 1	?	1420 ± 60; 1060 ± 60; 1200 ± 60[h]		
Hildalgo Survey 65	?	1185 ± 60[h]		
Hildalgo Survey 15	?	1060 ± 60; 875 ± 60[h]		

References: [a]McCluney 1965; [b]McCluney n.d.; [c]Kidder and others 1949; [d]O'Laughlin et al. n.d.; [e]Douglas 1996.; [f]Estimate by P. Fish; [g]Braniff 1992: 547; [h]De Atley 1980: 69; [i]Di Peso 1974: 46; [j]Mills and Mills 1969a; [k]Curtis Schaafsma, personal communication.

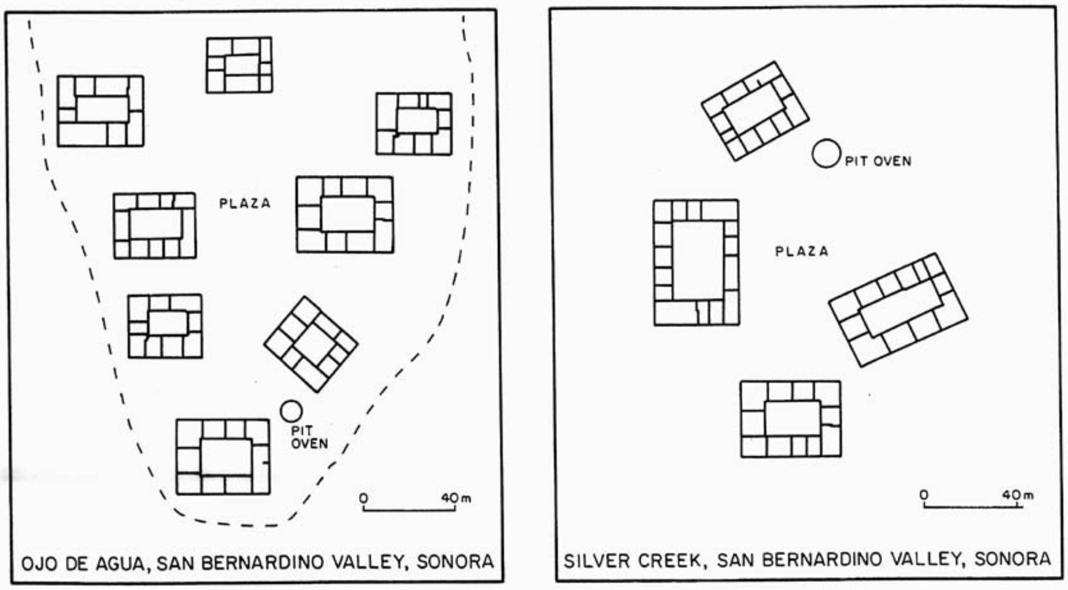

Figure 3.6. Selected site plans with compound architecture.

generally parallel ceramic estimates and postdate A.D. 1200. The late dates from Ojo de Agua are particularly intriguing as they are in clear association with ceramic assemblages (the range of polychrome types and Cloverdale Corrugated utility ceramics) and architecture that characterize late prehistoric (Animas phase) occupations in the Borderlands.

Geographic Variability

The presence of two stylistically discrete late prehistoric occupations in the Malpai Borderlands study area has been long distinguished on the basis of distinct plainware utility types (Brand 1943; Sauer and Brand 1930). One subdivision is in the Animas and San Bernardino Valleys and corresponds to utility ceramic assemblages dominated by Cloverdale Corrugated; the other is located in the Playas Valley where utility ceramics are principally Playas Red. Differences in frequencies of Chihuahuan and Salado polychrome types (Nelson and Anyon 1996: 284) also figure in this distinction; Salado polychromes are more common with Cloverdale Corrugated and Chihuahuan polychromes are more frequent with Playas Red.

Architectural tendencies crosscut these ceramic spheres. Compounds and *cimientos*-type wall footings (cobble or slab alignments without discernible melted adobe) are more frequent in the west, particularly in the San Bernardino Valley with Cloverdale Corrugated. At the largest sites such as Kuykendall (Mills and Mills 1969a,b), a short distance northwest of the study area, and Ojo de Agua (Braniff-C. 1992), spatially separate compounds are formed by a single row of rooms on all four sides of an open interior. At Ojo de Agua and other Sonoran sites recorded by Di Peso (n.d.), large open areas among the compounds may represent a central plaza (fig. 3.6). Contiguous roomblocks and plaza arrangements that have been designated as "puebloan" are recorded in the Animas and Playas Valleys (fig. 3.7). Massive, coursed adobe construction of the roomblocks, resulting in architectural remains of mounded adobe, is more commonplace in the Playas Valley. Smaller sites in the San Bernardino, Animas, and Playas Valleys exhibit great variability and range from isolated structures or field houses, to sets of contiguous rooms, to compounds with a few rooms dispersed in the courtyard or attached to the outer wall.

Geographic and stylistic contrasts have been noted between spatially discrete compounds and roomblocks of contiguous units (Brand 1943: 117; Douglas 1995: 243–244). The designation of "puebloan" for the roomblock layouts is suggestive of underlying cultural and organizational differences as well. However, roomblock sites are more "puebloan" than compound sites only in the sense of larger masses of contiguous rooms; neither of the architectural types exhibits northern elements such as kivas.

Questions among sites with compound and roomblock arrangements concerning organizational carryovers or similarities also can be raised, if not resolved, by our current understanding of site layouts. Di Peso's sketch of Ojo de Agua compounds (fig. 3.6) shows eight units, each outlined by a single row of rooms. If those compounds were conjoined along their outer edges, they would form a series of plaza and roomblock arrangements, with a row of two (or sometimes more) back-to-back rooms between adjacent plazas (fig. 3.7). Such a structure generally parallels the layout of the Joyce Well site

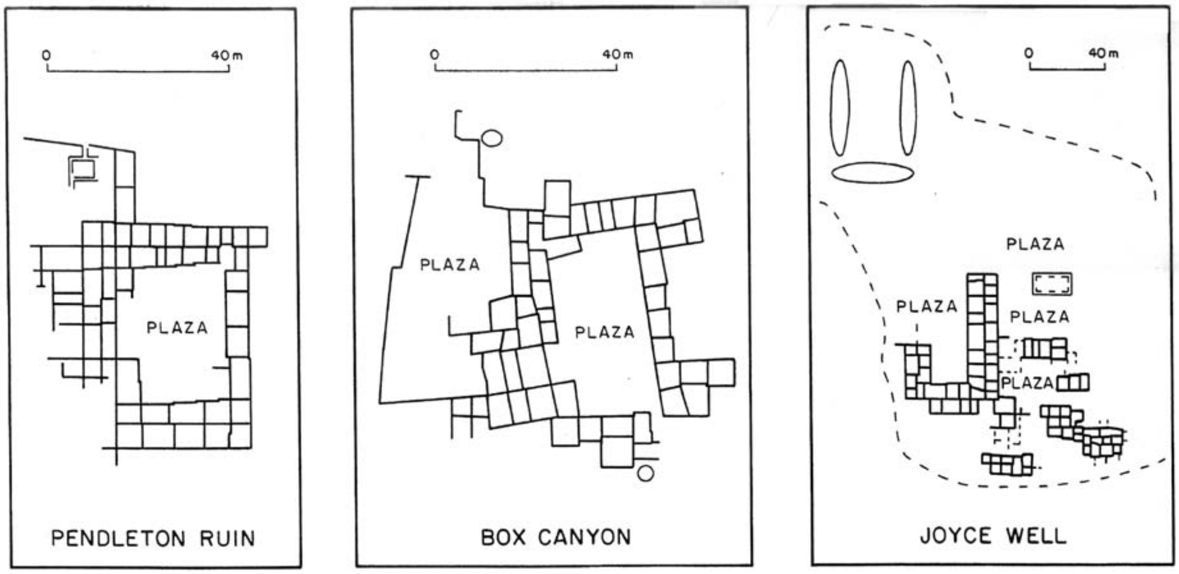

Figure 3.7. Selected site plans with roomblock architecture.

(fig. 3.8), which has five identified plazas and several more probable ones. The open areas in the center of Ojo de Agua compounds could conceivably correspond to the large plaza at Joyce Well. Pendleton and Box Canyon could be smaller multiples of similar arrangements (fig. 3.8). Precise comparison is not possible with sketch maps of most large sites, but the dimensions of plaza units at the three sites in fig. 3.7 appear similar to dimensions of Sonoran compounds provided by Di Peso (fig. 3.6). Thus, sites with separate compounds and sites with roomblocks and plazas may share aspects of demographic and organizational structure.

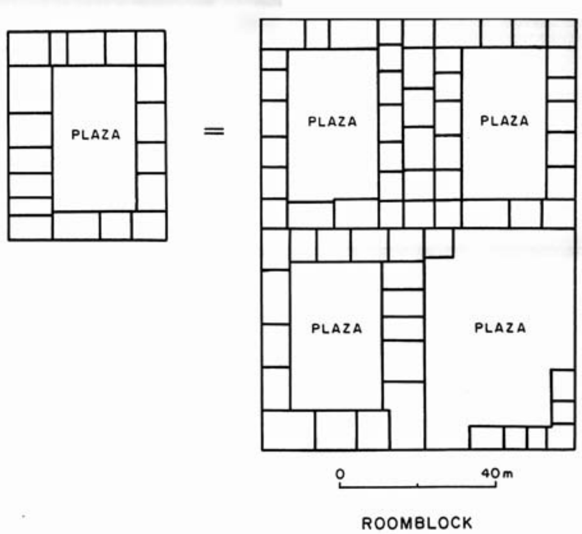

Figure 3.8. Comparison of residential units in idealized compound and roomblock architecture.

Architectural and ceramic styles of the late prehistoric Malpai Borderlands are more closely allied to expressions to the south than to the north. Sites with high frequencies of Cloverdale Corrugated extend to the south in the northern portion of the Carretas Basin and along the southward flowing streams immediately across the border from the San Bernardino Valley in Sonora. Whereas many of the larger sites in the Carretas Basin have even more massive, coursed adobe walls than in the study area, Ojo de Agua and other large Sonoran sites west of the Carretas Basin consist of compound and *cimientos*-style architecture. Brand (1933) and Sayles (n.d., 1936) record many mounded Chihuahuan sites with evidence for massive, coursed adobe south of their Borderlands counterparts at Joyce Well and the Culberson Ruin in the Playas Valley.

Subsistence

Qualitative evidence indicates that late prehistoric inhabitants of the study area had strong agricultural orientations. Ratios of formal groundstone grinding implements to sherds appear well within the range of excavated assemblages from Hohokam and Salado contexts to the north and west (table 3.4). In fact, high frequencies of well-worn grinding implements have often been used by study area researchers to characterize Animas phase remains (Brand 1943: 119–122; Kidder and others 1949: 142).

Three kinds of botanical samples supply information pertaining to Malpai Borderlands subsistence. Excavations in dry deposits in Pinnacle Cave, Buffalo Cave, and U-Bar Cave in the Alamo Hueco Mountains on the eastern edge

Table 3.4. Comparison of groundstone frequencies among sites in the Northwest Periphery, Hohokam, and Salado Regions.

Site or site group	Location	No. of sherds	No. of manos and metates	Groundstone ratio[a]	Reference
Pendleton	Cloverdale Creek	2,765	261	9.45	Kidder and others 1949
Joyce Well	Deer Creek	9,985	78	.78	McCluney n.d.
Box Canyon	Animas Valleu	1,017	17	1.67	McCluney 1965
Clanton Draw	Animas Valley	1,167	14	1.19	McCluney 1965
Boss Ranch	San Bernardino Valley	28,959	42	.15	Douglas 1985
Los Morteros	Tucson Basin	39,002	258	.66	Wallace 1995
La Lomita	Phoenix Basin	9,943	66	.66	Mitchell 1990
U:9:95 (ASM)	Phoenix Basin	5,216	33	.63	Doyel and others 1995
U:9:97 (ASM)	Phoenix Basin	907	23	2.54	Doyel and others 1995
Livingston Site Group	Tonto Basin	75,628	331	.31	Jacobs 1995
Roosevelt Community Development Sites	Tonto Basin	90,316	192	.21	Elson and others 1995

[a]The groundstone ratio is calculated by dividing number of manos and metates by total number of sherds and multiplying times 100.

of the study area furnished an array of well-preserved perishable artifacts and large quantities of cultivated and noncultivated plant foods (Lambert and Ambler 1961). Excavations at Pendleton Ruin, Box Canyon, Clanton Draw, and Joyce Well produced records of plant materials, although systematic recovery techniques such as screening and flotation were not employed. Hugh Cutler (1961; Cutler and Cutler 2002: table 3.1; Cutler and Eickmeier 1965; York 1961) provides quantified lists of plant remains for the caves, Box Canyon, Clanton Draw, and Joyce Well, but only impressions are offered by Kidder and others (1949) for the Pendleton Ruin. Data based on standard screening of all deposits and flotation analyses are available only for the Boss Ranch site (Adams n.d; Douglas 1996).

Charred corn remains are consistently described as abundant at excavated sites in the study area (Kidder and others 1949: 142; McCluney 1965a: 21, 36; 2002: 45–46). At Joyce Well, corn was present in many rooms and described as stacked like cordwood in several rooms (Cutler and Cutler 2002: table 3.1). Out of 25 flotation samples, 23 (92 percent) contained corn at the Boss Ranch site (Adams n.d.; Douglas 1996)—a high rate of recovery when compared with analyses for other prehistoric Southwestern farmers. Four varieties of corn that Cutler classified as Pueblo, Onaveno, Pima-Papago, and Reventado/Chapalote were usually present in assemblages at the dry caves, Box Canyon, Clanton Draw, and Joyce Well.

Other identifications of cultivated crops include numerous instances of cotton, several varieties of beans, cucurbits, and bottle gourd (Adams n.d.; Cutler and Eickmeier 1965; Kidder and others 1949; Lambert and Ambler 1961). The frequency of cotton in excavated samples is of note, particularly as no systematic methods such as flotation or even screening were attempted at most sites. Cotton is reported from the Alamo Hueco Caves (Lambert and Ambler 1961), Boss Ranch (Adams n.d.), and Joyce Well (Cutler and Cutler 2002: 100).

Tabular knives, usually associated with the harvest and processing of agave, are conspicuous components of lithic artifact assemblages, and large roasting pits are frequently found in both residential sites and as isolated features. Amerind Foundation site file information indicates that large ovens may be formal elements of plaza arrangements surrounded by compounds in the San Bernardino Valley and in the valleys of northeasternmost Sonora. Although this archaeological evidence suggests that agave or perhaps yucca or sotol were important sources of food and fiber, no direct evidence currently supports cultivation of agave as now recognized in the Hohokam region (see Fish and others 1985).

The record of wild plants from excavated study area sites, including dry caves, is modest compared to cultivated resources. Potential food resources include grass, yucca, sotol, mesquite legumes, acorns, walnuts, dock, and prickly pear, but ubiquity of each is often limited to a single instance and is always much lower than corn. Likewise, animal bones are not particularly common in excavated contexts. Kidder and others (1949: 142) specifically comment on their rarity at the Pendleton Ruin. With systematic recovery through screening and flotation at Boss Ranch, only 178 faunal specimens could be classified into the broad categories of canine (coyote and dog), artiodactyl (deer and antelope), or lagomorph (cottontail and jackrabbit). This assemblage was dominated by lagomorphs. Aside from the addition of a few small mammals (fox, rocksquirrel, skunk, bobcat, wood rat) and unidentified birds, a composite faunal assemblage from all reported late prehistoric sites is almost identical to that of Boss Ranch (Douglas 1996: 192–193).

Little direct information exists on agricultural technology and field locations. Location near surface flows and alluvial fans suggests an emphasis on small-scale irrigation and floodwater strategies. In a catchment analysis for residential sites, Frank Findlow (1979) suggests that there is a primary emphasis on first- and second-order streams permitting ditch irrigation and a secondary emphasis on alluvial fans. On the basis of farming observed in Mexico, Sauer and Brand (Brand 1933, 1943: 117–122; Sauer and Brand 1930: 426, 443–444) during early reconnaissance surveys in the region, drew similar conclusions about the importance of irrigation. By comparing catchments around these sites and randomly placed plots on Landsat photographs of the study area, Findlow and Confeld (1980) identified distinctions in soil composition at stream margins that they suggested could be associated with past farming activity. Supporting this interpretation, Allen Dart (1986) identified actual changes in waterlaid soil types, as classified by the Soil Conservation Service, along the paths of former Hohokam irrigation canals in the Phoenix Basin.

Stone features associated with prehistoric agriculture are not well documented in the study area. Without locations or descriptions, Brand (1943: 117) mentioned considerable use of stone for terracing in the San Bernardino Valley and along the Rio Bavispe, but noted its absence in the Animas drainage. In a large-scale map of Casas Grandes settlement pattern, Di Peso (1974: vol. 4, map insert) indicated several instances of extensive checkdam systems in the Playas Valley. The few instances in site files of features that might be agricultural usually consist of only one or two alignments.

Issues in Demography and Settlement

Comparative Population—Estimates by Findlow and De Atley (1976) and by Lekson (1992a) suggest that Borderlands population was relatively low in number and density. Findlow and De Atley proposed population of approximately 1,300 persons with a density of 0.96 individuals per square mile. Using Longacre's (1975) formula, Lekson (1992a: 113) projected back from this estimate to derive a figure of approximately 640 contemporary rooms within the study area outlined by Findlow and De Atley in their Hidalgo Project. Possibly a few hundred additional occupants could be added from southeastern Arizona portions of the Malpai Borderlands not included in the Hidalgo Project design. Brand (1943; Sauer and Brand 1930) believed that population sizes and densities were significantly greater among related peoples near Janos and in the Carretas Basin, the Bavispe drainage, and portions of the San Bernardino Valley to the south.

To put modest Borderlands population into perspective, contrasts can be made with more densely settled populations in surrounding areas. For example, residents of Casas Grandes alone have been estimated in a range between 2,500 and 5,000 (Di Peso 1974; Lekson n.d.); unfortunately there is no sound basis at present for estimating outlying population in any area approximating the size of the Borderlands. A rough comparison of magnitude vis-à-vis Hohokam large-scale irrigators along the Gila River also is revealing (table 3.5). An average population of 2,300 has been calculated for a single community, consisting of one mound center and its outlying settlements. Six such communities share an extensive canal network on the Gila River, for a possible total of 13,800 people in an area a fraction of the size of the Borderlands.

Short-Term Sedentism—Restricted refuse, limited architectural remodeling and superpositioning of features, and low numbers of burials at late prehistoric sites in the study area and in adjacent regional sectors have led researchers to believe occupation spans were short (Carmichael 1990; Douglas 1990; Kidder and others 1949: 146; Nelson and LeBlanc 1986; Upham 1992). Nelson and Le Blanc (1986) coined the descriptor "short term sedentism" to describe agriculturally committed and aggregated populations that occupy sedentary communities in sequential locations. More recently, Nelson and Anyon (1996) presented a model of "fallow" valleys in which sedentary populations shift from valley to valley to allow regeneration of critical resources. They posit a sequence of shifts in sedentary villages from the Mimbres Valley south to the Animas and Playas Valleys and then north to the Cliff and Mule Creek regions.

Depletion of faunal (Douglas 1996; Nelson and LeBlanc 1986) and fuelwood (Minnis 1985) resources are mentioned as examples of factors that might precipitate cycles of population movement. Soil exhaustion (Sandor and Gersper 1988; Sandor and others 1986) is also sometimes cited as a factor influencing regional settlement. Sequential movement might be the simple and convenient solution to resource depletion under conditions of low and discontinuous regional population. However, it is also clear that long-term sedentism was maintained in other sectors of the Southwest under environmental constraints as stringent or more so than those seen in southwestern New Mexico by Nelson and Anyon (1996).

Table 3.5. Interregional comparison of estimates for demographic parameters and resource requirements.

Community	Estimated population[a]	Hectares of farmland[b]	Cords of firewood[c]
Late Prehistoric Animas Pueblos	1,300	520	2,600
Average Hohokam Platform Mound Community in the Casa Grande Irrigation Community	2,300	1,041	3,450
Casa Grande Irrigation Community	13,800	6,245	9,370

[a]The estimate for the Animas population is from Findlow and De Atley (1976: 40), as amplified by Lekson (1992: 113). Estimates for an individual Hohokam platform mound community and the entire Casa Grande system are based on Crown (1987b) and the population/ha ratio for Pima irrigated land in Castetter and Bell (1942: 54).
[b]Estimates for the Hohokam are from Crown (1987b), and for the Animas region were derived from the population/ha ratio of Pima irrigated land.
[c]Fuelwood consumption per capita is based on Spoerl and Ravesloot (1994). Consumption estimates are arbitrarily reduced by 25 percent for Animas and 50 percent for the Hohokam because of proportionately milder climates.

To develop a general comparison, fuelwood and agricultural land requirements are examined for late prehistoric inhabitants of the study area and a single irrigation community of settlements sharing a canal network on the Gila River that was continuously inhabited for at least 800 years (table 3.5). Touchon (1988) used estimates for Emory oak in low-yield zones near the study area to show that sustained fuelwood needs could be supplied for the entire Borderlands population from approximately 155 km^2 (60 square miles). However, sustainable fuel for the Classic period Hohokam in the Casa Grande irrigation community is a problem of substantially greater spatial scale. Between 388 and 971 km^2 (150 and 375 square miles) of Sonoran Desert would be required to sustain the estimated level of fuelwood consumption by the Casa Grande community. This population was concentrated in an area of 78 km^2 (30 square miles). Problems of resource sustainability for even the largest Borderlands settlement clusters were minor compared to similar challenges for these densely packed Gila River irrigators.

Ceramic variability from one valley to the next is critical to Nelson and Anyon's (1996: 279) argument of sequential movements among fallow valleys. They reason that regional phases are difficult to establish because the ceramic assemblages in each valley are somewhat different, probably resulting from a lack of contemporaneity. Their model does not take into account the fact that the ceramic divisions among Borderlands valleys continue to the south into Chihuahua and Sonora, as do distributions of settlement during this period (Brand 1943; Sauer and Brand 1930; Whalen and Minnis 2001). Crossing the border at Antelope Wells, Brand (1943) continued to record Animas-like sites into the Carretas Basin. Files at the Amerind Foundation document six large sites (100 to 400 rooms) along the San Bernardino River between Fronteras and the international border in Sonora, suggesting that Slaughter Ranch and perhaps the Boss Ranch/San Bernardino complex are the northernmost expressions of a settlement distribution that stretch a considerable distance into Mexico.

The quality and extent of archaeological work in the Malpai Borderlands study area make it difficult to evaluate the "Short-term Sedentism/Fallow Valley" hypothesis. Site survey records do indicate that some continuity exists in settlement location between Mimbres horizon and later prehistoric villages. Large assemblages of heavily worn and worn-out grinding implements exist at many sites, suggesting some span of stable occupation (see, for example, Kidder and others 1949: fig. 22–23; and Brand 1943: 118–120, particularly the description of Double Adobe Creek on p. 119). The same degree of ceramic variability noted by Nelson and Anyon (1996) for Borderlands sites also occurs to the south among the contemporary sites of northern Sonora and Chihuahua and must reflect cultural factors as well as time. Finally, as will be discussed in the following section, even the most generous population estimates suggest that the Borderlands region always had relatively low populations, which should have exerted less pressure on resources than residents of various other Southwestern regions.

Settlement Hierarchies and Territorial Communities—Several discussions of late prehistoric settlement hierarchies in the study area have focused on site-size rankings. Steven LeBlanc (1989: 193) uses differences in site size as evidence that large pueblos were lower-order centers in the Casas Grandes polity. Findlow and De Atley (De Atley 1980; Findlow and De Atley 1976) also suggest an Animas phase settlement hierarchy, although they do not imply a dependency relationship with Casas Grandes. Their hierarchy is based primarily on site size, supported by artifact densities and diversity. The hierarchy consists of primary and secondary villages and at least some field houses.

Douglas (1995: 247–248) takes issue with attempts to define any sort of settlement hierarchy or integrative settlement structure above the village level. He observes a strong correlation between settlement size and agriculturally favored locales and favors a strong likelihood that tendencies towards larger site size may occur later in time during the Animas phase. He notes that archaeologists in the region frequently divide occupational loci dispersed over several kilometers but functioning as a single village into multiple sites; separate designations for the Boss Ranch and San Bernardino sites is a good example (Douglas 1996; Myers 1985). Finally, Douglas (1995: 246–247) and De Atley (1980) both note the apparent absence of ritually integrative features that mark integrative or communal nodes in a settlement hierarchy.

Earlier records, new comparative information, and site visits undertaken in the course of preparing this overview strongly suggest that politically and ritually integrative nodes marked by ballcourts are present in late prehistoric Borderlands settlement. These features may have been frequently overlooked by study area investigators because of their unobtrusive character and failure to match expectations for ballcourt morphology. Recent survey investigations in the Casas Grandes region have demonstrated numerous instances of ballcourt structures and have provided new criteria for their recognition elsewhere (Naylor 1995; Whalen and Minnis 1996). In the area surrounding Casas Grandes, courts in locales with appreciable settlement do not always occur within the largest site. Orientation seems to be consistently north-south. Although some Chihuahuan ballcourts are clearly I- or T-shaped, others are marked on the surface by simple parallel arrangements of rocks (Whalen and Minnis 1996).

The clearest examples of ballcourt structures in the Malpai Borderlands are at Joyce Well (Carpenter 1992) and the Timberlake Ruin (O'Laughlin and others n.d.). Both consist of north-south parallel embankments delimiting field areas of 650 and 850 m^2 (6,997 and 9,149 ft^2) respectively. A third possible instance is a heavily disturbed depression and set of embankments at the Maddox Ruin in the Animas Valley (Thomas O'Laughlin, personal communication). This feature is also oriented north-south and has an area of approximately 700 m^2 (7,535 ft^2). A fourth probable ballcourt, at New Mexico EE:5:1 (Animas Peak), is located to the south in the Animas Valley and was recorded by Roger Kelley (1963). The structure is oriented north-south with a field area of 480 m^2 (5,167 ft^2) and is associated with a pueblo of approximately 100 rooms. On the site card, Kelley indicates that the court is associated with School of American Research site 62Hi5 (the Cowboy site). Recent information from Roger Kelley (personal communication) and Curtis Schaafsma (personal communication) indicated that the actual site location might be near Clanton Draw. Brief reconnaissance by the authors in the vicinity of Clanton Draw and the Cowboy site failed to reveal evidence of a court. Using locations of known ballcourts and approximate locations for others, late prehistoric settlement in conjunction with ballcourt distributions is presented in figure 3.9. Finally, since preparation of this volume, a small (440-m^2 [4,736-ft^2]) ballcourt oriented north-south has been identified at the Culberson Ruin 7 km (4.3 miles) southeast of Joyce Well (Skibo and others 2001: 120).

Several ballcourts and possible ballcourts are reported just beyond the boundaries of the Malpai Borderlands study area. A court was recorded immediately west of Janos by Whalen and Minnis (2001). Naylor (1995) describes a ballcourt at Las Palmas just off the Janos-Carretas Pass Road in Chihuahua. William Doolittle (1984) describes two possible ballcourt structures in the Rio Sonora farther to the west. Beatriz Braniff-C. (1992) describes rectangular enclosed structures (*corrales*) that Whalen and Minnis (1996) believe may be ballcourts elsewhere in northern Sonora. A north-south Casas Grandes-type court is also recorded at the Santa Cruz site east of Nogales, Sonora (Kelley 1963; Wilcox and Sternberg 1983: 127). North-south parallel alignments at two sites north of Nogales along the Santa Cruz River reported by Frick (1954, also Whittlesey 1996) fit the criteria for additional instances.

The "great kiva," a likely ballcourt, at the Ringo site northwest of the Borderlands, may have implications for ballcourt recognition. The feature was marked on the surface by a shallow depression that was delimited by low adobe walls upon excavation. The flat floor showed patches of a former adobe surface. The feature is oriented north-south and encompasses approximately 900 m^2 (9,688 ft^2). The excavators, Alfred Johnson and Raymond Thompson (n.d., 1963: 469), considered the possibility of a ballcourt structure but rejected the idea because the structure was rectangular, unlike the oval courts of southern Arizona. Based on current knowledge of the Chihuahuan instances, Raymond Thompson (personal communication) now believes that this feature is most probably a Casas Grandes-style ballcourt. Without surface markers, other adobe courts might be dismissed as in the Ringo site instance.

Given conceptual and physical problems of recognition, it seems likely that ballcourt structures were at least somewhat more numerous than present records indicate for the Borderlands and other portions of the

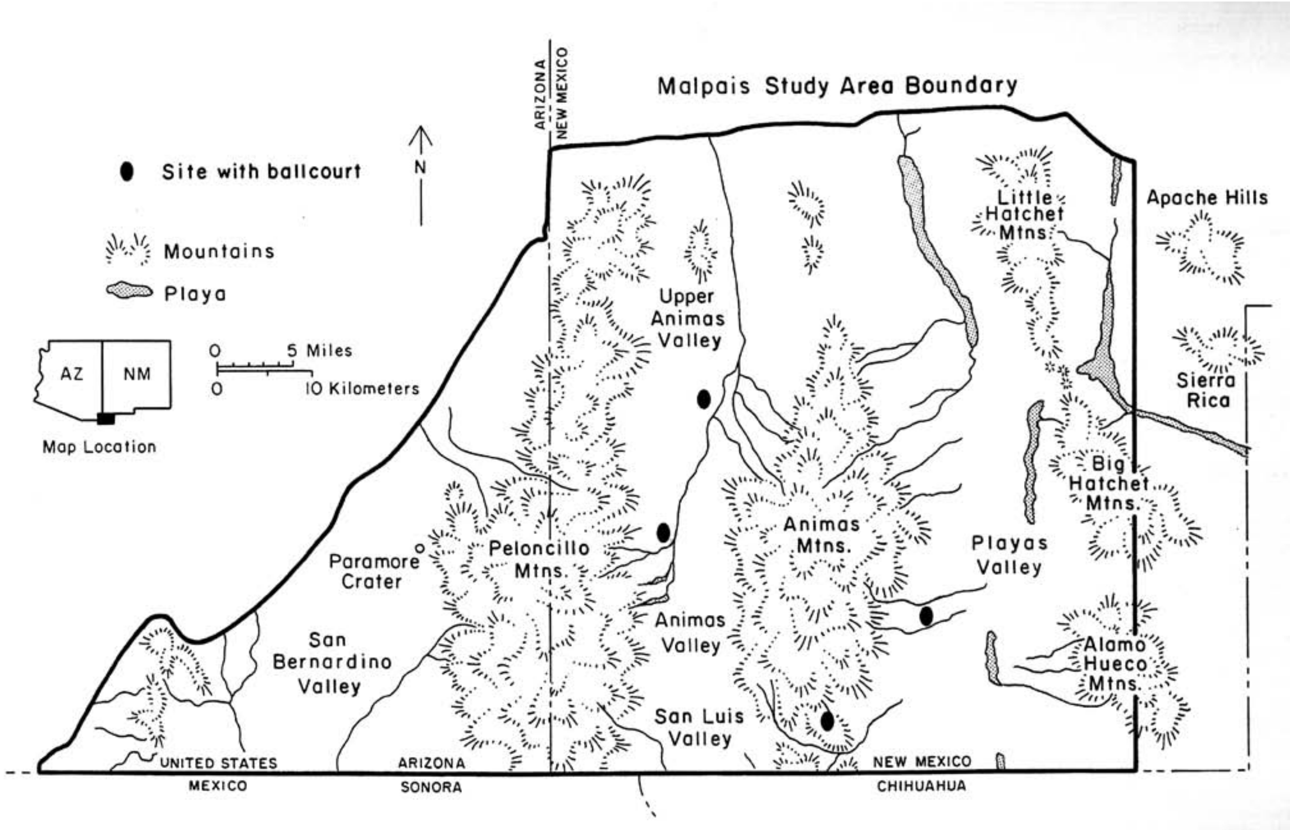

Figure 3.9. Distribution of probable ballcourts in the Malpai Borderlands.

northwestern periphery of the Casas Grandes regional system. We believe that these structures served as the focal, communal architecture for multisite communities similar to those now well established for the Hohokam culture area (S. Fish and Fish 1994) and other parts of the Southwest (Adler 1996; P. Fish and Fish 1994). In the apparent absence of kivas, platform mounds, or other integrative structures, events associated with ballcourts probably represent institutions and activities that crosscut social constituencies and ideologies, promoting commonality throughout community territory. A detailed model for zonally arranged multisite communities with differentiated topographic opportunities in the Malpai Borderlands is offered in chapter 6.

In a recent reanalysis of the occupational history of the Pendleton Ruin, John Douglas (2004: 432–434) argues that rooms at the plaza edge were intentionally filled to form a platform mound during the mid-14th century. Room walls would have functioned as retaining walls for mound fill as in well-documented Hohokam platform mounds in the Safford (Mills and Mills n.d.), Tonto (Craig and others 1998), and Tucson (Hayden 1957) Basins. It is conceivable that other such instances of mound construction will be identified in the Malpai Borderlands and the broader Casas Grandes regional system. If so, another indicator of centralized ritual or public architecture will be available to identify differentiated settlement patterns and community organization.

Regional Integration and Interaction

The degree to which Borderland settlements were integrated by the Casas Grandes polity has been the crux of a debate central to the interpretation of late prehistory in the Borderlands. Charles Di Peso (1974: 778) viewed Animas phase sites initially as satellites providing Casas Grandes with turquoise and obsidian, and later as population refuges after the collapse of the city in the early 14th century. Similarly, Steve LeBlanc (1989) portrays Animas settlements as outposts of Casas Grandes developed following the collapse of the Chaco Canyon and Mimbres cultural systems and the demise of their role in trade with central Mexico.

Other models portray considerably less economic and political dependency on Casas Grandes. De Atley (1980) and De Atley and Findlow (1982) describe Animas phase settlements as a frontier phenomenon, with loose participation in a Casas Grandes exchange system. Paul Minnis (1984, 1989) finds little linkage between the two areas and describes Borderlands villages as essentially autonomous.

Table 3.6. Distribution of Casas Grandes architectural traits among excavated late prehistoric sites in southeastern Arizona and southwestern New Mexico.

Site	T-shaped or keyhole doorways	Raised hearths	Scalloped hearths	Collared postholes	Reference
Ringo Site					Johnson and Thompson 1963
Kuykendall	Present	Present		Present	Mills and Mills 1969a,b
Boss Ranch					Douglas 1985, 1996
Clanton Draw					McCluney 1965
Box Canyon	Present	Present		Present	McCluney 1965
Pendleton					McCluney n.d
Joyce Well	Present	Present	Present	Present	Kidder and others 1949
Montoya		Present		Present	Ravesloot 1975
Walsh		Present		Present	Ravesloot 1975

Douglas (1995) argues that relationships were probably dynamic and situational, dependent on shifting alliances and exchange relations. The several measures traditionally used to measure Casas Grandes-Animas interaction are architectural traits, ceramic styles and production, and access to prestige goods.

Architectural Traits—Comparison with Chihuahuan patterns of architecture have been used to both support (Brand 1943; Carpenter 1992; Di Peso 1974; Le Blanc 1989; Ravesloot 1979) and refute (Douglas 1995: 243; Kidder and others 1949: 146) Animas phase affinity with Casas Grandes. The absence of T-shaped or keyhole-shaped doorways, raised and scalloped hearths, collared postholes, and subfloor inhumations at the Pendleton Ruin caused Kidder (Kidder and others 1949) to reject a Chihuahuan affiliation and to adopt the term "Animas." More recent excavations have demonstrated the widespread existence of these traits in southwestern New Mexico and southeastern Arizona (table 3.6). These traits measure relationships at the level of horizon style and reflect some degree of acceptance of "norms" that serve to distinguish broad cultural patterns. However, they do not measure intensity or manner of interaction.

Ceramic Styles and Production—John Carpenter (1992) shows that Animas phase settlements fall within a zone of Ramos Polychrome distribution that is separated from Casas Grandes by an intervening area of Carretas and Huerigos polychromes (fig. 3.10). Suzanne De Atley (1980; De Atley and Findlow 1982) attempted to measure the integration of the Borderlands region by Casas Grandes through attributes of style, but her results have been seriously challenged on grounds of sample size and an assumption of local production of ceramics (Douglas 1995: 247; Minnis 1984, 1989). Recently, some compositional evidence has indicated that local production of Ramos Polychrome occurred in the Sulphur Springs Valley of southeastern Arizona (Woosley and Olinger 1993), and at the Culberson Ruin (Woosley and Olinger 1993) and Joyce Well (Carpenter 1992, 2002) in southwestern New Mexico.

Access to Prestige Goods—Minnis (1984, 1988, 1989) argues that certain types of prestige goods characteristic of Casas Grandes are rare (shell, turquoise) or absent (copper, macaws) in Animas phase sites. On the other hand, John Douglas (1995: 246) points out that frequencies of prestige items may not equate with level of interaction or strength of integration. Douglas also notes that, with few burials and no exposed ritual contexts, excavated data may not be adequate to make such comparisons. Nevertheless, qualitative data from the study area and adjacent locations indicate a degree of access to prestige goods. Abundant shell and numerous artifacts of turquoise, slate, and hematite were recovered from funerary contexts at Joyce Well (McCluney 2002: 34–35), the one site where significant numbers of burials have been excavated. Two small copper pendants were recovered from the San Bernardino site (Myers 1985). Further south in the San Bernardino Valley, Braniff-C. (1992: 496) reports three copper bells from Ojo de Agua and two from Rancho Baviso. U-Bar and Pinnacle Caves produced large quantities of scarlet macaw feathers (Lambert and Ambler 1961: 101; C. Schaafsma, personal communication). Although not fitting the criteria established by Minnis and others (1993: 272–273), a possible macaw pen was identified at Slaughter Ranch (Mills and Mills 1969a).

Antelope Wells obsidian is a Malpai Borderlands resource that might have been economically valuable to Casas Grandes. Recent x-ray florescence studies of obsidian samples from the vicinity of Casas Grandes indicate frequent use of this resource. Furthermore, regional obsidian studies have also revealed that Antelope Wells material seldom occurs in assemblages to the north and west outside the distribution of Chihuahuan polychrome

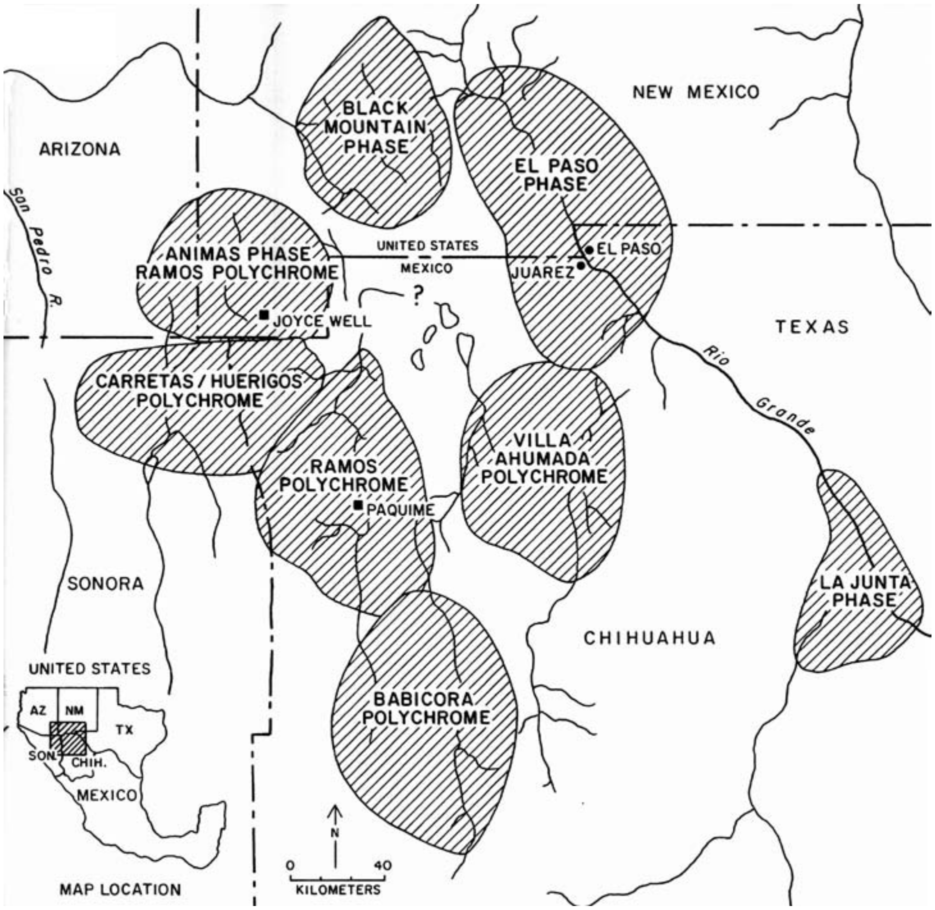

Figure 3.10. Distribution of Chihuahuan polychrome styles as outlined by Carpenter (1992).

(Steve Shackley, personal communication). Although this possible pattern of dual overlapping distributions does not necessitate any kind of economic dependency between the Malpai Borderlands and Paquimé, it deserves investigation as it may signify the directionality and special concentration of some economically interactive relationships.

A Final Comment on Regional Interaction

Most discussion of Casas Grandes-Borderlands interaction has focused on the presence or absence of dependency relationships in a political and economic sense. We can agree with Douglas (1995) and Minnis (1984, 1989) that current evidence for such asymmetric interaction is limited. On the other hand, it seems likely that late prehistoric Borderlands inhabitants participated at some level in an ideology that was shared with, and most elaborately encoded at Casas Grandes. This ideology involved the construction of ballcourts, and related tenets were probably symbolized in certain ceramic and architectural "horizon styles" (see Wilcox 1995: 289). This ideology was clearly differentiated from a Hohokam and western Salado ceremonial focus on platform mounds to the northwest and an Anasazi kiva and plaza orientation to the north. Massive hillside structures of the major trincheras villages may delineate a similarly distinctive realm of ideological orientation to the west in Sonora (Downum and others 1994: 292–293; P. Fish and Fish 1994: 22).

Casas Grandes clearly was a central exponent of this ideology. As defined archaeologically, this ideology likely represents a phenomenon broader than religion per se, perhaps in the realm of "world view." Archaeologically recognized variants of architecture and ceramics are subsumed by the most conservative distribution of ballcourts (Whalen and Minnis 1996). This stylistic diversity is increased if most of the instances proposed herein prove viable. The number and variety of ritual features at Casas Grandes set this site apart from all other sites in the region containing ballcourts. Eighteen platform mounds, each with a different shape, three ballcourts, and a wide range of ritual rooms are present. Each of these probably served as a location for ceremonies that affected some segment of the Casas Grandes population (see Minnis 1989: 277–280). Current archaeological data are insufficient to clarify the roles Casas Grandes served in this regional ideology; sharply contrasting models can be fitted to existing data.

David Wilcox (1995: 289–292), for example, proposes a system of ceremonial exchange between local elites, fostered by a version of the Mesoamerican ballgame, as a mechanism through which Casas Grandes exercised its influence and control. For the sphere within a 3.5 day walk of Casas Grandes that includes the Malpai Borderlands, he defines a system that was economically differentiated and politically dominated by the preeminent center. According to this model, the Casas Grandes regional system variously linked local elites to the center, and differentially facilitated exchange and tribute flowed among village or community nodes. As a result of recent surveys and ongoing excavations designed to illuminate the role of Casas Grandes in regional settlement, Whalen and Minnis (2000, 2001) find little support for Casas Grandes hegemony or integration of outlying settlements beyond a range as short as 30 km (19 miles). Thus, based on the distribution of elements such as site size, ballcourts, production of crafts, and other exotics such as macaws and ceramics, these researchers would exclude the Borderlands and adjacent areas in Mexico from any direct political and economic influence of Casas Grandes. Furthermore, they argue that the notable sparsity of courts at a distance from Casas Grandes denotes substantially weaker local integration and that presence of courts need not imply any type of integration into the Casas Grandes regional systems (Whalen and Minnis 1996: 741–744)

Plausible models for ideological centrality and directional emphasis in material exchange can be offered that do not emphasize political or economic domination. For instance, Casas Grandes could have been the destination for regional pilgrimages, serving to ideologically reinforce and unite outlying populations without tribute or political control. Models featuring pilgrimage have been considered for Chaco Canyon (Judge 1984: 241–242, 1989). There are examples of such pilgrimages in the ethnographic literature. For example, the annual Festival of San Francisco in Magdalena, Sonora involved multi-ethnic participants from all parts of Sonora and southern Arizona and is thought to have precontact origins (Dobyns 1960; Griffith 1992). Pilgrimages represented an individualized mechanism through which widely separated communities might participate at different levels in Casas Grandes ideology. Trade, local alliances, and a variety of other political and economic negotiations were likely byproducts of such occasions.

Just as it is difficult with existing data to detail the kind of regional integration embodied by Casas Grandes-style ballcourts, it is difficult to specify their significance at the local Borderlands level. Although all northern and western examples would fit into Whalen and Minnis' (1996: 737) simple, open ballcourt category, these too are morphologically variable. This variability includes size, construction material, and labor investment, which may have functional, ideological, and hierarchical implications. Unfortunately, none of the northwestern periphery sites with consensual or suspected ballcourts can be viewed in a context of comprehensive local settlement.

Despite these problems, the nature of the ballcourts themselves offers some insights into probable roles in local territorial organization. The communal nature of ballcourt construction is generally accepted. Furthermore, events held at these structures are also considered to be communal and frequently to have involved the competitive interaction of separate territorial entities. This interaction could have involved individual villages, but in the case of Hohokam ballcourts, interaction is generally conceived as taking place between "communities" or groups of settlements (Wilcox and Sternberg 1983). This kind of interpretation of ballcourt function seems no less applicable for Casas Grandes-style structures. It follows, then, that Borderlands sites with ballcourts served as integrative nodes for some community-like set of additional settlements.

Whalen and Minnis (1996) observe that the small number of courts at a distance from Casas Grandes indicate the majority of populations in these areas were not involved in ballcourt activities. However, the nature of internal integration and external interaction associated with ballcourt institutions is unknown. Whereas the participation of individual villages in Casas Grandes interactions may indeed have been autonomous in some cases (Douglas 1995), the presence of multiple ballcourts implies that groups of settlements also participated as territorial units in an ideology most elaborately expressed at that site. If ballcourts served as loci of intercommunity observances, the *raison d'etre* for their construction was a form of peer polity interaction.

To fully understand late prehistoric Borderland patterns within the context of the greater Southwest, the scale of reference ultimately must be extended beyond the Casas Grandes world system. Ballcourts were constructed in this system during an era when fully differentiated public architecture first appeared in other large sectors of the southern Southwest outside the earlier distribution of Hohokam-style ballcourts and Mogollon communal kivas. In addition to the Casas Grandes system, including Casas Grandes itself, these regional developments encompassed the appearance of platform mounds in Papagueria and the Tonto Basin and most likely the elaborated trincheras

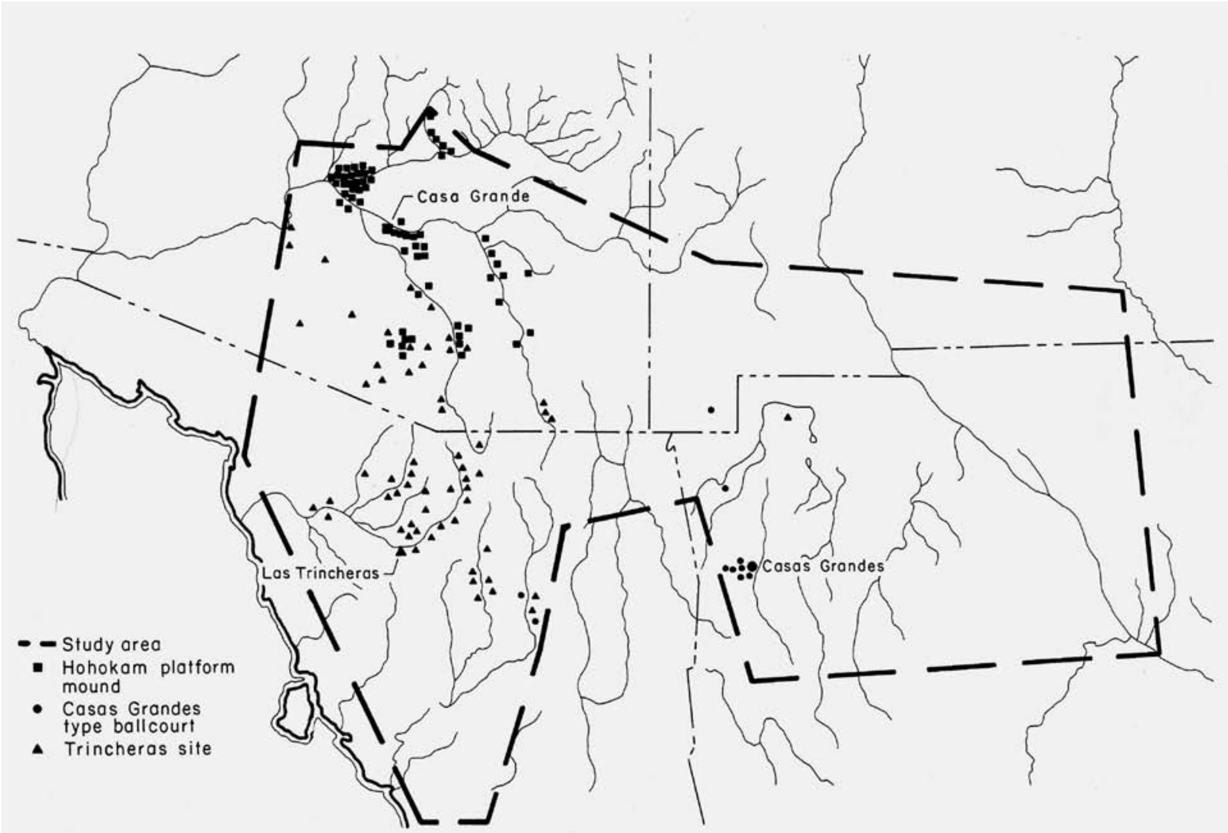

Figure 3.11. Confirmed and probable ballcourts in northern section of Borderlands study area.

phenomenon centered in northern Sonora (P. Fish and Fish 1994: 21–24). The confirmed and probable ballcourts of the northwestern periphery in figure 3.11 begin to fill a gap in the regional distribution of public architecture, and by inference community organization, in the poorly investigated area of juncture among Casas Grandes, Classic Hohokam, and Trincheras traditions. These developments also coincide with a dramatic reorganization of populations through abandonments and aggregation across the Southwest.

John H. Madsen

Chapter 4.

Summary of Spanish, Mexican, and Early American Exploration in the Borderlands

Introduction

The Hispanic period of Arizona and New Mexico spans roughly 320 years beginning in the mid-16th century with the arrival of Spanish explorers and culminating with the ratification of the Gadsden Purchase in June1854. This paper provides an overview of exploration, settlement and land use within and adjacent to the Borderlands during this time. From a review of historic documents, I will provide a general history and present information on Borderland ecology. The earliest descriptions of the environment are often brief and anecdotal, but of sufficient detail, in some instances, to permit comparison and contrast with present landscapes

Documentary Resources

Selected primary and secondary sources of historic information include personal narratives and diaries, letters, and governmental correspondence. Many of the sources are English translations of original Spanish text. Because Spanish authorities were meticulous record keepers, we are fortunate to have many documents related to the study area. The most useful documents are field journals kept by officers during various offensive campaigns against the Apache in the region of the Gila River. For example, during the 1780 campaign, Don Teodoro de Croix required field captains such as Don Joseph Antonio Vildosola to present not only captives, but "... the account of the rations which may be supplied according to the Regulation and a faithful diary of the campaign..." (Thomas 1932: 192). Diaries similar to Vildosola's are brief but provide useful insight into the Borderlands region between the years 1695 and 1786. Dating between 1846 and 1853, the early diaries of George Cooke (1964) and Boundary Commissioner John Russell Bartlett (1854) also provide useful information about the terrain, climate, and impacts of human use.

Other documents reviewed for this summary include cultural resource management reports for Hidalgo County, New Mexico, and Cochise County, Arizona. All pertinent site records for the two counties were provided by the Arizona State Museum, University of Arizona Site and Survey File Office (AZSITE), and the New Mexico Cultural Resource Information System (NMCRIS). An international archival search for pertinent Spanish and Mexican records related to the region in question is beyond the scope of this paper.

The Land

The Borderlands consist of alternating mountain ranges and valleys extending north from the international border that divides the States of Arizona and New Mexico from the Mexican States of Sonora and Chihuahua (fig. 4.1). The Animas Valley of southeastern New Mexico lies in the center of the study area. This valley is bounded on the west by the southern range of the Peloncillo Mountains and on the east by the Animas Mountains. Immediately west of the Peloncillo range is the New Mexico-Arizona state line. Here, the heads of the San Simon and San Bernardino Valleys mark the westernmost extension of

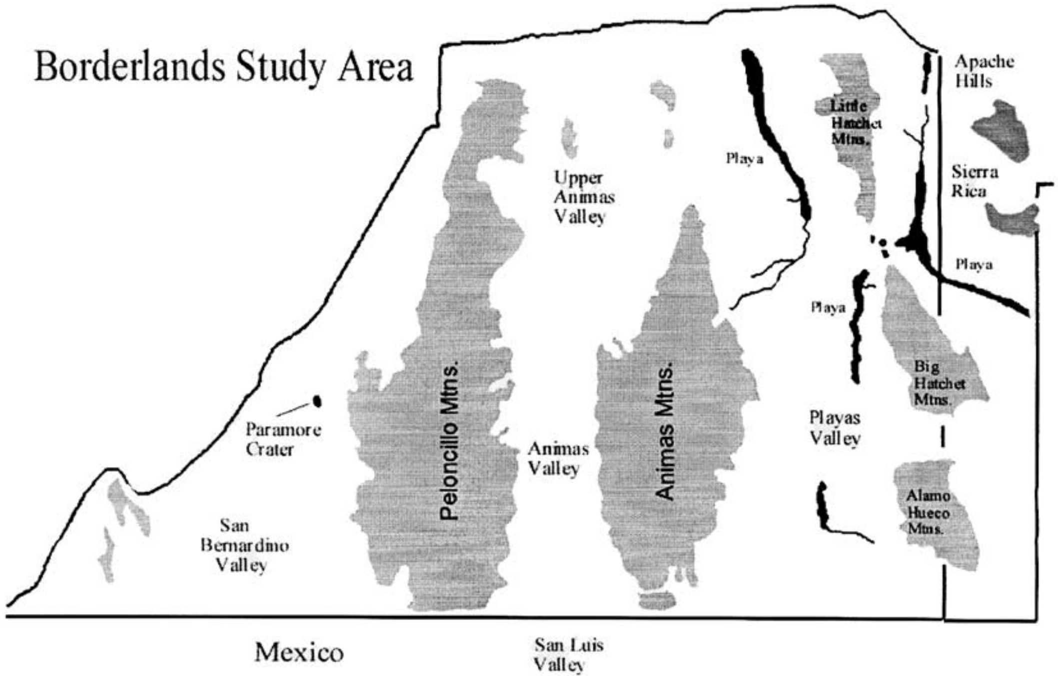

Figure 4.1. Mountain ranges, valleys, and drainage systems of the Borderlands study area.

the study area. East of the Animas range is the Playas Valley and beyond are the Little Hatchet, Hatchet, and Alamo Hueco Mountains.

Elevations within the basins of the San Simon, San Bernardino, Animas, and Las Playas drainages are between 1,200 and 1,600 m (4,000 and 5,200 ft) above sea level. In the Animas Mountains, Animas Peak towers to 2,621 m (8,519 ft) and the highest peak in the Peloncillo Mountains is Black Point at 1,980 m (6,467 ft). The Chiricahua Mountains west of and adjacent to the Borderlands rise to a maximum of 3,070 m (9,976 ft) surpassing both the Peloncillo and Animas Mountains. The Guadalupe Mountains south of the Animas Valley are rough, steep, and broken but do not exceed 2,030 m (6,600 ft).

In New Mexico the Animas watershed drains north into the alkali flats of the Lower Animas Valley. The Playas watershed also extends north and drains into the dry bed of Playas Lake. Both playas become temporary lakes during seasonal flooding. In Arizona, San Simon Creek extends north between the Chiricahua Mountains and the Peloncillo Range and enters the Gila River near Safford, Arizona. The San Bernardino River heads in Arizona; it is the only large watershed in the study area that drains south into Mexico and eventually joins the Rio de Bavispe.

The Peloncillo and Animas ranges of New Mexico have sufficient height and mass to allow annual rains and a light snow pack to accumulate and create temporary high-elevation brooks. In years when precipitation is high, some streams flow into the basins. None of the higher ranges in the borderland nor the Little Hatchet or Hatchet Mountains of southeastern New Mexico have sufficient runoff to produce perennial valley streams. However, boggy seeps and springs are scattered throughout these valleys and along the flanks of most of the mountains. The Chiricahua Mountains on the western edge of the study area have considerable mass and more snowfall than the other ranges. Some perennial streams of the Chiricahua Mountains flow onto the mountain pediment.

History of the Borderlands

Exploration Period: 1534 to 1680

The first Europeans likely to have passed through the region were survivors of the failed Panfilo de Narvaez expedition. On June 17, 1527, Narvaez sailed from Spain with five ships destined for the Rio de Palmas and the Harbor of Panuco on the coast of present-day Texas. Near the end of their transatlantic voyage, tropical storms slowed the progress of the small armada and forced the expedition to reconnoiter in the Caribbean until early 1528. Narvaez set sail for Havana, Cuba, but bad weather forced the armada to the west coast of present-day Florida and, unbeknownst at the time, nearly 600 leagues east of their original destination. Convinced by his pilot that he was near the harbor of Panuco, Narvaez and 300 men disembarked with supplies and horses and set out overland to explore the region. Some of the ships were ordered to sail west in search of the harbor of Panuco, where they were to wait and eventually meet with Narvaez. From April 15 to May 15, 1528, the expedition explored a considerable area in search of Apalachee, a region that native coastal populations described as a land of considerable agricultural productivity and mineral wealth, but none of these claims materialized. The inhospitable nature of the environment and the lack of cooperation by local tribes exhausted the expedition and they retreated to the coast.

By August 1528, the force was dwindling in size due to sickness and attacks by local tribesmen. Unable to find their ships, the leaders of the expedition voted to leave by sea and set about building five barges. By late September 1528, the expedition sailed west along the coast only to be scattered and beached by storms. Many men survived the landing only to perish on shore from exposure, hunger, and Native American attacks. A handful of survivors were enslaved by indigenous coastal populations and evaded death. After several years of wandering and being traded among various tribes, four of the men, Alvar Nunez Cabeza de Vaca, Andres Dorantes, Alonso del Castillo Maldonado, and Estevanico, were reunited and escaped from their captors in 1534. They made their way to the west coast of Mexico where they were found in 1536 by a small party of Spanish slave hunters.

The route taken by Cabeza de Vaca and his three companions is unknown, but scholars (for example Bancroft 1889; Rodack 1981) argue for a route in northern Mexico. On the other hand, Hallenbeck (1940: 220–234) suggests that the four men made their way to the Rio Grande River where they eventually turned west and, upon reaching the Gila River in New Mexico, traveled south between the Dos Cabezas and Chiricahua Mountains of Arizona, and then through the San Bernardino Valley to the valley of Sonora. In support of Hallenbeck's theory of the route, it is of note that as early 1851, travelers stopped at Ojo de Vaca south of the Mimbres River.

Interest in the unexplored northern regions grew as the story of Cabeza de Vaca's journey spread. The hint of precious metals and reports of large Native American towns set the stage for expeditions into the uncharted country north of Mexico. In 1539, the Spanish viceroy, Don Antonio de Mendoza, picked Marcos de Niza and Onorato to investigate the northern country. Estevanico was selected as their guide because he had traveled as a member of the Cabeza de Vaca party and was familiar with the customs of some northern tribes. This expedition suffered many mishaps, Onorato fell by the wayside with illness, and Estevanico and a number of Native American allies met their demise at Zuni. Fray Marcos, who never entered the Zuni towns, returned to Mexico safely that same year.

Marcos de Niza's glimpse of Cibola encouraged the viceroy, and he mounted a second expedition north in 1540. This expedition, of grand scale, had several hundred participants both of European and Native American descent. Accompanied by Fray Marcos, Francisco Vazquez de Coronado left Mexico City and spent several months on the trail north. Between 1540 and 1542, the expeditionary force had explored a considerable region of what is now Arizona, New Mexico, Texas, Oklahoma, and Kansas (Winship 1896). In addition, Coronado sent a considerable number of messengers and small parties back and forth over the trail between Zuni and Corazones, a small colony established by the expedition in northern Mexico.

The trail taken by Niza in 1539 and the route taken by the Coronado expedition in 1540 to 1542 have been debated for nearly a century and will be debated until physical evidence of the trail is found (Ivey and others 1991). The majority of early scholars such as Bandelier (1892), Winship (1896), Herbert E. Bolton (1930), and many other contemporary scholars, would place the point of entry in the Borderlands at or near the San Pedro River in present-day Arizona. Di Peso (1974), Strout (1958), and to some extent Carroll L. Riley (1975), place the point of entry of both the Marcos de Niza and Coronado expeditions at San Bernardino (fig. 4.2), with the expedition continuing north on San Simon Creek along the west side of the Peloncillo Mountains and eventually east of the chain to the juncture of the Blue and San Francisco Rivers. The 1539 and 1540 routes proposed by Di Peso and others are not widely accepted but should not be ruled out. In support of Di Peso's route, I would also contend that from San Bernardino these expeditions may have veered farther to the east and, after crossing the Gila River, may have followed the west flanks of the Burro and Mogollon Mountains, thereby intersecting the San Francisco River.

The return of Coronado to Mexico in 1542 marks a brief hiatus in documented Spanish exploration north of the present-day international border. It was not until 1580 that there was a renewed interest in colonization and exploration of the Pueblo country. From 1581 to 1582 Francisco de Chamuscado and Friar Agustin Rodriquez visited New Mexico with a small party of soldiers and Native Americans, and Antonio de Espejo

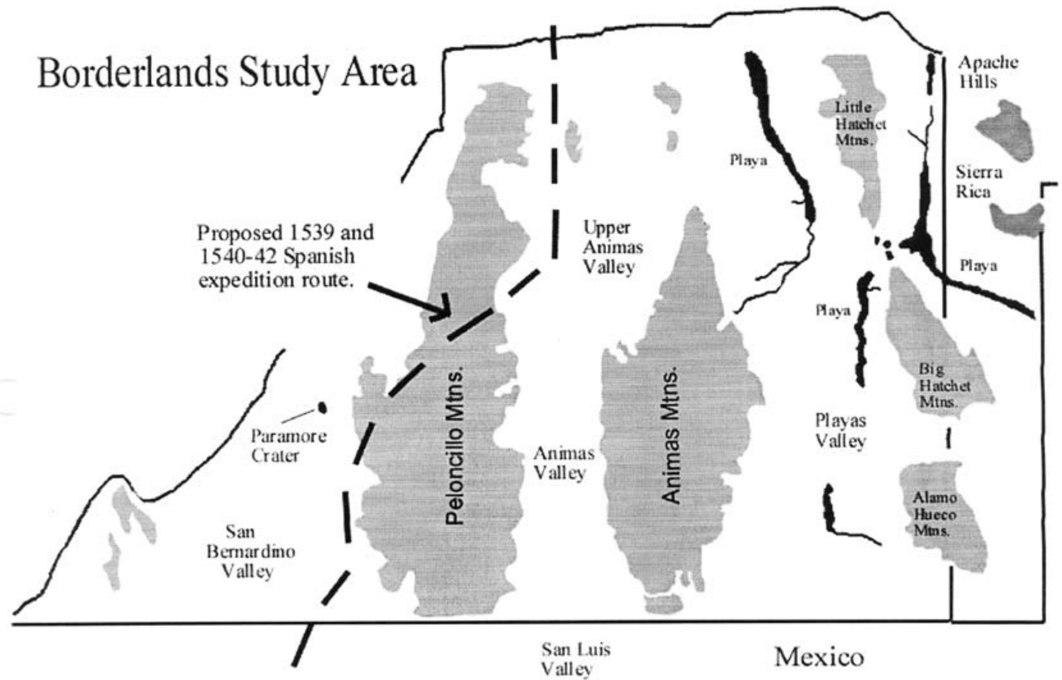

Figure 4.2. Fray Marcos de Niza (1539) and Francisco Vazques de Coronado (1540–1542) followed Native American trails north through Mexico, Arizona, and New Mexico in their search for Cibola. Charles Di Peso (1974) suggests these expeditions passed over the Peloncillo Mountains.

followed shortly in 1582. In 1590, Gaspar Castano de Sosa attempted to place a colony near Santo Domingo in present-day New Mexico but was ordered to withdraw the unauthorized expedition (Beers 1979: 3). In 1598, Spanish settlers under the command of Juan de Onate settled the upper Rio Grande Valley but were forced to flee to El Paso during the Pueblo Revolt of 1680. It was not until 1693 that the Spanish regained a permanent foothold in the Pueblo land as a result of a vigorous campaign by Diego de Vargas.

Although none of the expeditions from 1580 to 1593 passed through the study area, it is probable that the Upper Gila River and Animas region were traversed on occasion by hunters, trappers, prospectors, and Native American traders interested in the natural resources, information, and goods that the indigenous people of the region had to offer.

Spanish Sedentary Period: 1680 to 1821

It was not until the mid- to late-17th century that a Spanish presence was initiated in the study area. In the aftermath of the Pueblo Revolt of 1680, many displaced northern Spanish settlers began to migrate into the Casas Grandes Valley and the region of Janos. From the south, during this same period, settlers were moving steadily north into the river valleys of New Vizcaya and Sonora. As the migration continued, the indigenous population grew less tolerant and hospitable toward the newcomers. Naylor (1969: 11) notes that in 1684 the Suma, Concho, Janos, Jocomes, Mansos, and Apaches revolted. After this date, Native American revolt and short-term uprisings became a fact of life on the frontier of New Mexico, New Vizcaya, and Sonora; but in almost every instance the Spanish regained the upper hand and eventually those in rebellion yielded to Hispanic authority. The Apache, on the other hand, were persistent in their strategies of raiding and warfare, and the Spanish, no matter how hard they tried, could not force them into submission.

The Apache

The ethnography of the Athapaskan-speaking people called Apache has been thoroughly treated elsewhere and is not part of this overview. The historical information below provides a general sense of Borderlands use by Europeans and native peoples who frequented the area during the Hispanic period.

When the Spanish settled the region of Casas Grandes and Janos they clearly recognized a cultural difference between Apache, Suma, Janos, Jocome, and other tribes in that region, but by the early 18th century those Native Americans choosing to live near the missions and presidios were assimilated into the Spanish culture. Those groups refusing indoctrination allied themselves with the Apaches. For instance, a letter written by Captain Juan

Fernandez de la Fuente in 1695 indicates that displaced Suma, Janos, Jocome, Manso, Chinarra, and other Native Americans took shelter with the Apaches of the Gila River region (Naylor and Polzer 1986: 641). In addition "As the Apache gained dominance in the area the Spanish began referring to their allies by the same term....Thus in the west it appears that the remaining Sumas along with the Janos and Jocome merged with the Apache Tribe..." (Naylor 1969: 11).

Today the Apache of this region refer to themselves as Chiricahua, but throughout much of the Hispanic period we see reference to Gilenos, Ojo Caliente, Mimbrenos, and Mogollon Apaches. These bands lived on the banks of the upper Gila River and on the San Francisco and Mimbres Rivers. The permanence of Apache rancherias in the northern river valleys is revealed in three reports. At Zuni, Fray Silvestre Velez de Escalante wrote of a trail discovered from Zuni, New Mexico to Sonora in 1747. He noted that along this trail on the lower San Francisco River, Don Bernrado de Miera saw "... various rancherias of the Apaches who cultivate the valley and with the aid of irrigation, harvest much yellow corn" (Thomas 1932: 155). Thomas (1932: 12) also noted similar evidence of permanent Apache rancherias in his translation of Hugo O'Conor's diary. During O'Conor's campaign against the Apaches in 1775, he crossed the Rio de las Mimbres and found a great number of Apache fields near Picacho de las Mimbres. And finally, Henry Dobyns' (1981: 24) translation of Captain Comaduran's diary of 1830 notes that the Apaches near Pinal Creek and the Gila River "...have planted many fields which their land affords them. They dedicate themselves greatly to cultivation. The headgate they have of stakes and earth diverts an abundance of water."

The north-south orientation of the basin and range country of the Borderlands would have defined the most obvious path for the Apache coming down from the Gila country on raids. Spanish documents of military actions as early as 1650 suggest that the valleys of the San Simon, San Bernardino, Animas, and La Playa were corridors through which raiding parties from the well-watered Gila, San Francisco, and Mimbres Rivers reached the Hispanic frontier.

References throughout the translations by Thomas (1932) suggest many rancherias were located close to Janos and Fronteras between 1680 and 1790. Unfortunately these references provide no details on the nature of the rancherias. The rough terrain of the Chiricahua, Animas, and Peloncillo Mountains provided safety and shelter from the ever-present patrols dispatched from Janos and Fronteras during this period. There is also sufficient documentation to show that the springs and, in some instances, high-elevation perennial streams attracted Apache encampments, but it is not clear from the Spanish record whether these places often referred to as "rancherias" were locations frequented by Apaches prior to Spanish settlement of the frontier. The Chiricahua Apaches today certainly claim these ranges as homelands.

Apache and Euro-American Interaction

Beginning in the 1680s, the Apache staged opportunistic raids into fledgling Spanish communities from El Paso west to the Santa Cruz River. The Spanish settlements south of the Gila and Mimbres rivers bore the brunt of Apache forays. It is likely that in 1684 the Apaches assisted the Suma in burning Nuestra Senora de la Soledad de los Janos, a mission built in 1663.

To protect the settlers, presidios were built in Nueva Vizcaya and in Sonora's Pimaria Alta (Beers 1979; Naylor and Polzer 1986). By 1686 San Felipe y Santiago was established as the presidio for the Janos region, and west of Janos a permanent presidio was established in 1690 in the Cabullona Valley in a place known as Santa Rosa de Corodequaci, which was later referred to as Fronteras. From these presidios and from neighboring hamlets, presidial troops, settlers, and Native American allies waged a general offensive campaign against the Apache and their allies between the mid-17th and early 19th century. After the Mexican Revolution in 1821, patrols from the same presidios continued along the northern frontier. Bartlett (1854: 268) observed 400 Mexican troops at Fronteras preparing a campaign against the Gila Apache in 1851.

Appendix D is an annotated summary of the frequent Spanish offensive campaigns in the Borderlands. Although these were some of the largest campaigns against the Apaches, they were not the only military incursions into the Borderlands. Boundary Commissioner John Russell Bartlett (1854: 295), for example, had a friendly encounter in the Guadalupe Mountains with 200 Mexican troops on patrol from the garrisons of Fronteras in 1851.

San Bernardino Presidio

Between 1766 and 1768 Marques de Rubi examined the frontier from Texas to Altar in Sonora with an eye on the effectiveness of the presidio line. The appalling condition of the presidios, due in part to constant Native American raids, convinced Rubi that the relocation of some presidios would enhance the defense of the province. By Royal Regulation the presidio realignment was authorized September 10, 1772. "To carry out the royal order, Viceroy Bucareli commissioned Don Hugo O'Conor in 1772. By 1776 this officer, with the rank of Commander Inspector, had decided upon the exact sites and transferred the presidios to their new locations..." (Thomas 1941: 16).

Fronteras, the northeastern-most presidio in Sonora, was one of several outposts inspected by O'Conor and one of the few selected for repositioning. In 1775, the troops of this pueblo moved to the headwaters of the upper San Bernardino River at the present-day international boundary. As will be seen shortly, this was an ill-fated move that had to be corrected a few years later.

Fathers Garces and Juan Diaz first described the San Bernardino settlement in March 1775 as a good spot although with some inconveniences. It had the same number of troops as was assigned to Fronteras, namely, 100 men. It provided 10 men for Buenavista, and another 10 for the pueblo of El Pitic. It had 80 troops in all to protect the pueblos of its neighborhood and to pursue the Apache enemy (Bolton 1930: 285–286).

The realignment was ill conceived, and before long men such as Captain Don Joseph Berroteran and Don Juan Bautista de Anza were recommending that the government reconsider the presidio moves made by O'Conor. In 1776, Don Teodoro de Croix was appointed Commander General of the Interior Province of New Spain, and upon inspecting the frontier, he agreed that the realignment had in some instances made the Spanish defensive posture worse.

In 1777 to1778, Croix inspected the presidio line and observed that after the move of the presidio of Fronteras to the valley of San Bernardino in 1775, it was so far removed from presidios on either side (Janos and Terrenate) that it could neither give nor receive assistance from these places. He further stated (Thomas 1941: 146) that:

> ...when I went through the presidio of San Bernardino, I recognized that from that spot it could neither give nor receive assistance from the presidio of Janos. This contact, always difficult, was closed entirely to impede the ingress of Apaches into New Vizcaya and Sonora. The presidial company itself, reenforced with another flying company, was hardly discharging its obligation to defend the post and the horse herd, or furnishing escort for the mule train for their provisions....The building of the presidio of San Bernardino was just beginning; the works were menaced with ruin and funds consumed.

After his inspection, Croix quickly arranged for the abandonment of the post.

In 1820, Lieutenant Ignacio Perez sought a land grant at San Bernardino that extended a considerable distance into Sonora. James Officer (1987: 106–108) writes: "In May, 1822, Perez paid for the land—more than 73,000 acres—but no formal title was ever issued. To stock his large ranch, Teniente Perez contracted with Father Estelric of the Tumacacori Mission for the purchase of 4,000 cattle." Further archival work might provide information on whether the ranch ever materialized. When the Mormon Battalion passed through San Bernardino 24 years later, it was not occupied. On December 2, 1846, the Mormon Battalion descended Guadalupe Canyon. Cooke (1964: 139) notes:

> ...eight miles brought them into and across wide meadows to the old houses of the rancho of San Bernardino; it is enclosed by a wall with two regular bastions; the spring is fifteen paces in diameter. The soil was thought good, but the grass at the time was poor;...Before this rancho was desolated by Apaches, there were reported to be eighty thousand cattle on it; the Gila was said to be its northern boundary.

On May 21, 1851, members of the Boundary Commission also visited the ruin (Bartlett 1854: 255–256):

> San Bernardino is a collection of adobe buildings in a ruined state, of which nothing but walls remain. One of the buildings was about one hundred feet square, with a court in the center; and adjoining it were others with small apartments....The whole extending over a space of about two acres, was enclosed with a high wall of adobe, with regular bastions for defense. Being elevated some twenty or thirty feet above the valley, this hacienda commanded a fine view of the country around.

Because of the perennial springs, San Bernardino remained an important stop for weary travelers. There are other references to this spot in the diaries of immigrants on their way to California, but Cooke's diary from 1846 and Bartlett's from 1854 are the most explicit descriptions of the springs during the Hispanic period. See Hispanic Arizona 1536–1856 by Officer (1987) for other diary accounts regarding San Bernardino.

Ecology, Landscape, and Colonial/Mexican Period Use

I begin this section with an overview of early observations made about the Borderlands environment from about the year 1680 through 1853. A general historic sketch is based on several books but, in particular, Thomas (1932, 1941), Cooke (1964), and Bartlett (1854).

Water and Its Influence on Travel

The territory between what is now El Paso, Texas, and Tucson, Arizona, was one of the most troublesome regions to cross prior to the arrival of the railroad in the early 1880s. The availability of drinking water and good pasture for horses, mules, and oxen was an overriding concern for all who traversed this region. By 1854, the Borderlands had been crossed by many military detachments and by untold numbers of California emigrants. The names of some cienigas and springs appear repeatedly in field journals: San Bernardino, San Simon, Las Ojos de la Hacha (Hatchet); others became well known and influenced common routes of travel and lines of communication. The distances between perennial cienegas and springs were often great, and the reliability of intermediate springs and seeps was tenuous at best depending on the terrain and season of travel. Excerpts from three diaries (Anza, Cooke, and Bartlett) provide interesting insight into the region of the Borderlands and the influence of water on the development of routes for communication and commerce (fig. 4.3). Appendix D has additional information on trails and roads.

On November 9, 1780, Don Juan Bautista de Anza left Santa Fe with nearly 150 troops and as many settlers bound for El Paso. Anza's plan was to caravan down the Rio Grande as far as Fray Cristoval where he and his troops would leave the settlers and turn west to open a route of commerce to Sonora. From the Rio Grande, Anza veered west to the Mimbres River where he hoped to meet with a detachment from Sonora and one from New Vizcaya to assist him in finding a good route southwest. Thirteen leagues below the lower Mimbres River, out of water and not finding the two detachments, Anza notes, "We arrived ...at an arroyo which gave hardly sufficient for our horses. This together with the sorefooted and wearied condition in which I observed the herd, obliged me to seek for it in better known regions. Though at a cost of greater circumlocutions, it saved the expedition" (Thomas 1932: 202).

Anza diverted his troops to the eastern springs of the Sierra de la Hacha north of Janos. South of La Hacha, Anza found the Camino Real running between New Vizcaya and Sonora. Disappointed and well east of his proposed route, Anza later blamed his failure to find a short route to Sonora on the lack of water. During this expedition he followed the Camino Real along the southern boundary of the Borderlands by going over the pass of Guadalupe to San Bernardino and then on to the old site of Las Nutrias. Anza's caravan was plagued by heavy rain and snow from Santa Fe to the Mimbres River but still suffered from lack of water on the plain. Once past this plain he again encountered heavy snow in the Borderlands until he reached his destination, Arispe, Sonora, on December 18, 1780.

In his famous march of 1846 to the Pacific, Philip St. George Cooke lead the Mormon Battalion down the Rio Grande River from Santa Fe and veered to the west near Las Cruces in an attempt to find a direct route to Tucson. Unfortunately, Cooke encountered the same condition that Anza suffered several years earlier. Just below the lower Mimbres River on November 20, 1846, Cooke notes: "The guides had all returned, having found a little water in the end of a ridge, in a south-west course towards San Bernardino a deserted rancho, known only by report. By common consent the certainty of water at that point [thought to be about 70, but really above 100 miles distant] made it an objective point; for all shrink instinctively from entering the vast table land to the west..." (Cooke 1964: 128). Cooke, like Anza, traveled under stormy conditions to the Mimbres, and like Anza, still found the plains west of the Mimbres dry and uninviting. Once over this plain, Cooke's route passed through Las Playas, the Animas Valley, and through the Guadalupe Mountains to San Bernardino. Surface water within the Borderlands was present at every camp between Las Playas and the San Bernardino Valley.

One of the best accounts regarding the seasonal nature of some water supplies is provided by US Boundary Commissioner John Russell Bartlett (1854). In May 1851, Bartlett lead a small expedition from the Santa Rita copper mines near present-day Silver City, New Mexico, to Arispe in the State of Sonora, Mexico. Bartlett's plan was to follow the 1846 trail of Philip St. George Cooke through the Borderlands to the San Pedro River where Bartlett planned to turn south toward Arispe. Water holes described by Cooke were a major factor in Bartlett's direction of travel. Bartlett's party had little trouble in finding water in Las Playas, Animas, and the San Bernardino Valley, but many of the sources noted by Cooke could not be found or were disappointingly dry. Several hours past the ruins of San Bernardino Bartlett (1854: 258) notes:

> We were again doomed.... No water was found. I now hastened back with all speed to Black Water Creek, where the train with the rest of the party had arrived. They were pondering what to do in the dilemma. Their disappointment being no less than my own. We had now come about twenty-two miles from the last water, and nearly forty from our last camping place in the Guadalupe Pass. So confident had we been on leaving San Bernardino that we should find water at this place, if not at two intermediate stations, that we had not taken the trouble to fill our kegs.

The water holes in the hilly country between the San Bernardino Valley and the springs of Agua Prieta noted

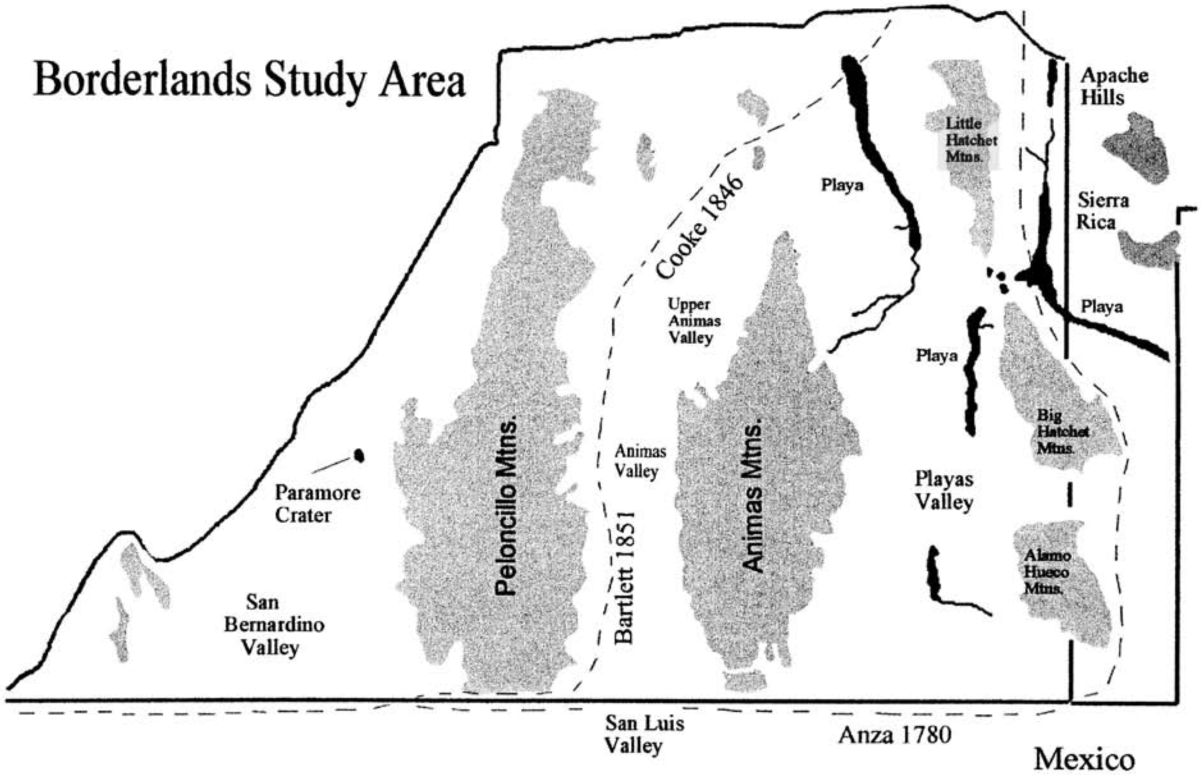

Figure 4.3. The trails of Anza (1780), Cooke (1846), and Bartlett (1851). The trail through the Animas Valley was referred to as the southern route by American immigrants and was used prior to 1846 by Spanish and Mexican military patrols.

by Cooke in November 1846, but found to be dry by Bartlett in May 5 years later, were obviously seasonal sources.

After Boundary Commissioner Bartlett returned to Santa Rita from Arispe, he again set out due west toward the Gila River to meet with his Mexican counterpart, Commissioner Padro Garcia Conde. The meeting was to discuss the progress of the survey both groups were performing with respect to the new boundary between the United States and Mexico. During this trip Bartlett was guided west by a Mexican Lancer sent by the Mexican Commission. The route was through country familiar to Mexican troops and had been crossed by at least one emigrant train in 1849 (Etter 1995: 7). Bartlett followed Conde's trail from spring to spring. The trail went from the Burro Mountains, southwest to a pass in the Peloncillo Range, on to the drainage of San Simon, and through Apache Pass between the Dos Cabezas and Chiricahua Mountains to the southern end of the Willcox Playa. Here, Bartlett found Conde in retreat south due to dwindling supplies.

The examples above reflect the character of water sources in and adjacent to the study area. The basin and range setting of the Animas, Peloncillo, and Chiricahua Mountains are subject to orographic rains. Undoubtedly, this moisture contributes to the springs along the edges of the intervening valleys, making these corridors preferred wagon routes. On the other hand, to get to these valleys by way of the Rio Grande/Mimbres route there was little choice but to cross the expansive 100-mile-long by 60-mile-wide dry plain on the northern and northeastern edge of the study area. It lacked the advantage of orographic moisture and elevated land features that might bring water to the surface. Anderson (1864) refers to this plain as the Plateau of the Sierra Madre. Traveling east from the Santa Cruz River to the study area was not as difficult as long as water and sufficient supplies were carried. Although Bartlett (1854), Cooke (1964), Naylor and Polzer (1986), and Thomas (1932), remark on the locations of springs, most are general descriptions.

During drier seasons and periods of drought, travel through the Borderlands would have been debilitating to travelers and livestock. There are no journal entries concerning drought for the Borderlands from materials reviewed, but a diary entry made by Captain Don Antonio Cordero during one campaign mentions an apparent range fire caused by excessive heat in late November 1785 (see Thomas 1932: 288). This suggests hot and dry condition, but oddly enough, 7 days later heavy snows covered the ground and 30 animals (horses or mules) died in the vicinity of the Animas Valley due to lack of pasture. Either the snow was covering the fodder or there was little grass in the valley that year.

In spite of a lack of specific references, the study area surely was impacted by the drought of 1670 and 1671 mentioned by Di Peso (1974: 864–866) as the Southwest Scourge, and by the severe drought of 1684 in the Casas Grandes district (Naylor 1969: 11). A letter translated by Thomas (1932: 166–168) from Anza to Senor Governor and Commander General Croix notes a severe drought in or about the year 1779 that caused substantial hardship to the Zuni and other groups in a far-reaching area.

Comments on Flora and Fauna

Spanish military journals provide only a few general references to the ecology of the Borderlands, and it is difficult to compile a thorough description of the environment prior to the mid-1840s. For instance, the south side of the Chiricahua Mountains was described by Captain Don Joseph Antonio Vildosola in 1780 simply as a fine-looking plain with water year round (Thomas 1932: 208). It is not until Cooke's expedition in 1846 and Bartlett's in 1851 that relevant comments were made about the interior of the Borderlands.

Cooke (1964: 134–139) described the Animas Valley as a smooth plain with the grama grass waving in the wind. Bartlett (1854: 250–255), five years later noted the same valley as having luxuriant grassland with black loam soils and with little wood for fires. Bartlett mentioned seeing a large grove of oak in the Animas Valley that was plotted on a sketch map prepared during Cooke's march to the Pacific.

Both these leaders describe the mountains and broken ravines of the Guadalupe Mountains as being covered chiefly with live oak and cedars. Also mentioned are canyons with ash, walnut, sycamore, and cottonwood, and hillsides dotted with yucca and mescal, small cactus, ocotillo, and other shrubs.

Beyond the Guadalupe Mountains is the San Bernardino Valley. Here Cooke (1964: 139) described the soil at the ruin of San Bernardino as good, but the grass on December 1, 1846, as poor. Bartlett (1854: 259), on the other hand, related that the horses were let out to feed on the rich grass of San Bernardino in May 1851. Beyond this valley, Bartlett's livestock suffered from poor grass. Both men note that the elevated country to the west of San Bernardino was covered with mesquite chaparral and thorny bushes. They may have been referring to the vast acacia forest that still exists in the area today.

Wildlife

In the mid-19th century, a considerable number of feral livestock roamed the western edge of the Borderlands. Wild cattle estimated in the thousands and herds of wild horses were commonly seen along the southern route between San Bernardino and the San Pedro River. The Mormon Battalion smoked a considerable amount of bull meat in 1846 prior to leaving the region. During Bartlett's second trip from the Santa Rita copper mines to the lower Gila River in late 1851, his party encountered 30 or 40 Mexicans from the town of Santa Cruz hunting wild cattle on the San Pedro River. These wild herds were a reminder of the failed attempt by the Spanish and Mexicans to gain a dominant position in the vast region controlled by Apache bands.

A number of comments were made about the wildlife of the Borderlands and adjoining regions. Antelope herds were observed in the Animas Valley and elsewhere by Cooke and Bartlett, suggesting they were plentiful, and three bears were observed by Cooke in the Guadalupe Mountains. California partridge, turkey, deer, goats, a young panther, grizzly bear, wolves, and various rodents and reptiles were noted by both men in adjacent regions. A flock of herons arose from the springs of San Bernardino in May 1851 as the Boundary Commission passed through the area to Arispe. The San Pedro River in 1846 was described as "...a fine bold stream!...[where] salmon trout, eighteen inches long, were caught" (Cooke 1964: 144–145). When the Boundary Commission passed through the region in September 1851, Bartlett's draughtsman Henry C. Pratt caught trout in Babocomori Creek some 7 miles above its juncture with the San Pedro River. Bartlett (1854: 396) described Babocomori Creek as a stream 20 feet wide and in some places 2 feet deep. Pratt also caught several small trout in a stream to the southwest that, more than likely was the headwaters of Sonoita Creek.

Concluding Remarks

Writers such as Dobyns (1981) or Hastings and Turner (1965) offer detailed discussion of the mid-18th and 19th century landscape. These authors compare and contrast the landscape of the past and near present and provide insight into change on a regional scale. Their accounts are based on multiple lines of evidence, including archival research.

Spanish settlement in the Borderlands was temporary; several Spanish troops with families moved from Fronteras to live at the springs of San Bernardino between 1775 and 1780, and a possible second occupation occurred when a Mexican rancher attempted to gain title to the same land in 1820. His tenure in the territory was short lived. All other occupations of the Borderlands by Euro-Americans during this period seem to have been transient, consisting of camp sites.

Records consulted for this summary mentioned only two kinds of direct and intentional manipulation of the Borderlands environment, hunting of native game and occasional road building. In addition, the terrain around San Bernardino probably was cleared of trees for firewood, furniture, corrals, and construction material associated with building the fledgling presidio in 1775. The more important impact of introduced livestock and subsequently feral animals can only be inferred. Other indirect impacts resulted from the Euro-American presence. For instance, Bartlett (1854: 295–296) suggested that a range fire in the Guadalupe Mountains was caused by careless Mexican patrols. It is also likely that Spanish troops had occasion to leave camps and signal fires unattended as did the Apache and their allies. Appendix D provides further information on fire.

The impact of Mexican cattle ranching on the Borderlands is difficult to measure. Cattle and horse herds were abandoned upon the retreat of Mexican ranchers who deferred to Apaches by the early 19th century. Dobyns (1981: 79–89) suggests that large numbers of wild cattle, horses, and mules set the stage for substantial erosion and grass depletion in the late 1800s. Dobyns (1981) used estimates of wild herd size reported by early travelers passing through the San Bernardino Valley and San Pedro River drainage. For instance, he uses Bartlett's estimate that there were over 100,000 head of feral livestock in the region in the early to mid-19th century. On the other hand, Sheridan (1995: 128) argues that early estimates of herd size were probably inflated. He (Sheridan 1995: 129) notes that:

> …cattle from the Mexican land grants must have clustered around the few springs and streams of the region, which may have given travelers the misleading impression that they were equally abundant away from water. Yet even though observers like Lieutenant-Colonel Philip St. George Cooke noted cattle trails and wallows along the San Pedro River, they also described lush grasslands and a flowing stream with beaver dams and 'salmon trout' (possibly squawfish) in 'great number' up to 'three feet long.' Such riparian exuberance would not have withstood the hooves and teeth of vast herds.

Undoubtedly, wild livestock roaming the west flank of the Borderlands had an impact on the natural setting. They caused erosion by creating trails, grazed near water sources, and competed for pasture with herds of antelope and deer. Beyond this, the degree of impact cannot be specified. Such herds of feral cattle and wild horses were not encountered in the Animas Valley, possibly because the Peloncillo and Guadalupe Mountains form a barrier or because the livestock did not have time and opportunity to range beyond their original pasture, the abandoned Mexican land grants.

In summary, the Spanish, Mexican, and American presence in the Borderlands study area, prior to 1856, was transient. Notations on human-initiated range fires, short-term settlement, and ranching provide no measurable information to indicate whether the presence of these groups caused significant and lasting ecological change. However, it can be argued that between 1680 and 1856 the Euro-American presence had a profound influence on the interaction between native peoples and the environment of the region. Once Spanish and Mexican patrols entered the Borderlands, native peoples relocated to more obscure locations and probably had to curtail much of their normal activity in an effort to remain hidden. Hunting in open country may have declined and resulted in increased herds of antelope and deer in the grasslands. Finally, signal fires, cooking fires in camps and villages, and fires used to flush out game or to increase forage for browsing game would have been used more discretely in an effort to avoid detection by Spanish and Mexican patrols.

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Chapter 5.

Borderlands Fire Regimes

Introduction

Fire is a keystone process in most natural, terrestrial ecosystems. The vital role that fire plays in controlling the structure of an ecosystem underscores the need for us to increase our knowledge of past and current fire regimes (Morgan and others 1994). Dendrochronological reconstructions of fire histories provide descriptions of past fire regimes across a range of spatial and temporal scales (Baisan and Swetnam 1995; Swetnam and Betancourt 1991; Swetnam and Dieterich 1985).

The historical fire regimes of the Borderlands ecosystem can be examined across broad spatial scales, from regional to local. Such cross-scale perspectives are needed because local scale patterns were embedded within regional scale patterns. These patterns are summarized by Swetnam and Baisan (1996), who compiled a network of 63 fire-scar chronologies from the Southwestern United States and demonstrated that fire recurrence was highly synchronous across the region and associated with interannual fluctuations in wet and dry conditions. Comparisons of individual fire histories revealed high variability in fire regime properties, such as fire frequency that were due primarily to local-scale influences such as vegetation composition, topography, or historical human impact. Hence, the influence of climatic variability on fire regimes was most evident at the coarse, regional scale, while the influence of other factors was most evident at the fine, local scales.

Climate and Study Area Information

Dendroecological sites in southern Arizona are distributed throughout the basin and range topography that extends from the Colorado Plateau to the Northern Sierra Madre Mountains. The sites are predominantly in upper-elevation, forested areas. These mountain islands, referred to as the Madrean Archipelago, are depicted as forested peaks surrounded by a shore of oak woodlands and a sea of semidesert grasslands. The regional climate is semiarid with a bimodal pattern of precipitation distributed between the summer and winter months.

The typical fire season occurs in the late spring or early summer, prior to the onset of the summer monsoon rain (Baisan and Swetnam 1990; Barrows 1978). High lightning incidence, accumulated dry vegetation, high ambient temperatures, and low relative humidity combine to create optimum fire conditions in a window from about late May to early July.

Regional Fire History Study

Fire-scar based fire history reconstructions for the Borderlands area were compiled from the University of Arizona Laboratory of Tree-Ring Research's database (Swetnam and Baisan 1996), and descriptive statistics were computed for these chronologies for the period 1700 to 1900 (table 5.1 and fig. 5.1). These fire-scar chronologies have been grouped into five broad forest and woodland types: mixed-conifer (MC), a combination of Douglas-fir, white fir, and pine; ponderosa pine (PIPO); pinyon/juniper (PJ); and oak (OAK). These groups were based on the dominant overstory trees in the sites from which the fire-scarred samples were taken. The Mean Fire Interval (MFI) and the Weibull Median Probability Interval (WMPI) are measures of central tendency of the fire interval. A fire interval is considered the number of

Table 5.1. Site information and fire-interval statistics for fire histories in and around the Borderlands ecosystem.

Number on map	Site	Mountain range	Species[a]	Elevation range in ft	WMPI[b]	Min-max. fireinterval	Standard deviation
1	Lemmon Peak	Sta. Catalina	MC	8,750-8,960	7.9	2–17	4.8
2	Rose Canyon	Sta. Catalina	PIPO/MC	7,000–7,600	7	2–16	3.8
3	Mica Mountain	Rincon	PIPO/MC	6,790–8,530	6	2–13	2.7
4	Josephine Saddle	Santa Rita	Pine/Oak	6,800–7,200	7.9	3–21	4.2
5	Sierra Ajos	Sierra Ajos	Pine/Oak	6,890–7,218	5.1	2–11	2.5
6	Camp Point	Pinaleno	MC	7,546–9,600	8.7	2–26	6.5
7	Peter's Flat	Pinaleno	MC	9,200–9,450	8.9	3–22	5.3
8	Rhylite Canyon, Middle	Chiricahua	PIPO/MC	5,920–6,300	14.2	4–50	11.4
9	Rhyolite Canyon, Upper	Chiricahua	PIPO/MC	6,800–7,000	12.2	4–31	6.7
10	Rhyolite Canyon, Lower	Chiricahua	Pine/Oak	5,600–5,920	8	1–17	4.6
11	Castle Creek	Mogollon Rim	PIPO	8,000–8,200	6.8	1–14	3.3
12	Thomas Creek	Mogollon Rim	MC	8,300–9,200	8.3	1–24	7
13	McKenna Park	Mogollon	PIPO	7,640–7,800	5.5	1–16	4.2
14	Gilita Ridge	Mogollon	PIPO	8,300–8,300	7.2	3–28	6.8
15	Black Mountain	Mogollon	PIPO/MC	8,400–9,300	5	1–20	4.5
16	Langstroth Mesa	Mogollon	PIPO/MC	7,800–8,400	4.5	1–22	3.8
17	Bearwallow	Mogollon	MC	9,000–9,600	14.4	2–32	10.9
18	Narrows	Organ	PIPO/PJ/Oak	7,000–7,300	9.5	3–21	6.5
19	Fillmore Side Canyon 3	Organ	PIPO	7,200–7,800	13.5	4–23	5.6
20	Ice Canyon	Organ	PIPO	7,500–7,800	23.8	7–35	10.8
21	Fillmore Side Canyon 1	Organ	PIPO	7,200–7,500	8.8	2–23	6.2
22	Ledge Site	Organ	PIPO	7,800–7,900	19.7	12–27	5.3
23	Snag Saddle	Organ	PIPO	7,800–8,000	18.7	9–27	8.1
24	Fillmore Side Canyon 2	Organ	PIPO/MC	7,200–,7700	8.7	2–23	7.3
25	Upper Fillmore West	Organ	PIPO/MC	7,800–8,200	3.4	1–23	4.1
26	Animas Peak , North	Animas	PIPO	8,000–8,400	11.9	3–36	11.1
27	Animas Peak, South	Animas	PIPO/MC	8,000–8,100	12.6	2–32	9.3

[a]MC = mixed-conifers, PIPO = ponderosa pine (*Pinus ponderosa*), PJ = pinyon-juniper. These designations refer to the dominant overstory tree species. All fire-interval statistics computed in years for the period 1700 to 1900 (Swetnam and Baisan 1996). See figure 5.1 for site locations.
[b]Weibull Median Probability Interval.

years between two successive fire occurrences (Romme and others 1980). The MFI is the average of all fire intervals within a specified area and designated time period (Romme and others 1980). WMPI is the estimated fire interval at which there is approximately a 50 percent probability of a longer or a 50 percent probability of a shorter fire interval occurring as computed by fitting a Weibull type model to the fire interval distribution (Grissino-Mayer 1995).

Swetnam and Baisan (1996) found that in general, historical fire frequencies decreased with increasing elevation and associated forest and woodland types. Fires burned at increasing intervals along the gradient from the lower pinyon-juniper, oak, and ponderosa pine cover types to the higher mixed-conifer sites. However, tremendous variability in fire frequency existed due to unique site characteristics, including topography and especially land-use history. This variability precludes any predictive generalizations of fire regimes based solely on forest or woodland type (as defined) or elevation. There was a tendency for slightly shorter fire intervals in ponderosa pine and mixed-conifer forests than in pure ponderosa pine stands. This may have been due to higher productivity in the more mesic sites that resulted in a more rapid buildup of fuels.

Despite the large variability of fire regimes at local scales, remarkable synchrony in fire events across the Southwestern region occurred during the pre-European settlement era. Swetnam and Baisan (1996) compared large and small regional fire years with a reconstruction of the Palmer Drought Severity Index (PDSI). A regionalized PDSI for the Southwest was computed by averaging 13 grid point time series to a single time series that represents an annual drought magnitude fluctuation from AD 1700 to 1978 (Cook and others 1996). Small fire years (those with few fire-scar sites recording fires) were significantly correlated with years of above-average moisture, and large fire years were significantly correlated with years of below-average moisture. Additionally, there was a lagged relationship between the prior year's

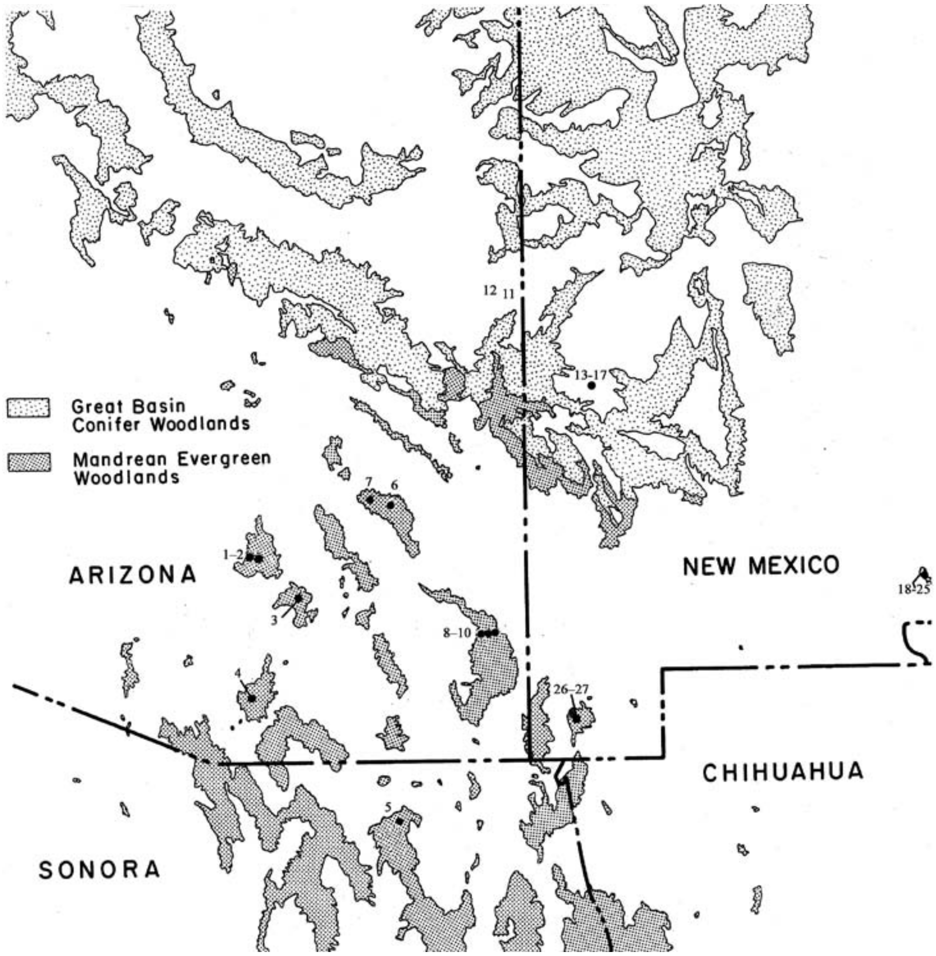

Figure 5.1. Site locations for fire history reconstructions. Numbers relate to information in table 5.1.

climate values and large fire years in many ponderosa pine stands. Large fire years often occurred during drought years that were preceded by 1 to 3 years of above-average moisture conditions. The underlying mechanism behind this lagging relation was attributed to fine fuel (grasses, needles, herbs) buildup during the years of high precipitation. Hence, a severe drought year following 2 or 3 wet years resulted in optimal burning conditions with an abundance of dry fuels. In contrast, comparison of regional fire years in mixed-conifer forests with the PDSI time series showed that large fire years depended only on extremely dry conditions during the fire year itself, with no important prior-year effects of climate. This suggests that fuel production was not limiting, but rather the key factor was dry fuels.

The regional comparison of fire dates reveals that local variations in fire regimes are embedded within large-scale patterns controlled to some extent by climatic variation. Although regional generalizations can be made, local-scale fire histories indicate that topographic, vegetative, and historical land-use characteristics determine the range and variability of fire regimes.

Local Fire History Reconstructions

Six studies from the Borderlands mountain ranges provide examples of variances in fire frequencies due to site-specific characteristics. The variability in fire regimes was associated with variability in vegetation composition, topography, and land-use history. The studies include: Rhyolite Canyon, the Rincon Mountains, the Pinaleno Mountains, and the Huachuca Mountains in southeastern Arizona, the Animas Mountains in southwestern New Mexico, and the Sierra de los Ajos Mountains in northern Mexico. Each study provides information on historical, spatial, and temporal fire patterns in the Borderlands region. When combined, these studies provide a large-scale picture of the role fire played in the area's prehistory.

Rhyolite Canyon

Rhyolite Canyon drains a major watershed in the Chiricahua National Monument, on the northwestern side of the Chiricahua Mountains, Arizona. Mixed-conifer and oak woodlands are found on north-facing slopes and in canyon bottoms of the valleys, and evergreen xerophytic plants of interior chaparral are found on the south-facing slopes. The fire-scarred species used to reconstruct the fire history in Rhyolite Canyon were ponderosa pine (*Pinus ponderosa*), Apache pine (*Pinus engelmannii*), and Chihuahua pine, (*Pinus leophylla* var. *chihuahuana*) Thirty-three samples were used to create the 380-year fire chronology, which was separated into three periods: 1604 to 1801, 1801 to 1851, and 1851 to the beginning of large-scale grazing by livestock and the onset of active fire suppression (Swetnam and others 1992).

The synchrony of fire scars from 1604 to 1801 indicated that fires generally spread throughout the canyon with a Mean Fire Interval (MFI) of 14.6 years and a range of 9 to 22 years. Slightly higher fire frequencies at the upper and lower elevations of the canyon compared to the fire frequency in the middle portion of the canyon suggested that not all fires burned throughout the whole canyon. Lightning likely started many high elevation fires, some of which spread down into the canyon, and grass fires probably also spread from the lower elevation. The regular fire regime found in the 17th and 18th centuries came to an abrupt end in 1801. There was an absence of fire scars in the upper and middle canyon for the next 50 years. This gap from 1801 to 1851 was anomalously long and was unusual compared to most other Southwestern fire history reconstructions in pine forests (Swetnam and Baisan 1996). Swetnam and others (1989) hypothesized that a flood or debris flow within the canyon was responsible for this gap. Tree-ring samples from flood-scarred trees along the canyon bottom support this interpretation.

In the second half of the 19th century the fire frequency exceeded that of the pre-1801 regime. The highest frequency was found in the lower canyon with a MFI of 6.0 years and a range from 3 to 9 years. Swetnam and others (1992) suggest that evidence of Apache occupation during that time may explain the high fire frequency. The possible role of fires ignited by Native Americans is discussed later in this chapter.

The fire history of Rhyolite Canyon was highly variable. The long interval in the early 1800s suggests that geomorphic events (floods and debris flows) may have been important interactions with resettlement fire regimes with Borderlands riparian canyons. Sources of fire ignition and the spread into these canyons include both high elevation conifer forests and low elevation grasslands and woodlands.

Rincon Mountains

The Rincon Mountain Wilderness is within the Saguaro National Monument in southern Arizona. Baisan and Swetnam (1990) combined modern fire and lightning records, analysis of fire-scarred trees, and historical accounts to reconstruct a fire history in the Wilderness area. The study focused on the fire regime of Mica Mountain above 2,134 m (7,000 ft). In the study area the slopes with northern aspects support a mixed-conifer vegetation type. The higher elevation south-facing slopes host a ponderosa pine/southwestern white pine (*P. strobiformus*) community referred to in this study as an "open pine forest" with a grassy understory and a number of small meadows interspersed. Lower elevations with south-facing slopes support pine communities with species of evergreen oak. Forty-nine samples, most from ponderosa pine and southwestern white pine (*Pinus strobiformus*), were used to reconstruct the fire history.

The fire history reconstruction showed that fires were probably large; fire dates recorded by fire-scarred trees were synchronous over the entire Mica Mountain study area, encompassing several thousand hectares. This may be due to the lack of topographic fire barriers within the study area. The MFI for the entire Mica Mountain study area was 6.1 years. The mixed conifer sites had a MFI of 9.9 years. The presence of quaking aspen (*Populus tremuloides*) stands indicates that high-intensity, stand-replacing fires have played a role in the mixed-conifer system. Quaking aspen rapidly colonizes openings in the landscape caused by fires. In the mixed-conifer stands, patchy, high-intensity, stand-replacing fires combined with the frequent low-intensity, surface fires to make a more dynamic fire regime in open pine forest.

In contrast to Mica Mountain, Rincon Peak showed more evidence of large-scale crown fires in mixed-conifer vegetation. Modern ignition records show that Rincon Peak was subject to less frequent, natural ignitions than Mica Mountain. The less frequent ignitions resulted in long periods without fire during which fuels accumulated. When an ignition did occur, the resulting fires were probably larger and more intense. This demonstrates the highly variable nature of fire regimes within a given vegetation type due to site-specific characteristics.

Despite the variation in fire occurrence between the sites, the areas sampled showed a period of no fires lasting at least 10 years in the first half of the 1800s. One area showed a 19-year fire-free interval from 1822 to 1841.

Baisan and Swetnam (1990) compared large fire years with a PDSI reconstruction. Large fire years were often associated with years of moderate drought that, more importantly, had been preceded by 2 to 6 years of above-normal moisture conditions. As previously discussed, this pattern has also been found in a coarser scale analysis of the entire Southwestern region fire history database (Swetnam and Baisan 1996).

The last large fire was in 1886. This abrupt change in fire frequency coincided with the removal of the Apaches from the area and the increased land use by Anglo and Hispanic settlers. Baisan (1990) found no evidence that the fire frequency in the Rincon Mountains was elevated due to fires ignited by the Native Americans. The incidence of lightning ignitions, based on 20th century records, appeared to be high enough to account for the fire frequencies observed in the presettlement period.

Pinaleno Mountains

Mt. Graham in the Pinaleno Mountains in southeastern Arizona is a rich area for investigating multiple and interacting roles of forest disturbance, climate, and land-use history. Ninety fire-scarred samples from two mixed-conifer sites were analyzed for the fire history reconstruction, and 291 samples from adjacent spruce-fir sites were analyzed for stand age structure (Grissino-Mayer and others 1995). The mixed-conifer sites had a MFI of 4.2 years before 1880. This is the shortest mean fire interval yet found in mixed-conifer sites studied in the Southwestern United States and is similar to the MFI commonly documented in presettlement ponderosa pine stands. Historical fires in mixed-conifer stands on Mount Graham are thought to have been low-intensity, surface fires that spread over at least 400 ha due to few topographic barriers. The sharp decline in fire occurrence around 1880 found in the fire-scar record coincided with a rise in grazing in the area.

Based on the stand age-structure of the spruce-fir site and the fire history from the adjacent mixed-conifer site, Grissino-Mayer and others (1995) suggest that a stand-replacing fire burned through the spruce-fir area around 1685. This was a year of widespread fires in the two mixed-conifer sites. Following the fire, Engelmann spruce (*Picea engelmannii*) dominated the stand and corkbark fir (*Abies lasiocarpa* var. *arizonica*) regenerated in smaller numbers. Corkbark fir then experienced a pulse of recruitment in the 1840s. Grissino-Mayer and others (1995) suggest this recruitment may have been partly due to extended drought conditions and the superior ability of corkbark fir to establish in low-light, closed canopy conditions.

Dendroclimatological comparisons between drought and fire occurrence showed a relationship between fire events and severe drought events. These fire events were often preceded by several years of above-average moisture conditions (Baisan and Swetnam 1995; Swetnam and Baisan 1996).

Comparison of the fire history from the mixed-conifer stands and the stand age structure of a spruce-fir stand shows that fires only rarely spread from the mixed-conifer into the spruce-fir forest. Fires in the spruce-fir forests were rare and stand replacing when they did occur. Frequent, low-intensity fires probably maintained the stability of both the mixed-conifer and spruce-fir stands. The frequent surface fires in the mixed conifer probably kept the forest open and parklike, and therefore less susceptible to high- intensity, stand-replacing burns. The proximity of these open mixed-conifer forests may have also preserved the spruce-fir forests for long periods because high-intensity crown fires sweeping up from lower elevations were unlikely to spread through the crowns of the mixed-conifer stand. Conditions have now drastically changed on Mount Graham. Closed canopy forests extend from the pine through the mixed-conifer zone on the mountain, threatening red squirrel habitat and astronomical observatories with catastrophic fire.

Huachuca Mountains

A fire history covering the last five centuries is currently being reconstructed for the area surrounding Pat Scott Peak, located at the boundary between Fort Huachuca Military Base and the Miller Peak Wilderness Area in the Huachuca Mountains in southeastern Arizona (Danzer n.d.). Overstory vegetation of the study area consists mainly of ponderosa pine, southwestern white pine, and Douglas-fir (*Pseudotsuga mensiezii*), with an understory of gambel oak (*Quercus gambelii*) and alligator juniper (*Juniperus deppeana*). The fire chronology is based on fire-scar samples from 33 trees and spans the period from A.D. 1499 through 1993.

The period from 1700 to 1899 was used for analysis of fire frequency because of the limited sample depth prior to 1700 and the lack of recorded fires after 1899. Fire interval statistics were analyzed separately for three periods: 1700 to 1899, 1700 to 1806, and 1807 to 1899. In addition, the fire frequency was calculated for three classes of fires. The first class included all fires that were recorded by the sampled trees. The fire data were then "filtered" by including only those fires that were recorded by less than 10 percent of the trees (interpreted to be small or spatially patchy fires) and by 20 percent of the trees (interpreted as large) (table 5.2). Fire interval statistics indicate that two types of fires were common in the area: small fires burned at an interval near 3 to 6 years, and less frequent, widespread fires burned at intervals from 7 to 9 years.

The effects of landuse on the fire regime of Pat Scott Peak were easily distinguishable by the end of the 19th century. Following 1874 few surface fires occurred, and by 1914 they were completely eliminated. The last

Table 5.2. Mean Fire Interval (MFI) statistics for three periods and three classes of fires at Pat Scott Peak, Huachuca Mountains, southeastern Arizona (Danzer n.d.b).

Class of Fire	MFI 1700 to 1899	MFI 1700 to 1806	MFI 1807 to 1899
All fires recorded	3.2	3.5	2.7
10% filtered	6.5	6.4	6.7
20% filtered	8.5	9.9	7.3

widespread fire occurred in 1899, and may have been due to the excessive buildup of fuels associated with the previous 25-year absence of fires. This drastic decrease in fire frequency was attributed to grazing, logging, and fire suppression activities associated with the growing population of settlers in the area (Danzer n.d.).

Animas Mountains

A fire history reconstruction in the Animas Mountains in New Mexico provides evidence of a mixed surface fire/crown fire disturbance regime for the range (Baisan and Swetnam 1995). The complex topography of the area resulted in a mosaic of plant communities determined largely by elevation and aspect. Coniferous forests are found on northeast-facing slopes and in mesic canyons. The fire history reconstruction in the conifer forests provided a unique insight into the interactions of fuels, vegetation, topography, and land-use history.

A combination of the rough topography, the heterogeneous vegetation, and the limited ignition sources for the Animas range resulted in occasional stand-replacing fires and episodic surface fires in the area. This fire regime was interrupted in the first half of the 20th century when the USDA Forest Service had jurisdiction of the range and practiced active fire suppression. The conifer forests of the Animas Mountains support a fire regime characterized by both frequent, low-intensity fires and occasional stand-replacing fires. Site-specific characteristics have overridden it with a more dynamic, mixed-fire regime.

Sierra de los Ajos Mountains

The Sierra de los Ajos Mountains are in northern Sonora, Mexico. The upper elevations of these mountains support conifer forests. In contrast to the Animas Mountains, the Sierra de los Ajos have a fire regime that is representative of the typical ponderosa pine forest type, with a MFI of 5.4 years. The Sierra de los Ajos have the unique characteristic of a continuous fire history throughout the 20th century. These mountains have not experienced disruptive fire control and intensive grazing characteristic of the mountain ranges north of the United States-Mexican border.

Human Influence on Fire Histories

The four major human influences on natural fire regimes in the Borderlands region in recent centuries have been the use of fire by the Native Americans, livestock grazing, logging and fuelwood harvest, and fire suppression. Although not all of these latter factors were influential upon the fire regimes during the prehistory of the Borderlands, they have all had an effect on our ability to understand the natural role of fire in forested systems.

Lightning versus Human Ignitions

Generally, it is difficult or impossible to completely distinguish between natural and human-caused ignitions in the historical record. Morgan and others (1994: 104) point out that "only the results of fire can be observed, not their causes." The 20th-century records showed that lightning strikes were common in the Borderlands mountain region. In addition, historical records showed that Native Americans used fire on the landscape. These two types of ignitions left identical physical scars on trees. It was thought that one of the only ways to discern between the two types of ignitions was to look at any changes in fire frequency. In some cases this may have been possible. Exceptionally inflated fire frequencies in the 18th century in the Organ Mountains, New Mexico, compounded with historical records documenting the presence of Apaches near the collection sites, and the documentation of the use of fire on the landscape by these Apaches, suggested that the Native Americans may have had an influence on the 18th-century fire regime (Morino, personal communication). Swetnam and others (1989) suggest that high fire frequencies following 1851 may be a result of Native Americans setting fire to the landscape. In other cases, variations in fire frequencies and evidence of fire ignitions by the Native Americans followed no clear pattern (Baisan and Swetnam 1990; Danzer n.d.).

Ignition sources for landscape fires was not a limiting factor in the Southwestern United States. In addition, an ecosystem generally has a particular capacity to burn, which, in the arid Southwest, is primarily determined by fuel amount and fuel moisture conditions. This meant that no matter how frequently the Native Americans ignited fires or how frequently lighting ignitions occurred, fuel had to be present and weather cooperative.

Post-1900 Influences on Fire Regimes

Hispanic and Euro-American settlers began to have an impact on the fire regimes of the Southwestern United States by the end of the 19th century when they brought large numbers of livestock to the area. The intense grazing of the animals in grass-covered areas altered the amounts of fuels available for burning. Logging practices also had an important impact on the composition of the forests, and the logging roads interrupted the connectivity of the forest and the fuels. Active suppression of fires by forest managers, which began in the first half of the 20th century, put an abrupt end to fire occurrence in many natural, forested areas in the United States.

Human impact on fire regimes has taken many forms. Native American use of fire over the landscape may have resulted in inflated fire frequencies. In contrast, grazing, logging, and fire suppression resulted in decreased fire frequencies.

Conclusions

Our review of climate trends from the perspective of tree-ring data from the Borderlands region and the discussion of departures from regional patterns, coupled with fire history preserved in fire-scarred, living trees, snags, and logs, have been the basis of our fire-regime review. Information about ignition sources, fire perimeters, and intensity of fires was not directly recorded. We must look to the Principle of Uniformity and assume that processes that occurred in the past were similar to those that occur now. Current fire behavior shows us how fires may have behaved in the past. This extrapolation, combined with the fire interval information reconstructed in fire histories, allows us to paint a general picture of past fire regime characteristics. In the case of the Borderlands, multiple fire history reconstructions have given us information on the historic fire regime for several of the mountain ranges in the area. The individual studies show the importance of site-specific factors, but general patterns in fire regimes can also be found. Stability in the upper-elevation pine and mixed-conifer forests in the mountain ranges surrounding the Borderlands was maintained by moderate- to low-intensity fires burning at moderate to high frequencies. Cultural influences have been shown to be both variable and site and time specific.

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Chapter 6.

Modeling Human Impacts to the Borderlands Environment From a Fire Ecology Perspective

Introduction

Theoretical and topical orientations in current archaeology address the interaction between past human populations and their environment. These themes reflect ecological frameworks that were incorporated into the social sciences by the 1950s, as exemplified by the influential publication, *Man's Role in Changing the Face of the Earth* (Thomas 1956). Cultural practices for actively manipulating targeted species and ultimately modifying vegetation structure have been highlighted in recent studies of foraging societies and have gained recognition as key processes in the transition from hunting and gathering to farming economies (for example, Hillman and Harris 1989; Price and Gebauer 1995; Smith 1992). From this background of such interests, archaeologists are increasingly involved in examining the relationships between prehistoric peoples and precontact vegetation on what are now public lands in the United States.

There is, of course, no unitary means of characterizing the manner and the magnitude of impact by preindustrial societies in North America or even in the Southwest. Natural vegetation dynamics over time are driven primarily by climate and secondarily by processes such as geomorphological change. However, these natural processes are more regular and subject to uniformitarian approaches than are the overlay of human interventions that affect them; no uniform reconstruction of human impact can be advanced without reference to economic orientation, population densities, or culture-specific practice. To assess human influence on a precolumbian baseline, it is necessary not only to specify a vegetation class consistent with environmental variables, but also to specify the dimensions of indigenous population, subsistence, and settlement.

Human-Induced Fire in Historical Perspective

The conviction that wildfire has played a decisive role in the evolution and maintenance of desert and plains grasslands and open forests in the American Southwest is an important component of range management philosophy and ecological thinking. According to this view, periodic and widespread grassland blazes in the past encouraged vigorous return of annuals but inhibited the survival of woody plants. Likewise, cyclical wildfires removed woodland understory so that forests of large trees were open and sprinkled with clearings. Changes in frequencies in the wake of fire suppression and overgrazing resulted in conditions that permitted the invasion of dense young trees, brush, and shrubs by the late 1800s.

Carl Sauer (1944, 1956) and Omer Stewart (1956) are among the most influential proponents of the hypothesis that the former broad, brush-free grasslands and mature, open forests of the New World originated with repeated fires set by Native Americans as much or more than from naturally occurring conflagrations. Stewart (1956:

118) believed that the unrestricted burning of vegetation was a universal trait among "primitive" peoples. Grasslands were repeatedly subjected to fires used in Native American hunting activities (Sauer 1944: 554, 1956; Stewart 1956: 129). Conversely, fire suppression is limited to contemporary societies (Sauer 1956: 55). Sauer and Stewart correlated this perceived universality of native burning with historic environmental change to arrive at the potent force shaping premodern grassland and forest landscapes. Some current environmental historians working in the Western United States have expanded this thesis to implicate burning by Native Americans in the overall development of North American ecosystem structure (Kay 1994; Pyne 1982).

Researchers in the Borderlands study area and adjacent regions (for example, Branscomb 1958; Cooper 1960; Humphrey 1958; and more recently Bahre 1985, 1991; Dobyns 1981: 27–44; Pyne 1982, 1984) have assembled an array of ethnographic, archival, and newspaper accounts of historic fire in general and anthropogenic fire in particular. Conrad Bahre (1985: 190, 1991: 124–142), reviewing local newspaper accounts of wildfires in grasslands of southeastern Arizona during the latter portion of the 19th century, summarizes that: wildfires were much larger and more frequent than at present; the occurrence of these fires declined dramatically during the 1880s; cessation of large fires preceded the "brush invasion" of the 1890s; Native Americans often set wildfires; and suppression of fires was encouraged by Anglo settlers.

Natural Versus Cultural Magnitudes

The scale and efficacy of naturally induced fire is a question that warrants serious consideration prior to retrodiction of human effects. If natural ignitions were plentiful and cultural suppression nonexistent, why would not the balance between accumulating fuels and recurrent fires be sufficiently close to preclude first order consequences of human initiations? Under conditions approaching such a balance, why would culturally generated fires transform or maintain vegetation types rather than affect relatively minor and local adjustments of vegetation potential? Proponents of Native American burning as a primary factor in the persistence of grasslands and open forests seldom confront this fundamental issue (but see Lewis 1973 for an exemplary analysis of the interplay between aboriginal burning and natural fire regimes in California).

The thoroughness and rapidity with which naturally ignited fires consume available fuels is particularly germane in assessing prehistoric human impacts on Borderlands ecosystems. Conrad Bahre (1991: 124) summarizes the impressive occurrence of lightning in the study area and vicinity. Nearby portions of Mogollon Rim country have among the highest incidences of lightning fires in the United States. Seventy-three percent of all fires since 1959 in the Coronado National Forest have originated in this way. The Coronado Forest leads the Southwest in average acreage burned annually by lightning fires, despite a long history of fuel reduction through grazing. These high natural ignition rates bring the role of aboriginal burning into perspective as a residual mechanism in total fire ecology. Bahre (1991: 128) noted, ". . .given the high incidence of lightning-caused fires, reliably documented by modern data, the relative importance of fires set by Indians is probably moot."

Although the exact nature of the relationship between natural fire and vegetation in the past cannot be easily resolved, it is possible to ask whether Borderlands trends attributed to historic human agency had earlier parallels. For example, Thomas Van Devender (1995: 89–94) cites packrat midden evidence for increases of desert shrubs in southeastern Arizona grasslands about 4,000, 3,000, and 1,000 years ago, in the absence of livestock or fire suppression programs. Although he attributes these prehistoric increases to climate, he acknowledges the unprecedented intensity and possible irreversibility of modern activities. In any case, there is wide concurrence on the two foremost causes for a decreased scope and frequency of fire by the latter part of the 19th century: the removal of ground cover and fine fuels through overgrazing and active fire-containment efforts (for example, Bahre 1985, 1995; McPherson 1995; Pyne 1984; Van Devender 1995). Thus, it is clear that prehistoric human fire ecology should be viewed in the framework of a more vigorous natural fire regime than at present.

Fire Ecology of the Early Archaeological Sequence

There is a substantial body of information on Native American use of fire in the southern Southwest during the historic era (see summaries in Bahre 1985; Dobyns 1981). But for the prehistoric era, unfortunately, direct evidence pertaining to the fire practices of Borderlands inhabitants is limited, and models of this behavior rely strongly on ethnographic accounts. Analogs must be judiciously selected for best fit with the demographic and economic profiles of specific groups of prehistoric peoples. No single, generalized model of human fire ecology can adequately encompass the demographic and economic variability in archaeological sequences.

Little is known about Paleoindian hunters of the study area beyond the existence of kill and butchering sites for large, extinct game such as mammoth. Paleoindian residence and mobility strategies are not well known, nor are other aspects of subsistence practices. Packrat middens in uplands suggest that grasslands emerged from more arboreal vegetation types about 8,500 years ago (Van Devender 1995: 89), but pollen diagrams associated with still earlier Paleoindian kill sites conform to grassland patterns (Mehringer and Haynes 1965: 22; Martin 1963a,b). The use of fire drives for game is plausible but assessing their overall effect is highly speculative.

Forms and distributions of desert grassland and scrub resembling those of the present were in place by approximately 4,000 years ago (Van Devender 1995: 89). With the demise of large Pleistocene fauna, subsistence practices shifted to a focus on diversesmaller animals and, as suggested by grinding stones and other implements in artifact assemblages, varied plant resources. Although we know little about the lifestyles of the Archaic peoples who succeeded Paleoindian hunters, the few known structures from the latter centuries before agriculture imply intervals of relatively prolonged occupation in some locales (for example, O'Laughlin 1980).

In a cross-cultural survey of foraging societies, Lawrence Keeley (1995) found a correlation between use of fire for landscape management, dietary reliance on seeds and nuts, intensive manipulation of wild plants, and decreasing mobility. Indeed, this combination of attributes fits those historic cultures of the Western United States for whom the most systematic and complex burning practices have been recorded, such as the Shoshone and Paiute of the Great Basin (Steward 1938; Stewart 1939) and a variety of groups in California (Bean and Saubel 1972; Lewis 1973). With longer residence in single locations, management efforts are both increasingly practicable and necessary to derive food supplies from circumscribed territories. Archaic foragers closely predating the transition to farming may well have been the premier landscape burners of Borderlands prehistory.

In the Tucson Basin and on its eastern borders, the threshold of agriculture dates back at least to 1,000 B.C. and probably centuries earlier (B. Huckell 1996; Mabry 1996; S. Fish and others 1990). Corn pollen recovered by Owen Davis (2001: 408) from the Animas Creek Cienega near the Gray Ranch Headquarters, in a level dated earlier than 3000 B.P., suggests that the appearance of farming was generally synchronous in the Borderlands. Late Archaic subsistence studies near Tucson show even the earliest cultivators possessed a full complement of aboriginal food crops, and corn remains are as common in their pithouse villages as in later agricultural settlements (L. Huckell 1996, n.d.).

Fire Ecology of the Late Prehistoric Archaeological Sequence

Information is most complete for later prehistoric sites in the Borderlands. Data on the distribution of residential sites, including the largest occupations of all times, provide the basis for modeling cultural dimensions of fire ecology in the last centuries before Old World intrusion, from about A.D. 1250 to 1450. Because archaeologists have undertaken little systematic inventory or excavation, reconstruction of human fire ecology during this era draws upon more numerous and refined studies to the west and north in southern Arizona, particularly studies of the Hohokam. Ethnographic analogs will similarly emphasize agricultural groups in those sectors.

Disjuncture with Apache Practices

It is useful to contrast the cultural contexts of the use of fire before and after Old World contacts in the Borderlands. Both proponents and discounters of aboriginal burning as a primary force invoke accounts of Apaches and similar groups from initial Spanish encounters to the late 19th century. It is improbable that these observations are valid reflections of precontact times. In addition to the tenuous cultural continuity of the Apache with prehistoric agriculturalists, their lifestyles were shaped by factors unique to historic.

Throughout the periods of Spanish, Mexican, and United States hegemony, the Apache were simultaneously in conflict and economically intertwined with these dominant societies and other Native American groups. Mobility was heightened by ongoing hostilities, capabilities for animal transport, and heavy economic involvement in raiding and trading. Although Apaches gathered plant resources and sometimes cultivated for subsistence needs, their opportunities for extended residence and intensive forms of land use often were limited. Furthermore, some Apache had more than a passing involvement with livestock. For example, Dobyns (1981: 24) cites a description of large numbers of Apache livestock along Pinal Creek by 1830. Livestock obtained in perpetual raiding also had to be temporarily sustained, even if later disposed of through trade.

Apache patterns of land use, including the application of fire, diverges from that of relatively intensive or sedentary foragers and, presumably, that of from late prehistoric agriculturalists. Mobile (and to some extent unpredictable) Apache lifestyles, in conjunction with low population size, would hold few incentives for regular, intensive, and fine-tuned manipulations of the environment. Relocation was a ready option and sometimes an urgent necessity. Not surprisingly, reports of Apache burning in historic records, though probably inflated by automatic attribution, are repeatedly linked with conflict (Bahre 1985; Dobyns 1981), and fire chronologies derived from Borderlands tree-ring studies suggest a correlation between increased frequencies and intervals of heightened warfare (Kaib and others 1996).

Late Prehistoric Settlement Patterns

Borderlands settlement patterns after A.D. 1200 are characterized by adobe structures at larger residential sites, with a range from 50 to perhaps several hundred rooms. All of these are pueblo-style with contiguous rooms. Compounds, consisting of more dispersed sets of rooms surrounded by a wall, were constructed at moderate-sized sites near the western boundary of the study area; room numbers are more difficult to estimate with this type of architecture. Locations of the large settlements correspond to better situations for irrigated and floodwater farming along the larger mid-valley drainages and along mountain edges where tributaries with large upland watersheds emerge (fig. 3.5). The importance of agriculture is inferred from these hydrological settings, and corn remains have been recovered in each of four substantial excavations at these sites (Kidder and others 1949; McCluney 1965a, 1965b) and in a number of dry caves (Lambert and Ambler 1961).

Although small residential settlements and other site types are numerous throughout the study area, occurrences are so spottily reported that their relationship to the larger sites cannot be documented in more comprehensive patterns. The presence of probable Casas Grandes-style ballcourts at four large sites in the study area and at three near its edges suggests some form of multi-site community organization similar to that in the Hohokam area (S. Fish and Fish 1994) and other parts of the Southwest (Adler 1996; P. Fish and Fish 1994). Communities in this sense are sets of closely interrelated outlying settlements that share a relatively large center with communal public architecture such as a ballcourt, platform mound, or big house. The roughly regular spacing of large Borderland sites (fig. 3.9) also resembles the spacing of centers in other community distributions (P. Fish and Fish 1994; S. Fish 1996)

A Zonal Model of Fire Use

Just as differing economic orientations have differing implications for the use of fire as a management tool, its use can also vary among differing locations within a single orientation. We will use the zonal character of prehistoric community territory as the principal point of reference in modeling this variability. Community boundaries encompass the primary sustaining area for the entire set of interrelated member settlements. Among the neighboring Hohokam, community territories exhibit an internal zonal arrangement corresponding to varied topographic opportunities for agriculture and the procurement of wild resources (Crown 1987b; Fish and others 1992; Masse 1991).

Zones of Intensive Cultivation

Communities usually include a productive core of hydrologically favored agricultural land. Such a core in the study area would consist of land irrigated from primary or large secondary drainages by small networks of canals. At the scale of Borderland watercourses, formal irrigation would intergrade with extensive floodwater systems, in which long ditches serve a series of fields (compare Doolittle 1984; Nabhan 1986; Withers 1973).

Within the radius of intensively cultivated land, uncontrolled fire would have posed a threat. Nearby village structures with highly flammable roofs contained household possessions and, more important, internal or adjacent facilities with stored food. During the growing season, crops would be threatened in fields. Throughout the year, however, fire might damage other vegetation elements of intensively farmed locales. As in Pima agriculture (Rea 1981, 1983), field edges and hedgerows may have consisted of woody plants and herbaceous species that were selectively spared in clearing and of herbaceous plants that, together, furnished gatherable resources and firewood and harbored a concentrated supply of small game. Species such as mesquite grew along outer edges of canals. A mesic flora also lined canal banks, extending riparian resources into the zone of cultivation. In adjacent northern Sonora, traditional farmers still plant “living fencerows” of cottonwood and willow to stabilize field edges on floodplains and to safely deflect nutrient-rich flood flows over fields (Sheridan and Nabhan 1978).

Uses of fire in intensively farmed zones are clearly documented for aboriginal and traditional farmers of the southern Southwest. Piled brush was sometimes burned in the initial clearing of fields (Castetter and Bell 1942: 125) and possibly to remove weedy growth in subsequent plantings. Canal channels were similarly cleaned at times. Burning to clear water delivery systems may have been extended to the dense growth of cienegas and drainage bottoms in locations where canals and ditches headed; an additional goal might have been to enhance the productivity of nonwoody riparian resources (Nabhan and others 1983; Rea and others 1983). Such practices could account for the charcoal of riparian species recovered from Borderland cienegas in levels predating the late 19th century (Davis n.d.). In all of these cases, unrestrained fires would have been destructive to residential and agricultural environs.

Table 4.5 gives estimates for amounts of irrigated land needed to supply projected populations at seven of the better-recorded large Borderlands sites. Quantities are based on historic Piman farming for which at least 2.5 persons could be supported by 1 ha (2.5 acres) of irrigated land (Castetter and Bell 1942: 54). Although irrigable land is intermittently distributed along adjacent streams for all but one of these sites, in no case does it satisfy even half of the projected acreage. This lack of congruence suggests a major role for alternative methods of agricultural production and gathering.

Areas of Runoff Cultivation

Somewhat removed from well-watered community sectors, more marginal plantings likely were situated on ephemeral tributaries. Such secondary floodwater plots likely were interspersed among more extensive fields watered solely by the concentration of surface runoff. Impressive arrays of runoff devices are widespread in portions of southern Arizona and northern Chihuahua surrounding the Borderlands. For example, in three Hohokam communities of the Tucson Basin, simple cobble devices called rockpiles covered between 550 and 600 ha (1,359 and 1,483 acres). In the two reliably bounded examples of these large territorial units (136 and 146 km^2; 53 and 56 square miles), such fields constituted about 2 percent of community land (S. Fish and Fish 1994). Terraces, linear borders, and checkdams were prominent stone features of the Casas Grandes region of Chihuahua (Di Peso 1984; Whalen and Minnis 2001: 71–75), and miles of large stone grids covered the upper terraces of the Gila River near present-day Safford, Arizona (Masse 1991).

Historically, aboriginal and traditional farmers most commonly constructed runoff diversion devices of earth and brush. Preserved stone features, then, may represent a minimum indication of prehistoric use. The lack of reports of runoff features in the Borderlands may reflect the rudimentary level of inventory or a predominance of earth and brush materials.

If present, as seems likely, zones of runoff farming defined further circumscription of anthropogenic fire. Agave has been documented as a principal cultigen, and cacti have been suggested for many Hohokam runoff complexes (Fish and Nabhan 1991). Such drought-adapted plantings are strong probabilities in the arid Borderlands as well. These are perennial crops, leaving no off-season in which burning of weeds could be freely implemented. Furthermore, succulents tend to be among the least fire tolerant of desert plants (Cave and Patten 1984; McLaughlin and Bowers 1982; McPherson 1995: 137–140).

Variable Radii of Gathering

The disturbed environs of prehistoric cultivation provided secondary resources in the form of weedy plants (Fish and Nabhan 1991). Typically, these were annuals that matured rapidly and produced edible greens and abundant seeds. Intensive gatherers burned plots to increase the production of such species, but broad applications of fire by agriculturalists would have been relegated to zones beyond residences and both intensively and extensively cultivated land. The lower needs of farmers than foragers for weedy harvests may have been largely satisfied from field margins and fallow land.

Labor expended in agriculture can be seen as a counterbalance to investments in wild plant manipulation near and beyond community boundaries. It is doubtful, for instance, that irrigation and floodwater farmers would have had sufficient time or incentive to routinely burn meadows in high elevation forests, despite potential enhancement of edible species. The most intensive manipulations of wild plants by agriculturalists might be expected near the margins of cultivation rather than at greater distances. Moreover, wild resources respond variably to fire. Grasses and other seed bearing annuals are more abundant after burning, while cacti providing fruit are damaged.

Strategies for Hunting

Vegetation effects at the broadest scale are often linked to hunting (for example, Kay 1994; Stewart 1956). Fire was widely employed for this purpose among cultural groups of the southern Southwest and northern Mexico (Dobyns 1981: 42). Hunters lit fires to flush out their prey, to direct or contain the flight of animals, and to promote abundant, palatable fodder. Mounted hunters in postcontact times could rapidly pursue fleeing game; prehistoric hunters

Table 6.1. Population and land-use characteristics for selected large, late prehistoric pueblos in the Malpai Borderlands study area.

Site No.	Site name	No. of rooms[a]	Estimated population[b]	Hectares of farmland[c]	Cords of fuelwood[d]
LA 1369	Pendleton	125	125	50	250
LA 4980	Box Canyon	175	175	70	350
LA 1823	Joyce Well	200	200	80	400
LA31050	Culberson	225	225	90	550
LA54033	Double Adobe	200	200	80	400
LA54034	Cloverdale Park	75	75	30	150
LA54038	Timberlake	200+	200	80	400

[a]Number of rooms is based on National Register Nomination forms for the Animas District.
[b]Estimated population is derived from William Longacre's (1970) room-to-person ratio.
[c]Hectares of irrigated land are estimated using Castetter and Bell's (1942:54) ratio of persons to farmland among the Gila River Pima.
[d]Estimates of cords of fuelwood are those of Spoerl and Ravesloot (1994). Estimates for Animas inhabitants were reduced by 25 percent because of milder climate.

on foot had more compelling motivation to carefully position fires to constrain the path of flight. Practices designed to control both fire and animals are illustrated by the description cited by Dobyns (1981: 43) of Yaqui setting a fire in a circle when there was no wind so that it burned toward the center. Hunters waited at the perimeter for game escaping outward. Despite such means for exerting control, fire drives among the Pima were carried out in areas more distant from villages and fields than other forms of communal hunting (Rea 1979: 114–115).

Burning at a landscape scale, such as throughout grasslands on Borderlands valley floors, is conceivable as a strategy to improve the carrying capacity for herbivores (compare Dobyns 1981: 39). In light of the already high incidence of natural fires to consume built-up fuels, such programmatic burning would have required persistent effort, and would have threatened the predominantly lower valley villages and fields. Detailed ethnographic accounts of burning for forage improvement, however, often describe small-scale, areally specific goals and events. Restricted burning, such as near a water source or in a forest clearing, offers the distinct advantage of attracting and concentrating game in a precise, predictable location.

Radii of Fuel Demands

During prolonged occupation of large sites, residents continually needed domestic fuel. Cleared land and culturally modified vegetation in the vicinity of settlements lengthened radii of firewood supply. Lower elevation woodlands of adjacent mountains must have been important sources. Fred Plog (1992) estimated 2.7 cords of firewood per capita annually for prehistoric populations of the Mogollon Rim. Adjusted downward to two cords for the somewhat milder Borderlands climate, areas of sustainable yield in low-density Emory oak woodland (Touchon 1988) range from 17 to 60 km^2 (6.5 to 23 square miles) for projected village populations in table 6.1. Repetitive harvesting of deadwood may have affected natural fire frequencies in areas of heavy fuel gathering, and it seems probable that intentional burning would have been avoided to conserve the nearest supplies.

Fire Ecology of Anthropogenic Landscapes

Multiple lines of evidence suggest that the applications and motivations for fire use were culturally and spatially complex for late prehistoric Borderlands agriculturalists. The productive potential of small-scale irrigation and intensive floodwater techniques is modest when compared to more hydrologically favored locales in other parts of the southern Southwest. In addition to runoff cultivation of marginal land, manipulations of vegetation to increase the returns of hunting and gathering are likely to have included the same uses of fire. It seems doubtful, however, that comprehensive burning was instituted at a landscape scale, for reasons advanced in the foregoing discussion.

The greatest variety of resources can be obtained from heterogeneous rather than homogenous landscapes, with patches of mature vegetation and other areas in multiple stages of fire succession. Mobile populations could attain resource variety by periodically moving from place to place, an option not equally viable for committed farmers. Particularly for agriculturalists, a vegetation mosaic would have been as valuable for gathering plants as for hunting, to ensure a variety of wildlife and predictable localization of game.

High incidences of lightning in the Borderlands guaranteed access to resources encouraged by fire succession. Cultural practices could accelerate vegetation response by introducing fire in seasons of natural ignition and by increasing periodicities to the extent that fuel buildups allowed (Lewis 1973; McPherson 1995). Nevertheless, fires of controlled extent were the route to achieving vegetation mosaics more diversified and resource-rich than natural zones.

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Chapter 7.

An Archaeological Research Design for the Malpai Borderlands

Borderlands Archaeological Context

Archaeological cultures of the Malpai Borderlands study area are intermediate between the homelands of several better defined and relatively well-studied prehispanic manifestations. To the northwest, the Hohokam represent a persistent cultural expression throughout ceramic times. To the north and northeast, before A.D. 1200, the Mimbres culture created dominant ceramic styles. Thereafter, the Salado and Casas Grandes spheres to the north and south respectively represent archaeological cultures in a broadly Mogollon tradition.

Located between some of the more dramatic developments in Southwest prehistory, the Malpai Borderlands have played a key role in regional synthesis and the development of interpretive constructs about frontiers (De Atley 1980), interaction spheres (Douglas 1995; P. Fish and Fish 1999; Skibo and others 2002), political dominance (Di Peso 1974; Wilcox 1995), and short-term sedentism with cycles of abandonment and migration (Nelson and Anyon 1996; Nelson and LeBlanc 1986). These regional models and related constructs necessarily incorporate fragmentary data from the Borderlands and reflect perspectives on better understood cultural systems in other regional sectors.

Local typological, chronological, and cultural sequences are poorly developed. Instead, archaeologists typically have projected established schemes from adjacent culture areas. Malpai Borderlands research invariably has been designed to address Casas Grandes, Mimbres, or Salado issues; there has never been a sustained, intensive investigative focus on locally generated problems. Because the study area has not had significant urban or agricultural development with direct Federal and State involvement, cultural resource management investigations have been limited to a few surveys. High-quality, large-scale excavations are lacking. As a result, any comprehensive attempt to understand past human-land relationships must be grounded in long-term interdisciplinary research that initially focuses on basic data collection.

Phase 1: Spanish and Mexican Archival Study

This phase of research has been initiated. Thomas Sheridan and Diana Hadley have been contracted to review original Spanish and Mexican archives for ecological and culture history information pertinent to the Malpai Borderlands. Colonial and Mexican period archives are believed to contain information regarding phenomena such as drought, flooding, human use of fire, Apache land use, and early ranching and farming activities. A brief overview of their work (Hadley and others 1999) has been published and a complete report should be available in the near future.

Phase 2: Malpai Borderlands Conference/Workshop

One aspect of the second phase of research has also been completed. A short conference (2 to 3 days) was called to acquaint all parties conducting research in the

Malpai Borderlands with the work of others. A wide range of natural and social scientists, including archaeologists and historians, reported on investigations conducted in conjunction with the Gray Ranch and governmental agencies, and on independent research interests (Gottfried and others 1999). A second week-long workshop or conference should be called once Malpai Borderlands archaeological investigations are resumed and should include scholars interested in dendrochronological studies, palynology, a wide range of studies on the existing environment, packrat midden analyses, and the Gray Ranch mapping project.

This workshop should initiate an interdisciplinary examination of prehistoric and historic environmental change in the Borderlands and should draft a proposal for support of research to one of several potential funding agencies. For example, the broad range of well-qualified researchers involved in Borderlands investigations could develop a compelling proposal to any number of the National Science Foundation competitions, particularly those pertaining to global climate change. A small group of six to 10 principal investigators could write such a proposal during the final 3 days of the conference in this workshop format.

Phase 3: Survey of Existing Artifact and Field Record Collections

An initial stage should consist of a concentrated effort to obtain valuable knowledge about the study area residing in the collections and recollections of amateurs. Extensive Arizona experience suggests that this effort is particularly crucial for compiling information on Paleoindian through Middle Archaic as well as historic time periods. A reference collection and graphics could be used to aid the recollection and identification of stylistically diagnostic artifacts. Amateurs could provide locations of features such as small springs and caves, in addition to sites. Field visits in the company of amateurs will be an important part of this phase. In this regard, the systematic and accurately located collections by Jeff Shauger of the Gray Ranch are particularly important and comprehensive.

A systematic review of existing museum collections from excavated archaeological sites in and near the Borderlands study area should be a secondary thrust of phase 3 investigations. It is likely that Museum of New Mexico and School for American Research collections from McCluney's (1965a, 1965b) and Lambert and Ambler's (1961) excavations, and Harvard's Peabody Museum collections from Kidder and others (1949) will contain material valuable for dating and ecological study. It is also possible that there are collections at the Maxwell Museum and Museum of New Mexico which are poorly documented in the literature, such as materials from the University of New Mexico's expedition to the Culberson Ruin in the 1930s (Osborne and Hayes 1938)

Phase 4: Tree-Ring Studies Pertaining to Archaeology

Detailed recommendations from both the Fire Ecology and Archaeology Sections at the University of Arizona Tree Ring Laboratory were presented as appendices to the overview manuscript (Baisan and others 1997; Dean 1997). Specific projects include: (1) resample tree-ring sites in the Pinaleno Mountains where the longest chronology for the region has recently been developed; (2) extend chronologies that are currently limited to the mid-15th century from the Animas Mountains and Sierra Ajos Mountains; and (3) conduct an in-depth search of archival and historical documents that would augment ecological models proposed from tree-ring studies. These investigations will enhance our understanding of regional prehistory through effective integration of archaeological information and paleoecological data. Because modest costs are anticipated, we recommend giving these studies high priority. They should be undertaken prior to archaeological studies beyond the reconnaissance level.

Phase 5: Geoarchaeological Assessment

A geoarchaeologist should be employed to delineate geomorphic surfaces of relatively uniform age and to identify processes that are likely to obscure surface indications of archaeological remains. In cases of recognized burial, depths to materials of particular age should be approximated. The geoarchaeologist would also construct a geological perspective on environmental history to evaluate settlement trends and their effects on the environment. Likely locations to obtain environmental sequences such as packrat middens and pollen cores should be identified. A hydrological assessment should include agricultural potential of drainages and age of spring locations.

Phase 6: Reconnaissance Survey

A reconnaissance level survey should be designed to obtain particular types of land use and cultural information. Existing aerial photographs for the Borderlands study area should be assembled and examined for their potential in revealing information on prehistoric land use, particularly modifications to the landscape resulting from past agriculture. Major village sites should be revisited with an eye toward identifying additional ballcourts.

Phase 7: Systematic Survey

A broad-scale, systematic survey should be conducted, based on prior stratification of the study area according to naturally and culturally relevant variables. Preliminary observation of settlement pattern suggests that concentrated ceramic era settlements on basin floors and mountain flanks should be subjected to large block or full-coverage examination. Mid-basin and upper elevation areas might be tied into these blocks through survey transects.

To efficiently sample preceramic and other less sedentary occupations including many of the historic period, survey blocks and transects may be designed around springs, playas and their associated high stand lakes, and other attractive features on the landscape. All exposed drainage profiles should be carefully examined, in addition to surface observations. In view of hierarchical tendencies in the late ceramic settlement patterns, block surveys should also be designed around large sites in areas of dense settlement and around focal villages containing ballcourts.

Phase 8: Studies in Holocene Environmental Change

Packrat Midden Studies

Packrat midden studies should be undertaken within the study area. Pollen and plant macrofossil studies of packrat middens have shown these deposits to be highly sensitive barometers of local environment. Reconnaissance during the present study confirms that numerous, well-preserved middens exist in grassland and higher elevation environments at a variety of locations in the study area. Current regional packrat studies are from higher elevation woodland environments, rather than valley floors. Middens located in present-day grasslands should be particularly valuable in testing previous models of post-Pleistocene invasions of shrubby plants into these lower elevation zones (Van Devender 1990).

Palynology

Pollen profiles at the Gray Ranch cienega and at cienegas adjacent to the study area (Davis n.d.) could be expanded to include other cienega or spring sequences. Replication of sequences will provide insights into both changing climate and prehistoric human practices involving water and vegetation near the cienegas.

Both the palynological and packrat midden studies must be accompanied by large numbers of radiocarbon dates for chronological control. These dates, combined with specialized botanical studies, make such investigations expensive. Therefore, this research should follow the geoarchaeological assessments and the archaeological surveys, during which deposits for sampling can be identified. It may also be possible to better relate this environmental research to locations selected for detailed archaeological study at a later phase of investigation.

Phase 9: Problem-Oriented Excavations

Data for solving particular problems pertaining to chronology, subsistence, and human-induced environmental change ultimately must come from excavation of archaeological deposits.

Geomorphological Studies Related to Hydrology

Such studies include focused trenching to retrieve the environmental and culture histories of cienegas, streams, and playas. Near cienegas, geological histories, and terrestrial sequences of botanical samples to match core records could be obtained; trenches might also reveal damming or ditching for agricultural purposes. History and stratigraphy could also be explored in this manner for playas, important long-term resource zones in regional prehistory. The history of Borderland drainages is also an important element in understanding irrigation and floodwater farming.

Extractive Sites

Survey and excavation can be designed to characterize hunting and gathering locations through time. Detailed study will be needed to pinpoint the date of use, duration of use, and resources obtained. Densities of extractive sites by zones such as grassland, high elevation forest, and playa margins provide evidence for magnitudes of resource use and human presence.

Agricultural Sites

Study of these sites will include intensive survey and mapping to understand agricultural technology and productivity, dates of use, associated tool assemblages, and field layout, including the location of ancillary facilities such as canals, ditches, roasting pits, and field houses. Excavations should target both constructed features and field sediments to retrieve botanical samples for reconstructing crop variety, weedy flora, and evidence for specific practices such as burning.

Residential Sites

Excavations at residential sites can be designed to recover dendrochronological specimens for dating and climatic reconstruction. Modern analog studies will be necessary to support this program. Additionally, construction timber identifications will indicate source and intensity of such wood use. Most Borderlands settlements fall in lower elevations that do not contain tree species suitable for tree-ring dating but are adjacent to higher mountain zones where such trees exist. Recent research in other desert locations such as the Tucson Basin (Dean and others 1996) and Casas Grandes (Dean and Ravesloot 1993) demonstrate the importance of timbers of high elevation species such as ponderosa pine, Douglas fir, and white fir in the construction of adobe buildings. Regular procurement of these species in construction suggests currently untapped potential for dendrochronological study in many desert locations, including the Borderlands.

Flotation and pollen samples are needed to indicate subsistence mixes of wild and later cultivated resources and the zonal emphasis and intensity of plant exploitation. These studies should also inform on natural environment, environmental change, and specifically human modifications of the environment. Weedy and successional floras are particularly relevant in these regards. Charcoal from fuel use is another way to monitor wood consumption and such issues as source areas and depletion.

Systematically recovered faunal samples are also critical to an evaluation of the zonal sources and relative mixes of animal resources. These studies may also inform on environmental change and resource pressures, as in the changes in lagomorph (jackrabbit, cottontail) species and reduction of artiodactyls (deer, antelope, and so forth) during extended occupations. Hunting patterns may be one of the better ways to monitor resource acquisition at a distance from residential sites, particularly at higher elevations.

Settlement Pattern Studies

Settlement pattern studies are the means for integrating all of the foregoing kinds of data. Occupational densities and relationships among site locations and resources are needed to evaluate human impacts through time. In particular, it is important to assess the contemporaneity and degree of relatedness of sites in areas of clustered settlement to assess population size and environmental pressures. It is important, therefore, to investigate hierarchical relationships among sites and evidence for territorial integration. Based on detailed settlement pattern studies, including all of the foregoing site-level information, simulations can be made of land-use patterns, resource consumption, and environmental impacts for various periods of study area prehistory.

Recommendations for Priority Excavation

Caves or rockshelters with high potential for long sequences or chronologically critical intervals should be targeted. There is a need for information from stratified deposits for all segments of the prehistoric sequence, and these can be acquired as efficiently in few other ways. Existing information from cave localities was not acquired using rigorous techniques, and biological and chronological information was not previously emphasized.

Early villages are virtually unknown from Borderlands investigations. Sites beginning with villages of Late Archaic farmers, if located, and a variety of pre-Casas Grandes settlements in both the eastern and western sectors should be tested before selections are made for more detailed excavation.

Later ceramic settlements with compound architecture in the western study area should be emphasized. These sites have been neglected more than those with closer stylistic ties to Casas Grandes. At present, it is difficult to predict architectural layout or even to roughly estimate room numbers. Initial efforts should emphasize efficient outlining of walls as well as intensive excavations.

Locations of consistent, long-term attraction should be targeted to convincingly monitor environmental impacts. Holding location constant, biological materials from sequential occupations would offer insights into changing magnitudes and kinds of modification. At Slaughter Ranch, for instance, Archaic, early ceramic, and late ceramic occupations could be contrasted with the historic Colonial and territorial archaeology of the locale. Evidence for farming technologies during each of these intervals could be examined concurrently. Consequences of the transition from prehistoric to early historic land use would be of particular interest. In the eastern portion of the study area, another locale with chronologically varied prehistoric occupation might be in the vicinity of the cienega at Maddox Ranch.

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APPENDIX A.

Borderlands Site Database

Database Key

The database includes modified components of the Arizona State Museum Site Recording System (Arizona State Museum 1993) and the New Mexico NMCRIS User's Guide (State of New Mexico 1993). When sites contain more than one recorded component, these instances were entered separately with the result that many sites have multiple entries. Information for this database originated in several sources, including the Arizona State Museum, Museum of New Mexico, USDA Forest Service, and USDI Bureau of Land Management. Approximately 5 percent of the identified components are recorded on the basis of excavation data, and the remainder are described solely by surface evidence. The key is organized by columns in order of occurrence in the database.

Column A—Site Designation: An institutional or research number is used as a primary designation for identification of the site. LA numbers are used for New Mexico sites and Arizona State Museum site numbers for Arizona sites. Other designations (for example, Gila Pueblo, Fitting, Myers) are used only when these are not available. See appendix C for a concordance of site names.

Column B—Universal Transverse Mercator (UTM) Easting: All UTM values are in Zone 12. In cases with conflicting UTM locations, placement was on a case-by-case basis rather than always adhering to one data source.

Column C—UTM Northing: See column B.

Column D—Elevation: All elevations are recorded as meters above sea level.

Column E—Ownership: Site ownership is coded using the following key:

(0) Unknown

(1) Private

(2) Private and Arizona State Trust Lands

(3) Municipal

(4) Arizona State Trust Lands and Arizona Department of Transportation

(5) Arizona Department of Transportation

(6) San Bernardino Land Grant (to the State of Arizona)

(7) Arizona State Trust Lands

(8) New Mexico State Trust Lands

(9) Bureau of Land Management

(10) United States Forest Service

(11) United States Fish and Wildlife Service

(12) Other

(13) New Mexico State Highway and Transportation Department

Column F—Culture: Culture names (archaeological periods) are assigned following appendix 5 in the NMCRIS key. Consecutive numbers were given to entries in that appendix. Additions are "Unknown Ceramic" (65) and "Generic Mogollon" (66). There are no deletions. This column also provides age ranges for sites following those specified in the NMCRIS key.

Column G—Phase: Site information occasionally allows more specific temporal placement, usually in terms of conventionally recognized phases. Projectile points and more often diagnostic ceramics are used for phase placement for those sites known only through surface survey. Some historic sites are identified following NMCRIS appendix 5 terminology and specifications.

The following alphabetically arranged list is used to designate phases:

(0) Not specified

(1) Anglo

(2) Animas

(3) Apache

(4) Black Mountain

(5) Colonial

(6) Jornada

(7) Mimbres

(8) Pinto

(9) Recent

(10) Salado

(11) San Luis

(12) San Pedro

(13) San Simon

(14) State

(15) U.S. Territory

Column H—Site Area: Site area is given in m^2. A value of "0" indicates unknown site dimensions and area. NMCRIS site area values often conflict with estimated site areas from other information sources. As the NMCRIS areas are categorical, these are used only when alternatives are not available. When area is not provided by a recorder, it has been calculated from field maps, if available.

Column I—Site Use: Site use follows the Arizona State Museum site file list of 21 possible uses. In that system "1" specifies unknown use, whereas "0" is used here. Other values are not adjusted down one integer; "1" is not a possible value for site use in this database. Sites are specified as habitation sites (19) only if habitation (residential) features such as pithouses or roomblocks are recorded at the site. This is an obvious biasing factor in the identification of residential sites prior to the late prehistoric times.

Column J—Surface/Excavation/Vertical Surface: This category also follows the Arizona State Museum convention. Sites recorded only with surficial data are designated "1," excavated sites "2," vertical surfaces such as cliffs or bluffs "3," and wholly or partially excavated sites set in vertical surfaces "4."

Column K—Flaked Stone: A value of "0" means that no flaked stone (debitage, cores, tools) was recorded. Sites with flaked stone are coded as "1."

Column L—Ceramics: A value of "0" means no ceramics were recorded. Sites with ceramics are coded as "1."

Column M—Groundstone: A value of "0" means no groundstone was recorded. Sites with groundstone are coded as "1."

Column N—Dwellings: Features that are generally identified as dwellings are identified in this column using values from the Arizona State Museum Keyword List.

Column O—Assorted Rock Features: A variety of rock features ranging from rockpiles and bedrock mortars to petroglyphs are identified in this column using values from the Arizona State Museum Feature Names Keyword List.

Column P, Q, R—Assorted Features: Several feature types are included in these columns. There is no significance in the order of listed features. Values are from the Arizona State Museum Feature Names Keyword List. Features are entered in numeric order with the lowest going into the first of the three columns (P).

Site No.	UTM E	UTM N	MASL	Owner	Cult.	Phase	sq.m.	Use	Su/Ex	Flake	Ceram	GS	Dwell	Rock	Asst	Asst	Asst
NEWMEX.																	
LA00498	706340	3511400	1460	1	33	11	15000	0	1	1	1	1	0	0	30	0	
LA00498	706340	3511400	1460	1	34	2	15000	19	1	1	1	1	65	0	30	0	
LA00498	706340	3511400	1460	1	34	10	15000	19	1	1	1	1	65	0	0	0	
LA00593	692200	3489500	1649	10	34	2	3500	19	1	1	1	1	65	43	0	0	
LA01369	697870	3476610	1602	1	34	2	20000	19	2	1	1	1	94	79	30	0	
LA01369	697870	3476610	1602	1	34	10	20000	19	2	1	1	1	94	79	0	0	
LA02469	697260	3477430	1601	9	24	0	0	0	1	1	1	0	0	0	0	0	
LA02469	697260	3477430	1601	9	25	0	0	0	1	1	1	0	0	0	0	0	
LA04979	701080	3490280	1557	1	34	2	12000	19	2	1	1	1	65	79	30	0	
LA04979	701080	3490280	1557	1	34	10	12000	0	2	1	1	1	0	0	0	0	
LA04980	701560	3495100	1533	1	34	2	6000	19	2	1	1	1	94	43	0	0	
LA04980	701560	3495100	1533	1	34	10	6000	19	2	1	1	0	94	43	0	0	
LA05689	743880	3484840	1494	8,9	34	2	1370	19	4	1	1	1	0	0	12	99	116
LA05690	752982	3483006	1577	9	29	7	150	19	4	0	1	0	0	77	0	116	
LA05691	752946	3482890	1585	9	29	7	70	19	4	1	1	1	0	89	7	60	
LA05691	752946	3482890	1585	9	30	7	70	19	4	1	1	1	0	0	60	0	
LA05691	752946	3482890	1585	9	31	7	70	19	4	1	1	1	0	0	60	0	
LA05692	747059	3482798	1501	1	65	0	12	0	3	1	1	0	0	0	0	0	
LA05692	747059	3482798	1501	1	53	1	12	0	3	0	0	0	0	43	111	0	
LA05693	747698	3483364	1554	1	25	6	8	19	3	0	1	0	0	0	0	0	
LA05694	747719	3480051	1554	1	62	0	27800	0	1	1	0	1	0	0	0	0	
LA05695	752819	3480407	1707	1	64	0	1375	0	1	1	0	0	0	0	0	0	
LA05696	752714	3478988	1654	1	65	0	1860	0	1	1	1	0	0	0	0	0	
LA05697	752729	3477239	1623	1	31	7	1060	0	1	1	1	0	0	0	0	0	
LA05698	756320	3475600	1500	1	64	0	186050	0	1	1	0	0	0	0	0	0	
LA05698	756320	3475600	1500	1	34	2	186050	19	1	1	1	1	94	0	0	0	
LA05698	756320	3475600	1500	1	34	10	186050	19	1	1	1	1	94	0	0	0	
LA05699	756209	3475844	1501	1	65	0	20	0	3	1	1	0	0	0	0	0	
LA05700	757127	3475432	1501	1	53	3	10	19	3	0	0	0	114	0	111	0	
LA05701	755130	3480001	1501	1	65	0	150	0	3	0	1	0	0	0	116	0	
LA05702	752988	3481945	1638	1	29	7	50	0	3	1	1	0	0	0	0	0	
LA05703	753123	3481798	1661	1	29	7	90	19	3	1	1	0	0	0	0	0	
LA05704	752828	3483206	1646	1	64	0	70	19	3	0	0	1	0	77	7	0	
LA05705	752722	3483097	1676	1	29	7	50	19	3	1	1	0	0	0	0	0	

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Site No.	UTM E	UTM N	MASL	Owner	Cult.	Phase	sq.m.	Use	Su/Ex	Flake	Ceram	GS	Dwell	Rock	Asst	Asst	Asst
LA11823	722300	3477780	1527	1	34	10	30000	19	2	1	1	1	65	79	4	12	
LA11823	722300	3477780	1527	1	34	2	30000	19	2	1	1	1	65	79	12	0	
LA11823	722300	3477780	1527	1	59	1	30000	19	2	0	0	0	46	0	0	0	
LA12129	701800	3490745	1573	12	32	0	7800	0	2	0	1	0	0	0	30	0	
LA12129	701800	3490745	1573	12	33	7	7800	19	2	0	1	0	65	0	0	0	
LA13199	734360	3533919	1394	9	65	0	750	0	1	1	1	0	0	0	0	0	
LA13200	720682	3539291	1410	9	64	0	300	0	3	0	0	0	118	0	0	0	
LA13201	739330	3513560	1317	9	10	0	3000	0	1	1	0	1	0	0	0	0	
LA13202	727477	3489240	1463	9	30	7	7500	0	1	1	1	0	0	0	0	0	
LA13203	727779	3488233	1334	9	10	0	750	0	1	1	0	0	0	0	0	0	
LA13204	728108	3489856	1475	9	64	0	300	0	1	0	0	0	0	0	0	0	
LA13205	728075	3490612	1467	1	65	0	3000	0	1	1	1	0	0	0	0	0	
LA13206	730184	3494110	1448	1	60	1	300	10	1	1	1	0	0	0	0	0	
LA13207	733520	3537358	1376	9	65	0	300	0	1	1	1	0	0	0	0	0	
LA20137	752778	3535714	1372	1	60	1	300	10	1	0	0	0	0	0	0	0	
LA20138	753020	3534010	1376	1	60	1	300	0	1	0	0	0	0	0	0	0	
LA20139	753446	3532209	1387	9	60	1	300	10	1	0	0	0	0	0	0	0	
LA20140	747600	3517348	1325	8	60	1	12	10	1	0	0	0	0	0	66	0	
LA20141	742904	3512314	1316	8	29	7	7500	0	1	1	1	1	0	43	0	0	
LA25970	693032	3511778	1847	9	62	0	12	19	0	0	0	0	65	0	0	0	
LA25971	693341	3511496	1802	9	62	0	12	0	1	0	0	0	0	0	112	0	
LA25972	694828	3510490	1680	9	62	0	3000	0	1	1	0	0	0	0	0	0	
LA25973	698369	3509185	1656	9	62	0	3000	19	0	1	0	0	67	0	0	0	
LA25973	698369	3509185	1656	9	62	0	3000	0	0	1	0	0	0	0	0	0	
LA29349	736630	3540230	1410	8	10	0	30000	0	1	1	0	0	0	0	0	0	
LA29349	736630	3540230	1410	8	23	6	30000	0	1	1	1	0	0	0	0	0	
LA29349	736630	3540230	1410	8	53	0	30000	10	1	0	0	0	0	0	66	0	
LA29350	726868	3530343	2224	8	64	0	30000	0	1	1	1	0	0	0	0	0	
LA31050	728360	3473215	1466	1	34	2	30000	19	2	1	1	1	65	79	0	0	
LA31050	728360	3473215	1466	1	34	10	30000	19	2	1	1	1	65	79	0	0	
LA34392	726064	3539695	1314	1	59	0	3000	19	1	0	0	0	67	90	66	0	
LA34393	736200	3540498	1384	1	64	0	30000	0	1	1	0	0	0	0	0	0	
LA34394	743130	3538290	1433	9	64	0	7500	0	1	1	0	0	0	0	0	0	
LA34395	751720	3534620	1362	1	59	0	750	19	1	0	0	0	67	0	66	0	
LA34907	709028	3522107	1424	1	31	0	3000	0	0	1	0	0	0	0	0	0	

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Site No.	UTM E	UTM N	MASL	Owner	Cult.	Phase	sq.m.	Use	Su/Ex	Flake	Ceram	GS	Dwell	Rock	Asst	Asst	Asst
LA34908	710156	3522384	1412	1	62	0	30000	0	0	1	0	0	0	43	0	0	
LA37397	715900	3525280	1494	9	64	0	30000	19	1	1	0	0	0	0	0	0	
LA37665	706748	3500136	1612	9	62	0	30000	0	0	1	0	0	0	0	0	0	
LA38041	692857	3541378	1496	9	62	0	300	0	1	1	0	0	0	0	0	0	
LA38051	753600	3517533	1387	8	62	0	300	0	1	1	1	0	0	0	0	0	
LA38057	705720	3537033	1340	9	58	15	300	10	1	0	0	0	0	0	33	0	
LA38057	705720	3537033	1340	9	59	14	300	10	1	0	0	0	0	0	33	0	
LA38449	734413	3487513	1372	13	27	7	30000	0	1	1	1	0	0	0	0	0	
LA38450	735890	3491330	1359	13	31	7	30000	0	1	1	0	0	0	0	0	0	
LA38450	735890	3491330	1359	13	59	0	30000	0	1	0	0	0	0	93	90	113	
LA38451	737259	3494291	1353	13	27	7	30000	0	1	0	0	0	0	119	0	0	
LA38452	736947	3493927	1353	13	27	7	3000	5	1	1	1	0	0	0	0	0	
LA49989	739840	3524100	1707	9	58	1	30000	5	1	0	0	0	0	62	0	0	
LA50085	742660	3533620	1481	1	58	1	?	5	1	0	0	0	0	62	41	0	
LA50093	720710	3502900	1585	1	58	1	?	5	1	0	0	0	0	62	0	0	
LA50162	756280	3541440	1442	9	27	7	30000	0	1	1	1	0	0	0	0	0	
LA50162	756280	3541440	1442	9	28	7	30000	0	1	1	1	0	0	0	0	0	
LA54015	690820	3481280	1662	12	34	2	300	19	1	1	1	0	67	0	0	0	
LA54016	691900	3480330	1650	12	62	0	4000	0	1	1	0	1	0	0	0	0	
LA54016	691900	3480330	1650	12	35	0	4000	0	1	1	1	1	0	0	0	0	
LA54017	705800	3507620	1484	12	62	0	5600	0	1	1	0	1	0	0	0	0	
LA54017	705800	3507620	1484	12	35	0	5600	0	1	1	1	1	0	0	0	0	
LA54018	701320	3493420	1545	12	33	0	4050	0	1	1	1	1	0	0	0	0	
LA54018	701320	3493420	1545	12	34	2	4050	0	1	1	1	1	0	0	0	0	
LA54019	692510	3479640	1635	10	62	0	1500	0	1	1	0	0	0	0	0	0	
LA54020	701540	3494780	1542	1	32	11	7700	19	1	1	1	1	65	0	30	0	
LA54020	701540	3494780	1542	1	34	2	7700	19	1	1	1	1	65	0	30	0	
LA54021	711640	3506550	1530	1	34	2	20000	19	1	1	1	1	94	0	0	0	
LA54022	692340	3479860	1644	10	62	0	7500	0	1	1	0	0	0	0	0	0	
LA54022	692340	3479860	1644	10	32	11	7500	0	1	1	1	0	0	0	0	0	
LA54022	692340	3479860	1644	10	34	2	7500	0	1	1	1	0	0	0	0	0	
LA54023	693810	3478805	1612	1	62	0	400	0	1	1	0	0	0	0	0	0	
LA54024	693880	3478790	1612	1	62	0	300	0	1	1	0	0	0	0	0	0	
LA54024	693880	3478790	1612	1	34	2	300	0	1	1	1	0	0	0	0	0	
LA54025	701770	3497750	1527	1	62	0	2000	0	1	1	0	0	0	0	0	0	

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Site No.	UTM E	UTM N	MASL	Owner	Cult.	Phase	sq.m.	Use	Su/Ex	Flake	Ceram	GS	Dwell	Rock	Asst	Asst	Asst
LA54026	691745	3480160	1655	1	28	7	53000	19	2	1	1	1	0	0	30	0	
LA54026	691745	3480160	1655	1	34	2	53000	19	2	1	1	1	94	0	0	0	
LA54026	691745	3480160	1655	1	34	10	53000	0	2	1	1	1	0	0	0	0	
LA54027	705290	3510030	1486	1	62	0	900	0	1	1	0	0	0	0	0	0	
LA54028	702460	3497140	1527	1	29	7	2000	19	1	1	1	1	65	90	30	0	
LA54028	702460	3497140	1527	1	34	2	2000	19	1	1	1	1	94	90	0	0	
LA54028	702460	3497140	1527	1	34	2	2000	19	1	1	1	1	65	90	0	0	
LA54029	704420	3501240	1519	1	34	2	7500	19	1	1	1	1	94	90	0	0	
LA54029	704420	3501240	1519	1	34	2	7500	19	1	1	1	1	67	90	0	0	
LA54030	696160	3483685	1627	10	62	0	8000	0	1	1	0	0	0	0	0	0	
LA54031	714425	3506900	1558	1	62	0	30000	0	1	1	0	0	0	0	0	0	
LA54031	714425	3506900	1558	1	34	2	30000	19	1	1	1	1	94	90	0	0	
LA54032	701620	3494660	1545	1	62	0	2500	0	1	1	0	0	0	0	0	0	
LA54032	701620	3494660	1545	1	35	0	2500	0	1	1	1	0	0	0	0	0	
LA54033	712140	3505820	1542	1	34	2	20000	19	2	1	1	1	94	0	0	2	
LA54033	712140	3505820	1542	1	34	10	20000	19	2	1	1	1	94	0	20	0	
LA54034	693100	3479150	1621	1	34	2	32500	19	1	1	1	1	65	43	0	0	
LA54035	693030	3479150	1628	10	62	0	39000	0	1	1	0	0	0	0	0	0	
LA54036	692200	3480000	1643	10	62	0	23000	0	1	1	0	1	0	0	0	0	
LA54036	692200	3480000	1643	10	33	11	23000	0	1	1	1	1	0	0	30	0	
LA54036	692200	3480000	1643	10	34	7	23000	0	1	1	1	1	0	90	0	0	
LA54037	692120	3480130	1643	10	32	11	4200	0	1	1	1	1	0	0	30	0	
LA54038	729425	3486080	1411	8	34	2	30000	19	1	1	1	1	94	0	60	0	
LA54038	729425	3486080	1411	8	34	10	30000	19	1	1	1	1	94	0	60	0	
LA54039	712750	3503220	1576	1	34	2	15000	19	1	1	1	1	65	0	20	0	
LA54039	712750	3503220	1576	1	34	10	15000	19	1	1	1	1	65	0	0	0	
LA54040	708030	3521360	1431	9	31	7	9000	0	1	1	1	1	0	0	0	0	
LA54041	706125	3510900	1479	1	62	0	1200	0	1	1	0	0	0	0	0	0	
LA54042	726720	3486500	1454	8	62	0	7500	0	1	1	0	0	0	0	0	0	
LA54042	726720	3486500	1454	8	34	2	7500	19	1	1	1	1	94	90	0	0	
LA54042	726720	3486500	1454	8	34	10	7500	19	1	1	1	1	94	90	0	0	
LA54043	727850	3525660	1314	12	62	0	30000	0	1	1	0	1	0	43	0	0	
LA54043	727850	3525660	1314	12	31	7	30000	0	1	1	1	1	0	43	0	0	
LA54044	712910	3502940	1580	1	32	11	7000	0	1	1	1	0	0	0	0	0	
LA54045	707880	3517080	1432	1	32	11	53000	19	1	1	1	1	78	0	0	0	

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Site No.	UTM E	UTM N	MASL	Owner	Cult.	Phase	sq.m.	Use	Su/Ex	Flake	Ceram	GS	Dwell	Rock	Asst	Asst	Asst
LA54046	701700	3497850	1534	1	62	0	1300	5	1	1	0	0	0	83	0	0	
LA54047	701470	3497850	1544	1	62	0	2500	5	1	1	0	0	0	83	0	0	
LA54048	732000	3486465	1384	1	34	2	30000	19	1	1	1	1	94	116	0	0	
LA54048	732000	3486465	1384	1	34	10	30000	19	1	1	1	1	94	116	0	0	
LA54049	730660	3486180	1396	8	62	0	30000	0	1	1	0	0	0	90	0	0	
LA54049	730660	3486180	1396	8	34	2	30000	19	1	1	1	0	0	90	0	0	
LA54050	731080	3486060	1393	1	62	0	30000	0	1	1	0	0	0	0	0	0	
LA54050	731080	3486060	1393	1	34	2	30000	1	19	1	1	1	94	90	0	0	
LA54051	726200	3483960	1449	1	62	0	30000	0	1	1	0	0	0	0	0	0	
LA54051	726200	3483960	1449	1	34	2	30000	19	1	1	1	1	94	90	119	0	
LA54053	744340	3481140	1457	1	62	0	30000	0	1	1	0	0	0	0	0	0	
LA54053	744340	3481140	1457	1	29	7	30000	19	1	1	1	1	78	0	0	0	
LA54053	744340	3481140	1457	1	34	2	30000	19	1	1	1	1	94	79	60	0	
LA54054	706380	3509760	1473	1	62	0	4500	0	1	1	0	0	0	0	0	0	
LA54055	706095	3509100	1479	1	62	0	2500	0	1	1	0	0	0	0	0	0	
LA54056	705920	3508140	1477	1	62	0	2500	0	1	1	0	0	0	0	0	0	
LA54057	704400	3501340	1521	1	62	0	2500	0	1	1	0	1	0	0	0	0	
LA54058	701580	3498420	1530	1	62	0	750	0	1	1	0	0	0	0	0	0	
LA54059	701590	397600	1534	1	62	0	2500	0	1	1	0	0	0	0	0	0	
LA54060	701450	3497550	1540	1	62	0	3000	0	1	1	0	0	0	0	0	0	
LA54061	701360	3497400	1533	1	62	0	3600	0	1	1	0	0	0	0	0	0	
LA54062	701280	3497800	1534	1	62	0	1500	0	1	1	0	0	0	0	0	0	
LA54063	701550	3496730	1560	1	62	0	1500	0	1	1	0	0	0	0	0	0	
LA54064	701830	3494620	1560	1	62	0	1500	0	1	1	0	0	0	0	0	0	
LA54065	701420	3494620	1559	1	62	0	1200	0	1	1	0	1	0	0	0	0	
LA54066	701340	3493700	1542	1	62	0	1200	0	1	1	0	0	0	0	0	0	
LA54066	701340	3493700	1530	1	62	0	30000	0	1	1	0	0	0	0	0	0	
LA54067	702810	3498110	1527	1	62	0	90000	0	1	1	0	0	0	0	0	0	
LA54273	745600	3484800	1430	9	64	0	300	6	1	0	0	1	0	0	7	0	
LA54954	744140	3503060	1439	9	31	7	300	5	1	0	1	0	0	89	119	0	
LA55873	737700	3533300	1536	9	64	0	300	0	1	1	0	0	0	0	0	0	
LA59936	692325	3489640	1649	10	53	0	0	0	1	0	0	0	0	0	0	0	
LA59937	692455	3489430	1649	10	31	7	3000	19	1	1	1	0	78	0	0	0	
LA59938	694495	3474310	1641	10	31	7	30000	0	1	1	1	0	0	0	111	0	
LA59939	694315	3474485	1649	10	62	0	3000	0	1	1	0	1	0	0	0	0	

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Site No.	UTM E	UTM N	MASL	Owner	Cult.	Phase	sq.m.	Use	Su/Ex	Flake	Ceram	GS	Dwell	Rock	Asst	Asst	Asst
LA59940	694270	3474710	1649	10	62	0	750	0	1	1	0	0	0	0	0	0	
LA59941	694595	3474595	1641	10	62	0	750	0	1	0	0	0	0	0	30	0	
LA59942	694700	3473980	1634	10	62	0	3000	0	1	1	0	0	0	0	0	0	
LA59943	695795	3473810	1626	10	62	0	72000	5	1	1	0	0	0	0	0	0	
LA59944	695245	3473800	1649	10	62	0	0	0	1	1	0	1	0	0	0	0	
LA59945	688850	3488850	1710	10	31	7	30000	0	1	1	1	1	0	0	0	0	
LA59946	688250	3488275	1710	10	65	0	30000	0	1	1	1	1	0	0	0	0	
LA59948	0	0	1466	10	62	0	0	0	1	1	0	0	0	0	0	0	
LA59949	0	0	1234	10	62	0	0	19	3	0	0	0	118	0	0	0	
LA59972	744350	3503060	1463	9	65	0	62	0	1	0	1	0	0	0	0	0	
LA61947	696280	3479300	1655	10	10	0	30000	0	1	1	0	0	0	0	0	0	
LA67961	686600	3524200	1258	1	60	1	30000	10	1	0	0	0	0	0	33	0	
LA67962	686705	3524321	1259	1	59	1	3000	19	1	0	0	0	47	0	33	84	
LA68028	686580	3525746	1253	1	59	1	30000	19	1	0	0	0	47	0	33	115	
LA71697	691000	3527160	1484	1	31	7	0	13	3	1	0	0	0	77	0	0	
LA71698	701640	3493400	1539	1	62	0	30000	13	3	0	0	0	0	77	0	0	
LA72893	720480	3498320	1798	9	9	0	30000	0	1	1	0	1	0	0	0	0	
LA72893	720480	3498320	1798	9	58	1	30000	19	1	0	0	0	46	0	88	0	
LA73401	692000	3469000	1282	9	58	15	30000	8	1	0	0	0	0	0	88	0	
LA75393	687450	3533160	1246	1	31	7	12	19	1	0	1	0	67	90	0	0	
LA75394	689850	3534080	1270	9	0	0	62	0	1	0	0	0	0	90	0	0	
LA75459	713680	3504440	1585	1	31	7	12	10	1	1	0	0	0	0	60	0	
LA77494	689075	3495800	1527	10	58	15	0	19	1	0	0	0	61	0	112	115	
LA78437	748100	3542980	1370	9	58	1	7500	0	1	0	0	0	0	0	0	0	
LA79732	695600	3474680	1624	10	31	0	0	0	1	1	1	1	0	0	66	0	
LA79733	695790	3474270	1624	10	62	0	0	0	1	1	0	1	0	0	0	0	
LA79734	696050	3473770	1612	10	31	0	0	0	1	1	1	1	0	0	0	0	
LA80525	691030	3515690	1649	9	31	7	62	20	1	0	0	0	0	89	0	0	
LA84973	686910	3539770	1221	1	28	7	30000	19	1	0	0	0	78	90	60	0	
LA86866	687140	3496140	1490	10	63	0	62	6	1	0	0	0	0	0	112	0	
LA86955	696100	3474140	1624	10	10	0	3000	0	1	1	0	0	0	0	0	0	
LA86956	695440	3474920	1637	10	65	0	7500	0	1	1	1	0	0	0	0	0	
LA88357	716780	3537760	1373	8	58	1	13750	5	1	0	0	0	0	62	35	105	112
LA89142	725560	3522780	1356	9	57	15	?	0	1	0	0	0	0	0	0	0	
LA89345	691620	3532670	1296	9	58	15	3000	10	1	0	0	0	0	0	0	33	

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Site No.	UTM E	UTM N	MASL	Owner	Cult.	Phase	sq.m.	Use	Su/Ex	Flake	Ceram	GS	Dwell	Rock	Asst	Asst	Asst
LA101502	689320	3492890	1637	10	62	0	750	0	1	1	0	0	0	0	0	0	
LA104052	738090	3523330	1478	9	59	1	5400	5	1	0	0	0	0	62	15	30	
LA104599	688320	3472600	1460	1	34	2	2100	0	1	1	1	0	0	0	0	0	
LA104600	685800	3470150	1368		62	0	5000	0	1	1	0	0	0	0	0	0	
LA104601	685680	3471200	1411		0	0	400	0	1	1	0	0	0	0	0	0	
LA104602	686700	3472000	1380		8	8	20000	0	1	1	0	0	0	0	0	0	
LA104602	686700	3472000	1380		34	2	20000	0	1	0	1	0	0	0	0	0	
LA104603	686060	3470740	1380		0	0	200	0	1	1	0	0	0	0	0	0	
LA104604	685720	3470060	1331		34	2	200	19	3	1	1	1	118	0	0	0	
USFS358	695380	3478870	1634	10	66	0	0	0	1	1	1	0	0	0	0	0	
USFS359	694640	3475660	1646	10	62	0	0	0	1	1	0	0	0	0	0	0	
ARIZONA																	
FF:04:01	680784	3534503	1335	1	66	0	0	0	1	1	1	1	0	0	0	0	
FF:04:02	679805	3533805	1353	9	66	0	0	19	1	1	1	1	78	43	12	0	
FF:04:17	683100	3517500	1280	1	34	2	0	19	1	1	1	1	94	0	12	0	
FF:07:07	661040	3488470	1378	1	34	2	60	0	1	1	1	0	0	0	0	0	
FF:07:08	661200	3488650	1384	1	64	0	600	0	1	1	1	1	0	0	0	0	
FF:07:09	660870	3488870	1292	1	28	13	4550	0	1	1	1	1	0	0	0	0	
FF:07:10	660570	3487850	1372	1	34	2	24,000	19	1	1	1	1	65	93	0	0	
FF:07:13	661000	3487900	1372	1	34	0	8100	19	1	1	1	1	94	0	0	0	
FF:07:18	660500	3487900	1366	1	0	0	0	19	2	1	1	1	94	0	0	0	
FF:08:02	671322	3500742	1426	7	10	0	0	0	1	1	0	0	0	0	0	0	
FF:08:02	671322	3500742	1426	7	31	7	0	0	1	0	1	0	0	119	0	0	
FF:08:03	674150	3492500	1351	7	10	0	0	0	1	1	0	0	0	0	0	0	
FF:08:04	674400	3491200	1414	7	66	0	150000	0	1	1	1	1	0	0	0	0	
FF:08:05	674950	3491250	1390	7	59	14	30	6	1	0	0	0	0	0	112	0	
FF:08:06	678325	3492350	1509	7	62	0	300	13	3	0	0	1	0	76	0	0	
FF:08:07	683260	3499800	1402	1	62	0	10	13	3	0	0	0	0	76	0	0	
FF:08:08	670500	3486900	1326	7	66	0	3000	13	3	1	1	1	0	76	0	0	
FF:08:14	684100	3497800	1585		62	0	10	13	3	0	0	0	0	76	0	0	
FF:08:15	671150	3500940	1426	7	59	14	120	8	1	0	0	0	0	0	84	0	
FF:08:16	667000	3496500	1424	7	62	0	8000	0	1	1	0	0	0	0	0	0	
FF:08:16	667000	3496500	1424	7	60	9	8000	19	1	0	0	0	47	0	0	0	
FF:08:17	681100	3501020	1378	7	62	0	7000	0	1	1	0	1	0	0	0	0	
FF:08:18	680900	3501100	1372	7	62	0	3800	0	1	1	0	1	0	0	0	0	

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Site No.	UTM E	UTM N	MASL	Owner	Cult.	Phase	sq.m.	Use	Su/Ex	Flake	Ceram	GS	Dwell	Rock	Asst	Asst	Asst
FF:08:19	680725	3501600	1372	7	62	0	900	0	1	1	0	0	0	0	0	0	
FF:08:20	no card																
FF:08:21	678400	3509760	1314	5	66	0	29000	0	1	1	1	0	0	0	0	0	
FF:11:02	664000	3468150	1158	6	58	15	0	16	1	0	0	0	67	0	33	0	
FF:11:03	666200	3470000	1158	6	65	0	0	16	1	1	1	1	67	0	33	0	
FF:11:04	664195	3468280	1158	6	58	15	40000	10	1	0	0	0	0	43	0	0	
FF:11:05	666120	3470050	1158	6	65	0	2000	10	1	1	1	0	0	91	33	0	
FF:11:06	665250	3470200	1158	6	66	0	8	0	1	0	1	0	0	0	0	0	
FF:11:07	664850	3468900	1158	6	62	0	8300	0	1	1	0	1	0	0	0	0	
FF:11:08	664800	3468700	1158	6	65	0	3500	0	1	1	1	0	0	0	0	0	
FF:11:09	664700	3468200	1158	6	62	0	900	0	1	1	0	0	0	119	0	0	
FF:11:10	664600	3468350	1158	6	62	0	400	0	1	1	0	0	0	0	0	0	
FF:11:11	664900	3468250	1158	6	53	0	200	19	1	0	0	0	22	0	33	0	
FF:11:12	665690	3469020	1158	6	65	0	500	0	1	1	1	0	0	43	0	0	
FF:11:13	664500	3467850	1158	6	65	0	0	0	1	1	1	0	0	0	0	0	
FF:11:14	664650	3467750	1158	6	53	0	2500	19	1	0	1	0	47	0	33	0	
FF:11:15	664500	3468050	1158	6	65	0	10	0	1	1	1	0	0	0	0	0	
FF:11:16	663750	3468000	1158	6	59	15	8100000	19	1	0	0	0	47	0	116	0	
FF:11:17	665000	3470500	1158	1	62	0	500	20	2	1	0	1	0	0	7	12	
FF:11:18	663295	3472780	1195	1	9	12	5000	0	1	1	0	1	0	43	0	0	
FF:11:21	665130	3470175	1159	1	34	2	0	19	2	1	1	1	94	0	29	0	
FF:11:22	642950	3469100	1273	3	59	14	18000	10	1	0	0	0	0	0	33	0	
FF:11:23	663550	3467700	1158	9	62	0	16000	0	1	1	0	1	0	0	0	0	
FF:11:24	660450	3480650	1280	7	62	0	40	0	1	1	0	0	0	0	0	0	
FF:11:25	660150	3484200	1280	7	66	0	2	0	1	0	1	0	0	0	0	0	
FF:11:26	656250	3483400	1347	7	62	0	5	20	1	1	0	0	0	0	7	0	
FF:11:27	655350	3483700	1341	7	66	0	10000	0	1	1	1	1	0	0	0	0	
FF:11:28	656200	3483700	1341	7	66	0	1800	0	1	1	1	0	0	0	0	0	
FF:11:29	664850	3470150	1158		9	0	8000	0	1	1	0	1	0	0	0	0	
FF:11:29	664850	3470150	1158		65	0	8000	0	1	0	1	1	0	0	0	0	
FF:11:30	666010	3469830	1158	11	9	0	7500	0	1	1	0	1	0	0	0	0	
FF:11:30	666010	3469830	1158	11	65	0	7500	0	1	0	1	1	0	0	0	0	
FF:11:31	666100	3469600	1146	11	10	0	2500	0	1	1	0	1	0	0	0	0	
FF:11:32	665800	3469520	1146	11	34	2	10000	19	1	1	1	0	94	79	12	0	
FF:11:33	665400	347000	1146	11	63	0	1250	20	1	0	0	0	0	0	116	0	

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Site No.	UTM E	UTM N	MASL	Owner	Cult.	Phase	sq.m.	Use	Su/Ex	Flake	Ceram	GS	Dwell	Rock	Asst	Asst	Asst
FF:11:34	665600	3469200	1146	11	10	0	800	0	1	1	0	0	0	0	0	0	
FF:11:34	665600	3469200	1146	11	65	0	800	0	1	1	1	0	0	0	111	0	
FF:11:35	666000	3469675	1146	11	10	0	100	0	1	1	0	0	0	0	0	0	
FF:11:36	665700	3469650	1146	11	10	0	1800	0	1	1	0	1	0	0	0	0	
FF:11:37	664600	3469200	1158	11	34	2	10000	0	1	1	1	1	0	0	0	0	
FF:11:38	664500	3469900	1158	11	62	0	1320	0	1	1	0	1	0	0	0	0	
FF:11:39	663350	3468450	1158	11	63	0	280	10	1	0	0	0	0	0	33	0	
FF:11:40	663650	3468950	1158	11	62	0	80	0	1	1	0	0	0	0	0	0	
FF:11:40	663650	3468950	1158	11	63	0	80	0	1	0	0	0	0	91	0	0	
FF:11:41	664600	3469775	1158	11	62	0	975	0	1	1	0	0	0	0	0	0	
FF:11:42	664900	3468500	1158	11	34	2	16700	0	1	1	1	1	0	0	0	0	
FF:11:43	664925	3468500	1146	11	59	14	2025	17	1	0	0	0	0	0	19	0	
FF:11:44	664450	3468375	1146	11	58	15	1350	10	1	0	0	0	0	90	33	0	
FF:11:45	664450	3468450	1146	11	34	2	45000	0	1	1	1	1	0	0	0	0	
FF:11:46	664850	3469525	1146	11	62	0	2450	0	1	1	0	1	0	0	0	0	
FF:11:47	664675	3468950	1146	11	10	0	1500	0	1	1	0	1	0	0	0	0	
FF:11:48	664925	3467800	1146	11	62	0	20000	0	1	1	0	1	0	0	0	0	
FF:11:49	665650	3469175	1146	11	62	0	30000	0	1	1	0	1	0	0	0	0	
FF:11:50	657050	3472775	1244	7	62	0	120	0	1	1	0	0	0	0	0	0	
FF:11:51	656975	3472750	1244	7	62	0	20	0	1	1	0	0	0	0	0	0	
FF:11:52	657075	3473700	1256	7	62	0	20	0	1	1	0	0	0	0	0	0	
FF:11:53	656600	3473900	1268	7	62	0	35	0	1	1	0	0	0	0	0	0	
FF:11:54	665500	3471550	1170	2	62	0	1690	0	1	1	0	1	0	0	0	0	
FF:11:55	665475	3471025	1158	7	34	2	1000	0	1	1	1	1	0	0	0	0	
FF:11:56	665200	3470975	1170	1	34	2	450	10	1	1	1	1	0	0	97	0	
FF:11:57	660890	3480000	1305	7	65	0	540	13	3	1	1	0	0	77	0	0	
FF:11:58	648000	3483750	1402	1	31	0	0	0	1	1	1	0	0	0	2	0	
FF:11:59	661350	3468250	1158	1	65	0	80000	0	1	1	1	0	0	0	0	0	
FF:11:60	645000	3475500	1326	7	65	0	202350	0	1	1	1	1	0	0	0	0	
FF:11:61	644800	3475700	1326	7	65	0	1020000	0	1	1	1	0	0	0	0	0	
FF:11:62	645800	3475000	1341	7	65	0	0	0	1	1	1	1	0	0	0	0	
FF:11:69	643510	3478370	1286	4	59	14	121000	19	1	0	0	0	46	0	5	115	
FF:11:70	643650	3478240	1286	5	59	14	42300	8	1	0	0	0	0	0	33	84	
FF:11:71	644220	3477680	1317	7	61	0	4200	8	1	0	0	0	0	92	19	0	
FF:11:72	646730	3477570	1366	7	65	0	4000	0	1	1	1	0	0	0	0	0	

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Site No.	UTM E	UTM N	MASL	Owner	Cult.	Phase	sq.m.	Use	Su/Ex	Flake	Ceram	GS	Dwell	Rock	Asst	Asst	Asst
FF:11:73	650900	3477500	1372	4	62	0	10300	20	1	1	0	1	0	0	7	0	
FF:11:74	654140	3475490	1289	4	62	0	3500	0	1	1	0	0	0	0	0	0	
FF:11:75	651530	3476730	1348	4	10	0	2400	0	1	1	0	0	0	0	0	0	
FF:11:76	655100	3471780	1280	4	65	0	14000	0	1	1	1	0	0	0	0	0	
FF:11:77	655200	3470690	1280	4	62	0	1200	0	1	1	0	0	0	0	0	0	
FF:11:78	652670	3476380	1323	4	62	0	2500	0	1	1	0	1	0	15	0	0	
FF:11:79	653210	3475870	1328	4	10	0	8000	0	1	1	0	0	0	0	0	0	
FF:11:80	653750	3475500	1345	4	66	0	2500	0	1	1	1	0	0	0	0	0	
FF:12:02	678700	3407650	1487	7	62	0	650	5	1	1	0	0	0	0	0	0	
FF:12:03	678200	3484650	1414	7	31	7	10000	0	1	1	1	1	0	0	0	0	
FF:12:04	678450	3484750	1439	7	34	2	10000	20	1	1	1	1	0	0	7	0	
FF:12:05	677950	3484850	1414	7	66	0	24000	0	1	1	1	0	0	0	0	0	
FF:12:06	681700	3469300	1341	7	62	0	400	0	1	1	0	0	0	0	0	0	
FF:12:07	681300	3469350	1353	7	66	0	450	0	1	1	0	0	0	0	0	0	
FF:12:08	681400	3468450	1317	7	62	0	2250	5	1	1	0	0	0	0	0	0	
FF:12:09	680300	3469500	1341	7	66	0	10	0	1	1	1	0	0	0	0	0	
FF:12:09	680300	3469500	1341	7	58	15	10	10	1	0	0	0	0	0	33	0	
FF:12:10	681750	3468300	1292	7	66	0	50	0	1	1	1	0	0	0	0	0	
FF:12:11	681400	3468350	1317	7	66	0	7000	0	1	1	1	0	0	0	0	0	
FF:12:12	681350	3468250	1317	7	31	7	5000	0	1	1	1	0	0	0	0	0	
FF:12:13	681950	3468050	1298	1	31	7	1200	0	1	1	1	0	0	0	0	0	
FF:12:13	681950	3468050	1298	1	59	14	1200	6	1	0	0	0	0	0	33	57	
FF:12:14	678700	3484650	1439	7	28	7	1200	0	1	1	1	1	0	0	0	0	
FF:12:15	667400	3468700	1158	11	9	13	40000	0	1	1	0	1	0	92	0	0	
FF:12:15	667400	3468700	1158	11	34	2	40000	0	1	1	1	1	0	92	0	0	
FF:12:16	667175	3468250	1170	11	10	0	400	7	1	1	0	0	0	91	0	0	
FF:12:16	667175	3468250	1170	11	63	0	400	0	1	0	0	0	0	91	0	0	
FF:12:17	667300	3468250	1146	11	64	0	1	0	1	0	0	0	0	0	1	0	
FF:12:18	667550	3468425	1146	11	62	0	10	0	1	1	0	0	0	0	0	0	
FF:12:19	667550	3468400	1146	11	62	0	10	0	1	1	0	0	0	0	1	0	
FF:12:20	667650	3468600	1146	11	64	0	1	0	1	0	0	0	0	43	0	0	
FF:12:21	667850	3468625	1146	11	64	0	20	0	1	0	0	0	0	43	0	0	
FF:12:22	667875	3468850	1146	11	64	0	3	0	1	0	0	0	0	0	1	0	
FF:12:23	685150	3484250	1597	10	10	0	1100	0	1	1	0	0	0	0	0	0	
FF:12:24	666770	3468950	1158	11	34	2	400	0	1	1	1	0	0	0	0	0	

Site No.	UTM E	UTM N	MASL	Owner	Cult.	Phase	sq.m.	Use	Su/Ex	Flake	Ceram	GS	Dwell	Rock	Asst	Asst	Asst
FF:12:25	673400	3468350	1231	7	62	0	10	0	1	1	0	0	0	0	0	0	
FF:12:26	678300	3483750	1463	7	64	0	120	0	1	1	1	0	0	0	0	0	
FF:12:27	678750	3480125	1366	7	64	0	1200	0	1	1	1	1	0	0	0	0	
FF:12:28	670250	3485990	1317	7	62	0	750	13	3	0	0	0	0	76	7	0	
FF:12:29	678750	3480125	1366	7	64	0	420	13	3	0	0	0	0	76	0	0	
FF:12:30	678520	3481790	1396		65	0	10000	0	1	1	1	0	0	0	0	0	
FF:12:31	682150	3468010	1283	1	66	0	14000	20	1	1	1	0	0	89	0	0	
FF:12:32	685460	3472490	1411	9	62	0	3700	0	1	1	0	1	0	0	0	0	
FF:12:33	684780	3469240	1320	9	65	0	500	0	1	1	1	0	0	0	0	0	
FF:12:34	684900	3469150	1317	9	59	14	19000	19	1	0	1	0	47	0	113	115	
FF:12:35	684640	3473360	1420	9	59	14	6000	19	1	0	1	0	47	0	28	39	
FF:12:36	684700	3472880	1384	9	66	0	50000	5	1	1	1	0	0	0	0	0	
FF:12:36	684700	3472880	1384	9	61	0	50000	19	1	0	1	0	47	0	33	0	
FF:12:37	682600	3468150	1292	1	62	0	1000	0	1	1	0	1	0	0	0	0	
FF:12:38	682920	3468650	1292	9	62	0	2000	0	1	1	0	1	0	0	0	0	
FF:12:39	683240	3469000	1295	9	66	0	10000	19	1	1	1	0	67	93	0	0	
FF:12:40	683580	3469200	1308	1	62	0	500	0	1	1	0	0	0	0	0	0	
FF:12:41	683700	3469190	1308	1	62	0	500	0	1	1	0	0	0	0	0	0	
FF:12:42	683840	3469200	1308	9	66	0	500	0	1	1	1	0	0	0	0	0	
FF:12:43	684620	3470420	1326	1	59	14	350	9	1	0	0	0	0	0	105	0	
FF:12:44	684620	3470180	1326	1	62	0	8500	0	1	1	0	0	0	0	0	0	
FF:12:44	684620	3470180	1326	1	59	14	8500	19	1	0	0	0	46	0	28	33	
FF:12:45	679820	3473900	1314	1	62	0	8300	0	1	1	0	0	0	0	0	0	
FF:12:45	679820	3473900	1314	1	59	14	8300	19	1	0	1	0	85	0	33	115	
FF:12:46	684500	3474750	1414	10	62	0	1000	0	1	1	0	0	0	0	0	0	
FF:12:46	684500	3474750	1414	10	59	14	1000	1	1	0	1	0	0	92	90	0	
USFS22	683510	3496160	1463	10	62	0	90000	0	1	1	0	0	0	0	0	0	
USFS23	683290	3496160	1463	10	58	3	0	16	1	0	0	0	0	0	116	0	
USFS24	684770	3496660	1475	10	58	3	0	16	1	0	0	0	0	0	116	0	
USFS46	685000	3496690	1449	10	62	0	1350	0	1	1	0	0	0	0	0	0	

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APPENDIX B.

Archaeological Surveys in the Borderlands Study Area Listed by USGS 7.5-minute Quad

Animas, New Mexico

03-77-2 (BLM)
03-77-22 (BLM)
03-78-8 (BLM)
03-79-34 (BLM)
03-81-48 (BLM)
03-86-65 (BLM)
03-90-50 (BLM)

Animas Peak, New Mexico

03-82-79 (BLM)

Animas Peak NE, New Mexico

03-77-22 (BLM)
03-82-79 (BLM)

Antelope Pass, New Mexico

03-77-3 (BLM)
03-78-8 (BLM)
03-79-22 (BLM)
03-81-48 (BLM)
03-82-66 (BLM)
03-83-12 (BLM)
03-83-60 (BLM)
03-83-68 (BLM)
03-90-25 (BLM)
03-92-100 (BLM)

Clanton Draw, New Mexico

FS-78-30
FS-78-61
FS-78-65
FS-82-13
FS-83-17
FS-84-15
FS-84-106
FS-85-93
FS-88-9
FS-88-34
FS-88-75
FS-88-85
FS-89-02
FS-90-78
FS-91-17
FS-91-71
FS-92-04
FS-93-29

Guadalupe Canyon, Arizona and New Mexico

03-80-17 (BLM)

Guadalupe Springs, Arizona and New Mexico

FS-84-98
FS-85-6
FS-85-83
FS-86-06
FS-87-49
FS-87-99
FS-89-33
FS-89-69
FS-90-44
FS-91-46
FS-91-37
1984-98 (ASM)
1985-102 (ASM)
1985-165 (ASM)
1988-9 (ASM)
1989-23 (ASM)
1990-138 (ASM)

Hachita, New Mexico

03-80-1 (BLM)
03-82-59 (BLM)
03-86-96 (BLM)

Hachita Peak, New Mexico

03-80-1 (BLM)
03-80-13 (BLM)
03-83-56 (BLM)
03-87-7 (BLM)
03-89-11 (BLM)
03-91-93 (BLM)
03-93-94 (BLM)
03-94-84 (BLM)
03-94-88 (BLM)

Hilo Peak, New Mexico

03-83-12 (BLM)

Indian Peak, New Mexico

03-86-59 (BLM)
03-90-17 (BLM)
03-92-89 (BLM)

Mount Baldy, New Mexico

03-90-17 (BLM)
FS-82-13

Playas Lake South, New Mexico

03-83-12 (BLM)

Playas Peak, New Mexico

03-86-96 (BLM)
03-86-108 (BLM)
03-92-136 (BLM)

Skull Canyon, Arizona and New Mexico

03-83-47 (BLM)
FS89-68
FS92-99
FS93-59
1991-002 (ASM)
1994-215 (ASM)

Tank Mountain

03-77-2 (BLM)
03-77-22 (BLM)
03-81-48 (BLM)
03-83-12 (BLM)
03-83-55 (BLM)
03-89-56 (BLM)

Walnut Wells NE

03-80-48 (BLM)
03-89-11 (BLM)

Key to Acronyms:

BLM = USDI. Bureau of Land Management

FS = USDA Forest Service

ASM = Arizona State Museum, University of Arizona

Appendix C.

Concordance of Site Names and Numbers From Different Institutions and Surveys

Site No.	Site Name	Other	Other	Other	Other	Other	Other	Biblio
NEWMEX								
LA00498	Maddox Ranch	A:5:1,3,4(GP)	5 (SB)	76 (B)	12? (KC)	32 (FD)	22 (JRA)	X1, X2, X3
LA00593		46? (FD)	33 (JRA)					X3
LA01369	Pendleton Ruin	1 (FC)	9 (FD)	20 (JRA)				X1, X3
LA04979	Clanton Draw	7, 8, 8? (KC)	A:5:5,6,7(GP)	29HISAR62-1	43 (JRA)			X1, X7
LA 04980	Box Canyon	23 (FD)	8 (JRA)	29HISAR62-2				X3, X7
LA05689	U-Bar Cave	NM-030-2089 BLM						X4
LA05690	Buffalo Cave	NM-030-2090 BLM	CAVE 4 (KC)	HI-3 (SCH)	14 (NMCA)			X4, X1, X5
LA05691	Pinnade Cave	NM-030-2091 BLM	CAVE 6 (KC)	16 (NMCA)				X4, X1
LA05692		NM-030-2092 BLM?	SITE 2 AMB?					x4
LA05693		NM-030-2093 BLM	SITE 3 AMB?					X4
LA05694		NM-030-2094 BLM						X4
LA05695		NM-030-2095 BLM	SITE 5 AMB?					X4
LA05696		NM-030-2096 BLM	SITE 6 AMB?					X4
LA05697		030-2035 (PC)	SITE 7 AMB?					X4
LA 05698	Sycomore Well	MN-030-2098 BLM?	AMBLER #8	HS-41 (JRA)	B (B)			X4
LA05699		MN-030-2099 BLM?						X4
LA05700		NM-030-2100 BLM?	AMBLER #10					X4
LA05701		NM-030-2101 BLM?	AMBLER #11					X4
LA05702		NM-030-2102 BLM?	SITE 12 AMB?					X4
LA05703		NM-030-2103 BLM?	SITE 13 AMB?					X4
LA05704	Picture Cave	NM-030-2104 BLM	CAVE 5 (KC)	HI-4 (SCH)				X4,X5,X1
LA05705	Angry Owl Cave	NM-030-2105 BLM	SITE 17 AMB?					X4
LA11823	Joyce Well	29HISAR62-16 (SAR)	18? (KC)	30 (JRA)				X1, X6
LA12129	Cowboy Site	29HISAR62-5 (SAR)						X7
LA13199		MN-030-990 BLM						
LA13200		MN-030-991 BLM						
LA13201		NM-030-992 BLM	GPU-4 (?)					
LA13202		NM-030-1058 BLM	GPU-5 (?)					
LA13203		NM-030-1059 BLM	GPU-6 (?)					
LA13204		NM-030-1060 BLM	GPU-7 (?)					
LA13205		NM-030-1061 BLM	GPU-8 (?)					
LA13206		NM-030-1062 BLM	GPU-8 (?)					
LA13207		NM-030-1063 BLM						
LA20137		NM-030-4626	NMSU 525					

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Site No.	Site Name	Other	Other	Other	Other	Other	Other	Biblio
LA20138		NM-030-345 (PC)	NMSU 526					
LA20139		NM-030-4625 BLM	NMSU 527					
LA20140		NM-030-4524 BLM	NMSU 528					
LA20141			NMSU 519					
LA25970								
LA25971								
LA25972								
LA25973								
LA29349		29HISAR62-18						
LA31050	Culberson Ruin	29HISAR62-18	29HISAR63-21	A:10:2 (GP)	5 (B)	19 (KC)	28 (JRA)	X1, X3, X7
LA34392		NM-030-3422 (PC)						
LA34393								
LA34394		NM-030-3424 BLM						
LA34395		NM-030-3425 (PC)						
LA34907								
LA34908								
LA37397		NMSU1391						
LA37665		NMSU1206						
LA38041								
LA38051		NM-030-4513 BLM?	NMSU 1246					
LA38057			NMSU1333					
LA38449		81-1 (?)						
LA38450								
LA38451		81-3 (?)						
LA38452								
LA49989	Sylvanite	NM-030-358 BLM						
LA50085	Old Hachita	NM-030-335 BLM						
LA50093	Gillespie	NM-030-351 BLM						
LA50162		NM-030-3665 BLM	ENM-20085					
LA54015		HS-1 (?)						
LA54016		HS-2 (?)						
LA54017		HS-3 (?)						
LA54018		HS-4 (?)						
LA54019		AR-03-05-??						
LA54020	Lunch Box	29HISAR62-10	22? (FD)	7 (JRA)				X3

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Site No.	Site Name	Other	Other	Other	Other	Other	Other	Biblio
LA54021		HS-9 (?)						
LA54022		HS-10 (?)	AR-03-05-??					
LA54023		HS-11 (?)						
LA54024		HS-12 (?)						
LA54025	Flat Site	29HISAR62-9						
LA54026	Fortress/Stewart F	AR-03-05-01-00070	40 (SB)	4 (KC)	1 (FD)	14 (JRA)	HS-14 (?)	X1, X3, X2, X7
LA54027		HS-15 (?)						
LA54028	Hoskins Site	29-HISAR62-3	45? (FD)	16 (JRA)				X3
LA54029	Little Site	29HISAR62-15	72 (FD)	23 (JRA)				X3
LA54030		AR-03-05-?????	HS-18					
LA54031	Pigpen Creek	HS-19 (JRA)						
LA54032		HS-21 (JRA)						
LA54033	Double Adobe Cre	29HISAR62-15	1 (B)	14 (KC)	72 (FD)	23 (JRA)		X1, X3
LA54034	Cloverdale Park	6 (SB)	HS-24 (JRA)	3 (KC)	10 (FD)	77 (B)		X1, X2, X3
LA54035		AR-03-05-?????	HS-25 (JRA)					
LA54036		80 (FD)	HS-26 (JRA)					
LA54037		AR-03-05-?????	HS-27 (JRA)					
LA54038	Timberlake/Walnu	80 (FD)	HS-29 (JRA)					X3
LA54039	Saddle Bronc/Batt	29HISAR62-13, 14	HS-31 (JRA)	74 (FD)				X3
LA54040		HS-32 (JRA)						
LA54041		HS-34 (JRA)						
LA54042		HS-35 (JRA)						
LA54043		HS-36 (JRA)						
LA54044		HS-37 (JRA)						
LA54045		HS-38 (JRA)						
LA54046		HS-39 (JRA)						
LA54047		HS-40 (JRA)						
LA54048	Metate Ruin	HS-42 (JRA)	A:10:5? (GP)	23 (KC)				X1
LA54049		HS-44 (JRA)	79? (FD)					X3
LA54050		HS-45 (JRA)	78? (FD)					X3
LA54051	Brushy Creek Rui	HS-46 (JRA)	A:10:6? (GP)	21 (KC)				X1
LA54052	Dog Srping	HS-47 (JRA)						
LA54053	Alamo Hueco	HS-48 (JRA)	A:11:1, 2 (GP)	6 (B)	28 (KC)	76 (FD)		X1, X3
LA54054		HS-49 (JRA)						
LA54055		HS-50 (JRA)						

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Site No.	Site Name	Other	Other	Other	Other	Other	Other	Biblio
LA54056		HS-51 (JRA)						
LA54057		HS-52 (JRA)						
LA54058		HS-53 (JRA)						
LA54059		HS-54 (JRA)						
LA54060		HS-55 (JRA)						
LA54061		HS-56 (JRA)						
LA54062		HS-57 (JRA)						
LA54063		HS-58 (JRA)						
LA54064		HS-59 (JRA)						
LA54065		HS-60 (JRA)						
LA54066		HS-61 (JRA)						
LA54067		HS-62 (JRA)						
LA54273		NM-030-2862 BLM						
LA54954		NM-030-3888 BLM						
LA55873		NM-030-3923 BLM						
LA59936		AR-03-05-01-00025						
LA59937		AR-03-05-01-00053						
LA59938		AR-03-05-01-00057						
LA59939		AR-03-05-01-00058						
LA59940		AR-03-05-01-00059						
LA59941		AR-03-05-01-00060						
LA59942		AR-03-05-01-00061						
LA59943		AR-03-05-01-00063						
LA59944		AR-03-05-01-00064						
LA59945		AR-03-05-01-00203						
LA59946		AR-03-05-01-00202A						
LA59948		AR-03-05-01-00022						
LA59949		AR-03-05-01-00046						
LA59972		NM-030-3887 BLM						
LA61947		AR-03-05-01-00234						
LA67961								
LA67962								
LA68028								
LA71697		HI-1 (SCH)						X5
LA71698		HI-2 (SCH)						X5

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Site No.	Site Name	Other	Other	Other	Other	Other	Other	Biblio
LA72893		NM-030-3426 BLM						
LA73374		NM-030-2994 BLM						
LA73401	Guadalupe Pass	NM-030-354 BLM						
LA75393								
LA75394								
LA75459								
LA77494		AR-03-05-01-00210						
LA78437		SITE 99 (?)						
LA79732		AR-03-05-01-00300						
LA79733		AR-03-05-01-00301						
LA79734		AR-03-05-01-00302						
LA80525								
LA84973								
LA86866		AR-03-05-01-00360						
LA86955		AR-03-05-01-00356						
LA86956		AR-03-05-01-00357						
LA88357	Antelope	NM-030-5265 BLM						
LA89142		NM-030-356 BLM						
LA89345		NM-030-5113 BLM						
LA101502		AR-03-05-01-?????						
LA104052		NM-030-5301 BLM						
LA104599								
LA104600								
LA104601								
LA104602								
LA104603								
LA104604								
USFS358								
USFS359								

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John H. Madsen

Appendix D.

Additional Observations on the Early History of the Borderlands

An Annotated Summary of Spanish Offensive Campaigns in the Borderlands

The following information is derived from Naylor and Polzer (1986). Captain Juan Fernandez de la Fuente and Captain Don Domingo Teran led a small force of 70 soldiers and 60 Native American allies through the Guadalupe Mountains to San Bernardino in June 1695. A temporary base camp was established there while the Spanish pursued a group of Native Americans into the Chiricahua Mountains. The encounter was brief and ended in temporary peace. Fernandez and Teran detoured south to assist the Presidio of Cucurpe in subduing a Native American uprising but returned to the Chiricahua Mountains to continue their search for Apache rancherias. A large force of friendly Pimas accompanied Fernandez as far as the Dos Cabezas Mountains (then called the Animas Mountains and not to be confused with Las Animas). With sickness spreading through the ranks of the main Native American and Spanish forces, the expedition moved slowly. Finally, at the springs of San Simon, the campaign formally ended with the death of Captain Teran. The route taken back to Janos by the detachment carrying Teran and by the force led by Fernandez is unclear, but mention of the Alamo Hueco Mountains by Fernandez suggests that he may have passed north of the Animas range and through the Playas Valley.

A small detachment of this force was successful in locating and destroying one Apache rancheria in the vicinity of the Gila River and the Peloncillo Mountains during the last days of this campaign, but for the most part the event had little impact on slowing the regional conflict. If anything was gained, it was a better understanding of the layout of the region and the locations of possible targets of future campaigns.

The remaining summary is compiled from Thomas (1932). By the mid- to late-18th century, frontier conditions were deteriorating and warfare between Spanish settlers and Native Americans had intensified. Apaches and other groups had by now acquired access to sizable horse and mule herds. With plundered military equipment, they conducted raids and vanished before presidio patrols could intercept them. In 1766, the Marques de Rubi was sent to inspect the condition of the northern presidios and to make recommendations to King Carlos III regarding how to correct the Spanish defensive posture. Rubi recommended a realignment of presidios, and in 1772 Viceroy Bucareli assigned Commander Inspector Don Hugo O'Conor the task. In addition to adjusting the line of defense, the Viceroy charged O'Conor with the protection of the region and, with this the Irish-born commander pursued a fierce campaign against the eastern Apache of the Rio Grande and against the Apaches in the region north of Janos and Fronteras.

Two of O'Conor's marches penetrated the Borderland. The first in 1774, was in response to the successful Apache attack on a Flying Company near Janos. Under O'Conor's direction, 259 men from Janos, Carrizal, and San Buenaventura, and several Native American allies pursued the Apaches throughout the sierra of Alamo Hueco, La Hacha, and Corral de Piedra.

The second offensive expedition was conducted between August and September 1775, when O'Conor attempted to muster 2,228 men in a major campaign against the Apaches. A portion of the force from New Mexico had to be withdrawn because of the short supply of horses, but "...it was one of the largest bodies ever brought together to war on the Apaches in the Southwest" (Thomas 1932: 10). The final number of participants cannot be determined from secondary source materials, but O'Conor did manage to gather three large regional forces. In the east, governors and presidial captains from the Rio Grande regions scoured the Pecos and Rio Grande. Governor Francisco Antonio Crespo moved north from Sonora to the Chiricahua Mountains and then to the Gila River and the Rio del Norte, where his detachment met the Carrizal detachment lead by O'Conor. Together they searched the Mimbres, Mogollon, and Gila Mountains. O'Conor sent a detachment to explore the Sierra of Las Animas, Alamo Hueco, and other ranges in the Borderlands. This campaign had little impact on the Apache and no lasting relief from Apache raids.

The next major campaign into the Borderlands was prompted by the need to find a route from Sonora to Santa Fe. In the year 1780, Don Juan Bautista de Anza was charged with this responsibility. Anza's expedition consisted of 151 soldiers, Native Americans, and settlers who caravanned south from Santa Fe to Fray Cristoval on the Rio Grande River where Anza departed the caravan with an unspecified number of men to find a short road to Sonora. Anza crossed the Rio de las Mimbres and then because of the lack of water went south through the eastern edge of the study area, where he camped at the eastern springs of the Sierra de la Hacha. From here he went on to the Camino Real and then east to the San Bernardino Valley. In 1777, Don Teodoro de Croix had taken over the Command of the Interior Provinces from O'Conor. Croix sent two detachments north to assist Anza and to protect the expedition by seeking out and destroying Apache rancherias.

On November 8, 1780 Captain Don Joseph Antonio Vildosola left Las Nutrias in Sonora with 116 solders and 80 Opata and marched north to intercept Anza. Vildosola's detachment was unable to find Anza, but during his trek he dispatched several parties into the Chiricahua Mountains, scoured the vicinity of the San Simon Valley, moved northeast to the Burro Mountains and then south into the Animas Valley. The second detachment of 474 troops and 120 Opata allies marched under Don Franco Martinez from Carrizal, New Vizcaya, to explore as far as the San Francisco Mountains, but remained east and north of the study area. Martinez did not find Anza either. In the end both detachments had encounters with Apache and retrieved stolen property from them.

Conditions on the frontier had not improved by 1783. From this year until his death in July 1884, Felipe de Neve was the Commander General of the Interior Province. He immediately set in motion a new campaign to seek out and destroy the Apaches in their own land. Neve's strategy was to dislodge the widely separated Apache rancherias from the mountains close to the frontier, thereby forcing the Apache to flee north to the Gila where detachments would follow and attack them. During the year 1784, a considerable number of men entered the Borderlands. Patrols searched the mountains near the frontier with such success that in March 1784, Neve sent two detachments under the direction of Adjutant Inspector Don Rogue de Medina. The General of the Opata Nation, Don Francisco Medrano, also set forth with over 100 men from the Presidio of Fronteras and surrounding communities into the Borderlands and the Gila country.

From April 15 to the middle of May 1784, five Divisions with over 300 Spanish troops, volunteers, and Pima and Opata allies again entered the Borderlands in a major move against the Apache. Two divisions from Fronteras and one division each from the Presidios of Janos, Tucson, and Velarde descended upon the Borderlands. Included in their search was the region of Animas Valley, Santo Domingo Playa, Mimbres Valley, Hachett Mountains, Burro Mountains, San Francisco Mountains, the San Simon, the Chiricahua Mountains, and the banks of the Gila River.

After Neve's death, Joseph Antonio Rengel was appointed interim Commander General and under his command in 1786, Lieutenant Colonel Don Francisco Martinez and Captain Don Antonio Cordero scoured the Borderlands with 354 men divided among three divisions from Carrizal, Janos, San Eleceario, and other outposts. The diaries of Martinez and Cordero indicate they carried out reconnaissance into all of the valleys and ranges in the Borderlands.

Early Observations Regarding Fire, Smoke, and Accidental and Natural Fires in the Borderlands

In the diary of General Juan Fernandez de la Fuente in June 1695 (Naylor and Polzer 1986: 592), he notes:

> After traveling about one league, we found a spring in a mesquite grove. Below it we found more than forty separate ash mounds with beds of grass around each one. Since the tracts and the hot ashes were very fresh, we asked the Indian captive when the enemy had been there and how long they had stayed at this place. He answered that they had spent the night there on their way to the frontier.

The entry for September 16, 1695 (Naylor and Polzer 1986: 640–641) recounts:

> The sentinel that we had posted reported seeing a smoke signal in the middle of the Mountains. When we saw heavy smoke rising from the canyon at the head of this arroyo, we knew that the thirty-six troops under the command of Lieutenant Antonio de Solis who had left the night before were in combat, because they had been told to send us a smoke signal.

Don Juan Bautista de Anza, Governor of the Province of New Mexico, also notes smoke rising from the surrounding sierras on his expedition to open a road from Santa Fe to Sonora. Along the road 51 leagues south of Santa Fe on the Camino Real of the Rio del Norte, Anza surmises the following (Thomas 1932:198):

> From ten in the morning until the end of the afternoon, a cloud of smoke was observed at five leagues distance along the way we were traveling. It was inferred from the smoke that the fire was made by our common enemies to advise each other, as they are always accustomed, that we were along this road.

From April 15, until May, 1784, Adjutant-Inspector, Don Rogue de Medina searched through the Borderland study area for rancherias of the Apache. His search was frustrating because, as he notes (Thomas 1932: 248), the:

> ...enemies situated on the top of the sierras which dominate the country had observed the camp, avoiding it carefully and communicated prompt advice of the troop movements from one rancheria to another now by smoke and again by messenger.

In the campaign of November and December 1785, Lieutenant Colonel Don Francisco Martinez (Thomas 1932: 283) indicates:

> During the morning I continued keeping near the slopes of this sierra on the route to El Cobre. I discovered on arriving at one of the canyons a considerable number of Indians discharging muskets from above. Having already without doubt learned of the other detachment from the many smokes and trails that had come from those directions they had entered this sierra with horse herds and stock.

The second detachment of the November and December campaign of 1785 was led by the Captain of the Royal Presidio of San Buenaventura, Don Antonio Cordero. This detachment searched the Animas Valley, Las Playas de Santo Domingo, and north to the Las Burras Mountains. Cordero's diary indicates he too saw many smoke signals in the Las Burras and elsewhere. He relates that a scouting party led by Lieutenant Don Manual Casanova reported "...large smoke having been sent up on El Picacho of Las Mimbres [Cooke's Peak], those of Las Burras were communicating with others, the ones I had seen..." (Thomas 1932: 288). Cordero also describes a possible range fire near Las Burras started from excessive heat on November 26, 1785. Oddly enough Cordero's detachment lost 30 horses or mules 8 days later in Las Animas from lack of pasture and heavy snows covering the ground.

In 1795, Zuniga found a burned area around a spring on his way to Zuni (Hammond 1931). This spring was between Zuni and the San Francisco River.

Dobyns (1981) provides insight into the intentional burning of the landscape by Apaches. He cites from the 1830 diary of Captain Don Antonio Comaduran who observed Apaches setting fires to the range north of Aravaipa Canyon. Although Comaduran does not state a reason for this act, Dobyns refers to it as a hunting tactic based on an earlier 1796 account by Colonial Don Antonio Cordero. Cordero "...described a large-scale circular fire-and-noise game drive as a major Apache hunting custom" (Dobyns 1981: 27). Such an account by Cordero was not encountered in the research for this paper.

Boundary Commissioner John Russell Bartlett journeyed from the copper mines of New Mexico to Arispe, Sonora, in May 1851. He and his party passed through the Borderlands on their way. On their return trip to the copper mines in June 1851, concerning Guadalupe Mountain he observed (Bartlett 1854: 295–296):

> A fire has passed over it, destroying all the grass and shrubbery, and turning the green leaves of the sycamores into brown and yellow. The surface of the earth was covered with black ash, and we scarcely recognized it as the enchanting place of our former visit. At first we feared that this devastation had been caused by our own neglect; but on reaching the spot where we had encamped, which was separated from the surrounding hills by the rocky bed of the stream, we found the dry grass still around the place, which alone had escaped the fire. A little further on we came to a camp of two hundred Mexican soldiers, a portion of the brigade of General Carrasco [from Fronteras]...It was evident now how the fire which I have mentioned originated. A portion of the brigade had passed the canyon a few days after us [June 1851]; and their twenty or thirty camp fires had, no doubt, communicated the flames to the grass, which had afterwards extended over the whole mountain.

Roads and Trails Through and Adjacent to the Borderlands

Native American Trails

Undoubtedly, prior to the Hispanic period extensive Native American trails lead north to south and east to west over the Borderlands. According Charles Di Peso (1974), Fray Marcos de Niza followed the old Bavispe-Acoma trail passing through the San Bernardino Valley.

Spanish Trails 1742 to 1800

In 1712, Juan Ignacio Flores Mogollon lead an expedition into unexplored land southwest of the Rio de Norte. He gave his name to the Mogollon Mountains of southwestern New Mexico, but it is unlikely he entered the Borderlands.

In a quest for a short route from Santa Fe, New Mexico to Sonora, the Spanish made several attempts to traverse the country north of the Borderlands. Some of these detachments may have entered the study area. Fray Silvestre Velez de Escalante's letter to Reverend Father Provincial Minister, Fray Ysido Murillo in 1776 relates two reports of potential routes between Zuni and Sonora (Thomas 1932). First, in 1747, Don Bernardo de Miera followed a route between Zuni and the San Francisco and Gila Rivers by proceeding from El Paso, Santa Fe, Janos, and Corodeguachi. This may be similar to a 1754 route that Escalente believed to have intersected the San Francisco River. Escalante states that Don Marcial Barrera "...with two other Spaniards and one hundred Zuni Indians set out in pursuit of some Apaches from this pueblo of Zuni. Having marched three days to the south, he attacked the rancheria of Chief Chafalote, a Gila Apache..." (Thomas 1931: 156).

Hammond (1931) provides the following information from the translated diary of Captain Don Jose de Zuniga (1795) regarding an attempt to find Miera's route from Sonora to Zuni. In October and November 1788, Captain Don Marcial de Echeagaray set out to find the pass reported by Miera that led from the San Francisco River to Zuni Pueblo. He traveled north from San Marcial with nearly 300 troops to the San Francisco River and was successful in finding the pass only to be turned back by exhaustion. At the end of the 18th century, Don Jose de Zuniga left Tucson with instructions to locate the pass reported by Miera in 1747 and by Echeagaray in 1788. Zuniga, with provisions for 50 days, traveled to the abandoned Presidio of Santa Cruz where he gathered additional men from adjacent towns (some from Fronteras). From Santa Cruz he marched north in a direct route with over 100 men to the San Francisco River where he found the pass and entered the Pueblo of Zuni on May 1, 1795. His exact route between Santa Cruz and the river is not known but he might have passed through the Borderlands. Zuniga followed portions of well-used Native American trails through the mountains and onto the upland north of the river.

As indicated in descriptions of military campaigns, Don Juan Bautista de Anza also attempted to find a short route from Santa Fe, New Mexico, to Arispe, Sonora. From Fray Cristoval on the Rio del Norte, Anza turned west, passing over the Mimbres, but out of desperation for water turned south to known sources in the vicinity of the Sierra de la Hacha. Anza then joined the Camino Real between Janos and Fronteras and followed it to San Bernardino.

Roads of 1800 to 1856

By 1804, ore bodies were being explored north of the study area at Santa Rita del Cobre east of present-day Silver City. Supply roads were established south into Chihuahua, and a minor trail went southwest to Janos. On November 13, 1846, the Mormon Battalion began its march west from the Rio Grande River to California. From the Rio Grande the party traveled to the mouth of the Mimbres River and then southwest crossing into the Borderlands on November 23, 1846, at Las Playas. For 10 days the battalion traveled southwest, passing to the right of the Animas Range. They cleared a road near the pass of Guadalupe and made their way to the old rancho of San Bernardino.

At the copper mine of Santa Rita in the vicinity of present day Silver City, the Boundary Commission established temporary headquarters while mapping the new boundary between Mexico and the United States. From this place on May 16, 1851, John Russell Bartlett set out with a party of 10 associates and a small support group to examine Cooke's wagon road to the Gila. Bartlett was eager to establish a transportation and supply route for the mapping parties that would be working on the Gila River survey. Bartlett also was eager to renew communication and trade with the Mexican frontier towns in Sonora to acquire flour, cattle, sheep, fruits, and vegetables for the Santa Rita headquarters and for survey parties working west of the Rio Grande.

Bartlett and his companions entered the study area on May 18, 1851, traveling through Las Playas, over the pass known as the Sierra de los Animas. The party made its way through the Animas Valley and with extreme difficulty crossed the pass of Guadalupe and reached the ruins of San Bernardino on May 21, 1851. Bartlett's party continued south and visited Fronteras on May 24 and Arispe on May 31, 1851. Bartlett returned to the copper mines in June of that year by the same route through the Borderlands. U.S. Boundary Commissioner Bartlett followed Mexican Commissioner Conde in September 1851, north of the Borderlands, and this trip set the stage for later use of this route west by others.

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