NEW MEXICO DEPARTMENT OF TRANSPORTATION

CULTURAL RESOURCE TECHNICAL SERIES 2004-2

Fallen Pine Shelter: 3,000 Years of Prehistoric Occupation on the Mescalero Apache Reservation

Yvonne R. Oakes

with contributions by

Nancy J. Akins
Philip R. Alldritt
Richard G. Holloway
Pamela J. McBride
M. Steven Shackley
Mollie S. Toll
C. Dean Wilson
Dorothy A. Zamora

Timothy D. Maxwell
Principal Investigator

ARCHAEOLOGY NOTES 325
OFFICE OF ARCHAEOLOGICAL STUDIES
MUSEUM OF NEW MEXICO

SANTA FE 2004 NEW MEXICO

ADMINISTRATIVE SUMMARY

An archaeological excavation was conducted by the Office of Archaeological Studies (OAS), Museum of New Mexico, at Fallen Pine Shelter (LA 110339) within the U.S. 70 right-of-way on the Mescalero Apache Reservation near Ruidoso. The work was undertaken intermittently between November 2001 and March 2002. Investigations were initiated at the request of Mr. Blake Roxlau of the New Mexico Department of Transportation (NMDOT) prior to proposed road widening along U.S. 70. Permission to conduct archaeological activities within the highway right-of-way corridor was granted by the Bureau of Indian Affairs and the Mescalero Apache Tribe.

LA 110339 was a small rockshelter almost covered by fallen trees, branches, and pine duff. During the excavations 81.2 cu m of soil were removed from the site by hand, and almost 6,000 artifacts were recovered. Artifact analyses and the results of 85 radiocarbon assays yielded dates ranging from 1410 B.C. to A.D. 1640, plus two modern readings. Based on the dates, occupation appears to have been not quite continuous, but on a fairly regular basis throughout prehistory. There was a strong Archaic presence, with numerous projectile points and associated dates. However, the primary occupation occurred between A.D. 1000 and 1200. Several hearths, roasting pits, and a child burial were found within the shelter, along with a series of eight occupational surfaces. Outside of the shelter, deposits reached 3.6 m in depth and contained numerous artifacts and an adult burial. No occupation surfaces could be found here, however, because of soil disturbance from exposure to the elements and erosion. Archaeological excavations removed all soils and artifacts from within the shelter and approximately 95 percent of cultural materials from outside of the structure.

Fallen Pine Shelter, because of its limited size, is considered to have been a short-term or temporary encampment for small groups of people while hunting or collecting, or as they traveled through the mountain pass. No remaining deposits are likely to yield additional information important to the prehistory or history of the area, and no further archaeological investigations are recommended.

Submitted in fulfillment of Professional Services Agreement C04159 between the New Mexico Department of Transportation and the Office of Archaeological Studies, Museum of New Mexico, Office of Cultural Affairs.

NMDOT Project No. NH-070-4(30)254, CN 2514.
MNM Project No. 41.698 (Mescalero Cave).
BIA Permit No. BIA/SRO-02-001.
Mescalero Apache Tribe letter of permission, October 5, 2001.
NMCRIS No. 82695.

CONTENTS

Figures

Tables

INTRODUCTION

Yvonne R. Oakes

Between November 2001 and March 2002, the Office of Archaeological Studies (OAS) conducted a data recovery program at Fallen Pine Shelter (LA 110339) for the New Mexico Department of Transportation (NMDOT). The work was undertaken within the U.S. 70 highway right-of-way on Mescalero Apache Tribal land near Ruidoso, in Otero County, New Mexico (Fig. 1 and Appendix 1). The site consists of a small rockshelter that was mostly covered by soil and brush. It was first recorded by Hohmann (1995) during a survey of the area. The OAS tested the site for buried deposits and cultural features in 1996 (Akins 1997). Testing yielded deep deposits extending from the Pueblo period back to the Archaic. A data recovery plan was prepared by Akins (1997) and subsequently amended by Oakes (2001).

Archaeological excavation began in November 2001 at the request of Blake Roxlau of the NMDOT. The project director, Yvonne R. Oakes, was assisted by Dorothy A. Zamora and Phil Alldritt. The report was compiled by Yvonne Oakes, and analyses were conducted as follows: lithic artifacts, Phil Alldritt; ground stone, Dorothy Zamora; ceramics, Dean Wilson; fauna and human remains, Nancy Akins; ethnobotany, Mollie Toll; palynology, Richard Holloway; obsidian sourcing, Steven Shackley; carbon dating, Beta Analytic, Inc.

Excavation at Fallen Pine Shelter revealed 3.6 m of cultural depth in some areas of the site. Within the shelter, eight discrete utilized surfaces were uncovered with features including expedient hearths, ash dumps, roasting pits, and a child burial. Outside of the shelter, soils were not stratified. A human burial had been placed in this area during the prehistoric period. Ceramics date into the A.D. 1400s; however, the primary occupation was between A.D. 1000 and 1200. An extensive Archaic component was also uncovered which was radiocarbon-dated as early as ca. 1400 B.C.

The OAS would like to express its thanks to the many members of the Mescalero Apache Tribe who showed an interest in our work and often came to the site to follow our progress. We particularly want to thank Delbert Mendez, Donna McFadden, Holly Houghton, and Jeff Hanson, our contact persons for the tribe. We also appreciate the tribe's involvement in the joint effort to remove the child burial from the site in an appropriate manner for reburial.

This undertaking complies with the provisions of the National Historic Preservation Act of 1966, as amended through 1992, and applicable regulations. The report is consistent with applicable federal and state standards for cultural resource management.

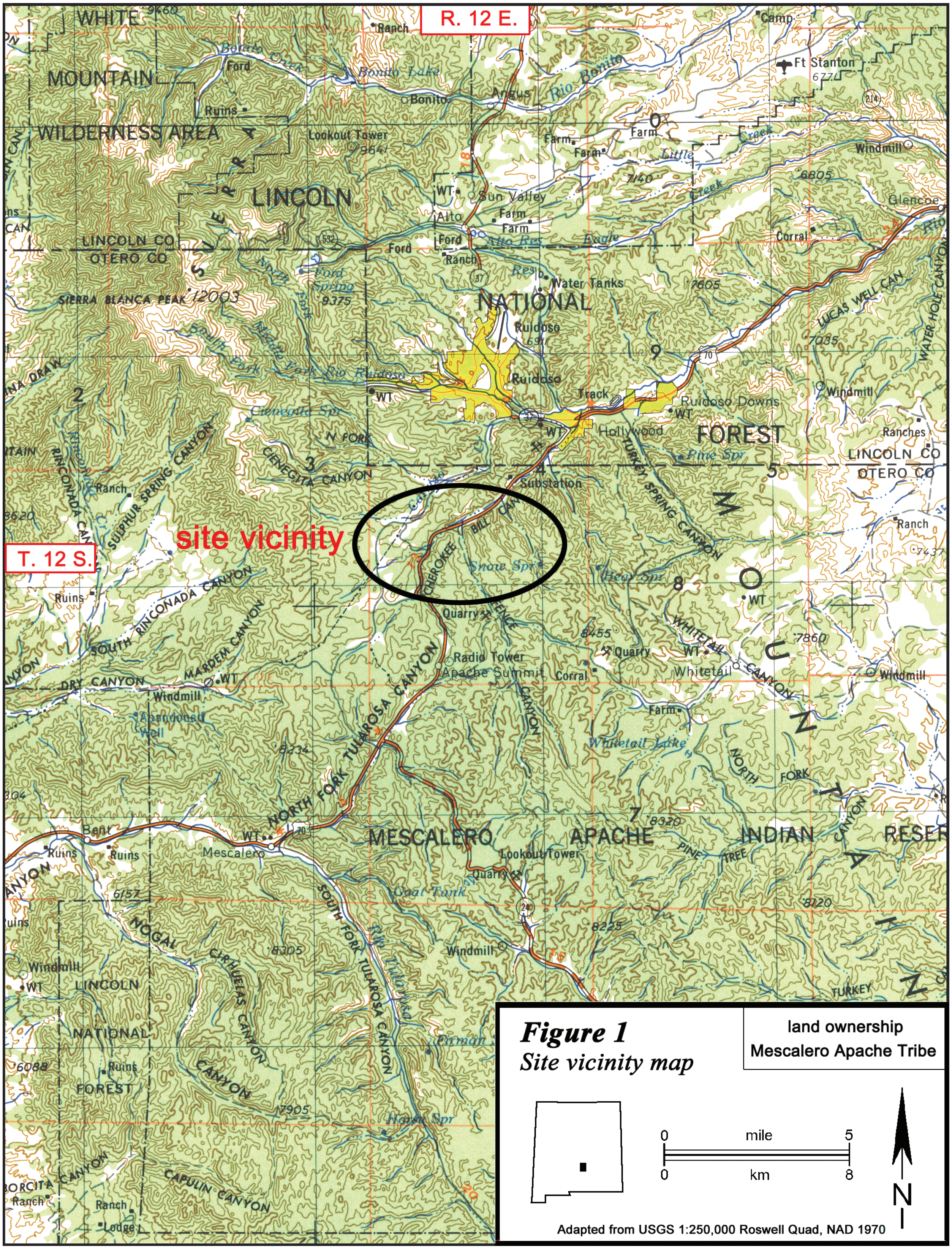

Figure 1
Site vicinity map

ENVIRONMENTAL SETTING

Yvonne R. Oakes

Fallen Pine Shelter (LA 110339) is near the northern limits of the vast holdings (460,384 acres) of the Mescalero Apache Tribe in Otero County, New Mexico. The land is mountainous, with dense forests, open meadows, valleys, deep canyons, and numerous small water courses (Spoerl 1985:33). It is part of the Sacramento Mountain range. Sierra Blanca Peak rises to 12,003 ft (3,660 m) at a distance of 17 km (10.5 miles) northwest of the site. To the southwest lies Apache Summit, at 7,620 ft (2322.5 m). From there the land drops down to the Tularosa Basin at about 4,000 ft (1,220 m). To the east, there is a gradual decrease in elevation as the topography opens up into Rio Hondo Valley. The site is at an elevation of 6,980 ft (2,127.5 m). The shelter sits at the base of a steep slope in Cherokee Bill Canyon, which contains an intermittent drainage (Figs. 2 and 3). This drainage flows east into Rio Ruidoso, which then becomes part of the Rio Hondo drainage basin as it descends to the Pecos River. Other intermittent drainages in the area are fed by runoff from the surrounding higher mountains. However, there are only a few small springs in the area (Harrill 1980:9).

Geology

The project area is within the Sacramento section of the Basin and Range physiographic province (Fenneman 1931:394). The Sierra Blanca volcanics are the major structural features, consisting of the Sacramento uplifts (uplifted fault blocks of sedimentary units) and the Mescalero Arch (Sloan and Garber 1971). These Tertiary volcanics (Ash and Davis 1964:14) are topped by Sierra Blanca Peak, northwest of the site. A series of igneous dikes radiate from this area.

Permian limestones consisting of San Andres limestone and the Yeso formation are found within the study area, as is Hondo sandstone. The San Andres limestone is a fossiliferous dolomite. The Yeso formation is interbedded siltstone, limestone, dolomite, shale, and fine-grained sandstone. The Hondo formation, a friable, fine to medium-grained sandstone, is found in massive beds of limestone (Warren 1971:18; Walt 1980a:10-11). Fine-grained to glossy volcanics are found in channel and terrace gravels of the Rio Ruidoso and Devil's Canyon. Lenses of gray clay occur in outcrops of the Yeso formation.

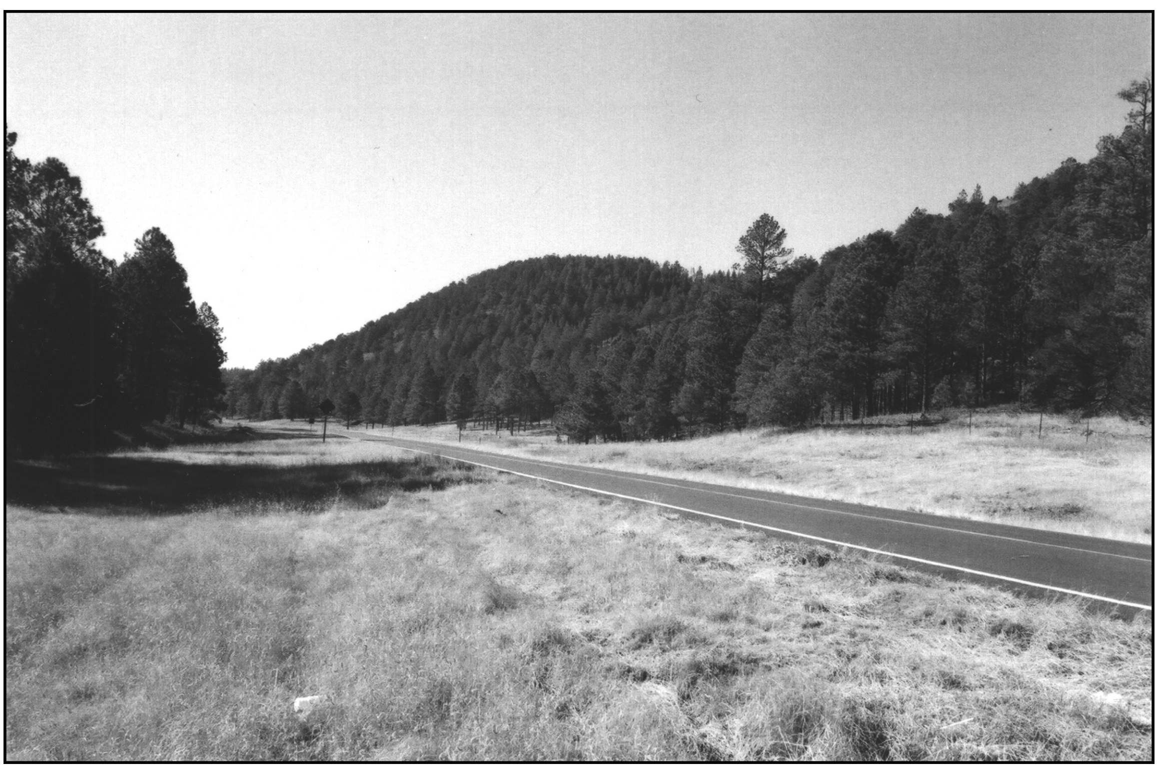

Figure 2. Cherokee Bill Canyon. The drainage is at the left in front of the trees.

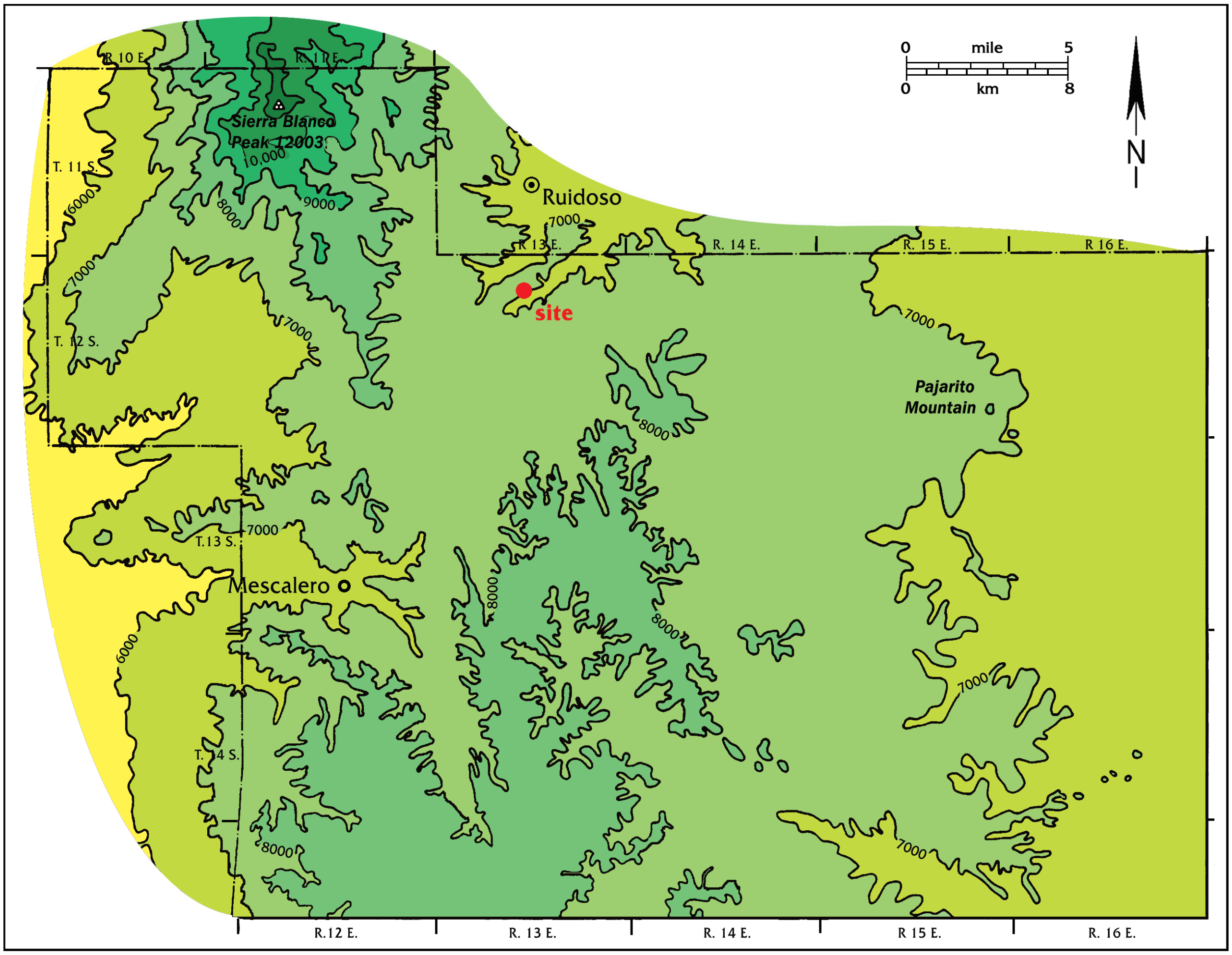

Figure 3. The topography of the region surrounding Fallen Pine Shelter.

Materials and minerals found in regional deposits that may have been useful to prehistoric populations include igneous rocks, primarily, but also red sandstone, vesicular lava (mostly from the Tularosa Basin), black quartz found in washes, and specular iron ore. The igneous rocks are found on Sierra Blanca Mountain and consist mostly of granite, but also rhyolite, trachyte, and diorite. Another available material is chert found as nodules in the San Andres limestone and as rounded cobbles in river and terrace gravels along the Rio Ruidoso. Its availability is wide, but sporadic, and it is often of poor quality. A light-colored, banded chert is found south of Fort Stanton cemetery, similar to the "fingerprint" chert of the Zuni Mountains (Warren 1971:5-6). Banded chert is also found in the canyons east of Cloudcroft (Chris Adams, pers. comm.).

Soils

Soils are mostly of the Arosa series, which are formed in alluvium and derived from mixed igneous and sedimentary rocks. These soils are confined to narrow mountain valley floors such as Cherokee Bill Canyon. They are only slowly permeable and generally best for livestock grazing, supporting wildlife, and recreation. Surrounding mountain soils are of the Peso series: cobbly clay loams or stony, silty clay loams formed from limestone. They are moderately to slowly permeable and are used mainly for timber and recreation, and as a watershed (Neher 1976:6, 21). Soils of this series are usually cobbly and dark. In general, both soil types support good stands of vegetation, primarily tree species. Limestone bedrock is generally found at 50 to 100 cm below the surface (Maker et al. 1972:15-16).

Vegetation and Wildlife

The project area falls within the Transition life association, where trees are the principal vegetation (Martin 1964:174). The conifer forest basically contains an open canopy of tall tree species with a mixture of tall grasses (LeBlanc and Whalen 1980:10). Ponderosa pine is the most common, but Engelmann spruce, white fir, and Douglas fir are also present on north- and east-facing slopes at higher elevations. Piñon and alligator and Rocky Mountain juniper are found at lower elevations. There is a wide variety of grasses and shrubs in open areas and in less dense tree cover. Some of the more prominent grasses are Arizona fescue, mountain brome, sideoats grama, little bluestem, pine dropseed, mountain muhly, western wheatgrass, and blue grama. Common shrubs are mountain mahogany and oakbrush (Maker et al. 1972:16). This wide variety of topography and vegetation results in much temporal and spatial variability in the distribution of subsistence resources, similar to the Western Apache area (Pool 1994).

Streamside habitats support a variety of grasses, forbs, rushes, piñon-juniper, oak, walnut, cottonwood, hackberry, and mountain mahogany. When considering hunting and gathering potential, this is the area's richest habitat (LeBlanc and Whalen 1980:10).

In the Sacramento Mountains, mule and whitetail deer are the major species (Whalen 1980:365), but the forest land is also excellent for elk, bears, and turkeys. Other species include bobcats, weasels, skunks, raccoons, ringtails, foxes, wolves, coyotes, porcupines, squirrels, mice, lizards, snakes, and 82 species of birds, including pheasant, dove, quail, hawk, golden eagle, and waterfowl (Neher 1976:45-46; Dart 1980:39-43). Mountain lion and bighorn sheep are much less common. Dart (1980:36) found a scarcity of wildlife in the forests, perhaps because of the lack of suitable areas and the presence of only intermittent streams.

Climate

The high, cool Sacramento Mountains capture moisture in an otherwise arid region (Keesling 1980:46). The highest elevations of the mountains have subhumid conditions, with an abundance of moisture throughout the year. However, a wide range of elevation and varying topography result in many diverse microenvironments with a variety of climatic patterns. Generally, there is a positive correlation between elevation and precipitation (Harrill 1980:9, 13).

In the summer, particularly July and August, the most important source of moisture is the Gulf of Mexico (Houghton 1976:76). Precipitation comes in the form of brief but often heavy thunderstorms. The Sacramento Mountains receive over 20 inches of rain per year (Harrill 1980:13). The driest months are April, May, and November (Mueller 1991:2). The high areas are characterized by a cool, moist zone within a generally dry region (Prince 1980a:18). In winter, moisture derives from the Pacific Ocean but is greatly decreased by condensation over the mountains to the west, producing only light precipitation.

The closest climate recording station is in Ruidoso at 6,823 ft (2,084 m). Mean precipitation of 54.25 cm (21.43 inches) per year (Mauldin 1997:11) has been recorded. There is a mean of 100 frost-free days per year, but the length of the growing season varies widely from one year to the next. Ruidoso has one of the shortest growing seasons in the area because cold, dry air tends to collect in the sheltered valleys (Tuan et al. 1973:79). Temperatures are relatively cool, averaging 9 degrees C (48.2 degrees F), with a high of only 18 degrees C (64.4 degrees F) in July. In winter, the air temperature is usually below freezing at night.

Paleoclimate

Over the past 8,000 years, the Sacramento Mountains region has experienced a generally drying climate with cycles of wetter and drier periods along with a change from winter-dominant precipitation to summer-dominant (Van Devender and Spaulding 1979:709). As a result, forest zones have shifted to higher elevations and juniper woodlands have replaced tall-growth forests, particularly on the eastern slopes (Keesling 1980:44). But basically, there has been little change in the composition of the plant communities, just an altitude shift. However, in the early Holocene (ca. 10,000-7,000 B.P.), the climate was much cooler than it is today, and large areas were covered by vegetative associations considered unproductive for early hunters and gatherers. The middle and late Holocene (8000 B.P. to present) was heavily influenced by Hudsonian and Arctic-Alpine life zones and experienced warmer temperatures and summer monsoons, conditions more favorable for hunters and gatherers (Van Devender and Spaulding 1979:708-709).

A study of packrat sequences for the Sacramento Mountains (Mauldin 1997:22-23) shows that piñon experienced a sustained absence prior to 350 B.C., and oak was absent around A.D. 250. Mauldin believes their reappearance indicates a more mesic climate during the late Archaic period. Pollen studies in adjacent areas also suggest a wetter, cooler climate from about 1000 B.C. to A.D. 250.

According to woodrat middens on the nearby Rio Bonito, Aguila et al. (2002:22) believe that by ca. A.D. 900, the environment was stable, and the dominant taxa were piñon, juniper, and grasses. By A.D. 1200, there was an increase in pine, oak, and maple pollen, indicating more moist conditions. Cheno-ams and high-spine asteraceae also increased. They think that by A.D. 1422, more xeric conditions may have prevailed in the area, based on a substantial drop in juniper pollen, although they caution that this decrease could be due to human disturbances in the area.

By the 1500s, weather patterns and land-use strategies may have led to a lowered agricultural productivity and reduced fuelwood, which may have contributed to the prehistoric abandonment of the area (Aguila et al. 2002:25).

CULTURAL SYNOPSIS OF THE REGION

Yvonne R. Oakes

South-central New Mexico, specifically the Sierra Blanca region, has basically lagged behind other cultural areas in the state in terms of amount of archaeological excavations, clear delineation of cultural phases, knowledge of ceramic trade associations, and general understanding of the temporal and cultural diversity among the different populations occupying the region. Based on small-scale excavations (Chapman 1926), new ceramic classifications by Mera (1931, 1943), and explorations in caves of the Hueco Mountains east of El Paso by the Cosgroves (Cosgrove 1947), the first comprehensive cultural history of south-central New Mexico was defined by Lehmer (1948). He proposed the concept of a Jornada branch of the well-established Mogollon culture to the west, dividing the Jornada Mogollon area into southern and northern regions, from Carrizozo on the north and extending south into northern Mexico. Distinctions between the two were based mostly on differences in brown ware ceramics, associating Jornada Brown with the north and El Paso Brown with the south.

The northern region of the Jornada Mogollon was not further examined in depth until Kelley's extensive work (Kelley 1966, 1984) around Sierra Blanca and the Capitan Mountains. She made a major contribution to the regional archaeology by developing a three-phase classification system specifically for this northern area. Kelley's phases begin with the appearance of ceramics on regional sites and do not cover earlier Paleoindian or Archaic cultural manifestations, because sites of these types were little known at the time. While it is the only classificatory system in use today, there are recent attempts to build upon her work with new data and to refine the phase system (Oakes 2000).

Paleoindian Period

The Paleoindian period in New Mexico is generally considered to have begun about 12,000 B.C. and lasted until 6,000 B.C. Recent exceptions to the starting date of the period are based on work at Pendejo Cave east of Orogrande, New Mexico (MacNeish 1991; Harris 1997), which has resulted in the recovery of radiocarbon dates as early as 25,000 B.C. The definite association of these dates with human occupation levels is, however, somewhat controversial.

Other Paleoindian sites in southeastern New Mexico are relatively rare. Only a few surveys have uncovered evidence of human activity during this period. A major factor in the low frequency of this type of site is that they are likely to be deeply buried. Most are found in the sandy enclosures of the Tularosa Basin (Beckett 1983; Laumbach 1985; Carmichael 1986; Elyea 1988). However, distinct Paleoindian projectile points have been found in a variety of topographic zones in the area, including grasslands, mesas, high mountains, river valleys, and dry lake beds, suggesting the use of diverse settings by Paleoindian populations (Kirkpatrick et al. 2000:69).

Paleoindian peoples are characterized as primarily adapted to a subsistence strategy of big-game hunting and foraging. The large, finely worked projectile points of this time attest to the importance of a viable hunting strategy. Types of points found in the area include Clovis, Folsom, Midland, Plainview, Meserve, and Cody (Beckett 1983; Elyea 1988). Numerous Pleistocene faunal remains have been found in cave settings, possibly associated with people of this period. These include horse, llama, antelope, bison, short-faced bear, camel, giant turtle, tapir, salamander, ring-tailed weasel, spotted skunk, and magpie. Mammals make up the majority (MacNeish 1991).

Few Paleoindian remains have been found in the Sacramento Mountains, the focus of this study. A Plainview and a Meserve point were recovered in the Rio Bonito Valley (Anderson n.d.; Sebastian and Larralde 1989:30), and a portion of a Folsom point was reported on the Mescalero Apache Reservation (Broster 1980a:97). These sites are between 5,000 and 6,000 ft in elevation and associated with rockshelters and caves (Spoerl 1983). Other nearby nonmontane Paleoindian localities include the Tularosa Basin, near Orogrande (Dodge 1980:68; MacNeish (1991); Jarilla Mountain (Elyea 1988), near Holloman Air Force Base; and at Lone Butte (Elyea 1988; Gibbs and Sale 1997).

Archaic Period

The Southwest Archaic has often been divided into varying cultural complexes, some covering the entire Southwest, but most are geographically restricted (Huckell 1996:9). Southeastern New Mexico is sometimes considered a "catch-all" area between the Archaic Cochise tradition to the west in Arizona and western New Mexico; the Trans-Pecos tradition in West Texas and to the east (Sebastian and Larralde 1989); and, more recently, the Chihuahuan tradition. There are even similarities with the Oshara tradition to the north (Irwin-

Williams 1979). The current trend is the adoption of the concept of panregional cultural systems, which emphasizes similarities between the areas rather than differences (Huckell 1996). Overall, the Archaic period is characterized by a lack of ceramics; smaller diagnostic projectile points than those from the Paleoindian period because of the decreasing availability of large megafauna; the additional use of some maize for subsistence; and the presence of small, shallow pit structures late in the period, which lasted from ca. 6000 B.C. to A.D. 350 or later.

But the origins of the southeastern Archaic are still not satisfactorily resolved. Early schemes considered the Sierra Blanca region and southeastern New Mexico as a whole to be part of the western Cochise culture tradition (Lehmer 1948). However, similarities to eastern Archaic point styles (Beckett 1983) and to the Oshara in northern New Mexico (Sebastian and Larralde 1989) have been noted. As a result, in the various areas, very similar projectile points have been classified as different styles based on the typology used by the researcher. More recently, MacNeish (1993) has attempted to resolve this disparity by looking at points temporally rather than by area. He grouped points found in southeastern New Mexico into Early, Middle, and Late Archaic and found that all time periods had projectile points from all areas of the Southwest. Then he developed an Archaic cultural sequence just for southeastern New Mexico, which he named the Chihuahua tradition.

MacNeish's (1993) projectile point classifications are based on a combination of point styles found in southern New Mexico but also known in several other nearby areas of the Southwest:

1. Early Archaic (6000-3500 B.C.): Jay, Bajada, Abasolo-like
2. Mid-Archaic (3500-1500 B.C.)
   a. Early: Bat Cave, Armagosa, Pelona Type 1, Almagro-Gypsum, side-notched with square base, Beckett's Type 5, and some Chiricahua points (renamed Todsen)
   b. Late: San Jose, Augustin Type 2, Chiricahua Type 3, side-notched with convex base (named La Cueva), Armijo Type 8, and Palmillas and/or Edgewood-like (renamed Fresnal)
3. Late Archaic (1500 B.C.-A.D. 250): En Medio, Shumla, San Pedro large and small, Marshall, Hueco Type 9 (new), Hatch (formerly small San Pedro)

MacNeish (1993:44-46) then proceeds to identify four Archaic phases within the Chihuahua tradition. These include:

Gardner Springs (6000-4500 B.C.). He considers 14 sites to date to this phase. No structures are known, and the sites seem to represent periodic seasonal movements by small groups of people. Some ground stone, end scrapers, and faunal remains have been found. The sites suggest summer or early fall movements based on the type of resources and bone recovered. Beckett and MacNeish (1994) say that materials at this time are unlike any Oshara artifacts; rather, they consider them typical of the Chihuahua tradition.

Keystone (4500-2500 B.C.). Twenty-three sites define this phase, which is characterized by large scraper planes and more abundant ground stone. Metates also appear for the first time. Pumpkin seeds from Todsen Shelter dating to 3434 B.C. may be an early domesticate. All known sites are situated in the Tularosa Basin except Fresnal Shelter, which is near Fallen Pine Shelter in the mountain foothills. Shallow pit structures at Keystone Dam seem to represent residential units. In the later part of the phase, some structures were trash-filled. Beckett and MacNeish (1994:349) say the phase is not like the Oshara or Cochise traditions.

Fresnal (2500-900 B.C.). MacNeish tallies 51 sites in this phase. Sites have more scraper planes, metates, and manos than in previous phases. Maize first appears on some sites in the form of Chapolote and proto-Maiz de Ocho. Maize at Fresnal Shelter dated to 995 ± 55 B.C. (Tagg 1996). Storage pits have also been found from this time. There also may be evidence of a division into base camps and task-force sites.

Hueco (900 B.C.-A.D. 300). This phase includes 85 known sites. Ground stone includes more two-hand and wedge manos than in previous phases, and trough metates can be present. Projectile points are smaller, and mortars and pestles, paint palettes, and baskets are evident. Some locales seem to represent succulent-processing sites. Squash, beans, and amaranth are also found. The use of turtle and fish are noted for the first time. Small pit structures are not uncommon.

Even Beckett and MacNeish (1994:339) note that the above point types and phases do not always match up. Many projectile point types extend into more than one of these arbitrarily created divisions.

Based on ethnobotanical data, the occupation of sites in the region primarily appears to involve the seasonal use of specific locales. Most occupations occur between June and October, peak periods of plant production (Johnson and Upham 1988:85; Fish et al. 1992). This would suggest that agricultural products, such as maize, were not a major subsistence activity during the Archaic, since maize requires intensive labor while wild foods are maturing (but see Johnson and Upham 1988:87). However, Sebastian and Larralde (1989) say that attempts to correlate Archaic sites with specific resources is rare for the area. In one exception, Roney

(1985) found that lithic artifact scatters in the Guadalupe Mountains are much more likely to occur on upland zones, where most of the available vegetal resources are to be found. This could suggest a serial foraging strategy in the area during the Archaic (Sebastian and Larralde 1989). However, modern land-use strategies have frequently obscured our ability to identify past vegetative conditions. Thus, it is difficult to evaluate the types and abundance of resources that attracted Archaic peoples to any particular place (Huckell 1996:13).

A large survey of Mescalero Apache lands consisting of 191,947 acres of forest land between 6,500 and 9,000 ft in elevation (Broster and Harrill 1983) found that Archaic sites seem to represent a consistently seasonal use of the area (as researchers have proposed). Archaic base camps appear to be close to hunting areas, as opposed to later Mogollon camps, which are found at lower elevations. Broster and Harrill (1983:165) suggest possibly different hunting strategies, a decline in availability of large game over time, or a lessening of the importance of hunting by the Mogollon.

The region abounds in excavated Archaic rockshelters. Those that can be dated are listed in Table 1 in chronological order, as much as possible. Many others are undated but should fall within Archaic parameters. Most of the shelters have yielded an abundance of cultural materials rarely found in open sites of this time period. Fresnal Shelter has produced baskets, sandals, and maize. Across the canyon, High Rolls Cave also contained baskets, sandals, matting, storage pits, and maize cobs dating to 1500 B.C. Fallen Pine Shelter did not yield these materials, possibly because of its small size (12.5 sq m) and shorter occupation spans. Many other Archaic sites are open-air lithic scatters, and these are found throughout the entire south-central region. Quite a few are along major drainages, with elevations ranging from high mountain zones to low flatlands to the east and west. Elevations of the known rockshelters (Table 1) range from 4,432 to 6,980 ft (1,351 to 2,127 m). Oakes (2000) comments that locational and environmental diversity is apparently characteristic of the Archaic period in the area.

Other Archaic sites include two possible astronomical observatories on top of the Sacramento peaks. They are classified as such on the basis of projectile point style and solar alignments (Eidenbach 1979). The North Mesa site (LA 5529), a rare Archaic open-air site near Las Cruces, seems to date to the Early Archaic (Beckett and MacNeish 1994:347). Fort Stanton Mesa near Ruidoso has a large lithic artifact scatter with an Ellis point dating to between 550 B.C. and A.D. 500 (Higgins 1984).

The variety of site types and locales utilized by Archaic peoples indicates a viable hunting/gathering population in the region. This suggests a highly mobile adaptive strategy in which people shift from resource to resource as climate, dietary need, or population pressure dictates, or it may indicate different groups of people selecting different environmental niches for their home bases. There are suggestions, however, that residential mobility may have been reduced by the Late Archaic (Fish et al. 1992; Roth 1992). The finding of shallow pit structures on some late sites may be a sign of a seasonal reduction in mobility or the presence of a locally abundant resource. The idea of much more extensive foraging has also been put forth (Wills 1988; Vierra 1990). The distribution of obsidian artifacts across the

Table 1. Archaic rockshelters in south-central New Mexico

Name	Earliest Date (B.C.)	Location	Elevation (feet)	References
Fresnal Shelter	5951 or 1510	High Rolls	6300	Beckett and MacNeish 1994
Gardner Springs	4400	San Andres Mountains	-	Beckett 1973
Todsen Rockshelter	3669	Organ Mountains	4432	MacNeish 1993; Beckett and MacNeish 1994
Roller Skate Shelter	3095	Organ Mountains	5000	Johnson and Upham 1988; MacNeish 1993
Rincon Shelter	3057	Organ Mountains	4580	Johnson and Upham 1988; MacNeish 1993
La Cueva	2600	Organ Mountains	5436	O'Laughlin 1973
Sonrisa Shelter	2523	Organ Mountains	4720	Johnson and Upham 1988; MacNeish 1993
Peña Blanca Rockshelter	1970	Organ Mountains	4640	Johnson and Upham 1988; MacNeish 1993
High Rolls Cave	1500	High Rolls	6240	Lentz, personal communication
Fallen Pine Shelter	1410	Mescalero	6980	This report
Tornillo Rockshelter	1225	Organ Mountains	4832	MacNeish 1993
Honest Injun Cave	980	Guadalupe Mountains	3700	Applegarth 1976
Hooper Canyon Cave	940	Guadalupe Mountains	6300	Roney 1985
Hermit Cave	900	Guadalupe Mountains	5320	Ferdon 1946
Chavez Cave	Archaic	Hueco Mountains	4060	Cosgrove 1947
Pfingston No. 1	Archaic	Rio Ruidoso	5483	Kelly 1984; Higgins 1984
LA 6385	Archaic	Near Lincoln	5978	Kirkpatrick et al. 2000

Southwest suggests that procurement ranges may have covered hundreds of kilometers (Shackley 1990). But this is assuming that nonlocal material, such as obsidian, was obtained directly from the sources by the users (Huckell 1996:14). Exactly how wide-ranging these groups may have been cannot be determined without better age determinations and more excavation of a variety of Archaic sites.

Ceramic Period

Lehmer (1948) placed the ceramics of the Sierra Blanca region into three sequential phases—Capitan, Three Rivers, and San Andreas—beginning about A.D. 900. These phases were patterned after southern New Mexico ceramics, mostly brown wares. In the 1960s, Kelley proposed phase sequences specifically for the northern Sierra Blanca area, creating the Glencoe, Corona, and Lincoln phases (Fig. 4). Her system was also fairly basic, with broad architectural and ceramic generalizations characterizing each phase. At the time, she had only a limited number of sites upon which to base her distinctions and limited geographic distributions. Today, many more sites have contributed to the data base, and Oakes (2000), building on the remarkable work by Kelley, has reassessed the Sierra Blanca classification system.

Kelley's three ceramic phases are briefly presented here, because new research indicates many of the underlying tenets of these phases have changed somewhat over time. The beginning of the Glencoe phase is currently established at A.D. 900 (Farwell et al. 1992), which we suggest is no longer a valid date. It is unlikely, although not impossible, that people who already produced brown ware pottery did not move into the Sierra Blanca before A.D. 900. Are we to conclude that after Archaic occupations of the region ended at ca. A.D. 350, it was vacant until A.D. 900? In recent years, tighter dating controls and more excavations have shown that ceramics *were* produced in the mountains prior to A.D. 900 (for example, LA 30949, on the Mescalero Apache Reservation, A.D. 875 [Robinson and Cameron 1991]; Roberts Shelter, A.D. 875-1200 [Roney 1985:9]; and Beth's Cave, A.D. 624-813 [Adams and Wiseman 1994:10]). Therefore, we must recognize that the "begin date" for ceramic occupation of the region was earlier than A.D. 900, possibly as early as A.D. 600.

Kelley's parameters for the Glencoe phase (which extends to A.D. 1450) include small pithouse communities with some jacal structures. Pithouses have a tendency to be nearly square, but they can vary substantially (Kelley 1984:47). Interiors usually contain a basic cylindrical or basin-shaped central hearth and no other features. Kivas may be present in the later, larger communities. Vierra and Lancaster (1987:14) suggest that the

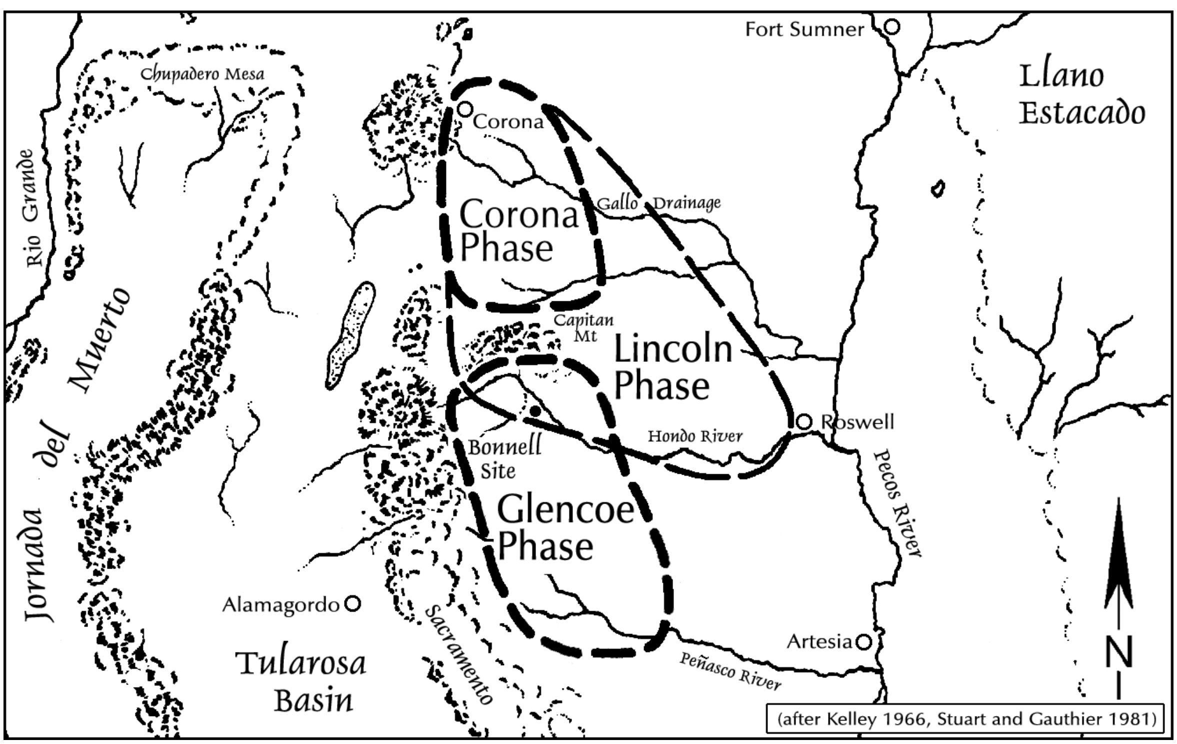

Figure 4. Geographic distribution of the Sierra Blanca phases.

labor invested in these pithouse structures does not necessarily indicate year-round occupation.

The assignment of a site to the Glencoe phase is based largely on pottery. The dominant type is Jornada Brown; however, Chupadero Black-on-white and Three Rivers Red-on-terracotta are also found at early sites, along with smaller numbers of Mimbres Boldface Black-on-white sherds. Also, some El Paso Brown wares begin to show up at this time. Later ceramics during this phase include El Paso Polychrome, some Lincoln Black-on-red, St. Johns Polychrome, and Rio Grande Glaze I. Minor representations of Gila Polychrome, Ramos Polychrome, Heshotauthla Polychrome, and Playas Red Incised may also occur late in the phase.

There could be a problem in grouping sites with Jornada Brown (which starts elsewhere in the region at A.D. 450), Mimbres Black-on-white (A.D. 1000), and Lincoln Black-on-red and Rio Grande Glaze I (A.D. 1300-1400) into the same Glencoe phase. With so many changes occurring in pottery, architecture, and social organization elsewhere in the Southwest during this time, is this broadly dated phase valid for the Sierra Blancas? The phase coexists with the following Corona (A.D. 900-1200) and Lincoln phases (A.D. 1200-1400). This has caused difficulties when sorting architectural, locational, and ceramic distinctions between the phases. However, the blurring of the phases often becomes unavoidable. The Corona phase was thought to occur only from the Capitan Mountains north to Corona (Kelley 1984:50). However, Corona-like sites have also been recognized in the Rio Bonito area (Oakes 2000) by the presence of slab-lined structures, a dominant characteristic of the phase. Pottery varies little from the Glencoe phase, with the possible addition of Red Mesa Black-on-white at some sites.

According to Kelley (1984), the Lincoln phase (A.D. 1200-1450) follows the Corona phase but encompasses a larger area and overlaps some of the contemporary Glencoe area. Architecture is notably different from that of other phases, with large adobe or masonry pueblos with plazas and possibly kivas. Pottery shows a much higher use of corrugated ware; Corona Corrugated mostly replaces Jornada Brown. Also present are El Paso Polychrome, St. Johns Polychrome, Gila Polychrome, Heshotauthla Black-on-white, and Rio Grande Glaze I. However, most of these types are also found in the Glencoe phase. Lincoln Black-on-red appears more strongly in the Lincoln phase. The Lincoln phase has been dated mostly by the presence of suites of pottery types, not unlike those from the Glencoe phase. But could architecture be a better indicator of change in the region than ceramics? There are sites with upright slabs that overlap chronometrically with sites without slabs, and the geographic boundaries of the phases, like those of pottery, also overlap.

Oakes (2000:15) attempts to isolate unambiguous variables that could be measured geographically and chronologically and match them to the existing phase sequences. To begin, no a priori geographic zones were established for the three cultural phases. Areas were defined by sorting specific variables. The entire ceramic sequence for the region was examined, and sites were sorted by the initial appearance of ceramic types, regardless of their location. Slab-lined structures were also mapped onto the neutral cultural landscape.

A chronological ordering of ceramic types was produced (Table 2). Six temporally ordered ceramic categories (Types I-VI) were created, and initial use was the most important determining factor in the study. Sites with these ceramic categories were then plotted onto base maps of the region (Oakes 2000:17-23). Geographic clustering does occur, but not in the pattern outlined by Kelley (1984) for the three phases.

Table 2. Chronology of ceramic types

Category	Ceramic Type	Date (A.D.)
I	Jornada Brown	450-1400
II	Mimbres wares	1000-1200
	Red Mesa Black-on-white	1050-1125
	Chupadero Black-on-white	1050-1125
III	El Paso Polychrome	1050-1550
	Gila Polychrome	1100-1450
	Three Rivers Red-on-terracotta	1150-1450
IV	Ramos Polychrome	1150-1520
	Playas Red Incised	1150-1350
	St. Johns Polychrome	1175-1350
	Mesa Verde Black-on-white	1200-1300
	Galisteo Black-on-white	1200-1400
	Santa Fe Black-on-white	1200-1450
	Corona Corrugated	1225-1460
V	Heshotauthla Glaze Polychrome	1275-1400
	Lincoln Black-on-red	1300-1400
VI	Glaze A (I)	1315-1425
	Glaze III	1450-1475

Oakes's research reveals that the breakdown of phases into geographic zones is somewhat ambiguous and creates a potentially serious problem for cultural interpretation. Overlapping of current phases, ceramics, and their boundaries occurs in every zone, and phase locations do not always correlate with ceramic or temporal sequences. As a result of the study, a working ceramic scheme for the region was produced (Table 2), allowing for classification of sites by pottery categories.

Phase designations were not used; however, they could easily be developed from the type categories with some necessary attention to the architectural correlates. This type of system is generally similar to what is in place today in other areas of New Mexico.

Excavations of Ceramic period sites have been few. The most recent is the Angus site, a Late Ceramic period roomblock with a kiva on the Rio Bonito (Zamora and Oakes 2000), High Rolls Cave (Lentz, in progress), and the Tortolita Canyon site near Nogal (Hard and Nickels 1994). Earlier excavations include the Crockett Canyon site (Farwell et al. 1992) and the Rio Bonito site (Vierra and Lancaster 1987), both on the river.

Lincoln National Forest has surveyed several areas in the project vicinity, recording sites ranging from Archaic to historic. Many are unidentified lithic artifact scatters with no diagnostic artifacts. Looking at sites in a 595 sq mile area, most are historic: log cabins, mine sites, homesteads, railroad beds, trash scatters, and portions of the Bonito pipeline.

Many of the formerly mentioned Archaic rockshelters also exhibit use by later Ceramic period populations, including Todsen, Peña Blanca, Rincon, Fresnal, La Cueva, and Hooper Canyon. A few shelters have only Ceramic period materials, including Ellis and Roberts Shelters (Roney 1985:9) and Beth's Cave (Adams and Wiseman 1994:10). The occupation of Fallen Pine Shelter extends from the 1400s B.C. to the end of the Ceramic period, in the A.D. 1400s.

Apache Occupation

The Apaches have a long history of occupation in the Sierra Blanca region, where the Mescalero Apaches continue to reside today. The Mescalero Apache Reservation encompasses 460,384 acres of mountainous terrain with steep canyons and narrow valleys. The present reservation was established by executive order on May 29, 1873. However, Apaches (if not specifically the Mescaleros) occupied the area for several hundred years before this.

It is difficult to identify early Apache sites archaeologically. Surveys on the Mescalero Reservation and Lincoln National Forest have found relatively few Apache manifestations. One hearth in Lincoln National Forest dated to 1625 ± 55 (Southward 1978). Beidl (1990) records a rock ring, a possible campsite, and a scatter with a metal tinkler as probably Apache. The Holloman site (LA 110997) at White Sands yielded 65 artifacts and 9 tipi poles with two cartridges dating to 1886 (Adams 1997:8). To the south, in the Guadalupe Mountains, Adams et al. (2000a and 2000b) have recorded two locations where military battles against the Apache have taken place. Three micaceous sherds classified as Athabaskan Plain were found at the Angus site on the Rio Bonito along with eight radiocarbon dates ranging in midpoint between A.D. 1400 and 1450 (Zamora and Oakes 2000). Peeled tree bark (ascribed to Athabaskan groups) has been recorded in the Sacramento Mountains, possibly dating to the late 1700s.

What we do know of early Apache lifestyles comes from Spanish accounts, but it can be assumed that the Apaches lived similarly in precontact days. Early Apaches sustained themselves by hunting and gathering. As Spanish (and later Anglo) contact increased, they survived by trading, limited agriculture, and raiding. Trade gave them corn, blankets, flour, sugar, salt, iron kettles, and clothing in exchange for buffalo hides, meat, and lard (Prince 1980b:81; Adams 1997:20). Agricultural pursuits consisted of planting corn and wheat in small plots and leaving them mostly untended throughout the growing season. After the 1870s the Apaches were also growing watermelons, cantaloupes, chili, beans, pumpkins, squash, and potatoes (Castetter and Opler 1936:38).

Shelters were called by several different names: lodges (built for several families), wigwams, tipis, camps, and *rancherías* (a group of structures). Tipis or wigwams were usually small (2.5-4 m in diameter) and dug 15-18 cm into the ground (Terrell 1972:53). Most housing was temporary or seasonal, and little remains archaeologically. Frameworks were of wood poles and branches, and hides were sometimes placed over them (Fig. 5). Large rocks were sometimes used to anchor the structures in place. Kilns used in preparing mescal were also a frequent feature of Apache sites. Adams et al. (2000b:6) also report that large piles of deer antlers sometimes signify an Apache presence. Aschmann (1974:199) notes that for the Western Apaches, storage was critical to their survival during winter and into summer. Families had up to 10 caches hidden in home localities or in disperse camping areas. These caches were in pits, rockshelters or caves, wickiups, and trees. The Mescalero Apaches may have used some of the same storage methods.

Artifacts recovered by Adams (1997) on Apache sites include metal projectile points, metal tinklers, drilled or punched coins, worked glass, glass beads, wire bracelets, pointed-bottom pottery, and bundle baskets. In 1534 Cabeza de Vaca saw Indians in the mountains with copper bells which they obtained from the Pueblos (Adams 1997:56).

The Apache presence was first recorded by Spanish explorers in the sixteenth century, although Apaches were certainly present in the region before then. With early Athabaskan occupation dates being pushed back into the 1400s in many areas of New Mexico as a result

Figure 5. Mescalero Apache campsite, ca. 1886. Photo by J. R. Riddle. Courtesy Museum of New Mexico, Neg. No. 76162.

of tree-ring or radiocarbon dating, it should be only a matter of time before sites in the Sierra Blanca region yield similar dates.

In 1534 Cabeza de Vaca encountered what may have been Apaches in the Guadalupe Mountains in the Pecos River area. He saw women with loads of ground corn and people wearing copper bells and buffalo robes which they obtained from the Pueblo Indians. The expedition also observed rabbit drives and deer hunts. In the houses, they noted mats and stored food (Bandelier 1972:109-112). Apache territory, at that time, apparently extended into the Plains east of the Pecos River, north beyond the Manzano Mountains to present-day Las Vegas, south past the Mexican border, and west to the Rio Grande (Basehart 1974:104-108). Walt (1980b) relates that in the early 1700s, Comanches moved down into the eastern plains, thus restricting the Apache range. Spanish populations in this region of the territory felt the effects of this territorial restriction and conflicts between the two soon arose. In the 1770s Spaniards led a major campaign against the Mescaleros of the Sierra Blanca and drove them to the east. Here they encountered Comanches again, and many lives were lost (Sonnichsen 1958:48). The Mescaleros sued for peace, and hostilities ceased until 1783, when Mescaleros were reported as far south as Mexico City (Thomas 1974:24). There was peace again between the 1790s and 1824 (Sonnichsen 1958:5), but the Apaches consisted of only a small number of families by this time (Matson and Schroeder 1957:354). In 1832 the Mexican Treaty provided rations and territorial access, but by 1846, the area was under American control. Although relations were friendly at first, raiding soon began again (Bender 1974:81; Walt 1980b:63).

Many military campaigns were waged against the Apaches of the region. By the 1850s the Sierra Blanca Apaches were trying to avoid contact with the Americans and stayed within their territory (Sonnichsen 1973:69). But the American government continually decreased their hunting and gathering range, thus increasing the necessity of raiding. In 1852 Governor William C. Lane signed a treaty with the Mescaleros providing rations for five years, but the government did not honor the treaty (Opler and Opler 1950:5). By 1854 raiding was prevalent throughout southeastern New Mexico. Basehart (1971:38) says that at that time there were as many as 26 leaders of the tribe. As a result, Governor David Meriwether intensified military actions against the Apaches.

Fort Stanton was established in 1855 to maintain control of the Mescalero Apaches. The Apaches did cease raiding, and a large band under Cadete settled near Fort Stanton that year (Schroeder 1974:599), while groups to the south continued to raid. However, the

Apaches that settled near Fort Stanton found their hunting and gathering range too small, and by the late 1850s, they were said to be near starvation (Sonnichsen 1973:85). They were not amenable to or able to provide food through farming, so many left the fort area and took the surrounding livestock with them to survive. The government agency at the fort cut off rations until the stock was returned. In 1856 livestock was returned, and raiding stopped again until 1861 (Sonnichsen 1973:90-98).

In 1861, Fort Stanton was abandoned as a military post as a result of the Confederate presence in southern New Mexico. The Confederates actually occupied the fort for a while but came under Apache attack (Walt 1980b:65). The surrounding landowners also suffered from Apache incursions. The United States reoccupied Fort Stanton in 1862, and resulting forays forced many Apaches to surrender (Sonnichsen 1973:106-113). They were sent to Bosque Redondo near present-day Fort Sumner. By 1863 there were over 400 Apaches at the Bosque. But the presence of Navajos also at the Bosque was sufficient to cause many Apaches to desert and go back to raiding. Most eventually returned to the Sierra Blanca area.

Tularosa, an early settlement to the west of the Mescalero territory, saw large-scale raiding by 1868 (Sonnichsen 1973:143-147). By 1870, however, the Apaches under Santana began to settle down and farm. But the lack of proper tools and seed for planting was a problem. The Mescalero Apache Agency, which oversaw the Mescaleros, was turned over to Mescalero religious leaders.

From 1873 to 1875, land extensions given to the Mescaleros could have led to greater productivity, but a smallpox epidemic and the Lincoln County War prevented any improvement in their living conditions. As a result of the Lincoln County War, fewer settlers remained in the territory. The Warm Springs Apache leader, Victorio, convinced many of the Mescaleros to leave the area with him and raid all across southern New Mexico. He eventually escaped to Mexico, where he was killed (Sonnichsen 1973:179-219). The Mescaleros returned to the Sierra Blanca region. The last military engagement against the Mescaleros took place in 1880 in Dog Canyon (south of Alamogordo), a stronghold of Apache groups. The army suffered great losses, but so did the Apaches. In 1881 Chief Nana and the Mescaleros went on one last raid. He also escaped into Mexico (Sonnichsen 1973:210). Troops stayed on the reservation until January 1883.

After military actions and Apache raiding ceased, modernization of the reservation began. Children attended local boarding schools, and log houses were built (Sonnichsen 1973:233-234). By 1885 there were 438 Mescaleros on the reservation (Schroeder 1974:567). In 1889, however, Anglo and Spanish ranchers were using Apache pasture lands under a federal severalty bill. By 1903 crop failures and high loss of life from tuberculosis left the Mescaleros in poor shape. At this time Albert Fall attempted to convert the Mescalero Apache Reservation into a national park because it adjoined his land and he didn't want problems with the Mescaleros. However, the bill never passed (Hertel 1980). By 1914 the government had increased the cattle herds, drilled new wells, and improved irrigation on the reservation. The first commercial timber sale, extending over 30,000 acres, took place in 1920.

In 1922 Congress confirmed Mescalero Apache title to the reservation (Dobyns 1973:80). In 1924 U.S. citizenship was granted to the Mescaleros. Prior to the late 1950s, cattle and timber were the major sources of income for the tribe. But by the end of the decade, the economy declined due to overgrazing, erosion, insect infestations, and wildfires. The search for new economic pursuits led to the development of the tourist and recreation industry. The Mescaleros bought the Sierra Blanca Ski Resort in the late 1950s, and in 1972 there was a hotel, a golf course, and two lakes on reservation property.

FALLEN PINE SHELTER (LA 110339)

Yvonne R. Oakes

Fallen Pine Shelter is a shallow limestone rockshelter within Cherokee Bill Canyon on the Mescalero Apache Reservation at 6,980 ft (2,127 m). It contains eight discrete occupation levels within the confines of the shelter and includes a roasting pit, several hearth areas, and a burial pit. The site was first recorded by Hohmann in 1995, who indicated there was potential for artifact deposition at the location. The shelter was subsequently tested for the presence of significant cultural deposits by Akins (1997) of the OAS. Cultural material was recovered to a depth of over 3.0 m in front of the shelter. It was determined that excavation of the shelter was necessary if highway work were to be conducted along U.S. 70 in the site vicinity. A data recovery plan was prepared (Akins 1997) and eventually implemented in November 2001.

A total of 5,785 artifacts were recovered from Fallen Pine Shelter (Table 3) and underwent in-depth analysis. Ceramics make up the largest percentage of artifacts (57.4 percent). There was a wide variety of ceramic types, but all are associated with a Jornada Mogollon occupation of the shelter. The projectile points ranged from small, Pueblo types to large Archaic varieties. Ground stone was present in surprising numbers (n = 69). All but a few are one-hand manos.

Table 3. Artifacts recovered from Fallen Pine Shelter

Artifact	Total	Percent of Total
Ceramics	3319	57.4%
Lithics	1194	20.6%
Fauna	1033	17.9%
Ground stone	69	1.2%
Projectile points	50	0.9%
Miscellaneous	35	0.6%
C-14 samples	85	1.5%
Total	5785	100.0%

The excavation area at the site measured 10.3 m north-south by 5 m east-west, an area of 52.5 sq m (Fig. 6), all within the highway right-of-way through Mescalero Apache land. The depth of excavations ranged from 0.22 m below ground surface to 3.60 m. An average of 1.62 m was removed from each 1 by 1 m grid, a total of 81.17 cu m of soil removed on the site.

Research Objectives

(adapted from Akins 1997 and Oakes 2001)

The most basic question to be addressed by the data recovery phase of this project was how groups with varying adaptations utilize the same locale and what this reveals about regional economic systems and social relationships. The use of this shelter, which could not have served as a full-time residence, implies some degree of mobility for all those who utilized this locale. At an elevation of 6,980 ft (2,127 m) in a ponderosa pine forest, Fallen Pine Shelter has a floor area of only about 12.5 sq m (Fig. 6). Yet this small rockshelter was utilized, and utilized repeatedly, for several thousand years. As a potential resource extraction area or way station between the Sierra Blanca region and the Tularosa Basin or Hondo Valley, the shelter was expected to provide a record of long-term and perhaps changing use of Cherokee Bill Canyon.

Previous inhabitants of the area faced a number of constraints. South-central New Mexico is characterized by severe weather and a short growing season in the mountains, while lowlands have variable water supplies and resources that tend to be scattered and subject to fluctuations in quality and quantity. These conditions are most effectively utilized by groups that exploit large regions and are highly mobile (Prince 1980b:80). While we cannot hope to reconstruct a complete record of the prehistoric groups using Cherokee Bill Canyon, this project can contribute to our understanding of the role of high-elevation resources in prehistoric economies.

Far more attention has been paid to hunter-gatherer mobility than to that of agricultural groups. The most common framework for describing hunter-gatherer subsistence and mobility is a continuum with foragers at one end and collectors at the other. Foragers occupy seasonal residences that are moved with respect to seasonal resource availability. Storage is not practiced, and members of the group range out from the base, taking food on an encounter basis and returning to the base for processing and consumption. Such a system produces two kinds of sites: a residential base where most processing, manufacture, and maintenance occurs; and a location where extractive tasks are carried out. Sites are scattered over the landscape and occupied for a short time, so few tools or other materials accumulate. Collectors rely more on a logistic strategy in which resources are gathered by task groups comprised of

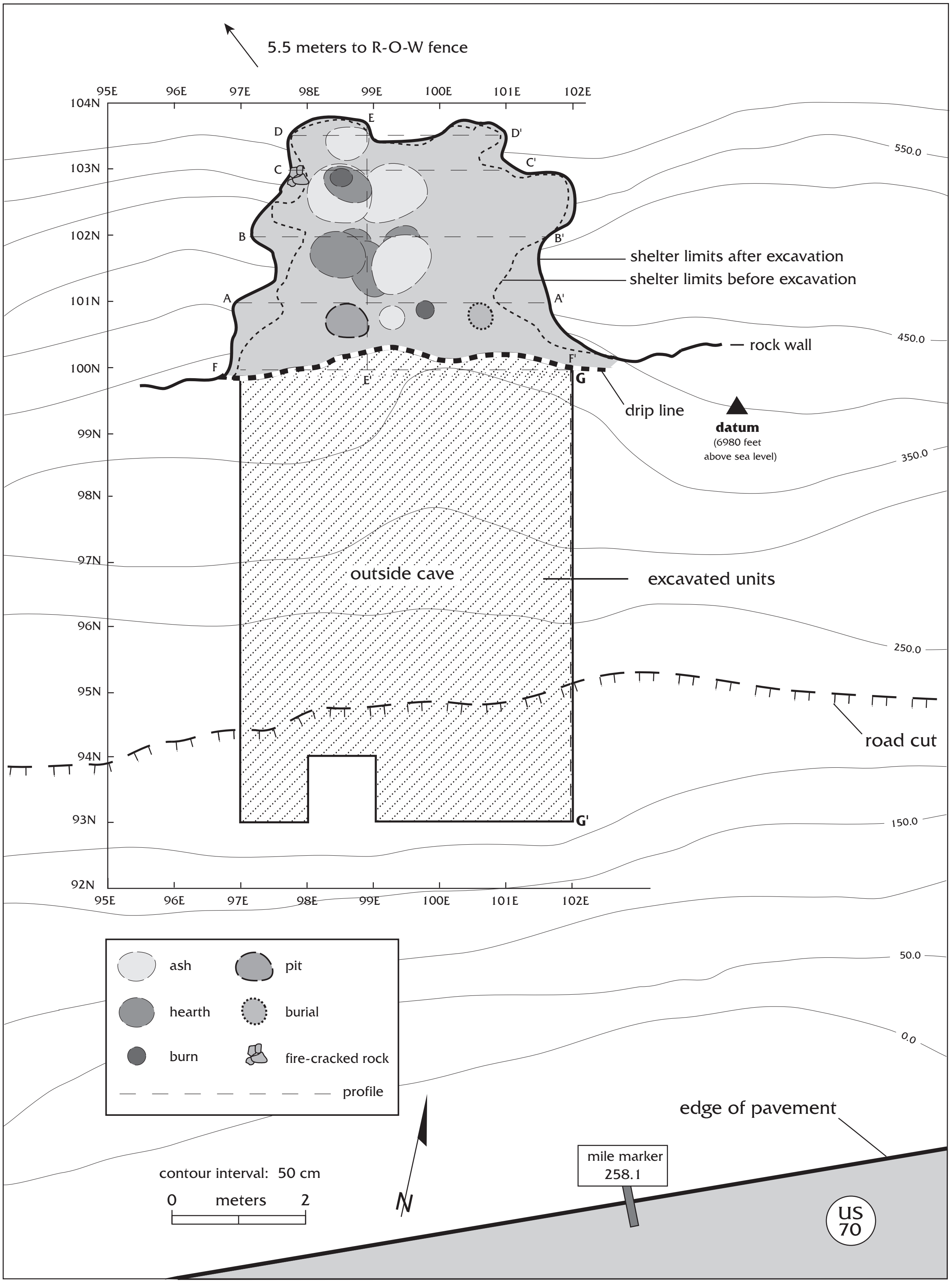

Figure 6. Plan view of Fallen Pine Shelter.

skilled individuals who leave camp for extended periods to acquire specific resources. Storage is practiced. Collectors produce not only residential bases and locations, but also field camps or temporary centers of operations where they eat, sleep, and maintain their tools; stations or information gathering locales such as hunting stands; and caches or field storage facilities (Binford 1983a:339-346).

Others have built on this framework and incorporated ethnographic data to develop general principals and expectations (e.g., Dean 1984; Chatters 1987). For example, the residential camps of foragers taking resources on an opportunistic basis should display more variability in taxa acquired than a task force seeking a narrow range of resources and operating out of a field camp (Chatters 1987:343-345).

Examining prehistoric use of southwestern mountain areas, Dean (1984) notes that hunter-gatherers exploit high-altitude resources somewhat differently from agriculturalists, especially when the resources sought are concentrated. When they are concentrated, hunters and gatherers locate their residential bases near these concentrations, and camps are used repeatedly, producing visible indications of use. Agriculturalists, whose residences cluster in arable areas, also exploit concentrated resources from base camps but return the resources to the residential site. Their base camps are of shorter duration but are again repetitive. Both hunter-gatherers and agriculturalists exploit dispersed or mobile resources through task groups that leave scattered short-term and largely invisible sites (Dean 1984:13-14).

While most researchers accept that agriculturalists also depend on hunting and gathering to meet their resource needs, the role of these alternative resources and the degree of mobility required is a frequent topic of discussion. Mobility and diversification are often viewed as coping strategies rather than integral parts of the subsistence system of agricultural groups (Rautman 1990:211; Minnis 1996:60). Others suggest the existence of parallel economies in southeastern New Mexico during the Ceramic period, one practicing agriculture, the other retaining a hunting and gathering adaptation (Sebastian 1989:83-84).

Material recovered from testing at Fallen Pine Shelter indicated that the site contained data that can be used to address prehistoric mobility and economic strategies in south-central and southeastern New Mexico. Both the lithic and the faunal data may demonstrate that the ceramic and preceramic occupations were distinctly different in both respects. Data recovery and analysis focused on defining these differences and their implications for archaeological studies in the region.

Problem Domains

Research concerns for Fallen Pine Shelter fell into three general categories or problem domains: chronology, assessment of site function, and regional settlement systems.

Chronology

Dating and chronology are always important issues in prehistoric research. Before we could compare the adaptations of the occupants of Fallen Pine Shelter, they were defined and related to site stratigraphy. Special efforts were made to determine if there was an Apache component to the site. Analysis of the upper level materials from the test pit gave no definite indications, however. Chronometric dating methods (radiocarbon and tree-ring dating) proved to be the best means to identify a relatively late use of the shelter.

Ceramic period deposits are dominated by long-lived brown wares and poorly dated painted wares. Chronometric dating in conjunction with relative dating, based on ceramic assemblages from nearby sites, helped determine the span of use by agricultural populations. Ceramic-bearing levels comprise much of the test pit fill and represent use over the entire Ceramic period. More intensive use occurred during the late Glencoe phase. A better understanding of chronology is necessary to relate the deposits to regional climatic patterns affecting agriculturalists.

The Archaic period, spanning a 6,000- to 7,000-year period, allows ample room for differing strategies by Archaic populations. The recovery of absolute dates helped define the character and duration of Archaic use of higher altitudes in the Sacramento Mountains.

Assessment of Site Function

Cherokee Bill Canyon and Fallen Pine Shelter probably served a number of needs throughout prehistory. We hoped that detailed examinations of the fauna and macrobotanical remains would provide an idea of the available resources, the seasons when they were utilized, and the extent to which they were processed for use at the site or to be returned to a base or residential site. Rates of trash deposition, the features present, and ground stone, lithic, and bone tool assemblages were used to provide additional information on the range of tasks carried out, group composition, and duration of occupation.

Once the activities represented at the site were defined and related to the chronological components, we attempted to determine the nature of use and changes in subsistence, mobility, and social interaction. Our test pit artifact data indicate that the Ceramic period occupants were agriculturalists who had contacts with groups occupying much of southern New Mexico. Their use of Cherokee Bill Canyon could be either as a regular resource extraction zone, where resources were hunted or collected and returned to residential sites, or as a stopping spot along an established exchange route. Similarly, the lower deposits were left by mobile hunters and gatherers. Whether their use of the canyon was more as foragers, repeatedly visiting the same area because of resources available as a part of an established seasonal round, or as collectors ranging out from a base to collect a seasonally available resource is unknown.

Regional Settlement Systems

This research domain involved integrating the chronological and site function data with that from the region as a whole. Data from Ceramic period residential sites are far more common than those from resource-extraction or other limited-activity sites and undoubtedly provide a biased view of subsistence and regional interaction. Data from all kinds of sites were used to complete our understanding of how agriculturalists utilize their environments. Comparing classes of data for similarities and differences between residential and limited-use sites helped to identify the ranges covered on a habitual basis as well as to trace occasional interactions with distant groups.

Archaic ranges, group sizes, and subsistence were addressed at a regional level. Abundance and predictability of critical resources often determine patterns of utilization (Dyson-Hudson and Smith (1978:25) at the local and regional levels. Data concerning resource availability and procurement of resources from Fallen Pine Shelter was compared with other sites with similar dates to help reconstruct seasonal patterns of utilization within a region.

Field Methods

The site was laid out in 1 by 1 m grids. A continuous profile of the midden area, and eventually the shelter, was obtained. All grids within and in front of the shelter were excavated to sterile soil. Excavations were conducted in 10 cm levels unless stratigraphic units or features were found. All fill was screened through 1/4-inch wire mesh. Soil within features was passed through 1/8-inch screen to recover small fragments of bone, lithics, and macrobotanical remains. OAS excavation forms were completed for each level of each grid. An east-west profile was produced for a line of grids in front of the shelter and within the shelter to provide additional information). The main profile ran north-south and pass through the shelter for a continuous record from the back wall of the shelter to the foot of the midden. Each feature was profiled, mapped, photographed, and recorded.

Macrobotanical sampling consisted of flotation samples taken from all features, various midden levels, within the shelter, and at the entrance area. Pollen samples were taken from the features on the site. Radiocarbon samples were taken whenever a concentration of charcoal was adequate for dating.

Analysis Methods

Prior to analysis, all materials were cleaned. The assemblage was analyzed by the general artifact categories of ceramics, lithics, ground stone, fauna, and macrobotanical and flotation remains. At the conclusion of the analysis, the artifacts, nonartifactual samples, and site and artifact documentation were returned to the Mescalero Tribe.

Laboratory analysis was conducted by the Office of Archaeological Studies staff and qualified professional consultants. Established analytical procedures and formats were utilized to address aspects of the problem domains.

Feature and Stratigraphic Information

Feature and stratigraphic information provide basic information on the duration and type of occupancy of the shelter. Large accumulations of debris imply long-term or repeated utilization of an area. When scarce, materials such as fire-cracked rock are reused and provide an unconventional source of data on availability and daily ranges. Numbers and types of features can indicate repeated occupancy: the more repetitive the occupancy, the more disruptive of feature integrity (Chatters 1987:346). Careful examination of feature and trash disposal helped determine the nature of the occupation and how this changed over time.

Ceramic Artifacts

The analysis addressed questions of when, where, and how Fallen Pine Shelter was utilized during the Ceramic period.

Dating. Studies included a careful examination of dating information from investigations in surrounding areas. We compared dating assignments from nearby sites with similar assemblages as well as those based on associated types. In particular, close attention was paid to the arguments concerning an ending date for Mimbres Black-on-white and beginning date for Chupadero Black-on-white.

Data from the fieldwork at Fallen Pine Shelter provided additional information concerning ceramic change and dating in this area. Distribution of types and attributes from stratigraphic sequences were used to examine potential temporal changes in ceramics.

Exchange and typology. Because spatially sensitive attributes such as paste and temper have long been used to define regional types, issues concerning typology and ceramic exchange are closely linked. For example, Jornada brown wares have been divided into spatially sensitive types based on slight differences in paste and granitic temper. The differences between Middle Pecos, El Paso, and Jornada brown wares, as previously defined, are based on the relative color and size of temper fragments. An important question was whether regional differences are in fact represented or if variation within various regional sources may be represented.

It is very likely that various painted types were produced in other regions and represent exchange with these groups or seasonal use of this locality by groups from other regions. Determination of the area of origin of painted types was attempted to provide important information on the nature of exchange and regional interaction; therefore, the visual characteristics of temper in Mimbres Black-on-white, Chupadero Black-on-white, El Paso Polychrome, and other painted wares were compared with information about these types from sites in other regions. A comparison of the dominant temper in probable local brown wares and decorated wares was used to help determine if some decorated vessels could have been locally produced.

Vessel form and function. The Fallen Pine Shelter assemblage is dominated by plain brown wares. While a variety of forms and treatments are represented, most brown wares are polished on both sides. The fairly wide range of ware groups and traditions probably reflects a wide range of uses associated with ceramics exhibiting various pastes, treatments, and forms. As much as possible, vessel form and wall thickness were used to assess mobility. Recent studies suggest that sedentary groups produce larger, heavier vessels that are less portable than those produced by mobile groups. But in some areas, thermal characteristics rather than portability was important in ceramic manufacture. Vessel size and wall thickness also provided clues as to what was processed (Whalen 1994:8).

Lithic Artifacts

Material selection. Material type, texture, and presence of cortex provided information on selection and whether the material was procured near the site or from a more distant location. Distinctive, nonlocal materials reflect the scale of mobility and interactions within the region.

Highly mobile groups tend to carry a limited number of tools, which may be smaller, lighter, and more multifunctional than those of less mobile groups (Shott 1986:19-20). Under such constraints, selection for materials suited to a variety of uses should be reflected in the types of material found. Groups with larger ranges have more opportunity to select suitable material resulting in the use of higher-quality local and nonlocal materials appropriate for the anticipated task. Exotic materials can serve as a measure of the scale of mobility (Binford 1983a:275).

Analysis from the testing program (Akins 1997) shows differences in material selection between the upper or Ceramic period and lower or Archaic period assemblages. More chert and obsidian are found in the Archaic component, indicating selection for flakability and sharpness, while the ceramic component has more durable materials. The larger assemblage from the data recovery phase allowed us to determine if this trend continues and address questions concerning the scale of mobility and factors influencing material selection.

Reduction technology. Numerous researchers have found that highly mobile groups invest substantial amounts of labor in tool production and produce high-quality implements that can be used for a number of tasks. Implements of less mobile groups have little modification and are discarded when they become dull or the task is completed (Whalen 1994). This dichotomy is often referred to as curated versus expedient technologies. Tools manufactured for future use and maintained, repaired, and recycled are curated tools. Expedient tools are produced when needed and used until dull, broken, or no longer needed (Chatters 1987:341). In the Southwest, curation strategies produced large unspecialized bifaces that were used for general chopping or cutting tasks, as cores for removing flakes for use as expedient tools, and as blanks. When bifaces are found in expedient technologies, these tend to be specialized in form and function.

As with material type, the Fallen Pine Shelter testing assemblage shows differences between the ceramic and Archaic components. The predominant strategy in the ceramic component was expedient, while that in the Archaic focused on the manufacture of curated tools. This distinction did not continue through the data recovery assemblage, and we were able to refine our observations on technology and address broader issues such as the degree of mobility.

Tool use. The size of the tool inventory, as well as the tools themselves, is smaller when mobility reduces transport capacity. Tools also become less specialized and more multifunctional (Shott 1986:20). In contrast, when groups set out to perform a specific task, the tool kit may include specialized tools and facilities carefully designed for a certain food type (Chatters 1987:337).

The types and diversity of tools provide information on activities that occurred at the site and on site function. Sites where a number of resources are processed and those that are occupied for extended periods of time should display evidence of a greater number of tasks. Field camps, where a narrow range of resources was exploited or the occupation was of limited duration, should contain fewer tool types (Chatters 1987:341).

The small testing sample of lithic artifacts from Fallen Pine Shelter produced two informal tools and three bifaces. The larger sample from the excavation provided better information on the range of activities that took place and how the shelter was used.

Ground Stone

No ground stone was recovered during testing. However, many pieces were recovered during the excavation. The specimens were examined for morphology, material type, manufacture, and evidence of specific processing activities using an established OAS format. Like lithic artifacts in general, the characteristics of grinding implements have implications for mobility and provide information on the resources that were processed. For example, one-hand manos and basin metates were mostly used for grinding wild seeds, while two-hand manos and trough metates indicate a heavy reliance on corn (Whalen 1994:9). Material selection, portability, and tool diversity was used to address issues such as mobility, seasonality, resource exploitation, and group composition.

Fauna

The faunal remains were analyzed using the methods described in Akins (1997). Special attention was paid to identifying the animals utilized, the season they were taken, the parts represented, and how the remains were processed.

In general, sedentary groups exploit a greater variety of animals than more mobile ones. They also depend more on smaller animals and use more traps, ambush hunting, and long-distance hunts (Kent 1989:3). Similarly, hunter-gatherer residential base camps from which groups hunt opportunistically should contain more diverse resources, while field camps are generally situated to acquire one or a few species (Chatters 1987:341). Species composition and seasonal implications for a larger sample of fauna from the shelter provided information on some differences in animal utilization over time. Comparison with assemblages from other sites, particularly sites in the Sierra Blanca region and residential sites, provided information on potential resources sought in Cherokee Bill Canyon. Speth and Scott's (1992:272) finding that Sierra Blanca sites show a shift toward greater use of large mammals, especially deer, was examined from the perspective of a potential resource-extraction area.

Species behavior and habitat preferences (Tainter 1984:25-26) can be used to examine the process of deciding which animals to hunt and the optimum size and composition of the hunting group. In a study of faunal data from the Sierra Blanca region, Driver (1985:59) found that assemblages from sites near extensive grasslands were dominated by pronghorn, while those near more dissected environs had more deer.

A great deal of attention has been devoted to determining which body parts are returned to a habitation or campsite. The general assumption, at least with larger animals, is that not all parts will be transported back to camp and that the parts left at the kill site are those with the least utility, generally those with small amounts of usable meat. This concept has been refined somewhat so that the variability in relative frequencies of parts is viewed as resulting from different strategies in the use of foods (Lyman 1994:224-225). Observations of modern hunters and gatherers have been used to produce indices reflecting the parts actually transported (Lyman 1994:234). When combined with data concerning survivorship of parts, these approaches were somewhat useful in comparing the assemblages at Fallen Pine Shelter, where the upper and lower deposits appear to reflect differences in mobility.

Bone fragmentation is often viewed as a measure of the degree of processing. Since consumption occurs proportionately more often at base and residential camps, and less often at field or logistic camps oriented to animal procurement, there should have been measurable differences in the assemblages from these site types, but there were not. Bone fragmentation may also serve as an indicator of food storage, so that bone crushing and marrow extraction is more likely when resources are low (Chatters 1987:344). Much of the Fallen Pine Shelter assemblage is small fragmented bone, presumably resulting from extensive processing. Analysis of a larger sample provided information on discrete areas of processing and differences in processing over time. These data were compared with those from other sites in the region to gain perspectives on processing at residential versus limited-activity sites.

Botanical Remains

The macrobotanical sampling strategy was designed to provide information on the resources utilized by the shelter inhabitants and their discard practices. Plant remains provide information on the kinds of resources sought, utilized, and perhaps brought to the shelter. Crucial to our understanding was determining the season or seasons of occupation and plant use.

Macrobotanical remains collected through water flotation were analyzed for species mix and seasonality. Special emphasis was placed on determining the species diversity and changes in diversity through time. Other macrobotanical remains were used to supplement this data.

Material densities were monitored to provide information on the quantity and spatial distribution of lost and discarded plant remains. Intensive analysis of material from the site provided baseline data for future research. Dispersal and preservation can be quantified and served as a guide for analyses of midden material.

Dry caves and shelters often contain quantities of perishable materials rarely found in open-air prehistoric sites. Fresnal Shelter, a much larger shelter between the Tularosa Basin and the Sacramento Mountains, produced plant remains from over 50 species (Bohrer 1973:211-218), coiled basketry, and twilled and twined matting (Allan 1973:403-405). Another, much larger shelter, Hermit's Cave, in the Guadalupe Mountains, contained sandals, coiled basketry, matting, cording, netting, fiber bundles, and grass rings (Ferdon 1946:7). Artifacts of this type were not found.

Human Remains

Human remains were encountered at Fallen Pine Shelter, and their treatment was determined by the Mescalero Apache Tribe. Excavation procedures followed Museum of New Mexico burial policy.

Research Results

This report on the excavations and analysis was published in the Office of Archaeological Studies' Archaeology Notes series. It describes the excavations, analyses, and interpretive results. Multiple data sets were needed to address complex issues concerning human adaptation, and this report endeavored to integrate the unique perspectives of each into a comprehensive assessment of the human use of Fallen Pine Shelter.

Field Methods

Fallen Pine Shelter is a very small opening (0.75 m high by 2.5 m wide) at the base of a steep limestone hill. Excavations expanded those measurements to 2.2 m high by 5 m wide). A dead ponderosa pine had fallen across the front of the shelter, and heavy duff and branches obscured much of the shelter from view (Figs. 7 and 8). All dead wood and loose pine duff were removed from the surface in front of the shelter. Sandbags had been previously placed across the front of the shelter by the Mescalero Apache to prevent flooding of the interior. These were also removed and placed along the sides of the excavation area for water control in case of heavy rains.

A primary datum was established 3.2 m east of the shelter, higher than the work area. Secondary datums were set up on the walls of the shelter as needed. A plan map was made of the area with an optical transit and stadia rod before excavations began (see Fig. 6). Next, a 1 by 1 m grid system aligned with the orientation of the shelter opening was laid out. Excavations initially proceeded in 10 cm levels, as dictated by the data recovery plan. All work was executed by trowel, brush, and shovel. Only a small amount of pick work was necessary. Generally, soils were screened with 1/4-inch wire hardware cloth except for the fill of features and pits, for which 1/8-inch wire mesh was used. All artifacts were bagged by type within levels in each grid provenience. Data sheets were completed for each level within each grid unit and a catalogue number assigned for each bag of artifacts. All features were photographed and drawn. Flotation, pollen, and radiocarbon samples were retrieved from features, where possible, and occasionally from general fill that contained charcoal specimens.

It was decided to first excavate a portion of the area immediately outside of the shelter to a depth of 1.1 m to evaluate the soil deposits and initiate a north-south soil profile (Fig. 9). All 1 by 1 m grids to the west of Grids 100E were excavated in 10 cm levels, gradually exposing a north-south profile. Work stopped at the Grid 101N line (also the drip line) to leave interior deposits intact for the present and to create an east-west profile extending across the entrance to the shelter (Fig. 10). It became obvious that stratigraphic levels, including floors, surfaces, or lenses, were not present in this outside area because of mixing of soil deposits over time, partially caused by the area lying just outside of the drip line of the shelter. However, artifacts, charcoal flecks, and much rock debris were present in the area. While discrete lenses were not visible in the soil deposits outside of the shelter, the 10 cm excavation units allowed for extremely good control over the changing ceramic types as site depth increased. The remainder of the outside midden area was taken down to 1.1 m to match the area west of Grid 101E. It was then possible to begin working into the shelter from the outside, in a standing position, without having to disturb or trample the fragile interior soils. The two stratigraphic profiles were maintained and continuously added to along the north-south and east-west lines of the shelter as excavations pro-

Figure 7. The shelter before excavation.

Figure 8. The shelter before excavation (side view).

Figure 9. Evaluating soil deposits.

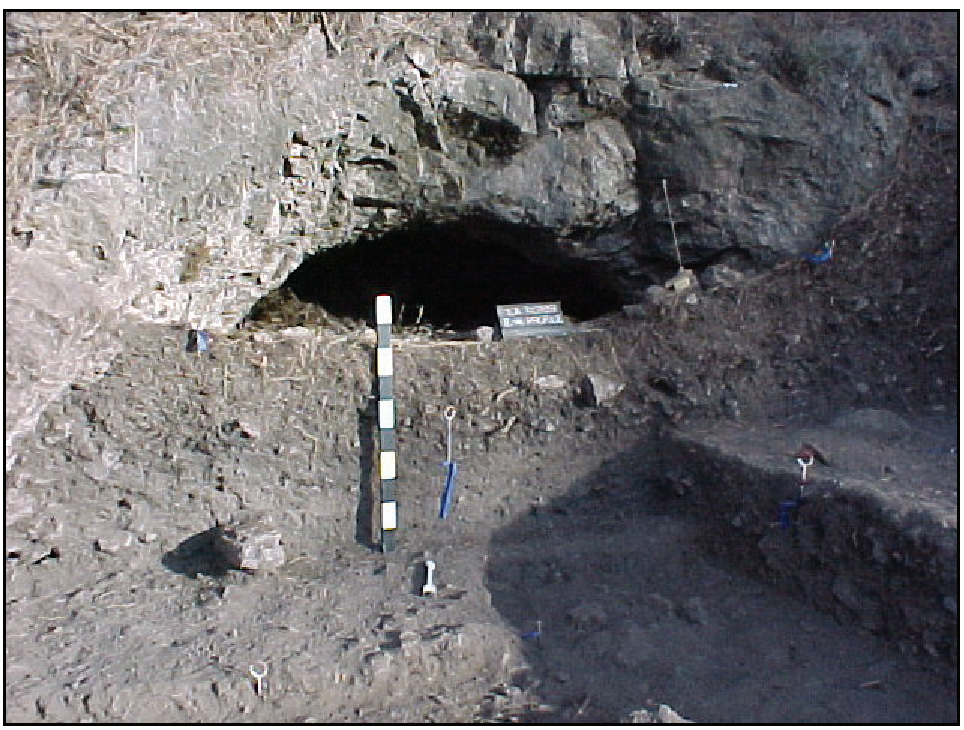

Figure 10. East-west profile.

ceeded (Fig. 11).

After finding a way to comfortably excavate the rockshelter working from the outside area to the interior, while also providing for an east-west profile, the soil from the rockshelter interior was removed in natural levels as it became clear that stratigraphic lenses were present. Eight occupation surfaces were uncovered, consisting of hard-packed dirt, which was sometimes difficult to trace and, in some cases, not present throughout the entire level. Each level ended when a compacted surface was encountered. All levels were numbered sequentially as each occupation surface was encountered. Most surfaces had at least one expedient hearth and sometimes an associated ash deposit. Level 4 contained the burial pit of a small child, probably of Jornada Mogollon descent, based on associated artifacts in the surrounding fill and a nearby radiocarbon date. An arbitrary cultural break between Ceramic period and Archaic levels was identified between Levels 4 and 5 (or Levels 5 and 6 in some cases), where ceramics dropped off decidedly and Archaic projectile points greatly increased in frequency. Excavations ceased when limestone bedrock was encountered at a maximum depth of 2.85 m below the surface (Fig. 12) of the rockshelter interior.

Features and Stratigraphy

Fallen Pine Shelter consists of a small rock shelter with a 12.5 sq m interior containing eight utilized surfaces inside of the shelter and a large trash midden outside of the structure. Numerous stratigraphic profiles were drawn of the various cultural levels, mostly of the interior of the shelter. Interior features described below are shown in the following profiles (Figs. 13-17) and plan view (Fig. 18). This report will discuss the site by levels and their associated features within the shelter and, then, outside of it. Note that overlapping levels occurred as excavations proceeded because of the west-trending nature of the surfaces within the shelter. There was no overlap within individual grids, only from grid to grid.

Within the Shelter

Level 1 (0.22-1.88 m). Excavation began on the east side of the shelter, where soil deposition was the highest. Excavations were in 10 cm levels until a surface or soil change was noted. The uppermost fill of Level 1 (15-35 cm) consisted of very loose, loamy soil mixed with much packrat dung and collections, including pine cones, needles, oak leaves, piñon shells, acorns, and twigs. Below this, the soil was silty and gray (7.5 YR 3/2 on the Munsell scale; Fig. 19). Features or objects of interest within Level 1 include a large packrat nest, two modern hearths, a human coprolite, a compacted surface, and several ash piles.

Both hearths were high in the fill of Level 1. One produced a modern C-14 reading. In Grid 103N/98E, at a depth of 1.50-1.66 m, large limestone rocks had been used to shelter a small, roughly circular hearth dug into the silty soil (Feature 3). The entire bottom had been disturbed by rodent activity. The hearth measured 60 by 33 cm and 16 cm deep. One shell button, five pieces of animal bone (four of skunk and one of medium-sized artiodactyl, all showing possible use as food) and five ceramics (probably introduced by rodent action) were recovered from the disturbed hearth. No radiocarbon date was obtained for this feature, but it sits higher in the fill than the modern hearth in the adjoining grid to the south and is undoubtedly historical.

The lower hearth (Feature 2) in Grid 102N/98E at a depth of 1.65-1.83 m was also basically circular, measuring 80 cm in diameter with a depth of 18 cm. Soil within the hearth was charcoal-stained and silty with charcoal fragments (Figs. 20 and 21). Within the hearth two sherds and four animal bones were recovered, including one woodrat, two skunk, and one medium-sized artiodactyl. The C-14 assay showed the hearth was modern with an uncalibrated date of 1910 ± 50 years.

A slight surface compaction was noted at 1.66-1.71 m below datum in the front of the shelter in Grid 101N/99E, but it only extended for 50 cm into the interior and had no artifacts associated with it (Fig. 13). The surface extended into the midden area for approximately 60 cm but then disappeared. Another compaction was found in the adjacent grid (101N/100E) at 1.72 cm and is probably associated with it. Excavations continued to a depth of 1.80 to 1.88 m in the front grids of the shelter, where a very compacted surface was found with a sherd embedded in it. This surface did not extend outside of the shelter into the trash area and was very poorly preserved on the east side of the structure.

A small burn area (Feature 1) was located on the floor of Level 1 in Grid 101N/99E at 1.80-1.84 m, measuring 20 cm in diameter (Fig. 13). It may be the remains of an expediently built hearth.

A human coprolite was recovered in Level 1 at 1.40-1.50 m depth in Grid 102N/99E. It was not associated with any feature but may be of Pueblo period origin.

Four piles of ash were discovered within Level 1 at various depths. In Grid 103N/99E, a large ash pile (Ash 1) was found at 1.72 m and extended for several levels down to the floor of Level 3 at 2.16 cm. It measured 80 cm in diameter. In Grid104 N/98E, another large ash pile (Ash 2) began in Level 1 at 1.70 m depth and extended down to the floor of Level 2. It measured 48

Figure 11. North-south profile.

Figure 12. Excavated shelter, facing north.

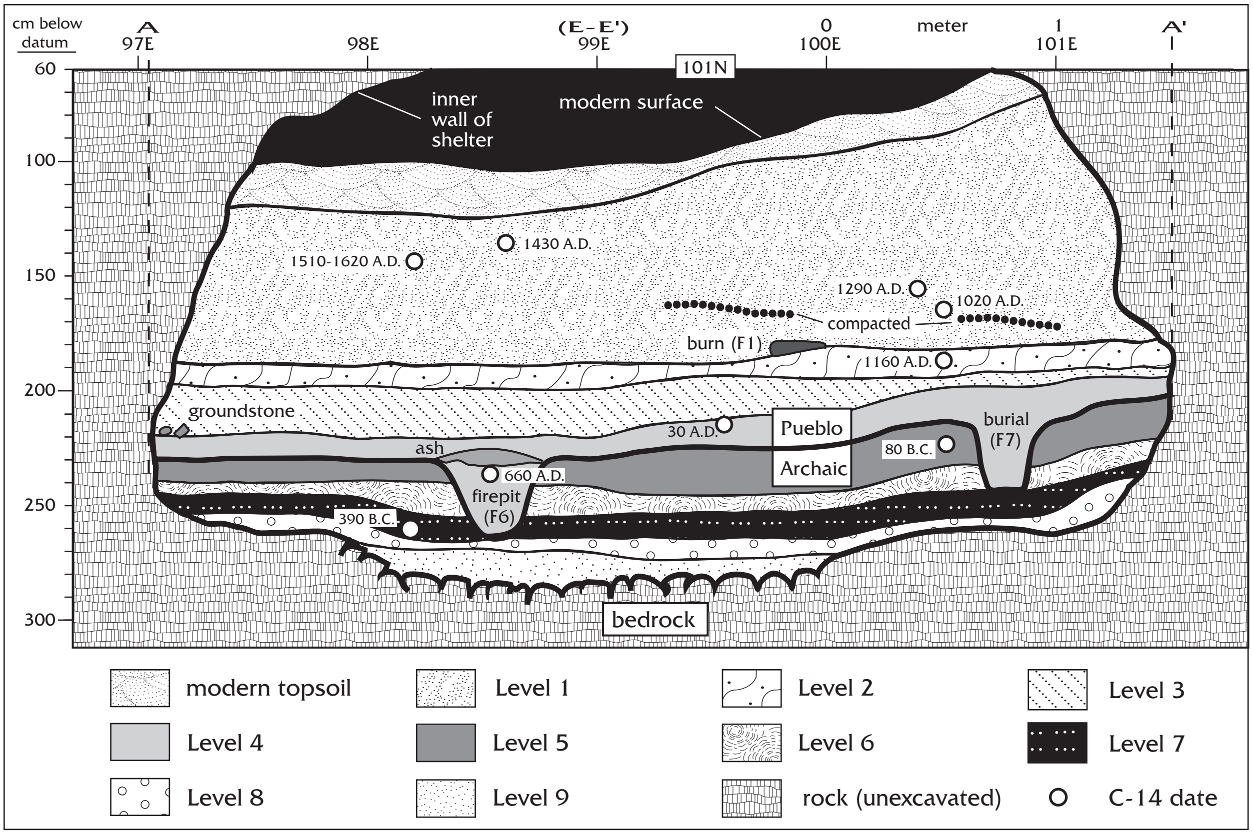

Figure 13. Profile of shelter at Grid 101N.

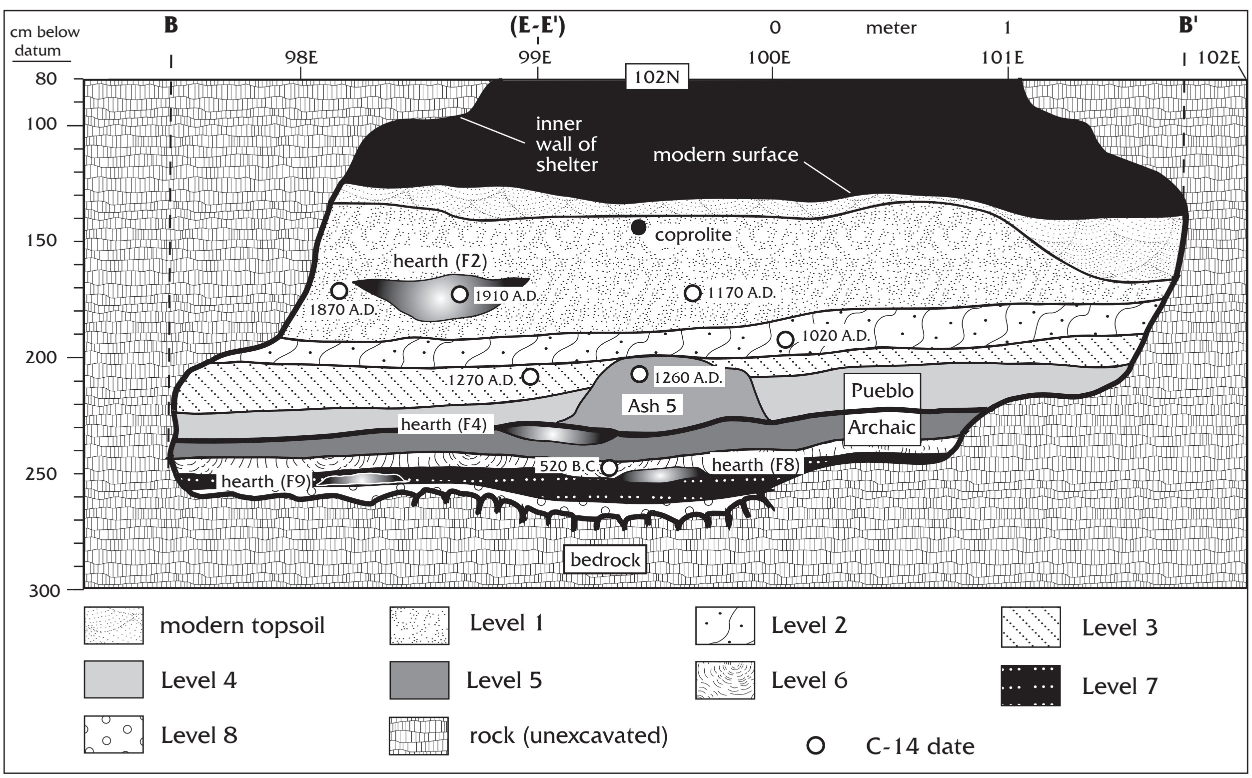

Figure 14. Profile of shelter at Grid 102N.

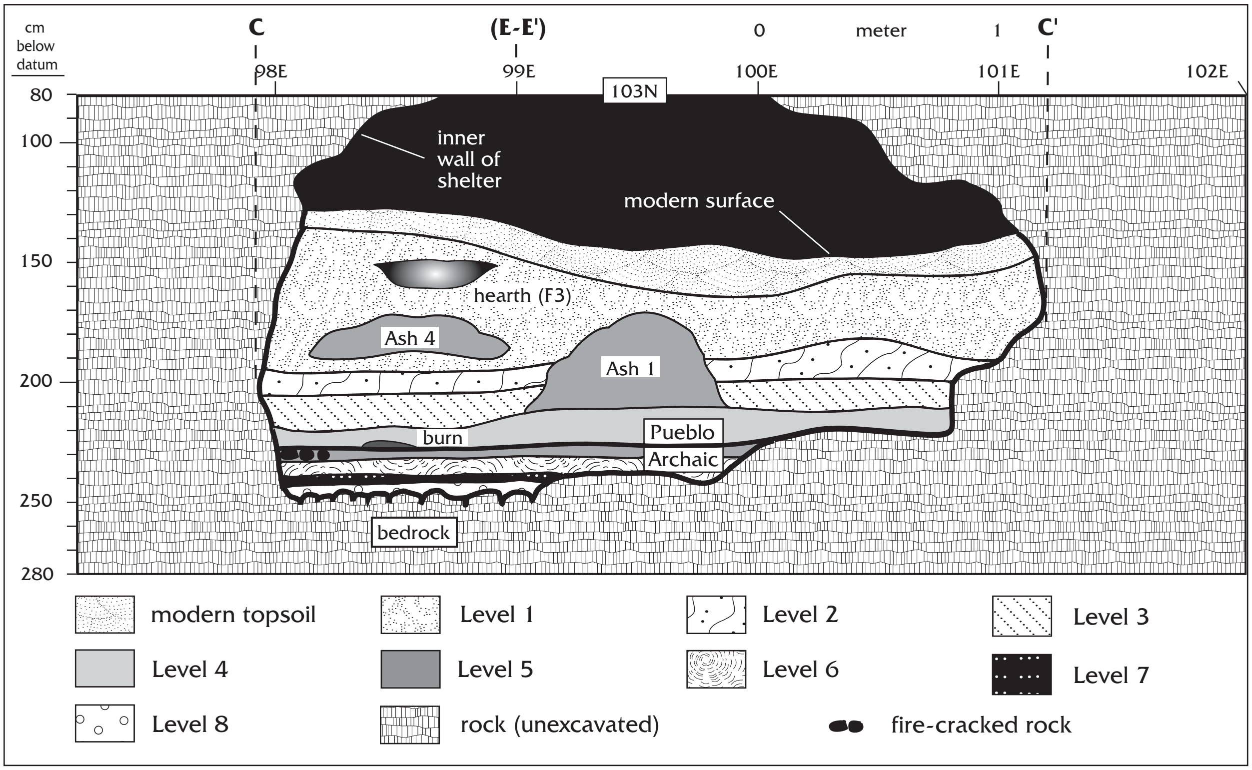

Figure 15. Profile of shelter at Grid 103N.

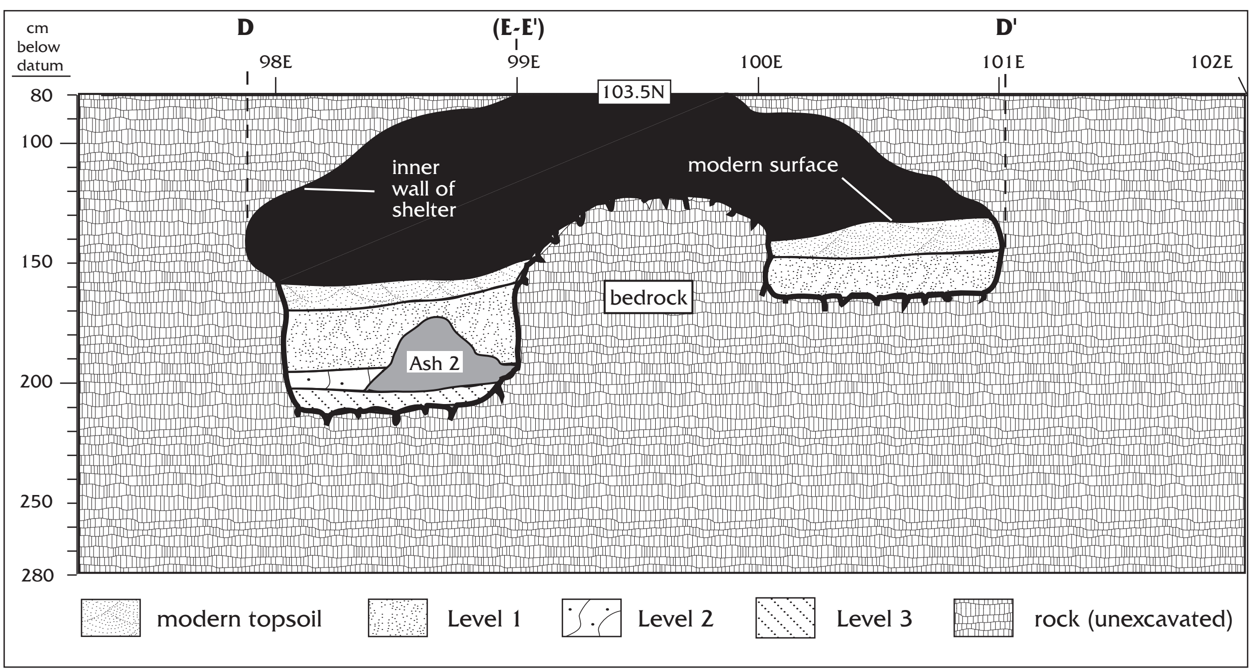

Figure 16. Profile of shelter at Grid 103.5N.

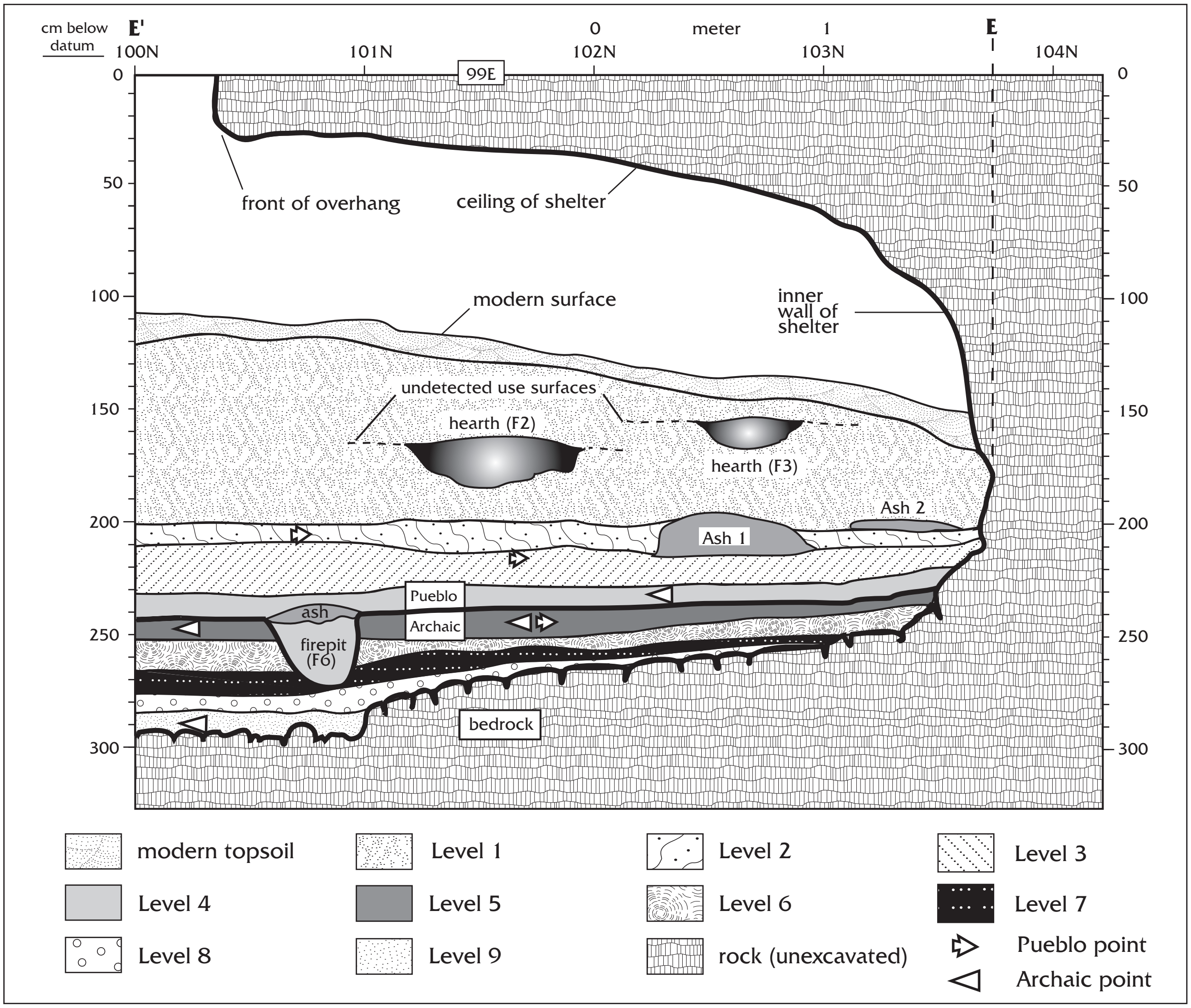

Figure 17. North-south profile of shelter at Grid 99E, facing east.

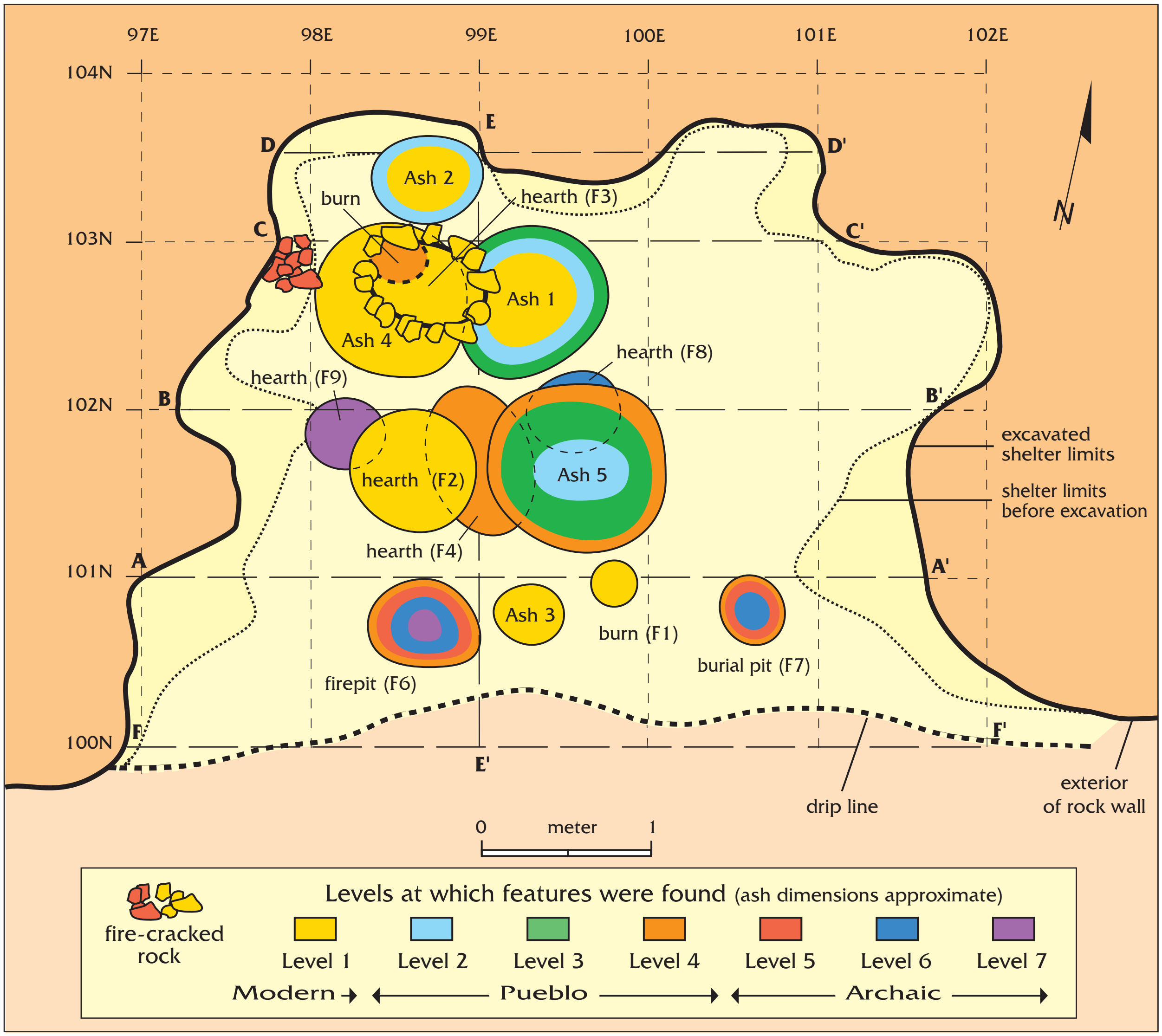

Figure 18. Plan view of shelter features, showing levels of occupation.

Figure 19. Soil profile of Level 1.

Figure 20. Hearth (Feature 2) in Level 1.

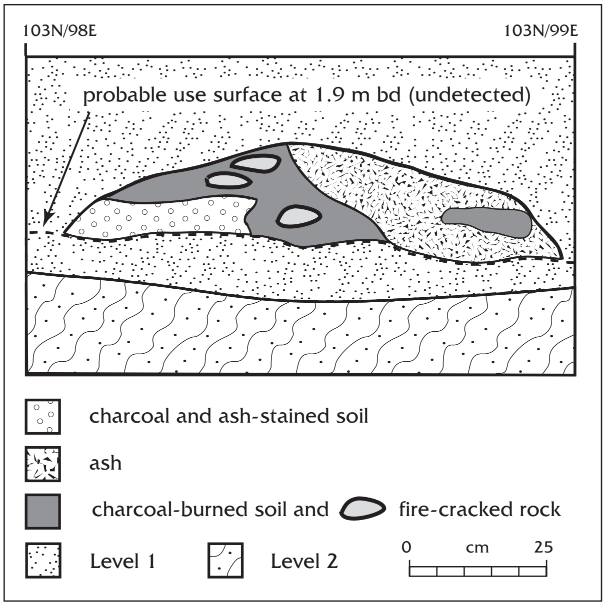

Figure 21. Profile of Ash 4 in fill of Level 1.

cm in diameter and was 32 cm high. In Grid 101N/99E, a small concentration of ash (Ash 3) was located on the floor of Level 1 at a depth of 1.80-1.84 m. It measured 28 cm in diameter. The final ash pile (Ash 4) was in Grid 103N/98E at a depth of 1.73-1.90 m and covered an area of 80 cm (Fig. 21). A surface below this ash concentration could not be found.

The bottom of Level 1 was found at 1.80-1.88 m below datum. The utilized surface was well-compacted except on the west side, where there was much wall fall in the form of medium-sized spalls. Charcoal and ash staining were prevalent on the surface, particularly in the back of the shelter. Artifacts embedded in this surface include three sherds (one a Chupadero Black-on-white) and a projectile point.

Thirteen C-14 samples were taken from Level 1. Table 4 shows results by depth, and all dates are calibrated intercept dates. The appearance of earlier dates in the stratigraphy above later dates indicates a mixing of soils within Level 1.

Level 2 (*1.81-2.05 m*). The fill of Level 2 was charcoal-flecked and ashy with fine, silty soil. Three cm above the surface in Level 2 within Grid 102N/ 99E (Figs. 14 and 18) was a white ash compaction (Ash 5) measuring 26 cm wide. It proved to extend on through the levels below and also into Grid 103N/ 99E (Figs. 22 and 23). Another ash pile (Ash 2) was located in Grid 104N/98E. It also continued below the Level 2 floor. It had a surface measurement of 44 cm wide by an eventual height of 24 cm. Numerous Pueblo period artifacts were recovered from this level within the rockshelter. Three radiocarbon dates were obtained within the fill of Level 2, with calibrated intercept dates of A.D. 1020, A.D. 1250, and A.D. 1160.

Level 3 (1.93-2.19 m). This level had a well-compacted surface (Fig. 23) that was charcoal-flecked and greasy in appearance and touch when scraped. The ash concentrations from Level 2 (Grids 102N/99E and 103N/99E) extended through the fill to deeper occupation surfaces below (Figs. 14 and 15). Other areas on the surface contained ash staining, possibly vestiges of expedient hearths. A mano and metate fragment were found on the surface of Level 3 in Grid 101N/97E, against the wall of the shelter. Numerous Pueblo period artifacts were also found in this level. A radiocarbon date of A.D. 1260 was recovered from the charcoal within Ash 5. A related date of A.D. 1270 was obtained from the fill of Level 2 near the ash pile. One date of A.D. 1250 and two of A.D.1020 were also obtained from Level 3.

Level 4 (2.05-2.32 m). The bottom of Level 4, in most areas of the site, marked the cultural break between the Pueblo period occupation of the shelter and the Archaic, based on the cessation of sherds and the presence of Archaic projectile points. This level exhibited the most intensive occupation in the shelter. A fire pit, a burial pit, an ash pile, a hearth, and a burn area were found. Feature 6 is a small fire pit dug into the Level 4 occupation level (Fig. 24) in Grid 101N/98E. It measured 60 by 40 cm with a depth of 36 cm. The upper 12 cm is composed of white ash and some charcoal pieces from which a C-14 sample returned a calibrated intercept date of A.D. 660. Ceramics, animal bone, and a few lithic artifacts were recovered from the fire pit.

The burial pit (Feature 7), in Grid 101N/100E, was also dug into the Level 4 surface (Fig. 25). The pit contained the tightly flexed remains of a small child. Two

Table 4. Calibrated intercept dates, Level 1

Grid	Depth (m below datum)	Date (A.D.)
101N/100E	1.3-1.4	1410
101N/98E	1.3-1.4	1430
101N/98E	1.4-1.5	1510-1620
98N/101E	1.5-1.6	900
101N/100E	1.5-1.6	1290
102N/98E	1.5-1.6	1910
102N/98E	1.5-1.6	1870
99N/101E	1.6-1.7	640
101N/98E	1.6-1.7	1290
101N/100E	1.6-1.7	1020
99N/101E	1.7-1.8	450
102N/99E	1.7-1.8	1170
102N/99E	1.8	1170

Figure 22. Utilized surface, Level 2, with large ash stain (Ash 5) in center of shelter.

Figure 23. Well-compacted surface in Level 3. The white ash (Ash 5) is still visible in the shelter.

Chupadero Black-on-white sherds had probably fallen into the pit during preparation of the feature. The pit measured 30 by 36 cm at the top and was 29 cm deep. It likely dates to the same time as the fire pit since it was on the same floor level.

Ash 5 ended on the floor of Level 4. The area was intensely burned and oxidized to a bright red hue.

On the use-surface of Level 4, slightly north of the fire pit, were the remains of Feature 4, an extremely oxidized hearth (Fig. 26). It measured 78 by 56 cm in diameter and was 13 cm deep. It contained white ash with no charcoal. Figure 27 shows the relationship of the fire pit and oxidized hearth.

A small burn area was found on the floor in Grid 103N/98E. It measured 18 by 22 cm. A calibrated radiocarbon intercept date of A.D. 30 was recovered from the fill of Level 4.

Level 5 (2.07-2.45 m). This level contained a small pile of nine pieces of fire-cracked rock in Grid 103N/98E toward the back of the shelter. Soil in the grid was heavily charcoal-stained with a greasy surface. The fire-cracked rock was lying within this stained area. A hearth (Feature 4) built directly on the surface of Level 5 is assumed to have been present during the Archaic period.

Level 6 (2.26-2.55 m). An expedient hearth (Feature 8) was found on the utilized surface of this level in Grid 102N/99E in an area of 51 by 43 cm. The soil was oxidized to an orange-red color, and much ash was present. The hearth had not been dug into the surface. A few pieces of fire-cracked rock were also present. In the fill near the hearth, a calibrated radiocarbon intercept date of 520 B.C. was obtained.

Level 7 (2.36-2.65 m). A hearth (Feature 9) was discovered in Grid 102N/98E at this level. It measured 30 by 23 cm and was located in the northwest corner of the grid. It had not been dug into the utilized surface, but rather expediently placed on the surface. Ash, some charcoal, and a few pieces of fire-cracked rock were concentrated here. A C-14 sample was obtained from the fill of the adjoining area (Grid 101N/98E) and produced a calibrated intercept date of 390 B.C. Level 7 was discontinuous in the eastern half of the shelter, abutting bedrock.

Level 8 (2.39-2.75 m). In many grids, Level 8 ended on bedrock, bringing an end to most excavations within the shelter. No features were found at this lowest occupation level.

Level 9 (2.41-2.82 m). This level was reached only in the front of the shelter in Grids 101N/98 and 99E. It lay directly above bedrock, but no occupation surface was present at this depth. Several artifacts, including a large projectile point, were present, however.

Outside of the Shelter

The west half of the midden area outside of the shelter, to the south, was excavated in 10 cm levels to an initial depth of 1.80 m to evaluate the resulting north-south and east-west soil profiles. While no cultural surfaces were located except for two very small areas that extended from the shelter, the resulting profiles did reveal some gradual soil changes.

East-west profile. The profile was taken from directly in front of the shelter opening (Fig. 28; see Fig. 10). A top layer of modern depositional soil (Layer 1), loamy in nature and of dark brown color, contained pine duff, grasses, tree roots, and some large rock spalls. This material disappeared at a depth of about 1.35 m, and the soil became black and very silty with much charcoal staining and some pieces of charcoal. Artifacts were visible in the profile.

Although Figure 10 does not show the soil below 1.80 m deep, the matrix did change at 1.35 m depth (Layer 2) to dark brown. It was semicompacted and somewhat clayey with more rock spalls than in the layers above. Artifacts were still present in this layer. A dark charcoal lens was observed in the profile within Layer 3 at a depth of 1.75 m; however, it dissipated within the midden area. Beneath Layer 3 was yellowish-brown, sterile-looking soil directly above bedrock. A few artifacts were recovered from within this layer, however.

The layering observed in the profile of Figure 28 did not hold for the remainder of the trash area. Distinctions could not be made between any layers except for the modern topsoil and the yellow-brown soil above bedrock. Also, the cultural surfaces within the shelter were not found within the midden. No layering was found in this outside area, probably because of exposure to the elements and erosion.

North-south profile. A north-south profile was maintained outside of the shelter throughout excavations as soils in each level on the west edge of Grids 100E were removed (Fig. 29). Absolutely no cultural breaks were seen in the profile except for the obvious layer of modern topsoil. Another profile was taken on the eastern edge of excavations showing the exact slope of the landscape. A portion of this profile can be seen in Figure 30. Because of the lack of stratigraphy, excavations outside of the shelter proceeded in 10 cm levels, which allowed for control over artifact placements on the site.

The profile in Figure 29 reveals limestone spalls throughout, with larger rocks and boulders toward the bottom of excavations. Many tree roots, some large, extended throughout the upper half of the profile. Soil color changed about halfway down the profile. Upper

Figure 24. Fire pit (Feature 6) on Level 4 floor, Grid 101N/98E.

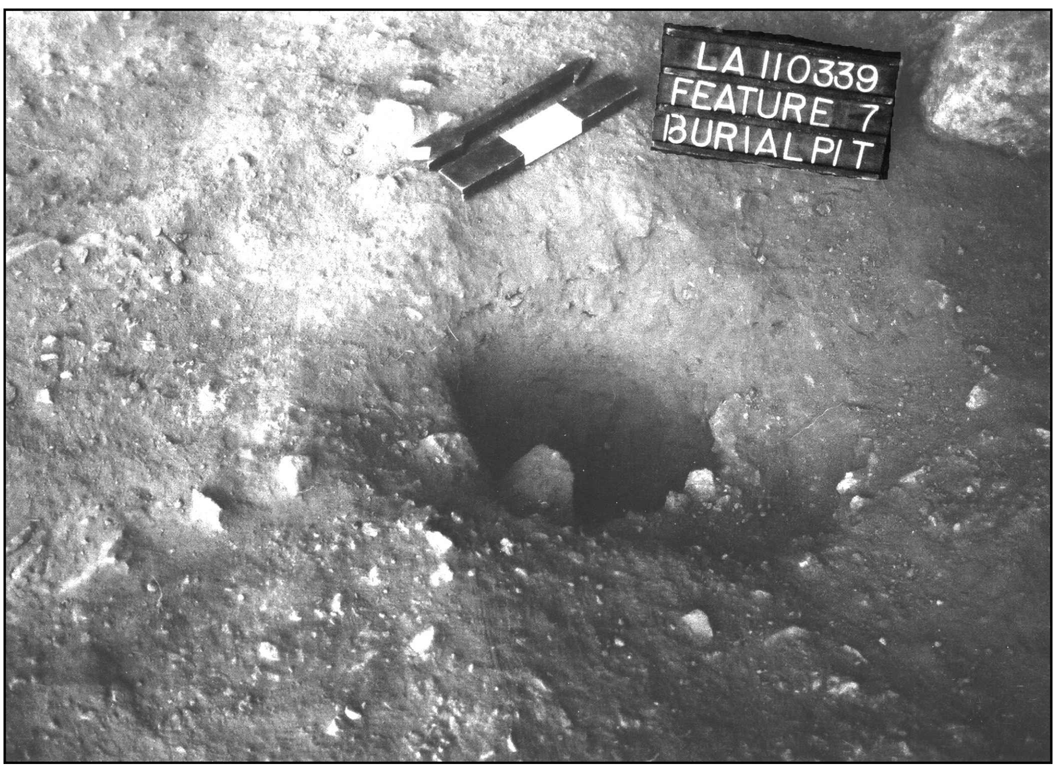

Figure 25. Burial pit (Feature 7) in Level 4 floor, Grid 101N/100 E.

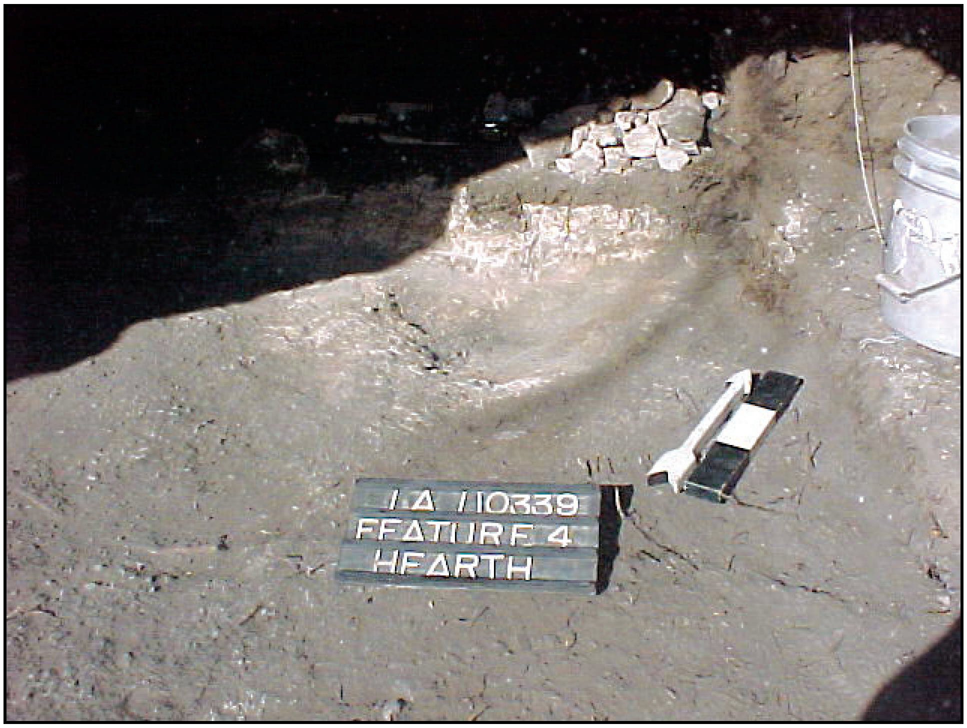

Figure 26. Hearth (Feature 4) in Grid 102N/99E, with heavy oxidation.

Figure 27. Surface of Level 4, showing relationship of ash pile (white) and hearth (red).

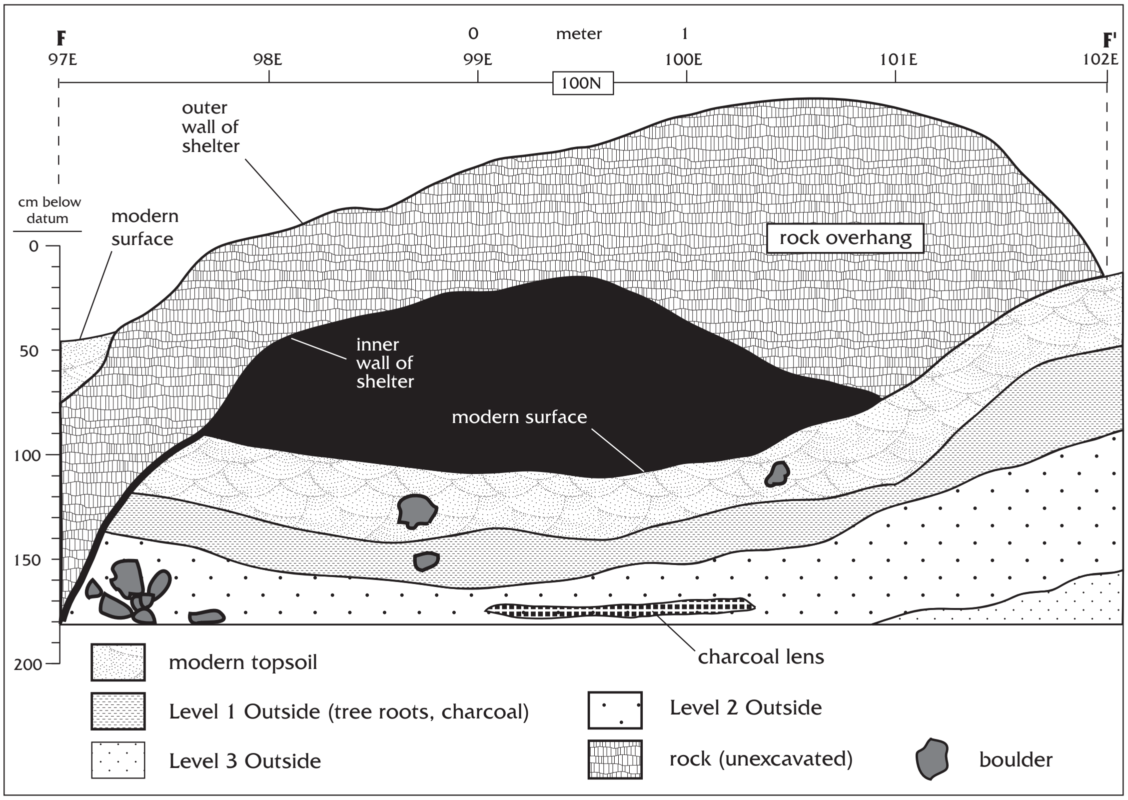

Figure 28. East-west profile across front portion of shelter before excavation.

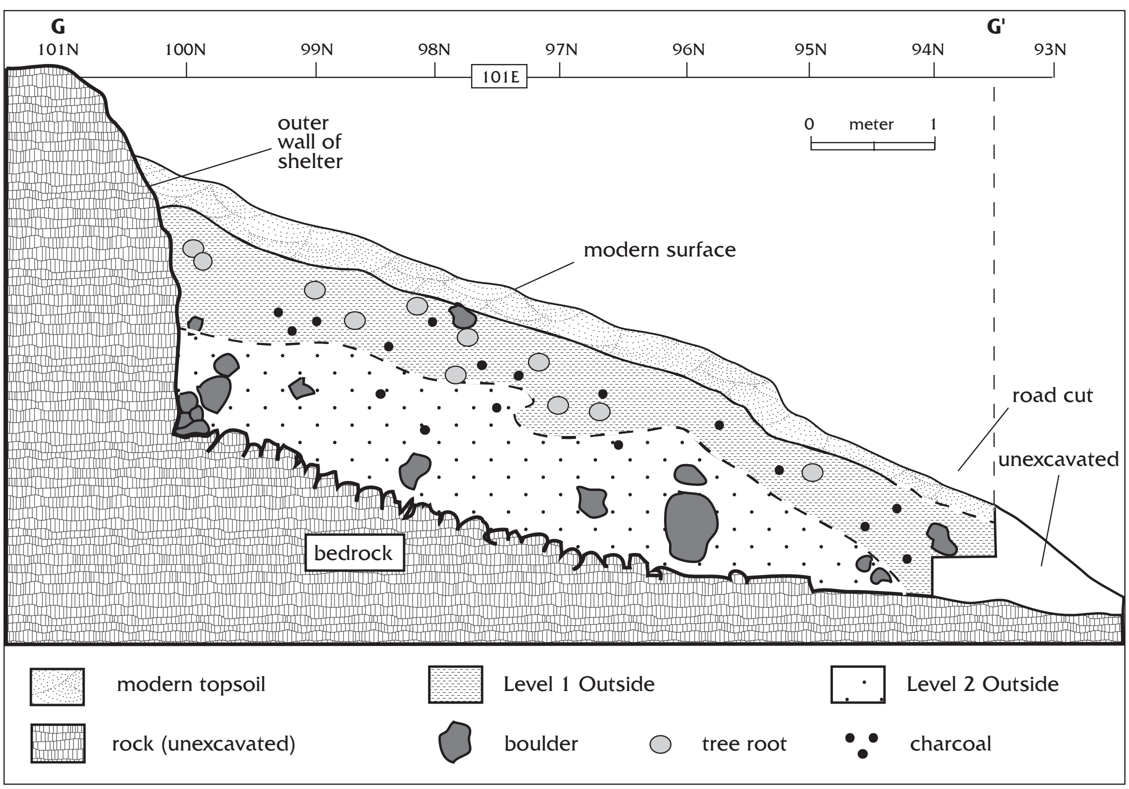

Figure 29. North-south profile outside of shelter.

soils were dark brown, while lower soils were yellowish brown. It was not difficult to determine when the yellow-brown horizon was reached (Fig. 30). Interestingly, artifacts did not end at this point; they continued almost all of the way down to bedrock.

Excavations extended south from the shelter opening for 6 m, whereupon soil was found to be greatly disturbed from the original blading of the slope for the construction of U.S. 70. Also, shrubbery had disturbed the soil. Excavations ended at a depth of 3.60 m below datum when bedrock was encountered. Distinctions between Pueblo and Archaic occupations could not be made on the basis of soil changes; rather, they were determined by the presence or absence of ceramics, the presence of diagnostic Archaic projectile points, and several radiocarbon dates.

Artifact Summary

The 5,785 artifacts retrieved from Fallen Pine Shelter consisted of a full spectrum of items ranging in time from the Archaic period to the late ceramic (see Table 3). They are briefly discussed below, and in greater detail in the chapters that deal with artifacts. Artifacts recovered from the testing program are not included in the discussion.

Ceramics (n = 3,319)

The sherd assemblage exhibits a time line of presence in Fallen Pine Shelter from the early Pithouse period to the late ceramic at ca. A.D. 1400. Most ceramics (70.0 percent) consist of the ubiquitous Jornada Brown Ware, found throughout all time periods in the region. A late Ceramic period El Paso Brown ware and Chupadero Black-on-white are also strongly represented. Glaze ware and Playas Red ware are minimally present. The frequency of ceramic types indicates that the heaviest utilization of the shelter took place between A.D. 1000 and 1200.

Lithic Artifacts (n = 1,180)

The lithic artifact assemblage consisted mostly of core flakes (81.2 percent). Cores represent 6.7 percent of the total artifacts and angular debris only 12.1 percent. Material types for the lithic artifacts overwhelmingly consisted of cherts of various types. The majority cannot be sourced, but two types are available in the nearby southern Tularosa Basin, including San Andres and Rancheria. This is true of both the Archaic and Pueblo assemblages. Obsidian (n = 5), sourced to the Valle Grande and Cerro Toledo, is present in small amounts, mostly associated with the Archaic occupation

Figure 30. The completed excavation. Bedrock and part of the north-south profile are exposed.

of the shelter.

Formal tools from the site consisted of 50 projectile points, 10 bifaces, 23 scrapers, and a graver. The cores (n = 76) are mostly unidirectional (76.6 percent) and made mostly of chert. The 50 projectile points range from 36 large Archaic dart forms to 14 small Pueblo types. Their numbers indicate that a considerable amount of hunting and related activities occurred on the site. Scraping of objects, such as hides, is thought to also have been a fairly consistent site activity.

Ground Stone (n = 69)

Ground stone recovered from Fallen Pine Shelter includes 42 manos (only one is a two-hand mano), 14 metates, a few polishing stones, abraders, a shaft straightener, a lapidary stone, and a hammerstone. Most ground stone was found, surprisingly, in the Archaic levels (63.8 percent of the assemblage). Material types selected by site occupants are mostly local sandstone (49.3 percent), followed by limestone (15.9 percent) and granite (13.0 percent), with smaller amounts of basalt, rhyolite, quartzite, and quartzitic sandstone. The 14 metates are mostly of indeterminate shape, but three slabs and one basin type were also recovered. The grinding of seeds, plants, and fibers definitely occurred on the site, and some corn was ground by later Pueblo groups.

Miscellaneous Artifacts

Three pieces of freshwater mussel shell used for ornamentation, a polished limestone pendant fragment, and a piece of unmodified chrysocolla were recovered from the excavations. The pendant and mussel shell were found in the Archaic levels.

Ancillary Studies

Faunal Remains (n = 1,033)

A large number of faunal remains were recovered from Fallen Pine Shelter. Most are medium-sized artiodactyls (up to 73.9 percent), probably deer. Large birds, or turkeys, are also well-represented (10.0 percent). Interestingly, rabbit representation is low (2.4 percent). However, 3.3 percent of the fauna consists of prairie dogs, gophers, and woodrats with indications, such as burning, that they may have been consumed by late occupants of the shelter.

Only 10 bone tools were found at the site. They include spatulates, an awl, two beads, and a flaker. The beads and flaker were from the Archaic deposits; the rest are from the Pueblo levels.

Human Remains

A child buried within a small pit inside of the shelter and portions of an adult male scattered in the trash midden in front of the structure were recovered from the site. The child burial had no goods associated with it and, based on associated radiocarbon assays, probably dates to the early Pithouse period. The middle-aged adult male is likely of Archaic origin. The child was reburied by the Mescalero Apaches soon after its removal from the pit and was not analyzed for pathologies.

Human Coprolite

A single human coprolite was recovered from Grid 102N/99E in the northwest corner of the shelter. It was at a depth of 140-150 cm within the large packrat midden and probably was brought up from the Pueblo levels to the midden by packrat activity. Found within the specimen were grass stems, some corn, and particles from the mustard family.

Macrobotanical Remains

A total of 11 flotation samples were taken from the several hearths and pits within Fallen Pine Shelter. Evidence of corn use and possibly storage in ceramic containers was found. Cupules and cob fragments were recovered from the Pueblo levels. Other economic species included squash, grasses, pigweed, goosefoot, sunflower, charred morning glory, mint, cattail, nightshade, mesquite, mustard family, and various species of cactus.

Pollen Remains

Fifteen pollen samples, including 11 pollen washes, were retrieved from the shelter. Corn was recovered from within hearths, on ceramic sherds, and on manos. Corn was definitely processed at the site; however, it all can be assigned to the Pueblo occupation. Other palynological remains that may have seen economic utilization include cheno-ams, grasses, sagebrush, cholla cactus, mesquite, Mormon tea, narrow leaf cattail, and mustard parts. Mesquite is not available in the immediate vicinity of the shelter and can be found , instead, at lower elevations to the west toward the Tularosa Basin. Portions were found adhering to ceramic vessels.

Obsidian Sourcing

Five obsidian samples were submitted to S. Shackley for source identification. All come from the

Jemez Mountains in the Valle Grande and Cerro Toledo complexes. Three of these pieces do not indicate riverine transport because they are angular, which suggests procurement at the source or the existence of a trading partnership.

Dating of the Site

Dating of the cultural deposits at Fallen Pine Shelter is based on ceramic cross-dating and radiocarbon analyses. Ceramic dating gives us definitive spans of dates, usually within a 100 to 300 year time frame. However, the technique often relies on ceramic dates obtained from outside of the immediate region of study and, therefore, could cause some skewing of the data. Therefore, the wide range in the dates of many southeastern New Mexico ceramic types leaves the begin and end dates for the different levels within the shelter somewhat subjective.

Radiocarbon samples were obtained from charcoal deposits recovered in hearth fill or within the general fill of the site. An effort was made to retrieve radiocarbon (C-14) samples from each of the eight levels present. Of 85 radiocarbon samples collected from Fallen Pine Shelter, 38 were submitted for dating analyses to Beta Analytic, Inc. The remaining samples have been sorted and submitted to the Mescalero Apache Agency for storage. All dates have been calibrated from conventional to calendar years, corrected, and processed for isotopic fractionation (Table 5 and Fig. 31). The time span of the radiocarbon dates is approximately 3,300 years.

As can be seen in Table 5, which is sorted from uppermost to lowest levels, there is a major problem with the chronological sequence of the obtained results, specifically, the apparent use of old wood for hearth fuel and the mixing of upper levels into lower ones within the shelter. Smiley (1994:169-170) indicates that the use of dead wood for fuel, for example, can cause the wood age to be overestimated by 200 years or more. To compensate for this problem, we looked at general periods of occupation of the shelter rather than matching a specific date to a single level.

Of the 38 radiocarbon dates obtained, two are very recent, from hearth areas near the top of the deposits within the shelter (FS 386 and FS 389). They indicate use within the mid-1800s to the early 1900s. Sheep dung found at these upper levels suggests that sheepherders and their sheep used the shelter during this time.

Of the 36 remaining dates, 12 are associated with a Late Archaic occupation of the shelter, the most recent at approximately A.D. 30 (using the intercept date for simplification in discussion) and the oldest at 1410 B.C. Table 5 presents the exact range of possible dates. This is a time span of 1,400 years, indicating a long period of utilization by Archaic people. The Archaic C-14 dates, however, reveal three periods of probable use during this time rather than continuous use: four dates between 80 B.C. and A.D. 30, some at 1100 to 1040 B.C., and a clustering between 1410 and 1260 B.C. Use of the shelter actually could have been much more frequent during these 1,400 years; however, these are the only times for which we have definite dates of use, based on charcoal derived from hearths.

Quite a few Archaic-type projectile points (n = 36) were recovered from Fallen Pine Shelter. Several are associated with specific time periods: Late Archaic (1500 B.C.-A.D. 500): Hueco, Shumla, Pendejo, and San Pedro; and Middle Archaic (3200-1500 B.C.): Fresnal, Armijo, Augustin, Augustin-Gary, and San Jose. The general dates for the Late Archaic projectile points from the shelter coincide nicely with the available radiocarbon dates from the Archaic period. However, there were 10 probable Middle Archaic points dating before 1500 B.C. for which there are no corresponding radiocarbon dates. Were these points curated by later Archaic or Pueblo peoples, or was there an actual Middle Archaic presence at the shelter that left no datable materials, such as charcoal, in association?

The remaining 23 dates correspond to a Pueblo period occupation of the shelter beginning in A.D. 240 and extending to possibly A.D. 1600. At least seven occupations are represented by the dates. Two periods of very late occupation are seen at A.D. 1410-1510 and A.D. 1600-1640. A cultural affiliation for the 1600s date is problematic. It could be Pueblo or Athabaskan: there were no artifacts that could be definitely tied to this date. The A.D. 1400s dates are likely to indicate Late Pueblo use, because several glaze ware sherds were recovered in these upper levels.

The two periods of heaviest utilization during the Pueblo period are A.D. 640-790 (six dates) and A.D. 1120-1290 (eight dates). Many of the ceramics (El Paso Polychrome, Chupadero Black-on-white, and Playas Incised) derive from this same time period of Late Pueblo occupation (or the Glencoe and Lincoln phases, as they are frequently called). This period seems to represent the major utilization or repeated utilization of the shelter. Earlier Pueblo dates recovered from the shelter extend from A.D. 450 back to A.D. 240. These dates, along with the six dates from A.D. 640-790, are relatively rare in this area of New Mexico and reveal definite use of features within Fallen Pine Shelter during Early Pueblo times. Many levels within the shelter contain only early ceramics, such as Jornada Brown, confirming an Early Pueblo utilization.

In summary, the shelter appears to have been used over the long span of time indicated by the radiocarbon and ceramic dates. Both Archaic and Pueblo occupa-

Table 5. Radiocarbon dates for Fallen Pine Shelter

Grid	Depth (cm)	Beta No.	Field No.	Conventional C-14 Age (B.P.)	1 Sigma Date	2 Sigma Date	Intercept Date	Extra Counting
101N/100E; 101N/101E	130-140	167033	83/69	540±50	A.D. 1400-1430	A.D. 1300-1440	A.D. 1410	
101N/98E	130-140	167037	229	480±70	A.D. 1410-1460	A.D. 1310-1360; A.D. 1390-1520; A.D. 1590-1620	A.D. 1430	extended
101N/98E	140-150	168872	237	350±60	A.D. 1460-1640	A.D. 1430-1660	A.D. 1510; A.D. 1600; A.D. 1620	extended
101N/100E	150-160	168873	361	710±60	A.D. 1270-1300	A.D. 1220-1400	A.D. 1290	
98N/101E	150-160	167036	190	1140±60	A.D. 810-840; A.D. 860-980	A.D. 770-1010	A.D. 900	
102N/98E	150-160	167041	386	80±50		modern		
102N/98E (hearth)	150-160	167042	389	40±50		modern		
101N/98E	160-170	174878	260	710±60	A.D. 1270-1300	A.D. 1220-1400	A.D. 1290	
99N/101E	160-170	167038	264	1430±60	A.D. 580-660	A.D. 530-690	A.D. 640	
101N/100E	160-170	167040	370	1010±50	A.D. 990-1030	A.D. 960-1160	A.D. 1020	
99N/101E	170-180	167039	267	1580±60	A.D. 410-550	A.D. 370-620	A.D. 450	
102N/99E	170-180	167043	441	890±50	A.D. 1040-1210	A.D. 1020-1260	A.D. 1170	
98N/98E	180-190	167034	115	1120±50	A.D. 720-740; A.D. 760-880	A.D. 680-910; A.D. 920-960	A.D. 790	
101N/100E	180-190	167046	602	910±50	A.D. 1030-1190	A.D. 1020-1240	A.D. 1160	
98N/98E	190-200	167035	140	1240±60	A.D. 690-880	A.D. 660-910; A.D. 920-960	A.D. 780	
101N/100E	190-200	174883	781	800±60	A.D. 1190-1280	A.D. 1060-1080	A.D. 1250	extended
102N/99E (ash pile)	190-200	167047	613	780±70	A.D. 1200-1290	A.D. 1060-1080; A.D. 1150-1300	A.D. 1260	
102N/100E	190-200	137051	775	1010±70	A.D. 980-1040	A.D. 890-1180	A.D. 1020	
101N/98E	200-210	174882	743	990±70	A.D. 990-1060	A.D. 900-1200	A.D. 1020	
102N/98E	200-210	167049	721	770±60	A..D 1220-1290	A.D. 1170-1300	A.D. 1270	
98N/100E	200-210	174879	397	1240±80	A.D. 680-890	A.D. 650-980	A.D. 780	extended
99N/100E	210-220	167044	446	1780±60	A.D. 150-340	A.D. 100-400	A.D. 240	
99N/101E	210-220	174880	435	2010±80	B.C. 100-A.D. 70	B.C. 200-A.D.140	B.C. 10	
101N/99E	210-220	167052	852	1980±60	B.C. 40-A.D. 80	B.C. 110-A.D. 130	A.D. 30	
97N/99E	220-230	167045	504	1370±60	A.D. 640-690	A.D. 580-770	A.D. 660	extended
100N/98E	220-230	174881	543	2040±100	B.C.180-A.D. 70	B.C. 360-A.D. 150	B.C. 40	extended
101N100E	220-230	167054	982	2080±60	B.C. 180-30	B.C. 350-310; B.C. 210-A.D. 50	B.C. 80	
101N/98E	230-240	167053	901	1370±70	A.D. 630-690	A.D. 560-780	A.D. 660	
97N/98E	240-250	167050	750	1730±60	A.D. 240-400	A.D. 140-430	A.D. 330	extended
102N/98E; 102N/99E	240-250	167057	1076/1123	2440±60	B.C. 760-620; B.C. 590-410	B.C. 790-390	B.C. 520	extended
101N/100E	245-255	174881	1154	2890±70	B.C. 1190-970	B.C. 1290-900	B.C. 1040	extended
101N/98E	260-270	167060	1169	2320±60	B.C. 410-370	B.C. 520-350; B.C. 310-210	B.C. 390	extended
100N/99E	280-290	167055	986	2700±40	B.C. 880-820	B.C. 920-800	B.C. 830	AMS
98N/100E; 99N/100E	290-300	167056	1047/1053	3000±60	B.C. 1360-1360; B.C. 1320-1130	B.C.1400-1030	B.C. 1260	
98N/100E	310-320	167061	1195	3050±70	B.C. 1400-1210	B.C. 1400-1100	B.C. 1310	extended
98N/100E	320-330	167062	1220	3140±90	B.C. 1500-1310	B.C. 1610-1190	B.C. 1410	extended
97N/99E	330-340	167063	1270	2910±80	B.C. 1250-990	B.C. 1380-900	B.C. 1100	extended

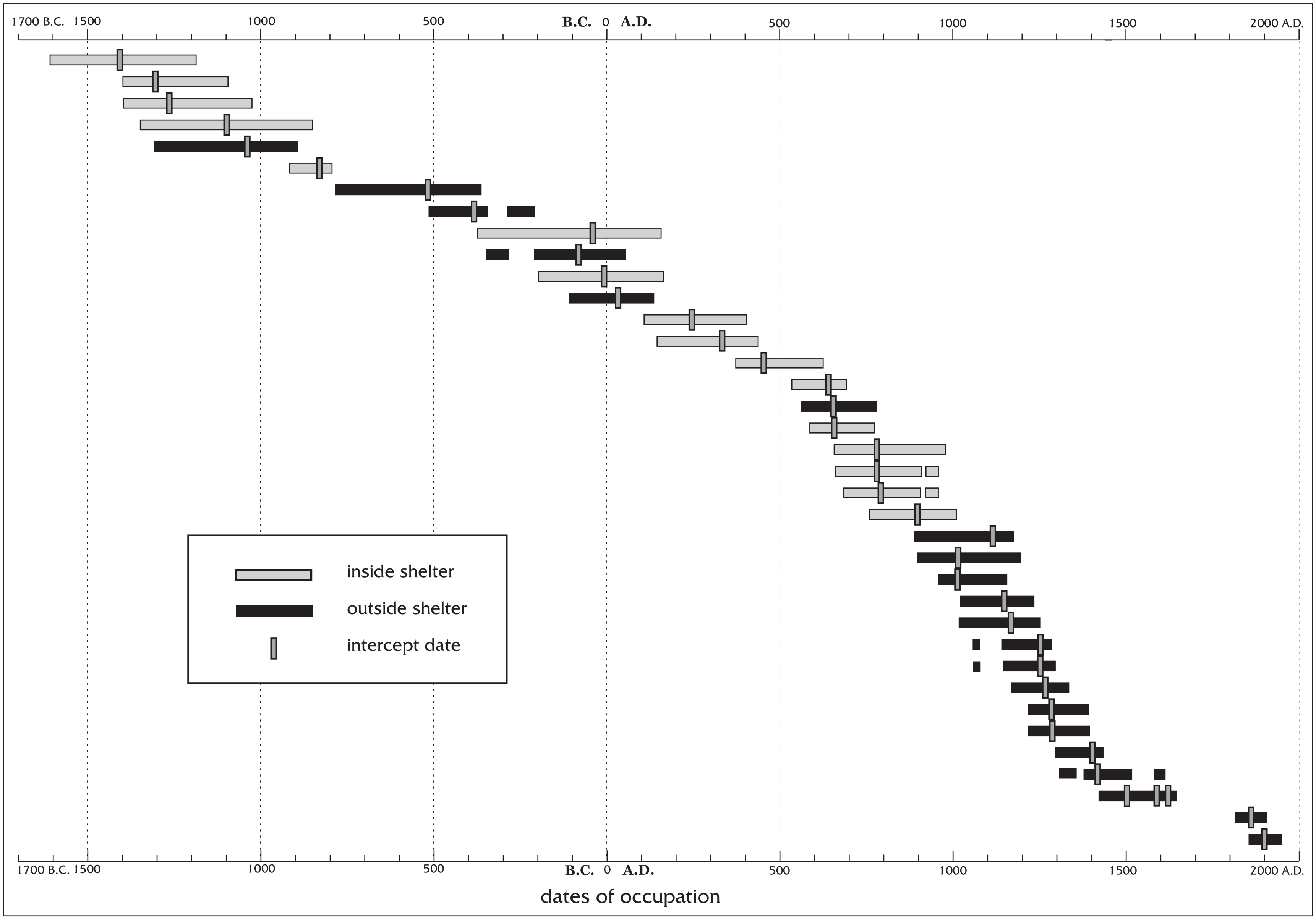

Figure 31. Radiocarbon dates (2 sigma calibration range).

tions are represented by the dates. Although the dates are not always sequentially ordered in the shelter because of, for example, old wood, mixing of cultural levels by downslope erosion, digging of pits, and trampling by humans and animals, a fairly consistent utilization of the shelter over time is indicated by the dates.

Interpretation

The association of Fallen Pine Shelter with a small drainage along a natural corridor through the Sacramento Mountains probably accounts for its repeated use for at least 2,800 years of prehistory, from the Late Archaic through the Late Pueblo periods. The shelter obviously saw only minimal use at any given point in time as attested to by the shallow and mostly expedient hearths and pits. The purposes the shelter was used for seem to have varied greatly over time. Its use throughout prehistory as protection from the elements and a place to sleep and prepare food is a warranted assumption. The presence of food remains (corn, cholla parts, and mesquite) in ceramic vessels suggests that Pueblo peoples, at least, cached some food items in the shelter. However, the amount and variety of vessels throughout the deposits would also indicate transport to the shelter, whether as part of group baggage when moving through the mountains or for use when staying in the shelter, as in planned hunting expeditions, for example. These scenarios will be discussed further in the conclusions to this report.

Determining seasonality of use for Fallen Pine Shelter is based on the relatively few preserved botanical and palynological remains and the fauna recovered on the site. The presence of corn remains does not necessarily imply a fall occupation because it appears that at least some corn was cached in the shelter and some very likely was transported there by groups passing through. This could have occurred in any season, although deep snow in the Sierra Blanca Mountain passes in winter months would probably have been somewhat prohibitive to foot traffic in the area. The planting of corn along the streamside of the narrow valley in front of the shelter is also a possible explanation for the presence of corn in the shelter. However, no sedentary communities were nearby to oversee such an activity. The presence of several types of cacti (from both macrobotanical and palynological samples), such as pincushion, cholla, and hedgehog, support a late summer gathering of their fruit. However, cholla fruit was found on the interior of a ceramic vessel and could have been cached for use in any season.

Deer remains are more useful in determining season of use. Their association with projectile points and scraping implements leads to the conclusion that hunting activities were a major activity carried out from the shelter. Most recovered deer remains are of mature individuals, suggesting typical fall procurement, although some late spring/early summer hunting is also indicated. The lack of deer parts with high meat value may imply that these remains were broken into small pieces for marrow and grease or carried back to home bases or settlements for future consumption. The eating of turkey and small rodents such as woodrats by Late Pueblo peoples while at the shelter is inferred by the burned remains of several of these species in the upper levels of the shelter deposits.

While absolute dates for sites within the Sierra Blanca Mountains are few, and an early Mogollon occupation of the region is often completely lacking, the radiocarbon dates for Fallen Pine Shelter do reveal repeated use of the area at this problematic time. Whether the peoples who visited the shelter during this early period were highly mobile or somewhat mobile, or maintained villages, is impossible to determine from site data. However, the early Mogollon populations did possess the ubiquitous Jornada Brown ceramic vessels. Dates associated with the Archaic occupation of the shelter match similar Archaic occupation dates at other sites in the Sacramento Mountains, such as Fresnal Shelter and High Rolls Cave.

In conclusion, the length of each of the multiple occupations at Fallen Pine Shelter is thought to have been short (from a single day to several weeks at maximum) for some users and seasonal for those who were hunting or gathering cyclically available economic resources. Correspondingly, group sizes would necessarily have been small and (hypothetically) varied from men in hunting parties to several women on gathering forays to families (suggested by the burial of a small child in the shelter).

POTTERY ANALYSIS

C. Dean Wilson

A total of 3,319 sherds were recovered and analyzed as part of the data recovery investigations at Fallen Pine Shelter (LA 110339). Earlier testing investigations at this site resulted in the recovery and analysis of 114 sherds (Wilson 1997). Data recorded during the present analysis includes attributes and categories of use to determine the time and nature of the ceramic-period occupations at this cave. In order to compare trends noted at the shelter to those documented during other investigations in this region, analysis strategies and categories similar to those employed during earlier studies of ceramics from sites in this region were used (Jelinek 1967; Kelley 1984; Runyon and Hedrick 1987; Levine 1992; Wiseman 1996; Wilson 1999, 2000a).

Descriptive Attributes

The recording of ceramic typological and descriptive attribute categories allows for the determination of possible time of occupation for a particular assemblage as well as patterns of interaction and relationships with groups in other areas and the use of pottery in various activities. Attributes recorded during the analysis of pottery from Fallen Pine Shelter include temper type, pigment, surface manipulation, slip, and vessel form.

Temper

Temper categories were identified through the examination of freshly broken sherd cross sections using a binocular microscope. The great majority of the pottery from the shelter was tempered with some form of crushed igneous rock indicative of production somewhere in the Jornada Mogollon region.

The most common temper category identified during the present study consisted of very small and abundant clear to dark fragments (Jelinek 1967; Kelley 1984; Runyon and Hedrick 1987; Wiseman 1991; Warren 1992; Hill 1996a, 1996b), which is referred to here as *fine Jornada crystalline igneous rock*. Larger grains, when present, are usually roundish and crystalline in structure. These fragments appear to be crystalline or sugary in appearance. Petrographic analysis of sherds with similar tempering material indicates a granite aplite. This temper is dominated by white or gray grains, probably feldspar, along with quartz. In addition, large rounded quartz fragments are sometimes present. Dark fragments representing hornblende may be present in low amounts. Similar temper is particularly common in brown wares produced in the El Paso area, where it appears to reflect the utilization of crushed granites from the Franklin Mountains. It is also possible, however, that some of the examples assigned to this temper represent the utilization of crushed igneous rock sources occurring in the Sierra Blanca region.

Another temper group identified during the present study is represented by *dark feldspar* fragments from syenites presumably from areas of the Sierra Blanca region (Wiseman 1991). Some examples assigned to this category could also represent part of the variation associated with sources normally assigned to the leucocratic igneous category. Feldspar fragments tend to be angular and sparsely scattered. These fragments are large compared to those noted in other temper categories. They are usually opaque and gray to off-white.

Temper occurring in Chupadero Black-on-white sherds often consists of similar combinations of *dark igneous and sherd* particles. Both sherd and rock particles tend to be small and dark, and these can be difficult to distinguish, particularly in vitrified pastes commonly found in Chupadero Black-on-white. Crushed rock particles appear to include white to gray feldspar and quartz fragments. The sherd fragments are recognized by their dull appearances and range from dark gray to brown. Rock particles are very fine and consist of isolated fine mineral grains, mainly of quartz and weathered feldspar. Similar dark, small igneous fragments without crushed sherd were assigned to a *dark igneous* category.

Calcium carbonate refers to temper dominated by dull buff to ivory-colored, fine caliche fragments. This temper is primarily associated with Chupadero Black-on-white and sometimes with sherd fragments and assigned to a *sherd and calcium carbonate* category.

Sand refers to the presence of rounded or subrounded, white to translucent, well-sorted medium to coarse quartz grains. Small angular fragments sometimes occur along with these grains and indicate the use of sands weathered from sandstone outcrops. Temper derived from crushed sandstone is similar, but rounded sand grains present may contain a matrix which in some cases may still be holding together sand grains. In addition, some sand temper was mixed with crushed potsherds and recorded as *sherd and sand*. Fine sand grains occurring with angular matrix were assigned to a *fine sandstone* category.

Another temper category employed during the present study was *sand and Mogollon volcanic rock*. This temper consists of fine shiny white to gray quartz and tuff particles. It reflects the use of weathered volcanic-clastic rocks with rounded particles derived from volcanic-clastic particles. These inclusions are similar to those noted in self-tempered clays used in the production of Mogollon brown ware and Mimbres white ware types in various areas of the Mogollon Highlands in southwest and south-central New Mexico (Hill 1999; Wilson 2002). In some cases similar temper was assigned to a *fine tuff and sand* category.

Latite or andesite is a common temper in glaze wares, although similar temper is known to have been produced in a number of localities. This category may refer to material from a number of source areas in the Rio Grande region, which consists of crystalline porphyries with quartz, feldspar, and hornblende (Shepard 1965).

Pigment Type

The presence, type, and color of paint pigments were recorded for all decorated sherds. Sherds without evidence of painted decorations were recorded as *none*. Those for which the type of pigment could not be determined were recorded as *indeterminate*.

Matte mineral paint refers to the use of ground minerals such as iron oxides as pigments. These decorations are applied as powdered compounds, usually along with an organic binder. Mineral pigment is present as a distinct physical layer and rests on the vessel surface. Such pigments are usually thick enough to exhibit visible relief when viewed through a binocular microscope. Mineral pigments usually obscure surface polish and irregularities. The firing atmospheres to which mineral pigments are exposed affects color. Mineral pigment categories identified during the present study include *mineral black*, *mineral red*, and *mineral brown*. Sherds containing mineral paint with a combination of colors were assigned to *mineral black or mineral red*.

Glaze paint refers to the use of a lead as a fluxing agent to produce vitreous decorations. Glaze pigments are often very thick and runny, and bubbles may protrude through the surface. The glaze may weather off, leaving a thin organic layer. Pigment color ranges from brown, black, and orange to green. Pigments on glaze polychrome types were described as *glaze and red mineral*.

Surface Manipulation

Attributes relating to surface manipulations reflect the presence and type of surface texture, polish, and slip treatments. Surface manipulation categories were recorded for both interior and exterior vessel surfaces.

Surfaces which have been too heavily worn to determine the original surface treatments were classified as *surface missing*. *Plain unpolished* refers to surfaces where coil junctures have been completely smoothed, but surfaces were not polished. Surfaces with numerous tiny parallel markings from smoothing were assigned to *plain striated*. *Indented corrugated* refers to the presence of fine exterior coils with regular indentations on the exterior surface.

Polished surfaces are those which have been intentionally polished after smoothing. Polishing implies intentional smoothing with a polishing stone to produce a compact and lustrous surface. A few sherds also had distinct slipped surfaces which had been polished over. Slips represent intentional applications of distinct clay, pigment, or organic deposits over an entire vessel surface. Such applications are used to achieve black, white, or red surface colors, not obtainable using paste clays or firing methods normally employed. Surfaces over which a high iron slip clay was applied to create a red ware were assigned to *polished red slipped*. Those to which a low iron slip was applied, as represented in some white wares, were classified as *polished white slipped*. Surfaces to which a black layer of soot appears to have been applied during the later stages of firing were assigned to *polished smudged*. A few sherds exhibiting intentionally tooled textures were assigned to *punctated* or *punctated with red slip*.

Vessel Form

Sherd-based vessel form categories reflect the shape and portion of the vessel from which a sherd was derived. Categories used during the present study are based on rim shape or the presence and location of polish and painted decorations. While it is often easy to identify the basic form (bowl versus jar) of body sherds from many southwestern regions by the presence and location of polishing, such distinctions are not as easy for Jornada brown ware types. This is because Jornada Brown Ware bowl and jar sherds are both often polished on either or both surfaces. Thus, during the present study many of the plain brown ware body sherds examined were assigned to a series of descriptive categories representing combinations of surface treatments.

Sherds with surfaces for which the treatment could not be determined were categorized as *indeterminate*.

Sherds were assigned to a *bowl body* based on the presence of polish, slip, or painted decoration on the interior surface. *Bowl rim* refers to sherds exhibiting inward rim curvature characteristic of bowls, regardless of associated surface manipulations.

Jar body was mainly limited to decorated sherds exhibiting higher polished, slipped, or painted decoration on the exterior surface. *Jar neck* sherds were identified by the presence of distinct curves associated with the neck area. *Jar rim* sherds exhibit the distinct curves of a jar neck along with a relatively wide rim diameter.

Canteen refers to small spherical vessels, with lug handles near the top and very narrow necks. Detached handles were assigned to *indeterminate coil/strap handle*.

Body sherds not exhibiting polished treatments on either surface were classified as *unpolished body*. Body sherds exhibiting roughly equal amounts of polishing on both sides were simply assigned to a *polished body* category. Other body sherds were assigned to a category based on the presence of a distinct polish on one surface, and include *exterior polished body* and *interior polished body*.

Ceramic Types

Pottery types represent categories often used to relay information about the distribution of sherds with combination of traits of temporal, spatial, and functional significance. Types recognized during the present study were lumped into types reflecting various combinations of ceramic wares and traditions. Ceramic groups recognized during the present study include Jornada Brown Ware, Three Rivers Red Ware, Chupadero Black-on-white, El Paso Brown Ware, El Paso Polychrome, Rio Grande Glaze Ware, and Chihuahua Red Ware (Table 6). The following section will describe characteristics of pottery types defined for various ceramic groups. These descriptions are followed by discussions of trends indicated by the characteristics and distributions of various types and attributes.

Jornada Brown Wares

The majority (89.4 percent) of the pottery recovered during excavations at Fallen Pine Shelter are plain brown ware. Plain brown ware was the dominant utility ware in assemblages covering almost the entire ceramic occupation of the Jornada Mogollon region. Plain brown ware pottery from various areas of the Jornada region has been divided into types based on combinations of attributes thought to be of spatial significance. The placement of sherds into various brown ware types is based on postulated areal differences in surface color, polish, and temper noted for plain brown wares from different areas of the Jornada Mogollon region (Jennings 1940; Lehmer 1948; Jelinek 1967; Whalen 1994; Wiseman 1996). Recent studies indicate considerable overlap in the attributes associated with brown ware pottery common in different areas of the Jornada Mogollon region (Whalen 1994). Some researchers have simply lumped plain brown ware sherds previously assigned to regionally specific types such as El Paso Brown, Jornada Brown, or South Pecos Brown into a single plain brown ware type category and attempted to document variation in pottery from different areas through the distribution of various paste and technological attributes (Whalen 1994; Hill 1996a, 1996b).

It has also been noted that subdividing brown ware pottery from sites scattered through the Jornada Mogollon region may be useful, while also recognizing the complex nature of such distributions (Wiseman 1996). Problems in the recognition of different plain brown ware types stem from the wide range of characteristics of pastes and surfaces resulting in a very high

Table 6. Pottery type by level

Count Column Percentage	Level 1	Level 2	Level 3	Level 4	Level 5	Level 6	Outside Cave	Total
Glaze ware	-	1	-	-	-	-	-	1
	-	0.4%	-	-	-	-	-	0.0%
El Paso Brown	118	38	32	21	7	-	159	375
	17.2%	15.1%	10.6%	4.9%	6.3%	-	10.5%	11.3%
El Paso Polychrome	64	13	33	25	1	-	52	188
	9.3%	5.2%	10.9%	5.9%	0.9%	-	3.4%	5.7%
Chupadero Black-on-white	86	31	36	23	2	-	71	249
	12.5%	12.4%	11.9%	5.4%	1.8%	-	4.7%	7.5%
Jornada Red	26	14	14	21	-	-	32	107
	3.8%	5.6%	4.6%	4.9%	-	-	2.1%	3.2%
Playas Red	6	-	3	4	-	-	1	14
	0.9%	-	1.0%	0.9%	-	-	0.1%	0.4%
Jornada Brown	372	151	184	328	102	29	1157	2323
	54.2%	60.2%	60.7%	76.8%	91.1%	100.0%	76.6%	70.0%
Mimbres Black-on-white	14	3	1	5	-	-	39	62
	2.0%	1.2%	0.3%	1.2%	-	-	2.6%	1.9%
Total	686	251	303	427	112	29	1511	3319

number of possible mixes of various traits. For example, some sherds may contain a temper class commonly used to define one variety along with a surface manipulation frequently used to define another (Wiseman 1996). Still, the use of such categories may allow for the monitoring of types of variability within assemblages that may be of spatial or temporal significance. Relaying this type of information through such categories is often less cumbersome than continual reference to combinations of attribute categories. The most important distinctions in brown ware groups employed during the present study involved the distinction of Jornada Brown Ware and El Paso Brown Ware types.

Jornada Brown

Jornada Brown as defined here was first described by Jennings (1940) as "common" or "unnamed brown." Mera (1943) proposed the name Jornada Brown to describe similar pottery. Some problems have resulted from the application of this type to such a wide variety of brown ware pottery that it has become largely meaningless. Wiseman (in prep.) refers to Jornada Brown (as defined here) as the Sierra Blanca variety. This type is described as normally having well-polished surfaces that obscure temper grains. Temper fragments are often very small, consisting of a profusion of equally sized grains. Jornada Brown as described here is very similar to Alma Plain, the dominant types produced in most areas of the Mogollon Highlands (Mera 1943; Wiseman 1991).

Most of the sherds assigned to Jornada Brown Ware types are highly polished on at least one surface, have small temper, and are brown, light brown, or tan. The great majority of Jornada Brown ware sherds have plain undecorated surfaces. During the present study, 52 sherds were assigned to Jornada Brown rim and 2,202 to Jornada Brown body.

As expected, most of the Jornada Brown Ware examined are tempered with the fine igneous temper characteristic of this type, while the remaining sherds are tempered with a variety of igneous tempers employed in the Jornada Mogollon region. Jornada Brown sherds were also placed into a variety of vessel form classes. Most of these sherds were polished on both sides, and the specific vessel form from which they derived could not be determined. For rim sherds, roughly even mixtures of jars and bowls are represented.

Some sherds with typical Jornada Brown Ware pastes were assigned to distinct types based on textured or slipped treatments. The 17 (0.5 percent) sherds with local pastes with incised decorations were assigned to Jornada Incised (Fig. 32).

A total of 17 sherds were assigned to South Pecos Brown. As is the case for El Paso Brown, this type is differentiated by temper and paste characteristics. This type is characterized here as a variety of Jornada Brown Ware. South Pecos Brown is usually described as well smoothed, and polishing may be strong to absent. Temper is represented by sparse large gray feldspar fragments that appear to indicate syenite from the Sierra Blanca Mountains, which frequently shows through the surface. This temper results in blocky to tabular paste cross sections. Protruding temper cracks are surrounded by very small radial cracks. Because this type is often separated from other plain brown wares on the basis of temper alone, a wide range of surface manipulations and treatments is represented and includes those with paste and treatments closer to El Paso Brown than Jornada Brown.

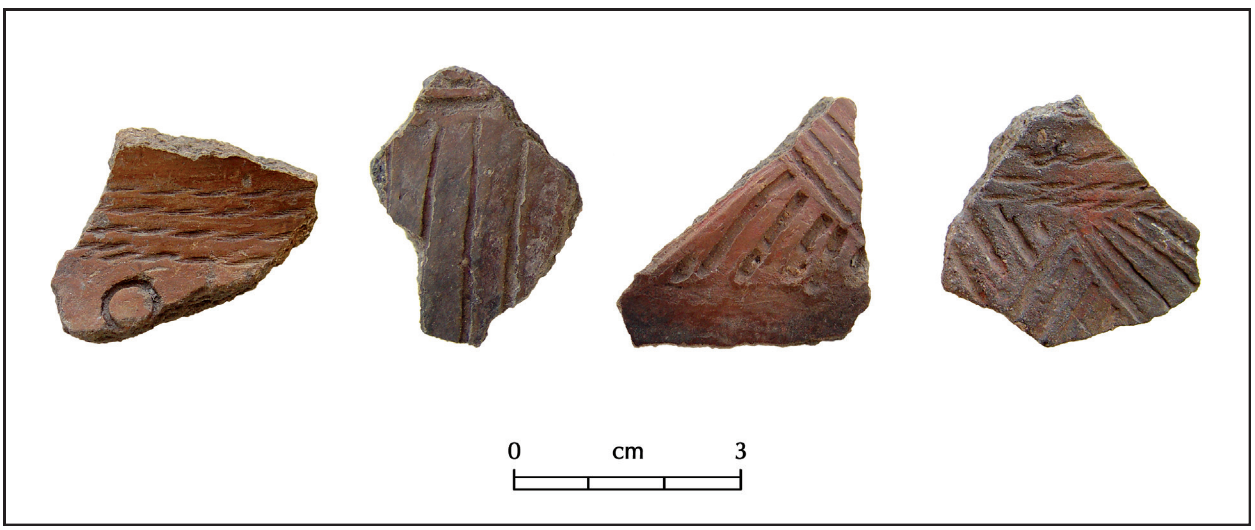

Figure 32. Jornada Incised.

Three Rivers Red Wares

Pottery with combinations of Jornada Brown pastes and red slips or painted decorations was assigned to types of the Three Rivers Red Ware tradition (Wimberly and Rogers 1977). During the present study, 107 (or 3.2 percent) of the sherds were assigned to this tradition. The initial use of a red slip is thought to have been inspired by San Francisco Red, which was produced very early in the Mogollon Highlands pottery sequence (Haury 1936a). Temper and pastes of Three Rivers Red Ware types were similar to that noted on plain brown wares, although surfaces tended to be more polished, and bowls are the dominant vessel form. Unslipped or unpainted sherds were generally not assigned to Three Rivers Red Ware types, and the number of sherds derived from Three Rivers Red Ware vessels is probably higher than indicated by sherd frequencies discussed here.

A total of 57 sherds with a bright red slip covering at least one surface was assigned to plain slipped red or red unpainted undifferentiated. These sherds exhibit thin to moderately thick red slips without any painted decorations. Some of the slipped red sherds identified could have derived from slipped versions of Jornada brown ware vessels, although most are probably derived from unpainted red-on-terracotta or black-on-red vessels. Forms are mainly represented by bowls with slipped interiors. While both the slipped and unslipped surfaces are polished, the slipped surface is usually more polished.

A range of forms reflecting the application of painted decorations over Jornada pastes was identified. This decorated pottery was assigned to type categories based on paint type or color and pottery styles. These types appear to represent a continuum of decorated pottery that reflects the wide range of pottery forms associated with Three Rivers Red Ware. While there appears to be considerable temporal overlap between types associated with this tradition, there is also a sequence of development which begins with San Andres or Broadline Red-on-terracotta, which developed into Three Rivers Red-on-terracotta, and finally into Lincoln Black-on-red (Mera and Stallings 1931; McCluney 1962; Wiseman 1991). Sherds exhibiting painted decorations but without styles or attributes clearly indicative of a specific type were assigned to other descriptive types. Most of the painted red ware sherds from Fallen Pine Shelter had red painted decorations over an orange to light brown, unslipped surface. Painted areas exhibit a similar appearance as the slip clay noted in previously described slipped red wares.

The first red-on-terracotta pottery produced in the Jornada region is thought by some to have been decorated with wide lines similar to those found in Mogollon Red-on-brown and may represent a local version of this type (McCluney 1962). Mera and Stalling (1931) note the existence of a red-on-terracotta pottery with wide line designs that they believe may have been antecedent to Three Rivers Red-on-terracotta. Based on investigations at the Hatchet site, McCluney (1962) placed pottery with lines between 5 and 8 mm wide into San Andres Red-on terracotta. During the present study red-on-terracotta sherds with lines thicker than 5 mm were assigned to Broadline or San Andres Red-on-terracotta. These lines are usually executed fairly crudely and begin just under the rim. These wide lines radiate downward and terminate above the bottom of a vessel. Joining of the lines may occur below the rim to produce triangular or diamond shapes. The rim is usually painted red. Vessel forms are mainly represented by deep and shallow bowls, although wide mouth jars and pitchers are also present.

Although Broadline Red-on-terra-cotta is assumed to represent the first of the Three Rivers painted red ware sequence, there is very little stratigraphic or dating evidence to support this view. The earliest date usually assigned to this type is A.D. 1100 (McCluney 1962; Runyon and Hedrick 1987), which appears to be much too late to indicate a development out of Mogollon Red-on-brown. Thus, it is possible that Broadline or San Andres Red-on-terracotta may not necessarily reflect the early stage of the Three Rives Red Ware developmental sequence, but instead a variation in the range of Three Rivers Red-on-terracotta (Wiseman 1991). It is also possible, however, that the Broadline form may have appeared earliest, after which it continued to be made along with Three Rivers Red-on-terracotta and even later with Lincoln Black-on-red.

A total of 38 sherds with similar characteristics was assigned to Three Rivers Red-on-terracotta (Fig. 33). The paste is similar to that noted in Jornada Brown sherds, although it tends to be harder (Mera and Stallings 1931; Mera 1943; Kelley 1984). Surface color tends to be light orange or terracotta, although some examples display light gray, tan, brown, or buff surfaces.

During the present study, Three Rivers Red-on-terracotta was almost exclusively distinguished from other red-on-terrracotta categories by designs executed in very thin lines. Primary designs consist of a series of two to five narrow lines that are 2 to 4 mm in width applied directly below the rim. These lines usually occur in rectilinear patterns, although curvilinear and scroll-shaped patterns are sometimes represented. Secondary designs are sometimes incorporated into these lines and include small solid triangles. This type is generally represented by bowl forms. Three Rivers Red-on-terracotta

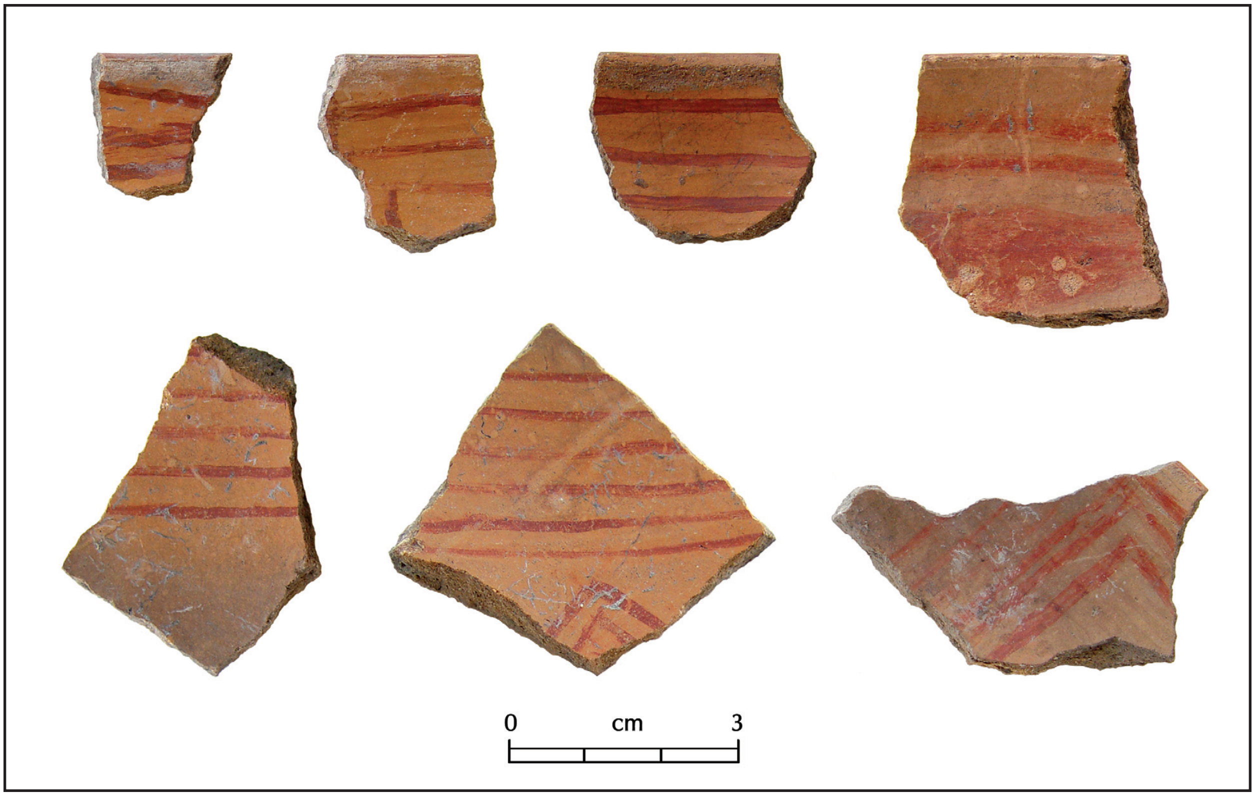

Figure 33. Three Rivers Red-on-terracotta.

is thought to have been produced sometime between A.D. 1150 and 1350.

The last type of the Three River Red Ware sequence is Lincoln Black-on-red (Fig. 34), represented by five sherds. Lincoln Black-on-red is similar to, and appears to have developed out of, Three Rivers Red-on-terracotta (Mera and Stallings 1931; Wiseman 1991). Pastes and surfaces are similar to those noted for Three Rivers Red-on-terracotta, although they tend to be redder. The red color is usually a reflection of an oxidizing firing atmosphere rather than the application of a slip. Vessel forms appear to be almost exclusively represented by round-bottomed bowls.

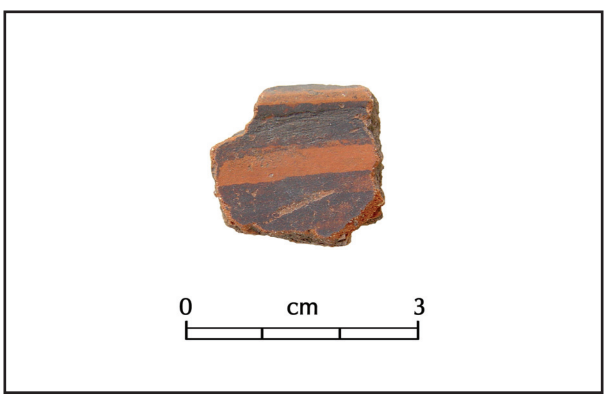

Figure 34. Lincoln Black-on-red.

Obviously, paint color is the attribute most commonly used to differentiate Lincoln Black-on-red from Three Rivers Red-on-terrracotta (Mera and Stallings 1931). Examination of sherds assigned to various types of the Three Rivers Red Ware tradition indicates a good but not absolute correlation between paint color, paste color, and design style. Wiseman (1991) notes that Lincoln Black-on red in the Roswell area commonly displays designs often found on Three Rivers Red-on-terracotta. The distinction of this type based on paint is further complicated by the occasional terracotta sherd with decorations in both red and black lines.

Painted decorations tend to be limited to bowl interiors. Designs most closely resemble those noted on Glaze A forms such as Aqua Fria Glaze-on-red, from the Rio Grande region. Lincoln Black-on-red is characterized by a limited decorative repertoire and a remarkable degree of uniformity over a wide area. Rims are usually solidly painted. Decorations usually consist of narrow lines and connecting triangles. Later Lincoln Black-on-red exhibits increased vertical and diagonal segments oriented around the vessel. Wide lines occasionally occur on vessel exteriors.

Chupadero Black-on-white

A total of 249 sherds (7.5 percent) identified during the present study exhibit traits characteristic of Chupadero Black-on-white vessels (Table 1). This type was first named and described by Mera and Stallings (1931). Chupadero Black-on-white is described from sites scattered over a wide area (Vivian 1964; Hayes et al. 1981; Wiseman 1986). Chupadero Black-on-white was first manufactured sometime between A.D. 1050 and 1100 and continued to be produced to about 1550. Through most of this period, Chupadero Black-on-white was the dominant decorated type at sites scattered over wide areas of central and southeastern New Mexico (Mera 1931).

The use of a low-iron clay firing to buff colors indicates a low-oxidizing or neutral atmosphere. This includes most of the Chupadero Black-on-white as defined by Wiseman (1986). Temper is often dark and includes fine sherd and rock fragments. The undecorated surfaces of Chupadero Black-on-white are often unpolished with striated or scored treatments resulting from scraping. Chupadero Black-on-white sherds identified during the present study display a wide range of characteristics. Striated treatments are common on vessel surfaces. Most surfaces are light gray with moderate polish. While most sherds are not slipped, a significant proportion display a white slip over a gray paste. Most Chupadero sherds are tempered with dark igneous rock and sherd, although a wide variety of tempers are represented. This may indicate that Chupadero vessels were derived from a number of sources.

Painted designs of Chupadero Black-on-white vessels often consist of combinations of hatchured and solid motifs. Designs were executed in a series of panels where the basic design was repeated every one or two sections. At least four and as many as eight panels may be represented.

During the present study, sherds thought to have derived from Chupadero Black-on-white were assigned to a series of categories based on the presence of painted decoration or style. These stylistic categories do not appear to have any spatial or temporal significance but simply reflect a range of styles associated with this type. A total of 57 sherds had no painted decoration and were classified as unpainted Chupadero Black-on-white. Painted sherds were placed into a specific category by the type of design (Figs. 35-38), and recognized categories include Chupadero Black-on-white *indeterminate design* (57), *solid design* (52), *hatchured design* (34), and *solid and hatchured design* (22 sherds).

El Paso Brown Ware

El Paso Brown ware types were mostly distinguished from Jornada Brown types by the absence of distinct polished surface and sometime the presence of large temper fragments, which includes rounded quartz fragments, often protruding through the surface. This

Figure 35. Chupadero Black-on-white (solid style).

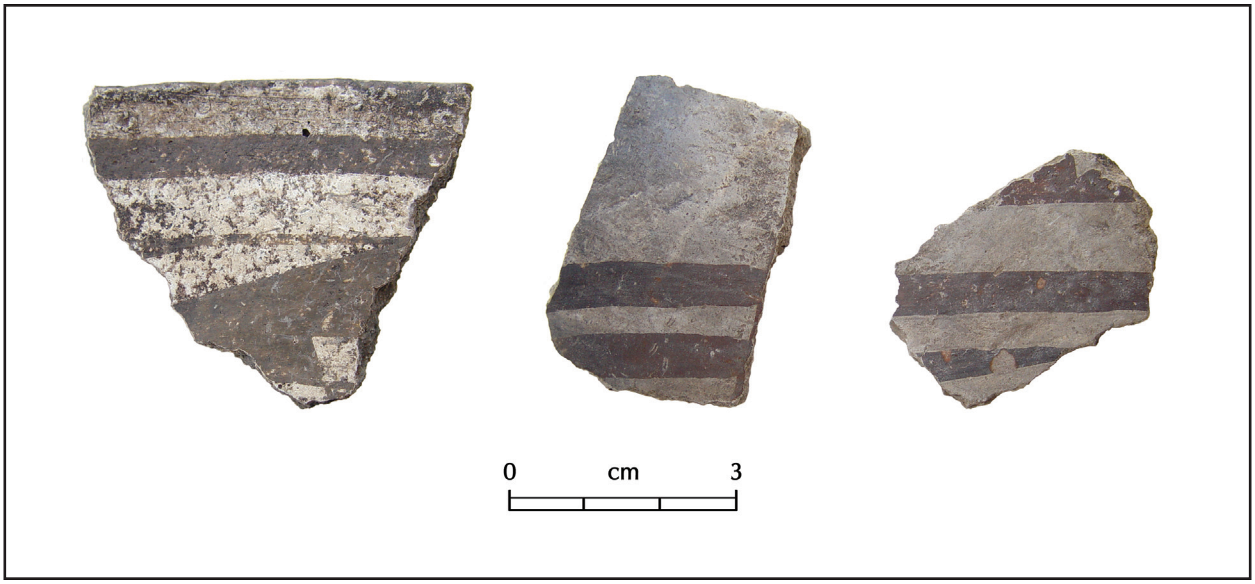

Figure 36. Chupadero Black-on-white (solid style).

Figure 37. Chupadero Black-on-white (hatchured style).

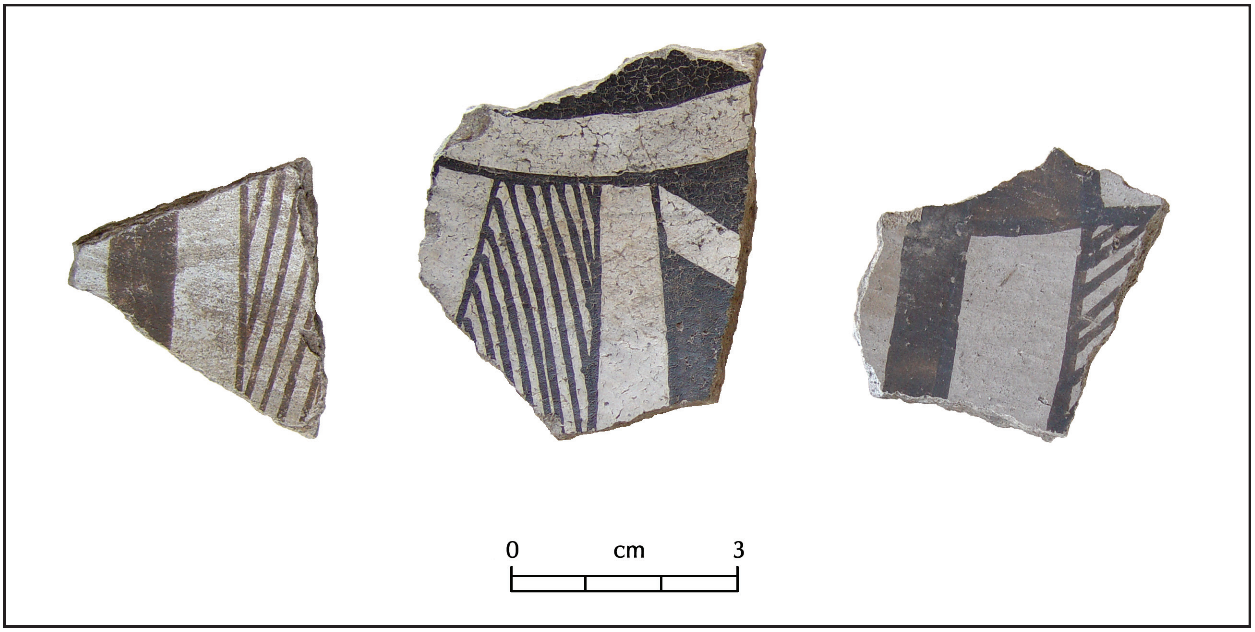

Figure 38. Chupadero Black-on-white (hatchured and solid style).

type was assigned to 375 sherds (11.3 percent). El Paso Brown sherds also tend to be soft and have less luster and more scraping marks on interior surfaces. Pastes tend to be dark or brown with a dark core, and surfaces are often gray to chocolate brown.

Most sherds displaying El Paso Brown Ware pastes exhibited plain surfaces without textured or slipped treatments. These sherds were categorized as El Paso Brown Rim (9) or El Paso Brown Body (248). Body and rim sherds were assigned to distinctive types, because El Paso Polychrome sherds are more likely to be painted or have other distinct decorative treatments near the rim.

Unpainted sherds less than 4 mm in thickness were assigned to Thin El Paso Brown (117). One sherd was assigned to Smudged El Paso Brown, as defined here, distinguished from other El Paso Brown Ware sherds by thick, black-sooted deposits rather than the usual high polish.

While all unpainted and unslipped sherds were assigned to El Paso Brown Ware, many of these sherds probably derived from El Paso Polychrome vessels. This appears to be supported by the high frequency of thin El Paso Brown, which is a common characteristic of sherds derived from El Paso Polychrome.

El Paso Polychrome

During the present study, 188 sherds (5.7 percent) with pastes similar to those described for El Paso Brown, but with decorations in black or red mineral pigments, were assigned to types of an El Paso Polychrome group (Fig. 39). Despite the presence of painted decorations, surfaces tend to be crudely smoothed or scraped. Vessels are commonly represented by very large and thin jars, although some examples are derived from bowls. Surfaces may be brown and unslipped or contain a thin red slip. Painted decorations often consist of combinations of red slip and black mineral paint. Of the sherds assigned to this group, 117 exhibited painted decoration and were classified as El Paso Polychrome. A total of 71 thin, red-slipped sherds, clearly from an El Paso Polychrome vessel, were assigned to El Paso Red Slipped.

Playas Red

A small number of sherds (14) exhibited a combination of red slip and surface texture similar to utility pottery types known to have been produced in the Casas Grandes region of Mexico. It is possible that some of these sherds were made locally (Wiseman, pers. comm., 2002). This pottery was assigned to two categories based on surface texture, including Playas Incised and Playas Punctated (Fig. 40).

Glaze Ware Tradition

A single sherd exhibited a distinctive lead glaze paint and paste characteristics indicative of glaze ware types thought to have been produced at sites in the Rio Grande region (Fig. 41). Glaze wares were produced in the middle Rio Grande from about A.D. 1325 to the early 1700s (Mera 1933; Kidder and Shepard 1936; Franklin 1997). The production of glaze ware pottery

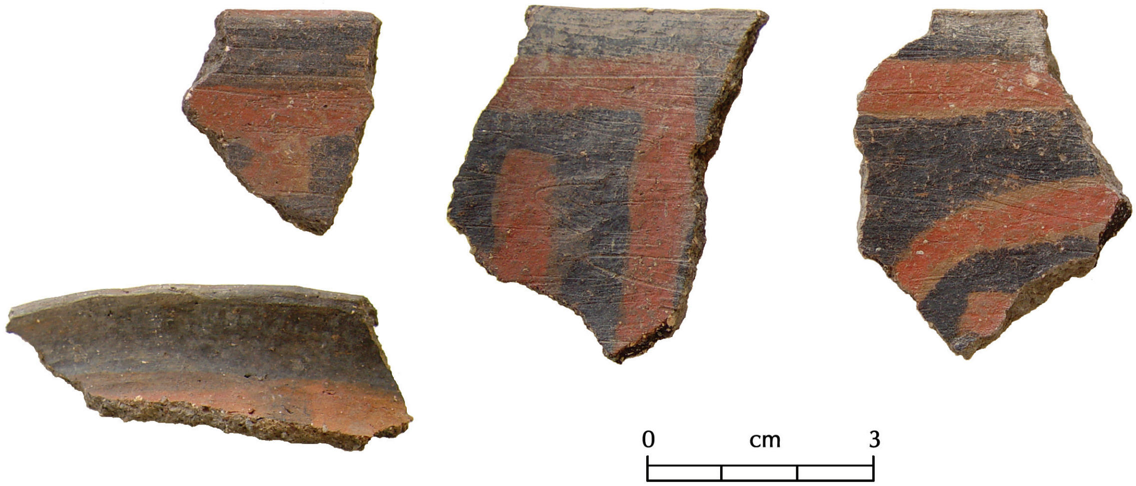

Figure 39. El Paso Polychrome.

Figure 40. Playas Red.

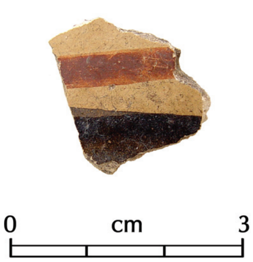

Figure 41. Rio Grande Polychrome.

appears to have extended into the western Jornada region, where, at Gran Quivira, ceramics belonging to this ware group represent about a third of the pottery recovered from the pueblo of Las Humanas and is represented by types covering the entire range of the glaze ware sequence (Hayes et al. 1981).

The glaze sherd exhibits decorations in a black glaze and red-slipped pigment and was classified as *glaze polychrome*. It was tempered with crushed latite.

Mimbres White Ware

Mimbres White Ware refers to the white-slipped and painted pottery mainly produced in the Mimbres region in the southern Mogollon area (Fig. 42). Painted decorations are executed in iron-based mineral pigments applied over a white-slipped surface and are usually polished over that. Surfaces are usually moderately to lightly polished, but not as lustrous as white ware types from other regions. A long-lived tradition reflecting the gradual development of Mimbres White Ware types from Three Circles Red-on-white to Mimbres Black-on-white is indicated. Mogollon Painted or Mimbres White Ware types were distinguished based on the presence of a slip, paint color, and stylistic attributes. Mimbres White Ware sherds examined during the present study were assigned to one of three types based on the presence and style of painted decoration.

A total of 62 sherds (or 1.8 percent) of the sherds from Fallen Pine Shelter were assigned to Mimbres White Ware types. Sherds without distinctive designs were classified as Mimbres White unpainted (22) or Mimbres Black-on-white undifferentiated (28 sherds).

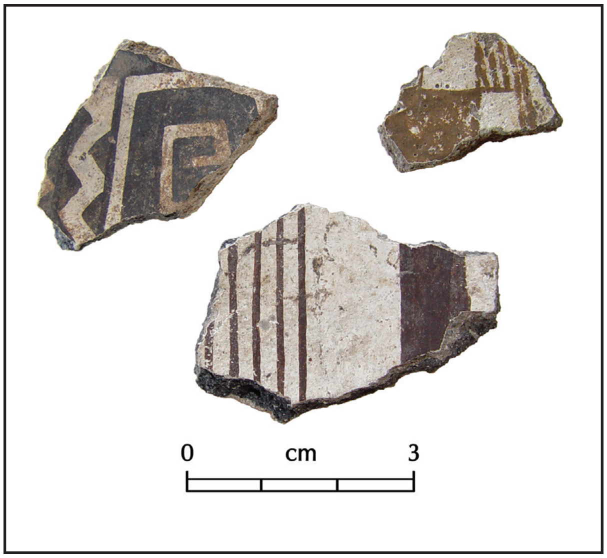

Figure 42. Mimbres Black-on-white.

Twelve sherds with distinct designs were assigned to Mimbres Classic Black-on-white. While sherds exhibiting late styles are usually classified as Mimbres Classic (Haury 1936a), they are sometimes referred to as Mimbres Black-on-white Style III. Mimbres Classic Black-on-white is mainly represented by bowl forms.

Characteristics of Mimbres Classic Black-on-white include the use of fine, regularly spaced hatchures bordered by thin lines. A diagnostic feature of this type is the presence of framing lines near the rim. These framing lines vary considerably and may include one to four broad lines, multiple fine lines, multiple fine lines bordered by one or two fine lines, or a single fine line. During the early part of the production of this type, often only one line was used to separate the bowl rim and the main field of painted design. Naturalistic motifs also became common and vary from simple to complex forms. The more elaborate forms are painted motifs divided by geometric motifs. Execution is variable and ranges from precise execution with dense black paint to watery brown motifs with less exact line work.

Temporal Trends

One of the most critical applications of pottery analysis from Fallen Pine Shelter is determining when and how long it was in use. The shelter is located in the Sierra Blanca or northern Jornada Mogollon region as normally defined. The prehistoric occupation of the Sierra Blanca region appears to have been fairly long, although the nature of pottery change and the occupational sequence is still not fully known.

The unique nature of the prehistoric occupations of this area was first noted by Jennings (1940). While mainly concerned with the southern Jornada Mogollon, Lehmer (1948) defined three phases for the northern sequence of the Jornada Mogollon. The earliest of these phases was the Capitan phase, which was described as similar to and contemporaneous with the Mesilla phase of the Southern Jornada and postulated to date from about A.D. 900 to 1100 (Lehmer 1948). Jornada Brown was the overwhelmingly dominant pottery type at Capitan phase sites. This phase was associated with lower frequencies of Mimbres Black-on-white and Broadline Red-on-terracotta. Next in this sequence was the Three Rivers phase, which was described as similar to the Dona Ana phase to the south and postulated to date between A.D. 1100 and 1200. In addition to the continuation of similar Jornada Brown pottery and other types associated with the previous phase, ceramic types of the Three River phase included El Paso Polychrome, Chupadero Black-on-white, and St Johns Polychrome. The last phase in this sequence was the San Andres phase, contemporaneous with the El Paso phase in the Southern Jornada and dated from A.D. 1200 to 1400. Local pottery types noted for this phase included Jornada Brown along with El Paso Polychrome, Three Rivers Red-on-terracotta, and Lincoln Black-on-white. Intrusive pottery types noted for this phase included Chupadero Black-on-white, Gila Polychrome, Ramos Polychrome, Playas Red Incised, Aqua Fria Glaze-on-red Polychrome, Arena Glaze Polychrome, St Johns Polychrome, and Heshotauthla Polychrome (Lehmer 1948).

Kelley (1984) revised the northern Jornada phase system based on extensive fieldwork begun in the 1950s. This phase system has been commonly used in recent studies (Stuart and Gauthier 1981; Sebastian and Larralde 1989; Farwell et al.1992; Wiseman 1996). Kelley's system (1984) placed all Ceramic period occupations defined at the time of her study into the Glencoe phase. This was further subdivided into the early and late Glencoe phases. While the Glencoe phase was assumed to date about A.D. 1100, the probable existence of earlier occupations has sometimes been characterized in terms of an undefined Ceramic period (Sebastian and Larralde 1989). The assignment of all known ceramic occupations for the southern occupations of the Sierra Blanca region into a single phase appears to have resulted from the conservative nature of the occupation, because occupations dating to various time spans appear to represent pithouse sites with ceramic assemblages dominated by Plain Jornada Brown ware sherds.

While Kelley characterized the Glencoe phase as spanning the Early Pueblo III to Pueblo periods, there is evidence of a very long ceramic occupation in this area of the Jornada Mogollon country that began much earlier. The earliest ceramic occupations in the northern

Jornada region appear to be characterized by Plain Brown ware as the dominant, if not sole, ceramic type. Small sites are often represented by scattered or shallow pithouses and appear to have been introduced into areas of the Jornada Mogollon by the fifth century and spread across most of this region by the eighth century. Sites dating to the tenth century are very similar but may also contain low frequencies of Mimbres Boldface Black-on-white in southern localities (Wiseman 1991), while a local variety of Red Mesa Black-on-white is the dominate white ware type at contemporaneous sites in the northern localities of the Sierrra Blanca region (Levine 1992). Components dating to the twelfth century may be characterized by a combination of Mimbres Classic, El Paso Polychrome, early forms of red-on terracotta, and Chupadero Black-on-white (Jennings 1940; Green 1956; Kelley 1984). While earlier occupations certainly are represented in this area of the northern Mogollon region, most sites previously assigned to the Glencoe phase exhibit similar ceramic traits and appear to date between A.D. 1100 and 1350. The Glencoe occupation, as normally defined, is characterized by the dominance of Jornada Brown Ware along with Chupadero Black-on-white, Mimbres Boldface, and Three Rivers Red-on-terracotta, with very little, if any, Corona Corrugated (Kelley 1984; Farwell et al.1992.) The presence of this combination of pottery may be used to define early Glencoe phase occupations. Late Glencoe phase occupations are characterized by similar assemblages along with Lincoln Black-on-red and low but significant portions of Corona Corrugated. Other types occurring in late Glencoe phase assemblages include Gila Polychrome and early Rio Grande Glaze ware types.

Recent attempts to further organize temporal data from this region by Oakes (2000) and Wiseman (2001) compare pottery distributions from a number of sites in southeastern New Mexico. These comparisons were used to produce a series of areal curves that may reflect a gradual series of changes in the occurrence and frequency of various types (Wiseman 2001). The earliest distributional curve appears to reflect the early Glencoe phase and includes assemblages from the Clint Sultemeier, Black Stump Canyon, and Hiner 1 sites. This curve is characterized by assemblages with high proportions of Plain Brown wares, good representation of Chupadero Black-on-white, and the rarity of other types, especially intrusives. The next distribution in the sequence is represented by assemblages probably dating to the middle and late Glencoe assemblage, found in assemblages from Crockett Canyon, Fox Place, and Rocky Arroyo. These assemblages are characterized by the continued dominance of plain brown wares, a continuation of Chupadero, a good showing of Three Rivers Red Ware, a variable showing of El Paso Polychrome, and the consistent presence of intrusive pottery types (Wiseman 2001). The next distinct groups of ceramic assemblages is reflected by Hiner 1, Bonnell House 9, Phillips Unit 46, LA 588, the Baca Site, and Smokey Bear. The characteristics of such assemblages include the absence or near absence of plain brown pottery and the presence of significant frequencies of Corona Corrugated or El Paso Polychrome pottery. The assemblages in this group embody the greatest variability, most of which is attributable to whether Corona Corrugated or El Paso is the dominant utility pottery. This supports the assertion by Kelley (1984) concerning the importance of high frequencies of Corona Corrugated as an indicator of the later Lincoln phase in mountainous areas of Lincoln and Otero counties.

Other observations about temporal variability in pottery from this area have resulted in investigations by Eastern New Mexico University of three sites along the Middle Rio Bonito and a pithouse village investigated earlier (Aguila 2002; Salazar 2002; Shelley 2002). Unfortunately, trends discussed in these studies are not well linked to distributions of pottery types. Studies of pottery from these sites did note a long-term relative frequency of plain brown ware pottery through time. Changes in frequencies of various attributes in brown utility ware pottery were also monitored (Salazar 2002). These include an increase in rim thickness and rim flare as well as a decrease in exterior polishing and rim tapering. Examinations of decorated pottery reflect changes in the nature of interaction with other areas (Aguila 2002). Pottery associated with the initial occupation (possibly dating to the late tenth and eleventh centuries) of the valley is reflected by Mimbres Mogollon types along with early Jornada painted forms. By the twelfth century, high frequencies of types such as Chupadero Black-on-white may reflect contact with groups on Chupadera Mesa. Later occupations are reflected by an increase in intrusive types including El Paso Polychrome, northern Mexican types, and Rio Grande types.

Discussions of temporal trends from several investigations in the Jornada area not included in Wiseman (2001) provide additional ceramic characteristics that are directly comparable to those for Fallen Pine Shelter. Data from ceramic assemblages from one project near Roswell (Wilson 2003) and another near Carlsbad (Wilson 2000a) indicate early assemblages are almost exclusively dominated by plain brown wares associated with a number of traditions that all date before the beginning of the eleventh century and as early as the ninth century. Investigations at the Angus site near Ruidoso also provide important data concerning pottery associated with late Glencoe phase occupations in this area (Wilson 2000b). Utility wares from the Angus site consist of a mixture of plain brown ware (66.9 percent), of which 8.9 percent is El Paso Brown and 59.1 percent Jornada Brown Ware. Corona Corrugated is consistently present in lower frequencies (8.4 percent of the pottery from this site). Decorated types include Lincoln Black-on-red, El Paso Polychrome, Chihuahua Polychrome types, glaze ware types, and Salado Polychrome. The occurrence of Lincoln Black-on-red, Corona Corrugated, and other late types indicates an occupation sometime after A.D. 1300, contemporaneous with the span sometimes defined for the Lincoln phase. The combination of characteristics including the presence of low frequencies of Corona Corrugated and Lincoln Black-on-red in assemblages dominated by earlier types was interpreted as reflecting an occupation during the late Glencoe spanning from about A.D. 1300 to 1350.

In contrast, pottery distributions recovered during investigations at Fallen Pine Shelter, while indicating some variation through stratigraphic units, seem to reflect an occupation spanning the earlier part of the Glencoe phase (see Table 6). This pottery reflects a wide variety of types belonging to several distinct traditions (Table 7). Most (81.3 percent) of the pottery from this site were assigned to plain brown ware types. The majority (86.1 percent) of the brown wares were assigned to Jornada tradition types, while the remaining (23.9 percent) were assigned to the El Paso tradition (Table 7). Almost all the brown wares associated with both traditions had plain exteriors. A very low frequency (0.6 percent) of the brown wares exhibited incised exteriors, and no sherds with corrugated treatments were present.

Decorated types are represented by a wide range of forms and types. Red ware or polychrome types include 310 sherds (9.3 percent) (Table 7). These sherds consist of types assigned to four distinction traditions. A total of 188 sherds exhibiting slipped or painted decorations were assigned to El Paso Polychrome. Other sherds that could have been easily derived from El Paso Polychrome vessels, but did not exhibit painted or slipped decorations, were assigned to El Paso Brown Ware types. A total of 107 sherds were assigned to Jornada red or polychrome types. A slight majority of these sherds represented unpainted slipped red wares. Most of the Jornada red ware sherds exhibiting distinctive painted designs were assigned to Three Rivers Red-on-terracotta, although lower frequencies were assigned to Broadline Terracotta and Lincoln Black-on-white. A total of 13 sherds exhibit red slips and textured designs similar to Playas Red from the Casas Grandes area. One sherd exhibits a combination of pastes and painted decorations indicative of Glaze Polychrome from the Rio Grande region.

White ware types are represented by 311 sherds belonging to two distinctive traditions (Table 7). A total of 249 of these represent painted or unpainted sherds derived from Chupadero Black-on-white. A total of 62 sherds represent forms derived from Mimbres White Ware types. The few Mimbres White Ware sherds exhibiting distinctive types were assigned to Mimbres Classic.

The lack of Corona Corrugated and presence of Mimbres White Ware indicates an occupation mostly dating to the early or middle part of the Glencoe phase. Variation in the combinations and frequencies of pottery types at different stratigraphic units identified during the excavation of Fallen Pine Shelter may provide information concerning the length of occupation and the relationship between different proveniences (Tables 8 and 9).

The distribution of various pottery types from various levels was defined during excavations of the interior of Fallen Pine Shelter. All the units outside the cave were considered together. While such comparisons indicate the presence of a wide range of types and traditions from various proveniences or units, some interesting trends in overall frequencies of pottery assigned to various types and traditions were noted.

Large enough samples were noted in Levels 1 through 4 within the shelter to discuss basic trends from the earlier lower to upper units. The frequency of sherds belonging to several distinct ceramic groups appears to have gradually increased during the different occupational episodes (Tables 6 and 7). For example, the overall frequency of El Paso Brown gradually increases above Level 4, where it makes up 6.9 percent of the total, while Level 1 consists of 17.2 percent. While the trend is not as consistent for El Paso Polychrome, the frequency of this pottery type does rise from 5.9 percent in Level 4 to 9.4 percent in Level 1. The frequency of Chupadero Black-on-white also gradually increases, consisting of 5.4 percent of the sherds from Level 4 and 12.5 percent from Level 1 assemblages.

The frequency of Jornada Red Ware pottery is similar at all levels, consisting of about 5 percent of the total pottery assemblage. The only trend noted for Jornada Red Ware was the occurrence of Lincoln Black-on-red in upper units, and its absence in lower units. Such an association is expected, given the lateness of Lincoln Black-on-red in the northern Jornada sequence. This is also consistent with the occurrence of the single Rio Grande Glaze Polychrome sherd at Level 2.

The overall frequency of Mimbres White Ware is similar for all units, where it makes up around 1 percent of all pottery types, although the lack of a trend may be partly due to the rarity of Mimbres White Ware at this site. No trends were noted for Playas Red, which tends

Table 7. Relationship between ceramic tradition and ware

Count Column Percentage Row Percentage	El Paso	Jornada	Casas Grandes (?)	Mimbres	Rio Grande	Total
Brown	375	2323	-	-	-	2698
	66.6%	86.7%	-	-	-	81.3%
	13.9%	86.1%	-	-	-	100.0%
Red or polychrome	188	107	14	-	1	310
	33.4%	4.0%	100.0%	-	100.0%	9.3%
	60.6%	34.5%	4.5%	-	0.3%	100.0%
White	-	249	-	62	-	311
	-	9.3%	-	100.0%	-	9.4%
	-	80.1%	-	19.9%	-	100.0%
Total	563	2679	14	62	1	3319
	17.0%	80.7%	0.4%	1.9%	0.0%	100.0%

Table 8. Ceramic tradition by level

Count Column Percentage	Level 1	Level 2	Level 3	Level 4	Level 5	Level 6	Outside Cave	Total
Northern Mogollon tradition	484	196	234	372	104	29	1260	2679
	70.6%	78.1%	77.2%	87.1%	92.9%	100.0%	83.4%	80.7%
Southern Mogollon tradition	182	51	65	46	8	-	211	563
	26.5%	20.3%	21.5%	10.8%	7.1%	-	14.0%	17.0%
Mimbres	14	3	1	5	-	-	39	62
	2.0%	1.2%	0.3%	1.2%	-	-	2.6%	1.9%
Mexican	6	-	3	4	-	-	1	14
	0.9%	-	1.0%	0.9%	-	-	0.1%	0.4%
Rio Grande	-	1	-	-	-	-	-	1
	-	0.4%	-	-	-	-	-	0.0%
Total	686	251	303	427	112	29	1511	3319

to be present but very rare in most units.

In contrast to the trends noted for most decorated pottery, the relative frequency of Jornada Brown Ware increases from lower to upper assemblages . For example, Jornada Brown Ware consists of 91.1 percent of all pottery from Level 4 and 54.2 percent from Level 1 (see Table 1). This trend is consistent with observations from other sites that indicate the almost complete dominance of Jornada Brown Ware in the earliest assemblages and its rarity in later assemblages.

The fairly large sample of pottery recovered from units outside the cave was not divided into specific units because of the homogeneity of the soil deposits in this area. Overall frequencies from these deposits are more similar to those noted in the lower units inside of the shelter (Levels 3 and 4). In addition, the frequency of Mimbres White Ware pottery is higher in these units than in those levels within the cave and tends to indicate that these units are contemporary with lower units inside the cave.

The various trends noted are consistent with other observations concerning ceramic change in the northern Mogollon region and seem to indicate a series of occupations, probably spanning sometime during the early to middle Glencoe period, or about A.D. 1100 to 1300.

Ceramic Patterns

While changes in the distribution of various forms of the pottery types have so far been discussed solely in terms of their importance as temporal indicators, they may also reflect various trends. These include changes in pottery production, interaction with other areas, and the use of pottery vessels in various activities. The presence of relatively low frequencies of pottery within various levels indicates a long history of seasonal use of this cave. Since a number of relatively large sites have been identified in the Ruidoso area (Kelley 1984), it is possible that this cave was exploited solely by groups known to have occupied the surrounding area during the

Table 9. Pottery type by level

Pottery Type	Level 1		Level 2		Level 3		Level 4		Level 5		Level 6		Total		Outside Cave
	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.
Glazed polychrome body	-	-	1	0.4%	-	-	-	-	-	-	-	-	1	0.1%	-
El Paso Brown rim	-	-	-	-	1	0.3%	1	0.2%	2	1.8%	-	-	4	0.2%	5
El Paso Brown body	63	9.2%	11	4.4%	26	8.6%	16	3.7%	5	4.5%	-	-	121	6.7%	127
El Paso (smudged surface)	1	0.1%	-	-	-	-	-	-	-	-	-	-	1	0.1%	-
Thin El Paso unpainted brown	54	7.9%	27	10.7%	5	1.7%	4	0.9%	-	-	-	-	90	5.0%	27
El Paso Polychrome	43	6.3%	11	4.4%	20	6.6%	17	4.0%	-	-	-	-	91	5.0%	26
Thin red-slipped	21	3.1%	2	0.8%	13	4.3%	8	1.9%	1	0.9%	-	-	45	2.5%	26
Unpainted Chupadero Black-on-white	35	5.1%	7	2.8%	9	3.0%	4	0.9%	-	-	-	-	55	3.0%	29
Chupadero Black-on-white (indeterminate design)	18	2.6%	9	3.6%	10	3.3%	5	1.2%	-	-	-	-	42	2.3%	15
Chupadero Black-on-white (solid design)	17	2.5%	9	3.6%	5	1.7%	1	0.2%	2	1.8%	-	-	34	1.9%	18
Chupadero Black-on-white (hatchure design)	10	1.5%	5	2.0%	7	2.3%	6	1.4%	-	-	-	-	28	1.5%	6
Chupadero Black-on-white (hatchure with solid design)	6	0.9%	1	0.4%	5	1.7%	7	1.6%	-	-	-	-	19	1.1%	3
Plain slipped red	14	2.0%	8	3.2%	2	0.7%	9	2.1%	-	-	-	-	33	1.8%	17
Red unpainted undifferentiated	-	-	-	-	-	-	7	1.6%	-	-	-	-	7	0.4%	2
Broad Line Red-on-terracotta	3	0.4%	1	0.4%	-	-	-	-	-	-	-	-	4	0.2%	1
Three Rivers Red-on-terracotta	7	1.0%	5	2.0%	11	3.6%	5	1.2%	-	-	-	-	28	1.5%	10
Lincoln Black-on-red	2	0.3%	1	0.4%	-	-	-	-	-	-	-	-	3	0.2%	2
Playas Incised	6	0.9%	-	-	3	1.0%	3	0.7%	-	-	-	-	12	0.7%	1
Playas Punctuated	-	- -	-	-	-	-	1	0.2%	-	-	-	-	1	0.1%	-
Jornada Brown rim	10	1.5%	5	2.0%	6	2.0%	10	2.3%	-	-	-	-	31	1.7%	21
Jornada Brown body	352	51.3%	141	56.0%	177	58.6%	310	72.6%	102	91.1%	29	100.0%	1082	59.8%	1091
Jornada Incised	4	0.6%	4	1.6%	1	0.3%	2	0.5%	-	-	-	-	11	0.6%	6
South Pecos Brown body	6	0.9%	1	0.4%	-	-	6	1.4%	-	-	-	-	13	0.7%	39
Mimbres Black-on-white unpainted	9	1.3%	-	-	-	-	-	-	-	-	-	-	9	0.5%	13
Mimbres Black-on-white (undifferentiated)	3	0.4%	3	1.2%	1	0.3%	3	0.7%	-	-	-	-	10	0.6%	18
Classic Mimbres Black-on-white	2	0.3%	-	-	-	-	2	0.5%	-	-	-	-	4	0.2%	8
Total	686	100.0%	252	100.0%	302	100.0%	427	100.0%	112	100.0%	29	100.0%	1808	100.0%	1511

Glencoe phase. It is also possible that this occupation could reflect use by other groups moving through this area because Fallen Pine Shelter is located along a natural corridor which connects the heavily used Tularosa Basin and Rio Hondo valleys (Oakes, pers. comm., 2002). If the latter is the case, it is possible that pottery produced in different areas was carried to the site by groups from those areas, which could explain the wide range of traditions represented.

Similarities in temper and paste of Jornada Brown and Jornada Red Ware pottery, dominating assemblages at Fallen Pine Shelter and other Glencoe phase sites in the area, indicate that the great majority of pottery from this site could have been produced locally or at nearby sites (Table 10). Characteristics noted in the fine reddish clay from local alluvial deposits and igneous rock outcrops in the Ruidoso area are similar to those noted in the majority of pottery from this site assigned to Jornada Brown Ware and Jornada Red Ware types, as well as the El Paso Brown Ware and El Paso Polychrome traditions. Despite similarities in temper in pottery assigned to the northern Mogollon and El Paso traditions noted in this study, it is more likely that the northern Jornada types were produced locally, in the area of the shelter. While some of the El Paso pottery could have been produced locally, it is more likely that it originated in areas to the south.

It is unlikely that Chupadero Black-on-white was produced in the immediate area. The distinct decorations and technology of Chupadero Black-on-white vessels were not produced by the same potters who produced Three Rivers Red Ware types. This implies regional specialization and the wide distribution of these white ware vessels. The wide range of tempers in Chupadero Black-on-white also indicates they were produced in several distinct areas, including Chupadero Mesa and Gran Quivira, to the west (Table 10).

Mimbres White Ware types were identified based on the presence of pastes and styles characteristic of pottery known to have been produced in the Mimbres region to the southwest.

It is likely that much pottery assigned here to Jornada Brown and El Paso Polychrome may have been derived from similar El Paso Polychrome vessels. The presence of types belonging to these traditions could indicate influence from the southern Mogollon region in south-central and far western Texas. Other possible connections with areas to the south may be indicated by the very small number of Playas Red Incised sherds exhibiting characteristics similar to those from the Casas Grandes region. The possible production of Playas Incised in the Jornada region has been previously noted (Wiseman, pers. comm., 2002). The Playas Red Incised examined during the present study displays a combination of distinct sand and local igneous material and may indicate a mixture of intrusive and local forms (Table 10).

Most of the potters residing in the area located immediately around Fallen Pine Shelter probably produced Jornada Brown and Jornada Red Ware. Types assigned to Jornada Brown represent the only group of pottery whose overall frequency decreased from older to more recent strata (Table 6). Jornada Red Ware represents the only decorated pottery group represented by significant numbers of sherds whose overall frequency decreased through time (Table 6). A gradual increase in pottery from other regions appears to have occurred. Exceptions to this are the Mimbres types whose overall frequency appears to have remained the same or decreased through time.

Similar trends noted in other studies (Aguila 2002) may reflect shifts in regional ties and networks. It also possible that the increasingly wide variety of traditions reflects the utilization of this area by a number of distinct groups moving between the Hondo and Tularosa Valleys.

Trends in Vessel Form and Use

Trends in the overall frequency of sherds assigned to various ware groups and forms at Fallen Pine Shelter may also provide clues about the use of pottery for various activities. The correlation between surface treatment and vessel form is often weaker in Jornada Mogollon wares (particular brown wares) than in other southwest traditions. It is often difficult to determine the vessel form from which body sherds derived in Jornada assemblages. An examination of sherd distributions, as well as just rim sherds, reveals some trends in vessel form through time (Tables 11 and 12). Most of the brown ware sherds (68.6 percent of all rim sherds) appear to have derived from wide-mouth jars, although a significant number are from bowls and seed jars (Table 12). In contrast, most (80.4 percent of all rim sherds) of the decorated red ware and white sherds appear to have derived from bowl forms.

An examination of pottery frequencies from different stratigraphic units indicates a slight decline in the amount of brown wares and an increase in decorated wares through time (Table 13). This may indicate that pottery was used in a wider range of activities during later periods.

Table 10. Temper by pottery type

Pottery Type	Glaze Ware		El Paso Brown Ware		El Paso Polychrome		Chupadero Black-on-white		Jornada Red		Playas Red		Jornada Brown		Mimbres Black-on-white		Total
Temper	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	
Sand	-	-	2	0.5%	1	0.5%	1	0.4%	-	-	3	21.4%	6	0.3%	-	-	13
Fine tuff and sand	-	-	1	0.3%	-	-	-	-	-	-	-	-	-	-	-	-	1
Leucocratic igneous	-	-	51	13.6%	15	8.0%	-	-	4	3.7%	1	7.1%	44	1.9%	-	-	115
Fine sandstone	-	-	1	0.3%	3	1.6%	2	0.8%	-	-	-	-	37	1.6%	-	-	43
Jornada leucocratic igneous	-	-	317	84.5%	164	87.2%	35	14.1%	102	95.3%	10	71.4%	2184	94.0%	-	-	2812
Dark igneous and sherd	-	-	2	0.5%	-	-	193	77.5%	-	-	-	-	-	-	-	-	195
Latite	1	100.0%	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1
Dark feldspar	-	-	1	0.3%	5	2.7%	-	-	1	0.9%	-	-	52	2.2%	-	-	68
Calcium carbonate and sherd	-	-	-	-	-	-	9	3.6%	-	-	-	-	-	-	-	-	9
Calcium carbonate	-	-	-	-	-	-	9	3.6%	-	-	-	-	-	-	-	-	9
Sand and Mogollon volcanics	-	-	-	-	-	-	-	-	-	-	-	-	-	-	62	100.0%	62
Total	1	100.0%	375	100.0%	188	100.0%	249	100.0%	107	100.0%	14	100.0%	2323	100.0%	62	100.0%	3319

Table 11. Vessel form by ware group

Count Column Percentage	Brown Ware	Red Ware or Polychrome	White Ware	Total
Indeterminate	1	1	2	4
	0.0%	0.3%	0.6%	0.1%
Bowl rim	14	38	36	88
	0.5%	12.3%	11.6%	2.7%
Bowl body	7	89	142	238
	0.3%	28.7%	45.7%	7.2%
Seed jar	8	3	-	11
	0.3%	1.0%	-	0.3%
Jar neck	100	43	5	148
	3.7%	13.9%	1.6%	4.5%
Jar rim	48	12	2	62
	1.8%	3.9%	0.6%	1.9%
Jar body	58	88	122	268
	2.1%	28.4%	39.2%	8.1%
Indeterminate coil/strap handle	1	-	-	1
	0.0%	-	-	0.0%
Canteen rim	-	1	-	1
	-	0.3%	-	0.0%
Body sherd polished interior and exterior	2115	20	1	2136
	78.4%	6.5%	0.3%	64.4%
Unpolished body	271	10	1	282
	10.0%	3.2%	0.3%	8.5%
Unpolished interior and polished exterior body	69	5	-	74
	2.6%	1.6%	-	2.2%
Polished interior and unpolished exterior body	6	-	-	6
	0.2%	-	-	0.2%
Total	2698	310	311	3319
	100.0%	100.0%	100.0%	100.0%

Table 12. Rim sherd vessel form by ware

Vessel Form	Brown Ware		Red Ware or Polychrome		White Ware		Total
	No.	%	No.	%	No.	%	No.
Bowl rim	14	20.0%	38	70.4%	36	94.7%	88
Seed jar	8	11.4%	3	5.6%	-	-	11
Jar rim	48	68.6%	12	22.2%	2	5.3%	62
Canteen rim	-	-	1	1.9%	-	-	1
Total	70	100.0%	54	100.0%	38	100.0%	162

Table 13. Ware group by level

Level	Brown Ware		Red or Polychrome Ware		White Ware		Total
	No.	%	No.	%	No.	%	No.
1	490	18.2%	96	31.0%	100	32.2%	686
2	189	7.0%	28	9.0%	34	10.9%	251
3	216	8.0%	50	16.1%	37	11.9%	303
4	349	12.9%	50	16.1%	28	9.0%	427
5	109	4.0%	1	0.3%	2	0.6%	112
6	29	1.1%	-	-	-	-	29
Outside cave	1316	48.8%	85	27.4%	110	35.4%	1511
Total	2698	100.0%	310	100.0%	311	100.0%	3319

LITHIC ARTIFACT ANALYSIS

Philip R. Alldritt and Yvonne R. Oakes

A total of 1,194 chipped stone artifacts were recovered from Fallen Pine Shelter, excluding projectile points, which are analyzed in the following chapter. In general, this analysis was designed to provide information regarding reduction strategies (including tool manufacture), informal and formal tool use, and material procurement by the various occupants of the shelter.

During the testing phase at Fallen Pine Shelter it was determined that some form of Archaic component was present beneath the Pueblo occupation. As the excavation proceeded, the data showed that there was a significant Archaic occupation, and subsequently a computerized provenience file for all artifacts was created to isolate these data and provide a chronological profile of both components of the site. This combined file was applied to the analysis of the lithic artifacts, and the results and conclusions are reflected in this data base.

Two general reduction strategies (methods used to remove materials from a core or a tool) have been recognized in the prehistoric Southwest. Curated strategies involve the manufacture of bifaces that are used as both unspecialized tools and cores, while expedient strategies are based on the removal of flakes from cores for use as informal tools (Kelly 1985, 1988). Lithic technology is often related to the various patterns of mobility of a group. Curated strategies are usually associated with a high degree of residential mobility, while expedient strategies are typically associated with sedentary lifestyles, with a large range of mobility patterns in between. Exceptions to this include highly mobile groups living in areas that contain abundant and widely distributed raw materials or suitable substitutes for stone tools (Parry and Kelly 1987). The broad territorial range of more mobile groups often allows for selection of better quality raw material, as seen in many Archaic assemblages. Prehistoric southwestern biface reduction strategies are similar to the blade technologies of Mesoamerica and western Europe in that they focus on efficient reduction with little waste. While initial production of large bifaces is labor intensive and results in a fair amount of waste, the finished tool can be easily and efficiently reduced (Moore 1996).

Employment of curated strategies also conditions flintknappers to produce the maximum length of usable edge per biface without wasting raw material. Variations in size of flakes should be minimal (Young 1993). Tools produced by this technique are often recycled for other purposes until used up (Bamforth 1985). By maximizing their return, knappers are able to reduce the volume of raw material required for the production of informal tools. This helps to lower the amount of weight transported between camps. Neither material waste nor transport cost were important considerations in expedient flake technologies. Flakes were simply struck from cores when needed. The result was the production of a wide variety of flakes (Young 1993) that were rarely modified; most were used only once and then discarded (Parry and Kelly 1987:287). Vierra (1994) argued that flake technologies are not related to mobility patterns but rather to changes in labor organization brought about by increased dependence on agriculture and its tethering effects. But the availability of raw materials and the need, or lack thereof, for efficiency must also be considered (Kelly 1988). Thus, analysis of the reduction strategy used at a site allows us to examine whether its occupants were residentially mobile, sedentary, or somewhere in between (Moore 1996).

Within this assemblage, we anticipated a difference in mobility patterns between the Archaic and Pueblo peoples who occupied the shelter. In short, we expected the Archaic occupation to have employed curated reduction strategies and the later Pueblo groups to have used expedient flake technologies. This would entail finding a larger number of generalized bifaces in the Archaic and specialized ones in the Pueblo period (Moore 1996:109), for example. The Pueblo occupation should also have a greater number of informal tools. However, there is the possibility that throughout both the Archaic and Pueblo periods, there were similar patterns of mobility for whatever reason. Differences could also appear in the raw materials used and in how they were reduced (Moore 1996:108). An examination of raw material sources can also provide us with information on the mobility patterns used during the two periods. It is also possible that those using a curated strategy could also have employed expedient flake production while camped at a site (Camilli 1988:158).

Analysis Methods

The lithic artifacts were analyzed and recorded according to *Standardized Lithic Artifact Analysis: Attributes and Variable Code Lists* (OAS 1994a). The analysis examined morphological and functional attributes, stages of reduction, manufacture and maintenance, and tool use and discard. A definition and discussion of the attributes are provided in the analysis manual, on file at the OAS. Each artifact was monitored using a binocular microscope to define morphology and material type, examine platforms, and determine wear patterns. The level of magnification varied between 10x and 100x, with higher magnifications used for wear-pattern analysis and identification of platform types. Utilized and modified edge angles were measured in degrees with a goniometer; other attributes were measured in millimeters with a sliding caliper. Results were entered into a computerized data base using the Statistical Package for the Social Sciences data entry program. Specific attributes monitored in this analysis included material type, artifact morphology and function, cortex type and percent present, platform type, thermal alteration, wear patterns, edge angles, and dimensional data.

A polythetic framework was used in this study to distinguish biface reduction flakes from other debitage. The framework is one in which fulfilling a majority of conditions is both necessary and sufficient for inclusion in a class (Beckner 1959). The polythetic set contains an array of conditions, and rather than requiring an artifact to fulfill all of them, only a set percentage in any combination needs to be fulfilled. This array of conditions models an idealized biface reduction flake and includes information on platform morphology, flake shape, and previous removals. Therefore, when a flake fulfilled 70 percent of the listed conditions, it was considered to be a removal from a biface. This percentage is high enough to isolate flakes produced during the later stages of biface production from those removed from cores, while at the same time it is low enough to permit flakes that were removed from a biface (but do not fulfill the entire set of conditions) to be properly identified. While not all flakes removed from bifaces could be isolated using the polythetic set, those that were could be considered definite evidence of biface reduction. Flakes that fulfilled less than 70 percent of the conditions were classified as removals from cores. Instead of rigid definitions, the polythetic set provides a useful means of categorizing flakes and helps account for some of the variability (Hayden et al.1998).

Material Types and Sources

An understanding of whether a raw material used in the production of lithic artifacts is locally available or nonlocal is critical to any discussion of prehistoric mobility patterns. In general, materials should be considered to be local if the source is no more that 10 to 15 km from the site. This distance is based on ethnographic studies which suggest that a 20 to 30 km round trip is the approximate distance that hunter-gatherers will walk comfortably in a day (Kelly 1995:133). While more distant regions were undoubtedly used, this zone represents the area that was most heavily exploited around sites. Raw materials are frequently considered nonlocal or exotic if the distance is further than this.

Moore (1996:228) suggests three ways that prehistoric peoples could have acquired lithic raw materials: (1) Transported to site from nonlocal sources. There would, therefore, be little evidence of manufacturing on the site. (2) Obtained from local sources. (3) Scavenged and reused. We suggest that one other means of obtaining raw material would be through trade. These methods will be examined in light of the Fallen Pine Shelter assemblage.

Table 14 presents the frequencies and percentages of raw materials from the shelter. Many of the materials are available in the immediate vicinity of the site. Andrefsky (1994:101) stresses that the availability of suitable raw materials has a critical impact on the type of lithic technology used by a group.

Chert is by far the most frequently used material (89.9 percent), with slightly more use during the Archaic period. This material is readily available local-

Table 14. Lithic raw material by time period

Material Type	Archaic		Pueblo		Total	
	No.	%	No.	%	No.	%
Chert	595	90.6%	479	89.2%	1074	89.9%
San Andres chert	27	4.1%	12	2.2%	39	3.3%
Limestone	23	3.5%	36	6.7%	59	4.9%
Chalcedony	5	0.8%	3	0.6%	8	0.7%
Obsidian	4	0.6%	1	0.2%	5	0.4%
Rhyolite	1	0.2%	3	0.6%	4	0.3%
Silicified wood	2	0.3%	1	0.2%	3	0.3%
Basalt	-	-	1	0.2%	1	0.1%
Quartzite	-	-	1	0.2%	1	0.1%
Total	657	100.0%	537	100.0%	1194	100.0%

ly, appearing as nodules in the surrounding San Andres limestone and as rounded cobbles in river and terrace gravels along the Rio Ruidoso (Warren 1971:5). The quality can range from fine to poor; however, most of the chert from Fallen Pine Shelter is classified as fine (90.7 percent).

San Andres chert can be readily distinguished from the others by its characteristic banding, very similar to “fingerprint” chert of the Zuni Mountains. One known outcrop is located on a ridge south of Fort Stanton cemetery (Warren 1971:6), and another is in the canyons east of Cloudcroft (Chris Adams, pers. comm., 2001), occurring as nodules in San Andres limestone. It was utilized more by Archaic peoples at Fallen Pine Shelter than by Pueblo groups (4.1 versus 2.2 percent). Archaic populations also used it more frequently as a material for producing projectile points.

Most of the limestone in the area is San Andres limestone, easily acquired in the immediate vicinity of the site within the Yeso formation (Allen and Kottlowski 1981). The Yeso formation also underlies most of the Rio Hondo basin and occurs as an aquifer in most of the basin (Warren 1971:5). It also outcrops along the Rio Ruidoso and on much of the Mescalero Apache reservation. San Andres limestone is the uppermost geologic bed covering the eastern slopes of the Sierra Blanca Mountains (Kelley 1984:2). Limestone was used for artifact material by both prehistoric groups, although somewhat more by Pueblo groups. The utilization of this material may be related to its availability, since it is found almost everywhere around the site.

Chalcedony is available locally. One known source is located north of the project area on the ridge tops north of the Rio Bonito (McNally 2002).

Five pieces of obsidian were retrieved from Fallen Pine Shelter and submitted to the Berkeley Archaeological XRF Lab for sourcing. All five pieces were traced to the Jemez Mountains, specifically from two separate sources within this area. Three are of Cerro Toledo rhyolite glass, which erodes into the Rio Grande and could be the source of the pieces. However, one of these samples (FS 1054) retains an angular cortex, and Shackley of the XRF Lab (this volume) believes this indicates direct procurement of the obsidian as opposed to obtaining it from secondary deposits (which have rounded cortex) in the lower Rio Grande. The other two pieces of obsidian are from the Valle Grande source within the Jemez Mountains. This material has not eroded into the Rio Grande, indicating that these pieces were also procured directly from their source. Valle Grande obsidian has been found not uncommonly on sites in the Southern High Plains (Baugh and Nelson 1987:319-322), and its quality is excellent. An extensive trade with Pueblo communities is suggested for this area to the east of the Sacramento Mountains.

The fact that four of the five pieces of obsidian (all within Archaic levels) strongly imply direct procurement from the Jemez Mountains provides a clue to the range of movement of at least some of the Archaic populations of the shelter—a distance of up to 295 km. This confirms what we have generally expected of Middle or Late Archaic groups, that they potentially could travel great distances on their annual rounds. Therefore, though small, the Fallen Pine obsidian assemblage provides us with an insight into the mobility pattern of some of the Archaic site occupants.

Only a few pieces of rhyolite and basalt were found in archaeological contexts on the site. The primary source underlies nearby Sierra Blanca Peak, to the northwest, with a series of igneous dikes radiating from there (Harrill 1980:5). The materials are fine-grained to glassy and can be obtained in channel and terrace gravels of the Rio Ruidoso and Devil’s Canyon and on Pajarito Mountain to the southeast (Warren 1971:6, 28). Quartzite can also be found as pebbles in Sierra Blanca washes (Kelley 1984).

No specific source of silicified wood was identified in a literature search and the few pieces recovered from the site may or may not have been locally available.

No more than 0.9 percent of all lithic materials for both the Archaic and the Pueblo occupations at Fallen Pine Shelter were exotic or not locally available (Table 14). This includes the obsidian and possibly the silicified wood. Igneous materials underlie the Sierra Blanca Mountains and outcrop in various formations throughout the area, with cherts and chalcedonies found in local washes, in gravel materials, and on ridge units.

When comparing other lithic material assemblages with Fallen Pine Shelter, there are no Archaic sites with really comparable distributions of material types. Three sites, including High Rolls Cave, Fresnal Shelter, and an open-air site at Santa Teresa (Lentz in prep.; Jones 1990; Moore 1996) were compared with the shelter (Table 15). Even High Rolls and Fresnal, which are directly across a canyon from each other, are not comparable in their percentages. Both are of the same Late Archaic period, but much more diversity appears in the Fresnal assemblage. Some of these differences could be due to analytical interpretation—for example, at Fresnal the percentage of limestone is greatly exaggerated by the inclusion of rock fall and spalls in the counts. Likewise, the lack of San Andres chert at both sites may also be the function of differing analytical classifications than those used at Fallen Pine Shelter. The Santa Teresa site (LA 86780), an open-air encampment away from the mountains, near El Paso, displays quite a bit of variance from the others. Chert is not nearly as common as at the three other sites, and it shares almost equal popularity with

Table 15. Raw materials at comparable Archaic sites (percentages)

Material Type	Fallen Pine Shelter	High Rolls	Fresnal	Santa Teresa Archaic
Chert	90.6	83.1	57.7	44.9
San Andres chert	4.1	-	-	-
Limestone	3.5	9.4	29.7	2.5
Chalcedony	0.8	-	2.5	2.8
Obsidian	0.6	-	1.3	0.9
Rhyolite	0.2	3.3	-	42.2
Silicified wood	0.3	-	-	0.9
Basalt	-	4	6.7	1.9
Quartzite	-	0.1	1.2	3.6
Siltstone	-	0.1	0	0.2
Andesite	-	-	0.2	-
Granite	-	-	0.2	-
Monzonite	-	-	0.1	-
Sandstone	-	-	0.1	0.1

Table 16. Raw material at comparable Pueblo sites (percentages)

Material Type	Fallen Pine Shelter	Angus	Rio Bonito	Santa Teresa Pueblo	Turquoise Ridge
Chert	89.2	5.3	2	22.4	66.4
San Andres chert	2.2	-	47.9	-	-
Limestone	6.7	0.4	-	-	16.5
Chalcedony	0.6	0.1	10.4	-	1
Obsidian	0.2	0.3	-	1	0.1
Rhyolite	0.6	0.3	-	70.8	0.7
Silicified wood	0.2	-	-	0.7	-
Basalt	0.2	-	25.0*	1.5	0.5
Quartzite	0.2	5.3	-	1.7	1.7
Andesite	-	3.4	2	-	-
Siltstone	-	0.8	12.5	1.2	8.3
Silicified shale	-	83.6	-	-	-
Sandstone	-	-	-	0.7	4

* May be silicified (Zamora and Oakes 2000).

rhyolite. Rhyolite is a frequently found material in the El Paso region, whereas it apparently was not used much in the Sacramento Mountains.

Table 16 compares the Pueblo period occupation at Fallen Pine Shelter with other ceramic sites in the region: the Angus and Rio Bonito sites, in the Sacramento Mountains, and Turquoise Ridge and Santa Teresa (LA 86774), in the lower Tularosa Basin (Zamora and Oakes 2000; Vierra and Lancaster 1987; Whalen 1994; Moore 1996). In general, the use of cherts (including San Andres) drops from an average of 70.1 percent in the Archaic (it is 78.5 percent in the Sacramento Mountains) to 47.1 percent in the Pueblo period. Since this material is locally available, the reason for the drop in use is unexplained. However, some researchers could have probably misidentified the silicified shale as black chert at Angus, and likewise for the glassy basalt at Rio Bonito, which would have greatly raised the percentages of chert used at both sites. Obsidian at no time on any site of any period exceeds 1.3 percent of an assemblage, even at the Santa Teresa sites, which are very close to the Rio Grande, a probable source. If obsidian was being exported or directly procured from the Jemez Mountains, the system for doing so was apparently very weak. San Andres chert is more popular in the Pueblo period than the Archaic, showing up also at the Rio Bonito site with the highest percentage of any material on the site. Diversity of material types is about the same for both periods, with many local choices from which to select a usable material.

Geologic material source is not necessarily an indicator of where the material was procured since it can be moved from its original source via many means. Methods by which materials are transported long distances include direct procurement from a source, through trade with other groups, or by natural processes. With natural processes, raw materials are transported from one place to another particularly through drainage systems. An evaluation of cortex types on lithic materials can indicate whether natural processes or human intervention have transported them (Hayden et al. 1998).

In the Fallen Pine Shelter lithic assemblage, 193 of 1,194 pieces (16.2 percent) contained cortex, either waterworn or nonwaterworn (Table 17). Waterworn cortex indicates that the material was transported away from its original source through drainage channels, and so procurement did not occur at the source. Nonwaterworn cortex implies that minimal or no water transport has taken place. Overall, 12.6 percent of the Archaic lithic assemblage and 17.1 percent of the Pueblo display waterworn cortex, while only 1.4 percent and 1.7 percent, respectively, are nonwaterworn. This would confirm above statements that minimal material was obtained from its geologic source in both assemblages.

Reduction Strategies

To determine the type of lithic reduction strategy used by the Archaic and Pueblo occupations of the shelter, we looked at the various means of identifying curated versus expedient reduction methods. Moore (1996:246-247) presents several indicators for examining the type of strategy used on a site. He looks at the following attributes of lithic assemblages to arrive at a determination of reduction strategy:

1. Percentage of noncortical debitage. High percentage equates with curated technology, while low percentage represents an expedient strategy.
2. Percentage of manufacturing flakes (bifaces vs. core

Table 17. Cortex type by material

Count Row Percentage Column Percentage	Cortex Type				Total
	Waterworn		Nonwaterworn		
Material	Pueblo	Archaic	Pueblo	Archaic	
Chert	88	77	8	6	179
	49.2%	43.0%	4.5%	3.4%	100.0%
	95.7%	92.8%	88.9%	66.7%	92.7%
Chalcedony	-	-	-	1	1
	-	-	-	100.0%	100.0%
	-	-	-	11.1%	0.5%
Silicified wood	-	1	-	-	1
	-	100.0%	-	-	100.0%
	-	1.2%	-	-	0.5%
Obsidian	1	1	-	-	2
	50.0%	50.0%	-	-	100.0%
	1.1%	1.2%	-	-	1.0%
Rhyolite	-	1	-	-	1
	-	100.0%	-	-	100.0%
	-	1.2%	-	-	0.5%
Limestone	2	3	1	2	8
	25.0%	37.5%	12.5%	25.0%	100.0%
	2.2%	3.6%	11.1%	22.2%	4.1%
Quartzite	1	-	-	-	1
	100.0%	-	-	-	100.0%
	1.1%	-	-	-	0.5%
Total	92	83	9	9	193
	47.7%	43.0%	4.7%	4.7%	100.0%
	100.0%	100.0%	100.0%	100.0%	100.0%

flakes). The higher the percentage of bifaces, the greater the focus on tool production.
3. Percentage of modified platforms. A large number of modified platforms indicates tool manufacture.
4. Flake to angular debris ratio. A high ratio represents tool manufacture; a low ratio indicates core reduction.
5. Flake breakage pattern. A higher number of broken flakes indicates tool manufacture; a lower number indicates core reduction.
6. Platform lipping. A high number of pressure flakes indicates tool manufacture.
7. Presence of opposing dorsal scars. A high percentage indicates biface manufacture.
8. Flake to core ratio. A high ratio indicates tool manufacture; a low ratio indicates expedient core reduction (however, cores could have been reduced elsewhere).

Moore (1996) requires that only 70 percent of the above conditions be met to indicate that either core reduction or biface manufacture occurred on a site. We used his methodology to determine the reduction strategies used at Fallen Pine Shelter.

Noncortical Debitage

Of the 1,194 lithic artifacts recovered, 1,021 (85.6 percent) exhibited no cortex (Table 18), with Archaic materials at 86.9 percent and Pueblo at 83.4 percent. Chert has by far the greatest number of pieces with no cortex. When adding in the number of materials with less than 25 percent cortex, the total of noncortical debitage can be considered to be 92.4 percent for the entire assemblage. Both the Archaic and Pueblo assemblages strongly favor curated strategies. While most debitage usually found on a site is noncortical, curated strategies should have significantly higher amounts (Moore 1996:246), as evidenced at Fallen Pine Shelter. The manufacture of tools, such as bifaces, usually requires removal of a large amount of flakes to produce the desired shape, increasing the amount of noncortical debitage. Thus, flakes have less and less dorsal cortex as tool reduction takes place. The presence of many flakes with minimal or no dorsal cortex indicates late stages of tool manufacture. In preparation for tool production, cores must be reduced and cortex removed. This is considered primary core reduction, while secondary core reduction is the removal of subsequent interior flakes. Moore (1996:250) considers primary core flakes to have 50 percent or more dorsal cortex, and secondary flakes have less than 50 percent dorsal cortex. A lack of primary flakes suggests that initial reduction occurred elsewhere. Fallen Pine Shelter contains very few primary flakes (4.4 percent), indicating that initial core reduction did not occur very often on the site.

This conclusion is verified by the presence of only 32 cores on the site, or 2.7 percent of the total assemblage (Table 19). As expected, chert cores are the most prevalent (87.5 percent), with only single examples of other materials. One example is an obsidian core from the Jemez Mountains. The core assemblage is divided evenly between Archaic and Pueblo occupations, indicating that neither group brought many cores to the site. Preparation of cores may have occurred elsewhere.

Manufacturing Flakes

The production of more biface flakes than core flakes indicates a strong focus on tool manufacture. Biface flakes are differentiated from core flakes by a set of attributes for whole and broken flakes (Acklen et al. 1983). To be considered a biface or manufacturing flake, a whole flake must meet 70 percent, or 7 of the 10 conditions listed below. A broken flake must meet 5 of the 7 broken flake conditions. Those that do not meet these requirements are considered core flakes. For whole flakes, the ten attributes are:

1. Platform. More than one facet, *or* it is modified.
2. Platform. Lipped.
3. Platform angle is less than 45 degrees.
4. Dorsal scar orientation is parallel, multidirectional, or opposing.
5. Dorsal topography is regular.
6. Edge outline is even or waisted.
7. Thickness is less than 5 mm.
8. Thickness relatively even throughout length.
9. Bulb of percussion weak.
10. Pronounced ventral curvature.

For broken flakes, the seven attributes are:

1. Dorsal scar orientation is parallel, multidirectional, or opposing.
2. Dorsal topography is regular.
3. Edge outline is even.
4. Flake less than 5 mm thick.
5. Thickness relatively even throughout length.
6. Bulb of percussion weak.
7. Pronounced ventral curvature.

While not all attributes could be monitored for each flake, a preponderance of biface flake attributes on a flake allowed us to comfortably assign categories. Results of the analysis show that core flakes far outnumber biface flakes in the Fallen Pine Shelter assemblage (Table 20), indicating more of a focus on core reduction than tool manufacture. There are, however, more biface flakes (5.7 percent vs. 2.1 percent of the

Table 18. Percentage of cortex by material types

Count	0%		1-24%		25-49%		50-70%		71-99%		100%		Subtotal		Total
Column Percentage	Pueblo	Archaic	Pueblo	Archaic	Pueblo	Archaic	Pueblo	Archaic	Pueblo	Archaic	Pueblo	Archaic	Pueblo	Archaic	
Chert	397	515	38	37	17	19	10	11	11	8	6	5	479	595	1074
	88.2%	90.2%	90.5%	94.9%	100.0%	90.5%	100.0%	100.0%	100.0%	88.9%	85.7%	83.3%	89.2%	90.6%	89.9%
San Andres chert	11	27	1	-	-	-	-	-	-	-	-	-	12	27	39
	2.4%	4.7%	2.4%	-	-	-	-	-	-	-	-	-	2.2%	4.1%	3.3%
Chalcedony	3	5	-	-	-	-	-	-	-	-	-	-	3	5	8
	0.7%	0.9%	-	-	-	-	-	-	-	-	-	-	0.6%	0.8%	0.7%
Silicified wood	1	1	-	1	-	-	-	-	-	-	-	-	1	2	3
	0.2%	0.2%	-	2.6%	-	-	-	-	-	-	-	-	0.2%	0.3%	0.3%
Obsidian	-	3	1	-	-	1	-	-	-	-	-	-	1	4	5
	-	0.5%		-	-	4.8%	-	-	-	-	-	-	0.2%	0.6%	0.4%
Basalt	1	-	-	-	-	-	-	-	-	-	-	-	1	0	1
	0.2%	-	-	-	-	-	-	-	-	-	-	-	0.2%	0.0%	0.1%
Rhyolite	3	-	-	-	-	1	-	-	-	-	-	-	3	1	4
	0.7%	-	-	-	-	4.8%	-	-	-	-	-	-	0.6%	0.2%	0.3%
Limestone	34	20	2	1	-	-	-	-	-	1	-	1	36	23	59
	7.6%	3.5%	-	2.6%	-	-	-	-	-	11.1%	-	16.7%	6.7%	3.5%	4.9%
Quartzite	-	-	-	-	-	-	-	-	-	-	1	-	1	0	1
	-	-	-	-	-	-	-	-	-	-		-	0.2%	0.0%	0.1%
Total	450	571	42	39	17	21	10	11	11	9	7	6	537	657	1194
	37.7%	47.8%	3.5%	3.3%	1.4%	1.8%	0.8%	0.9%	0.9%	0.8%	0.6%	0.5%	45.0%	55.0%	100.0%
	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%

Table 19. Lithic artifact function by material type

Count Row Percentage Column Percentage	Time Period	Chopper	Drill	Graver	Angular Debris	Flake	Core	End Scraper	Side Scraper	End/Side Scraper	Biface	Total
Chert	Pueblo	-	1	1	69	386	15	-	5	4	10	491
		-	0.2%	0.2%	14.1%	78.6%	3.1%	-	1.0%	0.8%	2.0%	100.0%
		-	50.0%	50.0%	50.7%	39.5%	46.9%	-	38.5%	44.4%	47.6%	41.1%
	Archaic	-	1	1	55	523	13	-	7	4	9	613
		-	0.2%	0.2%	9.0%	85.3%	2.1%	-	1.1%	0.7%	1.5%	100.0%
		-	50.0%	50.0%	40.4%	53.5%	40.6%	-	53.8%	44.4%	42.9%	51.3%
San Andres chert	Pueblo	-	-	-	-	-	-	1	-	-	-	1
		-	-	-	-	-	-	100.0%	-	-	-	100.0%
		-	-	-	-	-	-	50.0%	-	-	-	0.1%
	Archaic	-	-	-	1	5	1	-	-	-	1	8
		-	-	-	12.5%	62.5%	12.5%	-	-	-	12.5%	100.0%
		-	-	-	0.7%	0.5%	3.1%	-	-	-	4.8%	0.7%
Chalcedony	Pueblo	-	-	-	-	3	-	-	-	-	-	3
		-	-	-	-	100.0%	-	-	-	-	-	100.0%
		-	-	-	-	0.3%	-	-	-	-	-	0.3%
	Archaic	-	-	-	1	4	-	-	-	-	-	5
		-	-	-	20.0%	80.0%	-	-	-	-	-	100.0%
		-	-	-	0.7%	0.4%	-	-	-	-	-	0.4%
Silicified wood	Pueblo	-	-	-	-	1	-	-	-	-	-	1
		-	-	-	-	100.0%	-	-	-	-	-	100.0%
		-	-	-	-	0.1%	-	-	-	-	-	0.1%
	Archaic	-	-	-	-	2	-	-	-	-	-	2
		-	-	-	-	100.0%	-	-	-	-	-	100.0%
		-	-	-	-	0.2%	-	-	-	-	-	0.2%
Obsidian	Pueblo	-	-	-	-	-	-	-	-	1	-	1
		-	-	-	-	-	-	-	-	100.0%	-	100.0%
		-	-	-	-	-	-	-	-	11.1%	-	0.1%
	Archaic	-	-	-	-	2	1	1	1	-	-	5
		-	-	-	-	40.0%	20.0%	20.0%	20.0%	-	-	100.0%
		-	-	-	-	0.2%	3.1%	50.0%	7.7%	-	-	0.4%
Basalt	Pueblo	-	-	-	-	1	-	-	-	-	-	1
		-	-	-	-	100.0%	-	-	-	-	-	100.0%
		-	-	-	-	0.1%	-	-	-	-	-	0.1%
Rhyolite	Pueblo	-	-	-	-	3	-	-	-	-	-	3
		-	-	-	-	100.0%	-	-	-	-	-	100.0%
		-	-	-	-	0.3%	-	-	-	-	-	0.3%
	Archaic	-	-	-	1	-	-	-	-	-	-	1
		-	-	-	100.0%	-	-	-	-	-	-	100.0%
		-	-	-	0.7%	-	-	-	-	-	-	0.1%
Limestone	Pueblo	-	-	-	9	26	1	-	-	-	-	36
		-	-	-	25.0%	72.2%	2.8%	-	-	-	-	100.0%
		-	-	-	6.6%	2.7%	3.1%	-	-	-	-	3.0%
	Archaic	1	-	-	-	20	1	-	-	-	1	23
		4.3%	-	-	-	87.0%	4.3%	-	-	-	4.3%	100.0%
		100.0%	-	-	-	2.0%	3.1%	-	-	-	4.8%	1.9%
Quartzite	Pueblo	-	-	-	-	1	-	-	-	-	-	1
		-	-	-	-	100.0%	-	-	-	-	-	100.0%
		-	-	-	-	0.1%	-	-	-	-	-	0.1%
	Total	1	2	2	136	977	32	2	13	9	21	1195

assemblages) in the Archaic period.

Modified Platforms

A high frequency of modified platforms on flakes indicates that tool manufacture was of high priority on a site. The type of prepared platform can inform on the reduction technology involved. Cortical platforms usually indicate an early phase of core reduction. Single-facet platforms are frequently associated with removal of core flakes. Multifacet platforms infer previous removal along an edge and indicate that a great deal of earlier reduction has taken place (Moore 1996:251). Other types of modification include retouch and abrasion, used to prepare for flake removal, by increasing the angle of an edge, strengthening it to prevent shattering.

Some types of platform preparation could not be determined in the Fallen Pine Shelter assemblage, usually because of breakage. Table 21 shows the types of platforms that were found on the flakes at the site. Single-facet platforms constitute, by far, the most common form noted in both the Archaic and Pueblo populations. The use of this type of platform is mostly associated with the production of core flakes. Cortical platforms, while few, are more prevalent in the Pueblo assemblage, indicating the early-stage reduction of cores in this time period. The presence of multifacet platforms suggests that both groups were reducing raw materials until perhaps exhausted. Only one case of

Table 20. Lithic artifact function by time period

Count Column Percentage Row Percentage	Archaic	Pueblo	Total
Angular debris	58	78	136
	42.6%	57.4%	100.0%
	8.8%	14.5%	11.4%
Core flakes	521	409	930
	56.0%	44.0%	100.0%
	79.3%	76.2%	77.9%
Biface flakes	36	11	47
	76.6%	23.4%	100.0%
	5.5%	2.0%	3.9%
Cores	16	16	32
	50.0%	50.0%	100.0%
	2.4%	3.0%	2.7%
Scrapers	12	11	23
	52.2%	47.8%	100.0%
	1.8%	2.0%	1.9%
Bifaces	11	10	21
	52.4%	47.6%	100.0%
	1.7%	1.9%	1.8%
Choppers	1	-	1
	100.0%	-	100.0%
	0.2%	-	0.1%
Drill	1	1	2
	50.0%	50.0%	100.0%
	0.2%	0.2%	0.2%
Graver	1	1	2
	50.0%	50.0%	100.0%
	0.2%	0.2%	0.2%
Total	657	537	1194
	55.0%	45.0%	100.0%
	100.0%	100.0%	100.0%

preparation of a platform by abrasion was seen in the Archaic assemblage. In all, we can say that removal of flakes from cores was a primary concern of both prehistoric occupations at Fallen Pine Shelter.

Flake-to Angular-Debris Ratio

A high ratio of flakes to angular debris in an assemblage represents tool manufacture, while a low ratio indicates core reduction. At Fallen Pine Shelter, there are many fewer pieces of angular debris than flakes. The ratio of flakes (557) to angular debris (58) for the Archaic artifacts is 9.6; the ratio of flakes (420) to angular debris (78) for the Pueblo artifacts is 5.3. The ratios for both occupations are high, indicating curated rather than expedient strategies were employed. It can be seen that the Archaic occupation exhibits quite a higher ratio, suggesting much material may have been brought to the site at this time in an already reduced state.

Flake Breakage

The higher the number of broken flakes, the stronger the inference of tool manufacture. A low number of broken flakes suggests core reduction. Both assemblages reveal high percentages of broken flakes (Table 22): Archaic, 61.0 percent of the entire lithic artifact assemblage; and Pueblo, 60.7 percent. Within the broken flakes, the most common are the manufacturing breaks at 63.0 percent. This high figure suggests tool production that yields more manufacturing breaks than core reduction, which produces more snap fractures (20.6 percent). This figure indicates that some core reduction probably also occurred on the site.

Platform Lipping and Dorsal Scarring

Platform lipping is associated with the occurrence of opposing dorsal scars on a flake. The presence of this type of scarring indicates soft hammer percussion or the reduction of bifacial tools or cores. At Fallen Pine Shelter, there are few cases of either platform lipping or dorsal scarring in either assemblage. We can conclude, therefore, that little soft hammer percussion or reduction of biface tools occurred (Table 23).

Flake-to-Core Ratio

A high ratio of core flakes to cores suggests tool manufacture, while a low ratio implies expedient core reduction. At Fallen Pine Shelter, the flake-to-core ratios are moderate, although higher in the Archaic occupation. The ratio for the Pueblo artifacts is 25.6 (409 core flakes and 16 cores), and the ratio for the Archaic artifacts is 32.6 (521 core flakes and 16 cores). This perhaps indicates that cores were being reduced on the site, but that some tool manufacture also occurred.

Summary of Results

Table 24 presents a summary of the above eight attributes used to isolate tool manufacture or expedient core reduction strategies for the two occupations at Fallen Pine Shelter. The table reveals a great deal of ambiguity in the assemblage. In both occupations, curated strategies outweigh expedient, although not by a decisive margin. Looking at the results, it seems that formal tools (such as projectile points) may have been brought to the shelter in a completed or nearly completed stage, while many other tools were expediently produced for cutting or scraping activities. The abundance of raw material in the vicinity of the site would allow for this scenario. An examination of tools (other than projectile points) in the assemblage also supports expedient

Table 21. Type of modified platform by time period

Count Row Percentage Column Percentage	Archaic	Pueblo	Total
Cortical	30	34	64
	46.9%	53.1%	100.0%
	5.4%	8.1%	6.6%
Cortical and abraded	1	-	1
	100.0%	-	100.0%
	0.2%	-	0.1%
Single facet	265	205	470
	56.4%	43.6%	100.0%
	47.7%	48.9%	48.2%
Multifacet	99	86	185
	53.5%	46.5%	100.0%
	17.8%	20.5%	19.0%
Collapsed	1	-	1
	100.0%	-	100.0%
	0.2%	-	0.1%
Absent	40	19	59
	67.8%	32.2%	100.0%
	7.2%	4.5%	6.1%
Broken in manufacture	120	75	195
	61.5%	38.5%	100.0%
	21.6%	17.9%	20.0%
Total	556	419	975
	57.0%	43.0%	100.0%
	100.0%	100.0%	100.0%

Table 22. Flake breakage patterns

Portion	Archaic		Pueblo		Total	
	No.	%	No.	%	No.	%
Feather	56	16.5%	37	14.5%	93	15.6%
Hinge	2	0.6%	3	1.2%	5	0.8%
Snap	66	19.4%	56	22.0%	122	20.5%
Manufacture	216	63.5%	159	62.4%	375	63.0%
Totals	340	100.0%	255	100.0%	595	100.0%

Table 23. Platform lipping by dorsal scars

Count Row Percentage Column Percentage	No Scars		Some Scars		Total
	Pueblo	Archaic	Pueblo	Archaic	
Platform lipping present	2 18.2% 1.0%	5 45.5% 2.2%	1 9.1% 0.8%	3 27.3% 1.8%	11 100.0% 1.5%
No platform lipping present	203 28.6% 99.0%	226 31.9% 97.8%	120 16.9% 99.2%	160 22.6% 98.2%	709 100.0% 98.5%
Total	205 28.5% 100.0%	231 32.1% 100.0%	121 16.8% 100.0%	163 22.6% 100.0%	720 100.0% 100.0%

Table 24. Curated vs. expedient strategies by period

Attribute	Archaic	Pueblo
Percent noncortical debitage	Curated	Curated
Percent manufacturing flakes	Expedient	Expedient
Percent modified platform	Curated	Curated
Flake-to-angular-debris ratio	Curated	Curated
Percent broken flakes	Curated	Curated
Percent platform lipping	Expedient	Expedient
Percent dorsal scarring	Expedient	Expedient
Flake-to-core ratio	Curated	Curated

manufacture of flakes for immediate use. The fact that both occupations employed the same strategies implies that use of the shelter was basically the same for both groups. People used the cave as a short-term encampment, carried necessary or critical implements with them, and made use of surrounding materials for other on-site activities.

Cores

Only 32 cores were found at the shelter, and an equal number was recovered from both occupations. Unidirectional cores have flakes removed from only one platform, bidirectional cores have two opposing platforms, and multidirectional ones have more than two. It should hold that the more platforms on a core, the more reduction has taken place and, therefore, probably the smaller the core should be (Moore 1996:258). Table 25 presents the types of cores removed from the shelter and their material correlates. Table 26 displays mean volumes as influenced by material type.

We see that multidirectional cores, implying repeated reduction, are the most common in both occupations (72.0 percent of the core assemblage). Cores struck from only one platform have the lowest percentages. Most of the multidirectional cores are small, as expected, except for one large piece of limestone in the Pueblo assemblage, a locally available material. Size probably was not a factor in transporting it to the site. The unidirectional cores are smaller in volume than would be expected for their type; however, when considering material type, they all represent the best flaking material, chert. The chert cores, although small, apparently were purposefully selected for, suggesting they may have been acquired away from the shelter on seasonal rounds. The only obsidian core on the site is also quite small and was definitely brought there from as far as the Jemez Mountains. Thus, the type of material seems to have influenced the size of the cores present at the shelter.

Tool Use

The tool assemblage at Fallen Pine Shelter contains mostly informal, unmodified flakes that have been used for scraping or cutting implements. These informal tools exhibit utilization or marginal retouch. Formal tools are represented mostly by bifaces, some of which may be portions of projectile points, but they are too fragmented to say for sure.

Bifacial tools are listed in Table 27 and shown in Figure 43. They display an almost even distribution between Archaic and Pueblo occupations. The preferred material for these cutting or piercing implements with bidirectional wear is chert (95.2 percent of all materials). Many of the bifacial tools are very large and thick, and they may be knives (Figs. 43b and 43g). Both

Table 25. Core morphology by material type

Count Row Percentage Column Percentage	Unidirectional Core		Bidirectional Core		Multidirectional Core		Total
	Archaic	Pueblo	Archaic	Pueblo	Archaic	Pueblo	
Chert	1	2	2	3	10	10	28
	3.6%	7.1%	7.1%	10.7%	35.7%	35.7%	100.0%
	100.0%	100.0%	66.7%	100.0%	83.3%	90.9%	87.5%
San Andres chert	-	-	-	-	1	-	1
	-	-	-	-	100.0%	-	100.0%
	-	-	-	-	8.3%	-	3.1%
Obsidian	-	-	1	-	-	-	1
	-	-	100.0%	-	-	-	100.0%
	-	-	33.3%	-	-	-	3.1%
Limestone	-	-	-	-	1	1	2
	-	-	-	-	50.0%	50.0%	100.0%
	-	-	-	-	8.3%	9.1%	6.3%
Total	1	2	3	3	12	11	32
	3.1%	6.3%	9.4%	9.4%	37.5%	34.4%	100.0%
	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%

Table 26. Mean core volumes by material type

Material	Time Period	Unidirectional Core (cm^3)	Bidirectional Core (cm^3)	Multidirectional Core (cm^3)
Chert	Pueblo	24.9	28.2	23.8
	Archaic	4.6	28.2	19.2
San Andres chert	Archaic	-	-	16.4
Obsidian	Archaic	-	6.5	-
Limestone	Pueblo	-	-	126.5
	Archaic	-	-	19

Table 27. Bifacial tools by material type

Count Row Percentage Column Percentage	Archaic	Pueblo	Total
Chert	9	9	18
	50.0%	50.0%	100.0%
	81.8%	90.0%	85.7%
Sand Andres chert	1	1	2
	50.0%	50.0%	100.0%
	9.1%	10.0%	9.5%
Limestone	1	-	1
	100.0%	-	100.0%
	9.1%	-	4.8%
Total	11	10	21
	52.4%	47.6%	100.0%
	100.0%	100.0%	100.0%

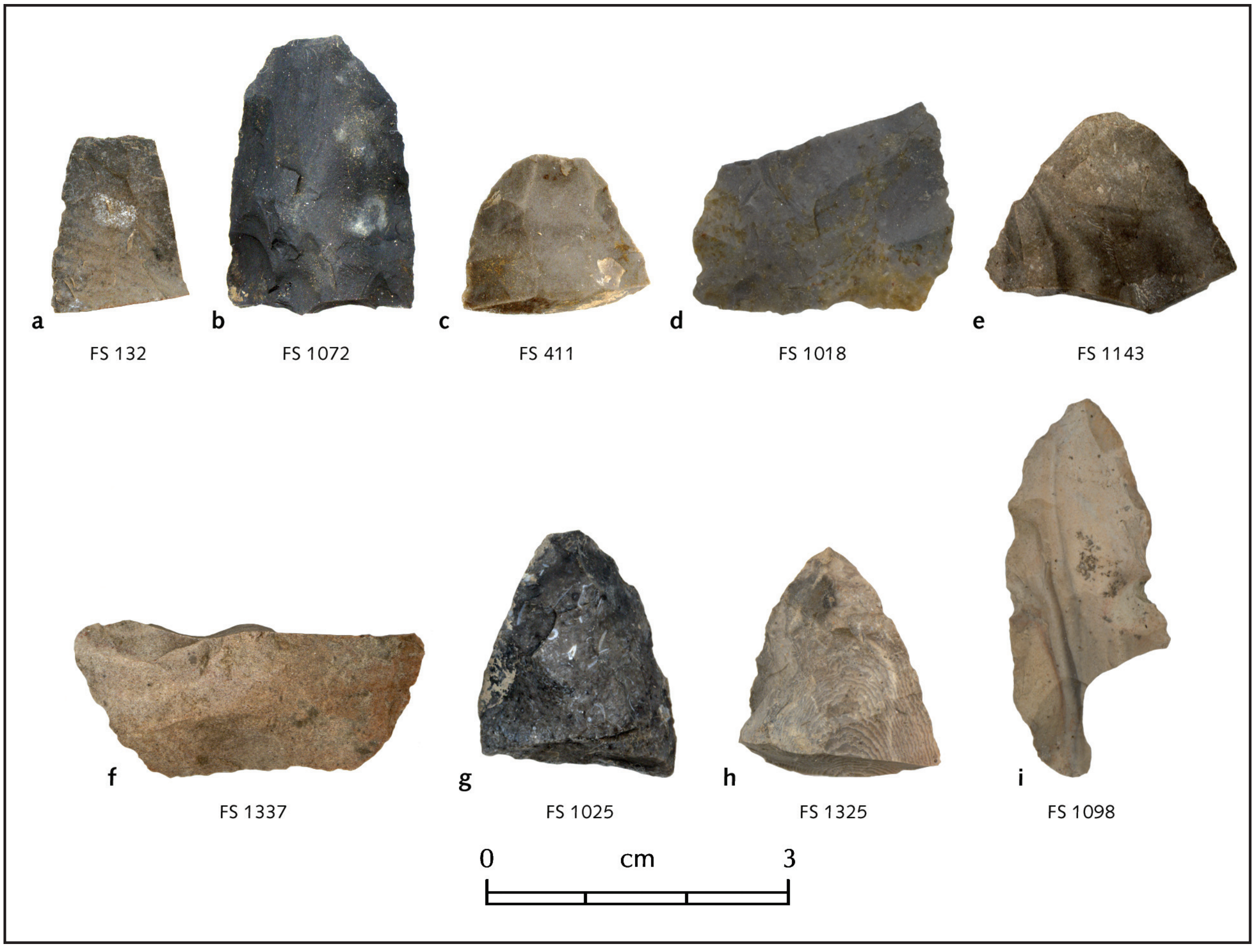

Figure 43. Biface tools: (a-c) Pueblo occupation; (d-e) Archaic occupation (probably unfinished projectile points); (f-i) Archaic occupation.

assemblages contain these chunky tools. Edge angles on these biface tools are slightly higher than would be expected, at a mean of 40.3 degrees for the Archaic and 41.7 degrees for the Pueblo, barely qualifying them as cutting implements (Schutt 1980). However, it is unknown how these thick bifaces were used, other than for cutting.

Of 23 scraping tools (Table 28 and Fig. 44), all but three are characterized by scraping scars, mostly along the sides of thin, secondary flakes (Fig. 44a). The materials seem very fragile, and the scarring is represented by small flakes with unidirectional wear. These scrapers could only have been used for very delicate work (perhaps small fibrous plants). The remaining three implements are almost miniature thumbnail scrapers with a flattened dorsal surface and scarring around the edges (Figs. 44d and 44e). While sturdier than the thin flake scrapers, their diminutive size precludes scraping of any large objects.

Most are side scrapers (52.2 percent), but also many display end and side use combined. Materials are limited to chert (91.3 percent) and obsidian. Edge angles for the unidirectionally flaked tools in the Pueblo assemblage have a mean of 44.7 degrees, excellent for scraping activities. However, the same type of tools in the Archaic assemblage are much more steeply angled (37.4 degrees). This angle is influenced by the presence of the three thumbnail-like scrapers.

Two drills were recovered from the shelter, one in each occupation. Both are chert, but the Archaic one (Fig. 44h) has a basal knob for handling. Two gravers were also found, one from each occupation (Fig. 44g). They are both chert. A limestone chopper found in the Archaic level exhibits use scars three-quarters of the way around the edges. It weighs 450.2 grams.

Conclusions

The lithic artifact analysis focused on differences between the Archaic and the Pueblo occupations of Fallen Pine Shelter in terms of material usage, reduction strategies, and site activities. The results were somewhat

Table 28. Scraping tools by material type

Count Row Percentage Column Percentage	Chert		Obsidian		Total
	Archaic	Pueblo	Archaic	Pueblo	
End scraper	-	1	1	-	2
	-	50.0%	50.0%	-	100.0%
	-	10.0%	100.0%	-	8.7%
Side scraper	7	5	-	-	12
	58.3%	41.7%	-	-	100.0%
	63.6%	50.0%	-	-	52.2%
End/side scraper	4	4	-	1	9
	44.4%	44.4%	-	11.1%	100.0%
	36.4%	40.0%	-	100.0%	39.1%
Total	11	10	1	1	23
	47.8%	43.5%	4.3%	4.3%	100.0%
	100.0%	100.0%	100.0%	100.0%	100.0%

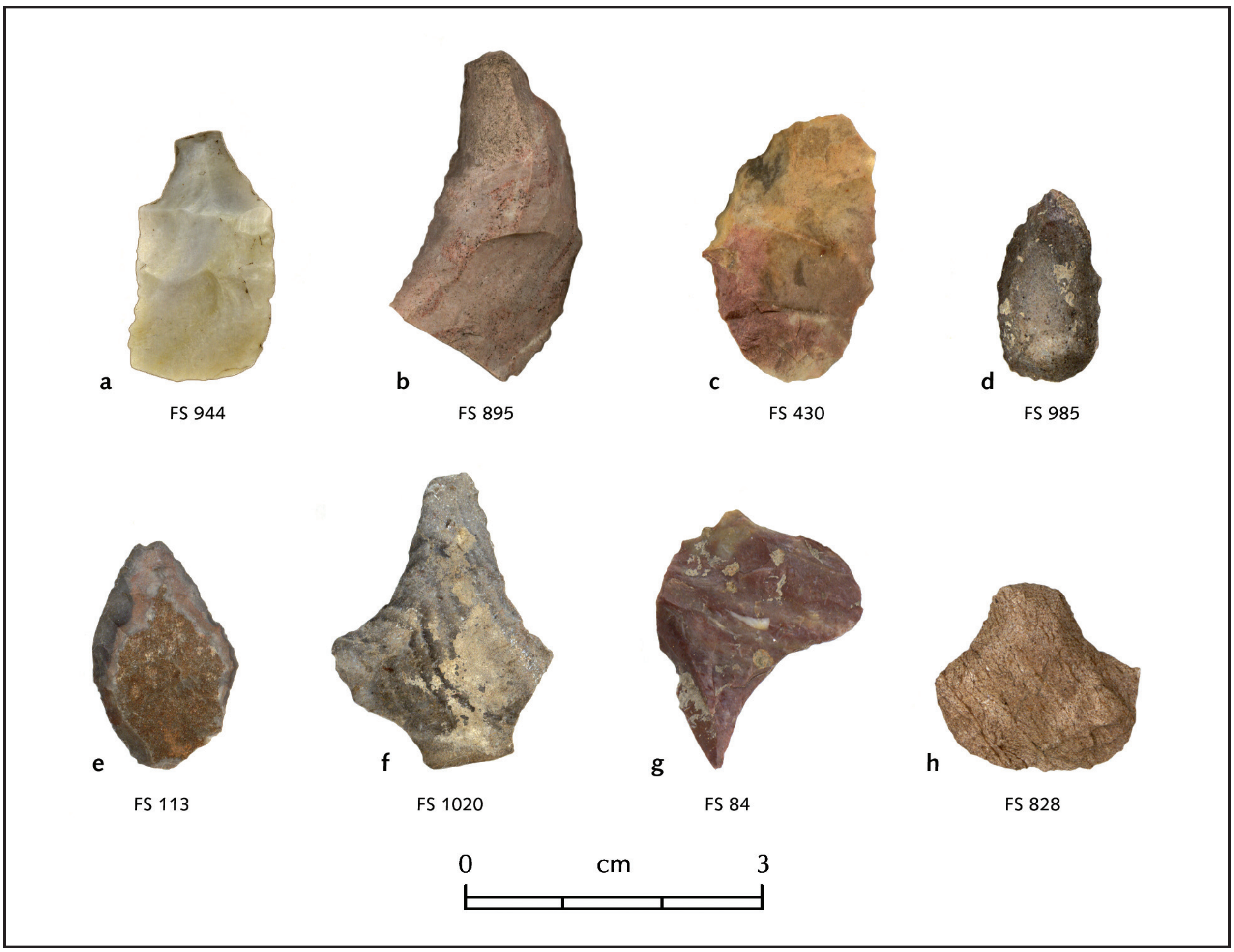

Figure 44. Scraping and other tools: (a-c) Pueblo scrapers on unmodified flakes; (d-e) Archaic scrapers, formal; (f) Archaic scraper, unmodified flake; (g) Pueblo graver; (h) Archaic drill or scraper.

surprising, because in many aspects, the two assemblages were more similar than expected. The explanation for this may simply be that both groups utilized the shelter in much the same ways, employing the same reduction strategies and performing many of the same activities. This is plausible given the size of the shelter and the nature of the environmental resources.

One other possible explanation is that the artifact deposits were more mixed than was apparent. The presence of utilized surfaces within the shelter probably allowed for an accurate assessment of the cultural association of each interior level. However, in the deep midden outside of the shelter, no surfaces could be found, and identification of cultural interfaces was based upon radiocarbon dates and diagnostic projectile points. It is not difficult to see how artifact movement may have taken place through bioturbation, erosion, human or animal trampling, or curation events. Mixing of cultural deposits at Fresnal Shelter and other rockshelters in the area is a fairly common occurrence (Bohrer 1981a). In hindsight, because there was so much depth to the deposits, perhaps 10 cm of soil on either side of the imposed demarcation lines between the two components should have been removed from analysis, possibly allowing for better definition of the two assemblages. For this discussion, however, we make the qualified assumption that the two lithic components on the site represent a generally accurate picture of prehistoric adaptations at Fallen Pine Shelter.

Both occupations utilized locally available materials, particularly chert, to a large extent. The only nonlocal material that could be identified was a small amount of obsidian sourced by the Berkeley Archaeological XRF Lab. Four of the five pieces were associated with the Archaic and traced to Cerro Toledo and Valle Grande sources in the Jemez Mountains. The presence of angular rather than rounded cortex suggests that direct procurement or trade occurred and that Archaic peoples were far more mobile in their procurement strategies than the Pueblo groups at the shelter.

An extensive examination of reduction strategies through the comparison of eight selected attributes aided in distinguishing between curated versus expedient lithic-reduction technologies. Both occupations at the shelter indicated the use of curated strategies, but also with a 30-percent occurrence of expedient tool preparation. The lack of significant amounts of angular debris and biface-thinning flakes suggests that tools, particularly projectile points and bifacial tools, were transported to the site already completed. However, expedient reduction of materials for informal tools also occurred, utilizing the abundantly available local resources. The fact that both groups employed the same strategies was surprising and may be the result of some mixing of levels. However, again, given the smallness of the shelter, the types of available resources, and the limited number of potential occupants at any one time, it is not difficult to envision that reduction strategies could have been quite similar for the two groups.

Cores on the site are few, and many are small, particularly the chert pieces. This indicates that primary reduction probably occurred at the collection locales prior to encampment at the shelter. Bifacial and scraping tools are equally present on the site and occur equally in both occupations. The scraping implements are mostly fashioned from thin flakes with very small use scars. Some site-specific use must have been designated for these tools because they are too fragile for heavy scraping activities. Several drills, gravers, and a chopper constitute the remainder of the lithic tool assemblage.

Fallen Pine Shelter could have been used for no more than short-term encampments because of its size. However, prehistoric peoples could have used it as a way station through the mountain pass, as a collecting or hunting camp, or as part of a seasonal round for the exploitation of a specific resource. As the lithic tool assemblage suggests, both Archaic and Pueblo peoples may have sought out the same resources. The number of projectile points and biface tools indicates that hunting was probably a primary activity. Scraping implements could have been used on hides, although the tools seem too fragile and small for such use. It is more likely that a particular fibrous plant was being exploited by both groups.

PROJECTILE POINT ANALYSIS

Yvonne R. Oakes

Fifty projectile points recovered from Fallen Pine Shelter were sorted into 36 Archaic points and 14 from the Ceramic period. Further sorting allowed for division into 13 classifications of projectile points. Complete dimensional and compositional data are presented in Table 29.

South-central New Mexico is known for having a conglomeration of points from across the Southwest, including the northern Oshara tradition, the Cochise of west-central and southern Arizona, western and central Texas, and into northern Mexico. Most have specific names that, unfortunately, are used no matter where in the Southwest they are found. Others are identical in appearance but have different names based upon where they were found. For south-central New Mexico, MacNeish (1993) has attempted to rework the point classification system, comparing Jornada styles with other southwestern areas (but not without criticism, e.g., Binford 1994). We have benefited from MacNeish's system and used his typologies, when possible, because they focus on classifications for this particular region. However, any sorting of points into types or styles is merely a convenience in labeling for the analyst, for example, for comparative purposes and for dividing points into possible temporal units.

The use of multiple variations of projectile points at any given time is clearly evident at Fallen Pine Shelter, where up to six different styles can be found in various grids at the same general depth. This deposition pattern certainly cannot be linked to different cultural groups utilizing the shelter one right after another, but rather to different functional needs or stylistic preferences as noted by Moore (1999:29).

Analytic Methods

All projectile points were analyzed using *Standardized Lithic Artifact Analysis* (OAS 1994a). Attributes monitored for all chipped stone included material type and quality, artifact morphology, function, edge alterations and angles, evidence of heat treatment, and dimensions. Specific projectile point attributes monitored included breakage pattern, preform morphology, reduction technique, scarring pattern, cross section, blade shape, barbing, and notch shape and type. A definition of the attributes monitored is provided in *Standardized Lithic Artifact Analysis*. A binocular microscope was used to examine each artifact, and measurements were taken with sliding caliphers and a goniometer. All data was entered into a computer utilizing the Statistical Package for the Social Sciences program for ease in manipulation.

Breakage patterns reveal how and when a point was broken and provide evidence of breakage during manufacture or use. Preform morphology allows us to determine how much of the original form was altered by manufacture. Reduction techniques distinguish between percussion and pressure-flake scars. Scarring patterns reveal the regularity and extent of flaking on a projectile point. Notching type refers to the location and orientation of notches and their shape. Also monitored were edge shape, serrations, presence of heat treatment, and evidence of resharpening or utilization (Moore 1999:22-23).

Classification of Projectile Points

Projectile point types at Fallen Pine Shelter range from the Middle Archaic up through the late Ceramic period, a span of 3,800 years, or ca. 2500 B.C. to A.D. 1300. The points are divided into stylistic classifications, utilizing regionally local typologies whenever possible, such as MacNeish (1993, 1998).

Middle Archaic Points

San Jose (Fig. 45j). This is a shouldered dart point with a deeply concave base. Early varieties of this type generally have ground bases (Moore 1994:472); this particular specimen does not. The distinctive Oshara tradition point is fairly commonly found on the southern Colorado Plateau and extends into central New Mexico and the Mogollon area. In California and the Great Basin it is called a Pinto point. This particular point is made from locally available Rancheria chert found in the Tularosa Basin area. It was recovered from a Late Archaic level (ca. 600 B.C.) and was possibly curated. A very small piece of the tip and bit of one tang are missing. Numerous other San Jose points have been found in shelters in the mountains near Las Cruces (MacNeish and Wilner 1998) and the southern Tularosa Basin (Carmichael 1986).

Augustin (Fig. 45h). This is an easily recognizable point form, first identified in New Mexico at Bat Cave in the Mogollon Highlands (Dick 1965:32). It is found primarily in the southern area of the Southwest and in the Jornada region in the southern Tularosa Basin (Schutt et al. 1991) and the Mesilla Bolson (Carmichael

Table 29. Projectile point data

Grid	Depth (cm)	FS	Time Period	Type	Material	Length (cm)	Width (cm)	Thickness (cm)
100N/99E	180-190	120	Archaic	Shumla	Chert	3.9	2.6	0.5
97N/97E	190-120	127	Ceramic	Perdiz	Chalcedony	2.3	1.6	0.3
99N/99E	190-200	151	Archaic	Unknown	Chert	2.8*	2.3	0.4
96N/99E	200-210	173	Archaic	Unknown	Chert	3.2*	2.5	0.5
98N/100E	150-160	201	Ceramic	Bonham	Chert	2.3	1.1	0.4
100N/97E	200-210	209	Archaic	Hueco	Chert	2.6	1.8	0.4
97N/100E	170-180	243	Ceramic	Unknown	Chert	2.7*	1.2	0.6
100N/100E	200-210	325	Archaic	Fresnal	Chert	3.5	2.5	0.7
99N/97E	210-220	340	Archaic	Hueco	Chert	4.2	2.2	0.5
100N/98E	210-220	353	Archaic	San Pedro	Chert	5	1.7	0.7
101N/101E	160-170	375	Ceramic	Scallorn	Chert	2.8	1.6	0.4
98N/101E	200-210	396	Archaic	Unknown	Chalcedony	4.1*	2.5	0.7
99N/101E	200-210	411	Archaic	Unknown	Chert	2.1*	1.9	0.6
102N/99E	188	452	Ceramic	Unknown	Chert	2.2*	1.4	0.3
97N/101E	220-230	483	Archaic	Unknown	Chert	2.7*	2.8	0.9
103N/99E	150-160	561	Ceramic	Unknown	Chert	2.7*	1.1	0.3
101N/98E	190-200	571	Ceramic	Fresno	Chert	2.3	1	0.3
101N/100E	180-193	601	Ceramic	Unknown	Chert	1.5*	0.8	0.3
97N/99E	230-240	604	Archaic	Unknown	San Andres chert	1.9*	1.3	0.3
99N/98E	230-240	657	Archaic	Fresnal	Chert	2.8*	2.7	0.6
95N/97E	240-250	692	Ceramic	Unknown	Chert	2.5	1.7	0.4
95N/98E	240-250	703	Archaic	Augustin-Gary	San Andres chert	5.3	2.3	0.8
97N/101E	240-250	715	Archaic	Unknown	San Andres chert	2.3*	2.3	0.4
102N/98E	203-219	720	Ceramic	Unknown	Chert	2.7	1.3	0.5
96N/99E	240-250	724	Archaic	Shumla	Chert	2.4	2	0.4
97N/100E	240-250	727	Archaic	Unknown	Chert	1.0*	1.6	0.4
96N/98E	240-250	731	Archaic	Unknown	Chert	1.4*	2.6	0.7
101N/99E	192-210	764	Ceramic	Unknown	Jemez obsidian	1.8	1.3	0.4
101N/100E	192-198	779	Archaic	Augustin	Chert	4	1.8	0.6
99N97E	270-280	867a	Archaic	San Jose	San Andres chert	3.1	1.8	0.5
99N/97E	270-280	867b	Archaic	Pendejo	Chert	4.4	2.1	0.6
100N/99E	270-280	875	Archaic	Unknown	Chert	1.7*	2.1	0.5
101N/98E	218-230	887	Archaic	Unknown	Chert	1.3	1.6	0.4
102N/98E	230-240	932a	Archaic	Hueco	Chert	5	2.7	0.6
102N/98E	230-240	932b	Ceramic	Scallorn	Chert	1.4*	1.3	0.2
101N/98E	226-241	946	Archaic	Unknown	Chert	1.2*	1.9	0.5
99N/99E	280-290	966	Archaic	Shumla	Chert	3.2	2.5	0.5
100N/98E	280-290	975	Archaic	Unknown	Chert	1.1*	1.9	0.5
101N/100E	220-235	980	Archaic	Shumla	Chert	3.3	2.5	0.5
96N/101E	290-300	1005	Ceramic	Unknown	Chert	1.7*	1.4	0.4
96N/100E	290-300	1010	Archaic	Fresnal	Chert	2.6	2.3	0.5
101N/97E	235-245	1065	Archaic	Hueco	Chert	3.7	2.5	0.7
101N/98E	270-282	1181	Archaic	Fresnal	Chert	4.3	2.5	0.6
95N/100E	320-330	1215	Archaic	Fresnal	Chalcedony	2.8*	2.2	0.6
96N/101E	320-330	1222	Archaic	Fresnal	Chert	3	2.2	0.7
96N/101E	340-350	1287	Archaic	Pendejo	Chert	3.3	2.1	0.7
97N/98E	340-350	1309	Ceramic	Unknown	Chert	1.2*	0.9	0.3
97N/99E	350-360	1325	Archaic	Unknown	San Andres chert	3.0*	2.6	0.4
96N/101E	350-360	1329	Archaic	Armijo	Rhyolitic chert	2.9*	1.7	0.5
96N/99E	350-360	1339	Archaic	Unknown	Chert	1.0*	1.6	0.4

* incomplete length

1988). This point is of a black, limey chert and has a snapped tip, indicative of breakage during use. It was recovered from an upper ceramic level and was probably a curated item. The point has a temporal range possibly as early as 4000 B.C. (Wills 1985), but at least from 3000 to 1300 B.C. (Thomas 1988). Augustin points seem to extend to A.D. 500 in the Great Basin (Holmer 1986:105).

Augustin-Gary (Fig. 45i). Dates for this type range from 8500 to 1800 B.C. (MacNeish 1993). This large dart point has been broken along the upper half of a lateral edge, and a small portion of the base is missing. It is manufactured from San Andres chert, another locally available material, and dates from ca. 2650 to 950 B.C. (Turner and Hester 1985). The point was retrieved from a ceramic level within the shelter dating to ca. A.D. 500 and was most likely a curated object.

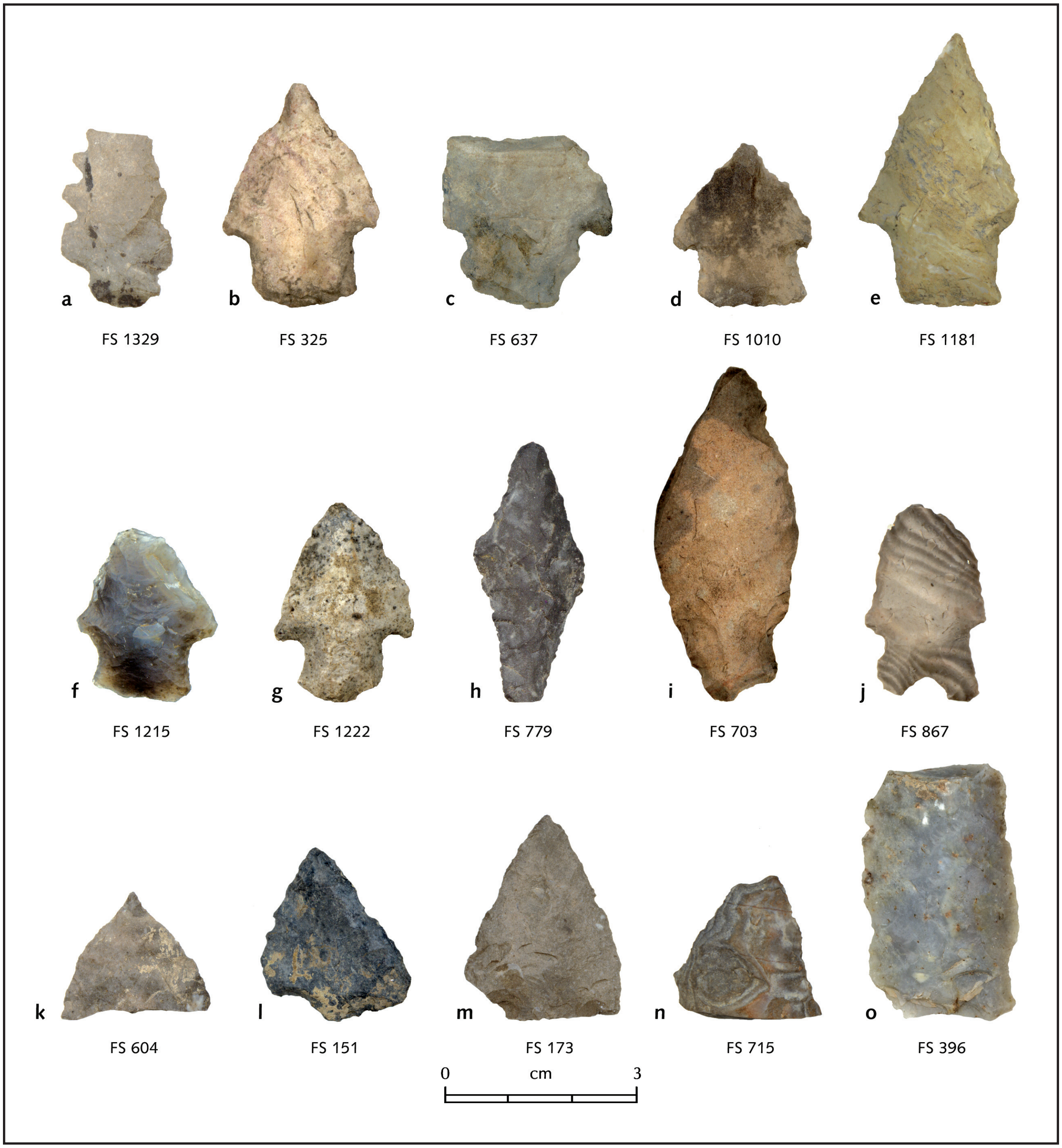

Figure 45. Archaic projectile points: (a) Armijo; (b-g) Fresnal; (h) Augustin; (i) Augustin-Gary; (j) San Jose; (k-o) undifferentiated Archaic.

Late Archaic Points

Fresnal (Figs. 45b-45g). The Fresnal point first appears in the Middle Archaic at ca. 2500 B.C. and extends to 600 B.C. in the Late Archaic. Six of these points were retrieved at Fallen Pine Shelter, the most of any recovered type. Four were in Late Archaic levels, and two were in early ceramic levels. Two have snapped tips, and one has a reworked tip. Fresnal points are a southern Archaic type and seem to be most common in the Jornada area.

Armijo (Fig. 45a). This point is of rhyolitic chert with deep barbs and a snapped tip. Armijo points originated in the Oshara tradition (Irwin-Williams 1973). Although found in southern New Mexico, it does not seem to extend into Texas or Arizona (Turner and Hester

1985). Dates for this type range from 1800 to 800 B.C.

San Pedro (Fig. 46a). This complete chert point was classified as a variant of the San Pedro type commonly found in southern and west-central New Mexico and into southern and eastern Arizona. The type has also been found in northern Mexico (Roth and Huckell 1992:355). In the Mogollon area, it may last well into the Ceramic period. The point is extremely well flaked with serrations along the edges. The base is side-notched, and the stem is short and does not totally match other San Pedro points found in the region, but it is basically similar. San Pedro points date to 1050 B.C.-A.D. 700 (Roth and Huckell 1992), but an early date of 1500 B.C. has also been given (Upham et al. 1986).

Shumla (Figs. 46h-46k). The four Shumla points all exhibit some form of breakage from probable use. These points are more typically found in West Texas and somewhat in central New Mexico (MacNeish et al. 1967), although they are increasingly being recovered from excavated sites in eastern and southern New Mexico. Three of the four chert points were found in early ceramic levels of the shelter, which may indicate a longer period of use than previously assumed. Dates for this point type are ca. 1200-200 B.C. (MacNeish 1998).

Hueco (Figs. 46d-46g). The four Hueco chert points display a characteristic length of 2.5- 4.9 cm. Three have complete lengths, while one has a snapped tip and missing basal and shoulder portion. A snapped tang occurs on one of the other full-length points. Hueco points are distinctive to the Jornada area of New Mexico (MacNeish 1993) but are similar to San Pedro and Cienega points found in west-central New Mexico, and they are from the same time period, ca. 1200 B.C. to A.D. 500.

Pendejo (Figs. 46b-46c). One chert point is complete, but the other exhibits a snapped tip, missing lateral side, and a broken tang. Pendejo points frequently co-occur with Hueco and Shumla points of the same time period. They are found mostly in the Jornada region but also extend into central Chihuahua, which may be the

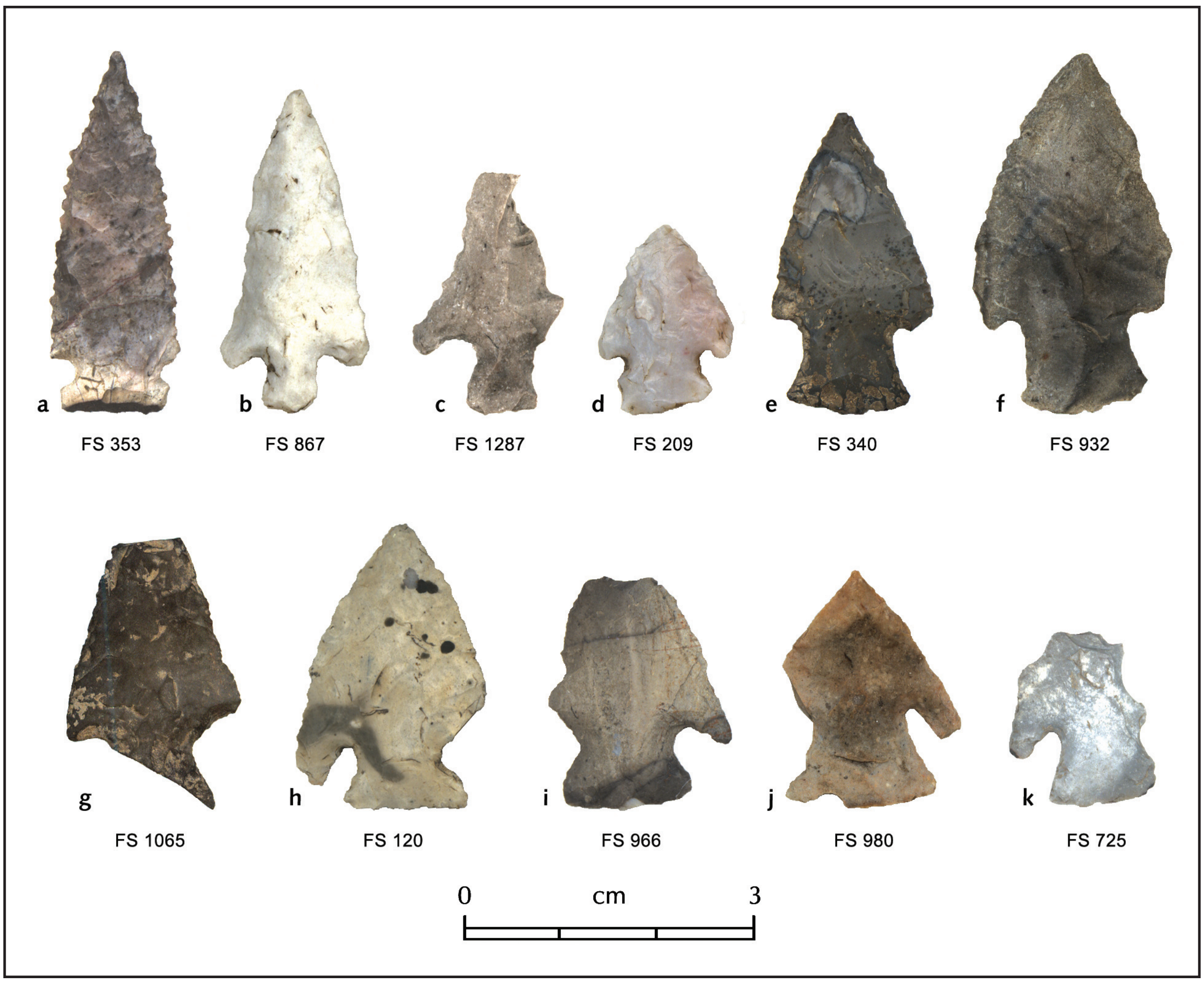

Figure 46. Late Archaic projectile points: (a) San Pedro; (b-c) Pendejo; (d-g) Hueco; (h-k) Shumla.

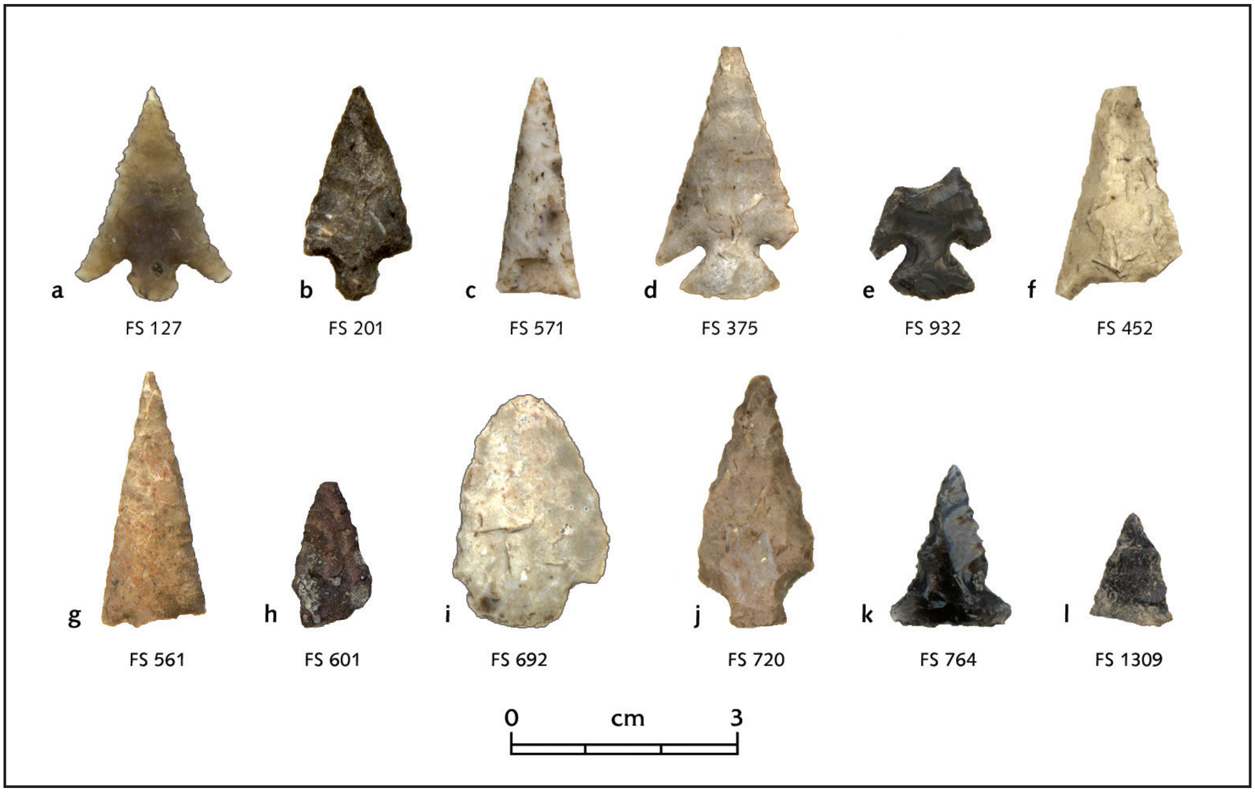

Figure 47. Ceramic period projectile points: (a) Perdiz; (b) Bonham-like; (c) Fresno; (d-e) Scallorn; (f-l) unidentified.

homeland of the type (MacNeish 1993). Dates range from 1000 B.C. to A.D. 500, although one at Fallen Pine Shelter was found at depth that dates it to ca. 1300 B.C.

Ceramic Period Points

Scallorn (Figs. 47d-47e). These two distinct chert points are commonly found in Texas and eastern New Mexico. They are small game points and serve as excellent time markers, extending from ca. A.D. 700 to 1200 (Turner and Hester 1985). One point has a missing tang but has finely serrated blade edges; the other is lacking the pointed half.

Fresno (Fig. 47c). This is a complete chert point. The type is often associated with Scallorn types, although its date of manufacture extends into the historic period (ca. 1600). These points are very common in Texas and Mexico.

Perdiz (Fig. 47a). The complete chalcedony point is very similar to the Scallorn type mentioned above in its size and finely serrated edges, but it does not have an expanding stem. Therefore, it is classified as a Perdiz, dating from ca. A.D. 1100 to 1500 and commonly found in Texas.

Bonham (Fig. 47b). This chert projectile point is smaller than the nine Bonham points recovered by MacNeish (1993) in the southern Tularosa Basin. MacNeish suggests that Bonham may be a variant of Perdiz points, and this point does fall within the Perdiz size range. Bonham and Perdiz points supposedly have Texas origins, and both are from the late Ceramic period.

Miscellaneous Points

The remaining 24 points could not be classified to type because of their fragmented condition, but they were identified in terms of temporal periods. Eleven, identified in particular by their wide body width, are Archaic (Figs. 45k-45o). Another 11 points are probably associated with the Ceramic period because of their small size (Figs. 47f-47l). One of the Ceramic period points is of Valles Grandes obsidian (Fig. 47k).

Regional Distribution of Projectile Points

Southeastern and south-central New Mexico have lagged behind the remainder of the state in identifying indigenous projectile points. Even now, researchers frequently use Texas and Oklahoma typologies to classify points found in New Mexico. While it may hold true that many points came from the east, it is not logical that *all* of the points found in the study region are nonlocal. This section briefly examines the possible origin of the projectile points found at Fallen Pine Shelter and the surrounding region.

First, using data from all known surveys and site excavations within the area, including the Sacramento Mountains, Tularosa Basin, Las Cruces area, the Hueco Bolson, and the Guadalupe Mountains, a list of 1,150 classifiable points was generated. The points were identified by established typologies and assigned a range of dates based on published data. Most recent point classifications for the specific study region (e.g., MacNeish 1993, 1998) were used whenever possible. However, some type classifications used in earlier reports were changed, at our discretion, to reflect the more recent typologies employed in the Jornada area (Roney 1985; Carmichael 1986; Schutt et al. 1991). The suggested area of origin for each type was also noted, and five general regions were identified: the local Jornada area, the Cochise region (including the Mogollon area, Arizona, and the Great Basin), Trans-Pecos Texas, the Oshara area to the north, and northern Mexico. Points were then sorted and counted by date from the Paleoindian through Ceramic periods (Table 30).

Largely because of MacNeish's work in identifying regionally local points, Table 31 reveals that a comparatively high percentage of points found in the Jornada area originated within the region (28.1 per cent), not from other areas, such as Texas. Among all regions, the Cochise influence is actually the highest (33.7 percent), while Trans-Pecos points are at 20.4 percent, suggesting we should look also to the west rather than mostly to the east for point similarities, particularly at the Bat Cave series (Dick 1965). All Paleoindian points from the Jornada area seem to be stylistically similar to those from the High Plains of eastern New Mexico and West Texas. Given the broad hunting range of populations at this time, this association appears valid. Points from northern Mexico have been found and identified in the Jornada area, particularly by Roney (1985). There are undoubtedly more types present that should be assigned to Mexico than currently appear in the record. But overall, we see that the Jornada region is the source of many of the projectile points found in the area. In the future, as more points are recognized as being made in the Jornada region, the percentage of Jornada points should greatly increase. This is a major step forward in understanding regional projectile point distributions and how they affect the Jornada area.

Table 30 also shows the distribution of points found in the Jornada region by area of origin within each time period. Beginning in the Paleoindian period, there is no localization of point distributions. While the origin of these points may have been the High Plains, their range is known to be widespread. In the Early Archaic, almost all regions are represented in the Jornada area; most are from the west within the Cochise tradition (53.5 percent). Oshara is the next highest (22.8 percent). Only 10 percent of the points are from the Jornada region, lower even than the Trans-Pecos area (13.5 percent). It seems that no points of this time period are unique to the Jornada region. By the Middle Archaic, Texas types are still poorly represented, while Oshara and Cochise styles increase slightly to 27.9 and 30.0 percent each. Jornada point types increase greatly to 38.0 percent, suggesting a strong localization of types. In the Late Archaic, this local manufacturing of Jornada stays about the same at 38.2 percent, with Oshara points dropping considerably in the area to only 2.3 percent. For the first time, Trans-Pecos styles are notable (9.6 percent), and Mexican points present an initial appearance. Not until the Ceramic period do Texas types totally dominate the points in the Jornada area (99.3 percent). This high percentage probably reflects the fact that Scallorn and Harrell types, for example, were made in New Mexico as well as Texas. They are not likely to be trade items from the east.

Another issue raised by Table 31 is the regional shifting in projectile point derivations through time in the Jornada area. This is a complex subject and, regretfully, cannot be tackled in this report. We can, however, raise some questions that need answering in the future. Does the early appearance and subsequent disappearance of Oshara points indicate an early range of resource use overlapping into the Jornada area and then withdrawal by Oshara populations, a trading of points into the area at specific times in prehistory, or the manufacture of Oshara types throughout New Mexico in the Early and Middle Archaic? And why the lessening of Oshara points in the Late Archaic? Similar questions could likewise be applied to each of the traditions or regions with a presence in the Jornada area.

Material Types

The materials selected for the projectile points found at Fallen Pine Shelter reveal little differentiation between the Archaic and Ceramic periods (Table 32). Chert is by far the material of choice at a combined 93.0 percent, with a slightly stronger use during the Ceramic period. The study of raw material sources for the Fallen Pine Shelter projectile points provided the following insight into the mobility or exchange patterns of site inhabitants. Good quality chert is locally available in the region (see preceding chapter for discussion of material types). Archaic populations tended to vary their point material selections slightly more, adding San Andres and rhyolitic chert to their choices. Obsidian points are

Table 30. Projectile points recovered from Jornada region by period

Period	Approximate Begin Date	Point Type	Tradition	Number	Percent Grand Total
Ceramic	A.D. 1200	Perdiz	Trans-Pecos	14	1.2%
	A.D. 1200	Clifton	Trans-Pecos	1	0.1%
Subtotals:	A.D. 1000	Cameron	Trans-Pecos	11	1.0%
154 Trans-Pecos	A.D. 900	Washita	Trans-Pecos	12	1.0%
1 Mexico	A.D. 900	Harrell	Trans-Pecos	27	2.3%
	A.D. 900	Garza	Trans-Pecos	4	0.3%
Total: 155	A.D. 900	Bonham	Trans-Pecos	19	1.7%
	A.D. 800	Deadman's	Trans-Pecos	1	0.1%
	A.D. 700	Zavala	Trans-Pecos	9	0.8%
	A.D. 700	Scallorn	Trans-Pecos	16	1.4%
	A.D. 500	Fresno	Trans-Pecos	15	1.3%
	A.D. 500	Toyah	Trans-Pecos	8	0.7%
	A.D. 500	Cuney	Trans-Pecos	2	0.2%
	A.D. 500	Starr	Trans-Pecos	2	0.2%
	A.D. 500	El Muerto	Mexico	1	0.1%
	A.D. 300	Steiner	Trans-Pecos	4	0.3%
	A.D. 1	Frio	Trans-Pecos	3	0.3%
	A.D. 1	Figueroa	Trans-Pecos	1	0.1%
	A.D. 1	Paisano	Trans-Pecos	5	0.4%
Late Archaic	800 B.C.	En Medio	Oshara	12	1.0%
	915 B.C.	Wells	Trans-Pecos	1	0.1%
Subtotals:	1000 B.C.	Ellis	Trans-Pecos	3	0.3%
Cochise 226	1000 B.C.	Maljamar	Trans-Pecos	3	0.3%
Jornada 199	1000 B.C.	Pendejo	Mexico	24	2.1%
Texas 50	1000 B.C.	Hatch	Jornada	51	4.4%
Mexico 33	1000 B.C.	Hueco	Jornada	148	12.9%
Oshara 12	1050 B.C.	Shumla	Trans-Pecos	43	3.7%
	1400 B.C.	Small San Pedro	Cochise	68	5.9%
Total: 520	1400 B.C.	Coahuila	Mexico	9	0.8%
	1500 B.C.	Large San Pedro	Cochise	158	13.7%
Middle Archaic	1800 B.C.	Armijo	Oshara	28	2.4%
	2000 B.C.	Gary	Trans-Pecos	1	0.1%
Subtotals:	2200 B.C.	Bulverde	Trans-Pecos	5	0.4%
Jornada 110	2500 B.C.	La Cueva	Jornada	28	2.4%
Cochise 87	2500 B.C.	Fresnal	Jornada	82	7.1%
Oshara 81	2500 B.C.	Chiricahua	Cochise	36	3.1%
Trans-Pecos 12	2500 B.C.	Augustin	Cochise	35	3.0%
	2500 B.C.	Williams	Trans-Pecos	3	0.3%
Total: 290	2500 B.C.	Langtry	Trans-Pecos	3	0.3%
	2650 B.C.	Augustin-Gary	Cochise	16	1.4%
	3200 B.C.	San Jose	Oshara	53	4.6%
Early Archaic	3500 B.C.	Todsen	Jornada	14	1.2%
	4000 B.C.	Uvalde	Trans-Pecos	6	0.5%
Subtotals:	4000 B.C.	Pandale	Trans-Pecos	5	0.4%
Cochise 75	4000 B.C.	Williams	Trans-Pecos	2	0.2%
Oshara 32	4500 B.C.	Bat Cave	Cochise	23	2.0%
Texas 19	4500 B.C.	Datil	Cochise	13	1.1%
Jornada 14	4500 B.C.	Pelona	Cochise	18	1.6%
	4500 B.C.	Armagosa-Pinto	Cochise	21	1.8%
Total: 140	4500 B.C.	Pedernales	Trans-Pecos	6	0.5%
	6000 B.C.	Bajada	Oshara	11	1.0%
	6000 B.C.	Jay	Oshara	21	1.8%
Paleoindian	7000 B.C.	Cody	Plains	2	0.2%
	8000 B.C.	Angostura	Plains	4	0.3%
Subtotal:	8000 B.C.	Plainview	Plains	2	0.2%
Plains 45	9000 B.C.	Folsom	Plains	29	2.5%
	9000 B.C.	Midland	Plains	1	0.1%
Total: 45	9600 B.C.	Clovis	Plains	7	0.6%
Grand total				1150	100.0%

Table 31. Derivation of projectile points by region/tradition

Region/Tradition	Number of Points	Percent Total
Cochise	388	33.7%
Jornada	323	28.1%
Trans-Pecos Texas	235	20.4%
Oshara	125	10.9%
Plains	45	3.9%
Mexico	34	3.0%
Total	1150	100.0%

Table 32. Material types by period

Material	Archaic		Pueblo		Total	
	No.	%	No.	%	No.	%
Chert	28	77.8%	12	85.7%	40	80.0%
San Andres chert	5	13.9%	-	-	5	10.0%
Rhyolitic chert	1	2.8%	-	-	1	2.0%
Chalcedony	2	5.6%	1	7.1%	3	6.0%
Obsidian	-	-	1	7.1%	1	2.0%
Total	36	100.0%	14	100.0%	50	100.0%

absent in the Archaic assemblage, and the one in the ceramic unit has been sourced to the Jemez Mountains. All other points may have been manufactured from locally available materials, mostly from the southern Tularosa Basin. This is not to say, however, that the chert points are from local sources, only that they may be. The availability of suitable, local raw material apparently was not a problem during the Archaic or Ceramic periods, so none of the Jornada populations may have strayed far from their home range for their materials.

Measurements

Each projectile point was measured (see Table 29), and the results were sorted by period and averaged. In Table 33, length data were included only for points with a complete dimension. Differences in length and width between the Archaic and Ceramic period points are notable, but there is some degree of overlap. Various analyses have been undertaken to distinguish dart points from arrow points (Thomas 1978; Roney 1985). However, in this analysis all Archaic points were identified as such by type, except for those that have missing bases. Confirmation of our point classifications was not pursued through dimensional means (Roney 1985).

Breakage Patterns

Breakage of a projectile point during reduction or manufacture can sometimes be determined by the number of distal versus proximal ends present. If distal portions are significantly higher in number than proximal ends, the breakage may have occurred during the reduction process (Moore 1996:254). Table 34 records the types of point breakages at Fallen Pine Shelter. In both the Archaic and Ceramic periods, larger numbers of distal fragments (30.9 percent compared to 9.1 percent) indicate that breakage occurred during manufacture. Breakage during use is indicated for 9.1 percent of the points, which have reworked tips and edges. Also, those with missing tips or tangs (25.4 percent of the point assemblage) were likely broken during use. Snap fractures probably resulted from impact upon use, but they may also occur during reduction of the point (Moore 1996:254). In the site assemblage, 17 points may have snap fractures that could have occurred during use.

Breakage during use and reduction occurred fairly evenly at the shelter; however, there is a notable lack of biface thinning flakes, which would have been present if much manufacturing was taking place. Therefore, the high percentage of distal portions of points may actually be a result of the points striking a hard object and retaining the hafted end.

Table 33. Dimensions of projectile points

	Length (cm)	Width (cm)	Thickness (cm)
Archaic			
Number	18	32	36
Mean	3.7	2.4	0.5
Range	2.4 to 5.3	1.3 to 2.8	0.3 to 0.9
Ceramic			
Number	7	14	14
Mean	2.3	1.2	0.3
Range	1.8 to 2.8	0.8 to 1.7	0.2 to 0.6

Table 34. Breakage and reworking of projectile points

Breakage Pattern	Archaic		Pueblo		Total	
	No.	%	No.	%	No.	%
Complete	5	13.2%	4	23.5%	9	16.4%
Fragmented	1	2.6%	-	-	1	1.8%
Upper half missing	4	10.5%	1	5.9%	5	9.1%
Base missing	11	28.9%	6	35.3%	17	30.9%
Tip missing	5	13.2%	4	23.5%	9	16.4%
Tang missing	4	10.5%	1	5.9%	5	9.1%
Mid-section only	2	5.3%	-	-	2	3.6%
Edge broken	2	5.3%	-	-	2	3.6%
Reworked tip	3	7.9%	1	5.9%	4	7.3%
Reworked edge	1	2.6%	-	-	1	1.8%
Total	38	100.0%	17	100.0%	55	100.0%

Comparison with Selected Sites

One research goal was determining if the variety of projectile points from Fallen Pine Shelter were typical of those found on other sites, particularly rockshelters, in the region. Therefore, we did a comparison of selected sites from which 490 identifiable projectile points were sorted by time period (Table 35). Most of the points from Fallen Pine Shelter fall within the Middle and Late Archaic periods, and none in the Early Archaic. One open-air Ceramic period site with a Late Archaic occupation (the Angus site) was included for comparison. Surprisingly, 40.7 percent of its points were Late Archaic. In fact, over 51.9 percent of all points in Table 35 are from the Late Archaic period. The period with the second highest number of points is the Middle Archaic (22.4 percent), followed by the Ceramic period (15.9 percent) and the Early Archaic (9.8 percent). Based on projectile point frequencies alone, this suggests that the Late Archaic and Middle Archaic were the times of heaviest use of the Jornada area by prehistoric peoples. Could this be true? There do seem to be more lithic artifact scatters (loosely implying Archaic origin) than any other site type in the region, and Ceramic period sites are much lower in frequency. Certainly, the rockshelters listed in Table 35 saw more Archaic use than Ceramic period use. Early Archaic use of the shelters was not rare, as might be expected; rather, most shelters displayed some evidence of occupation during this time.

Fresnal and San Jose points, also found at Fallen Pine Shelter, are the most common Middle Archaic points recovered from the sites. During the Late Archaic, Hueco points are by far the most commonly recovered style (41.7 percent), and Shumla points were also numerous. These points, along with a number of large San Pedros (also found on other sites) were also recovered at Fallen Pine Shelter. Of the Ceramic period points, Washita, Scallorn, Fresno, and Harrell points were the most numerous. High Rolls Cave contained no projectile points from the Ceramic period.

In sum, Fallen Pine Shelter sits very nicely within the range of projectile point types recovered from each time period within the Jornada region. Diversity is limited to seven to nine point styles during each of the

Archaic periods, with up to six types appearing on a single site during a single period. This probably is the result of different populations inhabiting a specific shelter during a given period, or it could just as likely imply the use of different points by the same population. At Fallen Pine Shelter, Hueco and San Pedro points were found at the same depth as Shumla, Augustin-Gary, San Jose, and Pendejo points (see Table 29), tending to support the latter suggestion.

Table 35. Projectile point types by period from selected sites

Period	Point Type	Angus		Pena Blanca		Rincon Shelter		Fallen Pine Shelter		Pintada Shelter		Fresnal Shelter		High Rolls Cave	
		No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
Ceramic	Perdiz	-	-	-	-	-	-	1	3.8%	2	0.8%	2	1.9%	-	-
	Clifton	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Cameron	-	-	2	7.1%	1	6.3%	-	-	5	2.0%	-	-	-	-
	Washita	4	14.8%	2	7.1%	1	6.3%	-	-	5	2.0%	-	-	-	-
	Harrell	3	11.1%	-	-	-	-	-	-	12	4.7%	1	0.9%	-	-
	Garza	-	-	2	7.1%	1	6.3%	-	-	-	-	-	-	-	-
	Bonham	-	-	1	3.6%	-	-	1	3.8%	-	-	3	2.8%	-	-
	Deadman's	-	-	-	-	-	-	-	-	1	0.4%	-	-	-	-
	Zavala	-	-	3	10.7%	1	6.3%	-	-	-	-	-	-	-	-
	Scallorn	5	18.5%	-	-	-	-	2	7.7%	-	-	-	-	-	-
	Fresno	3	11.1%	1	3.6%	1	6.3%	1	3.8%	2	0.8%	-	-	-	-
	Toyah	-	-	-	-	1	6.3%	-	-	3	1.2%	-	-	-	-
	Cuny	-	-	-	-	-	-	-	-	2	0.8%	-	-	-	-
	Starr	-	-	-	-	-	-	-	-	2	0.8%	-	-	-	-
	Steiner	-	-	1	3.6%	-	-	-	-	-	-	-	-	-	-
	Total	15	55.6%	12	42.9%	6	37.5%	5	19.2%	34	13.3%	6	5.7%	0	0.0%
Late Archaic	En Medio	-	-	-	-	-	-	-	-	1	0.4%	2	1.9%	2	6.5%
	Wells	-	-	-	-	-	-	-	-	-	-	1	0.9%	-	-
	Ellis	1	3.7%	-	-	1	6.3%	-	-	-	-	-	-	-	-
	Maljamar	-		-	-	-	-	-	-	-	-	1	0.9%	-	-
	Pendejo	2	7.4%	-	-	-	-	2	7.7%	1	0.4%	-	-	3	9.7%
	Hatch	-	-	2	7.1%	1	6.3%	-	-	23	9.0%	1	0.9%	-	-
	Hueco	5	18.5%	8	28.6%	5	31.3%	4	15.4%	66	25.9%	4	3.8%	10	32.3%
	Shumla	-	-	-	-	-	-	4	15.4%	25	9.8%	12	11.3%	4	12.9%
	Small San Pedro	1	3.7%	-	-	1	6.3%	-	-	14	5.5%	6	5.7%	-	-
	Coahuila	-	-	-	-	-	-	-	-	-	-	9	8.5%	-	-
	Large San Pedro	1	3.7%	4	14.3%	-	-	1	3.8%	13	5.1%	8	7.5%	6	19.4%
	Total	10	37.0%	14	50.0%	8	50.0%	11	42.3%	143	56.1%	44	41.5%	25	80.6%
Middle Archaic	Armijo	-	-	-	-	-	-	1	3.8%	8	3.1%	-	-	-	-
	Bulverde	-	-	-	-	-	-	-	-	-	-	4	3.8%	-	-
	La Cueva	-	-	-	-	-	-	-	-	2	0.8%	6	5.7%	-	-
	Fresnal	-	-	-	-	-	-	6	23.1%	21	8.2%	14	13.2%	1	3.2%
	Chiricahua	1	3.7%	-	-	-	-	-	-	4	1.6%	3	2.8%	1	3.2%
	Augustin	-	-	-	-	-	-	1	3.8%	-		4	3.8%	1	3.2%
	Augustin-Gary	-	-	-	-	-	-	1	3.8%	15	5.9%	-	-	-	-
	San Jose	-	-	-	-	-	-	1	3.8%	11	4.3%	2	1.9%	2	6.5%
	Total	1	3.7%	0	0.0%	0	0.0%	10	38.5%	61	23.9%	33	31.1%	5	16.1%
Early Archaic	Todsen	-	-	-	-	1	6.3%	-	-	5	2.0%	1	0.9%	-	-
	Uvalde	-	-	-	-	-	-	-	-	-	-	6	5.7%	-	-
	Williams	1	3.7%	-	-	-	-	-	-	-	-	-	-	-	-
	Bat Cave	-	-	-	-	-	-	-	-	1	0.4%	-	-	-	-
	Datil	-	-	-	-	-	-	-	-	-		5	4.7%	1	3.2%
	Pelona	-	-	-	-	-	-	-	-	3	1.2%	5	4.7%	-	-
	Armagosa-Pinto	-	-	-	-	-	-	-	-	4	1.6%	-		-	-
	Pedernales	-	-	-	-	-	-	-	-	-	-	4	3.8%	-	-
	Bajada	-	-	-	-	-	-	-	-	-	-	2	1.9%	-	-
	Jay	-	-	2	7.1%	1	6.3%	-	-	4	1.6%	-	-	-	-
	Total	1	3.7%	2	7.1%	2	12.5%	0	0.0%	17	6.7%	23	21.7%	1	3.2%
Grand Total		27	100.0%	28	100.0%	16	100.0%	26	100.0%	255	100.0%	106	100.0%	31	100.0%

GROUND STONE

Dorothy A. Zamora

Analysts are increasingly relying on ground stone from archaeological sites to help interpret site activity and subsistence strategies. Analysis of ground stone artifacts has become more than descriptive in nature. Bartlett (1933, 1936) was the first to look at ground stone as an important aspect of the Anasazi tool kit (Schelberg 1997:1013). She recognized that the Anasazi were highly dependent on corn for subsistence after the transition from wild food resources. In the Anasazi culture, metates changed from basin types during the Archaic period, to trough types beginning in Early Pueblo II, to slab forms until the end of Late Pueblo II. At Fallen Pine Shelter, basin and slab metates from the Archaic period were present.

Lancaster's (1983:47) study of ground stone from the Mimbres Valley found that slab metates were functionally similar to basin metates. Both were used to process wild foods. He further states that a rise in efficiency through time is noticeable in the form of larger grinding surfaces and more varied material textures. He found that trough metates were popular during the early Pithouse period and later were replaced by through-trough types (Lancaster 1983:47). In studying material texture, Lancaster (1983:87) was able to conclude that there was a shift from a single-stage to a multistage grinding process, determined by the coarseness of the ground stone being used.

Hard (1990) and Mauldin (1993) measure a group's dependency on agriculture through analysis of ground stone measurements. They believe that the ground surface area of manos increases with an increase in the amount of corn used in grinding, suggesting agricultural dependence. Diehl (1996), on the other hand, believes that the introduction and use of a new variety of *maiz de ocho* and an increase in population is what triggered the change in ground stone morphology.

Wright (1993), Stone (1994), and Adams (1999) argue that ground stone morphology is not a good predictor of subsistence strategies. Adams (1996) suggests that processing strategies and differing techniques explain mano and metate variation. She also states that mano size is more relevant to tool configuration and processing strategies.

Methods

The ground stone analysis from Fallen Pine Shelter attempted to answer questions on mobility, seasonality, resource exploitation, and group composition. Because Fallen Pine Shelter lacked a large sample of artifacts and food resources, Hard's (1990) model of agricultural dependency was not used, although ground surface areas were measured. The artifacts were also examined for function, material selection, shape, size, manufacturing techniques, and specific processing activities. Palynological (pollen and pollen washes) and botanical (flotation) samples from the ground stone were used to determine seasonality and food resources. Ground stone data from other sites in the area were also used to compare morphology, material selection, and the types of resources being used.

Since there are multiple components at the site, the ground stone was separated into two cultural phases: Pueblo and Archaic. Within the Pueblo phase, temporal periods such as the early, mixed, and late Ceramic periods were examined. The mixed Ceramic period was identified when it was obvious that the ceramics from the early and late periods had become mixed. Dates for these periods were obtained through ceramic serration and from calibrated C-14 analysis.

The ground stone was analyzed using the methods outlined in *Standardized Ground Stone Artifact Analysis: A Manual for the Office of Archaeological Studies* (OAS 1994b). Each artifact was examined with the use of a binocular microscope. Measurements were taken by calipers in centimeters, and each artifact was weighed in kilograms on a metric scale. The use-surface of each artifact was measured using a template of squares in 1 cm increments, which was placed over the artifact. The variables recorded during the analysis are as follows: field specimen number, material type, material texture, preform morphology, production input, shaping, length, length complete, width, width complete, thickness, thickness complete, weight, weight complete, ground-surface dimensions, mano cross section, metate depth, plan view outline, flaked surface or margin present, heat treatment, use number, portion, function, ground-surface cross section, ground-surface sharpening, ground-surface texture, primary wear, secondary wear, alterations, adhesions, and striations. The data was entered into a computer data base using the SPSS Data Entry Program.

Material Selection

An important part of the analysis was to determine what type of material was chosen for the ground stone and why was it selected. Sandstone was the preferred material for all the ground stone types (Table 36). The others are limestone (n = 11), granite (n = 9), and quartzite (n = 7), with small amounts of basalt, rhyolite, and quartzitic sandstone.

Stone (1994) hypothesizes that the choice of sandstone for grinding may be the result of the availability of suitable materials. Sandstone can be found around the immediate area in outcrops from the Dakota formation that outline the rim of the Sierra Blanca basin (Allen and Kottlowski 1981:26). The next most used material, San Andres limestone, is also readily available and outcrops throughout the area.

Stone (1994:680) also states that the material used for grinding must be sufficiently dense, hard, and durable to grind foodstuff effectively without wearing too quickly and not adding large amounts of grit to the foods being processed. In comparing material types between the manos and metates, sandstone is still the dominate type; however, now both granite and limestone are second in preference. Using Mohs's scale of hardness, on a scale of 1-10, sandstone has a hardness of 7, granite has a hardness of 5.5 (Zier 1981:36), and

Table 36. Ground stone material type by artifact function

Count Row Percentage Column Percentage	Basalt	Granite	Rhyolite	Limestone	Sandstone	Quartzite	Quartzitic Sandstone	Total
Indeterminate	-	-	-	2	2	1	-	5
	-	-	-	40.0%	40.0%	20.0%	-	100.0%
	-	-	-	18.2%	5.9%	14.3%	-	7.2%
Polishing stone	-	-	-	-	-	2	-	2
	-	-	-	-	-	100.0%	-	100.0%
	-	-	-	-	-	28.6%	-	2.9%
Abrading stone	-	-	-	1	2	-	-	3
	-	-	-	33.3%	66.7%	-	-	100.0%
	-	-	-	9.1%	5.9%	-	-	4.3%
Shaft straightener	-	-	-	1	-	-	-	1
	-	-	-	100.0%	-	-	-	100.0%
	-	-	-	9.1%	-	-	-	1.4%
Lapstone	-	-	-	-	1	-	-	1
	-	-	-	-	100.0%	-	-	100.0%
	-	-	-	-	2.9%	-	-	1.4%
Hammerstone	-	-	-	-	1	-	-	1
	-	-	-	-	100.0%	-	-	100.0%
	-	-	-	-	2.9%	-	-	1.4%
Mano	1	2	1	3	4	1	-	12
	8.3%	16.7%	8.3%	25.0%	33.3%	8.3%	-	100.0%
	33.3%	22.2%	33.3%	27.3%	11.8%	14.3%	-	17.4%
One-hand mano	1	5	1	3	15	3	1	29
	3.4%	17.2%	3.4%	10.3%	51.7%	10.3%	3.4%	100.0%
	33.3%	55.6%	33.3%	27.3%	44.1%	42.9%	50.0%	42.0%
Two-hand mano	-	1	-	-	-	-	-	1
	-	100.0%	-	-	-	-	-	100.0%
	-	11.1%	-	-	-	-	-	1.4%
Metate	1	-	1	1	7	-	-	10
	10.0%	-	10.0%	10.0%	70.0%	-	-	100.0%
	33.3%	-	33.3%	9.1%	20.6%	-	-	14.5%
Basin metate	-	1	-	-	-	-	-	1
	-	100.0%	-	-	-	-	-	100.0%
	-	11.1%	-	-	-	-	-	1.4%
Slab metate	-	-	-	-	2	-	1	3
	-	-	-	-	66.7%	-	33.3%	100.0%
	-	-	-	-	5.9%	-	50.0%	4.3%
Total	3	9	3	11	34	7	2	69
	4.3%	13.0%	4.3%	15.9%	49.3%	10.1%	2.9%	100.0%
	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%

limestone a hardness of 3.5 to 4 (Pough 1976:29). According to Zier (1981:36), sandstone is harder than basalt, but basalt does not produce the grit that sandstone leaves when grinding foodstuff. Vesicular basalt is usually found on sites where larger grains such as corn were ground. It is possible that basalt is absent because there are no close sources; however, there are some volcanic outcrops on the east side of the Sierra Blancas and along U.S. 54. Basalt can also be found at the Valley of Fires Park west of Carrizozo, where the lava flow covers a north-south distance of over 40 miles (Allen and Kottlowski 1981:66). Nelson and Lippmeier (1993:294) state that raw material determines the durability of metate use and affects labor costs and the manufacture and length of metate life. Most of the utilized ground stone materials found at Fallen Pine Shelter are locally available. Other material such as basalt may be absent because of the inefficiency of traveling to the source.

Two complete metates made from sandstone were recovered. The smaller basin type is heavily pecked on the used surface, and the larger slab type has a smooth ground surface. The manos are mostly made of sandstone, and a few are made of granite cobbles and quartzite cobbles. These manos are usually unmodified natural cobbles that fit comfortably in one hand. One rectangular two-hand mano of granite was also recovered during the excavation.

Many of the sites that we compared to the assemblage from Fallen Pine Shelter are similar in material selection, while some contained various material types of ground stone. These sites are in the Rio Bonito area (Vierra and Lancaster 1987; Farwell et al. 1992; Zamora and Oakes 2000), the Hondo Valley (Wiseman 1996), the Sierra Blanca region (Kelly 1984), the eastern edge of the Tularosa Basin (Oakes 1998), and in the Organ Mountains (MacNeish 1993, 1998).

The Angus site (Zamora and Oakes 2000) ground stone assemblage, slightly larger than that from Fallen Pine Shelter, contained a variety of different materials. However, the most common materials were syenite (25.5 percent), sandstone (22.4 percent), and granite (21.4 percent). The other materials, such as basalt, rhyolite, limestone, andesite, quartzite, serpentine, and metamorphic schistose, were minimally used (Zamora 2000). The ground stone recovered from the Crockett Canyon and Filingin sites (Farwell et al. 1992) showed that the most common material type was sandstone; however, other materials such as syenite and igneous and metamorphic materials were also used extensively (Wening 1992). Kelly's (1984) work in the Sierra Blanca region recorded that ground stone from the Hiner 1, Bonnell, and Bloom Mound sites were mostly sandstone and limestone.

Vierra and Lancaster's (1987) excavation of the Rio Bonito site recovered 22 ground stone artifacts. The materials for the ground stone consisted of igneous (54.5 percent), sandstone (31.8 percent), limestone (9.1 percent), and quartzite (4.5 percent). All the material from this assemblage is available on or near the site. The Florida Avenue excavations (Oakes 1998) in Alamogordo, New Mexico, had a larger assemblage than Fallen Pine Shelter, but the material selection is almost identical. Sandstone (66.0 percent) was the dominant material type, along with limestone (17.0 percent) and igneous material (13.0 percent). At the Sunset Archaic site (Wiseman 1996), sandstone was the preferred material type for most of the assemblage, and at Sunset Shelters the materials were evenly split between limestone and sandstone.

In all of these areas the material selected for the ground stone is readily available in river cobbles or outcrops near the sites. There is a notable absence of nonlocal materials, which are more durable and leave less grit in all of the assemblages. Basalt, for example, a nonlocal material, is absent or minimally used in these assemblages, probably because it is not available nearby and transporting it from areas far away would be quite an effort. It would make perfect sense to use the local materials that are available without having to spend too much time and effort procuring materials from areas that are far away. Also, if these sites are not permanent habitations but short-term or seasonal types, then one would expect to see material selection being restricted to local materials. The only exceptions are the Angus site (Zamora and Oakes 2000) and the Crockett and Filingin sites (Farwell et al. 1992), which are large habitation sites with several structures and outside features.

Ground Stone Assemblage

A total of 69 ground stone artifacts were recovered from Fallen Pine Shelter. As stated earlier, the ground stone has been divided into Pueblo and Archaic periods (Table 37).

The Archaic component (62.3 percent) contains more ground stone than the Pueblo component (37.7 percent). The dominant artifact in both periods is the one-hand mano (42.0 percent), more of which date to the Archaic period (69.0 percent).

More artifact varieties represent the Archaic period than the Pueblo period. A small shaft straightener was recovered from the Pueblo period, while a lapstone, hammerstone, and two-hand mano are present in the Archaic. One could hypothesize that more food processing occurred during the Archaic period than during the Pueblo. The shaft straightener suggests the manufacture of hunting items during Pueblo times. Two-hand manos and slab metates are usually associated with corn grind-

Table 37. Ground stone from the Pueblo and Archaic periods by artifact function

Count Row Percentage Column Percentage	Pueblo	Archaic	Total
Indeterminate	3	2	5
	60.0%	40.0%	100.0%
	11.5%	4.7%	7.2%
Polishing stone	1	1	2
	50.0%	50.0%	100.0%
	3.8%	2.3%	2.9%
Abrading stone	1	2	3
	33.3%	66.7%	100.0%
	3.8%	4.7%	4.3%
Shaft straightener	1	-	1
	100.0%	-	100.0%
	3.8%	-	1.4%
Lapstone	-	1	1
	-	100.0%	100.0%
	-	2.3%	1.4%
Hammerstone	-	1	1
	-	100.0%	100.0%
	-	2.3%	1.4%
Mano	6	6	12
	50.0%	50.0%	100.0%
	23.1%	14.0%	17.4%
One-hand mano	9	20	29
	31.0%	69.0%	100.0%
	34.6%	46.5%	42.0%
Two-hand mano	-	1	1
	-	100.0%	100.0%
	-	2.3%	1.4%
Metate	4	6	10
	40.0%	60.0%	100.0%
	15.4%	14.0%	14.5%
Basin metate	-	1	1
	-	100.0%	100.0%
	-	2.3%	1.4%
Slab metate	1	2	3
	33.3%	66.7%	100.0%
	3.8%	4.7%	4.3%
Total	26	43	69
	37.7%	62.3%	100.0%
	100.0%	100.0%	100.0%

ing; however, there is no other evidence that the Archaic people were processing corn.

Of the one-hand manos analyzed (n = 29), only one had secondary use. The use-wear was in the form of battering along the edge of the mano, suggesting it was used as a hammerstone, possibly for shaping the metates. None of the manos from either period exhibited resharpening by pecking on the ground surfaces. Two complete metates, a basin metate (Fig. 48a) and a slab metate (Fig. 48b) recovered from the Archaic period deposits, had been pecked or resharpened.

Two small polishing stones were recovered, one from outside of the shelter (Fig. 48c), within the Pueblo level, possibly suggesting pottery manufacture. The other was found inside the shelter in Level 5 (Archaic) (Fig.48d). Pottery making does not seem to have taken place at the site, however. Several metate fragments were also found scattered throughout the fill in both periods.

Several rockshelters investigated earlier have produced little or no ground stone. Because most of the rockshelters around the project area do not have any ground stone associated with them, other rockshelters from the southern half of the state were used for comparison. Hermit's Cave in the Guadalupe Mountains was excavated by Ferdon (1946:20), and he recovered several ground stone artifacts, including seven one-hand manos, a basin metate, a hammerstone, two smoothing stones, and a miscellaneous ground piece of limestone which was polished on both surfaces. Three of the manos were slightly convex on the grinding surface, one was wedge shaped, three oval manos were shaped by pecking, and the rest had surfaces ground on both sides. The assemblage from Hermit's Cave (A.D.1250 to 1300) is comparable to the assemblage from Fallen Pine Shelter because it consists mostly of manos and few metates. The one difference between the two site assemblages is that the one-hand manos recovered from Fallen Pine Shelter had been shaped by both pecking and grinding, and only one was pecked at Hermit's Cave, where most of the one-hand manos were unshaped natural cobbles. Wiseman's (1996) Sunset Shelters, in the Hondo Valley, had only one-hand manos (n = 11) and basin metates (n = 5). At Pintada Rockshelter, near Las Cruces, the ground stone artifacts consisted of mullers, one-hand manos, slab metates, two-hand manos, and paint palettes (MacNeish 1998). MacNeish (1993) also found the same assemblage at Todsen Cave near Las Cruces; however, trough metates and a Mexican metate were also present in the assemblage.

The Pueblo components at these sites are similar except for the paint palettes, trough, and Mexican metates found in Todsen Cave. One-hand manos seem to dominate the assemblages, and few two-hand manos are present. The metates found at Tintop Cave, Pintada Rockshelter, and Todsen Cave were large boulder types, whereas most of the metates found at Fallen Pine Shelter were fragments from smaller or possibly portable types.

Other Pueblo period sites that are open-air habitations contain ground stone assemblages very similar to that of Fallen Pine Shelter. The Angus site (Zamora and Oakes 2000), on the Rio Bonito, had a small assemblage for a large site; however, there was more variety. One distinct difference is that there are more one-hand manos present at LA 110339. Another difference noted between the two sites is that there are no trough metates

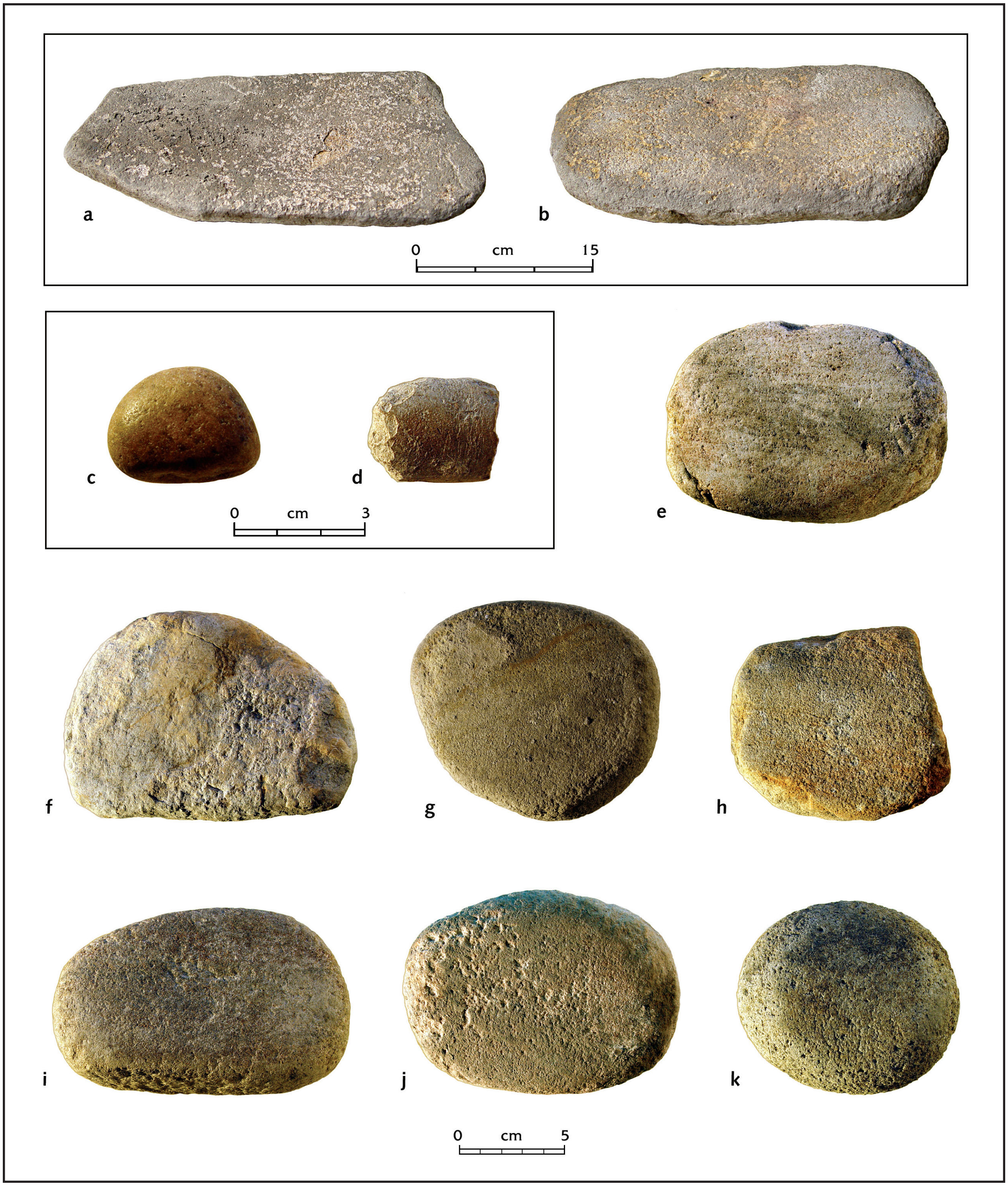

Figure 48. Ground stone artifacts: (a) basin metate from outside shelter (Archaic); (b) slab metate from outside (Archaic); (c) polishing stone from inside, Level 5 (Archaic); (d) polishing stone from outside (Pueblo); (e) one-hand mano from inside, Level 4, containing corn pollen (Pueblo); (f) abrading stone from outside (Pueblo); (g) one-hand mano from outside, associated with basin metate (Archaic); (h) one-hand mano from outside (Archaic); (i) one-hand mano from outside (Archaic); (j) one-hand mano from outside shelter (Archaic); (k) one-hand mano from outside (Archaic).

and only one two-hand mano at Fallen Pine Shelter. The ground stone from the Rio Bonito site near Fort Stanton consisted of 22 artifacts. Most of the manos were one-hand types (Vierra and Lancaster 1987:33), and six exhibited pecking on the concave surfaces. All the manos from Fallen Pine Shelter were smooth with no evidence of pecking for resharpening. Two slab metates were recovered from the pithouse floor at the Rio Bonito site, but only fragments from Fallen Pine Shelter.

At the Florida Avenue site (Oakes 1998), in Alamogordo, the assemblage consisted of 96 ground items. This assemblage contained a large number of two-hand manos (n = 38); however, one-hand manos still dominate. A total of 16 metates were recovered: three basin, four slab, four cobble base stone, one flat tabular base stone, and four unidentified fragments. At the Mockingbird site (Moore 1996), at the port-of-entry in Santa Teresa, 75 ground stone artifacts were recovered: 22 indeterminate, 26 manos, 1 one-hand manos, 25 metates, and 1 abrader.

There seems to be greater variability in the ground stone assemblage at the open-air sites; however, the differences are not great except for Florida Avenue, which contained more metates and many more two-hand manos. At most of these sites, two-hand manos were few or missing completely. The assemblages from the Rio Bonito and Mockingbird sites are almost identical to that of Fallen Pine Shelter in that they are small and there is not much variability within them.

Among the few comparable Archaic sites are Wiseman's (1996) Sunset Archaic, Moore's (1996) Santa Teresa site, and MacNeish's (1993, 1998) Todsen Cave and Pintada Rockshelter. The artifact assemblages from these sites contain many of the same ground stone items (Table 38), except for MacNeish's two sites, which have a larger variety. Boulder metates—large, chunky, heavy metates—are absent from the Santa Teresa and Fallen Pine Shelter. Wiseman (1996) found one boulder basin metate at Sunset Archaic. Such artifacts were not transported. Wright (1994) believes that large, heavy grinding tools caused difficulties for hunter-gatherers because of their lack of portability. The two complete metates found at the Fallen Pine Shelter were small and portable; the basin metate was thin and lightweight; and the slab metate was slightly thicker and heavier. The rest of the metate fragments were thin and probably from portable types. The slab metates from Santa Teresa were all fragments, and all the ground stone artifacts, except two manos, were fragmented in this assemblage.

Discussion

Besides separating the ground stone into time periods, we also differentiated between artifacts found inside of the shelter and outside. A total of 16 ground stone items were found inside the rockshelter (Table 39) and 53 outside (Table 40). Because the interior of the rockshelter contained several utilized surfaces, different levels could be assigned to these surfaces. Level 1 was reserved for the general fill throughout the excavation.

Mixing of cultural resources is evident outside the rockshelter. The upper levels are interspersed with the lower levels, making it difficult to classify some of the artifacts as Pueblo or Archaic. However, with the assistance of the radiocarbon dates we were able to place all the ground stone into a likely time period.

Why is there more ground stone from the Archaic period? Palynological evidence suggests that the Pueblo people were storing and processing foodstuffs inside the shelter. A pollen wash from a mano (Fig. 48e) found inside the shelter in Level 4, dating to the early Ceramic

Table 38. Ground stone from Archaic sites

Fallen Pine Shelter	Sunset Archaic	Santa Teresa	Todsen Cave	Pintada Shelter
One-hand manos	One-hand manos	One-hand manos	One-hand manos	One-hand manos
Two-hand manos			Two-hand manos	Two-hand manos
Mano indeterminate		Mano indeterminate		
Boulder metate	Boulder metate		Boulder metates	Boulder metates
Metates indeterminate		Metates indeterminate		
Basin metate	Basin metate			
Slab metate		Slab metate	Slab metate	Slab metate
Abrading stone			Pebble abrader	
Polishing stone				
			Boulder milling stones	Boulder milling stones
			Mullers	Mullers
			Anvil/Mortar	Boulder anvil
			Sinew stone	
				Hammerstone

Table 39. Ground stone from inside the rock shelter

Count Row Percentage Column Percentage			Function							Total
Level	Depth (cm)	Period	Indeterminate	Polishing Stone	Shaft Straightener	Lapstone	Mano	One-hand Mano	Metate	
1	110-120	Pueblo	-	-	-	-	-	1	-	1
			-	-	-	-	-	100.0%	-	100.0%
			-	-	-	-	-	14.3%	-	6.3%
1	170-180	Pueblo	-	-	1	-	1	-	-	2
			-	-	50.0%	-	50.0%	-	-	100.0%
			-	-	100.0%	-	50.0%	-	-	12.5%
3	200-220	Pueblo	-	-	-	-	-	1	1	2
			-	-	-	-	-	50.0%	50.0%	100.0%
			-	-	-	-	-	14.3%	50.0%	12.5%
4	208-220	Pueblo	-	-	-	1	-	1	-	2
			-	-	-	50.0%	-	50.0%	-	100.0%
			-	-	-	100.0%	-	14.3%	-	12.5%
4	210-220	Pueblo	1	-	-	-	-	-	-	1
			100.0%	-	-	-	-	-	-	100.0%
			50.0%	-	-	-	-	-	-	6.3%
4	210-225	Pueblo	-	-	-	-	-	1	-	1
			-	-	-	-	-	100.0%	-	100.0%
			-	-	-	-	-	14.3%	-	6.3%
4	213-223	Pueblo	1	-	-	-	-	-	-	1
			100.0%	-	-	-	-	-	-	100.0%
			50.0%	-	-	-	-	-	-	6.3%
4	218-228	Pueblo	-	-	-	-	-	1	-	1
			-	-	-	-	-	100.0%	-	100.0%
			-	-	-	-	-	14.3%	-	6.3%
4	218-230	Pueblo	-	-	-	-	-	-	1	1
			-	-	-	-	-	-	100.0%	100.0%
			-	-	-	-	-	-	50.0%	6.3%
5	220-225	Archaic	-	-	-	-	1	-	-	1
			-	-	-	-	100.0%	-	-	100.0%
			-	-	-	-	50.0%	-	-	6.3%
5	220-235	Archaic	-	1	-	-	-	-	-	1
			-	100.0%	-	-	-	-	-	100.0%
			-	100.0%	-	-	-	-	-	6.3%
5	226-241	Archaic	-	-	-	-	-	1	-	1
			-	-	-	-	-	100.0%	-	100.0%
			-	-	-	-	-	14.3%	-	6.3%
7	257-265	Archaic	-	-	-	-	-	1	-	1
			-	-	-	-	-	100.0%	-	100.0%
			-	-	-	-	-	14.3%	-	6.3%
Total			2	1	1	1	2	7	2	16
			12.5%	6.3%	6.3%	6.3%	12.5%	43.8%	12.5%	100.0%
			100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%

period, contained corn pollen, suggesting that corn was being processed, if only in small quantities. Another one-hand mano recovered from the fill between Surface 1 and Surface 2 had cholla cactus pollen present on the ground surface. Other taxa found on the ground stone from inside the shelter were pine, cheno-ams, composites, Mormon tea, and grasses. Small traces of cattail and mustards were also found, which suggests that the site was occupied at least once in the spring.

The rest of the ground stone assemblage suggests short-term habitations, especially since no large, whole grinding implements are present such as metates and two-hand manos. Most were probably portable tools. There are several whole one-hand manos made from natural cobbles, but only metate fragments were recovered. If this were a long-term habitation site, there should be more ground stone present and possibly more evidence of agricultural dependence. More features should also have been present inside and especially outside the shelter, where most of the work would have been done. The polishing stones recovered imply pottery manufacturing, but there was no other evidence of this activity. Hunting is suggested by a shaft straightener and abrader (Fig. 48f).

The Archaic period ground stone occurred almost twice as frequently as that from the Pueblo period. Most of the items were recovered outside of the shelter except for two manos (one-hand types) found in Levels 5 and 7. One of these manos was pollen-washed and contained very little pollen. The taxa consisted of cheno-ams,

Table 40. Ground stone from outside of the rock shelter

Count Row Percentage Column Percentage		Function										Total
Depth (cm)	Period	Indeterminate	Polishing Stone	Abrading Stone	Hammerstone	Mano	One-hand Mano	Two-hand Mano	Metate	Basin Metate	Slab Metate	
200-210	Pueblo	-	-	-	-	-	-	-	1	-	-	1
		-	-	-	-	-	-	-	100.0%	-	-	100.0%
		-	-	-	-	-	-	-	12.5%	-	-	1.9%
220-230	Pueblo	-	1	1	-	2	-	-	-	-	-	4
		-	25.0%	25.0%	-	50.0%	-	-	-	-	-	100.0%
		-	100.0%	33.3%	-	18.2%	-	-	-	-	-	7.5%
	Archaic	-	-	2	-	-	-	-	1	-	-	3
		-	-	66.7%	-	-	-	-	33.3%	-	-	100.0%
		-	-	66.7%	-	-	-	-	12.5%	-	-	5.7%
230-240	Pueblo	-	-	-	-	2	-	-	-	-	-	2
		-	-	-	-	100.0%	-	-	-	-	-	100.0%
		-	-	-	-	18.2%	-	-	-	-	-	3.8%
	Archaic	-	-	-	-	-	-	-	1	-	-	1
		-	-	-	-	-	-	-	100.0%	-	-	100.0%
		-	-	-	-	-	-	-	12.5%	-	-	1.9%
240-250	Pueblo	1	-	-	-	1	-	-	-	-	-	2
		50.0%	-	-	-	50.0%	-	-	-	-	-	100.0%
		33.3%	-	-	-	9.1%	-	-	-	-	-	3.8%
	Archaic	1	-	-	1	1	4	-	1	-	1	9
		11.1%	-	-	11.1%	11.1%	44.4%	-	11.1%	-	11.1%	100.0%
		33.3%	-	-	100.0%	9.1%	19.0%	-	12.5%	-	33.3%	17.0%
270-280	Pueblo	-	-	-	-	-	1	-	1	-	1	3
		-	-	-	-	-	33.3%	-	33.3%	-	33.3%	100.0%
		-	-	-	-	-	4.8%	-	12.5%	-	33.3%	5.7%
	Archaic	-	-	-	-	-	4	-	1	-	-	5
		-	-	-	-	-	80.0%	-	20.0%	-	-	100.0%
		-	-	-	-	-	19.0%	-	12.5%	-	-	9.4%
280-290	Pueblo	-	-	-	-	-	1	-	-	-	-	1
		-	-	-	-	-	100.0%	-	-	-	-	100.0%
		-	-	-	-	-	4.8%	-	-	-	-	1.9%
	Archaic	-	-	-	-	-	-	-	2	-	-	2
		-	-	-	-	-	-	-	100.0%	-	-	100.0%
		-	-	-	-	-	-	-	25.0%	-	-	
290-300	Archaic	1	-	-	-	-	1	1	-	-	1	4
		25.0%	-	-	-	-	25.0%	25.0%	-	-	25.0%	100.0%
		33.3%	-	-	-	-	4.8%	100.0%	-	-	33.3%	7.5%
300-310	Pueblo	-	-	-	-	-	1	-	-	-	-	1
		-	-	-	-	-	100.0%	-	-	-	-	100.0%
		-	-	-	-	-	4.8%	-	-	-	-	1.9%
	Archaic	-	-	-	-	1	2	-	-	-	-	3
		-	-	-	-	33.3%	66.7%	-	-	-	-	100.0%
		-	-	-	-	9.1%	9.5%	-	-	-	-	5.7%
310-320	Archaic	-	-	-	-	-	1	-	-	-	-	1
		-	-	-	-	-	100.0%	-	-	-	-	100.0%
		-	-	-	-	-	4.8%	-	-	-	-	1.9%
320-330	Archaic	-	-	-	-	2		-	-	-	-	2
		-	-	-	-	100.0%		-	-	-	-	100.0%
		-	-	-	-	18.2%		-	-	-	-	3.8%
330-340	Archaic	-	-	-	-	1	2	-	-	-	-	3
		-	-	-	-	33.3%	66.7%	-	-	-	-	100.0%
		-	-	-	-	9.1%	9.5%	-	-	-	-	5.7%
340-350	Archaic	-	-	-	-	1	2	-	-	1	-	4
		-	-	-	-	25.0%	50.0%	-	-	25.0%	-	100.0%
		-	-	-	-	9.1%	9.5%	-	-	100.0%	-	7.5%
350-360	Archaic	-	-	-	-	-	2	-	-	-	-	2
		-	-	-	-	-	100.0%	-	-	-	-	100.0%
		-	-	-	-	-	9.5%	-	-	-	-	3.8%
Total		3	1	3	1	11	21	1	8	1	3	53
		5.7%	1.9%	5.7%	1.9%	20.8%	39.6%	1.9%	15.1%	1.9%	5.7%	100.0%
		100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%

grasses, and high-spine composites. All the manos processed by pollen washes were from outside the shelter; they contained pine, cheno-ams, high and low composites, ponderosa pine, oak, sagebrush, and wild buckwheat.

Two metates—a small basin and a small slab—were recovered outside of the shelter. Both are portable and likely brought to the site from some other location. The basin metate and a one-hand mano (Fig. 48g) were found in situ in the outside fill. The mano produced pine, grasses, high and low composites, and sagebrush. The metate had cheno-ams, traces of high and low composites, and sagebrush. The slab metate contained only pine and cheno-ams. A nearby two-hand mano could possibly be the mate to the slab metate. Poor preservation could explain why there is very little pollen present on the artifacts. Both metates were heavily pecked to roughen the surfaces. There is no evidence that corn was being consumed here during the Archaic period. Instead, it seems that wild resources were being processed. Lancaster (1983) assumes that slab and basin metates are primarily used for processing wild foods, as they probably were at Fallen Pine Shelter during the Archaic period.

One-hand manos are the dominant artifacts found at Fallen Pine Shelter. None of them exhibit intense grinding or high polishing (Figs. 48h-48j). Calamia (1990) believes that one-hand manos could be part of a portable tool kit. Adams (1988) found that many one-hand manos used for hide processing are mistakenly coded as tools used in food processing. Looking at the use-wear on the one-hand manos, none exhibit the type of damage found in hide processing, however. The damage found on the surfaces of the manos consists of deep striations that indicate a back-and-forth grinding motion used on a hard surface, possibly to grind food. Only one mano had circular striations, which are usually associated with seed grinding (Fig. 48k). The preponderance of one-hand manos also implies that preparation of wild foods, rather than corn processing, was an important activity for Pueblo peoples at the shelter. This trend was also evident at the other sites examined in this chapter.

It may be possible that the Archaic people were discarding their manos and not reusing them, since material availability was not a problem. Once the mano was ground to a smooth surface and needed sharpening, another stone was used instead.

Moore (1996:280-281) notes that the ground stone from the Santa Teresa project exhibited thermal use in the form of discoloration or diagnostic breaks. He discovered that thermally altered ground stone was near hearths and concluded that the ground stone was probably scavenged from nearby sites and used as hearth stones. Almost all of the ground stone from the Fallen Pine Shelter was thermally altered, both inside and outside the shelter. It is possible that the stones were used as hearth stones, and maybe that is why there are so many of them. Instead of reusing the stones, another group may have used them for their hearths. Therefore, with repeated use of the shelter during both the Archaic and Pueblo period, it is possible that the ground stone was not used repeatedly as processing implements, but rather for hearth stones.

MISCELLANEOUS ARTIFACTS

Dorothy A. Zamora

The miscellaneous category for Fallen Pine Shelter was defined as artifacts that have not been classified as chipped stone, ceramics, or ground stone. These artifacts consist of ornamental items or minerals (Table 41).

Chrysocolla, along with other minerals, is present in the area (Northrop 1959) and is found with copper-related minerals north of the area (Anderson 1954:17). It is difficult to know the function of a small fragment of chrysocolla found at the site, the only piece recovered. It may have occurred naturally rather than being brought in. It was found inside the rockshelter in the upper fill within the Pueblo period.

Table 41. Miscellaneous artifacts from Fallen Pine Shelter

Material Type	Artifact Type	Length (cm)	Width (cm)	Thickness (cm)	Weight (g)	Comments
Chrysocolla	Mineral	0 .5	0 .3	0.2	0 .2	Unmodified natural mineral
Limestone	Pendant	2.6	1.5	0.6	3.8	Fully modified and highly polished
Fresh water mussel shell	Ornamental fragment	1.9	1.3	0.2	0 .7	Ground along the edges
Fresh water mussel shell	Ornamental fragment	2.1	1.1	0.2	1	Fragment ground along the edges
Fresh water mussel shell	Ornamental fragment	1.4	0.7	0.1	0 .3	Sliver

Stone jewelry requires much work. Suitable materials were selected and then ground into an appropriate shape and possibly drilled for suspension (Urban 1999:212). If the material selected was hard, then the process would be lengthy and time consuming. During the Archaic period in the Mogollon Highlands, the typical jewelry consisted of "simple" artifacts like beads and pendants (Martin 1939; Martin and Rinaldo1947).

A pendant (Fig. 49d) was found on Level 5, the level at which Archaic period deposits begin. It is made of limestone that has been ground for shaping and then polished, giving the item a high sheen. It is triangular with a flat back and a concave front that has been grooved at the top. Unfortunately, it is broken here. The hole, if one was present, is missing because of the breakage.

Three freshwater mussel shells were recovered outside of the shelter in the Archaic period deposits, 320 to 350 cm below datum, all in the same grid unit but at different depths. FS 1311 (Fig. 49a) was recovered at the lower elevation and has been ground on the sides for shaping; however, the shell apparently broke and was discarded. FS 1306 contained two small fragments of shell; one is larger than the other and exhibited grinding along the edges (Fig. 49b). The other fragment was a thin sliver of shell that did not exhibit any modification; however, it was a midsection fragment. It should be noted that the shell fragments do not fit together, even though they are the same type of shell.

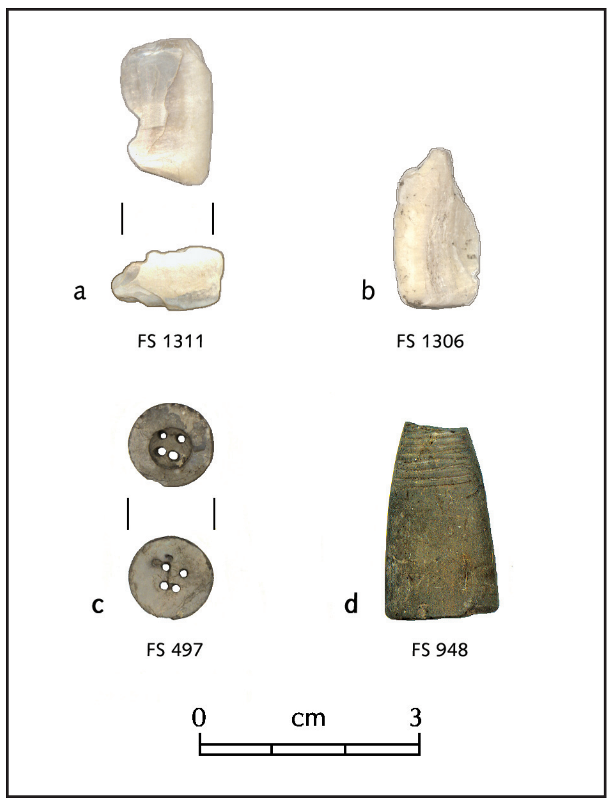

Figure 49. Miscellaneous artifacts: (a-b) freshwater mussel shell; (c) shell button; (d) limestone pendant.

It is not unusual to find fresh water mussel in this area. According to Jennings (1940:9), Lehmer (1948), Southward (1979:100-101), O'Laughlin (1981:144), Wiseman (1981:190), Kelly (1984), Wening (1992), and Woosley and McIntyre (1996:261), freshwater mussel is found throughout the Jornada Mogollon area. Local freshwater mussel shell has been found at several sites in this region and seems to have gained in popularity over time (Urban 2000). Although there is no mention of shell found at Archaic sites, most of the finds are at ceramic sites (e.g., Zamora and Oakes 2000; Woosley and McIntyre 1996; Farwell et al. 1992; Kelly 1984; Southward 1979).

There is a difference of opinion on whether or not the shell items were manufactured at the sites. Lehmer (1948) states that most of the shell ornaments were probably not locally manufactured, and there is no evidence of on-site manufacturing. Kelly (1984:267) found this to be true at the Block Outlook site, as did Woosley and McIntyre (1996:264). Southward (1979:101) postulates that there are three models for the procurement of freshwater shell: direct access for use or trade, access through trade, and a combination of the two. Southward (1979:102) also believes that at the Three Rivers site, there was no trading of shell ornaments because of the large number of unmodified mussel shell found. Kelly (1984:339, 428), however, did find evidence of manufacture at the Bonnell site. Urban (2000:183) suggests that the shell ornaments were manufactured at the Angus site because there was no imported shell present.

There is no evidence of shell trading during the Archaic period in the Jornada Mogollon. Archaic period sites in the area usually contain no trade items such as shell. Kelly (1984) states that the Jornada Mogollon area has been identified by others as a cultural backwater, and there was little personal ornamentation during the Archaic due to the remoteness and isolation of the region. It has been suggested that during the Ceramic period, trade for shell originated in Mesoamerica and spread north to the Hohokam and then along the Gila River into the Mimbres Mogollon area (Haury 1936b; Woosley and McIntyre 1996:263).

From the upper level of the fill inside the rockshelter, a four-hole shell button was recovered. A C-14 date of 1870 ± 80 was assigned to this level. Shell buttons were being manufactured by around 1850 and are still used today. The button could be from a shirt or blouse during this time period. It is possible that the button belonged to a Mescalero Apache that was in the rockshelter at one time or it could be from someone else camping in the shelter. The button is in fairly good condition, but it is starting to loose some of its outer material. The holes in the front of the button look uniform; however, on the back of the button, the holes are not uniform (Fig. 49c).

CHANGING PATTERNS OF ANIMAL USE AT FALLEN PINE SHELTER

Nancy J. Akins

Just over a thousand animal bones were recovered from excavations at LA 110339. They come from at least three cultural periods with a hint of late, possibly Mescalero Apache use. The sample is not evenly distributed and is mainly from the Archaic period. However, the data suggests a consistent but declining use of deer from early to late and considerable use of turkeys in the earlier Ceramic period deposits. The primary goal of the faunal report is to document changes in how the groups occupying the shelter used this locale and to relate these changes to broader patterns of mobility and subsistence in the region.

Methods

Deposits inside the shelter were screened with 1/8-inch mesh, while those outside were screened with 1/4-inch mesh. A single bone was retrieved from a flotation sample before this report was completed. Ultimately, three additional flotation samples yielded fauna that are not included in any of the discussions or the tables. Two of the samples are from features, and the fauna recovered are described in the feature section of this report. The other sample was from beneath a metate, where a single, small, scorched rodent caudal vertebra was found.

Most of the sample consists of small fragments of artiodactyl bone, the majority of which could not be identified beyond the level of medium artiodactyl (55.3 percent). All of the bone collected was analyzed. Specimens were identified using the Office of Archaeological Studies comparative collection. Recording follows the established OAS computer coded format that identifies the animal and body part represented, how and if the animal and part were processed for consumption or another use, and how taphonomic and environmental conditions have affected the specimen.

Provenience-Related Variables

Provenience and stratigraphic information is linked to the data file through the field specimen (FS) number. Each line contains the north and east coordinates of the grid, the level, the starting and ending depths, feature designation when applicable, and an assessment of the chronological group to which the specimen belongs. A lot number identifies a specimen or group of specimens that fit the description recorded in that line, and the count indicates how many specimens are described by that line of data. Bones broken into a number of pieces during excavation or cleaning are counted as a single specimen.

Taxon

Taxonomic identifications are made to the most specific level possible. When an identification is less than certain, this is indicated in the certainty variable. Specimens that cannot be identified to the species, family, or order are assigned to a range of indeterminate categories based on the size of the animal and whether it is a mammal, bird, other animal, or cannot be determined. Unidentifiable fragments often constitute the bulk of a faunal assemblage. Identifying these as precisely as possible supplements the information gained from the identified taxa.

Much of the bone from LA 110339 could be identified only as medium artiodactyl, that is, artiodactyls the size of a deer, pronghorn, or bighorn sheep. Assignment of a bone to this taxon was primarily based on the relative size, density, and morphology of the individual specimen, as well as a lack of indications for any other animals in this size group in this assemblage. Some specimens are so small and eroded that even the size of the animal is uncertain. These were assigned to the more ambiguous medium-to-large and large-mammal categories.

Element (Body Part)

The skeletal element (e.g., cranium, mandible, humerus) is identified then described by side, age, and the portion recovered. Side is recorded for the element itself or for the portion recovered when it is axial, such as the left transverse process of a lumbar vertebra. Age is estimated at a general level as fetal or neonate, immature (up to two-thirds mature size), young adult (near or full size with unfused epiphysis or young-textured bone), and apparently mature. The criteria used to assign the age is also recorded—generally, the size, epiphysis closure, or whether the texture of the bone is compact as in mature animals or porous as in less than mature animals. Aging based on texture alone is not absolute, since most growth in mammals takes place near the articular ends. Diaphyseal bone can be compact and dense while the bone near an end retains a roughened or trabecular structure (Reitz and Wing 1999:73). As a result, fragments from the same bone can be coded as different ages, and the number of juvenile bones is probably too low. The portion of the skeletal element represented by a specimen is recorded for estimating the number of individuals represented in an assemblage and to help discern patterns related to processing.

Completeness

Completeness refers to how much of that skeletal element is represented by the specimen (analytically complete, more than 75 percent complete but not analytically complete, between 50 and 75 percent complete, between 25 and 50 percent, or less than 25 percent complete). Completeness is used in conjunction with the portion represented to estimate the number of individuals present. It also provides information on whether a species was intrusive and on processing, environmental deterioration, animal activity, and thermal fragmentation.

Taphonomic Variables

Taphonomy, or the study of preservation processes and how these affect the information obtained, has the goal of identifying and evaluating at least some of the nonhuman processes affecting the condition and frequencies found in a faunal assemblage (Lyman 1994:1). Taphonomic processes monitored in this analysis include environmental, animal, and some types of burning. Environmental alteration is recorded as degrees (light, medium, and heavy) of pitting or corrosion from soil conditions, sun bleaching from extended exposure, checking or exfoliation from exposure or soil conditions, root etching from the acids excreted by roots, polish, or rounding from sediment movement, a fresh or greasy look, and damage caused by the soil or minerals. In this assemblage, mineral deposits often caused considerable pitting and sometimes dissolved parts of the surface or ends of bones. When more than one process affected a specimen, as often was the case, the one that did the greater damage was recorded.

Animal alteration is recorded by source or probable source and where it occurs on the specimen. Choices include carnivore gnawing, punctures, and crushing, scatological or probable scat, rodent gnawing, and altered but the agent is uncertain. The probable scat has rounding on the edges, and portions of the inner and outer tables can be partially dissolved. Much of the LA 110339 bone is so damaged by environmental conditions that some carnivore and rodent damage could have gone undetected.

Burning

Burning, when it occurs after burial, is also a taphonomic process. Furthermore, burning influences the preservation and completeness of individual bones. Heavily burned bone is friable and tends to break more easily than unburned bone (Lyman 1994:389-391; Stiner et al. 1995:223).

Burning can occur as part of the cooking process, part of the disposal process when bone is used as fuel or discarded into a fire, or after burial. The color, location, and presence of crackling, exfoliation, or caramelization were recorded. Burn color is a gage of burn intensity. A light brown, reddish, or yellow color or scorch occurs when bones are lightly heated; charred or blackened bone becomes black as the collagen is carbonized; and when the carbon is oxidized, it becomes white, or calcined (Lyman 1994:384-388). Burns can be graded, reflecting the thickness of the flesh protecting portions of the bone. Dry burns are light on the surface and black at the core or blackened on only the exterior or interior, indicating the burn occurred after disposal, when the bone was dry. Graded or partial burns can indicate a particular cooking process, generally roasting, while complete charring or calcined bone does not. Uniform degrees of burning are possible only after the flesh has been removed (Lyman 1994:387) and generally indicates a disposal practice. Potential boiling is recorded in a separate variable as brown and rounded, brown with no rounding, rounded only, waxy, and brown and waxy. Most bone in this assemblage was far too eroded and damaged to display these characteristics.

A fairly large proportion of this assemblage is burned. Much of the burning does not fit the usual models for burning; rather, it falls between a scorch and a heavy burn but is closer to heavy. Exteriors are brown to black and occasionally mottled, but the core of the bone is lighter in color, ranging from an orange brown (similar to a scorch) to a near black. Classic dry burns are the opposite, tan or brown on the exterior from lack of collagen but black at the core, where some collagen was retained. Since the outer surface has the more intense burn, these burns are most likely an intermediate stage between a scorch caused by roasting and a heavy or discard burn. Determining burn intensity was further complicated by dark brown environmental and charcoal staining on the surfaces of the unburned bone. Determining the type of burn, and often whether the bone is burned at all, required breaking a small piece off of most bones so that the core and burn depth could be observed.

Butchering and Processing

Evidence of butchering was recorded as cuts, grooves, chops, abrasions, saws, scrapes, peels, percussion pits and stria, and a variety of breaks. The location of these on the element was also recorded. A conservative approach was taken to recording marks and fractures that could indicate processing animals for food, tools, or hides, since many natural processes result in similar marks and fractures. Spiral fractures were recorded based on morphology, but they can be caused by other factors that occur well after discard. Impacts require some indication of an impact, generally flake scars or evidence of percussion. Impacts were not recorded when they were ambiguous or accompanied by carnivore gnawing. Again, the condition of the bone in this assemblage either obscured or destroyed much of the evidence of processing—well illustrated by the general lack of forms other than spiral breaks.

Modification

Tools or ornaments, manufacturing debris, utilized bone, possible modification, and pigment stains are recorded as examples of modification. The tools and bone ornaments are described in a separate section of this report. Worked bone in the lower levels may have been altered to the extent that they could not be recognized as such.

Data Analysis

Once the data was entered and checked, the provenience and chronological information was added. Data were tabulated and analyzed using SPSS (PC version 10.1).

Taxa Recovered

Most of the assemblage is artiodactyl (Table 42), particularly medium artiodactyl and deer. Few species of rodent, a few rabbits, a good range of carnivores, considerable turkey, and few other bird bones complete the assemblage. This section considers the taxa in terms of ecological distribution and habits along with specific information on temporal distribution, parts found, age, taphonomy, and processing.

Table 42. Taxa recovered from LA 110339

Taxon	Common Name or Description	No.	%
Small mammal, medium to large bird	Rabbit to turkey size	35	3.4%
Small mammal	Jackrabbit or smaller	4	0.4%
Small to medium mammal	Coyote or smaller	9	0.9%
Medium to large mammal	Coyote to deer size	72	7.0%
Large mammal	Wolf or larger	28	2.7%
Cynomys ludovicianus	Black-tailed prairie dog	14	1.4%
Thomomys bottae	Botta's pocket gopher	1	0.1%
Neotoma sp.	Woodrat	18	1.7%
Neotoma albigula	White-throated woodrat	1	0.1%
Sylvilagus sp.	Cottontail rabbit	17	1.6%
Lepus californicus	Black-tailed jack rabbit	4	0.4%
Medium carnivore	Dog- or coyote-sized carnivore	3	0.3%
Canis sp.	Dog or coyote	1	0.1%
Canis latrans	Coyote	4	0.4%
cf. *Canis familiaris*	Dog	1	0.1%
Urocyon cinereoargenteus	Gray fox	2	0.2%
Taxidea taxus	Badger	1	0.1%
cf. *Mephitis mephitis*	Striped skunk	16	1.5%
Felis rufus	Bobcat	3	0.3%
Small to medium artiodactyl	Sheep- to deer-sized artiodactyl	4	0.4%
Medium artiodactyl	Deer, pronghorn, bighorn size	570	55.2%
Odocoileus sp.	Deer	117	11.3%
Ovis or *Capra*	Domestic sheep or goat	1	0.1%
Large bird	Hawk or larger	50	4.8%
Meleagris gallopavo	Turkey	54	5.2%
Bubo virginianus	Great horned owl	2	0.2%
cf. Icteridae	Meadowlarks, blackbirds, orioles	1	0.1%
Total		1033	100.0%

Indeterminate Specimens

Relatively few specimens are completely unidentifiable (14.3 percent). This is mainly because most of the bones are clearly from large animals and are consistent with the texture and structure of artiodactyl bone and so were placed in one of the artiodactyl categories (67.0 percent). Few bones from small animals were recovered, and many are complete enough that they could be identified with a higher level of certainty. When small fragments were found, the condition of the bone often precluded distinguishing small- and medium-mammal from large-bird bones. The largest of the indeterminate categories, medium-to-large mammal (Table 43), are small, very eroded pieces in which the size is not clear, pieces that do not look like artiodactyl bones, or pieces from immature animals that could be young artiodactyls or one of the larger carnivores. Most of the unidentifiable bones are fragments of long bones (85.8 percent overall) or flat bones (6.8 percent); few are identifiable elements (five cranial and six rib fragments).

The proportion of the various indeterminate categories varies by time group and somewhat by location within and outside the shelter (Table 43). Most noteworthy, the early ceramic assemblage has proportionately more bone that is either small mammal or large bird, as well as the most turkey. Little small mammal or small to medium mammal is found in any assemblage. Nearly all of the unidentifiable bones are small fragments, and a fair number are burned (Table 43). Burning tends to be on the heavy side (moderate to calcined), with few that are only lightly or dry burned. Most have some degree of environmental alteration.

Small Mammals

Prairie dogs. Black-tailed prairie dog (*Cynomys ludovicianus*) bones are nearly as common as those from cottontail rabbits and woodrats (Table 44). This species prefers grassy slopes in open valleys, especially the elevated and more open margins of valleys. In higher mountain areas, prairie dogs may hibernate or at least den up during part of the winter (Bailey 1971:123-125).

Of the specimens recovered, half come from Archaic deposits, and the rest were scattered throughout the ceramic-bearing levels. If treated as a single sample, three prairie dogs are indicated by the element distribution, one juvenile and two mature. When broken down

Table 43. Indeterminate faunal remains

	Small Mammal, Medium to Large Bird (35)		Small Mammal (4)		Small-Medium Mammal (9)		Medium to Large Mammal (72)		Large Mammal (28)		Total
	No.	Row %	No.	Row %	No.	Row %	No.	Row %	No.	Row %	
Time Period											
Late Ceramic	1	12.5%	1	12.5%	-	-	4	50.0%	2	25.0%	8
Mixed Ceramic	3	18.8%	-	-	2	12.5%	10	62.5%	1	6.3%	16
Early Ceramic	12	37.5%	3	9.4%	1	3.1%	11	34.4%	5	15.6%	32
Archaic (shelter)	6	24.0%	-	-	2	8.0%	13	52.0%	4	16.0%	25
Archaic (talus)	13	19.4%	-	-	4	6.0%	34	50.7%	16	23.9%	67
Total	35	23.6%	4	2.7%	9	6.1%	72	48.6%	28	18.9%	148
	No.	Column %	No.	Column %	No.	Column %	No.	Column %	No.	Column %	
Age											
Fetal, neonate	-	-	-	-	-	-	-	-	1	3.6%	1
Immature	-	-	-	-	-	-	8	11.1%	-	-	8
Juvenile	-	-	-	-	2	22.2%	13	18.1%	-	-	15
Mature	35	100.0%	4	100.0%	7	77.8%	51	70.8%	27		124
Completeness											
25-50% complete	1	2.9%	1	25.0%	-	-	-	-	-	-	2
<25% complete	34	97.1%	3	75.0%	9	100.0%	72	100.0%	28	100.0%	146
Burning											
Unburned	19	54.3%	1	25.0%	7	77.8%	47	65.3%	22	78.6%	96
Light/scorch	1	2.9%	-	-	-	-	-	-	-	-	1
Light to heavy	1	2.9%	-	-	-	-	1	1.4%	-	-	2
Dry burn	-	-	-	-	1	11.1%	1	1.4%	-	-	2
Moderate or brown	6	17.1%	1	25.0%	-	-	9	12.5%	4	14.3%	20
Heavy or black	-	-	-	-	-	-	10	13.9%	-	-	10
Light to calcined	-	-	-	-	-	-	1	1.4%	-	-	1
Heavy to calcined	2	5.7%	-	-	-	-	1	1.4%	-	-	3
Calcined	6	17.1%	2	50.0%	1	11.1%	2	2.8%	2	7.1%	13
Environmental Alteration											
None	11	31.4%	4	100.0%	2	22.2%	16	22.2%	7	25.0%	40
Pitting/corrosion	11	31.4%	-	-	2	22.2%	24	33.3%	15	53.6%	52
Checked/exfoliated	1	2.9%	-	-	2	22.2%	11	15.3%	1	3.6%	15
Root-etched	4	11.4%	-	-	-	-	11	15.3%	3	10.7%	18
Precipitate damage	8	22.9%	-	-	3	33.3%	10	13.9%	2	7.1%	23

Table 44. Rodent and rabbit remains

	Black-tailed Prairie Dog		Botta's Pocket Gopher		Woodrats		Desert Cottontail		Black-tailed Jackrabbit		Total
	No.	Row %	No.	Row %	No.	Row %	No.	Row %	No.	Row %	
Time Period											
Late Ceramic	1	4.3%	-	-	16	69.6%	5	21.7%	1	4.3%	23
Mixed Ceramic	3	37.5%	1	12.5%	1	12.5%	3	37.5%	-	-	8
Early Ceramic	3	23.1%	-	-	2	15.4%	7	53.8%	1	7.7%	13
Archaic (shelter)	2	66.7%	-	-	-	-	1	33.3%	-	-	3
Archaic (talus)	5	62.5%	-	-	-	-	1	12.5%	2	-	8
Total	14	25.5%	1	1.8%	19	34.5%	17	30.9%	4	7.3%	55
	No.	Column %	No.	Column %	No.	Column %	No.	Column %	No.	Column %	
Age											
Immature	-	-	-	-	-	-	1	5.9%	-	-	1
Juvenile	1	7.1%	-	-	11	57.9%	-	-	-	-	12
Mature	13	92.9%	1	100.0%	8	42.1%	16	94.1%	4	100.0%	42
Completeness											
Complete	-	-	1	100.0%	11	57.9%	1	5.9%	-	-	13
>75% complete	3	21.4%	-	-	6	31.6%	1	5.9%	1	25.0%	11
50-75% complete	6	42.9%	-	-	-	-	5	29.4%	-	-	11
25-50% complete	3	21.4%	-	-	2	10.5%	5	29.4%	1	25.0%	11
<25% complete	2	14.3%	-	-	-	-	5	29.4%	2	50.0%	9
Burning											
Unburned	10	71.4%	1	100.0%	14	73.7%	10	58.8%	1	25.0%	36
Light/scorch	1	7.1%	-	-	1	5.3%	3	17.6%	3	75.0%	8
Moderate or brown	2	14.3%	-	-	-	-	1	5.9%	-	-	3
Light to heavy	1	7.1%	-	-	-	-	-	-	-	-	1
Heavy or black	-	-	-	-	4	21.1%	1	5.9%	-	-	5
Calcined	-	-	-	-	-	-	2	11.8%	-	-	2
Environmental Alteration											
None	3	21.4%	1	100.0%	16	84.2%	6	35.3%	2	50.0%	28
Pitting/corrosion	5	35.7%	-	-	-	-	2	11.8%	2	50.0%	9
Checked/exfoliated	-	-	-	-	1	5.3%	1	5.9%	-	-	2
Root-etched	1	7.1%	-	-	2	10.5%	2	11.8%	-	-	5
Precipitate damage	5	35.7%	-	-	-	-	6	35.3%	-	-	11

by time group, the number of individuals increases to five or six. Burned bone is found in the early ceramic and Archaic deposits, a graded burn suggests roasting or moderate or heavy burning, indicating burning as part of a discard process. Elements are all cranial (n = 4), innominate (n = 2), front limb (n = 4), or hind limb (n = 4). Complete or near-complete (more than half of the element) bones are typical of the Ceramic period prairie dog parts (six of seven), while more of those from Archaic deposits are fragmentary (four of seven are represented by less than half of the element). None have evidence of processing. Burned and fragmented bone indicates prairie dogs were used for food during the Archaic period. Burned but more complete bone in the Ceramic period assemblage suggest some, but not necessarily all, were food items left by humans.

Pocket gopher. A single complete pocket gopher (*Thomomys bottae*) femur was found in the mixed Ceramic period deposits in the talus outside the shelter. Botta's pocket gophers are widespread, inhabiting almost any habitat west of the eastern plains where there is suitable soil (Findley et al. 1975:144). Soil in the talus slope in front of the shelter would be suitable for this species to burrow and feed. Most pocket gopher parts are lost in 1/4-inch screening.

Woodrats. Woodrat is the most common rodent taxon. Most are not identifiable to a particular species, but one mandible retains the teeth and indicates that some or all are from a white-throated woodrat (*Neotoma albigula*). The Mexican woodrat (*Neotoma mexicana*), another possibility, is about the same size. The white-throated woodrat utilizes clefts and shallow caves to build nests of just about anything that can be transported and piled. Houses often consist of several rooms or nest cavities filled with finely shredded bark or soft plant fibers. Other rooms may be filled with food (Bailey 1971:175-178). Mexican woodrats have a much more limited distribution and prefer bare cliffs and rock slides mainly in forested areas. They, too, carry masses of sticks, bark, bone, stone, and rubbish into corners and entrances of caves (Bailey 1971:182-183). Having sampled woodrat flesh, Bailey described it as tender and of excellent flavor and as a popular game animal for many Native American groups (Bailey 1971:171).

Most of the woodrat bones were recovered from the upper levels of fill within the shelter, which is not surprising, because a woodrat still lived in the shelter until it was excavated. Based on element distribution, at least four juveniles and possibly one mature individual were found. Because most (16 of 19) are from late ceramic deposits, the number of individuals increases by only two each time grouping is considered separately. A variety of body parts was recovered, including cranial (n = 5), a cervical vertebra, innominates (n = 2), humeri (n = 5), femurs (n = 5), and a tibia. Again, most woodrat parts would not be recovered by 1/4-inch screen, which may account for its absence from the Archaic and near absence from the mixed ceramic assemblages. Low numbers in the early ceramic assemblage may be significant, because these deposits were screened through finer mesh.

Many of the woodrat bones are from juveniles, that is, full-sized individuals with unfused epiphyses. Most are complete or nearly so, and none are fragmentary (Table 44). When the bones were burned, the burns were usually heavy, but one element from the late ceramic deposits has a light scorch that could represent an accidental burn, roasting, or discard into a warm fire pit. None of the woodrat bones have evidence of processing.

Half of the rodent gnawing observed in this assemblage is from late Ceramic period deposits, where they occur on skunk (n = 1), medium artiodactyl (n = 2), and deer (n = 3) specimens. A single large mammal bone from the early ceramic deposits and a deer specimen from Archaic deposits inside the shelter are gnawed. Outside the shelter, a cottontail, a small to medium artiodactyl, and two deer specimens from mixed ceramic deposits are also gnawed. Much of the gnawing, more of which could have been obscured by the environmental damage to many specimens, probably reflects use of the shelter by woodrats during later prehistoric and historic times.

Rabbits. Biologists generally consider the cottontails living in piñon-juniper woodlands and below to be desert cottontails (*Sylvilagus audubonii*) and the cottontails from mid-woodlands and upward to be Eastern cottontails (*Sylvilagus floridanus*). They do not yet know whether these are biological species or morphological responses to different ecological conditions (Findley et al. 1975:83). The cottontail bones recovered from this site are considered *Sylvilagus* sp., especially since humans or wide-ranging carnivores and raptors could have deposited one or both species in the shelter. The only jackrabbit species found in this part of the state is the black-tailed jackrabbit (*Lepus californicus*), which is generally found below the ponderosa forest zone and occasionally within open ponderosa forests (Findley et al. 1975:93).

Few rabbit remains were recovered, but many have evidence they were left by humans. More ceramic than Archaic rabbit deposits were found within the shelter. If treated as a single sample, the element distribution indicates two mature and an immature cottontail rabbit. When broken down by time period, only one of the assemblages has more than a single rabbit, the late ceramic deposits: one mature and one immature rabbit. Cottontail rabbit parts are cranial (n = 3), scapula (n = 4), innominate (n = 3), humerus (n = 1), femur (n = 2), and tibia (n = 4). Elements tend to be fragmentary or represented by less than a quarter of the element (Table 44), more so in the late ceramic (40 percent) and early ceramic (42.9 percent) deposits. Burning is more frequent and more varied in the late and early ceramic deposits. Neither of the Archaic deposit cottontail rabbit bones is burned, and only one from the mixed ceramic deposits is lightly scorched. The only possible processing is a spiral break on a tibia from early Ceramic period deposits.

Jackrabbit remains are far less common. No more than one mature individual is indicated by the part distribution, but this number increases to three when each temporal assemblage is considered separately. Jackrabbit bones tend to be fragmentary (Table 44), and all but one are lightly scorched, suggesting incidental burning or roasting. One of the jackrabbit bones, a bone bead, was probably brought to the site in that form and lost. It was recovered from the uppermost part of the Archaic deposits in the talus.

Carnivores

In addition to a few pieces of bone from medium-sized carnivores, a variety of species were identified. The medium carnivore elements include a partial segment of a sternum and shaft fragments of a rib and a radius. None are burned, and they range from partial to fragmentary (Table 45). Evidence of carnivores inhabiting or using the shelter is fairly sparse. Only 17 specimens have visible traces of carnivore crunching, puncturing, or gnawing; another four could be scatological; and a skunk cranium is altered in an unusual manner that may be human or carnivore alteration. Most are from inside the shelter (18 of 22) and the late Ceramic period deposits (15 of 22). A variety of taxa are involved (Table 46). Bobcat and skunk have the greatest amounts.

Canids. Coyotes (*Canis latrans*) and dogs (*Canis familiaris*) lived throughout the prehistoric Southwest. Similarities between the two make the distinction difficult when the parts are fragmentary. Dogs were domesticated at least 10,000 years ago and came to the New World with humans. Evidence of dogs dating to about 2,000 B.C. was found in Ventana Cave (Schwartz 1997:16, 87).

The specimen identifiable only as dog or coyote is a partial mandibular canine that could be from either species. It is from Archaic deposits and unburned (Table

Table 45. Carnivore remains

	Medium Carnivore		Dog or Coyote		Coyote		Dog		Gray Fox		Badger		Striped Skunk		Bobcat	
	No.	Row %	No.	Row %	No.	Row %	No.	Row %	No.	Row %	No.	Row %	No.	Row %	No.	Row %
Time Period																
Late Ceramic	2	14.3%	-	-	1	7.1%	1	7.1%	-	-	-	-	9	64.3%	1	7.1%
Mixed Ceramic	-	-	-	-	1	50.0%	-	-	-	-	-	-	1	50.0%	-	-
Early Ceramic	-	-	-	-	-	-	-	-	2	25.0%	-	-	5	62.5%	1	12.5%
Archaic (shelter)	1	25.0%	1	25.0%	-	-	-	-	-	-	-	-	1	25.0%	1	25.0%
Archaic (talus)	-	-	-	-	2	66.7%	-	-	-	-	1	33.3%	-	-	-	-
Total	3	9.7%	1	3.2%	4	12.9%	1	3.2%	2	6.5%	1	3.2%	16	51.6%	3	9.7%
	No.	Column %	No.	Column %	No.	Column %	No.	Column %	No.	Column %	No.	Column %	No.	Column %	No.	Column %
Age																
Juvenile	-	-	-	-	-	-	-	-	-	-	-	-	1	6.3%	-	-
Mature	3	100.0%	1	100.0%	4	100.0%	1	100.0%	2	100.0%	1	100.0%	15	93.8%	3	100.0%
Completeness															-	-
Complete	-	-	-	-	-	-	1	25.0%	-	-	-	-	2	12.5%	1	33.3%
>75% complete	-	-	1	100.0%	1	25.0%	-	-	1	50.0%	-	-	11	68.8%	1	33.3%
50-75% complete	2	66.7%	-	-	-	-	-	-	-	-	-	-	3	18.8%	-	-
25-50% complete	-	-	-	-	1	25.0%	-	-	-	-	-	-	-	-	1	33.3%
<25% complete	1	33.3%	-	-	2	50.0%	-	-	1	50.0%	1	100.0%	-	-	-	-
Burning																
Unburned	3	100.0%	1	100.0%	3	75.0%	1	100.0%	2	100.0%	-	-	14	87.5%	3	100.0%
Dry burn	-	-	-	-	-	-	-	-	-	-	1	100.0%	-	-	-	-
Heavy or black	-	-	-	-	1	25.0%	-	-	-	-	-	-	-	-	-	-
Calcined	-	-	-	-	-	-	-	-	-	-	-	-	2	12.5%	-	-
Environmental Alteration																
None	1	33.3%	-	-	1	25.0%	-	-	-	-	-	-	11	68.8%	2	66.7%
Pitting/corrosion	1	33.3%	-	-	1	25.0%	-	-	-	-	1	100.0%	1	6.3%	1	33.3%
Checked/exfoliated	1	33.3%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Fresh/greasy	-	-	-	-	-	-	1	100.0%	-	-	-	-	-	-	-	-
Precipitate damage	-	-	1	100.0%	2	50.0%	-	-	2	100.0%	-	-	4	25.0%	-	-

Table 46. Animal alteration

	Carnivore Gnawing	Carnivore Tooth Puncture	Carnivore Gnawing and Puncture	Scatological	Possible Scat	Agent Unknown	Carnivore and Rodent	Total
Late Ceramic								
Small mammal	-	-	-	1	-	-	-	1
Medium carnivore	1	-	-	-	-	-	-	1
Coyote	1	-	-	-	-	-	-	1
Striped skunk	1	1	-	-	1	1	-	4
Bobcat	-	-	-	1	-	-	-	1
Medium artiodactyl	1	3	2	-	-	-	1	7
Total	4	4	2	2	1	1	1	15
Mixed Ceramic								
Medium artiodactyl	-	-	-	-	-	1	-	1
Total	-	-	-	-	-	1	-	1
Early Ceramic								
Bobcat	-	-	-	-	1	-	-	1
Medium artiodactyl	-	-	-	-	-	1	-	1
Turkey	-	-	1	-	-	-	-	1
Total	0	0	1	0	1	1	0	3
Archaic								
Small mammal/ medium-large bird	1	-	-	-	-	-	-	1
Deer	-	2	-	-	-	-	-	2
Total	1	2	0	0	0	0	0	3

45). The possible dog element is a complete rib that looks more like dog than any other animal in that size range. However, it is more gracile than prehistoric dogs and could be from a modern breed, especially since it was recovered from the first level of fill in the back of the shelter and could have been part of a road kill collected by the resident woodrats. The coyote parts include much of a burned mandibular carnassial from mixed ceramic deposits, a tibia from early ceramic deposits, and a nearly complete radius and most of an ulna shaft from the same Archaic-level grid and probably the same individual.

The gray fox (*Urocyon cinereoargenteus*) is found throughout the state but is most abundant in the Upper Sonoran Zone. They are most often found in foothill regions with pines and junipers among cliffs and canyons, where they den in cavities (Bailey 1971:301). The parts, a fragment of a maxilla and a badly eroded but complete mandible, are from adjacent grids and overlapping elevations, suggesting a single individual.

Mustelids. Badger and skunk remains were recovered. Badgers (*Taxidea taxus*) are most common in lower-altitude grasslands but are also found in non-forested areas such as alpine meadows. They often occur near burrowing rodents (Findley et al. 1975:308). The single badger specimen is a dry-burned partial mandible found in Archaic talus deposits.

The skunk remains from LA 110339 could be stripped skunk (*Mephitis mephitis*) or western spotted skunk (*Spilogale gracilis*). Bones of the two are quite similar, but the teeth in a maxilla and mandible are closer to those of a striped skunk, so all were tentatively identified as this species. Striped skunks, the more common species, range from low elevations to higher mountains. Western spotted skunks live in rocky and brushy areas from desert to woodland environs (Findley et. al. 1975:310-311). Skunks subsist mainly on small rodents and insects. They become fat in fall and probably hibernate during the cold part of winter in the higher parts of the state. Many consider the flesh tender, rich, and flavorful (Bailey 1971:331-332).

Skunk parts are fairly common and occur in all of the deposits. The upper shelter or late ceramic assemblage contains the greatest number and proportion. If treated as a single sample, two mature individuals are suggested by mandibles, humeri, and tibiae, and a juvenile by a complete but less than full-sized scapula. Divided into temporal groups, the number increases to five: four mature and one that may be more of a juvenile. Parts in the late ceramic deposits are from a fairly restricted area (102-104N 98-99E, 150-180 cm bd) and could be from the same skunk (a cranium, both mandibles, a lumbar vertebra, humerus, radius, femur, tibia, and astragalus). None are burned, but the essentially complete cranium has a hole broken in the side, probably to remove the brain, with no evidence that this was done by carnivore gnawing or opposing punctures. The brain could have been removed and possibly consumed, or it could have been removed and the skin used still containing the cranium and mandibles. A single unburned tibia was recovered from the mixed ceramic deposits of the talus. It is from a different individual from that in the late ceramic deposits. Early ceramic skunk elements include a mandible, a scapula, an innominate, and portions of two left humeri. All were found in Grids 101N 97-98E at elevations ranging from 200 to 266 cm bd. The mandible and one humerus are calcined, and the mandible has a snap break and peel, suggesting it may have been processed and discarded. The juvenile scapula was found in Archaic deposits within the shelter.

Bobcat. Bobcats (*Felis rufus*) are found in most habitats, including those within the Lincoln National Forest and at Ruidoso (Findley et al. 1975:320-321). The parts recovered include a metacarpal, a metatarsal, and a second phalanx, each from a separate temporal group. All are from inside the shelter and from two grids. The early and late Ceramic period specimens are from the same grid and adjacent levels and could be from the same animal. Those from the Archaic deposits are from an adjacent grid but at least 25 cm deeper. None of the bobcat bones are burned (Table 46), and only the phalanx is complete.

Artiodactyls

Most of the artiodactyl bones are deer or the size of deer (Table 47). The exceptions include a complete cervical vertebra from a domestic sheep or goat in the upper fill of the talus (96N 97E, 230-240 cm bd). It is

Table 47. Artiodactyl bone

	Small-Medium Artiodactyl		Medium Artiodactyl		Deer		Domestic Sheep or Goat		Total
	No.	Row %	No.	Row %	No.	Row %	No.	Row %	
Time Period									
Late Ceramic	1	1.7%	43	71.7%	16	26.7%	-	-	60
Mixed Ceramic	3	2.8%	81	75.7%	22	20.6%	1		107
Early Ceramic	-	-	138	80.2%	34	19.8%	-	-	172
Archaic (shelter)	-	-	107	87.7%	15	12.3%	-	-	122
Archaic (talus)	-	-	200	87.0%	30	13.0%	-	-	230
Total	4	0.6%	569	82.3%	117	16.9%	1	0.1%	691
	No.	Column %	No.	Column %	No.	Column %	No.	Column %	
Age									
Fetal, neonate	-	-	1	0.2%	1	0.9%	-	-	2
Immature	1	25.0%	3	0.5%	1	0.9%	-	-	5
Juvenile	-	-	38	6.7%	13	11.1%	-	-	51
Mature	3	75.0%	528	92.8%	102	87.2%	1	100.0%	634
Completeness									
Complete	-	-	-	-	5	4.3%	-	-	5
>75% complete	-	-	1	0.2%	4	3.4%	1	100.0%	6
50-75% complete	-	-	-	-	5	4.3%	-	-	5
25-50% complete	1	25.0%	2	0.4%	11	9.4%	-	-	14
<25% complete	3	75.0%	567	99.6%	92	78.6%	-	-	662
Burning									
Unburned	2	50.0%	359	63.1%	86	73.5%	1	100.0%	448
Light/scorch	-	-	11	1.9%	3	2.6%	-	-	14
Light to heavy	-	-	10	1.8%	7	6.0%	-	-	17
Dry burn	-	-	11	1.9%		0.0%	-	-	11
Moderate or brown	-	-	84	14.8%	10	8.5%	-	-	94
Heavy or black	2	50.0%	52	9.1%	2	1.7%	-	-	56
Light to calcined	-	-	4	0.7%	3	2.6%	-	-	7
Heavy to calcined	-	-	10	1.8%	2	1.7%	-	-	12
Calcined	-	-	29	5.1%	4	3.4%	-	-	33
Environmental Alteration									
None	2	50.0%	145	27.5%	19	16.2%	-	-	166
Pitting/corrosion	-	-	225	42.6%	44	37.6%	-	-	269
Checked/exfoliated	1	25.0%	55	10.4%	11	9.4%	1	100.0%	68
Root-etched	-	-	51	9.7%	18	15.4%	-	-	69
Polished/rounded	-	-	4	0.8%	1	0.9%	-	-	5
Precipitate damage	1	25.0%	90	17.0%	23	19.7%	-	-	114
Adhering tissue	-	-	-	-	1	0.9%	-	-	1

checked and has no evidence of processing or burning. Also coded as artiodactyl but possibly smaller than deer are four specimens that could be from small or medium artiodactyls. Three are from mixed ceramic deposits in the talus, and two are quite deep, suggesting they are probably not from the domesticates. These include an unburned long-bone shaft fragment, a heavily burned rib shaft fragment from an immature individual, and an unburned rib shaft fragment from a mature individual. The other specimen, from near the back of the shelter in late ceramic deposits, is a heavily burned rib shaft fragment that could be prehistoric or historic.

Medium artiodactyl. Artiodactyl bones identifiable only as the size of deer, pronghorn, or bighorn are the most common taxon in the assemblage. Most are long-bone (74.2 percent) or rib (9.1 percent) fragments, but a variety of other parts were found. Relative to deer, more of the Archaic assemblage is medium artiodactyl. Most are from mature individuals, with few from fetal or newborn, immature, and juvenile artiodactyls (Table 47). Nearly all are fragmentary, and a considerable number are burned—mainly moderate or heavy burns.

Deer. Deer are by far the most numerous of the animals identified. According to species distribution maps (Bailey1971:29, 35; Findley et al.1975:329, 331), the ranges of the mule deer (*Odocoileus hemionus*) and white-tailed deer (*Odocoileus virginianus*) overlap in the Sacramento Mountains and Tularosa Basin. Mule deer are fairly common in the Sacramento Mountains, where they often grow to very large sizes (Bailey 1971:31). The subspecies of white-tailed deer that inhabits the Sacramento Mountains (*Odocoileus virginianus texicanus*) is about the size of mule deer (Lang 1957:20-21). Historically, the white-tail deer inhabited the east slope of the Sacramento Mountains, favoring stream valleys and gulches (Bailey 1971:33-34). In areas where the two species overlap, white-tails favor more rugged terrain (Findley et al. 1975:330).

The Mescalero Apaches preferred the mule deer to the white-tailed deer. Groups of hunters and their families established base camps, and hunters ranged out alone or in small groups. Deer were butchered at the kill site (Dart 1980:39).

Deer specimens recovered from LA 110339 range from fetal or newborn to mature; the vast majority are mature (Table 47). Based on elements and considered as a single sample, at least seven deer are indicated: one newborn, one immature about six months old, one juvenile, and four mature. The newborn is represented by a partial ulna and the immature by a mandibular condyle. When each temporal group is tabulated separately, the late ceramic deposits have the remains of at least one juvenile and one mature deer; the mixed ceramic deposits have at least a mature deer and possibly a juvenile; the early ceramic deposits have the most variety, with the newborn, the immature, at least one juvenile, and at least one mature deer; and the Archaic deposits produced parts of a juvenile and two mature deer.

Few of the deer elements are complete or nearly so (Table 47). The Archaic deposits contain more very fragmentary (less than 25 percent of the element) bone (84.4 percent) than the Ceramic period deposits (75.0, 81.8, and 70.6 percent, respectively). Almost a quarter of the deer bone is burned (Table 47), mainly moderate to heavy burns with a few that would suggest roasting. The proportion of burned deer bone is greatest in the late ceramic shelter assemblage (62.5 percent) and least in the mixed ceramic talus assemblage (13.6 percent).

Only 22 (18.8 percent) of the deer bones display one or more forms of processing. Cuts are relatively rare, and impact breaks are by far the most common form observed. The mixed ceramic assemblage has proportionally the most altered bone (27.3 percent), followed by the early ceramic (17.6 percent), late ceramic (12.5 percent), and the Archaic (11.1 percent) samples.

Birds

Large bird. The large bird bone is mainly small pieces of long bones (92.0 percent) that are about the size of a turkey but could not be positively identified as such. All are very fragmentary (Table 48), nearly half are burned, and two have potential evidence of processing with one impact break and one spiral break. One piece is rounded and waxy as if boiled but could also be scatological. Large bird bones are most common in assemblages that also have turkey bones, another indication that many are probably turkey.

Turkey. Turkey (*Meleagris gallopavo*) is the second most common species identified. Wild turkeys, particularly Merriam's wild turkey (*Meleagris gallopavo merriami*), are found in many mountainous areas of the state at elevations between 1,829 and 3,678 m. Ponderosa pines are an essential component of their habitat, providing a source of mast and roosting sites. Primary foods are acorns, piñon nuts, juniper berries, other nuts, grass and weed seeds, grass, and insects. Bobcats, coyotes, skunks, gray fox, bears, and raccoons all prey on wild turkeys (BISON n.d.; Ligon 1961:102-103).

Recovered body parts are mainly wing and leg elements. Single mandible and innominate fragments are the only exceptions. Only one specimen is from a less than mature bird, and both male and female birds are present. This species is found in all of the temporal components but is far more prevalent in the early and mixed ceramic assemblages. When treated as a single sample and the sex of the bird (based on the presence and size of the spur on the tarsometatarsus) is considered, at least

Table 48. Bird remains

	Large Bird		Turkey		Great Horned Owl		Icteridae		Total
	No.	Row %	No.	Row %	No.	Row %	No.	Row %	
Time Period									
Late Ceramic	-	-	1	50.0%	-	-	1	50.0%	2
Mixed Ceramic	17	43.6%	21	53.8%	1	2.6%	-	-	39
Early Ceramic	19	-	29	59.2%	1	2.0%	-	-	49
Archaic (shelter)	3	-	1	25.0%	-	-	-	-	4
Archaic (talus)	11	-	2	15.4%	-	-	-	-	13
Total	50	46.7%	54	50.5%	2	1.9%	1	0.9%	107
	No.	Column %	No.	Column %	No.	Column %	No.	Column %	
Age									
Juvenile	-	-	1	1.9%	-	-	-	-	1
Mature	50	100.0%	53	98.1%	2	100.0%	1	100.0%	106
Completeness									
Complete	-	-	8	14.8%	-	-	-	-	8
>75% complete	-	-	3	5.6%	1	50.0%	1	100.0%	5
50-75% complete	-	-	7	13.0%	-	-	-	-	7
25-50% complete	1	2.0%	8	14.8%	-	-	-	-	9
<25% complete	49	98.0%	28	51.9%	1	50.0%	-	-	78
Burning									
Unburned	27	54.0%	43	79.6%	2	100.0%	1	100.0%	73
Light/scorch	5	10.0%	2	3.7%	-	-	-	-	7
Light to heavy	1	2.0%	2	3.7%	-	-	-	-	3
Dry burn	1	2.0%	-	-	-	-	-	-	1
Moderate or brown	13	26.0%	4	7.4%	-	-	-	-	17
Heavy or black	3	6.0%	-	-	-	-	-	-	3
Heavy to calcined	-	-	1	1.9%	-	-	-	-	1
Calcined	-	-	2	3.7%	-	-	-	-	2
Environmental Alteration									
None	18	36.0%	9	16.7%	-	-	-	-	27
Pitting/corrosion	15	30.0%	20	37.0%	-	-	-	-	35
Checked/exfoliated	1	2.0%	-	-	-	-	-	-	1
Root-etched	7	14.0%	4	7.4%	2	100.0%	-	-	13
Precipitate damage	9	18.0%	21	38.9%	-	-	1	100.0%	31

three birds are represented. The number increases to six or seven birds when each assemblage is tabulated separately. These include a male from late ceramic deposits, at least one male and one female from mixed ceramic deposits, a juvenile and at least one male and one female from early ceramic deposits, and at least one male from the Archaic deposits. Juvenile animals are expected in about late September, when poults reach the size of hens (BISON n.d.).

Complete bones are relatively common (Table 48), due in part to a number of phalanges (n = 4) and a complete humerus. Burning is not that common and found only in the early and mixed ceramic assemblages, where 24.1 and 19.0 percent are burned. Spiral breaks on a femur and tibiotarsus from the mixed ceramic assemblage, spiral breaks on a tibiotarsus and two femurs, an abrasion on a humerus, and an impact break on a tibiotarsus from the early ceramic assemblage are the only sign of processing. One fragment, a femur piece, has a worked edge and may have been a portion of an awl or other tool.

Great horned owl. A partial sternum and an ulna from a great horned owl (*Bubo virginianus*) were recovered from early Ceramic period deposits within the shelter and in the mixed ceramic talus assemblage. These owls are widespread, ranging from low elevations to the higher mountains. They prefer canyons with cliffs and crevices where they can spend the days in shaded recesses (Ligon 1961:145). Neither is burned or has potential evidence of processing.

Icteridae. A complete, unburned humerus from late ceramic deposits is similar to a western meadowlark (*Sturnella neglecta*) but more robust. It could be from one of the blackbirds.

Temporal and Spatial Groups

To divide the faunal assemblage into temporal groups, the provenience data was first sorted by grid and elevation. This list was compared to a similar sort of the ceramic data to determine the elevation where the ceramics stopped. Although it may not be an exact delineation, the absence of ceramics was considered the beginning of the Archaic deposits. The division between early and late ceramic deposits generally follows C. Dean Wilson's observations (this volume) that the first two levels of fill within the shelter had mainly late ceramics and the lower levels early ceramics. The talus area in front of the shelter was mixed but contains predominately early ceramics overlying Archaic deposits. Table 49 gives the elevation range for each grid by time grouping.

All of early and late ceramic assemblages are from within the shelter (100-104N). The mixed Ceramic period assemblage is from the talus in front of the shelter. Archaic deposits occurred both inside the shelter and outside in the talus area. Two of the shelter features contained faunal remains, Features 2 and 4. The former is in late Ceramic period deposits and the later in early Ceramic period deposits.

When the faunal assemblage is viewed through these time groups, and treating the shelter and talus deposits separately for the Archaic, several trends are evident (Table 50). Rabbit and small-mammal bones are never common, and the proportion increases through time from less than one percent in the Archaic deposits to just over 5 percent in the late ceramic deposits. The same is true of carnivore bones, which comprise less than 1 percent in the Archaic talus deposits and increase to just over 13 percent in the late ceramic deposits. At the same time, medium artiodactyl and deer proportions decrease from 77.1 percent in the Archaic shelter deposits to 45.2 percent in the late ceramic deposits. Turkey and/or large bird bones are found in all levels but occur in significant proportions only in the mixed and early ceramic deposits. They are nearly absent from late Ceramic period deposits and occur in small amounts but outnumber rabbits in the Archaic assemblages.

The upper shelter or late Ceramic period deposits are distinctive in many respects. Some of this is due to the more modern contaminants, including the resident woodrats, carnivores, and possible historic use of the shelter. Scavenging carnivores may have particularly increased the number of carnivores bones in this assemblage. Of the 14 carnivore bones, half have evidence of carnivore activity or digestion, compared to only 8.6 percent for the rest of the assemblage. In addition, potential contamination could at least partially account for the larger proportion of less than mature bones, the greater amount of complete and nearly complete bones, and more bone that is undamaged by environmental conditions (Table 50). This latest assemblage has by far the greatest amount of roasting burns along with the second highest amount of heavily charred and calcined discard burns (Table 51). Burning is mostly found on artiodactyl bones but occurs in most other size groups and is also high in the rabbits and small-mammal and more indeterminate group (Table 51).

Early Ceramic period deposits have mainly artiodactyl (62.8 percent) and turkey (17.5 percent) remains with few small mammals and rodents (5.9 percent) or carnivores (2.9 percent). Few bones are from immature animals, but the proportion is second only to the late ceramic assemblage (Table 51). Most are fragmentary, and the burning tends towards discard burns (Table 51). Proportions of burned bone are especially high in the rabbit/small mammal, the rodent, the deer/medium artiodactyl, and turkey/large bird groups. Most are environmentally altered (72.3 percent), predominately from precipitate damage and corrosion from the shelter soil. Slightly less of the early Ceramic period bone is burned (Table 51), and the burning tends to be of the intermediate or discard burn types. In contrast to the previous period, very little of the artiodactyl bone appears to have been roasted, while appreciable amounts of the rabbit, rodent, and turkey groups are.

As with the ceramics, the fauna from the mixed ceramic deposits outside the shelter probably dates to the early Ceramic period. This group contains proportionately more turkey and large-bird remains than any other (Table 50). Fewer smaller forms were recovered, but this is due in part to the use of a larger screen for the talus deposits. Carnivore bones are rare, as are those from immature animals. This group has the least burning. Relatively high proportions are found in the rabbit/small mammal, deer/artiodactyl, and turkey/large bird groups (Table 51). When found, the burnings are usually the intermediate brown burns. As expected for more exposed remains, much is environmentally altered.

Archaic deposits in the shelter and in the talus are quite similar. Neither has much in the way of small-animal, carnivore, or bird bone. Less of the bone is identifiable as deer, but the medium artiodactyl proportions are quite high (Table 50), and the combination of the two produces a considerably greater proportion than for the Ceramic period deposits. Young animals are again rare, and much of the assemblage is comprised of fragmentary bone. The amount of burning is similar between the two Archaic assemblages and less than the Ceramic period deposits found within the shelter. Animal groups with appreciable burning include the rodents, deer/medium artiodactyl, and turkey/large bird (Table 51). In the oldest of the deposits, both of the samples have large amounts of environmentally altered bone. Bone from the shelter is almost evenly split between corroded and precipitate-damaged bone with fewer checked and etched bones. In the talus, alteration

Table 49. Top and bottom elevations of deposits by grid and period (cm below datum)

North	East	Early Ceramic	Mixed Ceramic	Late Ceramic	Archaic
94	100	-	290-330	-	-
95	97	-	240-320	-	-
95	98	-	320-350	-	-
95	99	-	310-320	-	350-360
95	100	-	240-250	-	-
95	101	-	270-360	-	-
96	97	-	230-280	-	300-310
96	98	-	200-310	-	330-340
96	99	-	220-350	-	-
96	100	-	220-310	-	320-350
96	101	-	210-310	-	330-340
97	97	-	210-320	-	320-340
97	98	-	210-240	-	240-350
97	99	-	170-220	-	290-360
97	100	-	200-300	-	300-360
97	101	-	240-250	-	280-350
98	97	-	200-290	-	290-340
98	98	-	180-240	-	240-350
98	99	-	190-240	-	240-340
98	100	-	160-230	-	240-330
98	101	-	210-220	-	230-320
99	97	-	180-230	-	240-300
99	98	-	200-230	-	230-320
99	99	-	170-180	-	190-310
99	100	-	180-200	-	210-310
99	101	-	190-200	-	220-290
100	97	-	-	-	210-240
100	98	140-190	-	210-250	270-300
100	99	-	-	-	190-290
100	100	190-200	-	200-210	210-290
101	97	170-180	-	190-255	
101	98	140-180	-	190-270	270-282
101	99	120-130	-	190-225	225-265
101	100	-	-	193-215	220-280
101	101	-	-	180-190	194-225
102	97	-	-	200-240	240-247
102	98	130-190	-	190-240	237-255
102	99	140-190	-	190-226	228-255
102	100	131-150	-	213-223	233-240
103	98	140-195	-	190-231	232-240
103	99	140-190	-	190-240	-
103	100	150-180	-	215-225	-
104	98	170-180	-	190-202	-

Table 50. Distribution of taxa by period

Period	Late Ceramic		Mixed Ceramic		Early Ceramic		Archaic (shelter)		Archaic (talus)	
	No.	%	No.	%	No.	%	No.	%	No.	%
Taxon										
Small mammal/ medium-large bird	1	0.9%	3	1.7%	12	4.4%	6	3.8%	13	4.0%
Small mammal	1	0.9%	-	-	3	1.1%	-	-	-	-
Small-medium mammal	-	-	2	1.2%	1	0.4%	2	1.3%	4	1.2%
Medium to large mammal	4	3.7%	10	5.8%	11	4.0%	13	8.2%	34	10.6%
Large mammal	2	1.9%	1	0.6%	5	1.8%	4	2.5%	16	5.0%
Black-tailed prairie dog	1	0.9%	3	1.7%	3	1.1%	2	1.3%	5	1.6%
Botta's pocket gopher	-	-	1	0.6%	-	-	-	-	-	-
Woodrats	15	14.0%	1	0.6%	2	0.7%	-	-	-	-
White-throated woodrat	1	0.9%	-	-	-	-	-	-	-	-
Desert cottontail	5	4.7%	3	1.7%	7	2.6%	1	0.6%	1	0.3%
Black-tailed jack rabbit	1	0.9%	-	-	1	0.4%	-	-	2	0.6%
Medium carnivore	2	1.9%	-	-	-	-	1	0.6%	-	-
Dog or coyote	-	-	-	-	-	-	1	0.6%	-	-
Coyote	1	0.9%	1		-	-	-	-	2	0.6%
Dog	1	0.9%	-	-	-	-	-	-	-	-
Gray fox	-	-	-	-	2	0.7%	-	-	-	-
Badger	-	-	-	-	-	-	-	-	1	
Striped skunk	9	8.4%	1	0.6%	5	1.8%	1	0.6%	-	-
Bobcat	1	0.9%	-	-	1	0.4%	1	0.6%	-	-
Small to medium artiodactyl	1	0.9%	3	1.7%	-	-	-	-	-	-
Medium artiodactyl	43	40.2%	81	47.1%	138	50.4%	107	67.7%	200	62.3%
Deer	16	15.0%	22	12.8%	34	12.4%	15	9.5%	30	9.3%
Domestic sheep or goat	-	-	1	0.6%	-	-	-	-	-	-
Large bird	-	-	17	9.9%	19	6.9%	3	1.9%	11	3.4%
Turkey	1	0.9%	21	12.2%	29	10.6%	1	0.6%	2	0.6%
Great horned owl	-	-	1	0.6%	1	0.4%	-	-	-	-
Icteridae	1	0.9%								
Total	107	100.0%	172	100.0%	274	100.0%	158	100.0%	321	100.0%
Age										
Fetal, neonate	1	0.9%	-	-	1	0.4%	-	-	1	0.3%
Immature	3	2.8%	1	0.6%	6	2.2%	1	0.6%	3	1.0%
Juvenile	21	19.6%	4	2.3%	18	6.6%	16	10.1%	21	7.1%
Mature	82	76.6%	167	97.1%	249	90.9%	141	89.2%	269	91.5%
Total	107	100.0%	172	100.0%	274	100.0%	158	100.0%	294	100.0%
Completeness										
Complete	14	13.1%	8	4.7%	7	2.6%	-	-	1	0.3%
>75% complete	16	15.0%	5	2.9%	10	3.6%	3	1.9%	2	0.6%
50-75% complete	5	4.7%	7	4.1%	11	4.0%	1	0.6%	4	1.2%
25-50% complete	7	6.5%	5	2.9%	16	5.8%	3	1.9%	7	2.2%
<25% complete	65	60.7%	147	85.5%	230	83.9%	151	95.6%	307	95.6%
Total	107	100.0%	172	100.0%	274	100.0%	158	100.0%	321	100.0%
Burning										
Unburned	63	58.9%	125	72.7%	162	59.1%	106	67.1%	223	69.5%
Light/scorch	5	4.7%	7	4.1%	7	2.6%	1	0.6%	10	3.1%
Light to heavy	12	11.2%	-	-	7	2.6%		0.0%	4	1.2%
Dry burn	1	0.9%	1	0.6%	3	1.1%	1	0.6%	9	2.8%
Moderate or brown	9	8.4%	23	13.4%	44	16.1%	23	14.6%	35	10.9%
Heavy or black	12	11.2%	10	5.8%	13	4.7%	12	7.6%	28	8.7%
Light to calcined	1	0.9%	1	0.6%	3	1.1%		0.0%	3	0.9%
Heavy to calcined	1	0.9%	3	1.7%	6	2.2%	2	1.3%	4	1.2%
Calcined	3	2.8%	2	1.2%	29	10.6%	13	8.2%	5	1.6%
Total	107	100.0%	172	100.0%	274	100.0%	158	100.0%	321	100.0%
Environmental Alteration										
None	69	64.5%	38	22.1%	76	27.7%	38	24.1%	55	17.1%
Pitting/corrosion	10	9.3%	77	44.8%	62	22.6%	48	30.4%	172	53.6%
Checked/exfoliated	6	5.6%	23	13.4%	16	5.8%	14	8.9%	28	8.7%
Root etched	6	5.6%	24	14.0%	21	7.7%	9	5.7%	45	14.0%
Polished/rounded	3	2.8%	1	0.6%	1	0.4%	-	-	-	-
Fresh/greasy	1	0.9%	-	-	-	-	-	-	-	-
Precipitate damage	11	10.3%	9	5.2%	98	35.8%	49	31.0%	21	6.5%
Adhering tissue	1	0.9%	-	-	-	-	-	-	-	-
Total	107	100.0%	172	100.0%	274	100.0%	158	100.0%	321	100.0%

Table 51. Burning by animal size and burn type

Period	Size Groups	Unburned		Roasting Burn		Dry Burn		Intermediate Burn		Discard Burn		Total
		No.	Row %	No.	Row %	No.	Row %	No.	Row %	No.	Row %	
Late Ceramic	rabbit/small	4	57.1%	2	28.6%	-	-	-	-	1	14.3%	7
	rodent	13	76.5%	1	5.9%	-	-	-	-	3	17.6%	17
	carnivore	13	92.9%	-	-	-	-	-	-	1	7.1%	14
	artiodactyl	29	46.8%	15	24.2%	1	1.6%	7	11.3%	10	16.1%	62
	wild bird	1	100.0%	-	-	-	-	-	-	-	-	1
	turkey/large bird	1	100.0%	-	-	-	-	-	-	-	-	1
	miscellaneous	2	40.0%	1	20.0%	-	-	2	40.0%	-	-	5
Total		63	58.9%	19	17.8%	1	0.9%	9	8.4%	15	14.0%	107
Mixed Ceramic	rabbit/small	2	66.7%	1	33.3%	-	-	-	-	-	-	3
	rodent	5	100.0%	-	-	-	-	-	-	-	-	5
	carnivore	2	100.0%	-	-	-	-	-	-	-	-	2
	artiodactyl	74	68.5%	7	6.5%	1	0.9%	17	15.7%	9	8.3%	108
	wild bird	1	100.0%	-	-	-	-	-	-	-	-	1
	turkey/large bird	30	78.9%	3	7.9%	-	-	4	10.5%	1	2.6%	38
	miscellaneous	11	73.3%	-	-	-	-	2	13.3%	2	13.3%	15
Total		125	72.7%	11	6.4%	1	0.6%	23	13.4%	12	7.0%	172
Early Ceramic	rabbit/small	3	27.3%	2	18.2%	-	-	2	18.2%	4	36.4%	11
	rodent	2	40.0%	1	20.0%	-	-	1	20.0%	1	20.0%	5
	carnivore	6	75.0%	-		-	-	-	-	2	25.0%	8
	artiodactyl	107	60.5%	10	5.6%	3	1.7%	29	16.4%	28	15.8%	177
	wild bird	1	100.0%	-	-	-	-	-	-	-	-	1
	turkey/large bird	29	60.4%	8	16.7%	-	-	9	18.8%	2	4.2%	48
	miscellaneous	14	58.3%	2	8.3%	-	-	3	12.5%	5	20.8%	24
Total		162	59.1%	23	8.4%	3	1.1%	44	16.1%	42	15.3%	274
Archaic	rabbit/small	3	75.0%	1	25.0%	-	-	-	-	-	-	4
	rodent	5	71.4%	1	14.3%	-	-	1	14.3%	-	-	7
	carnivore	6	85.7%	-	-	1	14.3%	-	-	-	-	7
	artiodactyl	259	69.6%	18	4.8%	6	1.6%	45	12.1%	44	11.8%	372
	turkey/large bird	10	58.8%	-	-	1	5.9%	4	23.5%	2	11.8%	17
	miscellaneous	46	63.9%	4	5.6%	2	2.8%	8	11.1%	12	16.7%	72
Total		329	68.7%	24	5.0%	10	2.1%	58	12.1%	58	12.1%	479

Notes:

rabbit/small = rabbit and small mammal
rodent = rodents and prairie dog
carnivore = all carnivores
artiodactyl = large mammal, small to medium artiodactyl, medium artiodactyl, deer, and sheep/goat
wild bird = horned owl and Icteridae
turkey/large bird = turkey and large bird
miscellaneous = small mammal/bird, small-medium mammal, medium to large mammal

is mainly corrosion, followed by etched, checked, then precipitate-damaged bone (Table 50).

Only two features in the main sample contained bone (Table 52), a possibly modern fire pit high in the fill, and a roasting pit associated with early Ceramic period deposits. Feature 6, a small early Ceramic period fire pit, had no bone in the main sample, but the flotation sample contained two pieces of bone. The fire pit (Feature 2) contained a heavily burned woodrat maxilla, a radius and ulna from a skunk, and a partial deer scapula. The skunk humerus has signs of carnivore gnawing. A flotation sample from this feature produced additional fauna: a burned vertebra from a small venomous snake, a possible snake tooth that is unburned, a scorched axis vertebra from a small rodent, an unburned vertebral body from a small rodent, a small fragment of burned bone (either a flat bone or long bone end fragment from a rodent), and a long-bone end from a medium to large mammal that is immature, scorched, and digested or boiled.

The roasting pit (Feature 4) held a larger variety of animals. A good amount are burned, and most of the burns suggest discard (small mammal n = 1, cottontail n = 2, skunk n = 1, medium artiodactyl n = 1, large bird n = 1, and turkey n = 2). In addition, a cottontail ilium is lightly scorched, suggesting roasting, and a turkey femur that is a partial tool has a graded but mainly heavy burn. Much of assemblage is turkey, including parts of at least two birds, a large male and a female, based on the presence and size of spurs on the tarsometatarsi.

Table 52. Faunal remains recovered from Features 2 and 4

	Feature 2 (fire pit)		Feature 4 (roasting pit)	
Sample Size	4		27	
	No.	%	No.	%
Taxon				
Small mammal	-	-	1	3.7%
Black-tailed prairie dog	-	-	1	3.7%
Woodrats	1	25.0%	-	-
Desert cottontail	-	-	4	14.8%
Striped skunk	2	50.0%	1	3.7%
Medium artiodactyl	-	-	6	22.2%
Deer	1	25.0%	-	-
Large bird	-	-	3	11.1%
Turkey	-	-	11	40.7%
Age				
Immature	-	-	1	3.7%
Mature	-	-	26	96.3%
Completeness				
Complete	-	-	2	7.4%
>75% complete	2	50.0%	3	11.1%
50-75% complete	-	-	1	3.7%
25-50% complete	2	50.0%	4	14.8%
<25% complete	-	-	17	63.0%
Burning				
Unburned	2	50.0%	17	63.0%
Light/scorch	-	-	1	3.7%
Light to heavy	-	-	1	3.7%
Moderate or brown	1	25.0%	1	3.7%
Heavy or black	1	25.0%	-	-
Calcined	-	-	7	25.9%

Unburned parts include mandible, ulna, coracoid, tarsometatarsus, muscle splints, and a phalanx. In addition to the femur mentioned above, a tarsometatarsus shaft fragment and a complete phalange are burned. Medium artiodactyl bones are all long-bone or rib-shaft fragments. One of the long bones has the texture of an immature animal, suggesting summer or early fall deposition.

A flotation sample from Feature 6, a small fire pit, contained two bones. One is a calcined piece of a long bone, probably a rib, from a small mammal. The other is a small unburned pieces of long-bone shaft from a small mammal.

Species Utilization

Small Rodents

Other than woodrats, the only rodent found is a pocket gopher represented by a femur from the upper talus deposits. Given the location of the find, high in the talus, the fact that it is one of the larger bones in this animal, and that it is complete and unburned, it is most likely the remains of an intrusive burrower, most of which was lost through 1/4-inch screening. Since woodrats built nests in and inhabited the shelter, some of the woodrat remains collected from this site are probably from rodents who died naturally. Others are burned or broken and probably were consumed by humans. Most of the woodrat bones, except for cranial parts, were recovered from the upper levels of fill within the shelter and are generally complete or nearly complete elements. One femur from these upper deposits is lightly scorched and may have been roasted or accidentally burned. A maxilla and two partial femurs are heavily burned, suggesting they were discarded into a fire, perhaps after the rodents were consumed. The single woodrat bone from mixed ceramic deposits is an unburned complete humerus and could represent a natural death. The sample of two from early ceramic deposits is split. A complete humerus is unburned and could be from a rodent who died naturally, while a partial mandible is heavily burned, indicating discard into a fire. No woodrat remains were found in the Archaic deposits. However, testing in the talus and using 1/8-inch screen recovered both woodrat and large rodent bones (Akins 1997:57) from Archaic deposits, so the use of this species during the early use of the shelter should not be discounted.

Woodrats, as well as their stores of nuts, berries, fruit, and seeds, would have attracted humans and other predators to shelter locations. The data from LA 110339 seems to indicate that most groups took advantage of this species, and it may have been used more during the late Ceramic period.

Rabbits and Prairie Dogs

Prairie dog, cottontail rabbit, and jackrabbit bones were recovered in small numbers. None of the prairie dog bones are complete elements, and enough are burned to suggest at least some were brought to the shelter by humans and eaten. None from the late ceramic or mixed ceramic deposits are burned, but two of three 3) of those from early ceramic deposits and two from Archaic deposits are burned. A femur from early ceramic deposits has a graded burn, indicating it was roasted. Most other burning consists of moderate to heavy discard burns. Since prairie dogs probably hibernate or stay below ground at elevations where winter is severe, their presence indicates at least fairly warm weather.

Cottontail rabbit bones are most abundant in the early Ceramic period deposits. Those from late ceramic deposits include a complete unburned humerus from a mature rabbit and most of a femur from a very young rabbit. The complete humerus suggests some of the cottontail rabbit bones may not have been introduced by to the shelter by humans. Very young rabbit remains probably indicate warm weather deposition, because cottontail young would be present from about February through August or September (BISON n.d.). Only one of the late Ceramic period cottontail bones is burned, a heavy or discard burn on a femur shaft fragment. Mixed ceramic deposit cottontail bones are all mandible or scapulae fragments. One of the scapula fragments is lightly burned and suggests roasting. Cottontail bones from early Ceramic period deposits are mainly innominate and tibia pieces with a single maxilla fragment. All but two are burned: one innominate lightly burned and possibly roasted , a moderate burn on the maxilla, and calcined burns on two tibia fragments. The only cottontail bones with potential processing (a spiral break—a form that can occur other than by human action) comes from early ceramic deposits (Table 53). Neither of the fragmentary cottontail bones from Archaic deposits is burned. The counts and the amount of burning suggest that cottontails were more important to ceramic than Archaic period groups.

Few jackrabbit bones were recovered, probably because they are not that common in ponderosa pine environs. All but one are lightly scorched, suggesting they were brought to the shelter by humans and roasted or baked, or in one case, as a tubular bead.

If counts and relative proportions are an indication of use of these three species, there were changes in availability or choice. Prairie dog remains increase through time, while those from cottontail rabbits are most common in the middle or early Ceramic period deposits. Jackrabbit bones are never common, probably confirming their scarcity in the surrounding area.

Carnivores

Carnivore bones may have entered the site deposits through a variety of means. A few could be road kills or parts of animals dragged into the shelter by other carnivores or even woodrats. This is most likely true for the dog rib and possibly some of the skunk bones from the latest deposits. Other skunk bones are burned or have indications that humans are responsible for the deposition. Burning was also found on a coyote tibia fragment, and a badger mandible has dry burns. None of the carnivores occur in appreciable numbers, suggesting that few were actively sought out as food items or for their fur. Some of the carnivores may have been taken when encountered, but others probably arrived at the site by other means.

Artiodactyls

Mature mule deer bucks average 74 kg, does 59 kg, and newborn fawns from 2.7 to 4 kg. Fawns grow rapidly, averaging 30 kg in 5 to 6 months and 50 to 60 kg at a year. Weight is greatest during summer and early fall, decreasing between 19 and 22 percent in late fall and winter (Mackie et al. 1982:863). In the Sacramento Mountains, fawning peaks in the early weeks of July.

Table 53. Processing on faunal remains (counts)

Period	Taxon	Element	Type	Primary	Secondary
Late Ceramic					
	Medium to large mammal	Long bone fragment	Abrasion	1	
	Medium artiodactyl	Long bone fragment	Transverse cuts	1	
			Impact break	5	1
			Spiral break	1	1
			Abrasion	1	1
		Femur	Impact break	1	
	Deer	Scapula	Abrasion	1	
		Innominate	Transverse cuts	1	
			Abrasion	1	
			Percussion pit	1	
			Percussion stria		1
		Metatarsal	Impact break	1	
Mixed Ceramic					
	Medium to large mammal	Long bone fragment	Abrasion	1	
	Small-medium artiodactyl	Rib	Peel	1	
	Medium artiodactyl	Long bone fragment	Oblique cuts	1	
	Deer	Humerus	Impact break	1	
			Spiral break	1	
		Radius	Oblique cuts	1	
			Spiral break		1
		Tibia	Impact break	1	
		Metatarsal	Impact break	2	2
	Large bird	Long bone fragment	Spiral break	1	
	Turkey	Femur	Spiral break	1	1
		Tibiotarsus	Spiral break	1	
Early Ceramic					
	Small mammal/ medium-large bird	Long bone fragment	Impact break	1	
			Abrasion		1
	Cottontail	Tibia	Spiral break	1	
	Striped skunk	Mandible	Snap break	1	
			Peel		1
	Medium artiodactyl	Long bone fragment	Oblique cuts	1	
			Impact break	1	
			Spiral break	7	
			Abrasion	1	
			Bone flake	1	
			Percussion stria		1
		Humerus	Impact break	2	
		Ulna	Abrasion	1	
		Tibia	Spiral break	1	
	Deer	Cranium	Transverse cuts	1	
			Impact break		1
		Radius	Impact break	1	
		Metacarpal	Transverse cuts	1	
			Impact break		1
			Spiral break	1	
			Abrasion		1
		Tibia	Portion cut off	1	
		Metatarsal	Impact break	1	
Archaic (shelter)					
	Medium artiodactyl	Long bone fragment	Impact break	1	
			Spiral break	3	
		Humerus	Impact break	1	
		Tibia	Spiral break	1	
	Deer	Tibia	Cut and snap	1	
			Abrasion		1
		Metatarsal	Split	1	
Archaic (talus)					
	Small mammal/ medium-large bird	Long bone fragment	Spiral break	1	
	Medium to large mammal	Long bone fragment	Spiral break	1	
		Rib	Abrasion	1	
	Medium artiodactyl	Long bone fragment	Impact break	3	
			Spiral break	5	1
			Chop	1	
		Mandible	Impact break	1	
		Humerus	Impact break	1	
			Spiral break	1	
		Radius	Oblique cuts	1	
			Impact break		1
		Metapodial	Spiral break	3	
	Deer	Humerus	Spiral break	1	
		Femur	Impact break	1	
		Tibia	Impact break	1	

Does are isolated during this time and begin congregating into small nursery herds by the end of the summer (Wimberly and Eidenbach 1981:25). Mule deer tend to be dispersed during much of the year and are most dispersed during the summer, when the does seek isolation and the yearlings are driven off and wander together. Bucks share overlapping ranges. Toward the end of summer, family groups are reestablished, and does, fawns, and yearlings graze together. Group size increases through late summer and fall into winter, and the largest groups occur in midwinter, when snow restricts the available range, and in early spring in areas of new green forage. Breeding takes place in fall and early winter. Bucks wander extensively, seeking does and become highly aggressive. Otherwise, ranges tend to be small, with only short daily movements (Mackie et al. 1982:868-870).

In the LA 110339 assemblage, deer and medium artiodactyl (probably deer) bones comprise much of each of the time group assemblages, and proportions change substantially through time. Combined, these constitute 55.2 percent of the sample from late ceramic deposits, 59.9 percent of the mixed ceramic assemblage, 62.8 percent of those from early ceramic deposits, and 77.1 and 71.6 percent of the Archaic shelter and talus deposits. The counts and overall size of deer establish that deer provided most of the animal subsistence throughout the use of the shelter. However, some groups may have used the shelter area as a short-term base camp from which deer were hunted and returned for processing and consumption, while others could have used it as a logistical camp from which deer were hunted to transport the kills back to residential sites.

Counts for any one particular element are small (Tables 54-56). Those with the most value in terms of the associated meat, such as femur, thoracic vertebra, ribs, cervical vertebra, and scapula, or marrow, such as tibia, femur, radius, metatarsal, and humerus (Madrigal and Holt 2002:750-752), are not always the best represented elements at LA 110339. Some of this has to do with processing for marrow and grease. Breaking the more valued parts into small pieces leaves some of the more distinctively shaped elements (such as tibias and metatarsals) still identifiable while rendering others into generic long-bone shaft fragments. In addition, parts that are less dense, such as vertebra, pelvis, and crania, can be so processed they disappear or disintegrate and are more likely to disintegrate naturally.

When the medium artiodactyl and deer specimens are combined, long-bone shaft fragments are always the most numerous part, while flat bone fragments (small pieces of vertebra, crania, pelvis, and carpals or tarsals) are rare. The lack of flat bones and parts that are rendered into flat bones suggests that these parts were poorly preserved, were highly processed so that little remains, or were transported elsewhere. The same is true of long-bone ends (Table 54), which are rare or missing, but the presence of adjacent shaft portions indicates they were brought to the shelter.

Late Ceramic period deposits. Condensing this data (Table 55) reveals differences between the time groups not only in the proportion of long-bone fragments but also in the other parts. Late Ceramic period deposits have the lowest proportion of bone identified as long-bone fragments as well as the smallest ratio of deer to medium artiodactyl bones (1:2.7). The small number of long-bone fragments and the small ratio of deer to medium artiodactyl bone suggest that bones were less broken up or processed during the last use of the shelter. When the medium artiodactyl and deer are combined, the late ceramic assemblage has a considerable proportion of rib fragments as well as pelvis and front and rear leg pieces but has fewer foot specimens than any other group. Focusing on deer (Table 56), innominate fragments are the most common, followed by cranial and rear foot parts. Taken together, these findings suggest that only a scattered array of deer parts were left at the shelter, including few long bones, and these were broken into small pieces. In contrast, many of the flat bones that would have been largely destroyed by making bone grease (mandible body, scapula neck, and innominate pieces, and a complete calcaneus) survived, again suggesting these parts were less processed than in later periods.

If we take the minimum number of deer suggested by parts (a juvenile and a mature) and compare this to the amount of medium artiodactyl bones recovered, then the bone fragment count per individual is quite small (29). Either only parts of these animals were brought to the site and the associated bone discarded after the meat was removed and marrow extracted, or if complete animals were brought to the site for processing, then few bones were stripped of meat and left behind, and some marrow was extracted while most of the animal was transported elsewhere. These two alternatives should leave distinctly different part distributions. In the former, the parts found should be those likely to be transported, while in the latter, these parts would be absent. When the mean transport utility index, which considers not only the value in terms of meat, marrow, and grease but also accounts for the likelihood of transport because a part is attached to one of greater value (Lyman 1994:225-227), is calculated for the 19 parts represented (Table 57), the mean for the late ceramic deposits is considerably higher than that for the mixed talus area but less than for the early ceramic or combined Archaic assemblage. Some parts with the highest utility (femurs and proximal tibias) are absent. A relatively low trans-

Table 54. Temporal distribution of deer and medium artiodactyl body parts (count)

	Late Ceramic	Mixed Ceramic	Early Ceramic	Archaic (shelter)	Archaic (talus)
Long bone					
Shaft fragment	28	71	99	81	141
End fragment	-	-	1	-	2
Flat bone fragment	-	2	6	5	7
Antler fragment	-	1	1	2	2
Cranial fragment	1	-	1	-	-
Mandible fragment	2	3	2	1	7
Vertebra fragment	1	-	-	-	1
Cervical vertebra fragment	-	-	-	-	1
Thoracic vertebra fragment	-	-	-	-	1
Lumbar vertebra fragment	-	-	1	-	2
Rib					
Proximal	2	-	-	-	-
Proximal shaft fragment	-	-	2	3	1
Shaft fragment	8	4	8	5	18
Distal	-	1	2	-	-
Innominate	5	-	-	1	3
Scapula	2	-	-	-	4
Humerus					
Proximal	-	1	-	-	-
Proximal shaft fragment	1	1	2	-	-
Shaft fragment	-	-	4	1	5
Distal	-	1	-	-	-
Distal shaft fragment	-	2	1	2	3
Radius					
Proximal or proximal fragment	-	1	1	-	-
Shaft fragment	-	-	2	-	2
Distal shaft fragment	-	-	-	-	1
Ulna					
Proximal or proximal fragment	-	-	1	-	1
Proximal shaft fragment	-	-	1	-	
Shaft fragment	1	-	3	2	1
Distal shaft fragment	-	-	2	-	-
Metacarpal					
Complete	-	1	-	-	-
Proximal or proximal fragment	-	1	1	-	1
Proximal shaft fragment	-	-	-	1	-
Shaft fragment	1	1	2	1	2
Vestigial metapodial	-	-	3	-	-
Vestigial phalanx	-	-	1	-	-
Femur	-	-	-	-	-
Proximal	-	-	1	-	-
Proximal shaft fragment	2	-	2	-	2
Shaft fragment	-	-	-	1	2
Distal fragment	-	-	2	-	-
Tibia					
Proximal and shaft	-	-	-	1	-
Proximal shaft fragment	-	1	4	3	2
Shaft fragment	1	2	4	1	2
Distal fragment	-	-	1	-	-
Distal shaft fragment	1	-	-	-	-
Astragalus	-	-	1	-	-
Calcaneus	1	1	-	-	2
Metatarsal					
Proximal	1	1	2	1	-
Shaft fragment	1	1	3	3	2
Distal epiphysis	-	-	-	-	1
Distal shaft fragment	-	4	1	1	-
Metapodial					
Proximal fragment	-	-	-	1	1
Proximal shaft fragment	-	1	-	-	-
Shaft fragment	-	-	1	4	7
First phalanx	-	1	2	-	1
Second phalanx	-	-	1	-	-
Third phalanx	-	-	-	1	1
Totals	59	103	172	122	229

Table 55. Frequencies of medium artiodactyl and deer bones

	Late Ceramic		Mixed Ceramic		Early Ceramic		Archaic (shelter)		Archaic (talus)	
	No.	%	No.	%	No.	%	No.	%	No.	%
Long bone	28	47.5%	71	68.9%	100	58.1%	81	66.4%	143	62.2%
Flat bone	-	-	2	1.9%	6	3.5%	5	4.1%	7	3.0%
Horn or antler	-	-	1	1.0%	1	0.6%	2	1.6%	2	0.9%
Cranium	3	5.1%	3	2.9%	3	1.7%	1	0.8%	7	3.0%
Vertebra	1	1.7%	-	-	1	0.6%	-	-	5	2.2%
Ribs	10	16.9%	5	4.9%	12	7.0%	8	6.6%	19	8.3%
Pelvis	5	8.5%	-	-	-	-	1	0.8%	3	1.3%
Front limb	4	6.8%	6	5.8%	17	9.9%	5	4.1%	17	7.4%
Front foot	1	1.7%	3	2.9%	7	4.1%	2	1.6%	3	1.3%
Rear leg	4	6.8%	3	2.9%	14	8.1%	6	4.9%	8	3.5%
Rear foot	3	5.1%	7	6.8%	7	4.1%	5	4.1%	6	2.6%
Front or rear foot	-	-	2	1.9%	4	2.3%	6	4.9%	10	4.3%
Total	59	100.0%	103	100.0%	172	100.0%	122	100.0%	230	100.0%

Table 56. Temporal distribution of deer elements

Part	Element	Late Ceramic		Mixed Ceramic		Early Ceramic		Archaic (shelter)		Archaic (talus)	
		No.	%	No.	%	No.	%	No.	%	No.	%
Antler	Antler	-	-	1	2.3%	1	1.5%	2	7.4%	2	3.6%
Cranial	Cranium	1	3.8%	-	-	1	1.5%	-	-	-	-
	Mandible	2	7.7%	3	7.0%	2	3.0%	-	-	4	7.1%
	Cranial total	3	11.5%	3	7.0%	3	4.5%	-	-	4	7.1%
Vertebra	Cervical	-	-	-	-	-	-	-	-	1	1.8%
Thorax	Rib	1	3.8%	-	-	1	1.5%	-	-	-	-
Pelvis	Innominate	5	19.2%	-	-	-	-	1	3.7%	1	1.8%
Front limb	Scapula	2	7.7%	-	-	-	-	-	-	2	3.6%
	Humerus	-	-	5	11.6%	1	1.5%	2	7.4%	4	7.1%
	Radius	-	-	1	2.3%	1	1.5%	-	-	-	-
	Ulna	-	-	-	-	2	3.0%	-	-	1	1.8%
	Front limb total	2	7.7%	6	14.0%	4	6.1%	2	7.4%	7	12.5%
Front foot	Metacarpal	1	3.8%	2	4.7%	2	3.0%	1	3.7%	2	3.6%
	Vestigial phalanx	-	-	-	-	1	1.5%	-	-	-	-
	Vestigial metapodial	-	-	-	-	3	4.5%	-	-	-	-
	Front foot total	1	3.8%	2	4.7%	6	9.1%	1	3.7%	2	3.6%
Rear leg	Femur	-	-	-	-	5	7.6%	-	-	2	3.6%
	Tibia	1	3.8%	2	4.7%	5	7.6%	4	14.8%	1	1.8%
	Rear leg total	1	3.8%	2	4.7%	10	15.2%	4	14.8%	3	5.4%
Rear foot	Astragalus	-	-	-	-	1	1.5%	-	-	-	-
	Calcaneus	1	3.8%	1	2.3%	-	-	-	-	2	3.6%
	Metatarsal	2	7.7%	6	14.0%	5	7.6%	4	14.8%	4	7.1%
	Rear foot total	3	11.5%	7	16.3%	6	9.1%	4	14.8%	6	10.7%
Foot	Metapodial	-	-	-	-	-	-	-	-	2	3.6%
	First phalanx	-	-	1	2.3%	2	3.0%	-	-	1	1.8%
	Second phalanx	-	-	-	-	1	1.5%	-	-	-	-
	Third phalanx	-	-	-	-	-	-	1	3.7%	1	1.8%
	Foot total	-	-	1	2.3%	3	4.5%	1	3.7%	4	7.1%
Total		26	100.0%	43	100.0%	66	100.0%	27	100.0%	56	100.0%

Table 57. Transport utility of artiodactyl parts (does not include fetal or neonate remains)

Part	MGUI	Late Ceramic		Mixed Ceramic		Early Ceramic		Archaic	
		x MNE	MGUI	x MNE	MGUI	x MNE	MGUI	x MNE	MGUI
Cranium	8.74	1	8.74			1	8.74		
Mandible without tongue	13.89	2	27.78	2	27.78	2	27.78	2	27.78
Cervical vertebrae	35.71	1*	35.71					1	35.71
Thoracic vertebra	45.53							1	45.53
Lumbar vertebrae	32.05					1	32.05	1	32.05
Pelvis	47.89	3	143.67					2	95.78
Ribs	49.77	3	149.31	1	49.77	3	149.31	3	149.31
Scapula	43.47	1	43.47					2	86.94
Humerus proximal	43.47	1	43.47	2	86.94	1	43.47		
Humerus distal	36.52			3	109.56	1	36.52	2	73.04
Radius and ulna proximal	26.64			1	26.64	1	26.64	1	26.64
Radius and ulna distal	22.23	1*	22.23			1	22.23		
Metacarpal proximal	12.18			2	24.36	2	24.36	2	24.36
Metacarpal distal	10.5	1*	10.5	1	10.5	1	10.5		
Femur proximal	100	1	100			2	200	2	200
Femur distal	100					2	200		
Tibia proximal	64.73			1	64.73	2	129.46	3	194.19
Tibia distal	47.09	1	47.09	1*	47.09	1	47.09		
Astragalus	31.66					1	31.66		
Calcaneus	31.66	1	31.66	1	31.66			2	63.32
Metatarsal proximal	29.93	1	29.93	1	29.93	2	59.86	2	59.86
Metatarsal distal	23.93	1	29.93	2	47.86		23.93	1	23.93
Phalanges	13.72			1	13.72	1	13.72	1	13.72
Totals		19	723.49	19	570.54	25	1087.32		1152.16
Mean value per MNE		38.08		30.03		41.82		41.15	

Notes:
MNE = minimum number of elements.
MGUI = modified general utility index.
Utility index is Binford's MGUI for caribou as presented in Lyman (1994: Table 7.1).
* Unspecified vertebra counted as cervical or shaft fragment counted as this part.

port index and the absence of high-utility parts suggests that the highest-value parts (femur, tibia, thoracic vertebra) either never reached the site or were transported elsewhere. Parts left behind are those that could be stripped of meat (pelvis, scapula), waste parts (crania, lower limb bones, and feet), or parts that were consumed (ribs, long bones). This part distribution suggests that during the latest use the shelter served mainly as a short-term logistic camp. Deer were killed near the shelter, parts that are not as amenable to transport were consumed, and those parts most suited to transport were prepared and taken elsewhere.

Mixed Ceramic period talus deposits. The mixed ceramic assemblage is only slightly larger than the late ceramic assemblage. More pieces are identifiable only as long bones, but this may be due in part to the erosion and damage caused by exposure on the talus slope in front of the shelter. Even though this assemblage has the largest proportion of long-bone fragments found, the ratio of deer to medium artiodactyl bone is the second largest (1:3.7); that is, there are proportionately more specimens recognizable as deer than in the early ceramic and Archaic deposits. Similarly, the number of bones per individual artiodactyl (minimally, a juvenile and a mature animal) is considerably larger than in the later deposits (51.5), but smaller than in either of the earlier periods. No one part occurs with any great frequency, so that the combined foot total (11.6 percent) is the greatest, followed by front limb and rib parts (Table 55). This is heavily influenced by the deer contribution, where nearly half (45.4 percent) of the parts identified as deer are from feet (Table 56). This combination of many long-bone fragments for deer and medium artiodactyl and foot parts for deer may primarily reflect the nature of the assemblage; that is, the remains were deposited in a toss or discard zone, where waste parts were tossed and larger specimens were exposed to more environmental damage and fragmentation than those deposited within the shelter. This interpretation is consistent with the relatively low mean transport index for this assemblage (Table 57).

Early Ceramic period deposits. The early Ceramic period assemblage from within the shelter is the second largest and has only a slightly smaller ratio of deer to medium artiodactyl bone (1:4.1) than the late and mixed ceramic deposits. It also has a larger number of bones (85) per animal, again, at least a juvenile and a mature deer, not counting the few specimens from a neonate and an immature deer. Long-bone fragments are intermediate in proportion, and the front and rear legs and ribs are the best represented (Table 55). Pelvis, crania, and vertebra parts are rare or absent, suggesting some selection in the parts brought and left at the shelter during this period or that those parts were heavily processed, as suggested by the relatively large flat-bone category. Processing for grease during this period is also suggested by the presence of a few long-bone end fragments and even greater frequencies of near-end shaft fragments in those elements valued for grease (proximal humerus, distal femur, proximal tibia). Like the combined deer and medium artiodactyl part distribution, deer parts are predominantly rear leg, foot, and front leg elements (Table 56). Rear leg parts are by far the most valuable parts left behind, and they influence the relatively high mean transport utility index (Table 57). This assemblage contrasts markedly with that of the late Ceramic period. Rather than a short-term logistic camp, the shelter has evidence of consumption of some of the more valued parts and for time-consuming activities such as grease making. While the duration of visits to the shelter may have been short, it appears to have functioned more as a base camp during this period.

Archaic period deposits. Dividing the Archaic assemblage by whether it came from inside or outside of the shelter suggests some differential deposition of body parts (Tables 54-56). This is particularly true of cranial, vertebra, and front limb parts, which are far more likely to have been tossed onto the talus. The only part that is more likely to be found inside the shelter are the long-bone shaft fragments. If not the result of screen size or differences in preservation, this suggests that some processed bone, especially long-bone shaft fragments, was left in the shelter, while those parts with little marrow were tossed onto the talus. The ratio of deer to medium artiodactyl bone is lower for the shelter (1:7.1) than for the talus (1:6.7), which may again suggest more processed material was discarded in the shelter. Overall, the Archaic assemblage has a greater diversity of parts, but no parts are all that well represented given the time span involved. The few found have a relatively high mean transport utility index, suggesting higher-yield parts were commonly discarded at the shelter. This sample also has the highest number of bones per animal, assuming a juvenile and two mature deer (117), but again, this minimal count of only three deer is unrealistic given the amount of time covered by the Archaic deposits. As in the early Ceramic period, the shelter probably functioned more as a short-term base camp than a logistic camp during the Archaic period.

Birds

Other than turkey and probable turkey (the large bird), few bird bones were recovered from the shelter, and those found are probably unrelated to the human occupation. Turkeys undoubtedly lived and nested in the general vicinity of the shelter. At 2,120 m elevation, the shelter is close to their preferred nesting elevation of 2,134 to 2,743 m in coniferous forests as well as to potential winter feeding areas with oak, ponderosa pine, and juniper. Male turkeys weight 7 kg and females 5.4 kg (BISON n.d.). Turkeys generally live in flocks comprised of hens, younger turkeys, and experienced hens. Gobblers live apart but in close proximity. Wintering and nesting sites may be up to 64 km apart. Wild turkeys are extremely alert to any sound that could signal danger and are a very wary prey (Ligon 1946:8-11). Their habit of returning to preferred roosting trees may have benefited prehistoric hunters, as it did the Mescalero Apaches, who hunted turkeys when they were roosting (Dart 1980:40).

While turkeys may not have been all that easy to hunt, they are a good-sized resource and would have been available in the vicinity of the shelter. Yet, most use of this species seems to have been confined to the early Ceramic period. The single large-bird specimen from late Ceramic period deposits suggests that these groups utilized turkeys little if at all. Early ceramic and mixed deposits have the most turkey bone, including the single juvenile bird and both male and female mature birds. It is also the only period that has indications that some birds were roasted (Table 58) and other parts were discarded into fire pits. Turkeys also have an unusual body part distribution. Almost all of the parts are those that would be considered waste (crania, radius, ulna, tibiotarsus, fibula, tarsometatarsus, and feet), which suggests that the birds were indeed taken nearby but the meatier portions may have been transported. Archaic deposits produced fewer turkey bones. Again, many are waste parts (radius and tibiotarsus) or broken long bones (Table 58). No egg shell was recovered, but two pieces were found in the Archaic level of the test excavation in the talus (Akins 1997:55).

Site Structure

Table 58. Distribution of turkey and large bird body parts and burning

Part	Late Ceramic		Mixed Ceramic		Early Ceramic		Archaic (shelter)		Archaic (talus)	
	No.	%	No.	%	No.	%	No.	%	No.	%
Long bone	-	-	14	36.8%	19	39.6%	1	25.0%	10	76.9%
Flat bone	-	-	3	7.9%	-	-	1	25.0%	-	-
Cranial	-	-	-	-	1	2.1%	-	-	-	-
Thorax	-	-	-	-	1	2.1%	-	-	-	-
Pelvis	-	-	1	2.6%	-	-	-	-	-	-
Wing	-	-	-	-	-	-	-	-	-	-
Humerus	-	-	1	2.6%	5	10.4%	-	-	2	15.4%
Radius	1	100.0%	3	7.9%	-	-	1	25.0%	-	-
Ulna	-	-	-	-	2	4.2%	-	-	-	-
Rear leg	-	-	-	-	-	-	-	-	-	-
Femur	-	-	3	7.9%	6	12.5%	-	-	-	-
Tibiotarsus	-	-	4	10.5%	2	4.2%	1	25.0%	1	7.7%
Fibula	-	-	1	2.6%	1	2.1%	-	-	-	-
Tarsometatarsus	-	-	4	10.5%	5	10.4%	-	-	-	-
Muscle splint	-	-	-	-	3	6.3%	-	-	-	-
Rear foot	-	-	4	10.5%	3	6.3%	-	-	-	-
Total	1	100.0%	38	100.0%	48	100.0%	4	100.0%	13	100.0%
Burn type	-	-	-	-	-	-	-	-	-	-
Unburned	1	100.0%	30	78.9%	29	60.4%	3	75.0%	7	53.8%
Roasting burn	-	-	3	7.9%	8	16.7%	-	-	-	-
Dry burn	-	-	-	-	-	-	-	-	1	7.7%
Intermediate burn	-	-	4	10.5%	9	18.8%	1	25.0%	3	23.1%
Discard burn	-	-	1	2.6%	2	4.2%	-	-	2	15.4%
Total	1	100.0%	38	100.0%	48	100.0%	4	100.0%	13	100.0%

As a general rule, the longer the time spent in a place, the more diverse the activities performed there and the more effort put into cleaning and site maintenance (Binford 1983b:190). Small groups stopping overnight or long enough to rest and eat would be less motivated to keep the shelter free of debris and deposit refuse away from the rest area than a group using it for a more extended time as a base camp for gathering or hunting. The absence of storage features and few fire pits suggest that most use of the shelter was short-term but repeated. Cleaning behavior is examined by comparing the shelter and talus deposits.

When deposits within the shelter are examined (Table 59), the three time groups differ in many respects. The upper or late Ceramic period assemblage has by far the most rodent and carnivore remains and slightly more rabbit/small mammal bone. Some of the rodents and carnivores are undoubtedly more recent additions to the archaeological assemblage, which is also reflected in the greater proportions of complete and nearly complete bones and smaller amounts of environmentally altered bone. More bone is roasted, and considerable amounts have discard burns. More of the artiodactyl bone (Table 60) is identified to a particular part, more is roasted, and a greater proportion displays some form of processing. Fewer are very fragmentary or heavily burned. This combination of more compete, more identifiable parts, more roasted, and more processed bone in the late ceramic assemblage could mean that less attention was paid to maintaining the shelter and less time was spent there.

Characteristics of the early Ceramic period assemblage from within the shelter are intermediate between those dating to the late ceramic and Archaic periods in most respects. The main deviation is in animal use, where turkey (Table 59) frequencies peak at this time. Otherwise, compared to the later period, the bone is more fragmented, has more environmental alteration, and is about as likely to be burned as the later bone, but the proportion of intermediate and discard burns is greater. The same is true of artiodactyl remains (Table 60).

A comparison of the early Ceramic period shelter bone with the Ceramic period bone in the talus (Table 61) shows that bone in the shelter tends to be damaged by precipitates, while that outside the shelter is pitted, and less of the talus bone is burned. However, nothing

Table 59. Faunal remains from within shelter

	Late Ceramic		Early Ceramic		Archaic	
	No.	%	No.	%	No.	%
Sample Size	107		274		158	
Animal group						
Rabbit/small mammal	7	6.5%	11	4.0%	1	0.6%
Rodent	17	15.9%	5	1.8%	2	1.3%
Carnivore	14	13.1%	8	2.9%	4	2.5%
Artiodactyl	62	57.9%	177	64.6%	126	79.7%
Wild bird	1	0.9%	1	0.4%	-	-
Turkey/large bird	1	0.9%	48	17.5%	4	2.5%
Other	5	4.7%	24	8.8%	21	13.3%
Completeness						
Complete	14	13.1%	7	2.6%	-	-
>75% complete	16	15.0%	10	3.6%	3	1.9%
50-75% complete	5	4.7%	11	4.0%	1	0.6%
25-50% complete	7	6.5%	16	5.8%	3	1.9%
<25% complete	65	60.7%	230	83.9%	151	95.6%
Environmental alteration						
None	69	64.5%	76	27.7%	38	24.1%
Pitting/corrosion	10	9.3%	62	22.6%	48	30.4%
Checked/exfoliated	6	5.6%	16	5.8%	14	8.9%
Root etched	6	5.6%	21	7.7%	9	5.7%
Polished/rounded	3	2.8%	1	0.4%	-	-
Fresh/greasy	1	0.9%	-	-	-	-
Precipitate damage	11	10.3%	98	35.8%	49	31.0%
Adhering tissue	1	0.9%	-	-	-	-
Burn type						
Unburned	63	58.9%	162	59.1%	106	67.1%
Roasting burn	19	17.8%	23	8.4%	3	1.9%
Dry burn	1	0.9%	3	1.1%	1	0.6%
Intermediate burn	9	8.4%	44	16.1%	23	14.6%
Discard burn	15	14.0%	42	15.3%	25	15.8%

Table 60. Artiodactyl bone from within shelter

	Late Ceramic		Early Ceramic		Archaic	
	No.	%	No.	%	No.	%
Sample Size	59		172		122	
Part						
Long bone	28	47.5%	100	58.1%	81	66.4%
Flat bone	-	-	6	3.5%	5	4.1%
Antler	-	-	1	0.6%	2	1.6%
Cranial	3	5.1%	3	1.7%	1	0.8%
Vertebral	1	1.7%	1	0.6%	-	-
Thorax	10	16.9%	12	7.0%	8	6.6%
Pelvis	5	8.5%	-	-	1	0.8%
Front limb	4	6.8%	17	9.9%	5	4.1%
Front foot	1	1.7%	7	4.1%	2	1.6%
Rear leg	4	6.8%	14	8.1%	6	4.9%
Rear foot	3	5.1%	7	4.1%	5	4.1%
Foot	-	-	4	2.3%	6	4.9%
Completeness						
Complete	1	1.7%	2	1.2%	-	-
>75% complete	1	1.7%	2	1.2%	1	0.8%
50-75% complete	1	1.7%	3	1.7%	-	-
25-50% complete	3	5.1%	4	2.3%	-	-
<25% complete	53	89.8%	161	93.6%	121	99.2%
Burn type						
Unburned	28	47.5%	106	61.6%	83	68.0%
Roasting burn	15	25.4%	10	5.8%	3	2.5%
Dry burn	1	1.7%	3	1.7%	1	0.8%
Intermediate burn	6	10.2%	26	15.1%	16	13.1%
Discard burn	9	15.3%	27	15.7%	19	15.6%

Table 61. Early Ceramic shelter and talus deposits

	Shelter		Talus	
	No.	%	No.	%
Sample Size	274		172	
Animal group				
Rabbit/small mammal	11	4.0%	3	1.7%
Rodent	5	1.8%	5	2.9%
Carnivore	8	2.9%	2	1.2%
Artiodactyl	177	64.6%	108	62.8%
Wild bird	1	0.4%	1	0.6%
Turkey/large bird	48	17.5%	38	22.1%
Other	24	8.8%	15	8.7%
Completeness				
Complete	7	2.6%	8	4.7%
>75% complete	10	3.6%	5	2.9%
50-75% complete	11	4.0%	7	4.1%
25-50% complete	16	5.8%	5	2.9%
<25% complete	230	83.9%	147	85.5%
Environmental alteration				
None	76	27.7%	38	22.1%
Pitting/corrosion	62	22.6%	77	44.8%
Checked/exfoliated	16	5.8%	23	13.4%
Root etched	21	7.7%	24	14.0%
Polished/rounded	1	0.4%	1	0.6%
Precipitate damage	98	35.8%	9	5.2%
Burn type				
Unburned	28	10.2%	106	61.6%
Roasting burn	15	5.5%	10	5.8%
Dry burn	1	0.4%	3	1.7%
Intermediate burn	6	2.2%	26	15.1%
Discard burn	9	3.3%	27	15.7%

suggests major differences in what was deposited inside and outside the shelter. The artiodactyl bone differs some in the parts found. More fragmented long bones are found outside the shelter, while more ribs, flat bones, and limbs were discarded in the shelter. Slightly more bone is fragmentary and burned in the talus deposits, and fewer pieces have alteration (Table 62). While preservation, screen size, and the addition of feature bone to the shelter assemblage influence these results, there are no obvious patterns that suggest a great deal of deliberate maintenance of the shelter area.

Archaic bones from within the shelter are more likely to be from artiodactyls, are more fragmentary, and are most often environmentally altered, but they are the least burned of the shelter bone assemblages (Table 59). Similarly, artiodactyl bones from outside the shelter are more often unidentifiable long-bone shaft fragments, are almost always fragmentary, are less often burned, and, largely because of the environmental alteration, have little evidence of processing (Table 60). Unlike the early Ceramic period deposits, where more bone was found in the shelter than the talus, over twice as much bone was recovered from Archaic talus deposits than from within the shelter even though a larger screen size was used. This in itself could suggest more maintenance, and by extension, that more time was spent at this location in the Archaic than during the early Ceramic period. Otherwise, except for the kinds of environmental alteration, the shelter and talus assemblages are quite similar (Table 63). Archaic bones from within the shelter are more likely to be from artiodactyls, are more fragmentary, and are most often environmentally altered, but are the least burned of the shelter bone assemblages (Table 59). Similarly, artiodactyl bones from the shelter are more often unidentifiable long-bone shaft fragments, are almost always fragmentary, are less often burned, and largely because of the environmental alteration, have little evidence of processing (Table 64).

A comparison of the Archaic talus bone with that from the Ceramic period (Table 65) shows some fairly major differences in the animal group proportions. The Archaic talus deposits have slightly fewer rabbits (-0.8), rodents (-.1.3), carnivores (-0.3), and wild birds (-0.6), and far less turkey/large bird (-18.1). In the Archaic shelter deposits, the difference for rabbits is larger (-3.4), that for rodents is even smaller (-0.5), and that for carnivores slightly larger (-0.4), and it is not as great for turkey/large bird (-15.0) (Table 59). The Archaic bone is more fragmentary, less well preserved, and less often burned (Table 65). Artiodactyl body parts (Table 66) are more diverse in the Archaic assemblage, but slightly more bone is more fragmented. The amount of burning and processing is similar. Again, this confirms that a main difference between these two assemblages is the greater use of turkeys in the early Ceramic period. Only the relative shelter/talus counts suggest any difference in disposal and maintenance practices. Archaic groups placed considerably more material on the talus, which could suggest they spent more time at the shelter. However, none of the groups utilizing the shelter appear to have spent enough time to generate large amounts of bone debris that would require extensive maintenance behavior.

Summary of Animal Use Patterns

Late Ceramic Period

The faunal assemblage recovered from the late Ceramic period deposits probably results from the shelter's use as a logistic camp occupied by hunting parties based in more permanent agricultural communities in the Sierra Blanca and Pecos Valley regions to the north and east. Several aspects of this assemblage suggest that groups or individuals spent less time at this location than in earlier periods. Overall, little bone was recovered from these deposits. Taking the information in

Table 62. Artiodactyl bone in Early Ceramic shelter and talus deposits

	Shelter		Talus	
	No.	%	No.	%
Sample Size	172		103	
Part				
Long bone	100	58.1%	71	68.9%
Flat bone	6	3.5%	2	1.9%
Antler	1	0.6%	1	1.0%
Cranial	3	1.7%	3	2.9%
Vertebral	1	0.6%	-	-
Thorax	12	7.0%	5	4.9%
Front limb	17	9.9%	6	5.8%
Front foot	7	4.1%	3	2.9%
Rear leg	14	8.1%	3	2.9%
Rear foot	7	4.1%	7	6.8%
Foot	4	2.3%	2	1.9%
Completeness				
Complete	2	1.2%	2	1.9%
>75% complete	2	1.2%	-	-
50-75% complete	3	1.7%	-	-
25-50% complete	4	2.3%	2	1.9%
<25% complete	161	93.6%	99	96.1%
Burn type				
Unburned	106	61.6%	70	68.0%
Roasting burn	10	5.8%	7	6.8%
Dry burn	3	1.7%	1	1.0%
Intermediate burn	26	15.1%	17	16.5%
Discard burn	27	15.7%	8	7.8%

Table 63. Archaic shelter and talus bone assemblages

	Shelter		Talus	
	No.	%	No.	%
Sample Size	158		321	
Animal group				
Rabbit/small mammal	1	0.6%	3	0.9%
Rodent	2	1.3%	5	1.6%
Carnivore	4	2.5%	3	0.9%
Artiodactyl	126	79.7%	246	76.6%
Turkey/large bird	4	2.5%	13	4.0%
Other	21	13.3%	51	15.9%
Completeness				
Complete	-	-	1	0.3%
>75% complete	3	1.9%	2	0.6%
50-75% complete	1	0.6%	4	1.2%
25-50% complete	3	1.9%	7	2.2%
<25% complete	151	95.6%	307	95.6%
Environmental alteration				
None	38	24.1%	55	17.1%
Pitting/corrosion	48	30.4%	172	53.6%
Checked/exfoliated	14	8.9%	28	8.7%
Root etched	9	5.7%	45	14.0%
Precipitate damage	49	31.0%	21	6.5%
Burn type				
Unburned	106	67.1%	223	69.5%
Roasting burn	3	1.9%	21	6.5%
Dry burn	1	0.6%	9	2.8%
Intermediate burn	23	14.6%	35	10.9%
Discard burn	25	15.8%	33	10.3%

Table 64. Archaic artiodactyl bone

	Shelter		Talus	
	No.	%	No.	%
Sample Size	122		230	
Part				
Long bone	81	66.4%	143	62.2%
Flat bone	5	4.1%	7	3.0%
Antler	2	1.6%	2	0.9%
Cranial	1	0.8%	7	3.0%
Vertebral	-	-	5	2.2%
Thorax	8	6.6%	19	8.3%
Pelvis	1	0.8%	3	1.3%
Front limb	5	4.1%	17	7.4%
Front foot	2	1.6%	3	1.3%
Rear leg	6	4.9%	8	3.5%
Rear foot	5	4.1%	6	2.6%
Foot	6	4.9%	10	4.3%
Completeness				
>75% complete	1	0.8%	1	0.4%
50-75% complete	-	-	1	0.4%
25-50% complete	-	-	4	1.7%
<25% complete	121	99.2%	224	97.4%
Burn type				
Unburned	83	68.0%	157	68.3%
Roasting burn	3	2.5%	15	6.5%
Dry burn	1	0.8%	5	2.2%
Intermediate burn	16	13.1%	29	12.6%
Discard burn	19	15.6%	24	10.4%

Table 65. Ceramic and Archaic talus assemblage

	Shelter		Talus	
	No.	%	No.	%
Sample Size	172		321	
Animal group				
Rabbit/small mammal	3	1.7%	3	0.9%
Rodent	5	2.9%	5	1.6%
Carnivore	2	1.2%	3	0.9%
Artiodactyl	108	62.8%	246	76.6%
Wild bird	1	0.6%		0.0%
Turkey/large bird	38	22.1%	13	4.0%
Other	15	8.7%	51	15.9%
Completeness				
Complete	8	4.7%	1	0.3%
>75% complete	5	2.9%	2	0.6%
50-75% complete	7	4.1%	4	1.2%
25-50% complete	5	2.9%	7	2.2%
<25% complete	147	85.5%	307	95.6%
Environmental alteration				
None	38	22.1%	55	17.1%
Pitting/corrosion	77	44.8%	172	53.6%
Checked/exfoliated	23	13.4%	28	8.7%
Root etched	24	14.0%	45	14.0%
Polished/rounded	1	0.6%		0.0%
Precipitate damage	9	5.2%	21	6.5%
Burn type				
Unburned	125	72.7%	223	69.5%
Roasting burn	11	6.4%	21	6.5%
Dry burn	1	0.6%	9	2.8%
Intermediate burn	23	13.4%	35	10.9%
Discard burn	12	7.0%	33	10.3%

Table 66. Artiodactyl bone from talus

	Shelter		Talus	
	No.	%	No.	%
Sample Size	103		230	
Part				
Long bone	71	68.9%	143	62.2%
Flat bone	2	1.9%	7	3.0%
Antler	1	1.0%	2	0.9%
Cranial	3	2.9%	7	3.0%
Vertebral	-	-	5	2.2%
Thorax	5	4.9%	19	8.3%
Pelvis	-	-	3	1.3%
Front limb	6	5.8%	17	7.4%
Front foot	3	2.9%	3	1.3%
Rear leg	3	2.9%	8	3.5%
Rear foot	7	6.8%	6	2.6%
Foot	2	1.9%	10	4.3%
Completeness				
Complete	2	1.9%	-	-
>75% complete	-	-	1	0.4%
50-75% complete	-	-	1	0.4%
25-50% complete	2	1.9%	4	1.7%
<25% complete	99	96.1%	224	97.4%
Burn type				
Unburned	70	68.0%	157	68.3%
Roasting burn	7	6.8%	15	6.5%
Dry burn	1	1.0%	5	2.2%
Intermediate burn	17	16.5%	29	12.6%
Discard burn	8	7.8%	24	10.4%
Processing type				
Oblique cuts	2	1.9%	1	0.4%
Impact	6	5.8%	8	3.5%
Spiral	2	1.9%	11	4.8%
Chop	-	-	1	0.4%

Table 49 and calculating the relative densities of bone per 10 cm level of fill (Table 67) suggests that less bone was left in the shelter during this period. The overall density is slightly greater than in the talus assemblages, which is to be expected with a larger screen size. When only the artiodactyl bone is considered, the density is even lower than in the Archaic talus deposits.

While at the shelter, groups roasted and ate woodrats, small mammals, and artiodactyl parts. Relative to the other time periods, the artiodactyl bone is less broken up, there are fewer parts represented, and the parts left behind tend to be those that are less likely to be transported. Instead, the parts are those that could be stripped of meat or are waste parts. All this suggests that groups, mainly male hunters from residences at lower elevations, stayed at the shelter, often eating small animals and rodents while hunting deer. Deer may have undergone initial processing at the shelter, but for the most part, the meat was transported back to the residential sites. This is consistent with Driver's (1985:33) finding that in the two larger Sierra Blanca site assemblages (Bonnell and Phillips), the artiodactyl part distribution suggests selection for those with large quantities of meat and large marrow cavities.

Table 67. Relative bone densities

	No. 10 cm Levels	Total Count	Bones/Level	Artiodactyl Count	Artiodactyl Bones/Level
Late Ceramic (shelter)	39.5	107	2.7	62	1.6
Early Ceramic (shelter)	49.5	274	5.5	177	3.6
Early Ceramic (talus)	144	172	1.2	108	0.7
Early Ceramic (total)	193.5	446	2.3	285	1.5
Archaic (shelter)	44.5	158	3.5	126	2.8
Archaic (talus)	126	321	2.5	246	1.9
Archaic (total)	170.5	479	2.8	372	2.2

Early Ceramic Period

Several aspects of the early Ceramic period assemblage from the LA 110339 shelter are more consistent with a short-term base camp occupied by small groups of foragers than with a logistic camp produced by more settled groups practicing agriculture. Shelter deposits from this period have the greatest density of bones per 10 cm of fill for all fauna and for artiodactyl bone alone, but the talus deposits have the lowest densities (Table 67). Greater densities and more diverse activities suggest more time was spent at the shelter than earlier, but not enough to require much in the way of shelter cleaning and maintenance. Little of the artiodactyl bone appears to have been roasted; rather this cooking method was used for rabbits, rodents, and turkeys. Recovered artiodactyl parts suggest consumption of some of the more valued parts and processing for both marrow and grease. Using the shelter as a base camp, the group may have subsisted on small animals and turkeys found in the general vicinity while hunting deer. Once a deer was taken, the meatier parts were consumed, marrow extracted, and the cancellous bones crushed to make marrow. The lack of storage facilities suggests they did not stay long and soon moved on to other resources. The presence of fetal or newborn and a nearly six-month-old deer indicates that the shelter was used in more than one season, at least late spring or early summer and late fall into early spring. The juvenile turkey also suggests a fall occupation. No other time groups have this range of variability, and it could mean that the shelter was used during more seasons during this period, or it could simply mean that early Ceramic period groups were less discriminating about the animals they took. Other groups could have focused more on mature animals, especially bucks, and used the shelter during the same range of seasons.

Archaic Period

If bone densities are an indication of the length of time or intensity of use, then the Archaic deposits show a much less intense use of the shelter than during the early Ceramic period. However, more maintenance activity is indicated because over twice as much bone found its way into the talus deposits. The combined densities (Table 67) are greater than that for the early Ceramic period. Greater densities and more activities (also seen in the worked bone assemblage) suggest that Archaic groups spent more time at the shelter than later groups and while there engaged in a wider variety of activities.

Archaic groups using the shelter appear to have relied less on smaller animals and concentrated on deer. The greater amount of artiodactyl bone, more diversity in the parts found, and the higher mean transport utility index suggest that large parts of animals were processed and consumed at the shelter. The apparent absence of storage facilities and other features suggests that Archaic stays at the shelter were short, while the diversity of activities is more consistent with a base camp for foraging groups than a hunting camp.

Regional Perspectives

Late Ceramic (Glencoe and Lincoln Phase)

Evidence of use of the highlands, especially for hunting, during the Ceramic period is documented by surveys in the Lincoln National Forest (Spoerl 1985:40) and Mescalero Apache tribal land (Broster 1980b:130-131) south of the project area. While these large block surveys are concentrated in the area south of the site, most of the excavations with detailed faunal data are to the north and east. Assemblages from late Ceramic period upland residential sites in the Sierra Blanca region (Table 68) studied by Driver (1985:42-45) and Speth and Scott (1992:261) generally have high counts and proportions of medium artiodactyl and likely medium artiodactyl bones. Yet, another site in this area (the Angus site, LA 3334) has relatively little medium artiodactyl bone and abundant cottontail rabbit bones, suggesting a different animal procurement strategy, primarily garden hunting (Moga and Akins 2000:201). In this small sample, the higher-elevation sites have considerable amounts of medium artiodactyl bone, and it is almost all deer (LA 110339 and Crockett Canyon). When lower-elevation sites (Phillips and Block) have large amounts of medium artiodactyl bone, it is mostly pronghorn. The two sites at the lowest elevation (Bonnell and Angus) have the least medium artiodactyl bone and largest proportions of cottontails and jackrabbits. In all of the assemblages, cottontail rabbits greatly outnumber jackrabbits, which is also shown in the lagomorph index, which compares the amount of cottontail bone to the total amount of rabbit bone and undoubtedly reflects the habitat preference of the two species. Sites with the largest artiodactyl indices, which here compares the amount of medium artiodactyl bone to the sum of the artiodactyl and rabbit bone, are those at the highest elevations or those that have a greater concentration of pronghorn.

It is difficult to draw conclusions concerning chronological changes given the lack of chronometric dates, long occupations at all of the sites, and the differing architectural types and their implications. Like Driver (1985:59), I suspect the choice of which species of artiodactyl to exploit largely depended on the local environment. Phillips and Block border the flat grasslands inhabited by pronghorn, while Bonnell, Crockett, and Angus are in dissected areas more favorable to deer (Driver 1985:54). Any of the more southern groups could have included LA 110339 within their range of logistic hunts. The fact that these groups depended on logistic hunts may indicate that the surrounding population was sufficient to deplete the large game in the immediate vicinity, especially at lower elevations, where deer may have been less numerous to begin with.

Early Ceramic

Table 68. Comparison of Late Ceramic faunal assemblages from nearby sites

Site	LA 110339	Bonnell	Phillips	Block	Crockett North	Crockett South	Angus
Site type	shelter	residential	residential	residential	residential	residential	residential
Elevation (m)	2120	1756	2084		2126	2126	2088
Phase		Glencoe	Lincoln	Lincoln	Glencoe	Glencoe	Late Glencoe
Sample composition	shelter deposits	pithouse, jacal rooms	surface rooms	adobe rooms, kiva	rooms and pit structures		rooms, pit structures, kiva
Sample size	107	5826	2889	770	329	4243	1030
Medium artiodactyl (n)	62	1982	2327	440	153	1762	151
% medium artiodactyl	57.9%	34.0%	80.5%	57.1%	46.5%	41.5%	14.7%
Deer	16	152	100	18	25	404	20
% deer	15.0%	2.6%	3.5%	2.3%	7.6%	9.5%	1.9%
Pronghorn	-	82	333	60	-	3	11
% pronghorn	-	1.4%	11.5%	7.8%	-	0.1%	1.1%
Cottontail	5	1036	158	25	14	495	342
% cottontail	4.7%	17.8%	5.5%	3.2%	4.3%	11.7%	33.2%
Jackrabbit	1	250	51	9	5	142	104
% jackrabbit	0.9%	4.3%	1.8%	1.2%	1.5%	3.3%	10.1%
Lagomorph index	0.83	0.80	0.76	0.73	0.74	0.78	0.77
Artiodactyl index	0.91	0.61	0.92	0.93	0.89	0.73	0.25

Sources of faunal data: this report; Driver (1985:42, 44); Speth and Scott (1992: 278-279); Moga and Akins (2000:188).

Much less is known about the early part of the Ceramic period, and no information comes from the general project area. Recent excavations at the Townsend site along Salt Creek just north of Roswell suggests that at least some of theses groups maintained a good deal of mobility. They built shallow brush structures but no storage facilities and appear to have stayed longer at that particular location than the Archaic groups before them. Yet, they still practiced an essentially forager strategy of moving families or small groups from one base camp to another as resources became depleted or a more attractive resource became available at another location. Concentrating on local resources, animal subsistence centered around a diverse array of small forms, and bone was often burned and highly fragmented. While corn was present, it occurred in few samples, along with an array of weedy annuals, mesquite, and prickly pear (Akins 2003).

These or similar groups may have included the Sacramento Mountains within their range of foraging sites as they moved between the Pecos Valley and Tularosa Basin along what is now the U.S. 70 corridor. This route, from the Pecos River at Roswell to Tularosa, a distance of about 170 km, is well within the annual range of ethnographic groups primarily dependent on plant resources. Taking the mean number of moves per year (12.64 ± 9.90) and mean kilometers per move (25.49 ± 13.70) (Binford 2001:278), these groups moved on average 322 km (range 32-883 km) per year. The range for North American groups in desert and desert scrub environs ranges from 11.3 km in 2 moves for the Ownes Valley Paiute to 507 km in 14 moves by the Grouse Creek Shoshoni (Binford 2001:272-273).

Given the probability that early ceramic groups were quite mobile and largely dependent on wild plant resources, they probably moved a number of times each year and may have stayed longer in areas with abundant plant growth. Since they relied on the resources available at each successive camp, it is not surprising that the composition of faunal assemblages from the Pecos Valley are distinctly different from those at higher-elevation sites.

Archaic

Archaic subsistence and mobility was probably much like that of early Ceramic period groups—foraging on local resources but over a larger area, since population densities were not as great—and they were probably more dependent on large animal resources than later groups. In Pecos Valleys sites, such as Townsend, subsistence was fairly balanced between artiodactyls and small animals (Akins 2003), but at sites in mountain environs, artiodactyls far outnumber any smaller forms (Wimberly and Eidenbach 1981:25; Roney 1985:72; Akins in prep.).

Contrasting Archaic with Ceramic period site survey data from high elevations of the Sacramento Mountains just south of LA 110339, Broster and Harrill conclude, based on isolated finds and lithic artifact data, that Archaic groups returned to the same sites more than later groups. Archaic base camps were more frequently in high-altitude areas and closer to the areas hunted. Archaic hunters stayed longer at these sites, while Ceramic period groups used the higher elevations for short-term expeditions by small groups of hunters (Broster 1980b:130-131; Broster and Harrill 1983:165).

Recent work at High Rolls Cave, on the Tularosa Basin side of the Sacramento Mountains and about 48 km to the southwest of LA 110339, documents changing Archaic subsistence from 1700 to 1000 B.C. The faunal evidence suggests increasing human population densities caused a greater degree of intensification through time. The oldest deposits have the most artiodactyl bone, and the distribution of parts suggests that complete or nearly complete artiodactyls were brought to the cave and heavily processed. In the intermediate-dated deposits, there is more diversity, and rabbits and turkeys contributed more to the faunal assemblage. Artiodactyls were still brought to the cave as complete or nearly complete animals but may not have been as intensively processed as before. In the latest deposits, probably those most comparable to the LA 110339 Archaic assemblage, an even greater proportion of the assemblage is from rabbits, suggesting more use of smaller animals and more species. Yet in artiodactyl procurement, the focus during this latest use seems to have been more on deer. Pronghorn and bighorn contribute less of the assemblage. Bone continued to be heavily processed, perhaps even more so than in the intermediate period (Akins 2003).

With storage facilities, and more indications that it functioned as a longer-term camp occupied intermittently throughout most or all seasons, High Rolls Cave contrasts with the LA 110339 shelter assemblage in a variety of ways. Pronghorn and bighorn were hunted and returned to High Rolls Cave, while at LA 110339, deer is the only artiodactyl represented, suggesting hunters did not range as far to take artiodactyls. Unlike High Rolls Cave, where most strata had animals that were killed in winter, it is less likely that winter months were spent at the shelter, given its higher elevation, colder temperatures, and snowfall. Much more of the LA 110339 bone displays discard burns (15.8 percent, plus the 14.6 percent with intermediate burns) compared to a single calcined burn in the sample of 142 from High Rolls Cave. The amount of fragmentary bone (less than

25 percent of the element) is virtually identical at the two sites (95.8 percent at High Rolls Cave and 95.6 percent in the shelter at LA 110339).

Faunal assemblages from these two shelter sites, as well as lower-elevation sites like Townsend, indicate that Archaic groups generally concentrated on locally available resources, used more artiodactyls, and were probably more mobile than groups who followed. Again, LA 110339 was ideally positioned for short-term resource extraction, mainly hunting deer, by groups passing between the Pecos Valley and Tularosa Basin.

Worked Bone

Worked bone was rare. Only ten items have visible signs of modification or use (Table 69). More may have been worked or utilized, but pitting and corrosion badly damaged the surfaces and ends of many pieces of bone, possibly eliminating any evidence of modification or wear. The worked bone was analyzed following an established OAS format that records basic provenience information; taxon; element; side; element portion; tool condition; tool completeness; heat alteration; the item or tool type; the modification, shape, and cross section of the proximal end, shaft, and butt end; additional modification such as drill holes; wear; and a variety of measurements when a dimension is complete.

Tool types mostly follow Kidder's (1932:200-287) classification developed for the Pecos Pueblo collection. *Fragmentary* was used for two fragments that are too incomplete to determine the tool type. Awls are classified on the basis of tip size. Fine-point awls (Fig. 50) were presumably used for puncturing materials such as leather or fibers in making baskets (Beach and Causey 1984:191-192). Spatulate tools have a convex and often beveled end and were probably used for scraping a variety of materials such as hides or plant material. The tube and bead distinction is made on the basis of the relative diameter with respect to the length rather than overall size. While the two tubular bone objects from LA 110339 are classified as tubes because they are long relative to the diameter, they are small—probably beads (Fig. 51). The flaker is the tip of an antler with a distinct bevel that could have been used for flaking (Fig. 52), especially notching projectile points (Jim Moore, pers. comm., September 2002). The final object is a complete deer metacarpal that has two holes in the proximal end (Fig. 53). The holes have no obvious evidence of drilling and do not seem to have joined as they would if the purpose had been suspension. The function of this object remains unknown.

Figure 50. Fine-point awl.

Table 69. Worked bone

Period / Feature	Tool Type	Completeness	Taxon	Count
Late Ceramic	Spatulate	Complete	Deer	1
Mixed Ceramic	Spatulate	Distal	Medium artiodactyl	1
	Unknown function	Complete	Deer	1
Early Ceramic	Fragmentary	Medial or lateral	Medium artiodactyl	1
Feature 4	Fragmentary	Medial or lateral	Turkey	1
Archaic (shelter)	Fine point awl	Complete	Deer	1
	Tubular bead	End	Small mammal	1
Archaic (talus)	Spatulate	Distal	Medium artiodactyl	1
	Tubular bead	Complete	Jackrabbit	1
	Antler flaker	Distal	Deer	1

As with the general faunal assemblage, the Archaic deposits have the most worked bone and the most diversity (Table 69). These are equally divided between shelter and talus deposit proveniences. Spatulate-ended tools are the only type found in more than one time group. Most of the worked bone objects are made from

Figure 51. Bone tubes.

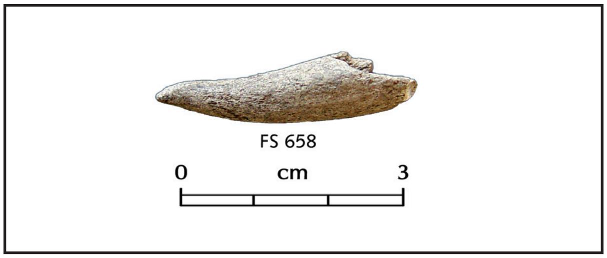

Figure 52. Antler flaker.

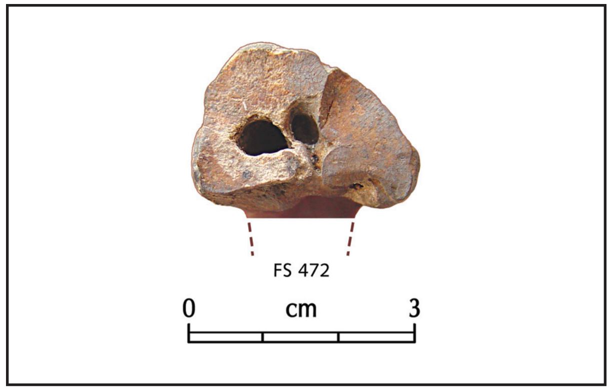

Figure 53. Altered deer metacarpal.

the bones of large animals (deer and medium artiodactyls) with the exception of single items of turkey and rabbit bone. Few are complete; rather, most were probably broken in use and discarded. All are in good condition, although the antler flaker is calcined, the turkey bone tool fragment has a graded, mostly heavy burn, and the jackrabbit tubular bead is scorched.

When modified, grinding and polish are the most common type of modification (Table 70). Distal or working ends received the most attention, although some of the polish could be from use rather than deliberate modification. Only the problematical deer metacarpal has any other form of modification. In this assemblage, wear is limited to polish, transverse striations, and a small use-spall on the end of the antler flaker. The complete measurements of each tool are found in Table 71.

With the possible exception of the problematical metacarpal, the bone objects are some of the more common forms found in prehistoric sites. Most are expediently made generalized forms that could have been used for a variety of functions. Spatulate-ended objects are the only tool form found in all time-group deposits (Fig. 54), possibly because they are hunting and animal-processing tools that reflect the primary use of the shelter as a base for hunting deer. Small tubular beads are found throughout the time span, beginning in the Archaic. Similar objects were found in Archaic levels at Bat Cave (Dick 1975:65) and Ventana Cave (Haury 1975: Table 31) but are absent from High Rolls Cave (Moga in prep.).

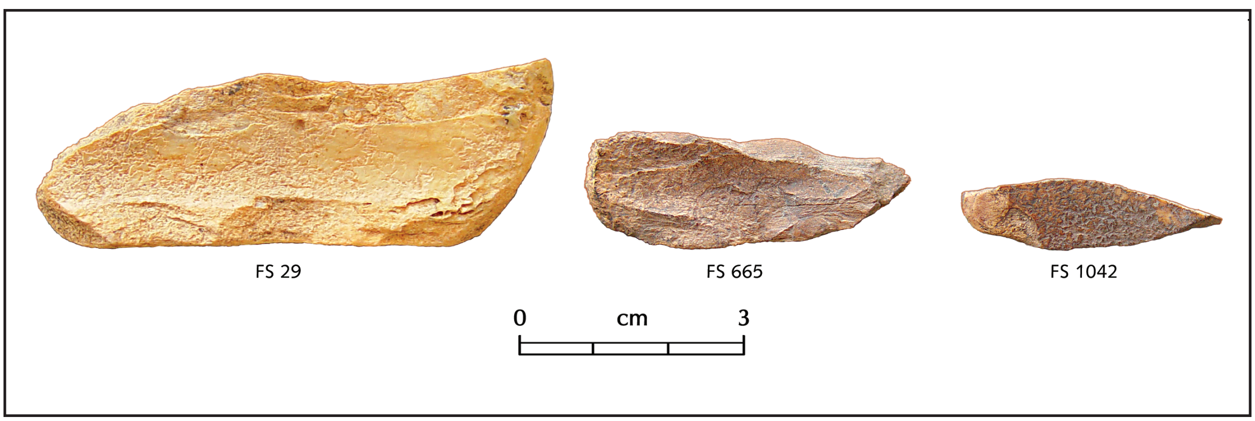

Figure 54. Spatulate-ended tools.

Table 70. Worked bone modification and wear

Period	Tool Type	Proximal Modification	Shaft Modification	Distal Modification	Other Modification	Primary Wear	Other Wear	Count
Late Ceramic								
	Spatulate	Unmodified break	Flaked/chipped	Polished/ground, moderate	None	Polish	Transverse striations	1
Mixed Ceramic								
	Spatulate	Missing	Unmodified	Polished/ground, minimal	None	Unknown (broken)	-	1
	Unknown function	Unmodified natural end	Unmodified	Unmodified	Holes	None	-	1
Early Ceramic								
	Fragmentary	Missing	Unknown	Polished/ground moderate	Unknown	Polish	-	1
	Fragmentary	-	Polished/ground, well shaped	Unknown	Unknown	Unknown (broken)	-	1
Archaic (shelter)								
	Fine point awl	Unmodified break	Unmodified	Polished/ground, completely modified	None	Transverse striations	Polish	1
	Tubular bead	Polished/ground, moderate	Unknown	Unknown	Unknown	None	-	1
Archaic (talus)								
	Spatulate	Missing	Unknown	Polished/ground, well shaped	Unknown	Polish	-	1
	Tubular bead	Polished/ground, moderate	Polished/ground, minimal	Polished/ground, minimal	None	None	-	1
	Antler flaker	Missing	Unmodified	Polished/ground, minimal	None	Flaking or spalling	-	1

Table 71. Complete measurements of worked bone (mm)

Period	Tool Type	Length	Functional Length	Proximal Width	Midshaft Width	Distal Width	Tip Width	Proximal Thickness	Midshaft Thickness	Distal Thickness	Count
Late Ceramic	Spatulate	69.8	24.2	8.9	21.4	21.9	-	5.4	5.7	4.5	1
Mixed Ceramic	Spatulate	-	-	-	-	-	-	-	-	2.8	1
	Unknown function	-	-	-	-	-	-	-	-	-	1
Early Ceramic	Fragmentary	-	-	-	-	-	-	-	-	-	2
Archaic (shelter)	Fine point awl	79.3	18	3.1	11.3	9.8	0.96	2.4	6.3	5	1
	Tubular bead	-	-	6.4	-	-	-	4.6	-	-	1
Archaic (talus)	Spatulate	-	-	-	-	-	-	-	-	3.2	1
	Tubular bead	23.8	-	6.7	6.7	6.4	-	6.2	6.3	6	1
	Antler flaker	-	4.9	-	8.5	4.1	1.4	-	8	1	1

HUMAN REMAINS

Nancy J. Akins

Portions of two individuals were recovered from the excavations at the shelter. One is a mostly complete burial of a child within the shelter, and the other is the scattered remains of a large individual, probably an adult male from the talus deposits. The child was immediately taken for reburial and was not analyzed. Photographs indicate a relatively complete individual. One permanent maxillary molar may have erupted, and the mandibular incisors are missing and may have been lost. At least one deciduous maxillary incisor appears to be in place. These factors suggest a child of 6 ± 2 years of age.

The remains of the adult male were not recognized as human bones during the excavation. They were found in seven separate grid units and collected in bags labeled "nonhuman bone." The bones concentrated in talus grids 95-96N/99-101E at elevations between 230 and 250 cm bd. A single adult rib shaft fragment found in grid 99N/97E at a higher elevation is similar in size, development, and preservation to the other adult bones. A child rib fragment was found in the vicinity of the child burial at 100N/100E, 210-220 cm bd.

Most bags contained a number of anatomically related parts (Table 72) and are consistent with a single disturbed adult male burial. Recovered parts include some of the cervical and thoracic vertebra, several ribs, most of the left shoulder, arm, and hand, and two teeth. The bone is in good condition except that some bones are partially dissolved by soil conditions, and some of the ribs were broken, possibly during excavation.

Methods

The adult remains were analyzed following the protocol established in Buikstra and Ubelaker (1994:4) This format collects data in a systematic fashion that aids in gathering information on demography, health, interment procedures, diet, and genetic relationships that provide information on the lifeways of prehistoric populations. Definitions and scoring follow those used in this manual.

Age and Sex

None of the parts that provide the more precise indicators of age or sex were recovered for this individual. The remains are those of a fairly large and robust individual, and the measurements, generally in the range of males found at nearby sites, strongly suggest a male. The age is more problematic. Slight degrees of lipping are present on most joint surfaces as well as some pinpoint surface porosity. Periarticular resorptive foci are present around the proximal humerus articular surface and on the ends of the clavicle. This slight amount of lipping as well as almost no wear on the maxillary third molar suggest a relatively young individual, probably 20 to 35 years of age. However, the pinpoint surface porosity and steep beveled wear on the maxillary central incisor may suggest an age on the older end of the spectrum, at least 30 to 40 years.

General Health

Researchers generally look at a variety of skeletal and dental indicators of stress to assess general health. When the population consists of a single adult, the most useful indicators are growth and development (stature and long-bone morphology), enamel defects, dental caries, osteoarthritis, ostophytosis, the presence of trauma, periosteal reactions, and porotic hyperostosis (e.g., Martin 1994:94-95; Larsen 1997:6-63), not all of which could be observed in this individual. Some stress indicators reflect conditions during childhood and are generally due to poor nutrition, population aggregation, and increased infectious diseases (Larsen 1997:61).

Little can be determined about the general health of this individual because so few parts were recovered. In overall size, he is almost always within the range documented for populations from the nearby sites of Angus (LA 3334) (Akins 2001:205), Henderson (Rocek and Speth 1986), and Gran Quivira (Reed 1981:191) (Table 73). The arm bones are long and slender and lack pronounced muscle development. The scapula has a fairly large scapula notch, and the clavicle has a raised attachment for the costoclavicular ligament.

Tooth enamel, especially sensitive to nutritional deficiencies and disease, provides a permanent record of juvenile developmental disturbances (Buikstra and Ubelaker 1994:56; Larsen 1997:44). Dental enamel begins forming in the fourth month in utero and continues to form until the twelfth year (Larsen 1997:48). The permanent incisors are the most sensitive to stressors, producing defects between birth and three years and canines between three and six years (Rose et al. 1985:289). Even minor metabolic disturbances can result in visible changes in tooth enamel, which range from small pits or furrows to large deep groves or large areas of missing enamel. Potential causes of dental

Table 72. Human bone recovered from outside of the shelter

FS No.	Grid	Elevation (cm)	Element	Portion	Comment
81	99N 97E	170-180	rib	shaft fragment	adult
423	100N 100E	210-220	right rib	shaft fragment	infant
557	95N 99E	230-240	left clavicle	complete	large, probably male
			thoracic vertebra 1	partial body and arch	large, probably male
565	96N 101E	230-240	7 right ribs	complete or nearly complete	large, probably male
			2 right rib	shaft fragments	large, probably male
			left rib	shaft fragment	large, probably male
			left metacarpals 3 and 4	complete	large, probably male
574	96N 100E	230-240	left humerus	complete	large, probably male
			left ulna	complete	large, probably male
			left radius	slight damage to ends	large, probably male
			left scapula	slight damage	large, probably male
			5 left ribs	complete or nearly complete	large, probably male
			left rib 1	partial	large, probably male
			cervical vertebra 7	slight damage	large, probably male
			thoracic vertebra 2	arch only	large, probably male
			right maxillary third molar	complete	large, probably male
689	95N 100E	240-250	3 left hand first phalanges	1 with slight damage	large, probably male
			left hand second phalanx	complete	large, probably male
700	96N 101E	240-250	left rib	complete	large, probably male
			left rib	shaft fragment	large, probably male
			right rib	proximal and 2/3 shaft	large, probably male
			right rib	proximal and 1/3 shaft	large, probably male
			2 left hand first phalanges	complete	large, probably male
			left hand third phalanx	complete	large, probably male
			thoracic vertebrae, probably 7-9	body missing from 7; 8 and 9 complete	large, probably male
706	96N 100E	240-250	thoracic vertebra probably 5	arch only	large, probably male
			thoracic vertebra probably 6	slight damage	large, probably male
			cervical vertebra 6	slight damage	large, probably male
			right maxillary central incisor	complete	large, probably male

Table 73. Comparative long-bone measurements

Measurement	LA 110339 (mm)	Angus Males (mm / sample size)	Henderson Males (range in mm / sample size	Gran Quivira Males (range in mm / sample size)
Clavicle: maximum length	164	152/1	133-162/4	144-167/29
Anterior-posterior diameter midshaft	10.1	12/1	-	-
Superior-inferior diameter midshaft	10	10/1	-	-
Scapula: height	est. 164	-	125-151/3	-
Breadth	103.7	-	95-106/2	-
Humerus: maximum length	318.5	296/1	278-339/4	292-325/38
Epicondylar breadth	58.2	-	-	-
Vertical diameter of head	47.2	45/2	38-49/4	38-49/31
Maximum diameter at midshaft	21.5	23/1	20-27/4	-
Minimum diameter at midshaft	11.3	17/1	14-19/4	-
Radius: anterior-posterior diameter midshaft	est. 11.4	-	-	-
Medial-lateral diameter midshaft	est. 11.3	-	-	-
Ulna: maximum length	276.5	-	239-281/4	246-270/23
Anterior-posterior diameter	11.4	14	-	-
Medial-lateral diameter	11.9	16	-	-
Physiological length	251	-	-	-
Minimum circumference	30	37	30-36/4	-

Sources: Angus: Akins (2000:205); Henderson Site: Rocek and Speth (1986:184); Gran Quivira: Reed (1961):191).

defects include relatively rare incidences of hereditary anomalies and localized trauma, and systemic metabolic stress, primarily due to dietary deficiency. Because the metabolic insult affects only that portion of the tooth that is forming, the location of the defect provides a chronological indicator of stress. The age at which the defect was formed is estimated by measuring the distance between the cementoenamel junction and the defect (Larsen 1997:45-50). Enamel opacities are believed to reflect systemic stress but can also be produced by trauma (Buikstra and Ubelaker 1994:56).

With only two teeth from this individual, the record of stress episodes is incomplete. The maxillary central incisor begins forming when an individual is about six months old and is complete by about four years, while the maxillary third molars form between the ages of four and seven or eight years (Buikstra and Ubelaker 1994:51). The molar recovered from LA 110339 has two relatively light hypoplasia lines near the cementoenamel junction, suggesting they formed late in the development of this tooth. The incisor has an area of scattered pits extending from 5.2 mm above the junction to near the occlusal edge of the tooth and probably began forming in the first year of life and continued into the second year. This tooth also has two brown discrete boundary opacities, one overlapping the area of the pits, and the other closer to the cementoenamel junction at 1.95 mm. These would have formed about the second and half way through the third year of life.

Osteoarthritis or degenerative joint disease is influenced by an individual's metabolism, nutrition, bone density, vascular deficiency, infection, trauma, and heredity; however, the primary contributing factor is mechanical stress and physical activity. Osteoarthritis increases with age and shows patterns related to particular physical activities (Larsen 1997:162-163). The individual from LA 110339 has slight or barely discernable lipping on intervertebral and rib facets of the thoracic vertebrae, the proximal ends of the ribs, both the medial and lateral ends of the clavicle, both the proximal and distal ends of the humerus, the proximal end of the ulna, and the proximal ends of the metacarpals. No lipping occurs on the glenoid, and that on the phalanges was so slight it was not recorded as such. Pinpoint porosity or thinning of the cortex on the joint surface was observed on proximal ends of the ribs, both ends of the clavicle, the rib facets on the thoracic vertebrae, and the distal ends of the metacarpals. Only the proximal humerus and the ends of the clavicle have periarticular resorptive foci. Cervical vertebrae six and seven have very slightly elevated rings on the inferior surfaces and elevated rings on the superior surfaces. The thoracic vertebrae also have elevated rings.

None of these conditions suggest that this individual was particularly stressed or provide information on the activities he habitually carried out. The dental defects are fairly light and indicate some low-level and repeated stress episodes. Similarly, the fairly slight amount of osteoarthritis and lack of indications of trauma indicate little stress that would provide information on the activities performed.

Disease Processes

The only evidence of disease process is a small smooth-walled lesion (6.06 by 2.71 mm and 1.8 mm deep) on the interior aspect of a left rib, probably the third or forth, about a third of the way from the proximal end. Resorptive rib lesions can be a sign of tuberculosis. *Mycobacterium tuberculosis* is primarily transmitted by breathing airborne microbes that result in a primary infection in the lung tissue. The vertebra, ribs, and sternum are favored sites of secondary infection. Incidences generally increase with population density and sedentism (Larsen 1997:100-103). The most common and characteristic site of infection is the vertebra, particularly the lower thoracic and lumbar vertebrae (Ortner and Putschar 1985:145). An often cited study of the Hamann-Terry collection dating from the early twentieth century found visceral rib lesions are commonly associated with pulmonary tuberculosis (62 percent of those dying from that disease) and much less common (22 percent) with nontubercular pulmonary diseases (pneumonia, bronchitis, emphysema, and pleurisy) (Mays et al. 2002:28). While not the only cause of rib lesions, tuberculosis is a possibility and one that would suggest this individual was from a late Ceramic period site where the population density was sufficient to maintain this disease.

Dental Observations

Both of the teeth recovered have some unusual aspects. The central incisor has extreme beveled wear to the interior. This wear obscures the amount of lingual shoveling, but it has a score of 5 double (labial) shoveling. In addition to the bevel, the occlusal wear is greater on the distal or lateral side, and the tooth has a small chip in the labial surface. The bevel could have been caused by a severe overbite, or this and the chip could result from using the teeth for a specific task. However, grooves and notches are the more common form of wear on anterior teeth (Milner and Larsen 1991:366-367). No similar wear is reported from Gran Quivira (Reed 1981) or Henderson (Rocek and Speth 1986). Measurements of the crown mesiodistal (9.5 mm) and buccolingual (7.8 mm) diameters are similar to those from Henderson (n = 6 from three individuals, range 8.9-9.7 mm mesiodistal; and n = 4 from three individuals, range 7.6-8.2 buccolingular) (Rocek and Speth 1986:176-177).

The third molar has a small hypocone (score 1) and little wear. Only the mesial portion of the crown is worn, and then the wear is slight (score 1 on a scale of 1 to 10; Buikstra and Ubelaker 1994:53). More unusual is a roughened area or shallow but broad irregular groove on the mesial surface of the root below the cementoenamel junction. Although the groove does not look post-mortem, the rough surface is inconsistent with wear, so it could indeed be taphonomic or could be the beginnings of a carious lesion. Measurements indicate this tooth is larger than those from the small Henderson population. The mesiodistal diameter is10.8 mm compared to a range of 8.5 to 10.5 for five measurements on three individuals, and the buccolingual diameter of 13.0 mm is larger than those of the same five teeth and three individuals, with a range of 10.5 to 12.1 mm.

Conclusions

The remains of the adult male found just outside the shelter suggest an individual who had a fairly healthy childhood. None of the dental defects are severe or indicate prolonged illness, and his overall size is similar to others from southeastern New Mexico. However, this conclusion is based on a small part of the individual. Other teeth (additional dental defects and other indications of dental disease such a caries and abscesses), the rest of the cranium (porotic hyperostosis in orbits and on the parietals and occipital), and leg bones (periostitis) could indicate otherwise. Additional parts might also provide information on the disease that caused the rib lesion. Since he died relatively young, it is possible that he suffered from some chronic disease or infection, but none of the parts recovered indicate a definitive cause of death.

ENVIRONMENTAL AND ECONOMIC PLANT REMAINS

Mollie S. Toll and Pamela J. McBride

Fallen Pine Shelter is a shallow limestone rockshelter located in Cherokee Bill Canyon along U.S. 70, on the Mescalero Apache Reservation south of Ruidoso, New Mexico. Within the shelter, eight distinct occupation levels were identified, but botanical remains were largely lumped into the two broader categories of Archaic and Puebloan eras. A roasting pit, several hearths, and a burial pit were associated with a Puebloan occupation of the shelter, primarily between A.D. 1000 and 1200, but extending to A.D. 1440. Three hearths and a pile of fire-cracked rocks derived from Archaic use of the site (as early as 1410 B.C.). Trash deposits extending about 6 m outside and downhill from the shelter were also examined.

The shelter, located in a canyon at an elevation of 2,141 m (6,980 feet), is surrounded by Madrean montane conifer forest (Brown 1994). The lower elevations of this conifer forest (just above the shelter from about 2,200 or 2,300 m to 2,450 m) are dominated by ponderosa pine (*Pinus ponderosa*). Great Basin conifer woodland (a juniper/piñon woodland characteristic of elevations from 1,500 to 2,200 or 2,300 meters) interfaces with the lower elevational limit of Madrean conifer forest in Cherokee Bill Canyon and to the north near the towns of Alto and Angus. Consequently, junipers and ponderosa pines are in abundance near the shelter, and reproductive and vegetative remains of these conifers (plus piñon) are found throughout the cave deposits. A cooler, mixed forest composed of Douglas fir (*Pseudotsuga menziesii*), quaking aspen (*Populus tremuloides*), and white fir (*Abies concolor*) is characteristic of elevations above 2,450 to 2,600 m, just 8 km to the west and north of Fallen Pine Shelter on the eastern slopes of Sierra Blanca.

Plants observed growing in the shelter environs during the testing phase of the project are listed in Table 74. Ponderosa pine was the dominant coniferous species observed, and scattered alligator junipers also occurred. Dicot shrubs included oak, mountain mahogany, and skunkbush. Non-native elms (*Ulmus pumila*) introduced as landscape trees were fairly common along U.S. 70. Herbaceous plants of economic importance included goosefoot, sunflower, woodsorrel, groundcherry, curly dock, cattail, and yellow salsify. Grasses were not abundant in the densely forested area surrounding the shelter.

Plant remains in the lower, earlier levels of Fallen Pine Shelter consisted of conifer debris (both burned and unburned) and carbonized seeds of a short list of weedy annuals. Three flotation samples and two macrobotanical samples form the basis of what we can say about Archaic plant use. The Puebloan occupation is detailed by seven flotation samples and seven macrobotanical samples. Here the list of floral remains is considerably longer, adding corn, some grasses and cacti, and acorns and squawbush. Abundant packrat (*Neotoma* sp.) scats warn us again of the numerous sources of stratigraphic mixing in these cave deposits.

For comparative purposes, we do not have extensive knowledge of pre-ceramic and Ceramic period occupation of the high elevation areas of the Sacramento Mountains and Sierra Blanca. Sites with detailed botanical analyses are in even shorter supply. Not surprisingly, archaeological analysis from the Archaic period has centered on other cave deposits, such as Fresnal and High Rolls shelters (Bohrer 1972, 1981b, in prep.). Beth's Cave, Feather Cave, and Arrow Grotto have remarkable botanical assemblages, but have been studied only partially to date (e.g., Adams 1997). Sunset Shelters (Toll 1996) in the Hondo Valley provide a perspective from a lower elevation (1,487 meters). For the Puebloan era, we can look at studies from Angus and Angus North (Toll and Donaldson 1992; Toll and McBride 2000), Tortolita Canyon (Holloway 1994), and at slightly lower elevations, the Bent and Abajo de la Cruz sites (1,753 m) and Block Lookout (1,865 m; Ford 1976).

Methods

Flotation

The 10 soil samples collected during excavation were processed at the Museum of New Mexico's Office of Archeological Studies by the simplified "bucket" version of flotation (see Bohrer and Adams 1977). Flotation soil samples ranged in volume from 0.70 to 2.56 liters, with a mean of 1.53. Each sample was immersed in a bucket of water, and a 30-40 second interval allowed for settling out of heavy particles. The solution was then poured through a fine screen (about 0.35 mm mesh) lined with a square of "chiffon" fabric, catching organic materials floating or in suspension. The squares of fabric were lifted out and laid flat on coarse mesh screen trays until the recovered material had dried.

Each sample was sorted using a series of nested geological screens (4, 2, 1, 0.5 mm mesh) and reviewed under a binocular microscope at 7-45x. Charred and uncharred reproductive plant parts (seeds and fruits)

Table 74. Plants observed near Fallen Pine Shelter

Plant Group	Scientific Name	Common Name
Tree and shrubs: conifers	*Juniperus* sp.	juniper
	Juniperus deppeana	alligator juniper
	Pinus ponderosa	ponderosa pine
Trees and shrubs: nonconifers	*Cercocarpus montanus*	mountain mahogany
	Quercus sp.	oak
	Rhus trilobata	skunkbush
	Ulmus pumila	elm
Herbaceous plants	*Achillea lanulosa*	yarrow
	Anoda cristata	anoda
	Aster cf. *pauciflorus*	purple aster
	Campanula sp.	harebell
	Chenopodium sp.	goosefoot
	Cirsium sp.	thistle
	Commelina sp.	day flower
	Convolvulus arvensis	bindweed
	Cosmos cf. *bipinnatus*	cosmos
	Curcurbita foetidissima	coyote gourd
	Dipsacus sylvestris	teasel
	Gaura parviflora	small-flowered gaura
	Geranium caespitosum	purple geranium
	Helianthus sp.	sunflower
	cf. *Hymenopappus biennis*	biennial white ragweed
	cf. *Lepidium montanum*	peppergrass
	Linum lewisii	blue flax
	Oxalis violacea	wood sorrel
	Penstemon sp.	penstemon
	Physalis sp.	groundcherry
	Ratibida columnifera	Mexican hat
	Rumex crispus	curly dock
	Sphaeralcea sp.	globemallow
	Tragopogon dubius	yellow salsify
	Typha angustifolia	cattail
	Verbascum thapsus	mullein
	Verbena sp.	verbena
Grasses	*Bouteloua* sp.	grama grass
	Chloris verticillata	windmill grass
	Panicum capillare	witch grass

were identified and counted. Flotation data are reported as a standardized count of seeds per liter of soil, rather than an actual number of seeds recovered. Relative abundance of nonreproductive plant parts such as pine needles and juniper twigs was estimated per liter of soil processed. To aid the reader in sorting out botanical occurrences of cultural significance from the considerable noise of post-occupational intrusion, data in tables are sorted into categories of *cultural* (all carbonized remains), *possibly cultural* (indeterminate cases, usually of unburned, economically useful taxa found together with burned specimens of the same taxon or found in large numbers), and *noncultural* (unburned materials, especially when of taxa not economically useful, and when found in disturbed contexts together with modern roots, insect parts, scats, or other signs of recent biological activity).

Charcoal Identification

From each flotation sample with at least 20 pieces of wood charcoal present, a sample of 20 pieces was identified (a maximum of 10 pieces from each screen size). In smaller samples, all charcoal from the 4 mm and 2 mm screens was identified. Each piece was snapped to expose a fresh transverse section and identified at 45x. Identified charcoal from each taxon was weighed on a top-loading digital balance to the nearest tenth of a gram and placed in labeled vials or plastic bags. Low-power, incident light identification of wood specimens does not often allow species- or even genus-level precision but can provide reliable information useful in distinguishing broad patterns of utilization of a major resource class

Macrobotanical Samples

Macrobotanical wood specimens (generally bigger pieces than those recovered in flotation samples) were similarly examined. Charcoal was separated by taxon, weighed, and placed in labeled foil packets ready for potential submission for carbon-14 dating.

A single carbonized corncob had a complete circumference and was measured to the nearest 0.1 mm using dial calipers, following parameters detailed in Bird (1994) and Toll and Huckell (1996). Other specimens were identified by taxon and part by comparing them to modern reference specimens. Fragile specimens were wrapped in acid-free tissue and/or polyester fiber and placed in durable archival containers to protect them from further breakage.

Results

Archaic contexts produced charred weedy annual seeds and pine duff (Table 75). The highest taxonomic diversity was found in the hearth and included pigweed, goosefoot, cheno-am, and unidentifiable seeds; pine bark; and cone scales. The wood assemblage from the hearth demonstrated the use of pine, oak, and unknown conifer as fuel wood (Table 76). A fragment of unburned conifer wood was identified in macrobotanical samples (Table 77). Also present was an unburned possible tool, 31.5 mm long and 4.2 mm wide, with notched edges about a third of the way from one end giving a "pinched in" effect. This specimen may have been a tool, but its function could not be determined.

Pueblo period cultural floral remains were most concentrated and diverse in the hearth, two ash areas, and the pit. In all, 19 taxa were encountered, plus four additional taxa in the possibly cultural category (Table 78). However, the hearth was also the locus of the highest concentration of noncultural taxa and large quantities of rodent fecal material, complicating the functional interpretation of plant remains. Of course the corn that was identified in all four features was cultural in origin. However, the large numbers of ponderosa pine needles and cone scales, other coniferous detritus, cactus areolas and seeds, piñon nutshell, and acorn caps easily could have been part of packrat nest material that was burned in an accidental fire and incorporated into hearth fill and/or could represent the remains of food and tinder. The piñon nuts were most likely brought in by humans. There are no piñon trees within easy reach of the site at present, and the pollen record indicates that the mesic conditions which today support a ponderosa- and oak-dominated forest date from about A.D. 1200 (Aguila et al. 2002).

Seeds that compare favorably to morning glory were identified in the hearth and pit. Morning glory seeds contain hallucinogenic compounds and were used in divinatory rites by the Aztec and Zapotec people of Mexico (Klein 1987:424). We could not begin to speculate whether these carbonized seeds represent an interest in hallucinogens by the Pueblo occupants, or packrat foraging. No food uses for this group of plants are known.

Floral remains from two grid units outside the cave entrance consisted of goosefoot, hedgehog cactus, juniper, and unidentifiable seeds, juniper twigs, and pine needles, bark, and cone scales. With very few exceptions, taxa both inside and outside the cave were also recovered uncharred, further complicating interpretation.

Macrobotanical samples from general fill inside the shelter included a corncob that was probably 10-rowed, 23.6 mm long, and with a cob diameter of 17.5 mm (Table 78). The cob was flattened, making it difficult to determine row number. A piece of unburned wood from outside the shelter that looked like a sliver from a two-by-four was determined to be a fragment from one of the screens used by archaeologists. Unburned fragments of coyote gourd rind were most likely remnants of rodent midden material (Table 79). Flotation wood charcoal was overwhelmingly coniferous, primarily pine and cf. ponderosa pine. Oak and mountain mahogany were also present (Table 80).

Summary

Considerable mixing was apparent in shelter deposits, yet there does seem to be discernible patterning in botanical remains according to chronology. Fallen Pine Archaic contexts are characterized by a short list of weedy annuals common in other Archaic shelter deposits (Table 81). In regional archaeobotanical assemblages derived from a larger number of flotation samples, abundant perennial taxa used for food, manufacturing, or fuel have occurred. Cacti (prickly pear, hedgehog), monocot leaf-succulents (yucca, agave, sotol), fruit- and nut-bearing shrubs and trees (piñon, mesquite, squawberry, chokecherry, walnut), and riparian species (cat's-tail, sedge) all appear in Archaic shelters of the Sacramentos. Where we have a record of fuel use, coniferous species dominate. Notably, grass species with food potential are more frequently found in Archaic than in later sites; dropseed is the most widely occurring grass type. Fallen Pine is the only regional Archaic assemblage lacking evidence of cultivars, more a sign of poor preservation and small sample size than of different adaptative focus.

Pueblo deposits at Fallen Pine tend to have many more taxa, both carbonized and uncarbonized, than the Archaic deposits. More broadly, however, there are not significant differences between earlier and later floral assemblages, but rather a regional adaptive signature, dominated by a variety of perennials species, and a short list of annuals. Thus, Fallen Pine's Pueblo period assemblage fits in well with botanical arrays seen throughout the middle elevation ranges of the Sacramentos, and the Archaic assemblage simply appears to suffer from poor preservation (and meager representation). Additional patterning at Fallen Pine relates to preservation conditions within the shelter, as opposed to the talus slope. Food taxa were largely restricted to interior proveniences, and talus samples contained little other than conifer detritus.

Though tiny, and suffering from considerable disturbance, Fallen Pine Shelter's deposits offer useful comparisons with floral materials in regional archeological sites.

Table 75. Flotation plant remains from Archaic occupation levels (frequency per liter and ubiquity)

Feature	Above Hearth	Hearth	Under Metate	Total Items	No. / % of Samples
Cm below datum	240-245, Floor 5	245-255, Floor 6	340-350, outside shelter		
FS No.	956	1075	1295		
Cultural					
Annuals:					
Amaranthus	-	1.8	-	1.8	1/33%
Chenopodium	1.7	9.7	5.7	17.1	3/100%
Cheno-am	-	0.9 pc	4.3	5.2	2/67%
Other:					
Unidentifiable	-	0.9	-	0.9	1/33%
Perennials:					
Pinus	-	bark +, umbo +	bark +	-	2/67%
Pinus ponderosa	needle +	-	-	-	1/33%
Noncultural					
Annuals:					
Chenopodium	0.9	-	-	0.9	1/33%
Euphorbia	0.9	-	-	0.9	1/33%
Franseria acanthocarpa	1.7	-	-	1.7	1/33%
Portulaca	2.9	-	1.4	4.3	2/67%
Perennials:					
Juniperus	-	1.8 ? cone	-	1.8	1/33%

Notes:

All cultural plant remains are carbonized.
Plant remains are seeds unless indicated otherwise.
+ = less than 10/liter.
pc = partially charred.

Table 76. Species composition of flotation wood charcoal from Archaic occupation levels (count and weight)

Feature	Above Hearth	Hearth	Under Metate	Total and % Pieces	Total and % Weight
Cm below datum	240-245, Floor 5	245-255, Floor 6	340-350, outside shelter		
FS No.	956	1075	1295		
Conifers:					
Pinus	11/0.3 g	5/0.1 g	-	16/40%	0.4 g/57%
Unknown conifer	-	13/0.2 g	9/0.1 g	22/55%	0.3 g/43%
Nonconifers:					
Quercus	-	2/<0.1 g	-	2/5%	+/+
Total	11/0.3 g	20/0.3 g	9/0.1 g	40/100%	0.7 g/100%

+ = <0.1 g, or <1%

Table 77. Archaic macrobotanical remains (count / weight in grams)

Grid Location	Inside Shelter		Outside Shelter
Grid		101N/98E	97N/99E
Cm below datum	Level 8	226-241, floor 5	310-320
FS No.	10	947	1190
Cultural			
Unknown wood	-	1 tool uncharred /0.1 g	-
Unknown conifer:			
Cf. *Pinus ponderosa*	15/4.58 g	-	-
Possibly Cultural			
Unknown conifer	-	-	1 uncharred /0.1 g

Table 78. Flotation plant remains from Pueblo levels (frequency per liter and ubiquity)

Grid Location	Outside Cave		Inside Cave					Total Items	No. and %
Grid/Feature	99N/98E	100N/100E	Feature 2 Hearth	Feature 4 Ash Area	Ash Area	Burned Soil	Pit		
Cm below datum	190-200	180-190	150-170, Floor 1	190-200, Floor 2	200-210, Floor 2	220-227, Floor 4	230-266, Floor 6		
FS No.	139	283	390	532	605	810	900		
Cultural									
Annuals:									
Amaranthus	-	-	8.2	-	-	0.6	-	14.2	2/29%
Chenopodium	-	0.4	14.0, 1.2 pc	0.6	-	1.8	1.7	19.7	5/71%
Cheno-am	-	-	3.9	-	-	-	0.9	4.8	2/29%
Helianthus	-	-	1.6	-	-	-	3.5, 0.9 pc	6.1	2/29%
Cultivars:									
Zea mays	-	-	cf. cupule +	c +, cf. 2.8 k fragment	c +	-	c +	2.8	4/57%
Grasses:									
Gramineae			0.4, stem +, stem pc +	cf. stem +	-	-	-	0.4	2/29%
Other:									
Cactaceae	-	-	areola +	-	-	-	-	-	1/14%
cf. Compositae	-	-	2.3	-	-	-	-	2.3	1/14%
cf. *Ipomea*	-	-	0.4 pc	-	-	-	0.9	1.3	2/29%
Labiatae	-	-	0.8	-	-		-	0.8	1/14%
Monocotyledonae	-	-	-	-	-	stem +	-	-	1/14%
Solanaceae	-	-	0.4	-	-	-	-	0.4	1/14%
Unidentifiable		0.4	16.8	0.6 pc	-	-	-	17.8	3/43%
Unknown	twig pc +	-	nr +, 0.8 pp, twig +	bark +	-	-	-	0.8	3/43%
Perennials:									
Echinocereus	-	0.4	-	-	-	-	-	0.4	1/14%
Juniperus	-	0.4	1.2, 0.4 pc, leaflet +, twig +	-	-	-	5.2, cf. 1.7 ? cone	8.9	3/43%
Mammillaria	-	-	-	-	-	0.6	-	0.6	1/14%
Pinus	bark +, umbo +	bark +	bark +, umbo +	-	bark +	bark +	bark +	-	6/86%
Pinus edulis	-	needle +	needle +, 0.4 ns	-	-	-	-	0.4	2/29%
Pinus ponderosa	needle +	-	needle ++++, needle pc +, umbo +	-	needle +	needle +	needle +, needle + pc	-	5/71%
Platyopuntia	-	-	6.3	-	-	-	-	6.3	1/14%
Quercus	-	-	attachment +, cup base +	-	-	-	-	-	1/14%
cf. *Rhus*	-	-	-	-	-	0.6 fragment	0.9 fragment	1.5	2/29%
Possibly Cultural									
Annuals:									
Euphorbia	-	-	0.4 pc	-	-	-	0.9	1.3	2/29%
Grasses:									
cf. Gramineae	-	-	0.4 floret pc	-	-	-	-	0.4	1/14%
Other:									
Dicot	-	-	leaf pc +	-	-	-	-	-	1/14%
Phacelia crenulata	-	-	0.4 pc	-	-	-	-	0.4	1/14%
Noncultural									
Annuals:									
Amaranthus	-	-	5.9	-	-	-	-	5.9	1/14%
Chenopodium	8.4	-	14	0.6	-	-	-	23	3/43%
Euphorbia	-	-	2	-	-	-	-	2	2/29%
Helianthus	-	-	2	-	-	-	-	2	1/14%
Phacelia crenulata	-	-	3	-	-	-	-	3	1/14%
Physalis	-	-	0.4	-	-	-	-	0.4	1/14%
Portulaca	-	-	-	1.7	-	-	-	1.7	1/14%
Other:									
Labiatae	-	-	2.3	-	-	-	-	2.3	1/14%
cf. *Ipomea*	-	-	0.4	-	-	-	-	0.4	1/14%
Unidentifiable	-	-	3.9	-	-	-	-	3.9	1/14%
Unknown	-	-	nr +	-	-	-	-		1/14%
Perennials:									
Echinocereus	-	-	1.6	-	-	-	-	1.6	1/14%
Juniperus	twig +	twig +	0.8, twig +	twig +	0.8 ? cone, twig +	-	twig +	0.8	6/86%
cf. *Picea*	-	-	0.8	-	-	-	-	0.8	1/14%
Pinus	umbo +	-	bark +, umbo +	-	-	-	-		2/29%
Pinus edulis	-	-	0.4 ns	-	-	-	-	0.4	1/14%
Pinus ponderosa	needle +	needle +	needle +	-	-	-	needle +		4/57%
Platyopuntia	-	-	2	-	-	-	-	0.2	1/14%
Quercus	-	-	0.4 acorn fragment	-	-	-	-	0.4	1/14%
Scirpus	-	-	-	0.6	-	-	-	0.6	1/14%
Sphaeralcea	-	-	0.4	-	-	-	-	0.4	1/14%

Notes:

All cultural plant remains are carbonized.
Plant remains are seeds unless indicated otherwise.
+ = less than 10/liter.
k = kernel
nr = nonreproductive
ns = nutshell
pc = partially charred
pp = point provenience

Table 79. Puebloan macrobotanical remains (count and weight)

Grid Location	Inside Cave							Outside Cave	
Grid			101N/98E	101N/97E	103N/98E	103N/99E	103N/99E	97N/101E	96N/100E
Cm below datum	Level 3	Levels 3 and 4	150-160	170-180	150-160	160-170	170-180	180-190	220-230
FS No.	4	6	245	287	496	568	583	357	493
Cultural									
Cultivars:									
Zea mays	-	-	-	1 cob/0.08 g, 1 cob fragment/0.03 g, 2 cupules/0.01g	-	-	-	-	-
Wood:									
Quercus	-	1/ 0.80 g	-	-	-	-	-	-	-
Unknown conifer	1/ 122.08 g[1]	10/ 6.47 g[1]	-	-	-	-	-	1 pc/0.4 g	1 worked wood u/0.4 g
Possibly Cultural									
Other:									
Cucurbita foetidissima	-	-	2 rind u/<0.1 g	-	-	-	-	-	-
Gramineae	-	-		-	-	1 stem u/ 0.1 g	-	-	-
Juniperus	-	-		-	1 seed fragment u/<0.1 g	-	-	-	-
Wood:									
cf. Juniperus	-	-	-	-	-	-	1 u/1.2 g	-	-

Table 80. Species composition of flotation wood charcoal from Pueblo levels (count and weight)

Grid Location	Outside Cave		Inside Cave					Total Items	No. and %
Grid/ Feature	99N/98E	100N/100E	Feature 2 Hearth	Feature 4 Ash Area	Ash Area	Burned Soil	Pit		
Cm below datum	190-200	180-190	150-170, floor 1	190-200, floor 2	200-210, floor 2	220-227, floor 4	230-266, floor 6		
FS No.	139	283	390	532	605	810	900		
Conifers:									
Juniperus	1/<0.1	-	-	4/0.2	1/<0.1	1/<0.1		7/5%	0.2 g/4%
Pinus	2/<0.1	-	-	1/<0.1	2/<0.1	9/0.3	15/0.2	29/23%	0.5 g/10%
cf. *Pinus edulis*	1/<0.1	8/0.3	1/0.6	-	3/0.1			13/10%	1.0 g/19%
cf. Pinus ponderosa	2/<0.1	5/0.1	17/2.4	-	3/0.1			27/21%	2.6 g/51%
Unknown conifer	10/0.2	4/0.3	-	2/<0.1	9/0.1	2/<0.1	3/0.1	30/24%	0.7 g/14%
Nonconifers:									
Cercocarpus	-	3/<0.1	-	1/<0.1				4/3%	+/+
Quercus	4/<0.1	-	2/<0.1	-	2/<0.1	8/0.1	2/<0.1	18/14%	0.1 g/2%
Total	20/0.2	20/0.7	20/3.0	8/0.2	20/0.3	20/0.4	20/0.3	128/100%	5.1 g/100%

Table 81. Comparative carbonized floral remains from sites of the Sacramento Mountains and Sierra Blanca

Era	Sites	No. Samples	Annuals	Grasses	Perennials	Cultigens
Archaic	**Fallen Pine Shelter** (LA 110339), elev. 2141 m 1410 BC-AD 200 (this study)	3	Ch-am, Ch, Am	-	P, P pond	-
	High Rolls Cave (LA 114103), elev. 1906 m 1500-200 BC Toll 1998 Bohrer 2003	 3 33	Ch-am, Ch, Am Port, Sphaer, Nicot, Art	Spor, Stipa, Oryz	P pond, P ed, Jun, Prosop Typha, Platy, Echino	Zea
	Fresnal Shelter (LA 10101), elev. 1922 m 1000 BC- AD 325 Bohrer 1972, 1981	-	Ch-am, Ch, Am	Spor, Stipa, Bout	P pond, P ed, Jun, Prosop Typha, Cyper, Platy, Echino, Atrip, Mirab, Dasyl, Agave, Larrea, Rhus, Allium, Prunus, Celtis	Zea, Cuc, Phas
	Sunset Shelters (LA 58917), elev. 1515 m AD 1-400? Toll 1996	26	Ch, Port, Desc	Spor	P ed, Rhus, Prosop	Zea, Phas
	Tintop Cave (LA 71167), elev. 1487 m Levels 8 and 9 Toll 1996	4	Ch, Am, Port, Hel, Nicot	Spor	Echino	Zea
	Beth Cave (LA 47481), elev. 1890 m AD 600s-800s? Adams and Wiseman 1994	-	-	-	P ed, Yucca, Juglans, Querc	Zea, Cuc, Phas
Pueblo	**Fallen Pine Shelter** (LA 110339), elev. 2141 m 1410 BC- (this study)	7	Ch-am, Ch, Am, Hel	Gram	P, P ed, P pond, Jun, Ipo Lab, Solan, Cact, Echino, Mam, Platy, Querc, Rhus	Zea
	Angus North (LA 3334), elev. 2088 m AD 1005-1455 Toll and McBride 2000	23	Ch-am, Ch, Port, Ment, Desc	Phrag, Monocot stem	P ed, P pond, Jun, Sphaer	Zea
	Angus (LA 2315), elev. 2135 m AD 1150-1350 Toll and Donaldson 1992	30	Ch, Am, Port, Hel, Desc	Phrag, Spor	P ed, Jun, Echino, Phys	Zea, Cuc
	Bent (LA 10835), elev. 1753 m AD 800-1000, AD 1100-1200 Minnis et al. 1982	8	-	-	Prosopis	Zea
	Abajo de la Cruz (LA 10832), elev. 1753 m AD 1150-1350 Minnis et al. 1982	17	Ch, Port	-	P ed, Prosopis, Opun Echino, Atrip, Vitis	Zea, Cuc
	Tintop Cave (LA 71167), elev. 1487 m AD 1100?-1250 Toll 1996	23	Ch, Port, Nicot, Sphaer	-	Juglans, Rhus, Echino Platyop, Yucca, Vitis	Zea, Phas
	Tortolita Canyon (LA 89652), elev. 2150 m AD 600-1000 Holloway 1994	30	Ch, Am, Comp	Pasp	P ed, Jun, Opun, Querc	Zea, poss. Phas

Ch (*Chenopodium*; goosefoot), Am (*Amaranthus*; pigweed), Port (*Portulaca*; purslane), Art (*Artemisia dracunculus*; false tarragon), Comp (Compositae; sunflower family), Hel (*Helianthus*; sunflower), Phys (*Physalis*; groundcherry), Desc (*Descurainia*; tansy mustard), Ment (*Mentzelia*; stickleaf), Sphaer (*Sphaeralcea*; globemallow), Nicot (*Nicotiana*; tobacco), Bout (*Bouteloua*; grama grass), Oryz (*Oryzopsis*; Indian ricegrass), Pasp (*Paspalum*), Phrag (*Phragmites*; reedgrass),Spor (*Sporobolus*; dropseed), Gram (Gramineae; grass family), P (*Pinus*; pine, P pond (*Pinus ponderosa*; ponderosa pine), P ed (*Pinus edulis*; piñon), Jun (*Juniperus*; juniper), Agave (*Agave*), Allium (*Allium*; onion), Atrip (*Atriplex*; saltbush), Celtis (*Celtis*; hackberry), Cyper (*Cyperus*; sedge), Dasyl (*Dasylirion*; sotol),Echino (*Echinocereus*; hedgehog cactus), Juglans (*Juglans*; walnut), Larrea (*Larrea*; creosotebush), Mirab (*Mirabilis*; four o'clock), Prosop (*Prosopis*; mesquite), Prun (*Prunus*; chokecherry), Quer (*Quercus*; oak), Rhus (*Rhus*; squawberry), Typha (*Typha*; cattail).

Fifteen samples were sent to Quaternary Services for pollen extraction and analyses from LA 110339, Fallen Pine Shelter. Four of the samples were soil samples, while the remaining 11 consisted of pollen washes from ground stone artifacts. LA 110339 is a small rockshelter dating between 1410 B.C. and A.D. 1440. The occupation of the site was intermittent between the Late Archaic and the primary occupation of A.D. 1000-1200.

The site is at an elevation of 6,950 ft along U.S. 70, south of Ruidoso, on the Mescalero Apache Reservation in Otero County. The modern vegetation consists of a *Pinus ponderosa* forest with some *Quercus* (oak), probably as an understory component. *Prosopis* (mesquite) is not present in the immediate area but is within 20-25 miles of the site.

Methods and Materials

Chemical extraction of pollen samples was conducted at the Palynology Laboratory at Texas A&M University, using a procedure designed for semiarid southwestern sediments. The method, detailed below, specifically avoids use of such reagents as nitric acid and bleach, which have been demonstrated experimentally to be destructive to pollen grains (Holloway 1981).

From each soil pollen sample submitted, 15 g of soil were subsampled. Prior to chemical extraction, three tablets of concentrated *Lycopodium* spores (Batch 307862, Department of Quaternary Geology, Lund, Sweden; 13,500 ± 500 marker grains per tablet) were added to each subsample. The addition of marker grains permits calculation of pollen concentration values and provides an indicator for accidental destruction of pollen during the laboratory procedure.

The 11 pollen washes of ground stone artifacts were processed by personnel of the Office of Archaeological Studies. The area washed was calculated by using a template marked in square centimeters. The template was placed over the artifact and the squares counted. The loose dirt adhering to the interior surface of the artifact was lightly brushed off. The interior surface was initially washed with distilled water. This was followed by a wash with a 10-percent solution of HCl, followed by a second wash with distilled water to remove all traces of the acid. The liquid portions of all three washes were combined in a single container and sent to Texas A&M University for extraction. The pollen wash samples were centrifuged to consolidate the particulate fraction, and the supernatant liquid was discarded. After adding three tablets of *Lycopodium* spores, these samples were processed according to the protocol described below.

The samples were treated with 35-percent hydrochloric acid (HCl) overnight to remove carbonates and release the *Lycopodium* spores from their matrix. After neutralizing the acid with distilled water, the samples were allowed to settle for a period of at least three hours before the supernatant liquid was removed. Additional distilled water was added to the supernatant, and the mixture was swirled and then allowed to settle for five seconds. The suspended fine fraction was decanted through 150 mesh screen into a second beaker. This procedure, repeated at least three times, removed lighter materials, including pollen grains, from the heavier fractions. The fine material was concentrated by centrifugation at 2,000 revolutions per minute (rpm).

The fine fraction was treated with concentrated hydrofluoric acid (HF) overnight to remove silicates. After completely neutralizing the acid with distilled water, the samples were treated with a solution of Darvan and sonicated in a Delta D-9 Sonicator for 30 seconds. The Darvan solution was removed by repeated washing with distilled water and centrifuged (2,000 rpm) until the supernatant liquid was clear and neutral. This procedure removed fine charcoal and other associated organic matter and effectively deflocculated the sample.

The samples were dehydrated in glacial acetic acid in preparation for acetolysis. Acetolysis solution (acetic anhydride: concentrated sulfuric acid in 9:1 ratio) following Erdtman (1960) was added to each sample. Centrifuge tubes containing the solution were heated in a boiling water bath for approximately eight minutes and then cooled for an additional eight minutes before centrifugation and removal of the acetolysis solution with glacial acetic acid followed by distilled water. Centrifugation at 2,000 rpm for 90 seconds dramatically reduced the size of the sample, yet from periodic examination of the residue, did not remove fossil palynomorphs.

Heavy density separation ensued using zinc bromide ($ZnBr_2$), with a specific gravity of 2.00, to remove much of the remaining detritus from the pollen. The light fraction was diluted with distilled water (10:1) and concentrated by centrifugation. The samples were washed repeatedly in distilled water until neutral. The residues were rinsed in a 1-percent solution of potassium hydroxide (KOH) for less than one minute, which was effective in removing the majority of the unwanted alkaline soluble humates.

The material was rinsed in ethanol (ETOH) stained with safranin-O, rinsed twice with ETOH, and transferred to 1-dram vials with tertiary butyl alcohol (TBA). The samples were mixed with a small quantity of glycerine and allowed to stand overnight for evaporation of the TBA. The storage vials were capped and returned to the Museum of New Mexico at the completion of the project.

A drop of the polliniferous residue was mounted on a microscope slide for examination under an 18 by 18 mm cover slip sealed with fingernail polish. The slide was examined using 200x or 100x magnification under an aus-Jena Laboval 4 compound microscope. Occasionally, pollen grains were examined using 400x or 1,000x oil immersion to obtain a positive identification to the family or genus level.

Abbreviated microscopy was performed on each sample in which either 20 percent of the slide (approximately four transects at 200x magnification) or a minimum of 50 marker grains were counted. If warranted, full counts were conducted by counting to a minimum of 200 fossil grains. Regardless of which method was used, the uncounted portion of each slide was completely scanned at a magnification of 100x for larger grains of cultivated plants such as *Zea mays* and *Cucurbita,* two types of cactus (Platyopuntia and Cylindropuntia), and other large pollen types such as members of the Malvaceae or Nyctaginaceae families.

For those samples warranting full microscopy, a minimum of 200 pollen grains per sample were counted (Barkley 1934), which allows the analyst to inventory the most common taxa in the sample. All transects were counted completely (Brookes and Thomas 1967), resulting in various numbers of grains counted beyond 200. Pollen taxa encountered on the uncounted portion of the slide during the low magnification scan are tabulated separately.

Total pollen concentration values were computed for all taxa. In addition, the percentage of indeterminate pollen was also computed. Statistically, pollen concentration values provide a more reliable estimate of species composition within the assemblage. Traditionally, results have been presented by relative frequencies (percentages) where the abundance of each taxon is expressed in relation to the total pollen sum (200+ grains) per sample. With this method, rare pollen types tend to constitute less than 1 percent of the total assemblage. Pollen concentration values provide a more precise measurement of the abundance of even these rare types. The pollen data are reported here as pollen concentration values using the following formula:

$$PC = \frac{K * \Sigma_p}{\Sigma_L * S}$$

where:
PC = pollen concentration
K = *Lycopodium* spores added
Σ_p = fossil pollen counted
Σ_L = *Lycopodium* spores counted
S = sediment weight

The following example should clarify this approach. Taxon X can be represented by 10 grains (1 percent) in a sample consisting of 1,000 grains, and by 100 grains (1 percent) in a second sample consisting of 10,000 grains. Taxon X is 1 percent of each sample, but the difference in actual occurrence of the taxon is obscured when pollen frequencies are used. The use of "pollen concentration values" are preferred because it accentuates the variability between samples in the occurrence of the taxon. The variability, therefore, is more readily interpretable when comparing cultural activity to noncultural distribution of the pollen rain.

The pollen concentration values for pollen wash samples were calculated using a modification of the above formula. This modification involved the substitution of the area washed (in cm^2) for the sediment weight (S) variable in the denominator from the above equation because the sample was in liquid form. The resulting concentration value is thus expressed as estimated grains per cm^2. The resulting pollen concentration values from pollen wash samples are treated independently of those from soil samples in the results and discussion sections, although the data are presented with the other samples in the tables. The use of pollen concentration values from these particular samples are preferred, as explained above, to accentuate the variability between pollen wash samples. The use of the area washed also provides a mechanism for comparing calculated pollen concentration values between artifacts.

Variability in pollen concentration values can also be attributed to deterioration of the grains through natural processes. In his study of sediment samples collected from a rockshelter, Hall (1981) developed the "1,000 grains/g" rule to assess the degree of pollen destruction. This approach has been used by many palynologists working in other contexts as a guide to determine the degree of preservation of a pollen assemblage and, ultimately, to aid in the selection of samples to be examined in greater detail. According to Hall (1981), a pollen concentration value below 1,000 grains/gm indicates that forces of degradation may have severely altered the original assemblage. However, a pollen concentration value of fewer than 1,000 grains/g can indicate the restriction of the natural pollen rain. Samples from pit structures or floors within enclosed rooms, for example, often yield pollen concentration values below 1,000 grains/g.

Pollen degradation also modifies the pollen assemblage because pollen grains of different taxa degrade at variable rates (Holloway 1981, 1989; Bryant and Holloway 1983). Some taxa are more resistant to deterioration than others and remain in assemblages after other types have deteriorated completely. Many commonly occurring taxa degrade beyond recognition in only a short time. For example, most (70 percent) angiosperm pollen has either tricolpate (three furrows) or tricolporate (three furrows each with pores) morphology. Because surfaces erode rather easily, once deteriorated, these grains tend to resemble each other and are not readily distinguishable. Other pollen types (e.g., cheno-am) are so distinctive that they remain identifiable even when almost completely degraded.

Pollen grains were identified to the lowest taxonomic level whenever possible. The majority of these identifications conformed to existing levels of taxonomy with a few exceptions. For example, cheno-am is an artificial, pollen morphological category which includes pollen of the family Chenopodiaceae (goosefoot) and the genus *Amaranthus* (pigweed), which are indistinguishable from each other (Martin 1963). All members are wind pollinated (anemophilous) and produce very large quantities of pollen. In many sediment samples from the American Southwest, this taxon dominates the assemblage.

Pollen of the Asteraceae (sunflower) family was divided into four groups. The high spine and low spine groups were identified on the basis of spine length. High spine Asteraceae contains those grains with spine length greater than or equal to 2.5 μ, while the low spine group has spines less than 2.5 μ (Bryant 1969; Martin 1963). *Artemisia* pollen is identifiable to the genus level because of its unique morphology of a double tectum in the mesocopial (between furrows) region of the pollen grain. Pollen grains of the Liguliflorae are also distinguished by their fenestrate morphology. Grains of this type are restricted to the tribe Cichoreae, which includes such genera as *Taraxacum* (dandelion) and *Lactuca* (lettuce).

Pollen of the Poaceae (grass) family are generally indistinguishable below the family level, with the single exception of *Zea mays*, identifiable by its large size (ca. 80 μ), relatively large pore annulus, and the internal morphology of the exine. All members of the family contain a single pore, are spherical, and have simple wall architecture. Identification of noncorn pollen is dependent on the presence of the single pore. Only complete or fragmented grains containing this pore were tabulated as Poaceae.

Clumps of four or more pollen grains (anther fragments) were tabulated as single grains to avoid skewing the counts. Clumps of pollen grains (anther fragments) from archaeological contexts are interpreted as evidence of flowers at the sampling locale (Bohrer 1981b). This enables the analyst to infer human behavior.

Finally, pollen grains in the final stages of disintegration but retaining identifiable features, such as furrows, pores, complex wall architecture, or a combination of these attributes, were assigned to the indeterminate category. The potential exists to miss counting pollen grains without identifiable characteristics. For example, a grain that is so severely deteriorated that no distinguishing features exist closely resembles many spores. Pollen grains and spores are similar in size and are composed of the same material (Sporopollenin). So that spores are not counted as deteriorated pollen, only those grains containing identifiable pollen characteristics are assigned to the indeterminate category. Thus, the indeterminate category contains a minimum estimate of degradation for any assemblage. If the percentage of indeterminate pollen is between 10 and 20 percent, relatively poor preservation of the assemblage is indicated, whereas indeterminate pollen in excess of 20 percent indicates severe deterioration to the assemblage.

In those samples where the total pollen concentration values are approximately at or below 1,000 grains/g, and the percentage of indeterminate pollen is 20 percent or greater, counting was terminated at the completion of the abbreviated microscopy phase. In some cases, the assemblage was so deteriorated that only a small number of taxa remained. Statistically, the concentration values may have exceeded 1,000 grains/g. If the species diversity was low (generally these samples contained only pine, cheno-am, members of the Asteraceae [sunflower] family and indeterminate), counting was also terminated after abbreviated microscopy even if the pollen concentration values slightly exceeded 1,000 grains/g.

Results

Table 82 contains a list of the common and scientific names of plant taxa used in this report. Tables 83a-83d contain the results of the pollen analysis of these samples, including both the raw counts and the calculated pollen concentration values.

Soil Samples

Four of the 15 samples submitted for examination were soil samples. Three of these 4 samples were collected from within the rockshelter, while the remaining sample was taken from the talus slope outside the dripline.

Sample 619 was taken from between Levels 1 and 2, near a rock, and contained 6,750 grains/g total pollen concentration values, based on a pollen sum of 110 grains. The assemblage contained 5.45 percent indeterminate pollen. *Pinus edulis* type (2,884 grains/g) dominated the arboreal component, with only a trace of *Pinus ponderosa* type pollen (123 grains/g). The assemblage contained high amounts of cheno-am (2,270 grains/g) pollen, with a high number of pollen clumps (61/g). Poaceae, *Artemisia* (123 grains/g), high spine Asteraceae (184 grains/g), and low spine Asteraceae (245 grains/g) were all present in high amounts. Cylindropuntia and *Zea mays* pollen (184 grains/g each) were very high.

Sample 620 was taken from below a large ceramic sherd from between Levels 1 and 2. It contained 6,821 grains/g total pollen concentration values and was based on a pollen sum of 96 grains. Indeterminate pollen accounted for only 1.06 percent of the assemblage. Undifferentiated *Pinus* (4,050 grains/g) was present in large amounts, and a fairly large quantity of *Prosopis* (142 grains/g) pollen was present. Cheno-am (1,350 grains/g) was present in moderate amounts, along with high amounts of Poaceae (142 grains/g), high spine Asteraceae (355 grains/g), low spine Asteraceae (213 grains/g), *Artemisia*, and Ephedra (71 grains/g each). *Zea mays* (213 grains/g) was very high, along with high amounts of Cylindropuntia and *Typha latifolia* (71 grains/g each), but the latter two taxa were calculated from single grains only.

Sample 663 was also taken from below a large ceramic sherd from between Levels 1 and 2. It contained 8,629 grains/g total pollen concentration values and was based on a pollen sum of 163 grains. Indeterminate *Pinus* (6,247 grains/g) dominated the assemblage, with small amounts of *Pinus edulis* type (53 grains/g) and *Pinus ponderosa* type (123 grains/g). *Prosopis* pollen (53 grains/g) was also present in moderate to low amounts. Cheno-am (1,535 grains/g) was moderate,

Table 82. Scientific and common names of plant taxa

Family	Scientific Name	Common Name
Amaranthaceae	*Amaranthus*	Pigweed
Asteraceae		Composite family
	Ambrosia	Bursage
	Artemisia	Sagebrush
	Helianthus	Sunflower
	Lactuca	Lettuce
	Taraxacum	Dandelion
	Chichoreae	Tribe of Asteraceae, heads comprised entirely of ligulate flowers
	Liguliflorae	Pollen morphological group, fenestrate type pollen
	Low spine	Pollen morphological group, spines <2.5 μ height
	High spine	Pollen morphological group, spines >2.5 μ height
Brassicaceae		Mustard family
Cactaceae		Cactus family
	Opuntia	Prickly pear or cholla cactus
	Cylindropuntia	Sub-genus of *Opuntia* , cholla cactus
	Platyopuntia	Sub-genus of *Opuntia* , prickly pear cactus
Chenopodiaceae		Goosefoot family
	Atriplex canescens	Saltbush
	Chenopodium	Goosefoot, lambs quarters
	Salsola kali	Russian thistle
	Sarcobatus vermiculatus	Greasewood
	Cheno-am	Pollen morphological group, members of the family Chenopodiaceae and the genus *Amaranthus*
Cucurbitaceae		Gourd family
	Cucurbita	Squash, gourd
Cupressaceae	*Juniperus*	Juniper
Cyperaceae		Sedge family
Ephedraceae		Joint fir family
	Ephedra	Mormon tea
Fabaceae		Bean family
	Prosopis	Mesquite
Fagaceae		Oak family
	Quercus sp.	Oak
Juglandaceae		Walnut family
	Carya	Hickory, pecan
	Juglans	Walnut
Lycopodiaceae		Club-moss family
	Lycopodium	Club-moss
Malvaceae		Cotton family
Onagraceae		Evening primrose family
Pinaceae		Pine family
	Pinus	Pine
	Pinus ponderosa	Ponderosa pine
Poaceae		Grass family
	Zea mays	Corn
Polygonaceae		Buckwheat family
	Eriogonum	Wild buckwheat
Typhaceae		Cattail family
	Typha latifolia	Narrow leaf cattail

Table 83a. Raw pollen counts and concentration values

Bag No.	Area	Provenience	Level: mbd	Type	Age (A.D.)	*Pinus*	*Pinus ponderosa*	*Pinus edulis*	*Quercus*	Onagraceae
Raw Pollen Counts										
619	between Levels 1 & 2	103N/98E	2: 1.92-1.98	Level 2: near rock	1000-1200	0	2	47	-	-
620	between Levels 1 & 2	103N/98E	02:02.0	Level 1: large sherd	1000-1200	57	-	-	-	-
663	between Levels 1 & 2	103N/99E	2: 1.9-2.0	ceramic: large sherd	1000-1200	118	3	1	-	-
1046	general fill	99N/100E	1: 2.9-3.0	gs: metate: below	1000-1200	3	-	-	-	-
697pw	between Levels 2 & 3	104N/98E	3: 2.03-2.13	gs: mano	1000-1200	13	-	-	-	-
846pw		98N/99E	1: 2.7-2.8	gs: mano	1000-1200	4	-	-	-	1
863pw		102N/98E	4: 2.18-2.28	gs: mano	1000-1200	3	-	-	-	-
919pw		102N/101E	4: 2.08-2.28	gs: mano	1000-1200	-	-	-	-	-
945pw		101N/98E	5: 2.26-2.41	gs: mano	1000-1200	-	-	-	-	-
1048pw		97-98N/100E	1: 2.9-3.0	gs: metate: slab	1000-1200	4	-	-	-	-
1062pw		99N/99E	1: 2.9-3.0	gs: mano	1000-1200	1	1	-	1	-
1104pw		97N/100E	1: 3.0-3.1	gs: mano	1000-1200	2	-	-	-	-
1279pw		97N/100E	1: 3.3-3.4	gs: mano	1000-1200	1	1	-	-	-
1293pw		96N/100E	1: 3.4-3.5	gs: mano	1000-1200	1	-	-	-	-
1296pw		96N/100E	1: 3.4-3.5	gs: metate: slab	1000-1200	-	-	-	-	-
Concentration Values										
619	between Levels 1 & 2	103N/98E	2: 1.92-1.98	Level 2: near rock	1000-1200	-	123	2884	-	-
620	between Levels 1 & 2	103N/98E	02:01.9	Level 1: large sherd	1000-1200	4050	-	-	-	-
663	between Levels 1 & 2	103N/99E	2: 1.9-2.0	ceramic: large sherd	1000-1200	6247	159	53	-	-
1046	general fill	99N/100E	1: 2.9-3.0	gs: metate: below	1000-1200	133	-	-	-	-
697pw	between Levels 2 & 3	104N/98E	3: 2.03-2.13	gs: mano	1000-1200	261	-	-	-	-
846pw		98N/99E	1: 2.7-2.8	gs: mano	1000-1200	61	-	-	-	15
863pw		102N/98E	4: 2.18-2.28	gs: mano	1000-1200	59	-	-	-	-
919pw		102N/101E	4: 2.08-2.28	gs: mano	1000-1200	-	-	-	-	-
945pw		101N/98E	5: 2.26-2.41	gs: mano	1000-1200	-	-	-	-	-
1048pw		97-98N/100E	1: 2.9-3.0	gs: metate: slab	1000-1200	5	-	-	-	-
1062pw		99N/99E	1: 2.9-3.0	gs: mano	1000-1200	14	14	-	14	-
1104pw		97N/100E	1: 3.0-3.1	gs: mano	1000-1200	13	-	-	-	-
1279pw		97N/100E	1: 3.3-3.4	gs: mano	1000-1200	5	5	-	-	-
1293pw		96N/100E	1: 3.4-3.5	gs: mano	1000-1200	12	-	-	-	-
1296pw		96N/100E	1: 3.4-3.5	gs: metate: slab	1000-1200	-	-	-	-	-

Table 83b. Raw pollen counts and concentration values

Bag No.	*Prosopis*	*Eriogonum*	Brassicaceae	Poaceae	Cheno-am	Cheno-am (af)	Asteraceae (high spine)	Asteraceae (low spine)	*Artemisia*	*Cylindropuntia*	*Ephedra*
Raw Pollen Counts											
619	-	-	-	2	37	1	3	4	2	3	-
620	2	-	-	2	19	-	5	3	1	1	1
663	1	-	-	3	29	-	3	1	2	-	-
1046	-	-	-	-	11	1	2	2	-	1	-
697pw	-	-	-	-	18	-	1	-	-	2	1
846pw	-	-	-	-	24	-	6	5	1	-	-
863pw	-	-	-	-	9	-	-	4	-	-	-
919pw	-	-	1	1	16	-	2	6	-	-	-
945pw	-	-	-	1	5	-	1	-	-	-	-
1048pw	-	-	-	-	11	1	-	-	-	-	-
1062pw	-	-	-	3	14	-	2	4	1	-	-
1104pw	-	1	-	-	16	-	3	-	-	-	-
1279pw	-	-	-	-	19	-	1	5	6	-	-
1293pw	-	1	-	1	51	-	7	5	5	-	-
1296pw	-	-	-	-	21	-	1	2	1	-	-
Concentration Values											
619	-	-	-	123	2270	61	184	245	123	184	-
620	142	-	-	142	1350	-	355	213	71	71	71
663	53	-	-	159	1535	-	159	53	106	-	-
1046	-	-	-	-	487	44	89	89	-	44	-
697pw	-	-	-	-	362	-	20	-	-	40	20
846pw	-	-	-	-	367	-	92	77	15	-	-
863pw	-	-	-	-	177	-	0	78	-	-	-
919pw	-	-	11	11	182	-	23	68	-	-	-
945pw	-	-	-	7	33	-	7	-	-	-	-
1048pw	-	-	-	-	14	1	-	-	-	-	-
1062pw	-	-	-	42	198	-	28	57	14	-	-
1104pw	-	6	-	-	101	-	19	-	-	-	-
1279pw	-	-	-	-	99	-	5	26	31	-	-
1293pw	-	12	-	12	594	-	81	58	58	-	-
1296pw	-	-	-	-	27	-	1	3	1	-	-

Table 83c. Raw pollen counts and concentration values

Bag No.	Indeterminate	*Typha*	*Zea mays*	Large Grass	Sum	Total	Marker	% Indeterminate	Transects	Total Transects	Markers / Slide	*Lycopodium* Added	Number / Area
Raw Pollen Counts													
619	6	-	3	-	110	6750	44	5.45	29	29	44	40500	15
620	1	1	3	-	96	6821	38	1.04	29	29	38	40500	15
663	-	-	2	-	163	8629	51	0	29	29	51	40500	15
1046	-	-	-	-	20	885	61	0	28	28	61	40500	15
697pw	1	-	-	-	36	723	56	2.78	24	24	56	40500	36
846pw	1	-	-	-	42	643	54	2.38	6	26	234	40500	49
863pw	-	-	-	2	18	353	59	0	8	27	199	40500	35
919pw	2	-	1	-	29	329	51	6.9	8	26	166	40500	70
945pw	-	-	-	-	7	46	51	0	16	26	83	40500	122
1048pw	-	-	-	-	16	20	63	0	20	29	91	40500	521
1062pw	-	-	-	-	27	381	61	0	10	27	165	40500	47
1104pw	-	-	-	-	22	138	92	0	8	28	322	40500	70
1279pw	3	-	-	-	36	187	62	8.33	8	26	202	40500	126
1293pw	4	-	-	-	75	873	58	5.33	12	25	121	40500	60
1296pw	3	-	-	-	28	36	59	10.71	20	28	83	40500	529
Concentration Values													
619	368	-	184	-	110	6750	44	5.45	29	29	44	40500	15
620	71	71	213	-	96	6821	38	1.04	29	29	38	40500	15
663	0	-	106	-	163	8629	51	0	29	29	51	40500	15
1046	0	-	-	-	20	885	61	0	28	28	61	40500	15
697pw	20	-	-	-	36	723	56	2.78	24	24	56	40500	36
846pw	15	-	-	-	42	643	54	2.38	6	26	234	40500	49
863pw	0	-	-	39	18	353	59	0	8	27	199	40500	35
919pw	23	-	11	-	29	329	51	6.9	8	26	166	40500	70
945pw	0	-	-	-	7	46	51	0	16	26	83	40500	122
1048pw	0	-	-	-	16	20	63	0	20	29	91	40500	521
1062pw	0	-	-	-	27	381	61	0	10	27	165	40500	47
1104pw	0	-	-	-	22	138	92	0	8	28	322	40500	70
1279pw	16	-	-	-	36	187	62	8.33	8	26	202	40500	126
1293pw	47	-	-	-	75	873	58	5.33	12	25	121	40500	60
1296pw	4	-	-	-	28	36	59	10.71	20	28	83	40500	529

Table 83d. Raw pollen counts and concentration values (based on counts and low-magnification scan of the slide)

Bag No.	*Zea mays*	*Onagraceae*	*Cylindropuntia*	*Prosopis*	Cheno af	*Eriogonum*	*Typha latifolia*	Large Grass	Max. Potential Concentration	Trilete Spores
Raw Pollen Counts										
619	3	-	3	-	-	-	-	-	-	-
620	3	-	1	2	-	-	1	-	-	-
663	2	-	-	1	-	-	-	-	-	-
1046	-	-	1	-	-	-	-	-	-	-
697pw	-	-	2	-	-	-	-	-	-	-
846pw	-	1	-	-	-	-	-	-	-	1
863pw	-	-	-	-	-	-	-	3	-	-
919pw	1	-	-	-	-	-	-	-	-	-
945pw	-	-	-	-	-	-	-	-	-	-
1048pw	-	-	-	-	-	-	-	-	-	-
1062pw	-	-	-	-	-	-	-	-	-	-
1104pw	-	-	-	1	1	1	-	-	-	-
1279pw	-	-	-	-	-	-	-	-	-	-
1293pw	-	-	-	-	-	1	-	-	-	-
1296pw	-	-	-	-	-	-	-	-	-	-
Concentration Values										
619	184.09	-	184.09	-	-	-	-	-	61.36	-
620	213.16	-	71.05	142.11	-	-	71.05	-	71.05	-
663	105.88	-	-	52.94	-	-	-	-	52.94	-
1046	-	-	44.26	-	-	-	-	-	44.26	-
697pw	-	-	40.18	-	-	-	-	-	20.09	-
846pw	-	3.53	-	-	-	-	-	-	3.53	3.53
863pw	-	-	-	-	-	-	-	17.43	5.81	-
919pw	3.49	-	-	-	-	-	-	-	3.49	-
945pw	-	-	-	-	-	-	-	-	4.01	-
1048pw	-	-	-	-	-	-	-	-	0.85	-
1062pw	-	-	-	-	-	-	-	-	5.23	-
1104pw	-	-	-	-	1.8	1.8	-	-	1.8	-
1279pw	-	-	-	-	-	-	-	-	1.6	-
1293pw	-	-	-	-	-	5.59	-	-	5.59	-
1296pw	-	-	-	-	-	-	-	-	0.93	-

with high amounts of Poaceae and high spine Asteraceae (159 grains/g each), *Artemisia* (106 grains/g), and moderate to low amounts of low spine Asteraceae (53 grains/g). *Zea mays* (106 grains/g) was present in high amounts.

Sample 1046 was taken outside the dripline and contained only 885 grains/g total pollen concentration values, based on a pollen sum of 20 grains. Undifferentiated *Pinus* (133 grains/g) was present in very low amounts. Cheno-am (487 grains/g) was low but dominated the assemblage and contained a fairly high number of pollen clumps (44/g). High and low spine Asteraceae were high (89 grains/g each). Cylindropuntia (40 grains/g) was present in moderate to high amounts.

Pollen Wash Samples

Sample 697 was taken from a mano between Levels 2 and 3 from near the back wall of the cave. The assemblage contained 723 grains/sq cm total pollen concentration values and was based on a pollen sum of 36 grains. Undifferentiated *Pinus* was fairly high (261 grains/sq cm), but cheno-am pollen (487 grains/sq cm) dominated the assemblage. A small amount of high spine Asteraceae and *Ephedra* (20/grains/sq cm each) were present, but Cylindropuntia (40 grains/sq cm) was fairly high.

Sample 863 was taken from a mano found along the west wall of the cave, within the rockshelter. The assemblage contained 353 grains/sq cm total pollen concentration values, based on a pollen sum of only 18 grains. A small amount of *Pinus* (59 grains/sq cm) was present. Cheno-am (177 grains/sq cm) was moderate but dominated the assemblage. Low spine Asteraceae (78 grains/sq cm) was also present.

Sample 919 was from a mano near the east wall of the shelter, within the cave. The assemblage contained 329 grains/sq cm total pollen concentration values, based on a pollen sum of 29 grains. No arboreal pollen was present. Cheno-am (182 grains/sq cm) was fairly high, along with moderate amounts of high spine Asteraceae (23 grains/sq cm) and low spine Asteraceae (68 grains/sq cm), and a low amount of Poaceae (11 grains/sq cm). *Zea mays* (11 grains/sq cm) pollen was present from this artifact.

Sample 945 was taken from a mano from the southwest quadrant of the rockshelter interior. The assemblage contained 46 grains/sq cm total pollen concentration values but was based on a pollen sum of only 7 grains. Cheno-am (33 grains/sq cm) was low but dominated the assemblage, with small amounts of Poaceae and high spine Asteraceae (7 grains/g each).

Sample 846 and all the remaining pollen wash samples were recovered from outside the dripline of the shelter. This pollen wash was also taken from a mano. The assemblage contained 643 grains/sq cm total pollen concentration values and was based on a pollen sum of 42 grains. *Pinus* (61 grains/sq cm) was present, but no other arboreal taxa were encountered. Cheno-am (367 grains/sq cm) clearly dominated the assemblage, with high amounts of both high spine Asteraceae (92 grains/sq cm) and low spine Asteraceae (77 grains/sq cm), and a small amount of *Artemisia* (15 grains/sq cm).

Sample 1048 was from a slab metate in the center and towards the eastern portion of the excavated area outside the cave. The assemblage contained only 20 grains/sq cm total pollen concentration values and was based on a pollen sum of 16 grains. *Pinus* (5 grains/sq cm) was very low from this sample. Cheno-am (14 grains/sq cm) was low, and a small amount of pollen clumps (1/sq cm) was also present. These were the only taxa recovered from this sample.

Sample 1062 was from a mano recovered from the central and northern portion of the rockshelter exterior. The assemblage contained 381 grains/sq cm total pollen concentration values and was based on a pollen sum of 27 grains. Small amounts of undifferentiated *Pinus, Pinus ponderosa* type, and *Quercus* (14 grains/sq cm each) were present but were based on single occurrences only. Cheno-am (198 grains/sq cm) pollen was high, with high amounts of Poaceae (42 grains/sq cm), high spine Asteraceae (28 grains/sq cm), low spine Asteraceae (57 grains/sq cm), and smaller amounts of *Artemisia* (14 grains/sq cm).

Sample 1104 was taken from a mano in the central and eastern portion of the rockshelter exterior. The assemblage contained 138 grains/sq cm total pollen concentration values, which was based on a pollen sum of 22 grains. *Pinus* (13 grains/sq cm) was low. Cheno-am (101 grains/sq cm) dominated the assemblage, with small amounts of high spine Asteraceae (19 grains/sq cm). A small amount of *Eriogonum* (6 grains/sq cm) was also present.

Sample 1279 was also from a mano from the same area of the cave exterior. The assemblage contained 187 grains/sq cm total pollen concentration values and was based on a pollen sum of 36 grains. *Pinus* (5 grains/sq cm) was very low. Cheno-am (99 grains/sq cm) dominated the assemblage. High spine Asteraceae (5 grains/sq cm) was very low, and low spine Asteraceae (26 grains/sq cm) and *Artemisia* (31 grains/sq cm) were present in fairly high amounts. Indeterminate pollen constituted 8.33 percent.

Sample 1293 was taken from a mano from the southern and eastern portion of the cave exterior. The assemblage contained 873 grains/sq cm total pollen concentration values and was based on a pollen sum of 75 grains. *Pinus* (12 grains/sq cm) was low, and no other arboreal pollen was present. Cheno-am (594 grains/sq cm) dominated the assemblage. Poaceae (12 grains/sq cm) was somewhat low, but high spine Asteraceae (81 grains/sq cm), low spine Asteraceae (58 grains/sq cm), and *Artemisia* (58 grains/sq cm) were present in high amounts.

Sample 1296 was taken from a slab metate from this same southern area. The assemblage contained 36 grains/sq cm total pollen concentration values and was based on a pollen sum of 28 grains. No arboreal pollen was present. Cheno-am (27 grains/sq cm) was low, with traces of high spine Asteraceae (1 grain/sq cm), low spine Asteraceae (3 grains/sq cm), and *Artemisia* (1 grain/sq cm).

Discussion

The pollen recovery from these wash samples was quite poor considering the high pollen concentration values obtained from soil samples taken within the rockshelter. In all of the soil samples, the entire slide was counted to obtain close to the 50 marker grains, and in only five of the samples were abbreviated counts obtained by counting fewer than ten transects. The samples contained large amounts of charcoal and debris, which was not unanticipated, given that the shelter contained large amounts of ash.

Upon examining the results of the four soil samples it was immediately obvious that the total pollen concentration values of those taken within the rockshelter were significantly higher than those taken from outside the shelter. In part, this may be a function of preservation. The soil sample taken from outside of the dripline would have been exposed to somewhat harsher weathering conditions, such as freezing and thawing temperatures or wet/dry conditions. As explained above, these conditions act to rapidly deteriorate fresh pollen assemblages, and after only 25 alternating cycles of these environmental factors, 75-80 percent of the fresh pollen deteriorates to some degree (Holloway 1981, 1989). Samples from within the rockshelter would have been protected to some degree from these conditions, particularly the wetting/drying, and thus the assemblages were better preserved (i.e., higher concentration values). Additionally, the physical presence of the shelter may have acted to increase the pollen concentration values inside the shelter. Wind, based on several factors, carries a particular load of suspended particulate matter, including pollen grains. When wind, at a certain velocity, passes over a topographic feature such as an opening to a rockshelter, the wind velocity is dramatically decreased. The sudden decrease in wind velocity causes some of the particulate matter to come out of suspension (Tauber 1965), and it is deposited within the rockshelter. Thus, it is not totally unexpected to obtain high pollen concentration values from within the rockshelter as opposed to the area just outside.

Table 83 compares the pollen sum, concentration values, transects, weight, and categories of pollen taxa by the sample type between the interior and exterior of the shelter. The concentration and pollen sum show a marked discrepancy between the interior and exterior of the shelter. The soil samples showed a much higher pollen concentration value for all three categories within the shelter than without. However, the average nonarboreal pollen from the manos was slightly higher outside the shelter than within. The arboreal component from the manos was essentially the same, although the economic category showed much higher concentration values from within the shelter.

The arboreal pollen component consisted primarily of *Pinus* pollen, and the extremely high pollen concentration values suggest that pines were close to the site, probably similar to the modern *Pinus ponderosa* forest found in the vicinity today. The lowered *Pinus* values from the exterior are probably the result of preservation problems rather than the proximity of a pollen source.

Prosopis pollen was recovered in moderate to high concentration values from two soil samples within the shelter, although their presence was based on the occurrence of only 1 or 2 grains. *Prosopis* is currently found within 20-25 miles of the site. Both samples containing the *Prosopis* pollen were associated with ceramic sherds, which indicates that the source of the pollen may have been from other plant parts, such as seeds, stored within the ceramic vessels. Ideally, the flotation analyses would verify this assumption.

Zea mays was present in fairly high pollen concentration values from all three soil samples taken from within the shelter. The sample from near a rock (FS 619) probably indicates processing within the shelter. However, the remaining two samples (FS 620 and 663) were associated with large ceramic sherds. This may suggest that the corn pollen was present in the ceramic vessels, rather than an indication of processing. Alternatively, FS 619 and FS 620 were taken from the same unit (103N/98E), and the presence of corn pollen in high amounts from both samples may indicate that the corn pollen is associated with ceramics and does not indicate a processing area. Either explanation is possible, but there is not enough information to ascertain which is more likely.

Another mano sample (FS 919) from the cave interior also contained a small amount of *Zea mays* pollen (11 grains/cm). Brassicaceae pollen (11 grains/cm) was also present, but both taxa were represented by only a single grain in the counts. Brassicaceae is an insect-pollinated taxon and produces relatively few pollen grains per flower, so it probably does not represent natural deposition. It also suggests a processing activity and further suggests that both cultivated and gathered plant materials were being utilized.

A large grass or small corn grain from FS 863, taken from a mano inside the shelter, presents the same problem as pollen samples taken from High Rolls Cave (LA 103114). The pollen grain was on the low side of the range for corn, but there are no native wild grass taxa that normally produce pollen within this size range. I am therefore treating the category of large grass within the category of *Zea mays* for purposes of discussion but have kept the separation between large grass and corn so that researchers have this data in the event that alternative explanations are developed later.

A single tetrad of *Typha latifolia* was also present in FS 620, in association with a large ceramic sherd. This also likely indicates storage of this particular taxon within the ceramic vessel. Based on a single grain, it is possible that it represents natural deposition, but it could be cultural.

Cylindropuntia pollen was present in four samples, three of which were taken from the interior of the rockshelter. Two of the soil samples (FS 619 and 620) contained this pollen taxon, as did FS 697, from a single mano at the extreme back of the cave. The presence of Cylindropuntia on the mano strongly argues for a processing activity. Cylindropuntia, like all members of the Cactaceae family, is insect pollinated, and the Cactaceae rarely contribute more than a trace of their pollen to a natural assemblage. Recovering this pollen type (2 grains) on a mano from the back of the cave almost certainly indicates a cultural vector. The two soil samples containing Cylindropuntia were taken from the same unit. Again, this may suggest storage within the ceramic vessel or a processing activity.

No activity areas were identified outside of the shelter (D. Zamora, pers. comm., 2002), but the two slab metates sampled were from this location. This may indicate that the metates were discarded from the shelter. Both metate samples contained extremely low pollen concentration values. One (FS 1048) contained only 20 grains/sq cm, while the other (FS 1296) contained only 36 grains/sq cm, the two smallest concentration values in the entire suite of samples. Neither contained any economic pollen taxa, which is not altogether unexpected, given their exposure. However, because of the paucity of pollen from these samples, they provide no data on possible uses of these artifacts.

The remainder of the mano pollen washes were from the exterior of the cave. Two of these (FS 1104 and FS 1293) contained very small amounts of *Eriogonum* pollen. Given their location outside the shelter, I suspect that these pollen types represented natural deposition, rather than implying a cultural, economic use. The low arboreal component and the presence of Asteraceae and Poaceae further substantiate this interpretation.

In general, the artifacts from the outside of the shelter appear to contain no pollen indicators. Those from the interior of the shelter revealed a rather heavy concentration of *Zea mays* pollen in addition to a number of taxa representing gathered plant materials. The high incidence of corn pollen from a number of locales within the shelter suggests that most, if not all, corn processing was occurring within the shelter and that corn likely formed a major component of the diet. Corn was likely supplemented by available gathered plant materials, which were also processed or prepared within the shelter.

Finally, based on the pollen taxa recovered, the question arises whether economic taxa are absent from these assemblages because they are truly not present or because they are present in such small amounts that they were missed during sampling. To assess the likelihood of their being missed, the estimated maximum potential concentration values (Dean 1998) of target taxa was computed. Since the entire slide was examined (either by count or low magnification scan of the slide), the estimated number of marker grains per slide was computed by averaging the number of marker grains per transect and multiplying this by the total number of transects examined. Assuming that the first grain observed on a hypothetical second slide was one of the target taxa, the maximum potential concentration value can be computed. Thus, the number of the fossil grains is one, and the number of marker grains per slide is substituted for the number of marker grains counted in the pollen concentration formula. These data are presented in Table 84 and indicate that the estimated potential pollen concentration values fall between 44.26 and 71.05 grains/g for the soil samples and between 0.85 and 20.09 grains/sq cm with a mean of 4.81 grains/sq cm, for the pollen washes. While at first inspection, the estimated maximum pollen concentration values from the soil samples appear somewhat high, this is likely a result of the higher pollen concentration values and the relatively low rate of recovery. Without examining the total of the pollen residues, we can never be absolutely sure that target taxa are indeed absent from the assemblage. Given the relatively low estimated potential pollen concentration values, particularly from the pollen washes, however, I conclude that it is more likely that the missing taxa were indeed absent from these assemblages.

Table 84. Average pollen data by sample type and position of sample

	Sum	Concentration	Transects Counted	Weight	Arboreal Pollen	Nonarboreal Pollen	Economic
Interior of Rockshelter							
Soil	123	7400	29	15	4570	2553	276
Gs: mano	22.5	467	14	65.75	80	257	26
Exterior of Rockshelter							
Soil	20	885	28	15	133	708	44
Gs: mano	40.4	444	8.8	70.4	28	410	7
Gs: metate	22	28	20	525	2	26	0

Note: Soil sample concentrations: grains/g; gs concentrations: grains/cm^2.

Conclusions

The pollen assemblages recovered from this site showed a marked difference between those taken from inside the shelter and those taken from outside the shelter. The soil samples showed the most difference, with a 9-10 times higher pollen concentration value inside the shelter. This discrepancy was thought to be caused by a combination of wind depositional factors and factors of preservation, in addition to pollen brought in via cultural vectors.

Two of the three interior soil samples were taken in association with ceramic sherds. These samples contained high levels of *Zea mays*, Cylindropuntia, and *Prosopis* pollen. This suggests that the original ceramic vessels may have been used to store several types of plants, including cultivated and gathered plant materials. The mano pollen concentration values from within the shelter reflect a processing activity involving similar combinations of taxa. Other economically important pollen taxa, including *Typha latifolia* and Brassicaceae, were also recovered from the manos, which supports the idea that these implements were used on a variety of cultivated and gathered plant materials.

The two slab metates sampled were both found outside the shelter and yielded very little pollen, none of which were economic. Since most of the activity appeared to be conducted within the shelter, and they were outside the shelter, the metates may have been intentionally discarded prior to abandonment of the site.

The manos recovered from the exterior of the shelter contained only very small amounts of economic pollen types, which could have been deposited under natural conditions and contained no evidence of cultivated plant materials. This may also suggest an intentional discard of these artifacts. The reduced pollen concentration values from outside the shelter supports the contention that the majority of activity was occurring within the shelter.

POLLEN ANALYSIS OF A SINGLE COPROLITE SPECIMEN

Richard G. Holloway

A single human coprolite specimen was sent to Quaternary Services for pollen extraction and analyses from Fallen Pines Shelter. Pollen and macrobotanical analyses were performed, and an additional subsample for parasite analyses was separated out. The coprolite was recovered in a large packrat midden in the rear corner of the cave. Pueblo period occupations lie just below the midden, and the coprolite is likely from a Pueblo person.

The modern vegetation at the site consists of a *Pinus ponderosa* forest with some *Quercus* (oak), probably as an understory component. *Prosopis* (mesquite) is not present in the immediate area but is present within 20-25 miles of the site.

Methods and Materials

The coprolite was subsampled at the Palynology Laboratory at Texas A&M University. The sample was split longitudinally, and a 3 g sample was reconstituted using a 0.5-percent w/v Na_3PO_4 solution. The samples were shaken periodically. After three days, the residues were screened after recording fluid color. The larger macroremains caught on the screen were saved for later analysis. The material was screened through 1/16-inch mesh and 350 μ mesh. Material smaller than 350 μ was collected, consolidated, and rescreened through 150 μ mesh. This liquid was again consolidated, and three Lycopodium tablets were added to each sample. From this point, the samples were processed as described for the soil pollen samples and the pollen wash samples. A separate sample was also collected and placed in a vial after reconstituting the specimen. This sample was kept for later parasite analysis, and no further procedures were conducted on it.

Results and Discussion

The results of the pollen analysis are presented in Tables 85a-85d, which contain both the raw counts and the calculated pollen concentration values. Table 86 contains the results of the macrobotanical materials recovered during the extraction of the pollen from this coprolite specimen.

The coprolite specimen contained a total pollen concentration value of 11,630 grains/g based on a pollen sum of 423 grains (almost the entire slide was counted). *Pinus ponderosa* type (1,842 grains/g) was present in moderate amounts, and *Pinus edulis* type (907 grains/g) was present in low amounts, but taken together, the *Pinus* values were quite high. *Quercus* (467 grains/g) pollen was also fairly high, and *Salix* (willow; 82 grains/g) was high for this taxon. Poaceae (1,952 grains/g) and cheno-am (1,760 grains/g) dominated the assemblage, along with high amounts of both high and low spine Asteraceae (1,045 grains/g each) and *Artemisia* (1,897 grains/g). Several grains of Brassicaceae (82 grains/g) were present, along with single incidences of Fabaceae (oak family) and Solanaceae (nightshade; 27 grains/g each). *Zea mays* (137 grains/g) was also present in a fairly high amount. The macroremains consisted of uncharred plant debris along with a large amount of very fine uncharred grass stems. These stems were quite small, which may have been the result of chewing.

Basically, the pollen assemblage reflects a majority of background taxa. The arboreal component is dominated by *Pinus* but also reflects a nearby presence of a riparian habitat containing both *Quercus* and *Salix*. The high pollen concentration values of arboreal taxa suggest that these taxa may have been incidentally ingested along with a meal. This likely would have occurred when the trees were pollinating or just after pollination, possibly in the early summer (June through early July). This is consistent with the high pollen concentration values of Poaceae, cheno-am, and Asteraceae.

Several potentially economic pollen taxa, such as Fabaceae, Solanaceae, and Brassicaceae, are also present in the specimen. These are present in very low amounts, but this is not unexpected, since the majority of types in these families are insect pollinated. The presence of these taxa within the coprolite suggest that these plants, or portions thereof, were ingested as part of a meal.

The presence of *Zea mays* pollen is not inconsistent with its occurrence in other samples from this site. *Zea mays* pollen was present from floor areas within the site. Some corn and/or large grass grains were also recovered from nearby High Rolls Cave (Holloway 2001). The presence of this taxon from the coprolite provides direct evidence of the consumption of this staple.

This is not to say that all of these plants were consumed together. Pollen grains, because of their generally small size, move through the digestive system at different rates. Often, pollen grains are trapped within the microvilli of the small intestine and may remain lodged there for some time. Thus, the pollen concentration values are, of themselves, not certainly indicative of the time elapsed since ingestion.

The presence of very small grass leaves and stems, and the high incidence of Poaceae pollen suggest that grass was eaten as a meal. Although no seeds of Poaceae were recovered, it was a common practice to collect small grass seeds by running the hand up along the stem and eating the collected seeds. The seeds may have passed through the system faster or slower than the pollen material and thus would not necessarily have been represented in this sample.

These results indicate that the specimen was produced in early summer, based on the higher pollen concentration values of the arboreal components. The high concentration values of cheno-am and Asteraceae could have occurred during this season, and the flowers of these taxa may have also been ingested. Direct consumption of grasses could also result in a high incidence of grass pollen, as suggested by the macroremains.

Conclusions

The coprolite specimen contained a fairly large quantity of pollen and was dominated by arboreal components in addition to cheno-am and Asteraceae pollen. The assemblage suggests the coprolite was produced in early summer. There is also a suggestion that grasses and some corn were consumed, although the latter could easily have been from stored materials. Several of the pollen taxa present—Fabaceae, Solanaceae, and Brassicaceae—are potentially economic and have a variety of uses, including food and medicine. Perhaps examining the parasite data will provide clues to the general health of the individual.

Table 85a. Raw pollen counts and concentration values of coprolite specimen

Bag No.	Provenience	Level: mbd	Age (A.D.)	*Pinus*	*Pinus ponderosa*	*Pinus edulis*	*Quercus*	*Salix*	Fabaceae	Solanaceae	Brassicaceae	Poaceae
Raw Pollen Counts												
422	102N/99E	1: 1.4-1.5	1000-1200	100	67	33	17	3	1	1	3	71
Concentration Values												
422	102N/99E	1: 1.4-1.5	1000-1200	2749	1842	907	467	82	27	27	82	1952

Table 85b. Raw pollen counts and concentration values of coprolite specimen

Bag No.	Cheno-am	Asteraceae (high spine)	Asteraceae (low spine)	*Artemisia*	*Ephedra*	Indeterminate	*Zea mays*
Raw Pollen Counts							
422	64	38	38	69	3	10	5
Concentration Values							
422	1760	1045	1045	1897	82	275	137

Table 85c. Raw pollen counts and concentration values of coprolite specimen

Bag No.	Sum	Total	Marker	Percent Indeterminate	Transects	Total Transects	Mark / Slide	*Lycopodium* Added	Weight (g)
422	423	11630	491	2.36	26	29	547.65	40500	3

Table 85d. Raw pollen counts and concentration values (based on counts and low-magnification scan of the slide)

Bag No.	*Zea mays*	Fabaceae	Solanaceae	Max. Potential Concentration
Raw Pollen Counts				
422	5	1	1	-
Concentration Values				
422	123	25	25	24.65

Table 86. Results of macrobotanical analysis of coprolite specimen

Bag No.	Provenience	Level	Age (A.D.)	Percent Recovery	Contaminants	Other	Notes
422	102N/99E	1: 1.4-1.5	1000-1200	26	ucpd	uc grass stems, fine	coarse, 20 ml; fine, 6 ml

THE SOURCE OF OBSIDIAN ARTIFACTS

M. Steven Shackley

The analysis of five obsidian artifacts from probable Archaic contexts at Fallen Pine Shelter indicates a diverse assemblage including obsidian artifacts originally procured from one of the sources originating in Valle Caldera in northern New Mexico. While some of the obsidian could have been procured as secondary deposits in the Rio Grande alluvium, 135 km west, one of the sources is not available as a secondary deposit.

Analysis and Instrumentation

All archaeological samples are analyzed whole. The results presented here are quantitative in that they are derived from "filtered" intensity values ratioed to the appropriate x-ray continuum regions through a least squares fitting formula rather than plotting the proportions of the net intensities in a ternary system (Schamber 1977; McCarthy and Schamber 1981). More essentially, through the analysis of international rock standards, these data allow for interinstrument comparison with a predictable degree of certainty (Hampel 1984).

The trace element analyses were performed in the Archaeological XRF Laboratory, Department of Earth and Planetary Sciences, University of California, Berkeley, using a Spectrace/ThermoNoran QuanX energy dispersive x-ray fluorescence spectrometer. The spectrometer is equipped with an air cooled Rh x-ray target with a 125 µ Be window, an x-ray generator that operates from 4-50 kV/0.02-2.0 mA at 0.02 increments, using an IBM PC based microprocessor and WinTrace reduction software. The x-ray tube is operated at 30 kV, 0.16 mA, using a 0.05 mm (medium) Pd primary beam filter in an air path at 200 seconds live time to generate x-ray intensity K-line data for titanium (Ti), manganese (Mn), iron (as Fe^T), thorium (Th), rubidium (Rb), strontium (Sr), yttrium (Y), zirconium (Zr), and niobium (Nb). Weight percent iron ($Fe_2O_3^T$) can be derived by multiplying ppm estimates by 1.4297 (10-4). Trace element intensities were converted to concentration estimates by employing a least-squares calibration line established for each element from the analysis of international rock standards certified by the National Institute of Standards and Technology (NIST), the U.S. Geological Survey (USGS), Canadian Centre for Mineral and Energy Technology, and the Centre de Recherches Pétrographiques et Géochimiques in France (Govindaraju 1994). Further details concerning the petrological choice of these elements in Southwest obsidians is available in Shackley (1995, 2002a; also Mahood and Stimac 1991; and Hughes and Smith 1993). Specific standards used for the best fit regression calibration for elements Ti through Nb include G-2 (basalt), AGV-1 (andesite), GSP-1, SY-2 (syenite), BHVO-1 (hawaiite), STM-1 (syenite), QLO-1 (quartz latite), RGM-1 (obsidian), W-2 (diabase), BIR-1 (basalt), SDC-1 (mica schist), TLM-1 (tonalite), SCO-1 (shale), all U.S. Geological Survey standards, and BR-N (basalt) from the Centre de Recherches Pétrographiques et Géochimiques in France (Govindaraju 1994). In addition to the reported values here, Ni, Cu, Zn, and Ga were measured, but these are rarely useful in discriminating glass sources and are not generally reported.

The data from the WinTrace software were translated directly into Excel for Windows software for manipulation and on into SPSS for Windows for statistical analyses. To evaluate these quantitative determinations, machine data were compared to measurements of known standards during each run. Table 87 shows a comparison between values recommended for RGM-1 as of December 1, 2002. RGM-1 is analyzed during each sample run to check machine calibration. With refinements to the calibration, the deviation will improve, although the measurements for the mid-Z elements is within 1 percent.

Trace element data exhibited in Tables 87 and 88, and Figure 55 are reported in parts per million (ppm), a quantitative measure by weight. Source nomenclature is from Baugh and Nelson (1987), Glascock et al. (1999), and Shackley (1988, 1995, 1998, 2002a).

Geochemical Results and Summary

While it is certainly expectable that the obsidian raw material used to produce these artifacts is from the Jemez Mountains in northern New Mexico, the presence of Valle Grande rhyolite glass is more interesting. The long-term study of the secondary distribution of the rhyolite glasses from Quaternary sources in and around the Valle Caldera indicates that Valle Grande, as the most recent event, has not eroded outside the caldera wall (Shackley 2002a, 2002b). While El Rechuelos, and most definitely Cerro Toledo rhyolite glasses have been eroding into the Chama and Rio Grande systems respectively for over 1 million years, Valle Grande has not, except for some very small marekanites that occur as a result of the pyroclastic eruption near Los Alamos (Shackley 2002a, 2002b). Any Valle Grande obsidian recovered in archaeological contexts must have been procured at or

Table 87. X-ray fluorescence concentrations of selected trace elements for RGM-1 (n = 11 runs)

Sample	Ti	Mn	Fe	Th	Rb	Sr	Y	Zr	Nb
RGM-1 (Govindaraju 1994)	1600	279	12998	15	149	108	25	219	8.9
RGM-1 (this study)	1741±37	296±11	14254±129	13±6	150±3	113±2	24±3	220±3	9±3

Note: ± values represent first standard deviation computations for the group of measurments. All values are in parts per million (ppm) as reported in Govindaraju (1994) and this study. Fe^T can be converted to $Fe2O3^T$ with a multiplier of 1.4297(10-4) (see also Glascock 1991).

Table 88. Elemental concentrations of the archaeological samples (ppm)

Sample	Ti	Mn	Fe	Th	Rb	Sr	Y	Zr	Nb	Source
FS24	1118	543	10450	25	209	0	57	181	107	Cerro Toledo rhyolite
FS717	1119	379	9719	19	160	14	38	160	60	Valle Grande
FS1054	1084	487	9890	22	194	16	59	166	95	Cerro Toledo rhyolite
FS1073	1428	513	12571	35	176	21	47	146	37	Valle Grande*
FS1106	1020	511	10051	15	199	0	60	179	97	Cerro Toledo rhyolite
RGM-H1	1759	268	14193	14	154	113	22	220	13	standard

* This sample is quite small and the elemental concentrations are slightly outside the source standard variability for this source, but most likely it was derived from Valle Grande (see Davis et al. 1998).

near the primary sources of Valle Grande (i.e., Cerro del Medio) on the caldera floor. If these Archaic knappers procured their raw materials as part of annual movements, then this would include a range with a radius of over 295 km, well within that suggested for the Archaic in the Southwest (Shackley 1990, 1996; Vierra 1994). Further evidence suggesting direct procurement from the Valle Caldera area is the angular to subrounded cortex on the secondary flake or bipolar core, FS 1054, that was produced from Cerro Toledo rhyolite obsidian. Secondary deposits of this source, even as near to the caldera as Tijeras Canyon in Albuquerque, all exhibit subrounded to rounded cortex (Shackley 2002a). The evidence, while not as solid as I would like, suggests that at least some of this obsidian was procured directly rather than through exchange. In any event, the Valle Grande obsidian had to have been procured originally from the caldera floor, regardless of the means by which it came to Mescalero Cave.

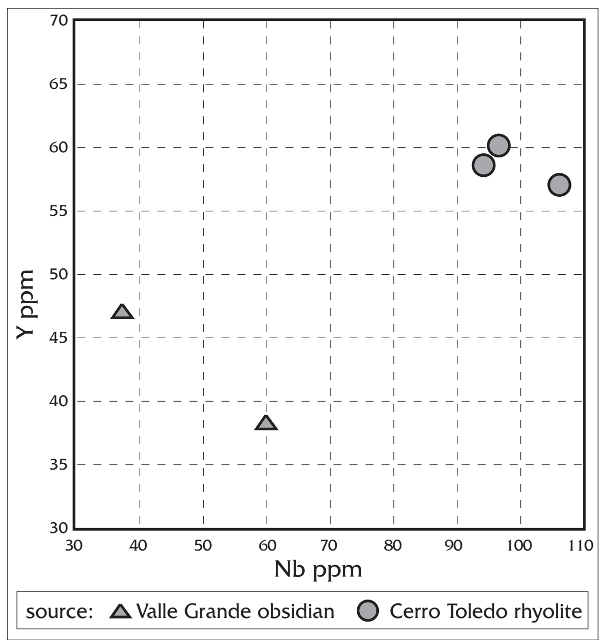

Figure 55. Y versus Nb biplot of the specimens.

CONCLUSIONS

Yvonne R. Oakes

Fallen Pine Shelter (LA 110339) consisted of a small rockshelter (12.5 sq m of floor area) along a major transportation pass through the Sacramento Mountains that served both Archaic and Pueblo populations intermittently for a period of several thousand years (1410 B.C. to the 1600s). Since we knew that both cultural groups utilized the rockshelter, the primary focus of the research was geared toward isolating and comparing the two entities in terms of their subsistence adaptations, mobility strategies, and settlement patterns. The research concerns were separated into three general problem domains: dating regional sites, regional settlement patterns, and site function (Akins 1997).

Dating Regional Sites

As noted in an earlier report on sites in the Sierra Blanca region, the chronological placement of sites within a cultural or temporal scheme in this area is quite confusing (Oakes 2000:239). Cultural phases tend to overlap temporally, and some time periods seem to be almost lacking a viable presence at all. The current increase in recorded sites and the recovery of 85 radiocarbon dates from Fallen Pine Shelter have made a contribution to our understanding of the utilization of the Sierra Blanca region through time. The radiocarbon dates from the shelter (see Fig. 31) indicate that there was almost continuous, short-term use of the site by various groups from ca. 1410 B.C. to recent times. This is one of the very few sites in the region to document this pattern of long-term occupation and one of the few to confirm continued use of the region by prehistoric populations since the Archaic period.

However, the supposition by researchers through the years has been that there is little evidence of occupation in the Sacramento Mountains (other than Archaic populations) before A.D. 700-900 (Kelley 1984; Vierra and Lancaster 1987; Lekson 1988; Sebastian and Larralde 1989; Farwell et al. 1992). This has been a difficult proposition to accept, because it leaves an attractive, resource-rich region of New Mexico lagging far behind cultural adaptations in other parts of the state. Therefore, a chart plotting all radiocarbon assays (n = 472) for all Archaic through Apache sites in the broader Sacramento Mountains and Tularosa Basin area was generated (Fig. 56). Expanding the data base to include the Tularosa Basin allowed the inclusion of regional sites that were likely part of seasonal or annual rounds by populations based in either the Sacramento Mountains or the Tularosa Basin.

It can be seen that a continuum of absolute prehistoric dates has been obtained for the region from about 1600 B.C. to A.D. 1460. While the dating assays are not as numerous as hoped, they do provide the data that reveal a consistent presence of prehistoric peoples during this lengthy time. Regarding the pre-A.D. 700 period, the chart reveals that numerous sites do exist during this time, indicating the presence of a viable pithouse population. Between ca. A.D. 660 and 900, there are numerous dates to support the potential presence of pithouse dwellers. Therefore, we reject the supposition that little occupation took place in the region during that time.

Clusters of dates in Figure 56 suggest more frequent site occupations at three specific times in prehistory: 1600-800 B.C.; 220 B.C., generally increasing to A.D. 850; and A.D. 1000-1440. Prior to 3700 B.C., radiocarbon dates are poorly represented, with only six in a 2,500-year span. The numerous Late Archaic dates indicate a healthy number of sites in the region between 1600 and 800 B.C. Before this time, dates are widely spread. Between 375 and 220 B.C., there is a slight decline in dates, perhaps because of fortuitous site dating by archaeologists or an actual hiatus at the end of the Archaic as settlement patterns changed to pithouse communities. However, the data are too few to make a judgment at this time. A strong Mogollon presence is represented on the chart, with peaks from about A.D. 200 to 1440. Most frequent Mogollon dates for the region occur at ca. A.D. 1030 and 1270. After A.D. 1440, dates become notably fewer, coinciding with the known abandonment of the region at this time. The few dates in the 1500-1700s may well represent Apache occupation of the area. At least one date of A.D. 1625 is confirmed to be of Apache origin (Adams et al. 2000a).

Regional Settlement Patterns

Patterns of site placement within the various topographic zones were plotted for the several cultural periods to delineate any elevational site preferences within the Sierra Blanca region. The region was defined by lands within a block of nine USGS quads with Fallen Pine Shelter at the center and covering 554.4 sq miles. This encompasses Sierra Blanca and Nogal peaks on the northeast, the Rio Bonito Valley to the north, Fort Stanton to the northeast, much of the Mescalero Apache Reservation on the south and west, and the Rio Ruidoso

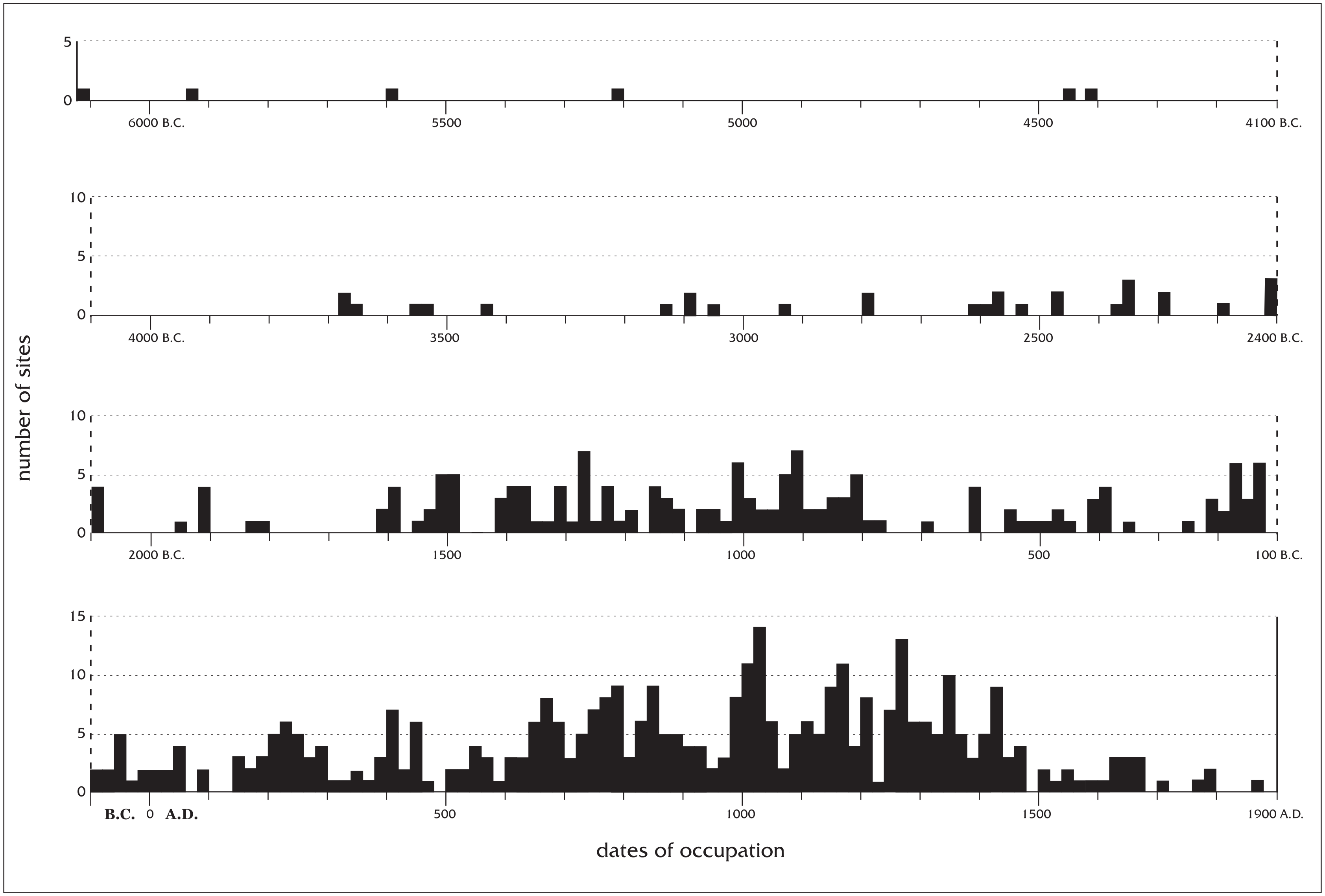

Figure 56. Radiocarbon-dated assays by date of occupation.

Valley on the east. The lowest elevations within this region are at 5,700 ft, near Bent, and the highest is 11,973 ft, at Sierra Blanca Peak, a range of 6,273 ft. The area is mostly mountainous with some well-watered, narrow valleys and rolling hills to the northeast and east. A similar, earlier study (Oakes 2000:9) examined 96 quads around the nearby Angus area. Only 38 of the quads (39.6 percent) contained sites, indicating that large areas within this block were almost surely under-surveyed archaeologically.

The site data were created from the files of the Archaeological Records Management Section (ARMS) of the Historic Preservation Division, Santa Fe, which produced 156 sites with known cultural affiliation and topographic location, far fewer than recorded during a similar study in the Mogollon Highlands of west-central New Mexico (Oakes 1999:29). From this data base, sites were plotted by cultural period and elevation (Table 89). Elevations are stated in feet for ease of correspondence with USGS topographic maps, whereby mean elevation shifts, along with their one-standard deviation, can be seen from one period to the next in Figure 57. These patterns will be explored in the following paragraphs.

A histogram for each cultural period within the region, showing actual elevations, not means, was created (Fig. 58). The Archaic sites display the highest elevations of any in the Sierra Blanca region. Considering the high mobility of this population, this result is not surprising. All but two sites range between 5,800 and 8,200 ft, and they are fairly evenly spread within this zone. These high elevations, likely above 6,000-6,500 ft, could not have been utilized regularly during winter months, therefore implying a summer use by Archaic peoples. Archaic sites in the lower Sacramento Mountain foothills to the west and the Hondo Valley to the east were outside of the study region but may well show a clustering of sites in those areas that could have been winter camps. The Archaic data base is too small to accurately define settlement patterns; however, the wide range of elevational zones used is certainly apparent.

Table 89. Mean site elevations by cultural period

Period	Mean Elevation (feet)	Standard Deviation	Number of Sites
Archaic	7370	1309	29
Pithouse	6690	539	36
Early Pueblo	6591	760	62
Late Pueblo	6930	454	21
Apache	6704	590	8

The Pithouse period has almost a 700 ft drop in mean site elevations. Figure 57 also displays a preference for lower elevations. Sites are not clustered, however, and no modality is discernible. Again, it is questionable whether sites much above 7,000 ft could be habitational, given the frequent harsh winters in the region. An argument could be made for winter vs. summer use of the Sierra Blanca Mountains by pithouse populations, with the implication of seasonal mobility. The use of lower elevations by at least half of the population, as shown in Figure 57, could also represent selection of environmentally favorable locales near streams and potentially arable lands because of the supposed dependency on agricultural products at this time.

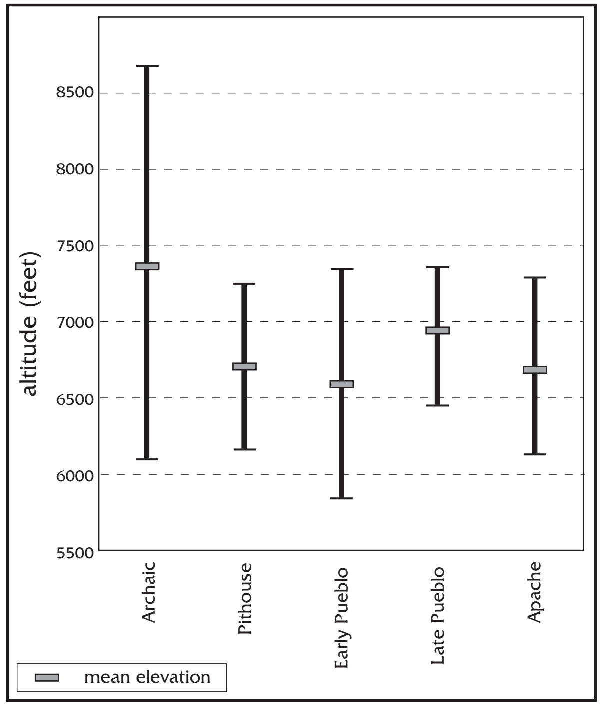

Figure 57. Mean elevation of sites by cultural period.

In the early Pithouse period, mean elevations of sites continue to drop even further, and bimodality is evident for the first time. This result generates several questions. Are sites increasing and being forced to spread out over the landscape to ensure adequate subsistence resources? Are there truly summer vs. winter habitation sites in the Sierra Blancas, or are other factors involved? There are many fewer recorded sites in the Late Pueblo period and these reveal a decided preference for higher elevations at a mean of 6,930 ft. Wood (1978:206) suggests such movement may be related to seeking better or more reliable water sources such as springs or to avoid floodplain channeling. However, the feasibility of growing maize at elevations above 7,000 ft is marginal, with the constant threat of crop failure from late spring freezes. A logical explanation for this late

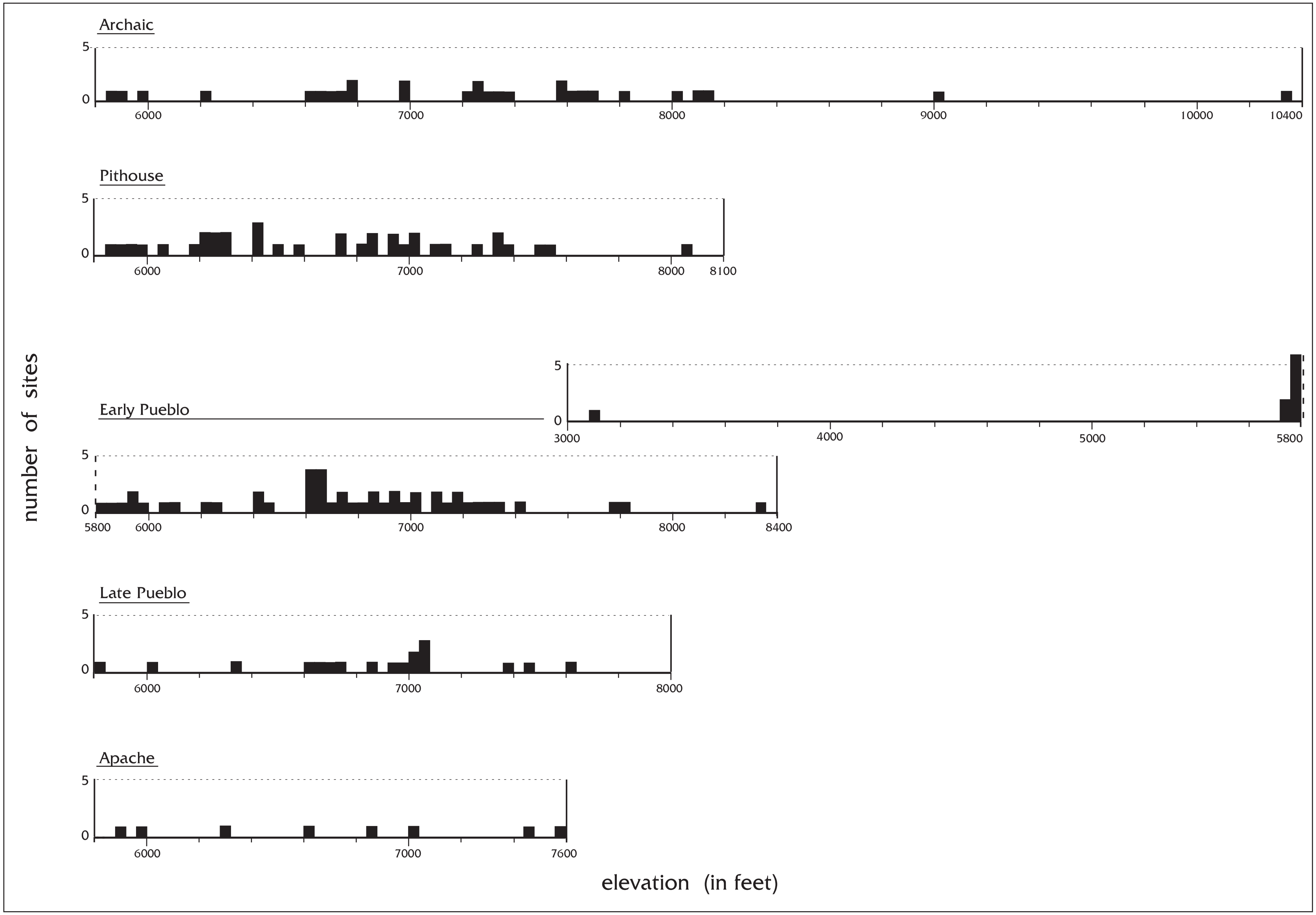

Figure 58. Elevation of sites by cultural period.

shift in elevation cannot be offered at this time. Because of the fairly small number of sites in this time period, competition for available resources would not seem to be a viable factor, nor would overutilization of the game and fuel areas at lower elevations. Also, climatic degradation, particularly drought, which sometimes causes a shift to higher, wetter elevations, does not seem to have been a problem either.

There are only eight known protohistoric Apache sites in the Sierra Blanca region. While no settlement patterns can be unequivocally discerned, it is evident that the sites are within a broad area over the landscape. Either summer and winter camps are both represented, or the site placements represent acquisition of a wide range of environmentally specific resources. As the data base grows for Apache sites in the future, better interpretation of the patterning will follow.

A part of the regional settlement pattern study was an examination of the placement of sites on the landscape, particularly in terms of USGS quads. For the Archaic period, sites are found in each of the nine quads studied, the only cultural period to have such a widespread representation (Fig. 59). Most, however, are on the east side of the study region along the Rio Bonito drainage, Fort Stanton Mesa, and the Mescalero Apache Reservation on mesas above Pine Tree Canyon.

In the following Pithouse period, most of the sites focus in the Ruidoso quad in Cherokee Bill Canyon and adjoining side drainages. There are a fair amount still found in the Fort Stanton area. A new area of study for pithouse development is along the Rio Tularosa and in Nogal Canyon near Bent. By the Early Pueblo period, there is evidence of a real split in location between the Bent/Mescalero area and the Rio Bonito/Fort Stanton area; most sites are near Bent and Nogal Canyon (Fig. 59). Many fewer sites date to the Late Pueblo period, and they are quite spread out, with the focus in the Ruidoso area and the low hills above Jose Second Canyon. By Apache times, few recorded protohistoric sites can be plotted, but those that can center in the Mescalero area. By historic times, Apache sites are mostly found in the Apache Summit and Whitetail quads.

To summarize, sites of all time periods seem to focus on the fairly well-watered drainages of the Rio Bonito, Rio Ruidoso, and the Rio Tularosa. Archaic and Late Pueblo peoples tended to utilize the foothills and mesas along these water courses more than the other cultural groups. Few sites, except Archaic, are found in the high-elevation quads of Nogal Peak, Sierra Blanca Peak, Whitetail, and Apache Summit. Figure 59 shows a strong difference between the regional Archaic settlement pattern and the one for the Early Pueblo period. The Archaic pattern is one of wide dispersal across the Sierra Blanca region, while the Early Pueblo pattern reveals clustering of population centers along the various drainages. It is not possible to determine at this time whether the Archaic pattern indicates high mobility or if different Archaic groups were utilizing the different locales shown on the map.

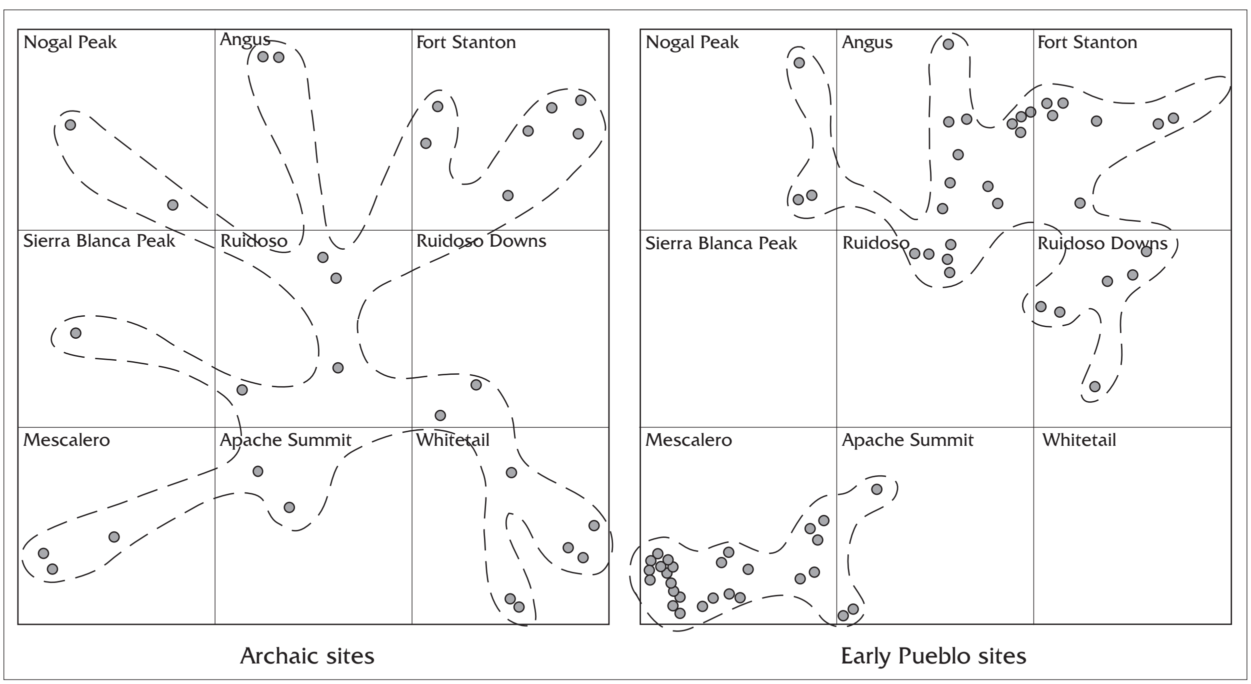

Figure 59. Location of sites by USGS quadrangle.

The Function of Fallen Pine Shelter

There are severe limitations to the functions that Fallen Pine Shelter would have allowed its various prehistoric occupants. One obvious limitation to a broad range of uses is its size—12.5 sq m—and the fact that it is a rockshelter. Rockshelters are fixed on the landscape with limited utilization areas. Their attractiveness to populations may depend on the size and quality of the usable space, location in the landscape, aspect, and proximity to water (Walthall 1998:224). After comparing the use of shelters by hunter-gatherer groups in New Guinea, western Cap San, and Australia, Walthall (1998:226) suggests that the use of shelters by such groups was structured, activities highly standardized, and residential use generally brief.

Characteristic activities recorded are sleeping, food preparation, cooking, storage, and maintenance of equipment (Walthall 1998:227). Gorecki (1991) has noted patterns in the use of shelters for Papua, New Guinea, groups and these are also evident at Fallen Pine Shelter. They include sleeping, indicated by areas free of debris and site furniture, usually in the back of a shelter near the wall. Frequently coexistent with sleeping areas are hearths or fire pits. Hearths are also present if cooking takes place, and they are usually at the front or just outside of the shelter, if warmth is also needed. Maintenance of tools and equipment occurs frequently at the front of a shelter for good lighting. Discard takes place here also or in front of the shelter. Because shelters have a fixed setting, Binford (1978) observes that the Nunamiut frequently used the same shelters repeatedly for the same purposes year after year. This pattern has been suggested in this report for Fallen Pine Shelter. Regarding the many shelters in the Las Cruces area, Johnson and Upham (1988:85) believe they display seasonal utilization between June and October, based on analysis of recovered botanical samples.

There seems to be no argument about the use of shelters for short-term occupation, given their generally small size. However, short-term use could imply an overnight stop while passing through the area, respite from inclement weather, or several days of use by hunter-gatherers seeking food, either as part of a serial foraging strategy whereby food is taken and eaten based on its current availability (Sebastian and Larralde 1989:55), or as part of logistical strategies. Fallen Pine Shelter is on a convenient route through the Sierra Blanca Mountains from the Tularosa Basin to the Hondo Valley and east to the Plains. It is also in what may be considered excellent hunting and gathering territory. Subsistence remains found within the shelter indicate that both activities were pursued from this locale. Several jars containing food items, such as corn, cholla parts, and mesquite were also found in the shelter, probably cached for future use. Young (1996:207) confirms that caves and rockshelters are known to be primary choices for storage by semisedentary groups. Goodwin (1941) observes that western Apaches often hid food in caves near collecting areas or along traveled trails. And the Mescalero Apache have stored food such as mescal, datil, mesquite, piñon, and sotol in caves in skin containers (Young 1996:209). Reuse of shelters is often determined by the amount of existing human disturbance to the site, including depletion of resources, overabundance of trash, and pollution of the water source (Smith and McNees 1999:118). These issues did not seem to concern the groups using Fallen Pine Shelter through time. Reuse may also depend upon whether the usually available resources need time to replenish themselves.

The size of any group using Fallen Pine Shelter was necessarily limited to a small, nuclear family, several hunters or gatherers, or a single person, depending on the type of activity being pursued. Group size is often determined by mobility costs and the rewards of obtaining a resource (Amick 1996:421). The presence of a child burial in a prepared pit in Early Pueblo times indicates that a small family probably occupied the shelter for a short time or while passing through the region. The other burial was in the trash deposit outside of the shelter, and its origin could not be determined. From the evidence of similar subsistence activities carried out over several thousand years, we can conclude that the function of the site remained basically the same through time, even though different cultural groups utilized the space. Schlanger (1990) labels such locations "persistent places," locales that remain in use for long periods of time.

Summary

Fallen Pine Shelter is a small rockshelter in a drainage within a mountain pass through the Sierra Blanca Mountains leading to the Tularosa Basin or the Hondo Valley and the Eastern Plains of New Mexico. The 85 radiocarbon dates obtained from the shelter provide a broad temporal range of 1410 B.C. to recent times. Trash deposits in front of the shelter were unexpectedly deep at 3.6 m. Both Archaic and Pueblo period occupations are notably present, along with several upper-level hearths that may relate to a very short-term protohistoric Apache use. While stratigraphic cultural levels could be discerned within the shelter, the outside deposits were devoid of stratigraphy because of soil erosion on the slope, water channeling off the shelter overhang, and the general bioturbation of the area. Identification of the interface between Archaic and

Pueblo occupations was difficult but determined, in most cases, by the presence of datable ceramics, diagnostic projectile points (n = 50), and the 85 radiocarbon dates.

After analysis of the cultural materials and assessment of the environment, and the shelter's placement within that environment, we conclude that Fallen Pine Shelter was occupied only on a short-term basis throughout its long history. Its limited occupational capacity, the presence of expedient hearths built directly on living surfaces with no attempts to remove ash residue, the presence of several storage vessels, and the limited lithic artifact array all point to sporadic utilization at any given point in time. The shelter could have served as a respite from inclement weather, a stop-over through the mountain pass, a hunting stand, or a gathering and processing locale for wild plant foods (several manos and metates were present). These activities are not bounded by cultural affiliation: anyone throughout prehistory could have utilized the shelter in any of these ways. We suggest that this is precisely what occurred, given the range in radiocarbon dates.

Assessing the overall mobility of the various groups that used the shelter was hampered by the fact that probably no complete band of people ever occupied the space, only a small portion of or party from a larger group. This would hold true whether hunting, gathering, or traveling were taking place. Given the shelter's location away from any known base camps or pueblos, anyone using the spot must have been somewhat mobile. There is evidence that the Archaic occupants had a much greater range of movement, if the Jemez obsidian found there was obtained from its original source, as suggested by Shackley (this report). Also, there is a wide range of Archaic projectile point styles ranging in origin from the Plains of San Augustin to the Colorado Plateau to northern Mexico and Trans-Pecos Texas. It is not clear at the moment whether projectile point style can be equated confidently with specific locations, but the great diversity at the site does indicate that Archaic peoples from several different areas visited the shelter, probably on hunting forays. Also, the presence of a variety of locally available subsistence items in both Archaic and Pueblo assemblages indicates some degree of travel by both groups to acquire them. For the Pueblo people, the shelter may have served as a type of "fieldhouse" whereby food was collected and processed before they returned to the home community. For the Archaic component, the acquisition of subsistence resources in the immediate vicinity may have been part of seasonal or annual rounds or embedded within a serial foraging strategy.

Other shelters, such as High Rolls Cave and Fresnal Shelter, are also known for their extensive Archaic occupations. Fallen Pine Shelter, however, contains almost the entire gamut (excluding Paleoindian) of known prehistoric use in the region and provides us with the opportunity to look at change—or, more accurately, the lack of change—through time.

REFERENCES CITED

Acklen, John C., et al.
1983 Supplemental Inventory of 53 Prehistoric Agricultural Sites for the Ute Mountain Land Exchange. PNM Archaeological Report No. 4 (draft). Public Service Company of New Mexico, Albuquerque.

Adams, Christopher D.
1997 *Malone Draw Cultural Resource Survey.* Cultural Resource Report 1995-018. Holloman Air Force Base, Alamogordo, New Mexico.

Adams, Christopher D., Diane E. White, and David M. Johnson
2000a *Last Chance Canyon, 1869 Apache/Cavalry Battle Site.* Lincoln National Forest Heritage Program, Alamogordo.

2000b *Dark Canyon Rancheria, Apache/Military Battle Site, Lincoln National Forest, New Mexico.* Lincoln National Forest Heritage Program, Alamogordo.

Adams, Jenny L.
1988 Use-Wear Analyses on Mano and Hide-Processing Stones. *Journal of Field Archaeology* 15:307-315.

1996 *Manual for a Technological Approach to Ground Stone Analysis.* Center of Desert Archaeology, Tucson.

1999 Refocusing the Role of Food-Grinding Tools as Correlates for Subsistence Strategies in the U.S. Southwest. *Kiva* 64(3):475-498.

Adams, Karen R.
1987 Uncarbonized *Zea mays* Cobs from Beth Cave (LA47481), Lincoln County, New Mexico. Manuscript on file, Museum of New Mexico, Santa Fe.

Adams, Karen R., and Regge N. Wiseman
1994 Uncarbonized Maize Cobs from Beth's Cave, Lincoln County, New Mexico. *The Artifact* 32(1):7-22.

Aguila, Lourdes
2002 Decorated Ceramic Diversity. In *Archaeological Variation within the Middle Rio Bonito,* edited by P. H. Shelley and K. E. Wenzel, pp. 95-142. Cultural Resource Series 14. Bureau of Land Management, New Mexico State Office, Santa Fe.

Aguila, Lourdes, Elizabeth McNally, and Phillip H. Shelley
2002 The Sierra Blanca Region. In *Archaeological Variation within the Middle Rio Bonito*, edited by P. H. Shelley and K. E. Wenzel, pp. 17-25. Cultural Resource Series 14. Bureau of Land Management, New Mexico State Office, Santa Fe.

Akins, Nancy J.
1997 *Archaeological Test Excavations along U.S. 70 and a Data Recovery Plan for LA 110339, Mescalero Apache Tribal Lands, Otero County, New Mexico.* Archaeology Notes 221. Museum of New Mexico, Office of Archaeological Studies, Santa Fe.

2001 Angus Human Remains. In *The Angus Site: A Late Prehistoric Settlement along the Rio Bonito, Lincoln County, New Mexico*, by D. A. Zamora and Y. R. Oakes, pp. 203-212. Archaeology Notes 276. Office of Archaeological Studies, Museum of New Mexico, Santa Fe.

2003 *Salt Creek: Data Recovery at Seven Prehistoric Sites along U.S. 285 in Chaves and De Baca Counties, New Mexico.* Archaeology Notes 298. Office of Archaeological Studies, Museum of New Mexico, Santa Fe.

in prep. Archaic Animal Subsistence in Fresnal Canyon. In *High Rolls Cave.* Museum of New Mexico, Office of Archaeological Studies, Santa Fe.

Allan, William C.
1973 General Description of the Basketry from Fresnal Shelter. In *Technical Manual: 1973 Survey of the Tularosa Basin: The Research Design*, pp. 403-405. Human Systems Research, Albuquerque.

Allen, John E., and Frank E. Kottlowski
1981 *Scenic Trips to the Geologic Past, No. 3, Roswell-Ruidoso-Valley of Fires.* 3rd ed. New Mexico Bureau of Mines and Mineral Resources.

Amick, Daniel S.
1996 Regional Patterns of Folsom Mobility and Land Use in the American Southwest. *World Archaeology* 27(3):411-426.

Anderson, Eugene Carter
1954 *The Metal Resources of New Mexico and Their Economic Features through 1954.* Bureau of Mines and Mineral Resources, Bulletin 39. New Mexico Institute of Mining and Technology. Socorro.

Andrefsky, William, Jr.
1994 Raw-Material Availability and the Organization of Technology. *American Antiquity* 59(1):21-34.

Aschmann, Homer
1974 Terrain and Ecological Conditions in the Western Apache Range. In *American Indian Ethnohistory: Indians of the Southwest.* Vol. 5, *Apache Indians*, pp. 233-260. Garland Publishing, New York.

Ash, Sidney R., and Leon V. Davis
1964 *Guidebook of the Ruidoso Country.* 15th Field Conference, New Mexico Geological Society.

Bailey, Vernon
1971 *Mammals of the Southwestern United States: With Special Reference to New Mexico.* Dover Publications, New York.

Bamforth, Douglas B.
1985 Technological Efficiency and Tool Curation. *American Antiquity* 51(1):38-50.

Bandelier, Fanny
1972 *The Narrative of Alvar Nuñez Cabeza de Vaca.* Imprint Society, Barre.

Barkley, Fred A.
1934 The Statistical Theory of Pollen Analysis. *Ecology* 14:283-289.

Bartlett, Katherine
1933 *Pueblo Milling Stones of the Flagstaff Region and Their Relation to Others in the Southwest.* Museum of Northern Arizona, Bulletin 3. Flagstaff.

1936 Symposium of Prehistoric Agriculture. *University of New Mexico Bulletin* 1(5):29-34.

Basehart, Harry W.
1971 Mescalero Apache Band Organization and Leadership. In *Apachean Culture History and Ethnology*, edited by K. H. Basso and M. E. Opler, pp.35-49. University of Arizona Anthropological Papers 21. Tucson.

1974 Mescalero Apache Subsistence Patterns and Socio-Political Organization. In *American Indian Ethnohistory, Indians of the Southwest.* Vol. 12, *Apache Indians,* edited by D. A. Horr. Garland Publishing, New York.

Baugh, Timothy G., and F. W. Nelson, Jr.
1987 New Mexico Obsidian Sources and Exchange on the Southern Plains. *Journal of Field Archaeology* 14:313-329.

Beach, Marshall A., and Christopher S. Causey
1984 Bone Artifacts. In *The Faunal Remains from Arroyo Hondo Pueblo, New Mexico*, by R. W. Lang and A. H. Harris, pp.187-225. Arroyo Hondo Archaeological Series. School of American Research Press, Santa Fe.

Beckett, Patrick H.
1983 The Paleoindian Prehistory of the Tularosa Basin. In *The Prehistory of Rhodes Canyon, N.M.,* edited by P. L. Eidenbach, pp. 95-103. Human Systems Research, Tularosa.

Beckett, Patrick H., and Richard S. MacNeish
1994 The Archaic Chihuahua Tradition of South-Central New Mexico and Chihuahua, Mexico. In *Archaic Hunter-Gatherer Archaeology in the American Southwest*, edited by B. J. Vierra.. Contributions in Anthropology 13(1):335-371. Eastern New Mexico University, Portales.

Beckner, Morton
1959 *The Biological Way of Thought.* Columbia University, New York.

Beidl, Jacqueline
1990 Analyses of Artifacts from Three Potential Apache Sites in the Mountains of Southcentral New Mexico. Master's thesis, Department of Anthropology, New Mexico State University, Las Cruces.

Bender, Averam B.
1974 A Study of Mescalero Apache Indians: 1846-1880. In *American Indian Ethnohistory: Indians of the Southwest.* Vol. 11, *Apache Indians,* edit-

ed by D. A. Horr, pp. 61-310. Garland Publishing, New York.

Binford, Lewis R.
1978 *Nunamiut Ethnoarchaeology.* Academic Press, New York.

1983a *Working at Archaeology.* Academic Press, New York.

1983b *In Pursuit of the Past: Decoding the Archaeological Record.* Thames and Hudson, New York.

1994 Systematic Integration of "Fragmentary Oddments": The Challenge of Settlement Pattern Approaches. In *Archaic Hunter-Gatherer Archaeology in the American Southwest,* edited by B. J. Vierra, pp. 527-565. Contributions in Anthropology 13(1). Eastern New Mexico University, Portales.

2001 *Constructing Frames of Reference: An Analytical Method for Archaeological Theory Building Using Ethnographic and Environmental Data Sets.* University of California Press, Berkeley.

Bird, Robert
1994 Manual for the Measurement of Maize Cobs. In *Corn and Culture in the Prehistoric New World,* edited by S. Johannessen and C. Hastorf, pp. 5-22. Westview Press, Boulder.

BISON (Biota Information System of New Mexico)
n.d. Species Accounts Developed by the New Mexico Department of Game & Fish and the Fish and Wildlife Information Exchange. http:/fwie.fw.vt.edu/states/nmex_main/species.

Bohrer, Vorsilla L.
1972 Paleoecology of the Hay Hollow Site, Arizona. Fieldiana: *Anthropology* 63(91). Field Museum of Natural History, Chicago.

1973 Tentative List of Utilized Plant Remains from Fresnal Shelter. In *Technical Manual: 1973 Survey of the Tularosa Basin: The Research Design,* pp. 211-218. Human Systems Research, Albuquerque.

1981a Methods of Recognizing Cultural Activity from Pollen in Archaeological Sites. *The Kiva* 46:135-142.

1981b Former Dietary Patterns of People as Determined from Archaic-Age Plant Remains from Fresnal Shelter, South-Central New Mexico. *The Artifact* 19(3-4):41-50.

in prep. *Flotation Analysis from High Rolls Cave (LA 114103), Otero County, New Mexico*. Southwestern Ethnobotanical Enterprises Report 37. Portales.

Bohrer, Vorsila L., and Karen R. Adams
1977 *Ethnobotanic Techniques and Approaches at the Salmon Ruin, New Mexico*. San Juan Valley Archeological Project, Technical Series 2. Eastern New Mexico University Contributions in Anthropology 8(1). Portales.

Brookes, David, and Karl W. Thomas
1967 The Distribution of Pollen Grains on Microscope Slides. Part 1, The Non-Randomness of the Distribution. *Pollen et Spores* 9:621-629.

Broster, John B.
1980a Projectile Point Analysis. In *A Cultural Resource Management Plan for Timber Sale and Forest Development Areas on the Mescalero Apache Indian Reservation,* vol.1, edited by B. Harrill, pp. 93-103. Bureau of Indian Affairs, Albuquerque.

1980b Prehistoric Analysis Summary. In *A Cultural Resource Management Plan for Timber Sale and Forest Development Areas on the Mescalero Apache Indian Reservation,* edited by B. Harrill, pp. 127-132. Bureau of Indian Affairs, Albuquerque.

Broster, John B., and Bruce Harrill
1983 Investigations of Prehistoric Remains at High-Altitudes in the Sacramento Mountains of South-Central New Mexico. In *High Altitude Adaptations in the Southwest,* edited by J. C. Winter, pp.159-167. Cultural Resources Management Report 2. USDA Forest Service, Southwestern Region.

Brown, David E.
1994 *Biotic Communities of Southwestern United States and Northwestern Mexico.* University of Utah Press, Salt Lake City.

Buikstra, Jane E., and Douglas H. Ubelaker
1994 *Standards for Data Collection from Human*

Skeletal Remains. Arkansas Archaeological Survey Research Series No. 44. Fayetteville.

Byrant, Vaughn M., Jr.
1969 *Pollen Analysis of Late-Glacial and Post-Glacial Texas Sediments.* Ph.D. dissertation, University of Texas, Austin.

Bryant, Vaughn M.., Jr., and Richard G. Holloway
1983 The Role of Palynology in Archaeology. In *Advances in Archaeological Method and Theory*, vol. 6, edited by M. Schiffer, pp. 191-224. Academic Press, N.Y.

Camilli, Eileen L.
1988 Lithic Raw Material Selection and Use in the Desert Basins of South-Central New Mexico. *The Kiva* 53:147-163.

Calamia, Mark A.
1990 Ground Stone Variability among Jornada Mogollon Sites and Its Implications for Interpreting Residential Mobility. In *Perspectives on Southwestern Prehistory,* edited by P. Minnis and C. L. Redman, pp. 135-149. Westview Press. Oxford.

Carmichael, David C.
1986 *Archaeological Survey in the Southern Tularosa Basin, New Mexico.* Historic and Natural Resources Report 3. Fort Bliss Environmental Management Office, Fort Bliss.

1988 *Patterns of Residential Mobility and Sedentism in the Jornada Mogollon Area.* Paper delivered at First Southwest Symposium, Phoenix.

Castetter, Edward F., and Morris E. Opler
1936 *The Ethnobiology of Chiricahua and Mescalero Apache: A. The Use of Plants for Foods, Beverages, and Narcotics*. Ethnobiological Studies in the American Southwest 3. University of New Mexico Bulletin 297, Biological Series 4(5).

Chapman, Kenneth M.
1926 An Archaeological Site in the Jornada del Muerto. *El Palacio* 20(6):24-28.

Chatters, James C.
1987 Hunter-Gatherer Adaptations and Assemblages. *Journal of Anthropological Archaeology* 6:336-375.

Cosgrove, Cornelius B.
1947 *Caves of the Upper Gila and Hueco Areas in New Mexico and Texas.* Papers of the Peabody Museum 24(2).

Dart, Al
1980 Animal Resources. In *A Cultural Resource Management Plan for Timber Sale and Forest Development Areas on the Mescalero Apache Indian Reservation,* by B. G. Harrill, pp.36-44. Forestry Archeological Program, Bureau of Indian Affairs, Albuquerque Area Office, Albuquerque.

Dean, Glenna
1998 Finding a Needle in a Palynological Haystack: A Comparison of Methods. In *New Developments in Palynomorph Sampling, Extraction, and Analysis,* edited by V. Bryant and J. H. Wrenn, pp. 53-59. Contributions Series No. 33. American Association of Stratigraphic Palynologists Foundation.

Dean, Jeffrey S.
1984 Environmental Aspects of Modeling Human Location Behavior. In *Stage I Site Locational Modeling in the Southwestern Region,* edited by L. S. Cordell and D. F. Green, pp. 8-20. Cultural Resources Management Report 5. USDA Forest Service, Southwestern Region.

Dick, Herbert W.
1965 *Bat Cave.* Monograph No. 27. School of American Research, Santa Fe.

Diehl, Michael W.
1996 The Intensity of Maize Processing and Production in Upland Mogollon Pithouse Villages, A.D. 200-1000. *American Antiquity* 61(1):102-115.

Dobyns, Henry F.
1973 *The Mescalero Apache.* Indian Tribal Series, Phoenix.

Dodge, W. A.
1980 Prehistory of the Sacramento Mountains. In *A Cultural Resource Management Plan for Timber Sale and Forest Development Areas on the Mescalero Apache Indian Reservation*, by B. Harrill, pp. 48-52. Forestry Archeological Program, Bureau of Indian Affairs, Albuquerque.

Driver, Jonathan C.
1985 *Zooarchaeology of Six Prehistoric Sites in the Sierra Blanca Region, New Mexico.* Research Reports in Archaeology, Contribution 12. Museum of Anthropology, University of Michigan Technical Reports 17. Ann Arbor.

Dyson-Hudson, Rada, and Eric Alden Smith
1978 Human Territoriality: An Ecological Reassessment. *American Anthropologist* 80:21-41.

Eidenbach, Peter L.
1979 Wizard's Roost and Wally's Dome: Continuing Investigations of Prehistoric Observatory Sites in the Sacramento Mountains, New Mexico. In *Jornada Mogollon Archaeology: Proceedings of the First Jornada Conference,* edited by P. H. Beckett and R. N. Wiseman, pp.103-105. Historic Preservation Bureau, Santa Fe.

Elyea, Janette M.
1988 Analysis of Paleoindian Tools from LA 63880. In *The Border Star 85 Survey: Towards an Archaeology of Landscapes,* edited by T. J. Seaman, W. H. Doleman, and R. D. Chapman, pp. 231-238. Office of Contract Archeology, University of New Mexico. Albuquerque.

Erdtman, Gunnar
1960 The Acetolysis Method: A Revised Description. *Svensk.botanisk Tidskrift* 54:561-564.

Farwell, Robin E., Yvonne R. Oakes, and Regge N. Wiseman
1992 *Investigations into the Prehistory and History of the Upper Rio Bonito, Lincoln County, Southeastern New Mexico.* Laboratory of Anthropology Notes 297. Museum of New Mexico, Santa Fe.

Fenneman, Nevin M.
1931 *The Physiographic Provinces of the Western United States.* McGraw-Hill, New York.

Ferdon, Edwin N., Jr.
1946 *An Excavation of Hermit's Cave, New Mexico.* Monographs of the School of American Research. University of New Mexico Press, Albuquerque.

Findley, James S., Arthur H. Harris, Don E. Wilson, and Clyde Jones
1975 *Mammals of New Mexico.* University of New Mexico Press. Albuquerque.

Fish, Suzanne K., Paul R. Fish, and John H. Madsen
1992 Early Sedentism and Agriculture in the Northern Tucson Basin. In *The Marana Community in the Hohokam World,* edited by S. K. Fish, P. R. Fish, and J. H. Madsen, pp. 11-19. Anthropological Papers of the University of Arizona 56. University of Arizona Press, Tucson.

Ford, Richard I.
1976 The Paleoethnobotany of Smokey Bear Ruin (LA 2112), New Mexico. In *Multidisciplinary Investigations at the Smokey Bear Ruin (LA 2112), Lincoln County, New Mexico,* by R. N. Wiseman, M. Y. El-Najjar, J. S. Bruder, and R. I. Ford, pp. 55-61. COAS Publishing and Research Monograph No. 4. Las Cruces.

Franklin, Hayward
1997 Valencia Pueblo Ceramics. In *Excavations at Valencia Pueblo (LA 953) and a Nearby Hispanic Settlement (LA 67321), Valencia County, New Mexico,* edited by K. L. Brown and B. J. Vierra, pp. 125-257. Office of Contract Archeology Report 185-400F. Albuquerque.

Gibbs, Victor, and Mark Sale
1997 Investigation of Paleoindian Remains on Holloman Air Force Base, Otero County, New Mexico. In *Proceedings of the Ninth Jornada Mogollon Conference,* edited by R. P. Mauldin, J. D. Leach, and S. Ruth, pp. 99-107. Centro de Investigaciones Arqueológicas, Publications in Archaeology 12. El Paso.

Glascock, Michael D., R. Kunselman, and Daniel Wolfman
1999 Intrasource Chemical Differentiation of Obsidian in the Jemez Mountains and Taos Plateau, New Mexico. *Journal of Archaeological Science* 26:861-868.

Goodwin, G.
1941 *The Social Organization of the Western Apache.* University of Arizona Press, Tucson.

Gorecki, P. P.
1991 Horticulturalists as Hunter-Gatherers: Rock Shelter Usage in Papua New Guina. In *Ethnoarchaeological Approaches to Mobile Campsites,* edited by C. S. Gamble and W. A. Broismier, pp. 237-262.

Govindaraju, K.
1994 Compilation of Working Values and Sample Description for 383 Geostandards. *Geostandards Newsletter* 18.

Green, Roger C.
1956 Excavations near Mayhill, New Mexico. In *Highway Salvage Archaeology.* New Mexico State Highway Department and Museum of New Mexico, Santa Fe.

Hall, Steven A.
1981 Deteriorated Pollen Grains and the Interpretation of Quaternary Pollen Diagrams. *Review of Paleobotany and Palynology* 32:193-206.

Hampel, Joachim H.
1984 Technical Considerations in X-Ray Fluorescence Analysis of Obsidian. In *Obsidian Studies in the Great Basin,* edited by R. E. Hughes, pp. 21-25. Contributions of the University of California Archaeological Research Facility 45. Berkeley.

Hard, Robert J.
1990 Agricultural Dependence in the Mountain Mogollon. In *Perspectives on Southwestern Prehistory,* edited by P. E. Minnis and C. L. Redman. Westview Press, Boulder.

Hard, Robert J., and D. Nickels
1994 *The 1993 University of Texas at San Antonio Excavations at LA 89652: The Tortolita Canyon Site.* Center for Archaeological Research, University of Texas, San Antonio.

Harrill, Bruce G.
1980 *A Cultural Resource Management Plan for Timber Sale and Forest Development Areas on the Mescalero Apache Indian Reservation.* Forestry Archeological Program, Bureau of Indian Affairs, Albuquerque Area Office, Albuquerque.

Harris, Arthur H.
1997 The Pleistocene Fauna from a Reputed Pre-Clovis Site in New Mexico. In *Proceedings of the Ninth Jornada-Mogollon Conference,* edited by R. P. Mauldin, J. D. Leach, and S. Ruth. Centro de Investigaciones Arqueológicas, Publications in Archaeology 12. El Paso.

Haury, Emil W.
1936a *Some Southwestern Pottery Types.* Medallion Papers 19. Gila Pueblo, Globe, Arizona.

1936b *The Mogollon Culture of Southwestern New Mexico.* Medallion Papers. Gila Pueblo, Globe, Arizona.

1975 *The Stratigraphy and Archaeology of Ventana Cave.* University of Arizona Press, Tucson.

Hayden, David J., Lloyd A. Moiola, and Yvonne R. Oakes
1998 *The Datil Mountain Project: Archaic, Puebloan, and Athabascan Campsites along U.S. 60 near Datil, Catron County, New Mexico.* Archaeology Notes 290. Office of Archaeological Studies, Museum of New Mexico, Santa Fe.

Hayes, Alden C., Jon N. Young, and A. H. Warren
1981 *Contributions to Gran Quivira Archaeology, Gran Quivira National Monument, New Mexico.* National Park Service, Publications in Archaeology 17. Washington, D.C.

Hertel, Joelle
1980 Early Statehood Period to Present. In *A Cultural Resource Management Plan for Timber Sale and Forest Development Areas on the Mescalero Apache Indian Reservation*, vol. 1, edited by B. G. Harrill, pp. 72-73. Forestry Archeological Program, Bureau of Indian Affairs, Albuquerque Area Office, Albuquerque.

Higgins, Howard C.
1984 *A Cultural Resource Inventory of Site "B" for the Proposed Sierra Blanca Airport, Lincoln County, New Mexico.* Office of Contract Archeology, University of New Mexico, Albuquerque.

Hill, David V.
1996a Ceramics. In *Archaeological Testing at LA 109291, LA 109292, and LA 109294: Sites along the Potash Junction to I.M.C. #1, Eddy County, New Mexico,* prepared by D. P. Staley, J. T. Abbott, K. A. Adams, D. V. Hill, R. G. Holloway, W. D. Hudspeth, and R. B. Roxlau, pp. 59-64. Mescalero Plains Archaeology, vol. 1. Technical Report 11034-0010. TRC Mariah Associates, Albuquerque.

1996b Ceramics. In *Archaeological Investigations along the Potash Junction to Junction to Cunningham Station Transmission Line, Eddy and Lea Counties, New Mexico,* prepared by D. P. Staley, K. A. Adams, T. Dolan, J. A. Evaskovich, D. V. Hill, R. G. Holloway, W. B. Hudspeth, and R. B. Roxlau, pp. 151-160. Mescalero Plains Archaeology, vol. 2. Technical Report 11034-0030. TRC Mariah Associates, Albuquerque.

1999 Petrographic Analysis of Seven Sherds from Red Lake Tank. In *Red Lake Tank: The Excavation of Four Sites East of Roswell,* by P. Y. Bullock, pp.41-43. Archaeology Notes 250. Office of Archaeological Studies, Museum of New Mexico, Santa Fe.

Hohmann, John W.
1995 *A Phase I (Class III) Archaeological Survey of 5.5 Miles along U.S. 70, Lincoln and Otero Counties, New Mexico.* Cultural Resource Group Report No. 45. Louis Berger & Associates, Albuquerque.

Holloway, Richard G.
1981 Preservation and Experimental Diagenesis of the Pollen Exine. Ph.D. diss., Texas A&M University, College Station.

1989 Experimental Mechanical Pollen Degradation and Its Application to Quaternary Age Deposits. *Texas Journal of Science* 41:131-145.

1994 Archeobotanical Remains: The 1994 Season. Appendix D in *The Tortolita Canyon Site: Report on the 1993-1994 University of Texas at San Antonio Field School,* by D. Nickels and R. Hard. Center for Archaeological Research, University of Texas, San Antonio.

2001 *Pollen Analysis of Samples from LA 114103, High Rolls Cave, Otero County, New Mexico.* Quaternary Services Technical Report 2001-01. Manuscript on file, Office of Archaeological Studies, Museum of New Mexico, Santa Fe.

Holmer, Richard N.
1986 Common Projectile Points of the Intermountain West. In *Anthropology of the Desert West: Essays in Honor of Jesse D. Jennings,* edited by C. Condie and D. Fowler, pp. 89-115. University of Utah Anthropological Papers 110. Salt Lake City.

Houghton, Frank E.
1976 Climate. In *Soil Survey of Mescalero Apache Area, New Mexico, Northeastern Otero County.* USDA Soil Conservation Service and USDI Bureau of Indian Affairs, Washington, D.C.

Huckell, Bruce B.
1996 The Southwestern Archaic: Scale and Perception of Preceramic Hunter-Gatherers. In *Interpreting Southwestern Diversity: Underlying Principles and Overeaching Patterns,* edited by P. R. Fish and J. J. Reid, pp. 7-15. Anthropological Research Paper 48. Arizona State University, Tempe.

Hughes, Richard E., and Robert L. Smith
1993 Archaeology, Geology, and Geochemistry in Obsidian Provenance Studies. In *Scale on Archaeological and Geoscientific Perspectives*, edited by J. K. Stein and A. R. Linse, pp. 79- 91. Special Paper 283. Geological Society of America.

Irwin-Williams, Cynthia
1973 *The Oshara Tradition: Origins of Anasazi Culture.* Eastern New Mexico University Contributions in Anthropology 5(1). Portales.

1979 Post-Pleistocene Archeology, 7000-2000 B.C. In *Handbook of North American Indians*, vol. 9, *Southwest*, edited by A. Ortiz, pp. 31-42. Smithsonian Institution, Washington, D.C.

Jelinek, Arthur J.
1967 *A Prehistoric Sequence in the Middle Pecos Valley, New Mexico.* Anthropological Papers 31. Museum of Anthropology, University of Michigan, Ann Arbor.

Jennings, Jesse D.
1940 *A Variation of Southwestern Pueblo Culture.* Technical Series Bulletin 19. Laboratory of Anthropology, Museum of New Mexico, Santa Fe.

Johnson, Michael, and Steadman Upham
1988 A Preliminary Report on Archaeological Investigations in the Organ Mountains, Southern New Mexico. In *Fourth Jornada Mogollon Conference (Oct. 1985), Collected Papers,* edited by M. S. Duran and K. W. Laumbach, pp. 65-74. Human Systems Research, Tularosa.

Jones, Robert C.
1990 Analysis of a Lithic Sample, Fresnal Rock Shelter, Southcentral New Mexico. Master's thesis, Department of Anthropology, Eastern New Mexico University, Portales.

Keesling, Henry S.
1980 Past Climate. In *A Cultural Resource Management Plan for Timber Sale and Forest Development Areas on the Mescalero Apache Indian Reservation,* by B. G. Harrill, pp. 44-46. Forestry Archeological Program, Bureau of Indian Affairs, Albuquerque Area Office, Albuquerque.

Kelley, Jane Holden
1966 The Archaeology of the Sierra Blanca Region of Southeastern New Mexico. Ph.D. diss., Harvard University, Boston.

1984 *The Archaeology of the Sierra Blanca Region of Southeastern New Mexico.* Anthropological Papers 74. University of Michigan, Ann Arbor.

Kelly, Robert L.
1985 Hunter-Gatherer Mobility and Sedentism: A Great Basin Study. Ph.D. diss., Department of Anthropology, University of Michigan, Ann Arbor.

1988 The Three Sides of a Biface. *American Antiquity* 53:717-734.

1995 *The Foraging Spectrum: Diversity in Hunter-Gatherer Lifeways.* Smithsonian Institution Press, Washington, D.C.

Kent, Susan
1989 Cross-Cultural Perceptions of Farmers as Hunters and the Value of Meat. In *Farmers as Hunters,* edited by S. Kent, pp. 1-17. Cambridge University Press, Cambridge.

Kidder, Alfred V.
1932 *The Artifacts of Pecos.* Yale University Press, New Haven.

Kidder, Alfred V., and Anna O. Shepard
1936 *The Pottery of Pecos.* Vol. 2, *Glaze Paint, Culinary, and Other Wares.* Papers of the Phillips Academy 7. Phillips Academy, New Haven.

Kirkpatrick, David T., Peter Eidenbach, Karl W. Laumbach, and Meliha S. Duran
2000 *Basin and Range Archaeology: An Overview of Prehistory in South-Central New Mexico.* Human Systems Research, Las Cruces.

Klein, Richard M.
1987 *The Green World: An Introduction to Plants and People.* 2nd ed. Harper Collins Publishers, New York.

Lancaster, James W.
1983 An Analysis of Manos and Metates from the Mimbres Valley, New Mexico. M.A. thesis, University of New Mexico. Albuquerque.

Lang, E. M.
1957 *Deer of New Mexico.* Bulletin No. 5. New Mexico Department of Game and Fish, Santa Fe.

Larsen, Clark Spencer
1997 *Bioarchaeology: Interpreting Behavior from the Human Skeleton.* Cambridge University Press, Cambridge.

Laumbach, Karl W.
1985 *An Archaeological Survey of Two Areas near the HELSTAF Facility, White Sands Missile Range, New Mexico.* Human Systems Research Report 8502. Tularosa.

LeBlanc, Steven A., and Michael E. Whalen
1980 *An Archaeological Synthesis of South-Central and Southwestern New Mexico.* Office of Contract Archeology, University of New Mexico, Albuquerque.

Lehmer, Donald J.
1948 *The Jornada Branch of the Mogollon.* Social Science Bulletin 17. University of Arizona, Tucson.

Lekson, Stephen H.
1988 Regional Systematics in the Later Prehistory of Southern New Mexico. In *Fourth Jornada Mogollon Conference, Collected Papers,* edited by M. S. Duran and K. W. Laumbach, pp. 1- 37. Human Systems Research, Tularosa, New Mexico.

Lentz, Steven C.
in prep. Excavations at High Rolls Cave. Office of Archaeological Studies, Museum of New

Mexico, Santa Fe.

Levine, Daisy
1992 Ceramic Analysis. In *Investigations into the Prehistory and History of the Upper Rio Bonito, Lincoln County, Southeastern New Mexico,* by R. E. Farwell, Y. R. Oakes, and R. N. Wiseman, pp. 191-194. Laboratory of Anthropology Notes 297. Museum of New Mexico, Santa Fe.

Ligon, J. Stokley
1946 *History and Management of Merriam's Wild Turkey.* University of New Mexico Publications in Biology, No. 1. University of New Mexico Press, Albuquerque.

1961 *New Mexico Birds and Where to Find Them.* University of New Mexico Press, Albuquerque.

Lyman, R. Lee
1994 *Vertebrate Taphonomy.* Cambridge University Press, Cambridge.

Mackie, Richard J., Kenneth L. Hamlin, and David F. Pac
1982 Mule Deer. In *Wild Mammals of North America: Biology, Management, Economics*, edited by J. A. Chapman and G. A. Feldhamer, pp. 862-877. Johns Hopkins University Press, Baltimore.

MacNeish, Richard S.
1991 *Preliminary Investigations of the Archaic in the Region of Las Cruces, New Mexico.* Andover Foundation for Archaeological Research, Andover.

1993 *Preliminary Investigations of the Archaic in the Region of Las Cruces, New Mexico.* Fort Bliss Historic and Natural Resources Report 9. Cultural Resources Management Branch, Fort Bliss.

1998 *Excavation of Pintada Rockshelter, McGregor Firing Range in New Mexico.* Publications in Anthropology, No. 12. El Paso Centennial Museum, University of Texas, El Paso.

MacNeish, Richard S., A. Nelken-Terner, and I. W. Johnson
1967 Nonceramic Artifacts. In *Prehistory of the Tehuacan Valley* 2. University of Texas Press, Austin.

MacNeish, Richard S., and Peggy Wilner
1998 Chronology. In *Excavation of Pintada Rockshelter, McGregor Firing Range in New Mexico*, edited by R. S. MacNeish, pp. 33-168. Publications in Anthropology, No. 12. El Paso Centennial Museum, University of Texas, El Paso.

Madrigal, T. Gregg, and Julie Zimmerman Holt
2002 White-tailed Deer Meat and Marrow Return Rates and Their Application to Eastern Woodlands Archaeology. *American Antiquity* 67(4):745-759.

Mahood, Gail A., and James A. Stimac
1990 Trace-Element Partitioning in Pantellerites and Trachytes. *Geochemica et Cosmochimica Acta* 54:2257-2276.

Maker, H. J., P. S. Derr, and J. U. Anderson
1972 *Soil Associations and Land Classification for Irrigation, Otero County.* Agricultural Experiment Station, Research Report 238. New Mexico State University, Las Cruces.

Martin, Debra L.
1994 Patterns of Diet and Disease: Health Profiles for the Prehistoric Southwest. In *Themes in Southwest Prehistory,* edited by G. J. Gumerman, pp. 87-108. School of American Research Press, Santa Fe.

Martin, Paul S.
1939 *Modified Basketmaker Sites in the Ackman-Lowry Area, Southwestern Colorado*. Fieldiana: Anthropology 23(3). Field Museum of Natural History, Chicago.

1963 *The Last 10,000 Years.* University of Arizona Press. Tucson.

Martin, Paul S., and John B. Rinaldo
1939 *The SU Site: Excavations at the Mogollon Village, Western New Mexico.* University of Arizona, Social Science Bulletin 17. Tucson.

1947 *The SU Site: Excavations at a Mogollon Village, Western New Mexico: Third Season, 1946*. Fieldiana: Anthropology 32(3).

Martin, William C.
1964 Some Aspects of the Natural History of the Capitan and Jicarilla Mountains, and Sierra Blanca Region of New Mexico. In *Guidebook*

of the Ruidoso Country, by S. R. Ash and L. V. Davis. 15th Field Conference, New Mexico Geological Society.

Matson, Daniel S., and Albert H. Schroeder
1957 |Cordero's Description of the Apache, 1796. *New Mexico Historical Review* 32(4).

Mauldin, Raymond P.
1993 The Relationship between Ground Stone and Agricultural Intensification in Western New Mexico. *Kiva* 58(3):317-330.

1997 Patterns of Climate and Production in the Past and Present Jornada. In *Proceedings of the Ninth Annual Jornada-Mogollon Conference,* edited by R. P. Mauldin, J. D. Leach, and S. Ruth. Centro de Investigaciones Arqueológicas, Publications in Archaeology 12. El Paso.

Mays, S., E. Fysh, and G. M. Taylor
2002 Investigations of the Link between Visceral Surface Rib Lesions and Tuberculosis in a Medieval Skeletal Series from England Using Ancient DNA. *American Journal of Physical Anthropology* 11:27-36.

McCarthy, J. J., and F. H. Schamber
1981 Least-Squares Fit with Digital Filter: A Status Report. In *Energy Dispersive X-ray Spectrometry,* edited by K. F. G. Heinrich, D. E. Newbury, R. L. Myklebust, and C. E. Fiori, pp. 273-296. National Bureau of Standards Special Publication 604. Washington, D.C.

McCluney, Eugene
1962 A New Name and Revised Description for a Mogollon Pottery Type from Southern New Mexico. *Southwestern Lore 27(4):49-55.*

McNally, Elizabeth
2002 Variation in Flaked Stone Tool Assemblages. In *Archaeological Variation within the Middle Rio Bonito,* by P. H. Shelley and K. E. Wenzel, pp. 143-196. Bureau of Land Management, Santa Fe.

Mera, H. P.
1931 *Chupadero Black on White.* Technical Series, Bulletin 1. Museum of New Mexico, Santa Fe.

1933 *A Proposed Revision of the Rio Grande Paint Sequence.* Technical Series 5. Laboratory of Anthropology, Museum of New Mexico, Santa Fe.

1938 *Reconnaissance and Excavation in Southeastern New Mexico.* Memoirs of the American Anthropological Association 51. Washington, D.C.

1943 *An Outline of Ceramic Development in Southern and Southeastern New Mexico.* Technical Series, Bulletin 22. Laboratory of Anthropology, Museum of New Mexico, Santa Fe.

Mera, H. P., and William Stallings
1931 *Lincoln Black-on-red.* Technical Series, Bulletin 2. Laboratory of Anthropology, Museum of New Mexico, Santa Fe.

Milner, George R., and Clark Spencer Larsen
1991 Teeth as Artifacts of Human Behavior: Intentional Mutilation and Accidental Modification. In *Advances in Dental Anthropology,* edited by M. A. Kelley and C. S. Larsen, pp.357-378. Wiley-Liss, New York.

Minnis, Paul E.
1982 *Plant Remains from the Bent and Abajo de la Cruz Sites, Otero County, New Mexico*. University of Oklahoma Ethnobotanical Laboratory Report 7. Norman.

1996 Notes on Economic Uncertainty and Human Behavior in the Prehistoric North American Southwest. In *Evolving Complexity and Environmental Risk in the Prehistoric Southwest*, edited by J. A. Tainter and B. B. Bagley, pp.57-78. Vol. 14, Proceedings, Santa Fe Institute Studies in the Sciences of Complexity. Addison-Wesley, Reading.

Moga, Susan M.
in prep. Excavation of High Rolls Cave (LA 114103), along U.S. 82, Otero County, New Mexico. Office of Archaeological Studies, Museum of New Mexico, Santa Fe.

Moga, Susan M., and Nancy J. Akins
2000 Angus Fauna. In *The Angus Site: A Late Prehistoric Settlement along the Rio Bonito, Lincoln County, New Mexico,* by D. A. Zamora and Y. R. Oakes, pp. 187-201. Archaeology Notes 276. Office of Archaeological Studies, Museum of New Mexico, Santa Fe.

Moore, James L.
1996 *Archaeological Investigations in the Southern Mesilla Bolson: Data Recovery at the Santa Teresa Port-of-Entry Facility.* Archaeology Notes 188. Office of Archaeological Studies, Museum of New Mexico, Santa Fe.

1999 Projectile Points. In *Archaeology of the Mogollon Highlands: Settlement Systems and Adaptation,* edited by Y. R. Oakes and D. A. Zamora, pp. 25-82. Archaeology Notes 232. Office of Archaeological Studies, Museum of New Mexico, Santa Fe.

Moore, Roger A.
1994 Archaic Projectile Point Typology/Chronology in Northern New Mexico and the Four Corners. In *Archaic Hunter-Gatherer Archaeology in the American Southwest,* edited by B. J. Vierra, pp. 456-477. Eastern New Mexico University, Contributions in Anthropology 13(1). Portales.

Mueller, Jerry E.
1991 Climate of Cloudcroft-Ruidoso Country. In *Geology of the Sierra Blanca, Sacramento and Capitan Ranges, New Mexico,* edited by J. M. Barker, B. S. Kues, G. S. Austin, and S. G. Lucas, pp. 2-3. Forty-second Annual Field Conference, New Mexico Geological Society, Socorro.

Neher, Raymond E.
1976 *Soil Survey of Mescalero-Apache Area, New Mexico, Northeastern Otero County.* U.S. Soil Conservation Service and Bureau of Indian Affairs.

Nelson, Margaret C., and Heidi Lippmeier
1993 Grinding Tool Design as Conditioned by Land-Use Patterns. *American Antiquity* 58:286-305.

Northrup, Stuart A.
1959 *Minerals of New Mexico.* University of New Mexico Press. Albuquerque.

Oakes, Yvonne R.
1998 *LA 457: An Early Mesilla Phase Occupation along North Florida Avenue, Alamogordo, New Mexico.* Archaeology Notes 180. Office of Archaeological Studies, Museum of New Mexico, Santa Fe.

1999 Changing Settlement Patterns in the Mogollon Highlands. In *Archaeology of the Mogollon Highlands; Settlement Systems and Adaptations,* by Y. R. Oakes and D. A. Zamora, pp.27-42. Archaeology Notes 232. Office of Archaeological Studies, Museum of New Mexico, Santa Fe.

2000 Cultural Associations in the Sierra Blanca Region. In *The Angus Site: A Late Prehistoric Settlement along the Rio Bonito, Lincoln County, New Mexico,* by D. A. Zamora and Y. R. Oakes, pp. 7-30. Archaeology Notes 276. Office of Archaeological Studies, Museum of New Mexico, Santa Fe.

2001 *Addendum to Archaeological Test Excavations along U.S. 70 and a Data Recovery Plan for LA 110339, Mescalero* Apache Tribal Lands, Otero County, New Mexico. Archaeology Notes 221A. Office of Archaeological Studies, Museum of New Mexico, Santa Fe.

OAS (Office of Archaeological Studies)
1994a *Standardized Lithic Artifact Analysis: Attributes and Variable Code Lists*. Archaeology Notes 24c. Office of Archaeological Studies, Museum of New Mexico, Santa Fe.

1994b *Standardized Ground Stone Artifact Analysis: A Manual for the Office of Archaeological Studies.* Archaeology Notes 24b. Office of Archaeological Studies, Museum of New Mexico, Santa Fe.

O'Laughlin, Thomas C.
1981 The Roth Site: A Pithouse Site in the Mesilla Valley of Southern New Mexico. In *Archaeological Essays in Honor of Mark Wimberly,* edited by M. S. Foster. *The Artifact* 19(3- 4):133-149.

Opler, Morris E., and Catherine H. Opler
1950 Mescalero Apache History in the Southwest. *New Mexico Historical Review* 25(1):1-36.

Ortner, Donald J., and Walter G. J. Putschar
1985 *Identification of Pathological Conditions in Human Skeletal Remains.* Smithsonian Institution Press, Washington, D.C.

Parry, William J., and Robert L. Kelly
1987 Expedient Core Technology and Sedentism. In *The Organization of Core Technology,* edited by J. Johnson and C. Morrow, pp. 285-304. Westview Press, Boulder.

Pool, Michael D.
1994 Implications of the Western Apache Settlement System for the Early Mogollon Period. In *Mogollon VII,* edited by P. Beckett, pp. 89-103. COAS Publications, Las Cruces.

Pough, Frederick H.
1976 *A Field Guide to Rocks and Minerals, Fourth Edition.* National Audubon Society and National Wildlife Federation. Houghton Mifflin, Boston.

Prince, Patricia A.
1980a Climate. In *A Cultural Resource Management Plan for Timber Sale and Forest Development Areas on the Mescalero Apache Indian Reservation,* by B. G. Harrill, pp. 9-18. Forestry Archeological Program, Bureau of Indian Affairs, Albuquerque Area Office, Albuquerque.

1980b Mescalero Apache: An Ethnographic Summary. In *A Cultural Resource Management Plan for Timber Sale and Forest Development Areas on the Mescalero Apache Indian Reservation,* by B. G. Harrill. Bureau of Indian Affairs, Albuquerque Area Office, Albuquerque.

Rautman, Alison Eunice
1990 The Environmental Context of Decision-Making: Coping Strategies among Prehistoric Cultivators in Central New Mexico. Ph.D. diss., Department of Anthropology, University of Michigan, Ann Arbor.

Reed, Erik K.
1981 Human Skeletal Material from the Gran Quivira District. In *Contributions to Gran Quivira Archaeology, Gran Quivira National Monument, New Mexico*, edited by A. C. Hayes, pp. 75-118, 183-207. Publications in Archeology 17. National Park Service, Washington, D.C.

Reitz, Elizabeth J., and Elizabeth S. Wing
1999 *Zooarchaeology.* Cambridge University Press, Cambridge.

Robinson, William J., and Catherine M. Cameron
1991 *A Directory of Tree-Ring Dated Prehistoric Sites in the American Southwest*. Laboratory of Tree-Ring Research, University of Arizona, Tucson.

Rocek, Thomas R., and John D. Speth
1986 *The Henderson Site Burials: Glimpses of a Late Prehistoric Population in the Pecos Valley.* University of Michigan Technical Reports 18, Research Report in Archaeology No. 13. Museum of Anthropology, Ann Arbor.

Roney, John
1985 Prehistory of the Guadalupe Mountains. M.A. thesis, Department of Anthropology, Eastern New Mexico University, Portales.

Rose, J. C., W. W. Condon, and A. H. Goodman
1985 Diet and Dentition: Developmental Disturbances. In *The Analysis of Prehistoric Diets*, edited by R. Gilbert and J. Mielke, pp. 281-305. Academic Press, Orlando.

Roth, Barbara
1992 Sedentary Agriculturalists or Mobile Hunter-Gathers? Recent Evidence on the Late Archaic Occupation of the Northern Tucson Basin. *Kiva* 57:291-314.

Roth, Barbara, and Bruce B. Huckell
1992 Cortaro Points and the Archaic of Southern Arizona. *Kiva* 57(4):353-370.

Runyon, John W., and John A. Hedrick
1987 Pottery Types of the Southwest Federation of Archaeological Societies (SWFAS). *The Artifact* 25(4):23-59.

Salazar, Matthew
2002 Variation in Mogollon Brown Wares of the Sierra Blanca Region. In *Archaeological Variation within the Middle Rio Bonito,* edited by P. H. Shelley and R. G. Holloway, pp. 59- 94. Bureau of Land Management, Cultural Resource Series 14. Santa Fe.

Schamber, F. H.
1977 A Modification of the Linear Least-Squares Fitting Method which Provides Continuum Suppression. In *X-Ray Fluorescence Analysis of Environmental Samples,* edited by T. G. Dzubay, pp. 241-257. Ann Arbor Science Publishers, Ann Arbor.

Schelberg, John D.
1997 The Metates of Chaco Canyon, New Mexico. In *Ceramics, Lithics, and Ornaments of Chaco Canyon: Analyses of Artifacts from the Chaco Project, 1971-1978,* vol. 3. Chaco Canyon

Studies, Publications in Archaeology 18G. National Park Service, U.S. Department of the Interior, Santa Fe.

Schlanger, Sara H.
1990 Recognizing Persistent Places in Anasazi Settlement Systems. In *Space, Time, and Archeological Landscapes,* edited by J. Rossignol and L. Wandsnider. Plenum Press, New York.

Schroeder, Albert H.
1974 A Study of the Apache Indians. *American Indian Ethnohistory, Indians of the Southwest. Apache Indians*, vol. 1, edited by D. A. Horr. Garland Publishing, New York.

Schutt, Jeanne A.
1980 The Analysis of Wear Patterns Resulting from the Use of Flake Tools in Manufacturing and Processing Activities: A Preliminary Report. In *Human Adaptations in a Marginal Environment: The UII Mitigation Project,* edited by J. A. Moore and J. Winter, pp. 66-93. Office of Contract Archeology, University of New Mexico. Albuquerque.

Schutt, Jeanne A., Richard C. Chapman, and Kathleen D. Morrison
1991 Tested Sites. In *Landscape Archeology in the Southern Tularosa* Basin. Vol. 2, *Testing, Excavation, and Analysis,* edited by W. H. Doleman, R. C. Chapman, J. A. Schutt, M. K. Swift, and K. D. Morrison, pp. 191-297. Office of Contract Archeology, University of New Mexico, Albuquerque.

Schwartz, Marion
1997 *A History of Dogs in the Early Americas.* Yale University Press, New Haven.

Sebastian, Lynne
1989 The Ceramic Period. In *Living on the Land: 11,000 Years of Human Adaptation in Southeastern New Mexico.* Cultural Resource Series 6. Bureau of Land Management, Santa Fe.

Sebastian, Lynne, and Signa Larralde
1989 *Living on the Land: 11,000 Years of Human Adaptation in Southeastern New Mexico.* Cultural Resource Series 6. Bureau of Land Management, Santa Fe.

Shackley, M. Steven
1988 Sources of Archaeological Obsidian in the Southwest: An Archaeological, Petrological, and Geochemical Study. *American Antiquity* 53(4):752-772.

1990 Early Hunter-Gatherer Procurement Ranges in the Southwest: Evidence from Obsidian Geochemistry and Lithic Technology. Ph.D. dissertation, Arizona State University, Tempe.

1995 Sources of Archaeological Obsidian in the Greater American Southwest: An Update and Quantitative Analysis. *American Antiquity* 60(3):531-551.

1996 Range and Mobility in the Early Hunter-Gatherer Southwest. In *Early Formative Adaptations in the Southern Southwest,* edited by B. Roth, pp. 5-16. Monographs in World Prehistory 25. Prehistory Press, Madison.

1998 Geochemical Differentiation and Prehistoric Procurement of Obsidian in the Mount Taylor Volcanic Field, Northwest New Mexico. *Journal of Archaeological Science* 25:1073-1082.

2002a *Little Black Rocks in the Desert: The Geology and Archaeology of Obsidian in the North American Southwest.* University of Arizona Press. Tucson.

2002b Archaeological Obsidian and Secondary Depositional Effects in the Jemez Mountains and Sierra de Los Valles, Northern New Mexico. Report prepared for the Ecology Group, Los Alamos National Laboratory, New Mexico.

Shelley, Phillip H.
2002 Volume Summary and Conclusions. In *Archaeological Variation within the Middle Rio Bonito,* edited by P. H. Shelley and K. E. Wenzel, pp. 59-94. Cultural Resource Series 14. Bureau of Land Management, Santa Fe.

Shepard, Anna O.
1965 Rio Grande Glaze-Paint Pottery: A Test of Petrographic Analysis. In *Ceramics and Man,* pp. 62-87, edited by F. R. Matson. Viking Fund Publications in Anthropology 41. New York.

Shott, Michael
1986 Technological Organization and Settlement Mobility: An Ethnographic Examination. *Journal of Anthropological Research* 42(1):15-51.

Sloan, C. E., and M. S. Garber
1971 *Ground-Water Hydrology of the Mescalero Apache Indian Reservation, South-Central New Mexico.* Atlas HA-349. U.S. Geological Survey Hydrological Investigations.

Smiley, Francis E., IV
1994 The Agricultural Transition in the Northern Southwest: Patterns in the Current Chronometric Data. *Kiva* 60(2):165-189.

Smith, Craig S., and Lance M. McNees
1999 Facilities and Hunter-Gatherer Long-Term Land Use Patterns: An Example from Southwest Wyoming. *American Antiquity* 64(1):117-136.

Sonnichsen, C. L.
1958 *The Mescalero Apaches.* University of Oklahoma Press, Norman.

1973 *The Mescalero Apaches.* 2nd ed. University of Oklahoma Press, Norman.

Southward, Judith
1978 *Archaeological Investigation of the Cultural Resources along a Water Distribution System in Caballero Canyon, Otero County, New Mexico.* New Mexico State University Occasional Paper 6. Las Cruces.

1979 A Summary of Ceramic Technology, Plant Remains, and Shell Identification Analysis from LA 7921, Three Rivers, New Mexico. In *Jornada Mogollon Archaeology,* edited by P. H. Beckett and R. N. Wiseman, pp. 91-102. COAS Publishing and Research. Las Cruces.

Speth, John, and Susan L. Scott
1992 Late Prehistoric Subsistence Change in Southeastern New Mexico: The Faunal Evidence from Angus. In *Investigations into the Prehistory and History of the Upper Rio Bonito, Lincoln County, New Mexico,* by R. E. Farwell, Y. R. Oakes, and R. N. Wiseman, pp. 259-319. Laboratory of Anthropology Notes 297. Museum of New Mexico, Santa Fe.

Spoerl, Patricia M.
1983 Thousands of Years of Use: Prehistory and History on the Lincoln National Forest. Manuscript on file, USDA Forest Service, Southwestern Regional Office, Albuquerque.

1985 Mogollon Utilization of the Sacramento Mountains of Southcentral New Mexico. In *Views of the Jornada Mogollon,* edited by C. M. Beck, pp. 33-40. Contributions in Anthropology 12. Eastern New Mexico University, Portales.

Stiner, Mary C., Steven L. Kuhn, Stephen Weiner, and Ofer Baar-Yosef
1995 Differential Burning, Recrystallization, and Fragmentation of Archaeological Bone. *Journal of Archaeological Science* 22:223-237.

Stone, Tammy
1994 The Impact of Raw-Material Scarcity on Ground-Stone Manufacture and Use: An Example from the Phoenix Basin Hohokam. *American Antiquity* 59(4):680-694.

Stuart, David E., and Rory P. Gauthier
1981 *Prehistoric New Mexico: Background for Survey.* Historic Preservation Division, Office of Cultural Affairs, Santa Fe.

Tagg, Martyn D.
1996 Early Cultigens from Fresnal Shelter, Southeastern New Mexico. *American Antiquity* 61:311- 324.

Tainter, Joseph A.
1984 Foragers in the Southwestern Forests. In *Stage I Site Locational Modeling in the Southwestern Region,* edited by L. S. Cordell and D. F. Green, pp.21-28. Cultural Resources Management Report 5. USDA Forest Service, Southwestern Region.

Tauber, Henrik
1965 Differential Pollen Dispersion and the Interpretation of Pollen Diagrams. *Danmarks. Geol. Unders.* 2(89).

Terrell, J. T.
1972 *Apache Chronicle.* World Publishing, New York.

Thomas, Alfred B.
1974 The Mescalero Apache:1653-1874. *American Indian Ethnohistory: Indians of the Southwest.*

Vol. 11, *Apache Indians,* edited by D. A. Horr, pp.1-48. Garland Publishing, New York.

Thomas, David Hurst
1978 Arrowheads and Atlatl Darts: How the Stones Got the Shaft. *American Antiquity* 43:461-472.

1988 *The Archaeology of Monitor Valley 3: Survey and Additional Excavations.* Anthropological Papers of the American Museum of Natural History 66(2). New York.

Toll, Mollie S.
1996 Picacho: A Record of Diverse Plant Use in a Diverse Ecological Setting. In *The Land in Between: Archaic and Formative Occupations along the Upper Rio Hondo of Southwestern New Mexico,* by R. N. Wiseman, pp. 125-156. Archaeology Notes 125. Office of Archaeological Studies, Museum of New Mexico, Santa Fe.

Toll, Mollie S., and Marcia L. Donaldson
1992 Remnants of Human Subsistence Behavior at Two Angus North Sites. In *Investigations into the Prehistory and History of the Upper Rio Bonito, Lincoln County, Southeastern New Mexico,* by R. Farwell, Y. R. Oakes, and R. N. Wiseman, pp. 239-258. Laboratory of Anthropology Notes 297. Office of Archaeological Studies, Museum of New Mexico, Santa Fe.

Toll, Mollie S., and Lisa Huckell
1996 *A Guide for Standardizing Collection of* Zea mays *Morphometric Data.* Sixth Southwest Paleoethnobotanical Workshop, Albuquerque.

Toll, Mollie S., and Pamela J. McBride
2000 Food and Fuel at the Angus Site. In *The Angus Site: A Late Prehistoric Settlement along the Rio Bonito, Lincoln County, New Mexico,* by D. A. Zamora and Y. R. Oakes, pp.213-226g. Archaeology Notes 276. Office of Archaeological Studies, Museum of New Mexico, Santa Fe.

Tuan, Y., C. E. Evard, J. G. Widdison, and I. Bennet
1973 *The Climate of New Mexico.* New Mexico State Planning Office, Santa Fe.

Turner, Ellen Sue, and Thomas R. Hester
1985 *A Field Guide to Stone Artifacts of Texas Indians.* Texas Monthly Press, Austin.

Upham, Steadman, R. S. MacNeish, and Christopher M. Stevenson
1986 Chronometric Dating of San Pedro Style Projectile Points in Southern New Mexico. In *Mogollon Variability,* edited by C. Benson and S. Upham, pp. 79-87. University Museum Occasional Papers No. 15. New Mexico State University, Las Cruces.

Urban, Sonya O.
1999 Miscellaneous Artifact Analysis. In *Archaeology of the Mogollon Highlands Settlement Systems and Adaptations,* by Y. R. Oakes and D. A. Zamora, pp. 183-220. Archaeology Notes 232, vol. 4. Office of Archaeological Studies, Museum of New Mexico, Santa Fe.

2000 Ground Stone Analysis: Angus Project. In *Investigations into the Prehistory and History of the Upper Rio Bonito, Lincoln County, Southeastern New Mexico,* by D. A. Zamora and Y. R. Oakes, pp. 175-185. Archaeology Notes 276. Office of Archaeological Studies, Museum of New Mexico, Santa Fe.

Van Devender, Thomas R., and W. Geoffrey Spaulding
1979 Development of Vegetation and Climate in the Southwestern United States. *Science* 204:701-710.

Vierra, Bradley J.
1990 Archaic Hunter-Gatherer Archaeology in Northwestern New Mexico. In *Perspectives on Southwestern Prehistory,* edited by P. E. Minnis and C. L. Redman, pp. 57-67. Westview Press, Boulder.

1994 Archaic Hunter-Gatherer Mobility Strategies in Northwestern New Mexico. In *Archaic Hunter-Gatherer Archaeology in the American Southwest,* edited by B. J. Vierra, pp. 121-154. Contributions in Anthropology 13(1). Eastern New Mexico University, Portales.

Vierra, Bradley J., and James Lancaster
1987 *Archaeological Excavations at the Rio Bonito Site, Lincoln County, New Mexico.* Laboratory of Anthropology Notes 358. Museum of New Mexico, Santa Fe.

Vivian, Gordon
1964 *Excavations in a 17th Century Jumano Pueblo, Gran Quivira.* Archaeological Research Series

8. National Park Service, Washington, D.C.

Walt, Henry J.
1980a Geology. In *A Cultural Resource Management Plan for Timber Sale and Forest Development Areas on the Mescalero Apache Indian Reservation,* edited by B. G. Harrill, pp. 5-15. Forestry Archeological Program, Bureau of Indian Affairs, Albuquerque Area Office, Albuquerque.

1980b Spanish Colonial to Early Territorial Period. In *A Cultural Resource Management Plan for Timber Sale and Forest Development Areas on the Mescalero Apache Indian Reservation,* edited by B. G. Harrill, pp. 63-65. Forestry Archeological Program, Bureau of Indian Affairs, Albuquerque Area Office, Albuquerque.

Walthall, John A.
1998 Rockshelters and Hunter-Gatherer Adaptation to the Pleistocene/Holocene Transition. *American Antiquity* 63(2):223-238.

Warren, A. H.
1971 *The Glencoe Project: Geology and Resources of the Tularosa Valley: Bent Highway Salvage Project.* Laboratory of Anthropology Notes 66. Museum of New Mexico, Santa Fe.

1992 Temper Analysis of the Pottery of Rio Bonito Valley. In *Investigations into the Prehistory and History of the Upper Rio Bonito, Lincoln County, Southeastern New Mexico,* by R. E. Farwell, Y. R. Oakes, and R. G. Wiseman, pp. 195-196. Laboratory of Anthropology Notes 297. Museum of New Mexico, Santa Fe.

Wening, Karen
1992 Ground Stone. In *Investigations into the Prehistory and History of the Upper Rio Bonito, Lincoln County, Southeastern New Mexico,* by R. E. Farwell, Y. R. Oakes, and R. N. Wiseman, pp. 81-106. Laboratory of Anthropology Notes 297. Museum of New Mexico, Santa Fe.

Whalen, Michael E.
1980 *Special Studies in the Archeology of the Hueco Bolsom*. Publications in Anthropology 9. El Paso Centennial Museum, University of Texas at El Paso.

1994 *Turquoise Ridge and Late Prehistoric Residential Mobility in the Desert Mogollon Region.* University of Utah, Anthropological Papers 118. University of Utah Press, Salt Lake City.

Wills, W. H.
1985 Early Agriculture in the Mogollon Highlands of New Mexico. Ph.D. diss., Department of Anthropology, University of Michigan, Ann Arbor.

1988 *Early Prehistoric Agriculture in the American Southwest.* School of American Research, Santa Fe.

Wilson, C. Dean
1997 Ceramic Artifacts. In *Archaeological Test Excavation along U.S. 70 and a Recovery Plan for LA 110339, Mescalero Apache Tribal Lands, Otero County, New Mexico,* by N. J. Akins, pp. 29-34. Archaeology Notes 221. Office of Archaeological Studies, Museum of New Mexico, Santa Fe.

1999 Ceramic Analysis. In *Red Lake Tank: The Excavation of Four Sites East of Roswell,* by P. Y. Bullock, pp. 31-40. Archaeology Notes 250. Office of Archaeological Studies, Museum of New Mexico, Santa Fe.

2000a Ceramic Artifact Assemblages. In *Prehistoric Burned Brush Structures and a Quarry Site along the Carlsbad Relief Route, Eddy County, New Mexico,* by D. A. Zamora, pp.63-72. Archaeology Notes 203. Office of Archaeological Studies, Museum of New Mexico, Santa Fe.

2000b Angus Ceramic Analysis. In *The Angus Site: A Prehistoric Settlement along the Rio Bonito, Lincoln County, New Mexico,* by D. A. Zamora and Y. R. Oakes, pp.101-134. Archaeology Notes 276. Office of Archaeological Studies, Museum of New Mexico, Santa Fe.

2001 Ceramics. In *Salt Creek: Data Recovery at Seven Prehistoric Sites along U.S. 285 in Chaves and De Baca Counties, New Mexico*. Archaeology Notes 298. Office of Archaeological Studies, Museum of New Mexico, Santa Fe.

2002 Ceramic Types and Attributes. In *Archaeology of the Mogollon Highlands: Settlement Systems* *and Adaptations,* edited by Y. R. Oakes and D. A. Zamora, pp. 5-85. Archaeology Notes 232. Office of Archaeological Studies, Museum of New Mexico, Santa Fe.

2003 Ceramics. In *Salt Creek: Data Recovery at Seven Prehistoric Sites along US 285 in Chaves and De Baca Counties, New Mexico*. Archaeology Notes 298. Office of Archaeological Studies, Museum of New Mexico, Santa Fe.

Wimberly, Mark, and Peter L. Eidenbach

1981 Preliminary Analysis of Faunal Remains from Fresnal Shelter, New Mexico: Evidence of Differential Butchering Practices during the Archaic Period. In *The Artifact: Archaeological Essays in Honor of Mark Wimberly,* edited by M. S. Foster, pp. 20-39. El Paso.

Wimberly, Mark, and Alan Rogers

1977 Archaeological Survey in the Three Rivers Drainage: Cultural Succession, A Case Study. *The Artifact* 15.

Wiseman, Regge N.

1981 Further Investigations at the King Ranch Site, Chaves County, New Mexico. In *Archaeological Essays in Honor of Mark Wimberly,* edited by M. S. Foster. *The Artifact* 19(3):169-198.

1986 *An Initial Study of the Origin of Chupadero Black-on-white.* Albuquerque Archaeological Society, Study 3. Albuquerque.

1991 Prehistoric Pottery of the Sierra Blanca, Roswell Region: Appraisal and Speculation. Paper delivered to 1991 Mogollon Conference, Las Cruces.

1996 *The Land in Between: Archaic and Formative Occupations along the Upper Rio Hondo of Southeastern, New Mexico.* Archaeology Notes 125. Office of Archaeological Studies, Museum of New Mexico, Santa Fe.

2001 *The Fox Place: A Late Prehistoric Hunter-Gatherer Pithouse Village near Roswell, New Mexico.* Archaeology Notes 234. Office of Archaeological Studies, Museum of New Mexico, Santa Fe.

Wood, Jon Scott

1978 Migration, Development, and Abandonment: Evidence and Hypotheses. In *An Analytical Approach to Cultural Resource Management: The Little Colorado Planning Unit,* edited by F. Plog, pp. 200-201. Arizona State University, Anthropological Research Papers No. 13. USDA Forest Service, Cultural Resources Report 9. Tucson.

Woosley, Anne I., and Allan J. McIntyre

1996 *Mimbres Mogollon Archaeology: Charles De Peso's Excavations at Wind Mountain.* University of New Mexico Press, Albuquerque.

Wright, Katherine I.

1994 Ground-Stone Tools and Hunter-Gatherer Subsistence in Southwest Asia: Implications for the Transition to Farming. *American Antiquity* 59:238-263.

Wright, Mona

1993 Simulated Use of Experimental Maize Grinding Tools for Southwestern Colorado. *Kiva* 58(3):345-355.

Young, Lisa C.

1993 Measuring Mobility and Sedentism: The Homolovi Pithouse to Pueblo Transition. Paper delivered at the 5th Occasional Anasazi Symposium, Farmington.

1996 Pits, Rooms, Baskets, Pots: Storage among Southwestern Farmers. In *Interpreting Southwestern Diversity: Underlying Principles and Overarching Patterns,* edited by P. R. Fish and J. J. Reid, pp. 201-210. Anthropological Research Papers No. 48. Arizona State University, Tempe.

Zamora, Dorothy A.

2000 Ground Stone from the Angus Site. In *The Angus Site: A Late Prehistoric Settlement along the Rio Bonito, Lincoln County, New Mexico,* by D. A. Zamora and Y. R. Oakes, pp.159-172. Archaeology Notes 276. Office of Archaeological Studies, Museum of New Mexico, Santa Fe.

Zamora, Dorothy A., and Yvonne R. Oakes

2000 *The Angus Site: A Late Prehistoric Settlement along the Rio Bonito, Lincoln County, New Mexico.* Archaeology Notes 276. Office of Archaeological Studies, Museum of New

Mexico, Santa Fe.

Zier, Anne Hummer
1981 An Experiment in Ground Stone Use-Wear Analysis. Master's thesis, Department of Anthropology, University of Colorado, Boulder.